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Reflections: The Telescope Visibility Factor

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Vancouver Centre
reprinted from *NOVA*

There appeared, in the May issue of *Sky & Telescope*, an article entitled "The Power of Binoculars". What made it particularly interesting was its discussion of an all-purpose "visibility factor" based upon Roy Bishop's article in the *Observer's Handbook*. What is stated, in a nutshell, was that if you multiplied a binocular's magnification by its objective lens diameter, you could determine a relative value for that instrument's visibility factor (VF). For example, 7×50 binoculars would have a VF of 350, while 10×50s would have a VF of 500.

This suggests that celestial objects should be more easily visible in the 10×50s than the 7×50s, and, indeed, observations bear this out. The darker skies and larger images in the higher VF instrument make globular clusters, nebulæ, galaxies and star clusters stand out much better from the background sky. This set me to wondering if it was possible to apply the VF to telescopes as well. Was there such a thing as a telescopic visibility factor (TVF)?

When I thought about it, a TVF actually explains some observations I had accumulated and lessons I had slowly learned. Many years ago, Lee Johnson used to observe exclusively with a 10" while I used a 12.5". I remember how often Lee's views were better than my own. I wondered how it could be that a 10" scope could show galaxies more plainly than a 12.5" scope that had roughly 50% more light-gathering power. It seems, in retrospect, that this was the TVF at work. Back then, Lee did practically all of his observing with a 7 mm Nagler. In his 10" it gave him about 160× and a true field of 30'. I typically used my trusty 16 mm Erfle which gave me close to 100× and 39' of true field. If we calculate the TVF of the two instruments, Lee's was around 1600 (using inches instead of millimetres) and my TVF was 1200. Little wonder that the smaller scope was outperforming the larger one! To get the same TVF, I should have been using something closer to 130×.

So, what is really going on here? Does this mean that a 1" scope working at 1000× would perform the same as a 10" working at 100×? Well, as you might have expected, there are other factors to consider—indeed there is an upper limit to one's TVF. What you are really accomplishing when you increase your TVF is an improvement in the signal-to-noise ratio. Since you cannot increase the signal, the total light from a galaxy, for example, all you can do is drive down the noise—the sky brightness. In effect, all you are doing is darkening the sky by using higher powers when you increase your TVF. I do not mean to suggest that you should not do this, you should, but not to the point where you start reducing your signal as well.

How, you may ask, can you reduce the signal, that is, to reduce the light coming from a galaxy? It is easy. Keep in mind that the trade-off for magnification is reduced true field. By applying too much magnification, your field of view shrinks to the point at which the galaxy can no longer be contained within it, effectively reducing the total light being received from the galaxy. What the TVF teaches us is that you should always operate at the highest power that permits the viewing of the complete object. This lets you maximize your TVF and, in effect, achieve the best possible signal to noise (object to sky glow) ratio possible. In practice, this seems to be when a given object fills a little more than the centre half of your field of view.

The TVF also helps to explain the often discordant reports of visibility of large, low surface brightness objects such as M33 and the North America Nebula. These objects are best seen in small wide-field telescopes, or even binoculars, but can be difficult in larger telescopes which typically possess smaller fields of view. In fact, few large telescopes possess sufficient true fields to contain the total light from these objects—that light being spread out over such a large area.

What the TVF really expresses is contrast, the difference in brightness between the sky background and the object being viewed. There obviously comes a point at which the sky simply cannot get any blacker. Even then, there is often good reason to increase the magnification and the TVF even further. Increased power means that the objects viewed will be larger and, consequently easier to see. This is especially true for extended objects, such as galaxies. This makes it easier for the high sensitivity/low resolution detectors in your eyes (the rods) to make out features. Experienced observers know that higher power will often draw out details invisible with lower magnification. The real limit is the

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Cover Picture: *Spirit of Windsor*, a 1911 locomotive, on the Windsor waterfront with Detroit's skyline in the background. The Renaissance Centre is on the right.

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Letters to the Editor

Non-doctors Talk Too

I would like to bring to readers' attention an error and omission that crept into Carole Talbot's report on the activities of the Montreal Centre, which was published in the April issue of the BULLETIN.

The error concerns the title given to Gilbert St-Onge. Mr. St-Onge is not a professional astronomer, nor does he hold a PhD. Nonetheless, at the request of Dr. P. Bastien of the Université de Montréal, he is collecting images of gas emissions around young stars using an 8" Newtonian and an inexpensive CCD detector. That Mr St-Onge is an amateur, observing out of his suburban backyard, certainly should not detract from the valuable research he is carrying out and his example should serve as an incentive to other amateurs.

I would also not want readers to think that presentations by professional astronomers are the only ones appeciated by the Montreal Centre. In fact, the Saturday night (usually) talks for the period reported on (aside from Mr. St-Onge's) included the presentations listed in the following table, all given by non-professionals.

Members of the Montreal Centre are very aware that a lot of work goes into preparing an interesting presentation, as does organizing the schedule of speakers. On behalf of my fellow attendees at these talks, I want to thank all those, professional and amateur alike, whose efforts made these talks both instructive and entertaining. I also believe that Mario Caluori's devotion and persistence in organizing these talks right up to the end of November 1994 ensured the very successful pre-Christmas season at the Montreal Centre, which saw the visit of such distinguished speakers as Dr. Halton Arp, among ohters.

Date	Speaker	Topic
Sept. 11/93	Bert Widdop	Occultations
Sept. 26/93	David Levy	The Centre's 75th Aniversary
Oct. 9/93	David Levy	Comet to Hit Jupiter
Nov. 13/93	Suzanne Moreau	Women in Astronomy
Nov. 20/93	George Livadaras	The Year's Astronomy Roundup
Feb. 12/94	Alain Rahill	Seeing
Apr. 9/94	Louie Bernstein	Observing Eclipses
Sept. 26/94	David Levy	Comet Crash on Jupiter: A Personal Perspective

Ron Pow
441 Argyle Avenue, Westmount QC H3Y 3B3 ✪

Mr. Hobbes told me that the cause of his Lordship's [Francis Bacon] death was trying an experiment: viz., as he was taking the air in a coach with Dr. Witheborne, a Scotchman, physician to the King, towards Highgate, snow lay on the ground, and it came into my Lord's thoughts, why flesh might not be preserved in snow as in salt. They were resolved they would try the experiment presently. They alighted out of the coach and went into a poor woman's house at the bottom of Highgate Hill and bought a hen and made the old woman exenterate it, and then stuffed the body with snow, and my Lord did help to do it himself. The snow so chilled him that he immediately fell so extremely ill that he could not return to his lodgings.

John Aubrey
English author/biographer (1626-1697)

The Saskatoon Centre's Temporary Membership Program

Richard Huziak
Saskatoon Centre

Building and holding a comfortable-sized membership has always been a concern with our centre and surely with other centres as well. There are some realities of having a membership of a certain size. First, you must pay the bills. You must have a certain amount of income to survive as a centre and enough cash available to do those projects you have always wanted to do. There is insurance to pay, telescopes to maintain, newsletters to publish and a host of other expenses. This cash is generated mostly by memberships. Next, you want to have sufficient people to fill all executive positions and have enough of a leftover group to fill the meeting room for presentations. Without enough members, the same people have to do the same jobs over and over again. When those people tire out, the centre begins to stagnate and soon nothing gets done. Members begin to leave because they see no benefit in remaining. Furthermore, I have often seen potential members turned away because someone says "It's July and our membership year does not start until October. You will not get your money's worth if you join now". This invariably results in a lost member. Year after year you plod on with the same number of members and the same old executive.

These were the symptoms of the Saskatoon Centre from about 1987 to 1994. We were not getting much done. We were always out of money. Members would come and go with no net gain or loss. The same executive had sat since the mid-80's. Sound familiar? I am sure our centre is not unique in being in this position.

It became abundantly clear that we had to revitalize the centre, and the way to do this was to revitalize the membership. More members meant new blood on the executive, new ideas in the club and more people to do the work. We had forty-eight members out of a possible pool of 200,000 residents of Saskatoon and a further extended pool of 800,000 across the rest of Saskatchewan. Surely we could attract and hold a few new members!

After some thought, we came up with a new program that we are now very proud of. We call it the Temporary Membership Program. This program attracts, holds and signs new members on an ongoing basis and is largely responsible for the revitalized, active centre we have today. In preparation and anticipation, we nominated a membership director to a new executive position, and administration of the program became the sole responsibility of this director. The program works as follows. We ask our members to keep their eyes and ears open, and when they hear of anyone who may be interested in astronomy, they report this person to the membership director. We also insert centre brochures into the astronomy magazines in bookstores where we can, and advertise our presence everywhere where we can get free ads. Potential members come from a lot of sources; friends, work buddies, star nights, displays, brochures and rumours. The director follows up by immediately calling the potential new member and offering them a temporary membership.

The temporary membership is simple in principle. We offer a no-obligation, free-of-charge enrolment in the Saskatoon Centre with the following benefits for a three month period: a subscription to the newsletter, an invitation to every event or meeting in that time, a guarantee of at least one night under the stars with a centre member, a tour of our facilities, and supervised use of our equipment. Basically, we treat the potential member like a new member of our centre. After three months, if there is no interest, the temporary member is dropped. However, we are finding that once the name is on the list, 65% of the names become members! In some cases, if there is continuing interest or if it is only midway through the membership year, we may extend the temporary membership by a month or two. The cost of the program is very low compared to its payback. The cost is the cost of copying three newsletters and mailing them out! That is pretty cheap when the return is an enthusiastic new member!

This program gets the names on the list and keeps them from getting lost until we can sign them up. Through these sources, we get at least two or three new names on the list every month. Still, one of the hardest parts of the program is getting our own members to report the names in the first place. At public star nights I still get the comment "I talked to this guy for half an hour. He's got a 6-inch telescope". The return is "Did you get him signed up on the temp list?" All too often the response is still "Well...no!". Your members are a key ingredient to the program and have to be convinced of its importance. Happily, our members are contributing more and more names all the time.

The follow-up by the membership director is the most important aspect, and the success of the program really depends on this person being enthusiastic and persistent, but not pestering. Our membership director, David Cornish, is this type of person and has done a fine job.

What about hard results? In the last year, our membership went from forty-eight to sixty-five. This year we already have fifteen postdated cheques from temporary memberships for the new year making seventy-five total members. In the next few years we want to peak out at about one hundred members - a 100% growth in only four or five years. For our centre, sixty-five members is our cash break even point, and guess what?—we are there! About two-thirds of the temporary members are from Saskatoon, and strangely enough, the other third are scattered all over the rest of Saskatchewan! More members means more ideas, more observers, more operating cash. This is so important as in the next few years we will be developing a new observatory and starting several new initiatives.

It is not all Easy Street though. With the rapid growth, we are being forced (pleasantly) to provide better and more diverse programs to keep our members interested. This is, however, not that difficult because we have attracted new, enthusiastic members, many of whom are self-starting. As well, we are now able to have a bigger, more active executive. There is far less "railroading" of positions going on.

In combination with the Temporary Membership Program, we are planning to merge in another good program initiative called Astrobuddies. Astrobuddies teams up a temporary or new member with an experienced member with similar interests for a minimum of three meetings, activities or observing sessions. The astrobuddy's responsibility is to get the member started in and informed about the centre, then to turn them loose. This ensures that new members are not quickly left abandoned.

I hope this program can help other centres who feel that they are floundering or need to build toward a future goal. All it takes is the dedication to make and maintain a list , to make a few phone calls every month, and to convince the general members to nominate new people to the list on a regular basis. Anyone who is interested in more details about the program can contact me by phone, mail or e-mail.

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Toronto's Planetarium To Close

Mary Anne Harrington
Toronto Centre

By now I am sure that you have read about the closing of the McLaughlin Planetarium in Toronto. This decision was made by the board of directors of the Royal Ontario Museum (ROM) and was only announced to the public on October 26th. The planetarium was closed to the public on November 5th, with previously-booked school shows continuing until December 15th. After that, the doors will be locked, the staff laid off and all of the displays, the Zeiss projector and the star theatre will be mothballed!

The McLaughlin Planetarium has served as a focal point of astronomy, not only for the people of Toronto, but also for some 50,000 students from all over Canada and the northern U.S., who journey to the dome to watch the magic of the universe unfold over their heads. It is an integral part of our heritage and our community.

As people who believe in the importance of taking astronomy to the members of the public, we are looking for your support. We are asking that the board of the ROM review and reverse their decision. This is a very unhealthy trend for those of us who are involved with public astronomy programs. The Toronto Centre's executive feels that it is critical that we make a very strong protest to this action. If we do not, which museum will be the next to make a similar decision? "After all," they will say, "it worked in Toronto. We can save a lot of money and no one is interested in astronomy any more."

We would encourage you to write to the director of the ROM and to send copies of your letter to two additional people, just to ensure your opinions will not be overlooked:

DR. JOHN MCNEILL
DIRECTOR & PRESIDENT
THE ROYAL ONTARIO MUSEUM

MRS ELIZABETH SAMUEL
CHAIRMAN OF THE BOARD
THE ROYAL ONTARIO MUSEUM

DR TOM CLARKE
THE MCLAUGHLIN PLANETARIUM

Mail for all three goes to:
100 QUEENS PARK CRESCENT
TORONTO ON M5S 2C6 ✪

Brilliant Bolide Blazes Over Beclouded Starfest

Dave McCarter
London Centre

Thin but persistent altostratus cloud at 10,000 feet (retired weather forecaster and ardent amateur astronomer Frank Lochner provided the identification) completely covered the starry vault on Friday night at Starfest '95, but a few of us still held on to the vain hope that the sky would soon clear. Joe and Susanne O'Neil, Steve Arenburg, Christie Carroll, Peter Dawes, and I were the last of a steadily dwindling crowd, the rest having given the situation a failing grade and headed off to sleep.

At 00:38:00 EDT our conversation was of Starfests past, the talks tomorrow, and such like, but at 00:38:30 all attention became riveted upon a brilliant blue-white light illuminating the clouds directly overhead. Moving slowly to the south this instant attraction seemed to dart to all sides to confuse easy understanding. In a faltering instant we understood that where thin spaces existed between the clouds more light was allowed entry, causing the appearance of sideways movement.

Over the next eight to ten seconds (some said twelve) the brilliant magnitude -15 bolide flashed and flickered a fantastic cobalt blue (much like an electric welding arc) with very frequent yellow-red flashes which could have been due to fragments breaking off the main body. There was enough time for the people sleeping nearby to wake to our shouts, and see the prolonged bright light through their tent ceiling!

The bolide covered a huge arc of the sky, moving from directly above us to only ten degrees above the south-southwest horizon. Then it seemed to just fade with no terminal burst. Across the park excited observers let out whoops of joy and excitement.

Steve Arenburg thought to start his watch timer (very professional of him don't you think?) and called out the distance which an acoustic shock wave would travel in ten kilometre increments, up to about five minutes or so. We managed, more or less, to control our excitement and listen for the sonic boom. Unfortunately none was heard.

People began stumbling out of tents, anxious to hear about what we had seen. Maybe there would be another! They had no trouble finding someone willing to retell the event. The next morning we awoke to the news that a large meteor had landed and started a truck fire in Windsor. We knew that report to be bogus of course, as simple map reading skills showed that the bolide path had travelled more towards the Niagara Peninsula. Peter Jedicke visited our site and pronounced the previous night's bolide "a once in a lifetime event". Of course, he had been in his trailer talking with his wife, Diane, and David Levy!

It is true that very large bolides, above magnitude -8 or so, occur very infrequently. All the more reason to be outside under the stars, and sometimes even under the clouds! Next year, Starfest will be held from August 9th to 12th, with a Perseid meteor watch planned for Sunday night/Monday morning. I plan to be there! ✪

New Space Science Resource for Canada

Mary Lou Whitehorne
Halifax Centre
and
Regional Coordinator
Atlantic Space Resource Centre

The Canadian Space Agency (CSA) has set up five new regional Space Resource Centres across Canada to serve the educational community and the public at large. These centres can be a very useful adjunct to the aims and activities of the RASC and there are plenty of opportunities for cooperation between the two organizations. Get in touch with the resource centre nearest you—they can help you promote astronomy and they can also serve as a link between the RASC and the public. The following is a short description of what these centres will be doing. Check it out—you may want to strike up a mutually beneficial friendship!

The CSA's Space Resource Centres are dedicated to promoting science and technology from a space perspective. They ensure that teachers, educators, and students have full and convenient access to a wide range of information, materials and resources about the activities of Canada and other space-faring nations.

Established in partnership with well-recognized institutions, actively involved in promoting space science education and activities, the centres bring a wide pool of knowledge and resources to bear, in support of the educational community and in raising general awareness of Canada's space program.

Space offers an endless frontier of knowledge and exploration and a powerful magnet for drawing young people into the study of science, engineering and mathematics—the building blocks of a knowledge-based economy.

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The RASC Meets the Internet

David J. Lane
Halifax Centre
Chair, National Computer Use Committee

The national RASC has recently joined the internet's World Wide Web. The growth of the Internet is currently exponential, which makes it a superb place from which to promote the RASC, its centres, and its publications. Internet users around the world can quickly search for the RASC and be directed to our home page in only a few seconds. For those of you who are connected to the Internet, our address is:

http://apwww.stmarys.ca/rasc/nat/rasc.html

This site is provided courtesy of the Department of Astronomy and Physics at Saint Mary's University. It currently contains introductory information about the RASC, the addresses of all the centres including links to centre-operated home pages (nine centres are currently on-line), and the minutes of recent annual and national council meetings. Much more information will be added in the near future. I have volunteered to maintain the site, but anyone willing to help expand its contents, can contact me by e-mail at: dlane@ap.stmarys.ca. ✪

Book Review: *The Hubble Wars* by Eric J. Chaisson

Dan Collier
Vancouver Centre
reprinted from *NOVA*

In answer to your first question: yes, this is a post-repair book, with an afterword tacked on at the last moment. No matter how successful the billion dollar repair may turn out to be, the skeptics, including Washington politicians, will not be fooled into believing that NASA is now healthy. Those opposed to the space station heaved a sigh (not one of relief) when NASA's man-in-space sector pulled off this brilliant mission. Chaisson's concluding remarks were ready before the repair mission, and were not superseded in the afterword. Based on his experience with the Hubble program, he disparages NASA's competence to handle a space station, and gives support to those who think the agency's collapse is inevitable, and rebirth necessary.

What we get is a sweeping tale of incompetence, broken careers, grinding axes, public relations, political spin, and primal screams. It is exciting, muck-raking, and informative, on levels technical, organizational and human. Careful notes are made of doors slammed off their hinges, overhead projectors smashed, and, oddly, the vomiting of several persons. It also has flaws of fact, balance, and construction, but amateur astronomers will be entertained and informed anyway.

"Readable" historians often strain to find a balance. Chaisson hardly tries, short of mentioning NASA's cave-in which led to the public release of early images over the objections of defensive executives and astronomers with vested interests. Page after page of alleged snafus and distortions leaves you pining for the "old" NASA. Chaisson served as education and media coordinator for the Space Telescope Science Institute (STScI), an independent group set up by NASA to operate the Hubble. He is very partial to STScI and to its dynamic, abrasive director Riccardo Giacconi, probably the world's most respected science administrator. The author's enemies include NASA engineers and administrators driven to hysteria by the Hubble's problems, and certain scientists who regarded astronomical objects as personal property. Lines of communication snapped between Hubble, NASA and STScI, engineers and scientists, and naturally, between all of the above and the public.

Large military telescopes have been flying for decades, culminating with the big "Keyhole" birds. Does the Hubble benefit from this technology? On this topic Chaisson wraps himself in an enigma, and admits being muzzled by the defence department. On the one hand he is distraught about the "black" engineers who knew that Hubble's ESA-made solar panels were too flexible and would flap like wings when exposed to the rising sun. (He jokes that "Big Bird", the nickname of the KH-11 reconnaissance satellite, derived from the air force's experience with flapping solar arrays in the 1960s.) On the other hand we read of irretrievable, billion dollar "Keyholes" tumbling end over end, tales which would have outraged American taxpayers had they been told.

I have had certain doubts about the ability of engineers to design reliable spacecraft, but Chaisson comes straight out and says they are incompetent. Lockheed engineers knew that energetic protons in the Van Allen Belts would probably cause the failure of critical Hubble subsystems. When they bolted "unhardened" equipment left over from earlier projects into Hubble, they knew full well that articles from the same production lots had flown and failed. As they sat down to eat their lunches, colleagues engaged in military satellite projects bit their tongues and laughed up their sleeves at them. This is how Sensitive Compartmentalized Information "SCI", or "need to know" has damaged promising civilian programs like Hubble, while guarding with dubious success the secrets which the Soviets were buying for mere thousands of dollars from persons with top secret clearances.

We know all along that the mirror had its damnable flaw, but in the meantime we learn of venal infighting between Chaisson, who sensed a growing public backlash, and astronomers, who did not want any observations to be released before they could capitalize on them. As we remember, the very first picture arrived on a wave of bugs: blind fine guidance sensors, slamming aperture doors, "safing" events, culpable human error, and yes, poor focusing.

This was to be a very prosaic image indeed. NASA went out of their way to select a first-light target which would not offend any astronomers, finally settling for a field with only a few stars in it. Meanwhile, NASA's public relations office was worrying more about its image, and was even reissuing Science Institute press releases with the STScI and ESA logos blanked out and the NASA "worm" substituted.

What about that flaw! We hear a Kodak executive accuse Perkin-Elmer of "low-balling" by

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f-Values

Jeremy Tatum
Victoria Centre

Having just read with interest Gary Seronik's instructive article in the June 1995 **BULLETIN** on f-ratios (also called f-numbers), I recalled another astronomical term with a similar-sounding name—"f-values", which have nothing whatever to do with f-ratios or f-numbers, but are at least as important. I had just returned from the Fifth International Conference, in Paris, on f-values, in which 150 scientists from eighteen countries expounded earnestly on the subject for four days. At the end of it, Dr Donald Morton (Director of the Hertzberg Institute of Astrophysics) and I invited them all to hold a sixth international conference on the same subject in 1998 in Canada. What can possibly be so important as to hold the attention of so many scientists to a subject that I suspect not many amateur astronomers are all that familiar with? I thought I should do my best to explain.

Near the Paris Observatory, headquarters for the conference, is a street called avenue Auguste Comte. Comte was a nineteenth century philosopher and eccentric (very) who described his philosophical ideas in a book entitled *Un Cours de Philosophie Positive*. One of the tenets of his philosophy, of which he gave several examples from various branches of science, was that there are some things of which the human mind shall remain forever ignorant, not because of mere technical limitations of the day, but because by their very nature they are unknowable.

I do not know whether this is philosophically sound or not, but the example he chose from astronomy is well-known to every astronomical spectroscopist. He wrote "Nous concevons la possibilité de déterminer leurs formes, leurs distances, leurs grandeurs et leurs mouvements; tandis que nous ne saurions jamais étudier par aucun moyen leur composition chimique." (We can imagine the possibility of determining their shapes, their distances, their sizes and their movements; whilst we shall never be able to study by any means their chemical composition.)

This was an unfortunate example, because his writings show that Comte was very conversant with most of the accumulated knowledge of the physics, chemistry, astronomy and mathematics of his day. Yet he had somehow managed to overlook the fact that some years previously the German optician and instrument maker Joseph Fraunhofer had already mapped the strongest dark absorption lines (now known as Fraunhofer lines) in the solar spectrum, and had recognized that the two close lines in the orange part of the solar spectrum, known as the D lines, are identical in position to two bright lines observed in laboratory flames. Through the work of Kirchhoff and Bunsen (of Bunsen burner fame) these lines were later to be recognized as characteristic of the element sodium, so already the seeds had been sown to study the "composition chimique" of the heavenly bodies.

The principles of identifying the chemical elements in the stars are now well-known. One passes the light from a star through a spectrograph, which splits the light up into its constituent colours, traditionally given as Red, Orange, Yellow, Green, Blue, Indigo, Violet (Richard Of York Gave Battle In Vain). The spectrum of colours is seen to be crossed by a number of dark lines, and each chemical element has its own characteristic set of lines.

It is one thing, however, merely to identify the elements present in a star, but quite another to determine the relative proportions of each element present. There are more lines of iron identified in the visible portion of the Sun's spectrum than of any other element. This does not mean that the Sun is largely composed of iron; it merely means that iron is quite a complex atom, having 26 electrons, and so has quite a complicated spectrum. The strongest lines are those of ionized calcium; but no, the Sun is not mainly composed of calcium, either; it just means that these particular lines are intrinsically strong, and even a relatively few calcium ions can produce a strong line.

So, just how do we determine the amount of a given chemical element from the strength of its lines in a stellar spectrum? Well, we need to know just how much light energy will be absorbed by a single atom as the light struggles to work its way through the stellar atmosphere on its way to Earth.

We can work this out from classical electromagnetic theory. The argument goes something like this. We imagine the outermost electron of an atom to be attached, by a spring, as it were, to the rest of the atom. This electron has a natural period of vibration. When the atom is irradiated by light (that is, by an oscillating electric field) it does not react very greatly to light whose frequency is very different from its natural period of vibration; but it resonates and absorbs energy very efficiently from that part of the light that has just the right frequency. The amount of energy so absorbed by this resonance process can be calculated from classical physics very precisely, and so we should be able to predict the strength of the resulting spectrum line.

Atoms, though, obey the laws of quantum mechanics, not of classical physics, and in any case an atom does not consist of an electron attached to the rest of the atom by a spring. The intensities of spectrum lines vary greatly from the prediction given by the simple model described above. The ratio of the actual strength of a spectrum line to the strength predicted from the simple model is called the "oscillator strength". It is usually given the symbol f, and is often called the "f-value" of the line, instead of the more correct term, oscillator strength.

At any rate, the strength of a given spectrum line depends on two things—the number of atoms in the stellar atmosphere producing the line, and the oscillator strength of the line. It is easy (well, sort of) to measure the strength of a spectrum line in a stellar spectrum; but, in order to tell how many atoms produced the line, we must know the oscillator strength of the line, or its f-value. Thus we can see the tremendous importance of the concept. The entire edifice of our knowledge of the chemical constitution of the universe depends on our knowledge of f-values, and an enormous effort has gone into measuring these in the laboratory or trying to figure them out theoretically.

One way to measure f-values is merely to set up a light source in the laboratory and just measure the intensities of the lines obtained with a spectrograph. Easy to say, very difficult in practice. For one thing, you need a homogeneous light source; that is, one that is uniform in temperature and pressure throughout. How are you going to measure the temperature and pressure? How are you going to measure the absolute intensities of the lines in watts? Even if you could do that, you cannot convert your measured intensities into oscillator strengths unless you know how many atoms are in your light source. (The problem for laboratory astrophysicists is the opposite of that of their observational colleagues. In the laboratory, you must know the number of atoms in order to determine the f-value. The astronomical observer must know the f-value in order to determine the number of atoms.) In spite of these difficulties, this method has been used successfully to determine the **relative** f-values or oscillator strengths of many lines, and this in itself is very useful, but putting these on an absolute scale is very difficult.

Some ingenious methods are used for the determination of absolute oscillator strengths, and once a few absolute oscillator strengths have been measured, all the relative oscillator strengths can be fitted to an absolute scale. A spectrum line is emitted when an atom falls from a high energy state to a lower energy state. Generally atoms stay in excited states for a time

of the order of nanoseconds or so. (That is a billionth of a second.) During a few nanoseconds of the excitation of a large number of atoms, the atoms decay to lower states (and hence emit light) at an exponentially decreasing rate, and the mean lifetime of an atom in an excited state is inversely proportional to the oscillator strength of any line arising from that state. The smaller the oscillator strength, the longer the lifetime.

In one class of experiments, ions are accelerated with an accelerator (what else?) and slammed into a thin carbon foil. This raises them to an excited state, from which they are going to decay (and hence emit light) exponentially. After passing through the carbon foil, the beam continues at high speed, and is observed from the side, the light from the beam gradually getting fainter as the ions speed further from the foil. Since the speed of the ions is known, the rate of decay with time and hence the absolute oscillator strength, can be calculated in absolute units without having to measure the intensity of the light in absolute units at all.

Can an amateur astronomer measure usable oscillator strengths? I have never heard of any amateur doing so, but it would not surprise me if someone has done so somewhere. The beam foil experiment just described is probably beyond the realm of most amateurs, but I am sure that there are amateurs who have constructed very serviceable spectrographs and ingenious light sources. In the days of photographic plates, the measurement of even relative intensities was a major headache, and some would say a well-nigh impossibility. Now that we are in the CCD age, it is probably not out of the question for an amateur to try his or her hand at measuring intensities of spectrum lines and perhaps converting them into oscillator strengths. There are lots of things to know about before tackling such a problem, but to get one's measurements accepted by a prestigious journal would be quite a feat. But make no mistake, it would be a very useful contribution indeed to astronomy to do so. ✪

National Awards

The RASC may, from time to time, confer awards on members in recognition of meritorious service or achievement. Nominations for such awards should be made in writing by individuals or centre councils not later than December 31st. They should be sent to the awards committee c/o the national office or directly to the chairman, Peter Broughton, ac372@torfree.net. The awards committee will consider all nominations and make recommendations to the national council for final approval.

CHANT MEDAL

The Chant Medal was established in 1940 in appreciation of the great work of the late professor C. A. Chant in furthering the interests of astronomy in Canada. This medal is awarded, not more often than once a year, to any amateur astronomer resident in Canada on the basis of the value of the work for which he or she has carried out in astronomy and closely allied fields of investigation.

SERVICE AWARD MEDAL

The Service Award was established in 1959. This bronze medal is presented to members who have performed outstanding service to a centre or to the national society.

KEN CHILTON PRIZE

The Ken Chilton Prize was established in 1977 by the national council in remembrance of the late K. E. Chilton, an active member of the Hamilton Centre. The prize is awarded annually to an amateur astronomer resident in Canada, in recognition of a significant piece of astronomical work carried out or published during the year.

SIMON NEWCOMB AWARD

Though articles or essays for this award need not be submitted until March 31st, this is an early reminder to potential authors to start writing.

The Simon Newcomb Award is named in honour of the famous astronomer Simon Newcomb (1835-1909) who was born in Nova Scotia, and later served for twenty years as superintendent of the American Ephemeris and National Almanac Office at the United States Naval Observatory in Washington. The award was created in 1978 on the initiative of the Halifax Centre. It is intended to encourage members of the society to submit well-written articles of general interest to the membership and to recognize the best of these contributions through an annual award. It is not intended for those who normally publish articles or papers on astronomy as part of their professional work.

Who can enter? Any member of the society may submit an article.

Format: There are no limits on submission length but 2000-3000 words is recommended. The submission should be written in proper grammatical form, and be presented typewritten and double-spaced. The additional submission of an electronic version, if available, would be appreciated, although it is not a requirement.

Diagrams need not be in a finished form but should be complete and ready for drafting. Photographs may also be submitted and, if possible, original negatives should be available on request. The author's name should appear only on the title page and reference to centre affiliation should not appear in the submission.

Submission of Entries: Articles must be received by the national awards committee, care of the national office, by March 31st of the year during which the award is sought. All entries must be original and should not have been previously published in any substantially similar form (although appearances in centre newsletters is permissible).

Judging: The awards committee will judge submissions based on their originality, literary merit and scientific accuracy. The submission should be suitable for publication in one of the society's national publications. Regarding style and content, submissions may be of any type: scientific papers, historical essays, education notes, accounts of observing expeditions, etc.

Presentation: The award is a trophy which will be presented at the General Assembly and remains in the hands of the winner's centre for display until the following April. A prize of two books will be provided by the Halifax Centre. One will be a copy of one of Simon Newcomb's works, while the other will be contemporary. A cash prize of $250 will be awarded to the winner by the RASC. ✪

Heard Has Been Seen

Jeremy Tatum
Victoria Centre

Members may remember from the October 1994 **BULLETIN** that I mentioned that two asteroids with a Canadian connection, namely (3023) Heard and (4340) Dence, were on the "critical list", not having been observed at all adequately in recent years. Shortly after that, Dence was recovered, but Heard proved to be a good deal more difficult.

I am now happy to report that Heard, which had been observed on only one night (in 1988) since 1984, was recovered August 6th, 1995 by Rob McNaught on a pair of CCD exposures with the 1-metre Siding Spring telescope in Australia. It would be good to have a few more observations of it during this apparition, although it was very close to its predicted ephemeris position and its orbit is now sufficiently secure that it has been removed from the critical list.

All "Canadian connection" asteroids are now safe and in no danger of being lost. Heard was named in honour of the distinguished Canadian astronomer, Jack Heard of the University of Toronto and the David Dunlap Observatory. ✪

I have the result but I do not yet know how to get it.

Karl Frederick Gauss
German mathematician (1777-1855)

Lightwaves: Good Lighting / Bad Lighting: What is The Difference?

Bill Broderick
Kingston Centre

What is the difference between "good" lighting and "bad" lighting? For a quick answer, go around your home some evening and remove all the lampshades, so that there is nothing between your eyes and the naked light-bulbs. The harsh illumination and glare will soon convince you that lampshades perform a couple of fairly useful functions:

- they shield your eyes from the direct rays of the light source and,
- they direct the light to where it is needed.

Design Important

Some kind of shading and shielding of outdoor lighting is helpful too. For many years, glaring, unshielded lighting was the norm. Then in the 1970s and 80s, shielded lighting began to make an appearance. In shielded or partly shielded lighting, the light source is hidden or recessed into the light fixture so that, insofar as possible, no direct rays reach the eyes. Glare is thus eliminated or at least minimized. Today one can see many examples of well-designed, full cut-off outdoor lighting fixtures almost everywhere—in street lighting, parking lot illumination, security lighting and other applications. In other words, light fixture design is an important element of "good" lighting.

Light-Source Important Too

Besides the design of the light fixture, another consideration is the light-source itself. For many years the light source of choice for outdoor lighting was the mercury vapour lamp (MV). This type of lamp was both bright and cheap. When combined with the older design of light fixture, it made for very bright, very glary street, parking lot and security lights.

A Crisis of Sorts

It was the sheer proliferation of mercury vapour lighting that produced a crisis of sorts in the astronomical community a few years back. Large cities anywhere near an important astronomical facility were rendering them practically useless as far as useful astronomical work was concerned. Skyglow from such cities blocked out much of the sky. Cities like Tucson in Arizona and San Diego and Los Angeles in California were major threats to some of the largest astronomical observatories in North America. Mount Wilson Observatory, near Los Angeles, was actually shut down for a time, and Mount Palomar came near to being closed as well. It was only by convincing municipalities in their neighbourhoods to switch to more efficient kinds of lighting that the observatories could be saved. ("Neighbourhood" is a funny choice of word here: Palomar Observatory is over 150 kilometres from San Diego!)

One of the first cities to make changes to its lighting was San Diego. In 1983 it began a program of converting MV to low-pressure sodium (LPS) lighting. Another city that made wide use of LPS was Tucson in Arizona. Today, LPS together with full cut-off lighting fixtures makes Tucson one of the best places in the world for astronomy. Not perfect, mind you, but pretty darn good!

Amateurs Suffer Too

Besides the large observatories, amateur astronomers by the thousands were also suffering. To do any serious observing, it became necessary for amateurs in or near large cities to bundle telescopes and observing gear into their cars and vans and drive for an hour or two to a remote observing site. Even then, light pollution filters were often necessary to cut through some of the skyglow and help make those faint fuzzy-wuzzies more visible.

Incentives for Change

Cities far from major astronomical observatories had few incentives to install better lighting or make any kind of change to the status quo. Today, though, that is changing. It is now generally recognized that mercury-vapour illumination is relatively expensive compared to the alternatives that are available today, such as high- and low-pressure sodium (HPS and LPS). In the 90s, what with tax-payers growling and threatening revolt at every proposed tax increase, saving a buck in any way practicable becomes a very attractive incentive to any municipality or utility.

What kinds of savings can be realized with sodium lighting? Well, to take one example, in 1984 the town of LaSalle, Quebec, replaced its mercury vapour lighting with high-pressure sodium at a cost of $605,000. Some 3,585 MV lamps formerly used about 1,200,000 kwh annually; the new lamps, 3,575 fixtures with HPS, use only 540,000 kwh—almost 55 percent less energy! In addition, the entire cost of replacement was paid for in five years—after that, it was money in the treasury! (The above figures were reported in the January-February 1992 issue of *Astronomie Québec* in an article entitled "Pollution Lumineuse: Cette Lumiere Qui Salit le Ciel" by Jacques-Serge Neveu.)

Low-pressure sodium uses even less energy. How much less? Well, according to one International Dark-Sky Association (IDA) information sheet, typical wattages for major highway and street lights would be 400 to 1000 watts for MV, 250 to 400 watts for HPS, and 135 to 180 watts for LPS. So you can see that there are really significant economies to be realized by getting rid of mercury-vapour wherever possible and going to sodium lighting. I can imagine that there are probably some municipalities out there that are not interested in switching, but I cannot imagine why!

LPS or HPS?

From an astronomical standpoint, LPS in a well-designed fixture is the best kind of outdoor lighting going. If we imagine that any kind of lighting is a kind of picket fence that blocks our view of the universe, at least to some extent, then LPS is a fence with only one picket, the bright yellow sodium line. This is an analogy first coined by Bob Brucato at Palomar Observatory, and it is an apt one. The single line of sodium light (actually, it is a close double line) is easily filtered out, leaving the rest of the spectrum available for our observing use.

From the perspective of most installers of outdoor lighting, LPS leaves much to be desired. For one thing, the intense yellow light is essentially a monochrome with practically no colour rendering. Preferable is HPS, which looks a little funny but at least leaves colours distinguishable. HPS is the way most municipalities are going. It still provides considerable energy savings over mercury. If properly shielded, HPS lighting is a good compromise. It is still a picket fence, but is a lot better than mercury.

If you have managed to struggle all the way through this little essay, you now know more about what makes for "good" and "bad" lighting than some lighting engineers! Doesn't that make you feel good?

Readers are invited to share their news and views on this problematic subject. Please send correspondence to:

BILL BRODERICK
RR#1
SHANNONVILLE ON K0R 3A0 ✪

"If light pollution continues to increase at anything like its present rate, not one child in ten being born in the United States today will ever really see a star. What kind of people will be those who have never had this experience. I hope we never find out."

Fred Schaaf

The 1995 Mount Kobau Star Party

Bob Drew
Edmonton Centre

Because of its dark and steady skies, 1842 metre high Mount Kobau, near Osoyoos, B.C. had been selected as the site of a major observatory. Unfortunately, the project was abandoned in the late 1960s. Led by the Okanagan Astronomical Society, amateurs have been exploiting the virtues of the site anyway. They have been making their pilgrimage to the Mount Kobau Star Party annually since 1984. The emphasis at MKSP is on deep-sky observing. This year's MKSP ran from August 23rd to 27th.

The first thing that struck me as I arrived at the peak, full of anticipation, was a real sense of community. Familiar, smiling faces were everywhere. Whatever we would be facing in the forthcoming week, we would be facing it together. So, what did we experience at the MKSP this year? Excellent skies on three nights, good seeing for the balance of the week, pesky winds and rather miserable conditions during the daytimes. The first rule of mountain observing is to ignore the daytime conditions and focus on what you came to do—observe.

Of the 178 registrants, there were twenty-four from Calgary and twenty-one from Edmonton. British Columbian amateurs were there from all reaches of the province, including Vancouver Island. Due to a conflicting star party, only six Americans came this year. Steve McAllister drove from Illinois with his 20″ f/5. One of the three regulars from California, a jovial, white-bearded chap, is a dead ringer for Santa Claus. He is popular because he always brings a shovel. You see, this wilderness site is also used for grazing land. The first step in preparing your site is to borrow his shovel—to remove any evidence of cattle having been there recently. When your mind is in the heavens, you do not want your shoes in something less noble!

"Twang!... Dammit!... Sorry about that!" was a constant refrain through the night as everyone stumbled over everyone else's tent lines. Tent placement was downright chaotic. Kobau is always very friendly—except when it comes to claiming your scope and tent turf. For the first half of the week, it is rush seating at its worst. The terrain just does not allow nicely organized telescope lines.

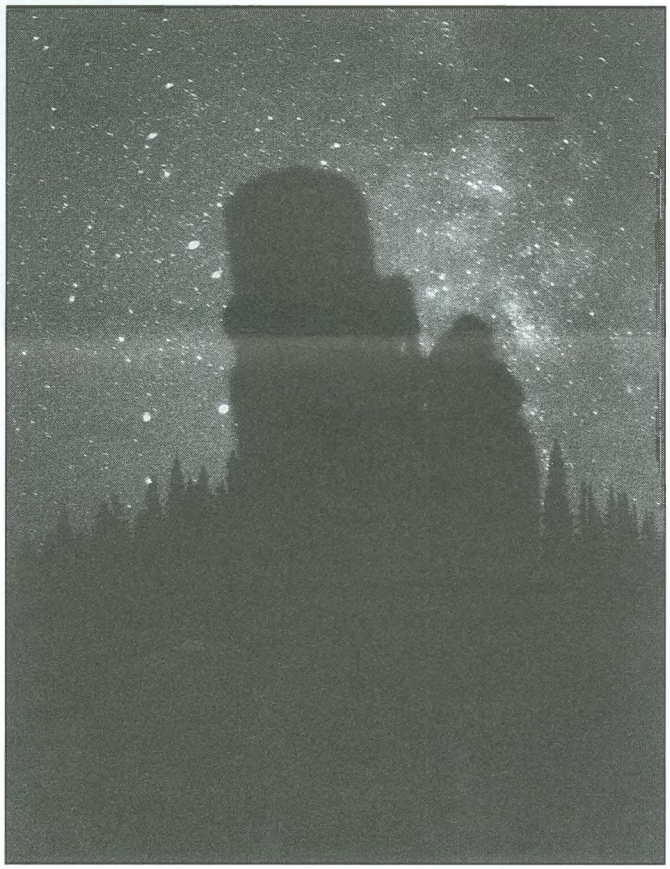
The temperature dipped well below freezing on three nights—cold enough to freeze the Naglers off a brass scope—and full winter garb was de rigeur. It is a thirteen hour drive for us Edmontonians and that damn aurora followed us down. Could it be our magnetic personalities? Fortunately, the low, auroral arch on those two nights did not curtail observing. In spite of all of this, everyone came away satisfied, with many new entries on their logs.

Regulars like John Casino's 36″ and the McMillan Planetarium's 25″ were not there this year, so the usual privileged sightseeing trips were out. Instead, a phalanx of 16″ and 20″ scopes all got a real work-out. There were even airborne optics—although not quite of the Kuiper variety. Brian Findlay packed a 4.5″ scope in his Cessna, flew almost 900 km from near Dawson Creek and landed at the tiny Osoyoos airstrip. He finished his trek in style. He took a Mercedes taxi up the wretched 20 km road to the peak, where he was greeted with applause.

With eyes to eyepieces until 4:20 every morning (last call for deep-sky!), we shut the joint down most nights. When you do not get clouded out for six straight days, sleep deprivation exacts its toll. Coherence, social graces, and especially the ability to converse intelligently with other humans desert you. This may have led outsiders to suspect that some Edmonton observers, although very keen, were also somewhat dim-witted!

Annoying winds buffeted unprotected scopes for two nights. One gust toppled Don Brown's 8″ SCT (no damage!). You should have seen the gigantic windbreak Alister Ling rigged up. It would have done an America's Cup sailor proud. Since I was also in the wind shadow of his "Great Wall", we could continue observing after others had packed it in.

Alister volunteered to perform "optical tests" on the Edmonton Centre's 18″ scope for the whole week. For his club, he would toil far into the night. What dedication! Nasty work but someone has to do it! As I was set up next to Alister, I could not help but notice how quickly he could change gears. I remember him stopping his study of some esoteric object during the best skies to generously take an enthusiastic couple from Saskatchewan on a delightful star tour. With a new f/4.3 primary from Arnold Optics, the scope is quite fast and performs splendidly with a Televue Paracorr, a coma reducing field flattener. Used in conjunction with the new 27 mm or 35 mm Panoptic eyepieces, the scope produced many "golly gee whiz" vistas.



Alister Ling and the Edmonton Centre's 18" club telescope silhouetted against the star clouds of Sagittarius.

It was nice to see the return of Bryce Hartwell (formerly of the Edmonton, Calgary and Ottawa Centres, and now back in Edmonton). He switchhit between his 8″ and 14.5″ scope for seven nights of solid observing. Nearby, Bruce McCurdy enjoyed his analysis of the planetary nebula NGC 246. Through both scopes, he noted some remarkable features when looking through a variety of filters.

A little further up the hill, John Myrtle from Calgary, prepared his site for astrophotography. Even though he had garnered the site that was best protected from the wind, his scope was surrounded by a low, circular wind screen, kind of like a duck blind. Either John really wanted protection from the wind, or as a kid he just liked building forts.

Next to John, Rick and Carol Weis, also from Calgary, had set up their beautifully crafted 14.5″ truss-designed Newtonian. After nine days, they were still unbelievably cheerful and amiable. After a week on the mountain, it seemed

A view of the main observing site at the 1995 Mount Kobau Star Party.

that most of the rest of us had degenerated into crude, unkempt mountainmen.

At a discreet distance a little further up the road, you might just notice the soft amber glow of a CRT and hear quiet discussion as Vancouver's Craig McCaw and Helen Griffith were capturing another CCD image through his 17.5″ They had just finished a series of images of Comet d'Arrest as it moved into Cetus. Craig said that when strung together, they would give a movie effect. Craig is too modest to say so, but he is one of the pioneers in developing the Poncet equatorial platform, which he has been using with great success since 1986.

I strolled up to the peak where Barry Arnold was introducing himself face-to-face to a netter he had been communicating with on the Internet. Barry came to Kobau to critically test the optics of his new 16″ f/3.7. The scope passed with flying colours. On one of the steady nights, the Calgary crowd enjoyed stunning views of Saturn at 375x.

First-timer David Goldengay was out of control as he took his C-8 on a Messier feeding frenzy, devouring fifty-seven of the 110 objects in three nights. M22 was an "incredible globular" for David. Sharon Tansey also enjoyed exploring the Sagittarius region and worked on some holes in her observing list. Denis Roy snagged his last two Messiers, M6 and M7 in Scorpius, qualifying him for a Messier Certificate. Kathy McKinnon, who was there with her beautiful "Phantom of the Opera" 10″ Dobsonian, advanced her star-hopping technique.

Edmonton's bionic observer, Larry Wood, said that he just liked being there with all of the serious observers, doing the same thing. You could not help but notice Larry's observing technique. His grunts, groans and play-by-play descriptions, as he zeroed in on some object, would drift down the mountainside. Ben Gendre and his 8″SCT could be found surrounded by a forest of big Dobs from Vancouver. Constantly experimenting with astrophotography, I found him at 4:30 one morning working on a knife edge camera focusing technique. Both Barry and Terry Nonay did some real turbo-observing with their 10″ SCT. Had there been a telescope making contest this year, Barry would have easily won for best accessory. The travel case for his 12.5″ reflector tube reminded me of the travel pods from *2001: A Space Odyssey.*

Very steady seeing was offered on Wednesday and Thursday nights. The seeing was so steady that even large aperture scopes were getting splendid views of Saturn and its many moons. Mottled detail in the cloud belts and festoons were obvious. The club's 7″ Starfire refractor would have revelled in these conditions. With the good seeing, the elusive globular Palomar 13 fell to three observers. Larry Wood, Alister Ling and I independently observed Pal 13 in our respective scopes. Larry and I revisited it on Saturday night. In my 20″ we were able to detect a few sparkles glimmering in and out of this globular's soft glow. We could also see IC 1296, a low surface brightness galaxy close to M57, and the small galaxy that is halfway between M13 and the 11.6 magnitude galaxy NGC 6207.

After suffering through a Saturday afternoon of bitterly cold showers, we were treated to the darkest skies of the week. This was a Kobau magic night for hunting the deepest objects. Many could see an obvious extended elongation of M31 with the naked eye. In a scope, NGC 7331 looked softly extended, like a miniature M31. NGC 7331's companions were obvious. The tight galaxy cluster, Stephan's Quintet, displayed well in almost any scope. My goal was to observe some galaxy clusters of varying

difficulty. My scope was ready, the skies were willing and the galaxies were Abell. (Sorry, I could not resist!) Everyone enjoyed the beautiful NGC 383 chain of eight bright galaxies. In the meantime, deep-sky astrophotographer Jim Himer from Calgary was photographing the same object! It was fun to compare the slide negative that he developed on-site the next day with both our observations and the computer program Megastar. That night, you could also see some of the dimmer, 15.6 magnitude members in galaxy clusters such as the NGC 80 cluster in Andromeda. At 4:00 AM, I proudly invited Alister for a view. He observed, politely, then commented that he had submitted a study of this cluster for the Webb Society. Make a note: do not try to impress anyone at the MKSP.

By Sunday, of the twelve vehicles remaining on the hill, eight were from Alberta. The smoke which had been contaminating the lowest skies retreated, revealing the southern Sagittarius region at its best. That quiet Sunday night underlined just how busy and crowded it had been on the mountain. There were now only two vehicles left at the peak, where at 1:00 AM, three of us sat for a couple of hours just doing some naked eye observing. Sunday's cirrus cloud had dissipated and we could still easily see nine of the Pleiades easily (twelve plus is normal from here). Frequent meteors punctuated the black skyscape. After an exhausting and hectic week, it was now so very different. It was tranquil, almost spiritual and I could feel that Kobau magic overtaking me again. It is this private feeling many of us get for this place, its skies and its people. It is what lures many of us back. See you there next year. ✪

Book Review: The Hubble Wars

(continued from page 5)

deleting crucial optical tests from their bid. P-E offered, and NASA accepted, a pledge for quality based on a reputation for delivering Keyhole-class mirrors to the air force. No test of Hubble's assembled Cassegrain assembly was performed by P-E or required by NASA. The public was aware of this before the launch, and I for one had my fingers crossed.

From the outcome we know quality control had slipped badly at P-E. The null tester used for final figuring was clearly not in top condition when the civilian technicians inherited it from P-E's military division. Under normal circumstances, NASA quality auditors, tipped off by the tester's sloppy assembly and scratched paint, could have saved the day by demanding an inspection of P-E records. They were effectively barred from the premises because the defense department, still fighting the Cold War, feared disclosure of secret technology to civilians. At first glance this sounds like a reasonable excuse, but NASA was reamed out by Al Gore in the subsequent Senate inquiry for not anticipating it, and trying to shift the blame.

Having selected P-E's low bid, NASA paid them to subcontract Kodak to build a backup mirror with unclassified technology, causing an obvious conflict of interest. Hereafter Chaisson's story is marred by hindsight. An independent competition, or "fly-off", between Kodak and P-E could have prevented the egregious flaw from reaching orbit—but only if the firms perceived their interests being advanced by it. Assuming P-E lost this "flaw-off", to whom could they sell a mirror produced with classified technology? Only to the Department of Defense, their principal customer! Since reconnaissance mirrors did not have to be as good as Hubble's, there would have been little incentive to produce a really good figure for a fly-off.

By the way, Chaisson does not reveal whether Kodak's mirror rests in its storage crate (made of wood!) or was flown in a Keyhole reconnaissance satellite in the 1980s. Come to think of it, the air force birds just burn up at the end of their useful lives because the shuttle cannot be launched into polar orbits.

The flaw's revelation struck like a tidal wave on the morning after a hurricane. Reporters did not stick around to hear that the Hubble could still take pictures; the glum expressions on the faces of the PR men told them all they wanted to know. The damage was done. Managers at NASA, STScI and Hughes started weeding out potential suicide cases. Chaisson relates a remark by a Hughes Danbury engineer who had nothing to do with the mirror. Fearing the hysterical media reaction, he wanted never to show his face among astronomers again. It was during this terrible period that Chaisson's continual pressure on NASA finally bore fruit. STScI was directed to snap some images and release them to a skeptical media before the legislators pulled the plug. As we know, the resulting favourable publicity pulled the project back from the brink.

In referring to NASA's PR blitz following the 1993 repair mission, Chaisson uses the word "spin" where he wanted to use "lie", and "spinner" instead of "liar". NASA could not bring itself to admit that the optical specifications were still not being met. The faint-object spectrograph was just plain dead. The solar array flapping was not markedly improved by the replacements. Junking the high-speed photometer to make room for the optical bench permanently hampers the Hubble's photometric calibration. New measurements of Virgo Cluster variables should be out by now, and we shall see if Hubble can reach the galaxies it was designed to reach. The Virgo Cluster is Hubble's (and NASA's) reality check.

I am longing to agree with Chaisson on the subject of NASA's honesty, yet those little matters of balance and bias do intrude. Fairness required NASA to enforce a proprietary period, effectively a one year copyright of the sky, to protect astronomers who had signed up a long time ago to use the scope. If you were a Hubble investigator, would you be glad to see a Hubble image of "your" object, M42 for example, on someone else's workstation monitor?

Chaisson tries explaining spherical aberration to the reader whose grasp of optics is likely limited to "stronger" or "weaker" contact-lens prescriptions. Other technical sojourns are less successful; I balked on the claim that Hubble increased man's resolving power more than anything since Galileo. That is untrue, and surprising from someone who accuses NASA of overselling. We read that Hubble's resolving power (one tenth of an arc second) is enough to read a license plate at 300 miles; I would buy 30 miles. Chaisson should be embarrassed for calling the Hubble's mirror the first diffraction-limited mirror in history. By the end of the book I was checking the accuracy of all his techno-similes.

Turning to matters of construction, the author does not divide his material into chapters very well, though it is well choreographed at the punch-by-punch level. His language is stimulating but his spelling and grammar is distracting at best. This book was rushed into print without the rewrite that would have made it a whistle blowing classic. I am distressed that a well educated, experienced author could be so slack in ways I would not permit of myself.

Chaisson accidentally insults Chris Burrows, an Oxford University astronomer seconded to STScI, whose abilities are compared with Isaac Newton's. He reproduces Burrows' memo, the first to draw attention to the mirror flaw, in a well-meaning attempt to honour him, but as the memo is full of optical jargon, Chaisson paraphrases it "in English" (his words)!

Some colour plates, including the breathtaking post-repair image of M100, and numerous photos and illustrations complement the story fairly well. Tellingly, the only persons actually identified in any photo were Edwin Hubble and astronaut Kathy Sullivan; a suspicious chap like me might jump to the conclusion that Chaisson was rebuffed by the other personalities.

Overall, I think *The Hubble Wars* was worth waiting five months on the library's reserve list.

(continued on page 12)

Canadian Astronomical History: 1991-1994

Professor Ed Kennedy
Saskatoon Centre

Four years subsequent to the celebration of its centenary in 1990, the RASC published a book, *Looking Up: A History of the Royal Astronomical Society of Canada*. In this book, Peter Broughton provides an interesting and informative account of the society, from its early beginning to the present. The society's two major publications, the*Journal* (currently in its eighty-eighth volume) and the *Observer's Handbook* (now in its eighty-seventh year of publication) have provided a valuable resource not only in Canada but throughout many other countries.

In their annual reports to the general meetings of their respective societies, the chairmen of both the Canadian Astronomical Society (CASCA) Heritage Committee and the RASC Historical Committee always include a list of Canadian publications in the history of astronomy, thus providing an indication of current research activity in this field. (The committee chairs, whose names and addresses are appended, would be pleased to supply additional information to any historian involved in research in the history of astronomy.)

The astronomical community in Canada lost two prominent and internationally recognized astronomers. During their lengthy and distinguished careers in their respective fields, both Dr. Peter M. Millman (d. December 1990) and Dr. Helen S. Hogg (d. January 1993) were strong and continual supporters of research in the history of Canadian astronomy.

Members of the astronomical community were saddened to learn of the death of Professor Stillman Drake in late 1993. James MacLachlan, in the obituary which appeared in the *Journal for the History of Astronomy* (XXV, 1994) stated that "For more than thirty years, Stillman Drake was the world's pre-eminent interpreter of the life, work and times of Galileo."

Colleagues in the history of astronomy will appreciate being informed of several items of note. The papers of Professor Emeritus J. E. Kennedy have been donated to the University of Saskatchewan Archives at Saskatoon. A brief account of the collection may be found in the Spring 1994 issue of the *History Newsletter of the American Institute of Physics*. The typescripts of the extensive Airy correspondance relating to the Maine-New Brunswick boundary survey of the mid-1840's (prepared by J. E. Kennedy) were purchased by the Cambridge University Archives as an addition to the Airy material already held there. Lastly, from the reports of the Heritage Committee of CASCA and the Historical Committee of the RASC, the following publications give an indication of the variety of historical work undertaken in Canada.

Alan H. Batten "Johann Franz Encke, 1791-1865", JRASC 85, 316-23, 1991.

Randall C. Brooks & **Mary Lou Whitehorne** "Interpretation of Wolf-Rayet Stars, C. S. Beals' Contribution", JRASC 86, 228-247, 1992.

Stillman Drake "Authentic Galileo Materials in North America", Nuncius 5, 221-228, 1991.

R. A. Hazard & **M. Pim V. Fitzgerald** "The Regulation of Ptolemaieia", JRASC 85, 6-23, 1991.

Alan Hildebrand "The Cretaceous/Tertiary Boundary Impact (or the Dinosaurs Didn't Have a Chance)" JRASC 87, 77-118, 1993.

Richard A. Jarrell "The Origins of the Dominion Observatory, Ottawa", JHA 22, 45-53, 1991.

J. E. Kennedy & **W. O. Kupsch** "A Canadian Life with Geomagnetism: The Research of Frank T. Davies", published in The Earth, the Heavens and the Carnegie Institution of Washington, History of Geophysics, Volume 5, 165-169, 1994.

David H. Levy "Clyde Tombaugh, Discoverer of Planet Pluto", University of Arizona Press, ISBN 0-8165-1148-9, 1991.

Robert D. McClure "Scientific Highlights from the Dominion Astrophysical Observatory", JRASC 87, 218-222, 1993.

Donald E. Osterbrook "The Canada-France-Hawaii Telescope & George Willis Ritchey's Great Telescopes of the Future", JRASC 87, 51-63, 1993.

Howard Plotkin "William H. Pickering in Jamaica: The Founding of Woodlawn and Studies of Mars", JHA 24, 101-122, 1992.

M. Thomas "The Beginnings of Meteorology in Canada", ECW Press, Toronto, 1991. (This book contains a detailed history of the origins of the Magnetic and Meteorological Observatory in Toronto.)

William R. Topham & **Bernard Ziomkiewicz** "Nathan Fellowes Dupuis: Scholar, Teacher, & Craftsman", Bulletin of the Sci. Inst. Soc., #38, 5-10, 1993.

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The investigator may be made to dwell in a garret, he may be forced to live on crusts and wear dilapidated clothes, he may be deprived of social recognition, but if he has time, he can steadfastly devote himself to research. Take away his free time and he is utterly destroyed as a contributor to knowledge.

Walter B. Cannon
American physiologist (1871-1945)

Reflections: The Telescope Visiblity Factor

(continued from page 1)

point at which the object starts spilling out of the field of view, in effect offering less total light to your eyes.

For clusters and other point sources, an upper limit is reached when the seeing (the steadiness of the air) becomes troublesome. Face it, big boiling blobs of starlight are just not as attractive as the nice sharp stars one sees at lower power—even with a brighter sky. The best views of planets likely will not happen with the maximum TVF either, with seeing being a much greater problem here than the brightness of the background sky.

The important thing to keep in mind is that the TVF applies to all telescopes, be they Schmidt-Cassegrain, refractors or Newtonians. No matter what size or type, your views of most deep-sky objects could be improved with an awareness of the TVF. Many times, particularly with objects at the threshold of visibility, **how** the telescope is used is as important as **what** one is viewing. The effective use of magnification is, perhaps, one of the least appreciated factors affecting the capability of a telescope. I have seen all types of telescopes in use that were terribly underpowered. The TVF gives us a way of understanding the importance of magnification and a guide to its effective use. Give it a try! You might just develop a new appreciation for what your telescope can do. ✪

Book Review: The Hubble Wars

(continued from page 11)

Richard Feinberg, who reviewed this book in *Sky & Telescope* last July, bluntly rejected Chaisson's account of the repair results, but the spectrograph IS working! The resolution IS doubled! Mr. Feinberg, was not the purpose of the book to cast doubts on the truthfulness of NASA's statements?

When Chaisson's deputy Ray Villard appeared at a 1994 meeting of the Vancouver Centre, he told us Hubble was really fixed. Should I believe him? Hubble reinforces the perception of disgruntled taxpayers that smoothness is a more important qualification for advancement than the ability to get things done correctly. Executives cannot order electrons to go around in a circuit; only nature can. ✪

Science when well digested is nothing but good sense and reason.

Stanislaw Leszczynski
Polish king (1688-1744)