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Reflections: Can We Afford Space?

Chris Brown
Winnipeg Centre
reprinted from *Winnicentrics*

The western world is trying to pull itself out of another recession. Thousands are starving to death as you read this sentence. Diseases like AIDS are spreading at an alarming rate, in large part because we are not willing to pay for the education and research necessary to stop them. In the meantime, some of us dream of the next space station, future space flights, and improved images from the Hubble Space Telescope.

Space exploration is incredibly expensive—its cost is measured in billions of dollars per year. Perhaps the most expensive undertakings involve sending people into space. Human biol-

ogy is so sensitive to changes in the environment that we require elaborate and costly preparations to do this. Many argue that robots can do a much better job and at a lower cost.

Even if we could reduce the cost of space exploration by excluding people, the cost would still be high. The Hubble Space Telescope is costing billions of dollars and is plagued by human error. The Voyager program was considered by its supporters to be tremendously successful, yet opponents of space exploration question the benefits to humanity, especially in light of the global problems we face on Earth.

One might be tempted to put a stop to space exploration until the major problems on Earth have been solved—yet we have not stopped. What is driving this activity many consider frivolous and wasteful?

Space exploration continues a long tradition. As far back in history as we are aware, some people have been willing to leave the comfort

and safety of the community to explore the unknown. As with lotteries, most returned empty handed, if they returned at all, while a few struck it rich. The gambling analogy lets us glimpse at that part of human nature that prompts some to take risks even when the odds are against them.

The gains made through exploration include huge prizes. Traders have always known that. For the Europeans, the discovery and conquest of the New World brought enormous rewards in terms of wealth and comfort. Some of this gain was immediate but most was realized by the offspring of those who risked taking the voyage.

Pure research is similar to exploring. We allow, and pay for, thousands of highly trained people to poke into unknown areas in the hope that they will discover something that is of value to the rest of us, and they certainly have made discoveries. Perhaps an acid test for the value of

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Left: Part of the crowd at Saint Mary's University in Halifax for the May 10th annual eclipse. Above: Blair McDonald shows a child a view he will probably never forget. Story begins on page 3. Photos by Keith Vaughan.



BULLETIN

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Supplement to the *Journal* * Supplement au *Journal*

Cover Picture: A view of the St. John's skyline, dominated by the Anglican Cathedral.

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Letters to the Editor

Did He Really Say That?

I have enjoyed greatly the quotations that you have been inserting as column fillers in recent issues of the **BULLETIN**. I applaud this innovation and hope that you will continue it. However, I do regret that these quotations are sometimes less than fully accurate.

What has provoked me to write is the claim that Sir Isaac Newton said, "The total energy of the universe is a constant and the total entropy is continually increasing." Be it ever so difficult to prove a negative, I am sure that Newton never said any such thing, or even anything remotely like it. Newton could not have said such a thing because Newton did not have the concepts of energy or of entropy. Moreover, the style is completely wrong. No one talked that way in the seventeenth or eighteenth centuries. Further, the *New English Dictionary*, surely the greatest authority, tells us that it was Thomas Young in 1807 who first used, in English, the word *energy* in its physical sense as we understand it today. Also, the *NED* says that Clausius introduced the name *entropy*, although in German, in 1865.

Despite this flaw, the quotations have been a great addition to the **BULLETIN**. Please keep them coming.

Maurice Bruce Stewart

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[The quote in question comes from a book of science and nature quotations, edited by the late Isaac Asimov called, *oddly enough*, Isaac Asimov's Book of Science and Nature Quotations. I suspect that Newton's name was used, by mistake, with someone else's quote. Since neither Newton or Asimov are now able to resolve this question, I would appreciate hearing from any readers who may be able to shed light on this.—PMK]

Journal Comments Appreciated

The February **BULLETIN** carried a short item, written by Doug Hube, regarding the recently completed membership survey. I found the article most interesting and would like to respond with three observations.

First, it is encouraging to read that the *Journal* will continue to welcome submissions from amateur astronomers. Excluding them would be a mistake. The mix of professional and amateur papers gives the *Journal* a unique quality. The serious amateur is exposed to the high, technical calibre of professional papers and is given a model to emulate.

Secondly, the technical level of the publication should certainly remain unchanged, with both the professional astronomer and the amateur each writing at their own level. Thirdly, the *Journal* editor could consider another source of scholarly research papers, should the rate of submissions ever become a problem. Universities have a pool of graduate students in departments of astronomy, physics, geology, earth sciences etc., working on research topics that might be relevant to *Journal* readers and may qualify as submissions for publication. Master and doctoral level students could be encouraged to submit their papers for consideration.

The *Journal* has a long history and an important role to play in the field of astronomy. The fact that it is keeping up the good work is most encouraging and appreciated.

Andrew I. Oakes

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A Telescope for Viet Nam

Last year, on behalf of the I.A.U., I visited Viet Nam, spending four nights there and trying to learn how the international community might help the recovery of astronomy in that war-torn country. One of the places that I visited was the Hanoi Pedagogical University, where many of the country's schoolteachers are trained. Some

basic astronomy is included in their courses, but the only telescopes that they have are old and small examples of what most of us would call "department-store junk". A good, modest-sized telescope could provide a wonderful experience to many of the students that go through the university and would, indirectly, influence schoolchildren all over that country. At its March meeting, the national council approved my efforts towards finding and sending a suitable telescope. The council did *not* authorize any expenditure of society money on this project, unless it is raised for that specific purpose.

We hope, however, that it may be possible to locate a suitable telescope that some member has and no longer uses, and that he or she would be willing to donate, or sell at a favourable price, to the society. (Gifts in kind can qualify, in certain circumstances, for a tax donation.) Indeed, one or two possibilities came to light at the council meeting, but we cannot be sure yet that they will materialize. I have in mind an equatorially mounted Newtonian telescope of about 25 cm (or 10") aperture. The simpler and more rugged, the better. The equatorial mount should be adjustable, since the latitude of Hanoi is about 21°. I would be grateful to hear details from anyone who has an instrument that might be suitable and who is willing to dispose of it.

Alan H. Batten

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Astronomy Material Sought

[The following letter was received at the national office and has been reproduced in its original form—PMK]

Dear scientists,

I saw address of your society in the american book "Astronomy, A self-teaching guide" written by prof. Dinah L. Moché.

My name is Uros Burger and I am very interested in astronomy. I am 17 years old and I read (continued on page 8)

Solar Eclipse a Ringing Success

Good weather and lots of publicity made the May 10th annular eclipse one of the most widely viewed public events in recent years. To help promote public awareness, a solar eclipse committee of the R.A.S.C. was formed in 1992, co-chaired by Randy Attwood and Michael Watson. The committee was given the use of the funds remaining from the R.A.S.C. 1991 solar eclipse expedition to Mexico. It focused on two areas—providing information about the eclipse and making viewers available for distribution.

The R.A.S.C., along with nine other scientific and educational institutions in Ontario, supported the production of a two-sided information flier. The flier described the aspects of the eclipse on one side and explained how to safely observe it on the other. The committee purchased 7 600 of these fliers as well as 5 000 cardboard solar viewing glasses which were distributed to all twenty-two centres. These were to be used in conjunction with planned public eclipse viewing or information sessions organized by each centre. Unfortunately, the fliers were not provided to some centres early enough to be very useful.

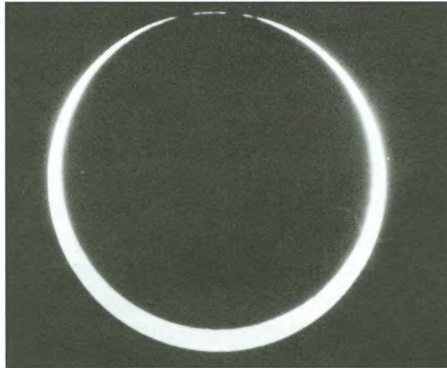
An Almost-Missed Opportunity

The eclipse occurred on a school day and would have been a great way to introduce a lot of children to the wonders of astronomy. Unfortunately, many schools either kept their students indoors during the event, or let the children out early so that they would be home during this period. Despite this, there were some exceptions which have come to my attention.

Chris and Liz Malicki, who are self-confessed eclipse chasers, wanted to share this event with their son's grade six class at St. Christopher School in Mississauga. Although they started to seek official approval in early January, they did not get a go-ahead until April. The school board was finally convinced of the safety of their proposal after they submitted a copy of Ralph Chou's article "Safe Solar Filters" and a sample of aluminized Mylar. This was the only class in the entire Dufferin-Peel Separate School Board to receive approval to observe the eclipse.

Three weeks before the eclipse, they gave three one-hour lessons about eclipses and how and what to observe. This was done by using scale models of the Sun-Earth-Moon system, slides and videos. Eclipse day arrived with beautiful blue skies. Three telescopes were set up for projection viewing, with the help of their daugh-

ter and two friends, while a C8 with a full aperture filter was used for direct viewing. The students were outside for two hours, doing experiments and making observations (timing of contacts, temperature readings, etc.) Each had their own viewers, but for the critical times of second and third contact, they were asked to view the approaching solar horns and Bailey's Beads on the high-magnification projection screens. A nice highlight was Venus, which the majority observed with the unaided eye.



Bailey's Beads are visible in this photograph taken at Point Pelee by Zdenko Saroch

In Nova Scotia, Halifax members Sherman Williams and David Chapman each were able to introduce a school to the wonder of an eclipse—the former in Avonport, the latter in Dartmouth.

Williams is a grade six teacher at L.E. Shaw Elementary in Avonport who also teaches science to two other classes. The children from his classes were invited to bring their parents to the school and over 120 people showed up. There were several activities that the children were involved in. They used small mirrors to project the Sun's image into their darkened classroom. Outside, there were Mylar viewers for direct observation. Two video cameras were also set up outside. One fed a direct image into the school where students from other classes could watch. The other was used in conjunction with a small refractor, whose projected image, along with an outside sound feed of the children went to another monitor and a VCR. Inside, two Macintosh computers, were set up running *Voyager*, to give a real-time representation of the eclipse's progress. One was set for the location of Avonport, while the other was set for the location of a school in Alberta that is twinned with their school. Intermittent clouds blocked the first half of annularity but it cleared for the last half. Similar activities also took place at the district school in Coldbrook, where Sherman's wife is the principal. It is amazing what can happen with the right people in charge!

Across the harbour from Halifax, in the sister city of Dartmouth, there was a small eclipse

party at Crichton Park Elementary School. The Home & School Association, aided and abetted by Dave Chapman (whose daughter attends the school) decided to capitalize on the educational opportunity and ordered 250 eclipse viewers. In spite of the school board's early dismissal of grades primary to three that day, parents were invited to return to the schoolground with their children to witness the eclipse. The older children in school were released to view the annular phase. The same TV station that covered the Halifax Centre/Saint Mary's University event sent a small team to cover the "children's view" of the eclipse, and they broadcast several minutes of this satellite eclipse party along with the main coverage. A mixed group of parents, children, and school staff jointly viewed the high point of the eclipse, a stirring sight likely to be remembered by all. It is generally agreed that the success of the event was due to the combined involvement of the principal, teachers, and parents, with timely and accurate eclipse information (including safe viewing techniques) provided by a reliable source (i.e. an R.A.S.C. member).

Ontario—Coping on the Fringe

While a sizable strip of Ontario was touched by the path of annularity, only a few points were actually on the centreline. Zdenko Saroch, Jim Selinger and Joe Donahue, all of the Sarnia Centre, travelled to Point Pelee National Park, where, by Saroch's calculations, the centreline crossed the parking lot. There were amateur astronomers there, but most of the observers were birdwatchers, including some German tourists who had not known an eclipse was going to take place. A dramatic drop in temperature was noted, reminding Donahue that he had a thermometer in his car. He left the thermometer in the sunlight and recorded the temperature at regular intervals. A total change in radiant temperature of almost 20°C corresponded very well when plotted on a chart which also showed the percentage of exposed solar surface.

Still, many people ventured across the border to get a better view. Michael Watson (unattached) went to Toledo, Ohio and reported an interesting observation. One of the many photographs that he had taken at that site turned up a pleasant surprise. It was a 1/500th exposure taken when the Moon was barely in contact with the Sun's edge. Along a 20° arc, a pink crescent of chromosphere is visible! In his letter, Michael noted that Nova Scotia had received more than its fair share of eclipses of late and that none should be scheduled for that area for at least the next fifty or sixty years!

(continued on page 8)

A Polar Expedition of a Different Kind

Russ Sampson
Edmonton Centre

Here is a story of triumph and tragedy. A story of intrepid explorers. A story of science in the unforgiving Canadian wilderness. A story of one man who should have his head examined.

It began as a simple request from the International Occultation Timing Association (I.O.T.A.). Would I like to observe the graze occultation of the star ZC 646 during the November 29th total lunar eclipse? "Sure", I replied, "Why not?"

A graze occultation occurs when the Moon's north or south pole grazes a star as viewed from some point on the Earth. If observers are located at the right place they will see the star blink on and off as it passes behind the lunar mountains. Normally, one pole of the moon is sunlit and makes the star difficult to see once it gets really close. As the entire moon would be dark during the eclipse, and due to the geometry of the event, both a north and south graze could be observed for this star. An American team was planning to travel to Baja Mexico to see the star pass behind the moon's south polar mountains. What was needed was someone willing to attempt the northern graze.

So why would anyone want to do this? The purpose of the experiment was to try and measure the polar diameter of the Moon to a higher precision than ever before. Today we know the Moon's diameter to an accuracy of about one kilometre. If this experiment was successful we should be able to know the polar diameter to a precision of a few hundred metres or less. This same experiment was tried during the total lunar eclipse of January 9th, 1982, but one team failed to obtain any data. If both expeditions were successful it would be a first in history.

This sounded easy enough. The catch was the location. Our graze line crossed either the MacKenzie Highway in a sparsely populated region around Meander River, Alberta or the Alaska Highway near Fort Nelson, British Columbia. Temperature records suggested that we could have temperatures around -30°.

Tony Gardner wisely suggested we leave our vehicles at home and charter a bus. The money was raised from generous donations from the national office of the R.A.S.C., I.O.T.A. (which included a private donation), from our own centre and the individual team members.

On Saturday, November 27th at 6:00 A.M. our team of thirteen well-trained and enthusiastic explorers left the city and headed north into the unknown. Blazing a trail ahead of us was the

surveying crew of Mike Noble and Larry Wood. Arriving a day early, they would establish the exact location for the seven observing stations. Bringing up the rear in an acrid blue cloud, was the smokers' truck with Don Brown and Paul Campbell. After a fourteen hour trek, we arrived in Fort Nelson. The skies were clear and our spirits were high.

The town went all-out to make us feel welcome. Chris Morey, the town's director of tourism and economic development, arranged for billets and transportation to our observing stations. Doug Hube and I were given keys to the town's administration building and Janet Couch got to use the town car. In return for this unbelievable hospitality, we were to provide free public astronomy programming on the day of the eclipse. This was made easier as we had brought with us an inflatable planetarium provided by the Edmonton Space & Science Centre.

Sunday morning saw the sky gray and overcast. The team began to get anxious. The festivities started at noon with a civic luncheon followed by free planetarium shows for the public. Janet Couch, Cary Smialek and Krysta Stephan did seven star shows for about 160 people. Meanwhile, next door in the Phoenix Theater, preparations were being made for the afternoon's lectures, displays and solar observing. Persistent overcast skies prevented Don Brown and Richard Vanderberg from showing off the Sun, but they quickly set up a display of telescopes near the lobby. Franklin Loehde set up Mike Noble's computer at the other end of the lobby for free demonstrations of *Dance of the Planets* and *Orbit*. A happy pandemonium set in as I bounced back and forth trying to calm jangled nerves and put out the occasional fire, some of them my own.

I started off the lecture series with a talk on the lunar eclipse and our graze occultation experiment. Doug Hube followed with a warp speed overview of the universe and extraterrestrial life. The next presentation had Bruce McCurdy give an introduction to atmospheric phenomena and the planets. Paul Campbell followed with a talk on his favourite deep-sky objects while Murray Paulson finished off the afternoon with a presentation on telescopes. All together we entertained between 300 and 400 people, about 8 percent of the population of Fort Nelson. While all this was going on, Sharon Tansey and Harold Jacobson were busy recording this entire crazy affair on film and video.

As the afternoon drew to a close, the billets picked us up and fed us at their homes. Gulping down a quick meal, we quickly dressed and returned to the town square. Krysta was to remain behind to show the town the eclipse. With final instructions we headed down the

Alaska Highway to our stations. Glancing out the window every few minutes we could see a faint glow in the clouds marking the location of the Moon. It looked bad.

We arrived at our site more than an hour before the occultation. R.C.M.P. cruisers were stationed at the two ends of the graze line. Their red and blue lights flashed a warning to on-coming traffic. Growling logging trucks crawled along the highway, making us nervous. Cary Smialek and I were stationed in the middle of the graze zone, on top of a small hill. Looking south I could see the red lights of the observers extending off into the distance. An oppressive blanket of haze still obscured the Moon.

Murray Paulson had brought along walkie-talkies for each station. At first, very little was said. I knew what everyone was thinking and I could sense their disappointment. We had come all this way, done all this work, and we were going to see nothing. With less than twenty minutes to go the skies looked full. I scanned the south and saw some structure to the otherwise featureless cloud. Could this be a clearing? Within a few minutes the first star appeared. The walkie-talkies exploded with voices, one on top of the other. With only ten minutes to go, a frantic voice broke through the air waves: "I can see the star!... I can see the star!". Adrenaline coursing through our bodies, we sprang into action. Most had given up and left their radios and tape-recorders in the cars. With only a few minutes to go I saw the star for the first time. It sat on the darkened limb of the eclipsed moon like a beacon on some dark faraway mountain.

I was now glued to the eyepiece. Thin bands of haze drifted over the star threatening to extinguish its feeble light. I held my breath. The time signal pulsed in the background announcing the time. Only seconds to go. "Hang on!", "Hang on!", I kept saying to myself, afraid that at any moment the clouds would close back up... "IN!" We shouted in unison as the star instantly disappeared. I took a breath... "OUT!"... "IN!" Within a few seconds it had reappeared and then it was gone. Now the haze started to thicken. Where is it? A minute passed. Suddenly, it reappeared but I was caught off guard. Damn! We waited a few more seconds. Nothing happened. It was over. The radios crackled with shouts and garbled screams. "We did it!"

One by one the reports came in. To the north, Larry, Mike, Sharon and Harold saw the star miss the moon. Don, Paul, Murray and Franklin saw plenty of action, at least 6 events. South of us, Bruce and Richard reported two events, but one of Bruce's tapes broke. Tragically, the last station with Janet and Doug saw nothing since the advancing clouds covered their view before the event started. We got little sleep that night.

We arrived back in Edmonton late Monday night and waited for the word from Mexico. If they were unsuccessful the experiment would be a failure. Early Wednesday morning the news came over the wire. The Mexican expedition was a success. We had just made astronomical history.

I would like to personally thank all the people and organizations who made this expedition a reality. The town of Fort Nelson, who showed us the warmth that only a northern community can; Park Lane Buses who provided extraordinary service; Frank Florian and the Edmonton Space and Science Centre for loaning us the planetarium, telescopes and slides; Dick Haley, Spence Jamison, Bill Ireland, Herman Biffert and Murray Paulson for supplying radios; Cansel Survey Equipment for supplying global positioning systems; Gene Sydor of Shaw Cable for loaning us a video camera; Tony Gardner, George Graham, Joan Hube, Alister Ling, Randy Pakan and Mel Rankin who helped in many ways even though they did not go; the council and general membership of the Edmonton Centre who supported us with their encouragement and donation; the national council of the R.A.S.C. who provided much-needed funds; I.O.T.A. for starting it all and providing funds from its meagre budget; and finally, all the observers, especially Doug Hube who put up with endless meetings and a neurotic leader. ☺

Light Pollution Update

Ruth Lewis
Calgary Centre

Last year the national council approved a Certificate of Merit to recognize those using responsible lighting. At the G.A., these were ready for distribution and a number were taken by representatives from several centres. I have not heard from any of the centres, so I do not know how things worked out, but would like to report on the Calgary Centre's effort. Hopefully others have had equally positive experiences.

We chose several well know local companies and associations: The Alberta Science Centre/Centennial Planetarium; Carma Developers Limited, property developers; Boucock, Craig and Partners, architects; Stebnicki, Robertson and Associates Ltd., lighting engineers; and the Calgary Co-operative Association, retailers. All had used very environmentally sound ideas, like low pressure sodium parking lot lighting, full cut-off street lighting for an entire subdivision and full cut-off and shielded lighting in a new mall.

When I called to advise of the award, I was amazed at how pleased they were to have their work praised. A representative and guest at-

tended our Annual Awards Banquet. I was also surprised when they took this award, which, after all, came from a relatively small group, so seriously. Obviously it cost us a bit but I think the benefits will outweigh the few dollars spent. We assigned a host couple for each pair of guests which worked very well. All indicated they had a very interesting and informative evening. We were informed that now that they were aware of several other reasons for using that type of lighting, they would never look at lighting the same way again. They complemented us on the ingenuity of making such an award and asked if it would be okay if they put something into their own publications. An article will be in the local paper shortly. As for us, we also had a most 'rewarding' evening and feel this is a worthwhile avenue to pursue in public awareness regard- less of the size of the centre.

If you have not made use of this certificate yet, why not give it a try. I think you may be pleasantly surprised, as we were.

The Halifax Centre recently made use of the International Dark-Sky Associations's Light Pollution slide set. Paul Gray made good use of it at a centre meeting and again at their local planetarium. However, his main presentation was a classroom presentation for his building technology classmates. In his words, "We will be the ones who will be helping to design buildings for the next decade or two and will, therefore, have a say in lighting practices. I believe this is an area in which designers can be easily educated in exterior lighting the proper way and that presenting talks to such post secondary classes is the place to start." I say "Well done, Paul." This is exactly what these slides are for.

In this time of budgetary restraints, administrators have to go at things as money becomes available. As they learn the advantages of quality lighting, it will then be appropriate to suggest lighting bylaws for new subdivisions, malls, etc. Keep in mind that we are dealing with some people who have been doing things the same way for a long time. Changing is not easy, but it can be done. Please be careful not to belittle what has been done in the past. Most of us were not aware of the issues until recently and I think we all have not converted to good lighting practices ourselves—so let us not throw stones. ☺

Across the R.A.S.C.

London

The London Centre in recent years has seen a resurgence in activity, with a number of members pursuing busy lives as observers, notably John Rousom, Dave Clark and Dave McCarter.

Well-known meteor enthusiast Peter Brown is a graduate student at the University of Western Ontario and he has encouraged meteor observing among centre members. As well, Joe O'Neil and Dave Toth (rasc@toth.uwo.ca) both operate computer bulletin boards which contain astronomy data and discussion groups.

Meetings have also recently enjoyed better attendance since the location was moved to the Masonville Mall where parking is free and public exposure is excellent. Terry Dickinson spoke to the centre in December, and centre member Martin Beech—a recent Ph.D. at U.W.O.—presented his thesis work on early stages in the development of massive stars at the January meeting. One exciting development is that an elderly Londoner named Art Claughton had a small observatory in his backyard and he bequeathed it to the centre before he recently passed away. It is a sturdy but somewhat eccentric structure which will have to be moved to a new location. Centre members are considering how best to take advantage of the facility.

For the summer of '94, centre members are looking forward to the annular eclipse and the crash of Comet Shoemaker-Levy 9 into Jupiter. The centre will also once again provide volunteers to the U.W.O. astronomy department's Saturday evening open houses at the Hume Cronyn Observatory, with its 0.25 m refractor. ☺

Reflections: Can We Afford Space?

(continued from page 1)

pure research is to ask ourselves if we would give up all the benefits, cures and inventions that this research has uncovered. I expect most of us would refuse. There was certainly a cost involved but one has only to look at our standard of living to see that the benefits far outweigh the costs. Even though there are many problems yet to be solved, including those mentioned in the opening paragraph, the human race has improved its living conditions greatly over the last few centuries. In other words, exploration and pure research do pay off in the long run despite short term costs and failures.

The exploration of space combines both pure research and exploration. If history is any guide, one can expect a lot of failures in space. However, in the long run we are likely to benefit from what we discover. What form these benefits take is anybody's guess. At the near end of the spectrum of possibilities we may find new materials and technologies. At the far end, the colonization of space may save our species should some catastrophe strike the Earth.

The exploration of space is very expensive but if history is any indication, it is just a matter of time before we see the results. ☺

The S's in SL9

David Chapman
Halifax Centre

All the hoopla over the expected Jovian demise of Periodic Comet Shoemaker-Levy 9 (also known as the "String of Pearls Comet" the "Kamikaze Comet" or simply "SL9") has catapulted the names of Eugene Shoemaker, Carolyn Shoemaker, and David Levy into the public eye. The name David Levy is quite familiar to R.A.S.C. members, but what about these Shoemakers? The following profile was derived from several sources, most notably David Levy's recent book "The Quest for Comets: An Explosive Trail of Beauty and Danger" (Plenum Publishing Corporation, New York, 1994). Other sources of information were: John K. Davies, "Cosmic Impact" (St. Martin's Press, New York, 1986); the CBC Radio Programme "Quirks and Quarks" (23 April 1994); and David Levy's lecture "The Great Comet Crash" (Acadia University, 26 April 1994).

Eugene

Eugene Shoemaker was born in 1928 and became interested in the study of geology at an early age. At age seven, he was fascinated by a set of agate marbles (a family keepsake) given to him by his mother; the next year, he began collecting minerals during a trip with his father to South Dakota's Black Hills. A special science education program that including geological field trips gelled this early interest and set the young Eugene on a career path as a geologist.

Shoemaker entered college at Caltech in 1944 during the Second World War, graduating in less than three years, thanks to the U.S. Navy's requirement for accelerated training of engineers. He earned his Master's degree in geology in 1948 and joined the U.S. Geological Survey in their search for uranium deposits in western Colorado.

One morning, the twenty-year-old Shoemaker experienced a calling: he wanted to be one of the first people to travel to the Moon! "Why will we go to the Moon? To explore it, of course! And who is the best person to do that? A geologist, of course!" In 1951, now enrolled in the Ph.D. programme at Princeton University, he turned his attention to the study of craters and violently explosive volcanoes. He found himself at the Barringer Meteor Crater in Arizona, trying to solve the mystery of its origin: collapsed salt dome, volcanic eruption, or asteroid impact? Shoemaker pieced together the intricate geological clues and proved once and for all that the Barringer Meteor Crater was indeed carved out of the plain during the five second impact of a small fifty metre asteroid.

Following this success, Shoemaker turned his attention to the Moon, where the history of asteroid impacts has not been erased by the action of wind and water, as on Earth. At the time, in early 1957, the Russian satellite Sputnik had not yet been launched into orbit and space science was not a priority for the U.S. Government. The coming of the Space Age was a large impetus for Eugene Shoemaker's interests, and in 1961 the U.S. Geological Survey asked him to be the first chief of the newly-created Branch of Astrogeology. Shoemaker's team prepared geological profiles of the areas of the Moon later visited by unmanned spacecraft and astronauts from the Apollo programme.

Shoemaker's dream to one day walk on the Moon's surface was quashed by a medical condition that—although under good medical control—disqualified him from the astronaut corps. Instead, he ended up chairing the selection committee for scientific astronauts. Of 1 000 scientists who originally applied, only one (Harrison Schmidt) actually made it to the Moon.

"...all of a sudden, there it was, and I knew it was a comet. I had a feeling it was a new comet, but I wasn't sure."

Shoemaker continued to participate in N.A.S.A.'s exploration of the Moon, being a member of the teams that worked on the unmanned Ranger and Surveyor moon probes. He also worked on the Apollo project, although he was disappointed that N.A.S.A. did not make full use of the opportunity for scientific discovery: "My dream for Apollo was to create the opportunity to show what a well-trained human being could do, what kind of science he could do on the spot... Apollo was not a highlight of my career by any means. The main issue for me was not flags and footprints, but to show why you needed a human there."

In 1972 Shoemaker and co-worker Eleanor Helin drew up a proposal to use the small, little-used, 18" Schmidt telescope at Mount Palomar to search for asteroids on near-collision courses with Earth. Most asteroids inhabit the wide gap between the planets Mars and Jupiter, but there are hundreds—possibly thousands—of errant asteroids that venture out of the main belt, following orbits that take them very near Earth. Shoemaker suspected that these asteroids—named Apollo asteroids after the first one of their class discovered—caused the impact craters he had studied on the Earth and Moon.

The discovery rate of Earth-grazing asteroids was slow: the team discovered their first asteroid six months after starting, and then waited two and a half years for their next. To improve their yield, Shoemaker devised an ingenious stereo technique for analysing the photographs. When examined as time-separated pairs through a stereo viewer, images of nearby asteroids virtually leap out of the photographs relative to the distant background stars.

Carolyn

Carolyn Shoemaker makes her scientific entrance in this chapter of the story. Born Carolyn Spellmann in 1929 in New Mexico, she received her B.A. and M.A. degrees at what is now the University of California at Chico. Married to Eugene in 1951, her energies were happily absorbed by family and home for the next two decades. Looking for more stimulating pursuits, she trained herself in the art of examining astronomical photographic plates. Joining Eugene's project, she quickly became an expert operator of the stereomicroscope. She found two new asteroids in 1983 and then—in September 1983—she discovered her first comet, Comet Shoemaker 1983p: "...all of a sudden, there it was, and I knew it was a comet. I had a feeling it was a new comet, but I wasn't sure."

By 1987, Carolyn Shoemaker had discovered eight comets, creating history as the most successful comet-hunting woman. This record had previously been held by another Caroline from another century: Caroline Herschel. In 1989, Carolyn Shoemaker discovered her fifteenth comet and became the most successful living comet-hunter, surpassing William Bradfield's record of fourteen comets. In breaking these records, however, Carolyn is mindful of the difference between purely visual and photographically-assisted comet-hunting: "Visual comet-hunting takes an awful lot of patience that I'm not sure I would have. It involves a lot of cold hours and a lot of discomfort, and a lot of looking before you find anything."

At the time of writing, Carolyn Shoemaker has bagged a total of thirty-two comets in just over ten years. Frenchman Jean Louis Pons is thought to have discovered as many as thirty-seven comets during his lifetime, but he was not very careful at record-keeping, and some authorities dispute this number. In any case, at her rate of discovery, it will not be long before Carolyn Shoemaker becomes, without argument, the most successful comet hunter of all time.

Shoemaker-Levy 9

Carolyn's most famous comet will be short-lived. She discovered Periodic Comet Shoemaker-Levy 9 in March 1993 and astronomers

soon predicted that it was destined for a catastrophic impact with the planet Jupiter in July 1994. The discovery photographs were exposed by her husband Eugene and colleague David Levy, who joined the team in 1989. They took the discovery photographs of P/Shoemaker-Levy 9 on March 23rd 1993, but Carolyn did not inspect them until two days later. She had been discouraged about the team's lack of progress and then, while peering through the stereomicroscope used to detect the motion of asteroids and comets against the background stars, she saw something that really shook her. "I don't know what this is but it looks like a squashed comet."

The comet had apparently survived a close brush with the planet Jupiter in July 1992, but the differential gravity or tides of the giant body had drawn the nucleus apart into about two dozen separate pieces. Orbital calculations then showed that the "String-of-Pearls" comet, as some people called it, was in orbit around Jupiter, and would in fact collide with the planet over several days in July 1994.

Carolyn Shoemaker received this news with mixed emotions: "My first reaction when I found out that it was going to impact Jupiter was 'Oh no! I don't want to lose one of my comets!' and then I thought 'Well if I'm going to lose one I'd like it to go out with fireworks.' But, all of that aside, I think I've been utterly thrilled by the knowledge of how many people can work on this and learn from it. I had no idea that there were so many things that one could learn from an impact. I've always fantasized that I would find 'the comet of the century'. When I thought of 'the comet of the century' I assumed that that would be one that could be seen by everyone naked eye, one like those that were found in last century. But I think as it turns out I have found the comet of the century, perhaps of the millennium, and I'm very thrilled about it."

For Eugene Shoemaker, the demise of Comet P/Shoemaker-Levy 9 in the clouds of Jupiter may be the fulfilment of a career of studying asteroid impacts on Earth, the Moon, and the moons of other planets. A pioneer of the field of astrogeology, Eugene Shoemaker has long argued that asteroids and comets regularly bombard their larger cousins in the solar system. Far from being saddened by the destruction of SL9, he remarks: "We're going to get to see one [a collision] and it's not going to be here!" ☼

We are as much gainers by finding a new property in the old earth as by acquiring a new planet.

Ralph Waldo Emerson
American essayist/philosopher/poet (1803-1882)

Observing Faint Bright Nebulae

Randy Pakan
Edmonton Centre

On the afternoon of October 16th the family room in my home was completely strewn with atlases and reference books. Had the place been burglarized? Had there been an earthquake? No, I was just preparing my observing plan for that evening. I assumed that the night would be transparent and free of dew—conditions that I needed to go after my favourite deep-sky objects—large faint bright nebulae.

If you like oxymorons, faint bright nebula is a good one. It is a faint nebula that is light as opposed to being dark. However, do not let the word "bright" mislead you; they can be so incredibly faint that you may need a nebula filter, a dark cloth, an eyepiece that is dew-free, and averted vision to see them. They are strictly for those who are not fainthearted.

The Deep Sky Field Guide to Uranometria is an excellent place to start the hunt for these elusive objects. It lists the coordinates, the photographic brightness (1 is the brightest; 5 the faintest), and the approximate dimensions. This does not really tell you a whole lot because many of them meander over several degrees and are very patchy in brightness, but it gives you a good starting point. I have an early copy of *Uranometria 2000*, and many of these objects are not plotted (they have since been plotted in later printings). Using the coordinates from the *Field Guide*, I mark an "X" in *Uranometria* where the objects should be. With only a general idea of where the nebula is, I now go into the field totally unbiased as to what area they cover. Many of the Sharpless nebulae are so large that I found the easiest way to record them is to draw them directly into *Uranometria*. This really simplifies the sketching process because often they are in very rich starfields and trying to sketch all of the stars could drive you mad!

The two inch OIII filter combined with a 40 mm wide-field eyepiece is an excellent combination for hunting down these objects. When using these, a darkcloth is an absolute must because the two inch filter is extremely bad for reflecting ambient light back into your eye. This reflected light is in the form of a ghost image that makes it impossible to see the nebulosity you are searching for. Condensation on the eyepiece is equally as troublesome; it looks just like nebulosity. Whenever I think that I have found a nebula the first thing I do is check to see that the eyepiece is free of condensation.

On October 8th I spent forty minutes exploring Sh2-157 in Cepheus and drawing it in *Uranometria*. It was plotted as only a small nebula, but I was seeing it extending over an area of a degree and a half. I drew it in as accurately as I could. This was not as hard as it sounds because I had several reference points to work from. It is flanked by the Bubble Nebula on one side, NGC 7510 on another, and NGC 7538 on a third. As it turns out the small square that is plotted in *Uranometria* is Sh2-157a. It is only a tiny bright section of the overall giant nebulosity.

On October 16th Alister Ling brought over the *Atlas of Galactic Nebula* which contains the POSS plate of this area. As we oriented the photo to the area I had outlined in *Uranometria* I was thrilled to discover that my sketch was very accurate—the forty minutes of hunting had revealed almost all of this elusive giant. That night I spent an hour on two more of these massive nebulae. Using the OIII and the 40 mm wide-field in my 16" Newtonian, I explored Sh2-132 (also in Cepheus) and Sh2-205 in Perseus. I thoroughly enjoyed these challenging objects.

Alister tells me that hard-core nebula hunters are rare and that there are many regions containing these objects that are virtually unexplored. Some of these objects are best seen with the OIII filter while others require an H β filter, but all require a keen eye and perseverance. I find these objects to be mysterious and intriguing and recommend them to anyone looking for something off the beaten track. Happy hunting! ☼

Look Out for Looking Up

Looking Up—A History of the R.A.S.C. by Peter Broughton is now available from the R.A.S.C. national office, 136 Dupont Street, Toronto, Ontario M5R 1V2. The price is \$34.95 plus \$5 for shipping and handling, plus 7% G.S.T. on the total for deliveries to Canadian addresses. If centres wish to arrange a bulk order, the shipping charges can be waived.

The book is hardcover with 288 pages. It is lavishly illustrated and has a comprehensive index. Members who have already read the book have described it as "a real treasure", "a great accomplishment", and "a superb history". The R.A.S.C. holds copyright and all net proceeds go to the society, so do yourself and the R.A.S.C. a favour and order your copy now! ☼

The discovery of a new dish does more for human happiness than the discovery of a new star.

Anthelme Brillat-Savarin
French gastronomist (1755-1826)

Take A Deep Galaxy Tour

Randy Pakan
Edmonton Centre

Imagine a transparent night in March with the snow gone from the ground, no aurora, no dew and an overnight low of plus three degrees. Sound to good to be true? These were the conditions that we had on the night of March 30th. On such a night can you imagine yourself spending an hour and a half looking at one Messier object—a naked eye object, no less? Well, that is exactly what Larry Wood and I did on that particular night. Am I serious? Very. Are you daft? That is beside the point.

What Messier object could we be talking about? Would you believe that there are over 2 000 stars in M44 (also known as the Beehive or the Præsepe)? Did you know that there are *ten* galaxies among these stars? I am sure that there are many more than ten, but there are ten that can be seen, that on average, are about visual magnitude 14.5. The faintest of these galaxies is Keel 152 at fifteenth magnitude and the "brightest" is NGC 2624 at magnitude 13.6. Among the ten you find exotic galaxies such as ZWC 089.064 at magnitude 14.8.

This project is not as difficult as it sounds. I found them in my 16" and Larry found them in his 12.5". The *Webb Society Quarterly Journal*, Volume 87, 1992, contains an excellent finder chart for these galaxies. Do not even attempt to use *Uranometria*—it shows some of the galaxies but the scale is nowhere near large enough. The *Webb* chart makes this exercise very enjoyable. There are many well-defined asterisms and pointer stars to guide you on your way. There are also numerous double stars that make excellent bench marks for your journey as you meander through the cluster at 300x. If you decide to go after these objects, allow yourself *plenty* of time to really explore the cluster. You do not absolutely need a driven scope, but since you will have to constantly refer back to the finder chart, it would be very easy to lose yourself with a drifting field.

In the April *Sky & Telescope* Roger N. Clark had an excellent article called "How Faint Can You See?". In it he gives various tips on how to get the most out of your telescope by using various observing techniques such as holding your eye steady enough to allow your eye to collect photons. He goes into more detail in his book, *Visual Astronomy of the Deep Sky*. This tour of the galaxies in M44 is a perfect choice if you want to try out some of Mr. Clark's tips.

This is a fun project to share with two or three observers on one scope. I look forward to taking the tour again. The most difficult part is having the patience to spend a lot of time on one set of observations on a good night. We get so many nights that are "just O.K." that when a good night comes along, it is hard not to get antsy. *I want to see it all!* ☺

Letters to the Editor

(continued from page 2)

couple books with this subject, but unfortunately I did not notice nearly any pictures of planets or galaxies. So I can not imagine how do these things look like. I would be very grateful, if you do me a favour and send me good views and big sized pictures (coloured if possible) of planets of our solar system and moons, where they exist. I beg you to send me pictures of basic sources of stars, galaxies of various classifications and extraordinary appearances (phenomena) like great clouds. Please write basic characteristics of them. Please, let my request come true.

I look forward to hearing from you, and thank you very much in advance.

Uros Burger

100 Moste, Komenda 61218 Slovenia ☺

Solar Eclipse a Ringing Success

(continued from page 3)

Nova Scotia—Bull's Eye!

The centreline of the eclipse passed over Nova Scotia, travelling across the Annapolis Valley and just skirting Halifax, before heading out to sea. While some areas of Nova Scotia experienced some cloudiness, most of the province enjoyed perfect (or near-perfect) skies.

The largest gathering took place at Saint Mary's University in Halifax, where the Halifax Centre and the Department of Astronomy and Physics jointly hosted between one and two thousand people over the course of the afternoon (annularity occurred at 3:00 P.M.). Over 700 Mylar sunglasses were given out to the public. Because of the advance publicity, a large number of parents showed up with their children, including *Journal* editor, David Turner, who had taken his daughter out of school so that she could see the eclipse. Members from all over the province, and some from as far away as Prince Edward Island, showed up, armed with telescopes. These joined the many others that were brought by local members, and all of them drew large line-ups as people marvelled at the sight of a Sun that slowly, but surely, began to look more and more like a crescent Moon. A carnival atmosphere pervaded the whole site.

Thanks to the marvels of computer technology, images of annularity that had been taken an hour earlier in the U.S. midwest and uploaded to bulletin board systems, were downloaded by Dave Lane and passed about, giving us an idea of what was to come.

Adding to the atmosphere were the many television cameras and reporters from the national and local media. One of the local TV stations tapped into a video feed provided by the university's Burke-Gaffney Observatory, using a camcorder provided by Halifax Centre member Blair McDonald. The signal was sent by a mobile microwave link back to their studio. We were unaware of it at the time, but several Nova Scotia cable companies picked up the signal and broadcast it live on their community channels for all to see! Reporters and their cameramen prowled the grounds looking for interesting footage. In the end, many of us were surprised at how much of the national coverage, particularly on *CBC Newsworld* and *Prime Time News* originated from Halifax.

In the last fifteen minutes leading up to annularity, the temperature started to drop noticeably, and a light breeze began to blow. Many people had not expected annularity to come so quickly, judging by the gasps as the horns of the Sun raced around to encompass the Moon. When the Moon was fully encircled, there were cheers and exclamations of amazement from all sides. Although there were still a lot of people who had been too late to get proper viewing glasses, in true Maritime style, those who had been fortunate enough to have received one passed them on to others (although not after having had a good look themselves!)

Although it had not gotten as dark as some people had expected, many found the dim light disquieting as it did not have the reddish tinge one comes to expect from dusk or dawn, nor the grayishness of an overcast day. Instead, everything kept the colours one would associate with a sunny day, but at much lower levels.

When the annularity phase finally came to an end, the TV crews drove off, the crowds slowly began to disperse and the astronomers started packing up their gear. The event had been a great success with the crowds even larger than the ones that had shown up to see Halley's Comet. It is a shame that such events are few and far between. Michael Watson's opinion notwithstanding, Halifax members are looking forward to the August 11th, 1999 eclipse which will begin off Sable Island and head eastward across the Atlantic. Wouldn't it be nice to leave Halifax the day before on a cruise ship, bound for the path of annularity... Anybody interested? ☺