NATIONAL NEWSLETTER

October 1976

Our New National Home

The National Office moved into its new home at 124 Merton Street, Toronto, Ontario, M4S 2Z2, on Friday, July 15, 1976.

The move was the culmination of a great deal of planning and hard work by Miss Rosemary Freeman, our capable Executive Secretary. A major project involved moving the Library and its associated collection of books, periodicals and slides. Surplus back issues of the *JOURNAL* were forwarded to Centres and universities which requested copies prior to the move. Mr. Richard Winiarz, a Toronto student, was responsible for this task, under the general supervision of Librarian Harlan Creighton and Miss R. Freeman. At the time of writing, an announcement is expected shortly from the new Librarian, Mr. Troyer, on when the Library will again be open to members.

Members who are in Toronto are cordially invited to visit the new National Office which is open from 9:30 a.m.–4:30 p.m. Monday to Friday.

We believe the Society owes a special vote of thanks to all those who helped with the move, and particularly to Miss R. Freeman, Peter Broughton, Mr. and Mrs. Cyril Clark, and Richard Winiarz. Many thanks, and congratulations on a fine job!

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October 1976

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Dr. Helen Hogg Honoured

by Norman Green

Over the years many awards and honours have come to Dr. Helen Sawyer Hogg, one of Canada's most distinguished and well-known astronomers. Last June she received a further tribute by being named a Companion of the Order of Canada. Dr. Hogg joined the staff of the David Dunlap Observatory and of the University of Toronto over forty years ago, but through the years her greatest joy has been to popularize the science of astronomy and to encourage the average person to look up and thrill to the lovely sight of a clear, star-studded night sky. With this in mind, Dr. Hogg has been writing, for twenty-five years, a weekly column for the Toronto Star, and recently she has written a non-technical but authoritative book entitled, *The Stars Belong to Everyone*. Mrs. Hogg is a Past-President of the R.A.S.C. and currently is Honorary President of the Toronto Centre. She continues her professional career as an international expert on globular clusters of stars.

The country-wide membership of the R.A.S.C. will be delighted to learn that the Government of Canada has bestowed this latest honour on Dr. Hogg and, in so doing, has, in turn, been honoured in the inclusion of her name on the list of the Companions of the Order of Canada.

Where to go and how to get there...

by John R. Percy

The National Council of our Society has recently established a committee, with the undersigned as chairman, to consider *the long-term goals of the Society and its Centres, and the relationship of these goals to the finances of the Society*. By the time this note appears in print, I shall have sent a more detailed notice to the presidents and secretaries of the Centres. I urge them to discuss "goals" at their council meetings, and send me their views. I also urge unattached members, and other individual members, to feel free to write to me about this important matter if they wish. It would be helpful for them to read some recent annual reports of the Society; these are published in the annual supplement to the *JOURNAL*.

The major sources of income of the Society are (i) membership fees, (ii) publications (sales, page charges, government grants), (iii) interest on investments. The major expenditures of the Society are (i) rebates of membership fees to centres to support local activities, (ii) publications (printing and mailing), (iii) rental and maintenance of a national office and (iv) salary of an executive secretary.

Among the questions which our committee might consider are the following. Why do people join the Society? How can membership be retained and increased? What are the long-term goals and aspirations of the Centres? Are the relationships between the Centres and the Society adequate: should they be looser or stronger? Are the present services of the Society (publications, library, national meetings, secretariat) to its members adequate? Should publications be expanded, both in number and in circulation? Should the Society embark on new programmes in the educational or observational areas? What fees, what division of fees between Society and Centres, and what investment strategy would best meet these goals now and in the future? What new sources of income might the Society develop?

My committee hopes to hear from the Centres by *mid-January* 1977, to report to National Council in the spring, and to report to the membership of the Society at the 1977 General Assembly in Toronto. My address is: Department of Astronomy, University of Toronto, Toronto, Ontario, M5S 1A7.

DUE$ DUE

All members are reminded that their 1977 fees were due on October 1, 1976. Members of Centres should remit directly to their Centre's Treasurer; unattached members should send their fees to the National Office, 124 Merton Street, Toronto, Ontario M4S 2Z2. Please include apartment numbers and your postal code.

Fees are $12.50 for regular members and $7.50 for members *under the age of 18 years* as of October 1, with proof of age required to be eligible for the student rate. As well, some Centres have special fees in addition to the above. Please consult your local Treasurer for further details.

Treasurers of Centres are reminded that all membership fees received up to December 31 must reach the National Office by January 15 in order to permit membership lists to be updated in time to mail the February issue of the *JOURNAL*. It will not be possible to retain membership and receive the publications of the Society unless such fees are received by January 15.

Good Luck, Bill

Members will note a change in the masthead of this issue. Bill Peters' name is missing.

Bill has asked to be relieved of his editorial duties in order to put his full efforts into his work at the McLaughlin Planetarium and at the University of Toronto. This is the last issue in which he will be heavily involved.

During his two years as an Assistant Editor, Bill has put a tremendous amount of work into our *NEWSLETTER*. Among other things, he was responsible for the introduction of photographs and for substantial improvements in the layout of this publication. He has worked tirelessly on our behalf, and to him must go a large share of the credit for the recent success of the *NATIONAL NEWSLETTER*.

To Bill Peters, all members owe a debt of thanks for his efforts.

Good luck, Bill! And best wishes in all your endeavours.

The Time Inventors

by Dr. J. D. Fernie

Shortly after I had arrived in Canada I committed a very grave *faux pas*. In conversation with Ruth Northcott one day the name of Sandford Fleming happened to come up, and in all innocence I asked who he might be. The effect on Ruth was much as though I had casually announced that I really had no idea of the difference between a planet and a star. Luckily, news of this dreadful lacuna in my knowledge never reached the ears of the Canadian immigration authorities, who would doubtless have instantly revoked my status of landed immigrant. For, as every native Canadian learns at his mother's knee, Sir Sandford Fleming was the national hero who gave to the world the concept of standard time. However, now that Canadian citizenship is firmly mine, I might make so bold as to reveal that he was not entirely alone in this vision.

Today we flash around the world with an ease and frequency limited only by the size of the travel allowance in our NRC grants or what monies we can wheedle out of the Director. It is, as the saying goes, lunch in London, dinner in Toronto, and your baggage in Buenos Aires. Even on a more local scene it is nothing to leap into the family car and take off on a hundred-mile drive to the cottage for a weekend. All of which makes it difficult to appreciate how very slowly the idea of travel for the common people developed historically. Even in a small developed country like England, it is hardly more than a century since the vast majority of the population ever travelled anywhere. Go back another century or so and one finds there were no public conveyances at all, so if a person wasn't rich enough to own a horse or his own small carriage, travel was very much a matter of walking. Thus most people lived all their lives within a radius of a few miles.

Add to that the fact that there was no radio or telegraph to bring instantaneous communication with the outside world, and one sees that there was no need for everyone to keep the same system of time. So it was that even well into the nineteenth century almost every town and village in England kept its own local time. Life was leisurely; there was no need for any great accuracy in regulating work or sleep; and the old church clock, occasionally checked against a sundial, did very nicely for everyone.

The man who first really got the idea of public coaches going was a theatre owner by the name of John Palmer. He had great difficulty in moving his travelling actors around in a hurry, and worked hard at developing a network of public transport by coach. So successful was he that in 1782 he gave up his theatre interests and went into the transport business fulltime, even convincing the Government to develop a system of mailcoaches. (One hopes the Canadian Government will soon see the advantages of horse-drawn coaches over cleft-stick runners.) This did wonders for the highwayman business – mailcoach drivers came equipped with no less than a cutlass, two pistols, and a blunderbuss – but the roads were such that many people preferred to stay home. The Greenwich Observatory staff, for instance, would sooner use the expensive (a sixpence) river craft in getting to London than entrust their lives to what they called the hackney hell-cart.

And it still didn't do much for the idea of a standard time. Bristol and London, for example, had a twenty-minute time difference; and the mailcoach driver, already a-jangle with his armaments, was further encumbered with a remarkable leather-pouched watch that could be set to lose twenty minutes on the down run and then reset to gain them back on the up run.

It was the Industrial Revolution that changed all that: the coming of the railways and the telegraph. In 1835, for instance, there were 400 people a week travelling by coach between Leeds and Bradford; a year later the railway was carrying 3500 a week – much to the surprise of the railway authorities, who had originally seen the railway mainly as a freight service. Things really took off in 1851, when more than six million people flocked to see the Great Exhibition in London, less than 75,000 of them being foreigners. Suddenly all Britain was travel-mad, and a certain Thomas Cook began to have visions of a prosperous future.

Until mid-century the railways got along with an unbelievable timetable that took account of local time differences, but now, with the telegraph available to distribute time signals, they began a clamour to have a single time system in the country. Immediately, all the activist citizen groups of the day took up vehement opposition against this creeping technology. (The British, of course, are a conservative race even in their sports. As Edwin Newman has recently reminded us, a soccer player found kicking the flesh off the legs of an opponent will, according to the rule book, "have his name taken by the referee"; although in cricket, a gentleman's game, should a bowler be found delivering the ball in a manner calculated to crush the skull of an unwary batsman, the umpire will merely "have a word with him".) *The Times* of London, wherein has always been delivered the quintessential of British opinion, found its letter columns deluged. Someone signing himself 'Chronos' issued a thunderous denunciation of the entire scheme, demanding that there be a "return to the only true and simple rule of keeping our clocks right instead of keeping them wrong. It happens that the world takes 24 hours to rotate on its axis. This fact may be considered 'objectionable' but so long as it remains unaltered it is simply impossible that it should be the same hour at two different places at once. ..."

More surprising was the fact that the Astronomer Royal, Sir George Airy, was at best lukewarm to the idea of forcing 'the provinces' to keep Greenwich time, as he later would be towards the suggestion that the Greenwich meridian be adopted as the world's prime meridian. But he, of course, by allowing the dissemination of Greenwich time signals via the electric telegraph, had really made the whole thing possible. In any case, despite the likes of Chronos, the railway authorities got the scheme approved, although it would not be until 1880 that the last of the traditionalists was stamped out by a legal Act making it mandatory for all in Britain to keep Greenwich Mean Time.

Already the question of standard time had begun to rear its head on a much wider scale, this time international. Two factors made it increasingly urgent that a solution be found. The first was the rapid increase in seafaring during the Industrial Revolution, which gave rise to the need for adopting a single prime meridian on which to base nautical charts. Hitherto every nation had adopted its own prime meridian, often not indicated on its charts, so that a navigator using someone else's charts was in a hazardous position over longitude determinations. The second factor was the opening up of the railroads across the North American continent, and already by 1879 the American railroads found themselves with 75 different time systems to contend with across the United States.

But if it was difficult to get one small country to agree internally to a system of standard time, how would it be to get international agreement when all kinds of nationalistic fervour would be brought to bear? As far back as 1824 Laplace had been able to foresee the fighting that would break out over whose meridian should be the prime one, and had therefore made the remarkable suggestion that the prime meridian be that at which it was midday when the sun reached the vernal equinox in the year 1250, the year in which the apogee of the terrestrial orbit coincided with the solstice in Cancer. (This turns out to be about 11° W longitude on a modern map.) It was a suggestion worthy of a celestial mechanician from the Age of Reason, but crusty Victorian seadogs and railroad engineers failed to appreciate its charms.

Cartographers the world over were being driven into a frenzy before the nineteenth century was even three-quarters over. When, oh when, would the nations of the world get together and agree on a single prime meridian on which to base maps? True, for maritime purposes at least, many countries did in effect use the Greenwich meridian, simply because the British Nautical Almanac found widespread use and was based on the Greenwich meridian. But topographic maps –! At one time or another there were prime meridians of Toledo, Cracow, Uraniborg, Copenhagen, Goes, Pisa, Augsberg, Rome, Ulm, Tubingen, Bologna, Rouen, Paris, St. Petersburg, Washington, and Philadelphia to mention only some. Supposedly, something was being done about it. There were frequent international congresses on the subject through the 1870's and early 1880's, but trying to get scientists with their mixtures of theoretical ideas and nationalistic enthusiasms to agree, proved a slow game indeed.

Meanwhile, in North America, the needs of the transcontinental railroads could not await the vagaries of international congresses. It was Charles F. Dowd, rejoicing in the title of Principal of Temple Grove Ladies Seminary in Saratoga Springs, N.Y., who seems to have been the first in 1869 to suggest that the continent be divided into time zones encompassing 15° of longitude, a size that would separate the zones by exactly one hour. Dowd initially suggested that these zones be based on the meridian of New York, but the details were argued over for some time, and the 15° suggestion had to compete against Cleveland Abbe's idea that the entire United States have only one time system, as well as against a French proposal that the world be divided into 144 time zones of only 2°.5. But New Yorkers no more fancied taking lunch at 8:00 a.m. than did San Franciscans breakfast at noon, and who wanted to change his watch every hundred miles or so? The 15° size seemed best, and was strongly championed during the 1870's by Sandford Fleming in Canada and Benjamin Pierce in the U.S. They also urged that the system be tied to maritime usage by making the zones integral hours behind Greenwich time. So it was that on April 11, 1883, both Canadian and American railroads agreed on the system of time zones as we have them today, and also at that time specified their names as Atlantic, Eastern, Central, Mountain, and Pacific standard times.

On the world scene Fleming's name is usually recognized for his urging that there be – at least for scientific purposes – one uniform 24-hour system of time based on Greenwich. It was an idea first proposed by John Herschel in 1828; he called it Equinoctial Time, Fleming called it Terrestrial Time, and today we know it as Universal Time. The astronomers didn't like it. "I set not the slightest value on the remarks extending through the early part of Mr. Fleming's paper [on Terrestrial Time]," said Sir George Airy, and "secondly, as to the need of a Prime Meridian, no practical man ever wants such a thing. But, if a Prime Meridian were to be adopted, it must be that of Greenwich, for the navigation of almost the whole world depends on calculations founded on that of Greenwich. But I, as Superintendent of the Greenwich Observatory, entirely repudiate the idea of founding any claim on this. It has not been [our] custom to introduce novelties ..."

Airy's counterpart in the United States, Simon Newcomb, concurred: "A capital plan for use during the millenium. Too perfect for the present state of humanity. See no more reason for considering Europe in the matter than for considering the inhabitants of the planet Mars. No; we don't care for other nations, can't help them, and they can't help us."

But if astronomers could afford to be indifferent or chauvinistic over a prime meridian, more practical men could not. Successive congresses, especially one in Rome in 1882, were rapidly coming to the conclusion that the prime meridian should be that of Greenwich. The main stumbling block was a strong French counter-proposal that a 'neutral' meridian be selected, in particular one previously used by the French which passed through Ferro, a minute speck of an island near Madeira. This was countered by the argument that the prime meridian should pass through some major observatory for practical reasons. A compromise was suggested that would make the prime meridian what is now the International Date Line at longitude 180°; it itself would be neutral, but practical determinations would still rest with Greenwich. But eventually common sense prevailed; the British with their 40,000 ships exceeded the maritime tonnage of the rest of the world combined, and their charts were much more widely used than anyone else's. So, at a Washington congress in October of 1884, the Greenwich meridian was adopted as prime, the French rather graciously bowing out with the observation that since Britain would undoubtedly very soon adopt the French metric system, it was only fair that a British meridian be used. They had one last fling at trying to get the congress to recommend a decimal system of time, but this was judged to be "somewhat premature".

The same congress also adopted a world-wide system of time zones which were consistent with the North American scheme, although a previous suggestion that they be labelled with the letters of the alphabet was dropped.

The idea of Universal Time, as it had already come to be called, was also accepted, although this now brought another difficulty into focus. Again it was Fleming who pointed out that three different kinds of solar day were in use: the Civil Day, which began at midnight; the Astronomical Day, which began at the following noon; and the Nautical Day, which ended at the following noon. I have no idea what became of the Nautical Day, but Fleming, in numerous publications of the Royal Society of Canada and the (Royal) Canadian Institute, concentrated on reconciling the Civil and Astronomical Days. By the mid-1890's it was generally agreed that the Astronomical Day should be changed to begin at midnight like the Civil Day, but as usual everyone was overcome by inertia and for years nothing concrete was done about it. Only after the First World War, when apparently there had been some unpleasant confusion over times, was the system changed. On January 1, 1925, the Astronomical Day was changed to start at midnight, a change still reflected in our system of Julian Dates, where that wretched 0.5 day always crops up to retain consistency with the old Astronomical Day.

So that was Sandford Fleming: a tough Scottish railway engineer (you'll find much about that side of him in Pierre Berton's *The National Dream* and *The Last Spike*) who also accomplished much on the international scene. And you newcomers to Canada – just don't go asking the natives who he was.

The Queen Elizabeth Planetarium

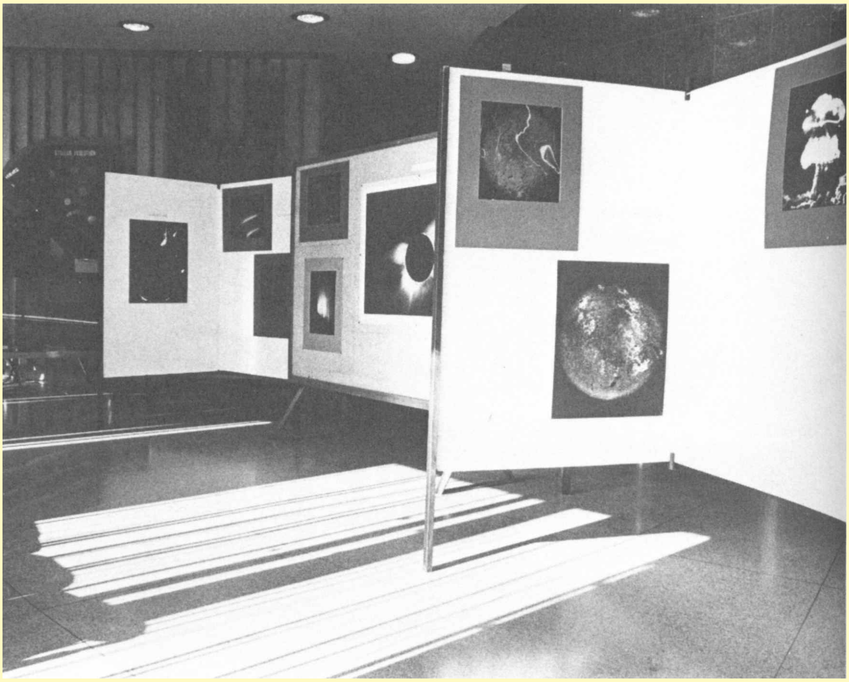
by Paul Deans

Edmonton's Queen Elizabeth Planetarium.

The Queen Elizabeth Planetarium is the oldest and smallest public planetarium in Canada. During its sixteen years of operation, many internal changes have occurred, but the building itself has remained virtually unaltered. Within the confines of our "little round house" are seven full-time staff members, a technical workshop, a dark-room-to-be, and a fully-equipped sound studio, as well as offices, display area and the star theatre itself. All this is crammed into a circular building smaller than the planetarium *theatres* found in Calgary, Vancouver, Winnipeg, Toronto and Montreal. However, despite our size, we feel that our various programmes are equal to those of any other planetarium in Canada, and we can claim that, without doubt, we are the best-equipped small planetarium in the country!

During 1976, a wide variety of topics are being covered in our public presentations. *South of Capricorn* – a look at stars of the southern hemisphere, *The Unknown Astronomers* – an examination of the contributions made by women to astronomy from earliest times to the present day; and *New Worlds Are Coming* – a look at future prediction and science-fiction ideas from various angles, brought us through the first half of '76. A "double" feature filled in the summer months. *One Summers Night* is an annual program that covers the constellations and objects of interest within the summer night sky, while *Mind and Space* tackles the history of our changing astronomical ideas from Stonehenge to the present time.

This autumn will find us presenting *The Archive Project*, a science-fiction program purchased from the Strasenburgh Planetarium in Rochester, New York. We import a



Part of Edmonton Planetarium's Astronomical Displays.

"foreign" show once a year since not only does it expose our patrons to different styles of planetarium programming, but it also gives some of our staff members a short break in an otherwise heavy production schedule. Topics to mid-1977 will include *Sky Color* – an examination of various phenomenon related to color; *The Star of Christmas* – a traditional show that will run concurrently with *Sky Color; Forgotten Worlds* – a look at the natural satellites of our solar system; and *Newton's Apple* – the story of gravity (adapted from a show presented in the Dow Planetarium some time ago).

Between September and June of each year, the star theatre is occupied almost continuously by school children. An average of nearly four programs daily are presented to the more than 26,000 children who appear each year. This number may seem small, but in our 65 seat theatre, it means that many shows are near the B.I.T.E.C. stage (Bring In The Extra Chairs). In fact, last year the load was too much for one person to handle and a cutback in programming resulted. School show titles (grade level and topic) include *Stories From the Sky* (K–l), *Worlds of the Sun* (2–3), *The New Pioneers* (3–4, deals with spacecraft visitations to planets), *Universe in Motion* (4–5), *In the Light of the Sun* (5–7), *Saucers, Signals and Little Green Men* (7–9, life in the universe), *Mind and Space* (8–10, history of astronomy), and *Cosmic Connections* (10–12, stellar evolution).

Perhaps of particular interest to R.A.S.C. members is our attempt to bring astronomy to the people. It appears we are the first planetarium to have on full-time staff a Community Programmer whose sole purpose is to initiate and present astronomy courses and displays, night sky lectures, and special courses for Boy Scouts, Girl Guides and other interested groups. This summer saw the construction of a display on the Sun at Edmonton's Nature Centre, a display at the Edmonton Public Library, and in August, (when it finally gets dark enough soon enough) the start of lectures under the stars. During the autumn, winter, and spring seasons two sessions of Junior and Adult level astronomy courses are offered at various locations throughout the City. The Scout/Guide astronomy courses are presented at the planetarium and a special program *Beyond the Earth* is also available to these groups.

In addition to these various productions, the planetarium offers for sale a wide variety of books, charts and telescopes in the bookstore. Edmontonians seem to be rapidly becoming sky-conscious as all types of telescopes from 60mm refractors to Celestrons are selling rapidly. The Edmonton Centre of the R.A.S.C. continues to meet at the Planetarium, although their rapid membership growth may soon force us to build a new astronomy complex just for them. Indeed, expansion of the present facility is our prime goal at the moment. Hopefully, in the not too distant future, we can change our title from the oldest to the newest public planetarium in Canada.

Public Visits to the U. of A.'s Campus Observatory

Beginning September 17, and every Friday thereafter, the 12-inch telescope at the University of Alberta will be made available for use by the general public. Up to 30 people will be accommodated at each of two one-hour sessions. Reservations must be made in advance by contacting the Public Relations Office of the University. They will provide information about on-campus parking, give directions for reaching the Observatory, and indicate what objects might be observed. In the event of inclement weather, a program consisting of a film, slides and/or lecture will be presented.

Group visits (Scouts, schools, etc.) will be arranged for Friday evenings or other mutually convenient times. Again, reservations must be made well in advance.

Quebec and Saskatoon take top honours at Calgary

By Ulrich Haasdyk and Dustan Pasterfield, Co-Chairmen, Observing Competition

A new feature was introduced into our General Assembly this year with the sponsoring by the host Centre of an Observing Competition. Detailed information about the project had been sent to Centres twelve months prior to the Assembly, and the Calgary members had high hopes of a good response.

Not as many entries came in as we had hoped for, but the quality of those which did fully justified the work put into organizing the project. In many cases the judges had a very difficult time in deciding on the "best" entry (taking into account the age and experience of the entrants); and more than once they had to declare a tie between two excellent entries.

The winners were declared, and the prizes given out, at the Saturday evening banquet. The first prize winners in each category were: *Category 2*, Binocular observing; Greg Towstego (Saskatoon). *Category 3*, Photo of a thin lunar crescent; Richard Dietz (University of North Colorado). *Category 4*, Drawings of a lunar crater; Mrs. Lillia Wilcox (Saskatoon). *Category 6*, Meteor observing; tie between: Kenneth Hewitt-White (Vancouver), Mario Lapointe (Quebec). *Category 7*, Occultations; F. John Howell (Calgary). *Category 9*, Photos of open clusters; Doug Beck (Saskatoon). *Category 10*, Drawings of globular clusters; Kevin Atchinson (Saskatoon). *Category 12*, Colour slides; tie between: Jack Newton (Toronto), Damien Lemay (Quebec). *Category 13*, Open; tie between: Damien Lemay (Quebec), Mrs. Lillia Wilcox (Saskatoon). *Category 14*, Constellations: F. John Howell (Calgary). (No entries were received in Categories 1 Naked-eye astronomy, 5 Sunspots, 8 Jupiter or 11 Galaxies.)

Grand Prize

Damien Lemay of Rimouski, Que., a member of the Quebec Centre, was the Grand Prize winner. Damien had two excellent First prizes and a Third.

Centre Prize

The plaque for the Centre whose members gained the most points in the categories was won easily by the Saskatoon Centre.

Prizes

For prizes we had considered giving astronomical books or equipment, but eventually decided that money prizes would be the most satisfactory. We were able to give $50 to the First Prize winners in the categories, $100 to the Grand Prize winner, and $100 to the winning Centre, plus plaques in the last two cases; but we were able to do this only because of generous donations from a number of firms in the oil industry, i.e. Aquitaine of Canada, Gulf Oil, Home Oil, Hudson's Bay Oil & Gas, Imperial Oil, Mobil Oil and Shell Canada. We are most grateful to them.

Finally

We very much hope that the Centres which host future Assemblies will seriously consider sponsoring a similar competition. We believe that it would be of great benefit to the Society, and to amateur astronomy in general. Such competitions could, of course, take different forms each time. We would make only two recommendations – first, that the main emphasis always be on practical observing and astrophotography rather than on 'armchair' or 'tabletop' astronomy; and secondly, that the "Open" category be retained so that no observer be unable to enter because his or her particular interest was not included.

We hope that the round of applause at the banquet which followed our expression of hope that our Society might become a great observing Society shows that there is widespread support for the idea.

Our grateful thanks to all who helped us in any way in this project.

The Temiskaming Astronomical Society

by Peter Ryback and Dalton Farrow

M27, "The Dumbell Nebula" July 21/22, 1976. Celestron 8 with telecompressor. Tri-X 15 minutes. Photo by Peter Ryback.

About two years ago, a small group of amateur astronomers formed an astronomy club in the Temiskaming District of Northeastern Ontario. Today, the Temiskaming Astronomical Society has 25 members, some of which are R.A.S.C. members affiliated with the Ottawa Centre. The club meets monthly in Haileybury, Ontario, and publishes a newsletter, *The Astro-Almanac*, before each meeting.

A very active core of observers keeps in constant communication in order to observe astronomical events as they occur and to maintain a regular observing program. The program includes meteor observing, comet and asteroid hunting, deep sky photography, as well as the occasional general observation night.

The club has just completed construction of a 12′ × 12′ observatory clubhouse at Long. 79°34′ W; Lat. 47°35′ N, approximately 10 miles northeast of New Liskeard, Ontario. At our "Casey Mountain Observatory", the first of 3 telescope piers has been completed. An 8-inch Celestron is mounted on the completed pier. Shortly, a 3-inch f/13 refractor and a 6-inch f/8 reflector will be mounted on the other two piers. The club also uses an automatic meteor camera to supplement the visual meteor program. The observatory site is attractive, not only for its dark skies, but also for its central location to the membership, and easy access.

Ed. Note: Mr. Ryback's address: Box 323, Cobalt, Ontario, P0J 1C0

Catadioptric Telescope Systems

by Jack Winzer

Although the term "catadioptric" may be unfamiliar to many amateurs, telescopes of this type are quite common, and include such well-known makers as Questar (Maksutov) and Celestron (Schmidt-Cassegrain). The Maksutov and Schmidt-Cassegrain designs are the most popular type of catadioptric telescope, but they do not represent the entire range of possible configurations. It will be the object of this present article to provide a more extensive sampling of catadioptric telescopes, and to discuss in some detail how they work.

To start with, let us define the term "catadioptric". Catadioptric implies simply that the optical system contains a combination of both refracting (lens) and reflecting (mirror) elements. Consider first the common Newtonian reflector. With a parabolic mirror, the images are essentially perfect on the axis of the telescope. But only a small distance off the axis, the image deteriorates quite rapidly, largely due to the effects of coma, but also due to the effects of astigmatism and Petzval curvature. A dramatic illustration of the problem with a parabolic mirror is afforded by the fact that the 200-inch reflector has a usable field of view *the size of a quarter*(!). Coma and astigmatism can be eliminated by using a spherical mirror, but at the cost of introducing spherical aberration which makes the images uniformly poor over the entire field of view. The simple refractor also has problems. An objective lens can be designed to be free of both spherical aberration and coma, but, because of the nature of the refractive elements, a new aberration arises – chromatic aberration, or colour. For any lens system to be able to produce an image, it must have positive power. But if a lens has power it also has dispersion, and hence colour. An achromatic lens can eliminate colour error, but only at two discrete wavelengths. There is still residual colour present. The catadioptric system combines a mirror system as the image-forming component, with an essentially zero power (colour free) correcting lens. This combined system has the potential of producing images of far superior quality than a simple reflector or refractor over a large field of view.

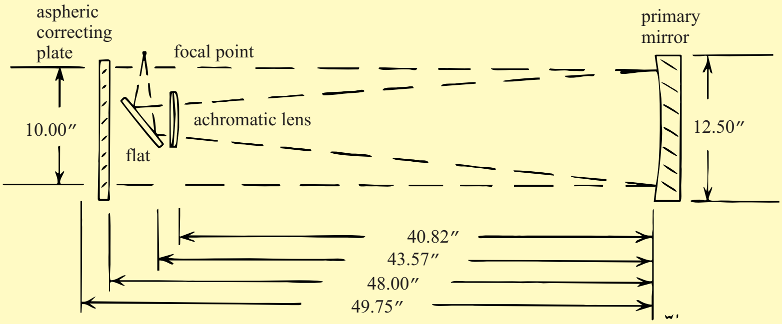
There is no unique solution to the problem of combining lens and mirror systems to produce a superior telescope design. There are a number of possibilities which can he broadly divided into four main classes. These include the Schmidt, Maksutov, the reflector-corrector, and the flat-field Cassegrain anastigmat. Each of these classes will be discussed separately in the following four issues of *Stardust*.

(1) The Reflector-Corrector:

The reflector-corrector catadioptric design is the most complex of all the systems that will be discussed, but it also represents the least deviation from the classical Newtonian. This type of system was originally discussed by Baker (*Amateur Telescope Making*, Volume 3, page 1). Baker does not describe how such an instrument is designed, but rather gives a single example and instructions for scaling. For a more detailed discussion on the design of such systems, an article by Wynne (*Proceedings of the Physical Society*, Volume 62, page 772) is useful.

Figure 1. The reflector-corrector design.

(a) Diagram of the optical system drawn to scale for a nominal 10-inch F/4 telescope.



scale 10 inches

primary mirror
- focal length = 52.37 inches
- diameter = 12.50 inches

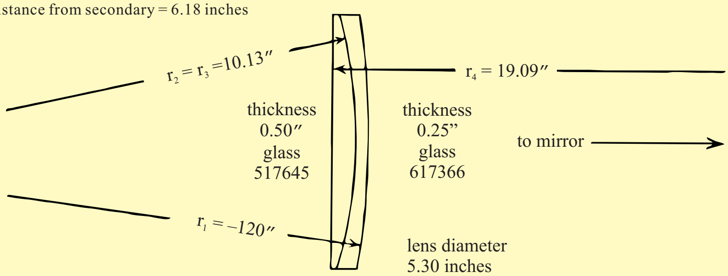
achromatic lens
- distance from primary = 40.82 inches
- thickness = 0.75 inches
- diameter = 5.30 inches

secondary mirror
- distance from primary = 43.57 inches
- minor axis = 4.00 inches

correcting plate
- distance from primary = 48.00 inches
- clear aperture = 0.50 inches
- thickness = 0.50 inches

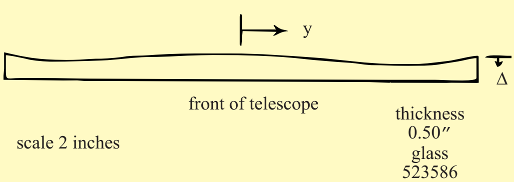
focal point
- distance from primary = 49.74 inches
- distance from secondary = 6.18 inches

(b) Enlarged diagram of the achromatic lens.



scale 2 inches

(c) The figure on the aspheric corrector lens (magnified by a factor of 1000).



$$\Delta = 9.60 \times 10^{-7}\, y^4 - 3.9 \times 10^{-5}\, y^2 \text{ inches}$$

This design was originally proposed as a means of converting a conventional telescope into a wide-field photographic camera. For some reason, this design has never been popular. I know of only two telescopes of this design that have been constructed. Both of these are professional instruments, one at Dyer Observatory in Tennessee, the other in South Africa. There will be one other of this type with the completion of the 20-inch reflector at the University of Alberta. To my knowledge, no amateur telescopes of this type have been constructed, although such an instrument should not be beyond the capabilities of an advanced amateur, and such an instrument would make a superb wide-field, Schmidt-quality, photographic telescope.

The reflector-corrector consists of 3 parts: the primary mirror, the achromatic lens, and the aspheric correcting plate. The primary mirror is a conventional paraboloid and can be used in a simple Newtonian or classical Cassegrain. The positive achromat is similar to an ordinary refractor lens and is used to provide a flat field, to eliminate astigmatism (in an achromat, both field curvature and astigmatism are opposite to what are found in a mirror), and reduce coma. Because it has magnifying power (necessary to flatten the field), however, there is some colour introduced, but much less than in an ordinary refractor. The almost full aperture correcting plate is similar to a Schmidt-type corrector and eliminates the spherical aberration introduced by the lens. It also eliminates residual coma by virtue of its position in the system.

The design of a 10-inch F/4 reflector-corrector system suitable for amateur construction is presented in figure 1. This system is slightly different from the Baker design in that a flat mirror has been introduced to allow the telescope to be used visually. It was also necessary to place the aspheric corrector somewhat farther from the primary mirror than in the Baker design. The position of the corrector is not critical and can be changed (with a slight modification in curves) as necessary. You will note from this design that it has a 10-inch clear aperture, but requires a 12½-inch primary mirror. This is to reduce vignetting (non-uniform field illumination), and while the loss in aperture may seem large, it should be pointed out that it is only half the loss of an equivalent Schmidt. Both the Maksutov-Cassegrain and the Schmidt-Cassegrain have a similar loss in aperture, although not as severe because of the longer focal ratios. For visual use, or for non-critical photographic use, the corrector could be made full aperture. The obstruction by the achromatic lens may also seem large, but this is only marginally larger than the obstruction by the diagonal in an equivalent Newtonian telescope.

There is some problem in using this type of telescope for visual observations. If the diagonal is placed behind the achromatic lens (as in figure 1), the focal plane falls only 6.18 inches from the optical axis which is inside the tube (if the tube size is dictated by the size of the primary mirror as it usually is). If the diagonal is placed in front of the lens, the size becomes prohibitive. The position of the achromatic lens is quite critical to the design and cannot be varied. This would place some restriction on the choice of eyepieces, complicate the design of the focusing mount, and necessitate a specially designed camera for photographic use. If we ignore these minor shortcomings however, we find that this instrument is capable of producing essentially perfect images (better than 1 second of arc) over a flat field some 4 degrees in diameter – a tremendous gain over a simple paraboloid!

Daytime and Twilight Observation

by Fr. Lucien J. Kemble, OFM

I have often wondered, since discovering the delights of daytime sightings of planets and stars myself, whether many other amateur observers have pursued this interesting side-line to regular, dark-sky observation. I wish to present the following in the hopes it may encourage those who wish to extend their time at the telescope.

Here on the prairies we are favored with excellent sky conditions: absence of pollution (light, industrial or other), many dry and cloud-free days and nights, etc. Ideal, in many respects, if one is willing to face the cold of prairie winter nights and the annoyance of spring-time mosquitoes.

A more serious drawback at this latitude (Lumsden, Sask., 50° 38′ N) is the prolonged twilight from early May to mid-August, greatly restricting one's available dark-sky observation hours. A good way to increase one's time at the telescope, when one cannot do serious, deep-sky work, is to observe the brighter planets and some interesting double stars during the long twilight and even during the daytime.

Method

A permanent pier, and wedge or mount properly aligned on polar axis, is a must. (I use a Celestron 5, with wedge permanently fixed in as accurate a polar alignment as possible). Cover the front of the telescope to avoid solar damage to the mirror. Without looking through the finder, point the telescope to the sun so that its light, shining through the finder, makes a projected spot of light centred on the finder's shadow on the ground or some other dark object. Lock the telescope in Right Ascension and Declination and set the R.A. setting circle to the proper R.A. of the sun for that day (data for this setting may be obtained from the *American Ephemeris and Nautical Almanac*). It is now a relatively simple matter to move the telescope, remove the cover, and to find some bright star, e.g. Sirius, Arcturus, Vega, etc., using proper co-ordinates; and to re-set more precisely the R.A. setting circle. If the sun's co-ordinates are not available, another method, involving a bit more searching, is to set the Dec. for a given star and, using a low-power eyepiece, sweep in R.A. in the area of sky where the star should be until it is found, then fix the R.A. setting circle accordingly.

Planets

I have frequently observed Venus at various times in daylight, sometimes at noon, with naked eye, binoculars and telescope, whenever it is in sufficient elongation east or west of the sun. Several times I have found Jupiter, first with binoculars then with telescope and have found daytime observation even better than at night, as the glare of the planet is greatly reduced and much fine, subtle detail can be detected. The same applies to both Saturn and Mars. I have observed some shadowy markings on the latter at 100× during the day that I have been unable to detect at night.

Daytime Observation – Planets – Jupiter

On May 19, at about 8:30 a.m. CST, the sun was already well up for several hours when I decided to try to find Jupiter which only recently passed conjunction with the sun.

Using the procedure described I found the sun's co-ordinates and set the R.A. setting circle accordingly. It was then relatively easy to locate Vega and Deneb and more accurately re-set the setting circle. At 9:00 a.m., I located Jupiter in the strong glare of the bright sun and, at R.A. 2h 42m, it was only one hour or so west of the sun (R.A. 3h 46m). It was really a thrilling sight to see the planet so close to the sun in broad daylight. Jupiter showed a beautiful, pale grey-blue disk on which some fine shadowy detail could be seen, in spite of considerable solar glare coming into the unshielded telescope (Celestron 5, 50× eyepiece).

April 7 Occultation by Mars of ε Geminorum (mag. 3.18)

Predictions of this event stated that it would not be seen by observers in the Western half of America and in fact, at my location – 104° 50′ W – the sun was still well above the horizon at the predicted time of occultation. However, my previous experience with daytime use of the telescope enabled me to locate Mars and ε Gem. just 15 minutes before occultation. In spite of a strong wind at my unsheltered observing site that evening, and some consequent telescope vibration, I experienced the thrill of watching the whole phenomenon, with immersion at 18h 55m 16s and emersion at 19h 00m 06s, C.S.T. Against the brilliant, blue sky, Mars was a beautiful, pinkish, disk and ε Gem. a sparkling point of light.

Stars and Double Stars

I have an extensive list of stars seen in the daytime – Sirius, Procyon, Arcturus, Vega, Deneb, Regulus, and I was even able to see Aldebaran on May 3 before sunset when it was just 1h 53m east of the sun. I have made double star observation a special part of my time at the telescope and have found it a rewarding challenge in twilight, making it a point to look for ones with low magnitude and close separation: e.g., 5062 Gem., m 6.8/9.5, sep. 3.2″; 15 Gem., m 6.5/8.0, sep. 28.6″; 38 Gem., m 4.7/7.6, sep 6.8″. A beautiful sight was γ Virginis. My notes read: "Resolution and separation very sharp in broad daylight, the sun having just set behind the hill at 2007 CST, May 2". On May

16, while the western sky was still very light, just out of curiosity I was able to pick out at least 10 of the brighter stars in M44 (Praesepe) in Cancer.

I hope these few remarks will interest and encourage those amateurs, especially in northern latitudes, wishing to make the most of their observing time to avail themselves of daylight and late summer twilight hours for some interesting planetary and double star observations. It is a most pleasant and profitable use of one's time before darker skies permit other deep-sky observations. Spurred by these experiences I now project to search for stars in daylight and to try to determine the magnitude limitations at which stars can be observed.

Astronomy Update

by Dr. D. Hube

Recent Results of Research in Astronomy

A total of 5 supernovae events are known to have occurred in our Galaxy during the past 1000 years. One of the brightest was the supernova of AD. 1006 which was first seen in May of that year, remained brighter than Venus for about 3½ months, and was visible to the naked eye for several years thereafter. Records of the event were made in the Middle East, China and Japan. [*Astronomical Journal* **70**, 105 and several following papers, 1965.] Of these 5 supernovae, SN1006 is the only one which has not left a remnant visible at optical wavelengths. It has, however, been observed at radio and X-ray wavelengths. SN 1006 is one of 7 supernovae remnants whose X-ray spectra have been measured. For 6 of these, including SN 1006, the observed characteristics are explainable for the most part by a thermal source. The seventh source is the Crab Nebula in which much of the radiated energy is generated by processes involving the underlying pulsar. [*Astronomical Journal* **204**, L111, 1976]

The first asteroid found this year (January 7) has also proved to be unique in being the only known asteroid with a period less than one year and, hence, with an average distance from the Sun which is less than the Earth-Sun distance. Radiometric observations imply a diameter of about 900 metres (the smallest yet *measured* for any asteroid) and an albedo (surface reflectivity) which suggests that it has a stoney composition. This composition places it in a class with several Apollo asteroids, including Icarus.

[*Nature* **260**, 691, 1976, April 22]

We are all familiar with at least one technique for measuring the rotation period of the Sun's surface: the observation of sunspots. Since sunspots are believed to be a phenomenon of the Sun's magnetic field and since the Sun's surface magnetic field is expected to be locked into the ionized surface gases (plasma), we would expect *all* measurements of the rotation of the surface gases to give the same result. This aspect of the Sun's rotation has long been assumed to be true, but, being such an obvious thing, has never been carefully tested. The assumption of a unique rotation period for a given solar latitude has now been shown to be invalid. The spectroscopically determined plasma rotation velocity is approximately 4 per cent less than that based on the proper motions of sunspots. [*Nature* **260**, 227, 1976, March 18]

The universally held belief that the gravitational force varies inversely with the distance squared for all distances from zero to infinity has been challenged by the results of recent experiments. Using a Cavendish torsion balance, the value of the gravitational constant, G, has been measured for mass separations of 30 and 4.5 cm. A significant difference of 0.4% was found. The 'simple' explanation is that at small distances the exponent on the distance coordinate appearing in the force law is not 2. A critical experimental test of this result is needed since the consequences are substantial. For example, it contradicts General Relativity. [*Nature* **200**, 395 and 417, April I, 1976]

The variable star VV Cephei has one of the longest periods (approx. 20 years) of all known eclipsing binaries. It is a member of a class of binaries consisting of a very large (100 to 1000 solar radii) late-type supergiant and a small, hot, early-type dwarf. The eclipse of the dwarf by its larger companion is of interest because the light of the former fades very slowly as it passes behind the extended, semi-transparent atmosphere of the latter. Apparent changes in the spectrum of the dwarf directly reveal details of the atmospheric structure of the supergiant. The next eclipse should begin in the middle of November of this year. The apparent magnitude varies from 6.65 to 7.46.

[*Astronomy & Astrophysics* **46**, 317, 1976]
(From Edmonton Centre's *Stardust*)

While their basic structure remains unresolved, several intrinsic properties of the quasi-stellar objects can be measured. If the measured redshifts are cosmological then the distances and intrinsic luminosities are known. The time scale of the observed light variations can be used to place upper limits on the diameters. The observed line spectrum (emission and absorption lines) provides clues to the gas density and temperature in the emitting and absorbing regions. A fundamentally important parameter to be determined is the mass. By assuming that a QSO consists of a non-thermal central source surrounded by clouds or filaments of gas (which give rise to the line spectrum), and by assuming that this gas has been driven out of the central source by radiation pressure, limits can be placed on the allowed masses. The masses are found to lie in the range 5×10^7 to 2×10^9 solar masses. (These limits are reduced by a factor of 100× if the QSOs are at local rather than cosmological distances.) This mass range is consistent with the widely accepted picture of QSOs being the cores of young galaxies.

[*Astrophysical Journal* **205**, L55, 1976]

Of much current popular and scientific interest is the question of whether Earth is, or is not, entering into a new ice age. Directly related to this is the question of the cause, or causes, of ice ages. A theory which was developed several decades ago has recently been resurrected and is gaining in popularity. It holds that ice ages are due to variations in solar radiation at critical northern latitudes. This is the Milankovitch theory. Variations in solar radiation will occur because of changes in the Earth's orbit and alignment of its axis of rotation. Such changes are periodic and can be computed from the known dynamics of the Earth-Sun system. Earth's orbital eccentricity varies from 0 to 0.06 with a period of 93,000 years; the obliquity of the ecliptic varies between 21°.1 and 24°.5 with a period of 41,000 years; the direction of the axial tilt varies with an average precessional period of 21,000 years. Various measureable quantities such as isotopic abundances in deep-sea cores are expected to depend on solar radiation and, indeed, are found to vary with the periodicities given above. [*Nature* **261**, 11 and 17, May 6, 1976]

Another suggested cause for the ice ages is the passage of the Solar System through a cloud of interstellar matter. It is clear from the numbers and sizes of such clouds in the disk of the Galaxy that Sun-cloud "collisions" must have occurred many times during the 4½ billion year history of the Solar System. A cloud of suitable composition and density could, for example, prevent or reduce the impact of the solar wind on the Earth and thereby induce climatic changes.

[*Nature* **261**, 32, May 6, 1976 and **261**, 298, May 27, 1976]

Terrestrial surface rocks suffer erosion by running water, diurnal and seasonal temperature changes, and by wind-born particle abrasion. On the surface of Venus there is no running water (the surface temperature is too high), temperature changes are extremely small because of the thick atmosphere and small axial tilt, and wind velocities at the planet's surface are very small. Nevertheless, both angular and smooth surface rocks were photographed by Veneras 9 and 10. The erosion of surface rocks on Venus is possibly due to one or both of the following: the atmosphere of Venus is highly acidic (hydrochloric, hydrofluoric and sulphuric acid are present) so that chemical erosion will occur; the high temperature acting on minerals with low melting points will lead to a softening of the contours of rocks. [*Nature* **261**, 31, May 6, 1976]

Using image tube infrared photographs, two extended objects have been found in the region of the North America Nebula in Cygnus. They were found in much the same way and are similar in appearance (one more than the other) to Maffei I discovered a few years ago and now known to be an external galaxy. It is suggested that one (or both) of these new objects is a relatively nearby galaxy possibly in, or close to, the Local Cluster of Galaxies. [*Astronomy and Astrophysics* **48**, 327, 1976]
(From Edmonton Centre's *Stardust*)