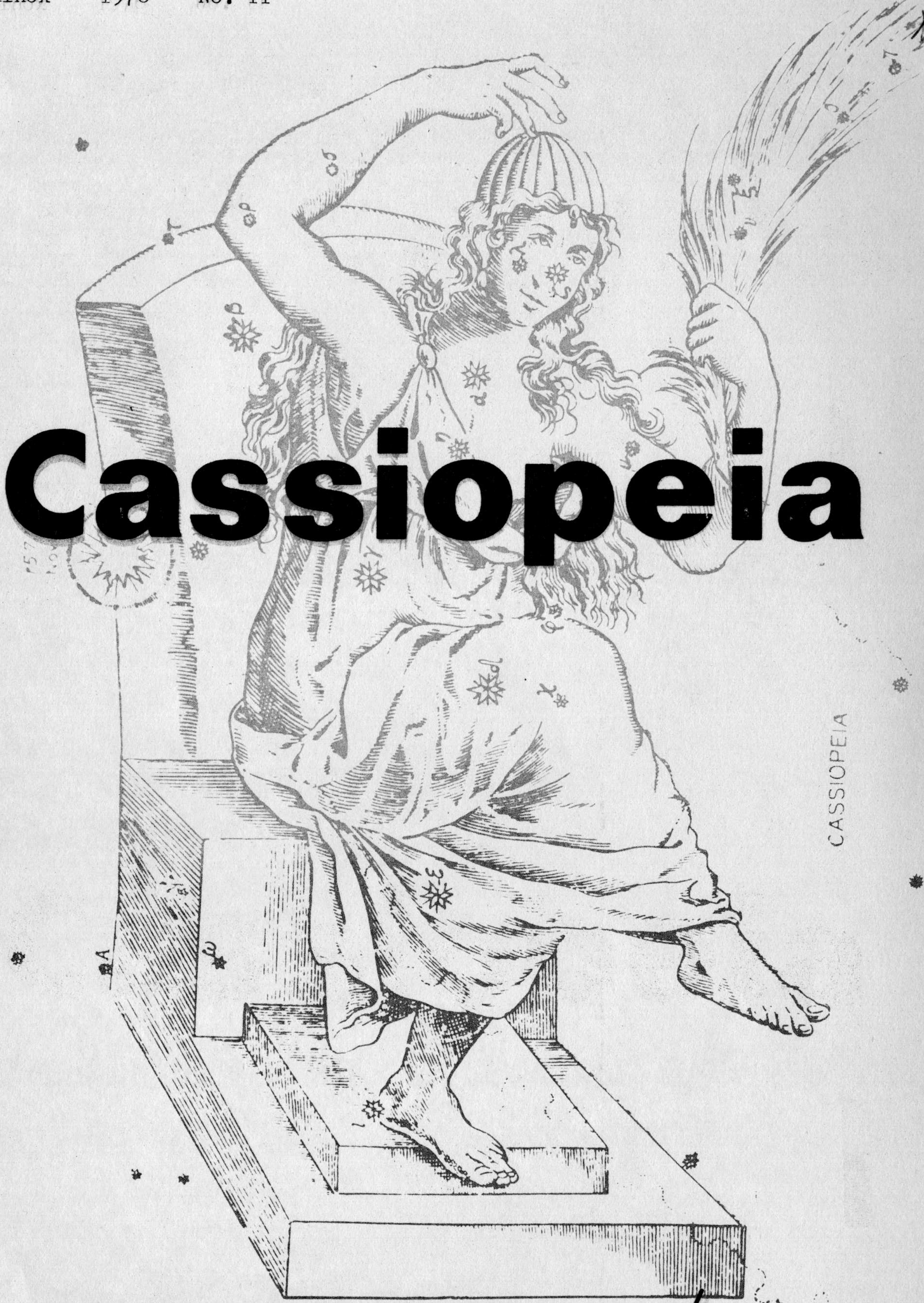
Vernal Equinox 1976 No. 11

Cassiopeia



Canadian Astronomical Society

Société Canadienne d'Astronomie

Cassiopeia

No. 11 Vernal Equinox Issue 1976

CANADIAN ASTRONOMICAL SOCIETY
SOCIÉTÉ CANADIENNE D'ASTRONOMIE

Editor: Dr. John F. Heard, University of Toronto

Assoc. Editor: Dr. David L. DuPuy, St. Mary's University

A Correction

In the Autumnal Equinox issue of Cassiopeia (page 2) I referred to Dr. C.S. Beals as the last Dominion Astronomer. Time plays tricks with memories. The last Dominion Astronomer was actually Dr. R.M. Petrie, Director of the Dominion Astrophysical Observatory from 1951 till his untimely death in 1966. During those years he was Dominion Astrophysicist and his many years with this title overshadowed in my mind the regrettably short span during which he held the title of Dominion Astronomer. When Dr. C.S. Beals retired on June 29, 1964 as Dominion Astronomer and Director of the Dominion Observatories Branch of the federal Department of Mines and Technical Surveys, Dr. Petrie was named Dominion Astronomer. Dr. John H. Hodgson was appointed Director, Observatories Branch. (See J.R.A.S.C. vol. 58, October, 1964, pages 232-234).

H.S.H.

DEADLINE for the Summer Solstice issue of CASSIOPEIA is JUNE 15, 1976. Please single space your contribution to avoid retyping, and mail to: David L. DuPuy, Department of Astronomy, Saint Mary's University, Halifax, Nova Scotia B3H 3C3.

The Astronomical Institute

A progress report and
a solicitation.

Last summer CASCA supported an Astronomical Institute as an experiment to try to determine what sort of arrangement would be useful for CASCA members. The institute was located on a 50-acre property in the Ontario countryside, at a picturesque and quiet spot just outside the village of Erin. Sandra and I spent a delightful summer in a small cottage there, ready and willing (nay - eager) to act as host-persons for the institute. The cabin in which the meetings were to be held is about 50 yards from the cottage. It was built by squatters early last century, and has recently been restored to a reasonable condition, tastefully furnished. The building is very 'atmospheric' and provides the ultimate in quick removal from the world for short periods of creative thought and discussion.

The facilities, philosophy, etc., of the institute were described in a letter sent to members of CASCA in May of last year. The basic idea is to gather a small group which normally does not have such an opportunity, for the purpose of solving some particular problem of mutual interest, exploring some particular area of research, or whatever the group itself feels would be useful. The only amendment to the original letter is that the rent charged for the property is $300/month, rather then the very high figure mentioned there.

The response from the members of CASCA was varied as might be expected, but enough interest was shown for the Council to decide to sponsor such an institute on an experimental basis. The financial arrangement was that they would provide $200 for each group which met, a group being four or more, up to a maximum of three groups. Any expenses above this - in particular the rent of the property - were to be borne by Sandra and myself.

At the beginning of the summer three different groups emerged as possible users of the Institute. One request for a discussion between laboratory astrophysicists and observational astrophysicists, to deal with the measurement of f-values and the problem of cosmic abundances, came to naught because of a lack of interested participants of the latter persuasion.

A second group, which was to have combined theoretical, radio, and optical expertise in a discussion of variable radio sources, remained viable throughout the summer (and still is, as far as I know) but proved impossible to schedule. Finally, a small group did actually meet, bent on constructing a dynamic model of V1016 Cygni which would incorporate all available data - optical, infrared, and radio. As this group formed the entire experiment for the summer, it is worth while describing it in more detail.

Six persons were interested initially, but ultimately only four were able to take part: M.P. FitzGerald, F.J. Ahern, K.A. Marsh and myself. The meeting took place over the weekend of Aug. 23/24. Pim FitzGerald came by car with his family and they stayed at our house in the village of Erin. The others came by bus from Toronto, and were met at Caledon, a few miles away. Plans to embrace the Great Outdoors in the form of a tent dissolved in a stupendous series of thunderstorms, and everyone slept indoors. For the same reason, most of the meals were served indoors as well, but they were quite satisfactory. In fact, the cuisine was remarkably good, providing a plentiful variety of foods which had been imaginatively prepared and superbly cooked .

The business aspect of the meeting was also satisfactory. The atmosphere in the cabin was all I had hoped for, and the discussions were delightfully free of interruptions - telephones and students in particular. The opportunity to clear all extraneous material from the mind and concentrate on this specific problem for a space of two days was an exhilerating experience. The small library of journals and reference books which had been imported for the occasion, together with a hand calculator and a plentiful supply of paper, proved to be adequate. In the space of two days a dynamic model was constructed and the rough draft of a paper written.

Two days is not really enough, even for such a restricted topic. The model and the paper are still being refined, but on a greatly expanded time scale. The latter effect is, unhappily, a normal state of affairs resulting from the variety of demands made on one's time, and from the geographical separation of those involved. Altogether, it emphasises the usefulness of the type of discussion/meeting which the Institute is trying to promote.

A two-day meeting, with one of the participants doubling as host, is a bit thin for an experiment, but in fact I was greatly encouraged by the experience. The council of CASCA has agreed to continue the experiment for one more summer, on the same basis, and the cabin is available for June, July, and August. If you feel that you and a few colleagues could make use of such an environment for a period of a few days or a week, please write to me as soon as possible (in fact, any comments concerning the Institute would be welcome).

A meeting is organised around those involved, so finding possible participants is the first step. Scheduling is a major problem, and the sooner the problem can be attacked, the better. The participation of astronomers from abroad who may be visiting Canada during the summer is encouraged.

Another major problem is travel costs. The financial arrangements for the present experiment offer no help in this regard, and, the Institute being where it is, Ontario astronomers have an advantage. If interested individuals were in the vicinity during the summer for some other reason, meetings would be scheduled accordingly. I hope that, if the Institute survives, CASCA will address the problem of travel, which underlies any Canadian activity. It is possible that the Institute could, in the future, move about the country in much the same way as the CASCA meetings.

Chris Purton
CRESS
York University
Downsview
Ontario M3J 1P3

A photograph of the Astronomical Institute's cottage.

UNIVERSITY OF TORONTO

Department of Astronomy
David Dunlap Observatory

J U N E   I N S T I T U T E   1976

MODERN ASTRONOMY AND ASTROPHYSICS

The Graduate Department of Astronomy and the David Dunlap Observatory of the University of Toronto announce the 1976 JUNE INSTITUTE. This will be held from TUESDAY JUNE 8 to FRIDAY JUNE 11 inclusive, on the St. George campus of the University. Four invited speakers will each present four lectures on topics related to recent developments in astronomy and astrophysics. The speakers, and their major fields of interest are:

JAMES E. GUNN - California Institute of Technology
Pasadena, California

Observational Cosmology

DONALD LYNDEN-BELL - Institute of Astronomy
Cambridge, England

Theoretical Astrophysics, Stellar Dynamics

MIROSLAV PLAVEC - University of California
Los Angeles, California

Binary Star Evolution; Mass Loss and Mass Transfer in Single and Multiple Stars

JOSEPH VEVERKA - Laboratory for Planetary Studies
Cornell University
Ithaca, New York

Planets and Their Satellites

The proceedings will be informal, and there will be many opportunities for the speakers and participants to meet together, during the day and at evening social events.

Graduate students, faculty members and other scientists whose interests lie in one or more of these fields are invited to attend and participate.

continued bottom of page 6

No. 76-4

Received: 23 February 1976

Institution: Department of Physics
McMaster University
Hamilton, Ontario, L8S 4M1
Canada

Direct Correspondence to: Dr. M. W. Johns, Chairman
Department of Physics

Position: Two faculty positions at the Assistant Professor level. Applicants with postdoctoral experience will be preferred. The Department has major research programmes (both pure and applied) in experimental and theoretical low energy nuclear physics (centered on a 5 megawatt research reactor and a Model FN Tandem VandeGraff accelerator), in experimental and theoretical solid state physics (based on the well equipped laboratories of the Materials Research Institute and the reactors at McMaster and Chalk River) and in quantum optics. The Department is interested both in strengthening these programmes and in extending its efforts to other fields, such as astronomy and intermediate nuclear physics or plasma physics. Within this rather broad definition of interests, the quality of the applicant will weigh more heavily than his field of experience.

Salary: The salary attached will be commensurate with qualifications. The salary floor for 1975-76 is $14,300.

Beginning Date: The sppointments are expected to take effect on July 1, 1976, but can be held over until 1977 if necessary.

NOTE: Application, including curriculum vitae and names of three referees should be sent as soon as possible.

June Institute (continued)

ALL PROSPECTIVE PARTICIPANTS ARE INVITED TO WRITE TO:

PROFESSOR JOHN R. PERCY
DEPARTMENT OF ASTRONOMY
UNIVERSITY OF TORONTO
TORONTO, CANADA M5S 1A7

AS SOON AS POSSIBLE.

Rooms for single persons and married persons (unaccompanied by children) will be available in the University residences at a nominal cost. There will be a modest registration fee for participants from outside the University of Toronto.

Donald A. MacRae
Chairman & Director

CAS/SCA Employment Committee Job Circular

No. 76-3

Received: 9 February 1976

Institution: Department of Astronomy and David Dunlap Observatory
University of Toronto
Toronto, Ontario

Direct Correspondence to: Dr. John R. Percy, Erindale College,
University of Toronto,
Mississauga, Ontario L5L 1C6

Position: Assistant Professor, Astronomy and Astrophysics

Tenure-stream appointment, beginning July 1 or September 1, 1976. Duties include undergraduate teaching on the Erindale Campus of the University, research and graduate teaching and supervision. Excellent and varied facilities are available for astronomical observation, data reduction and computation.

Applicants must have a Ph.D., and should have had post-doctoral experience; those with higher qualifications in terms of experience are also encouraged to apply, as it is possible that, for such an applicant, the appointment might be made at the associate professor level. Some preference will be given to applicants with an interest in observational and theoretical aspects of stellar atmospheres, or in modern optical instrumentation and the study of stars and stellar systems.

Salary: Not specified

Beginning Date: July 1 or September 1, 1976

NOTE: Application, including curriculum vitae and names of two or three suitable referees should be sent as soon as possible.

CAS/SCA Employment Committee Job Circular

No. 76-2

Received: January 28, 1976

Institution: Department of Mathematics and Astronomy
University of Manitoba
Winnipeg, Manitoba
R3T 2M8

Direct Correspondence to: Dr. D. R. Bochonko

Position: A position as Visiting Assistant Professor (Astronomy) is available. The position is a replacement for a faculty member on sabbatical leave. The position will be a sessional appointment for one year only beginning July 1, 1976. Primary duties will be teaching the equivalent of three undergraduate sections in Astronomy.

Salary: Not Specified

Beginning Date: July 1, 1976

NOTE: Applications and supporting documents, including names of persons willing to write letters of reference, should be sent before April 10 1976.

The U of T Telescope and Auxiliary Instruments at Las Campanas, Chile

by René Racine

The University of Toronto telescope at Las Campanas was installed in August 1971 and the first observation — a photograph of the globular cluster 47 Tucanae — was obtained on 28 Aug., by William Harris with the author as night assistant. Since that historic moment a complement of basic auxiliary instrumentation has become available at Las Campanas and modifications have continuously been made to the equipment. The Las Campanas Observatory remains to this date the only Canadian astronomical facility in the southern hemisphere and, despite the relatively modest size of the 24-inch telescope, has proved to be an extremely valuable research installation. Visiting astronomers are welcome to apply for telescope time; the Department of Astronomy of the University tries to accommodate as many visitors as possible.

For the information of the astronomical community and as an introductory guide to prospective users we present here a short description of the Las Campanas facilities. The present equipment comprises: the telescope, the X-Y base and guider, the photographic camera, the image-tube direct camera, the classification spectograph, the photoelectric photometer, general purpose electronic instruments and the dark-room facilities.

1. The Telescope

The 24-inch (61-cm) "Ealing" telescope is of the off-axis German-mount type with classical Cassegrain optics - f/3.5, f/15. The Cassegrain plate scale is 22.5"/mm and the unvignetted and shielded field has a diameter of 10.8 cm (40 arc min.) at its nominal position 38 cm behind the Cassegrain tail plate. Auxiliary instruments are usually mounted on the X-Y base (see Sec. 2) for which the nominal back-focal distance is 23 cm. Axial translation of the secondary mirror allows this distance to range between zero and 65 cm. The mechanical assembly of the telescope is very rigid, and instruments weighing up to 200 lbs. can be carried by the Cassegrain tail plate.

The intersection of the R.A. and Dec. axis of the telescope is located above the spring-line of the dome to allow unobstructed view down to the horizon. Reversing the telescope becomes necessary at large hour angles for observations south of -70° with instruments extending more than 85 cm behind their mounting surface.

The optics have proven to be excellent and fully capable of taking advantage of better -than-1" seeing. However, the fast primary and the large amplification factor of the secondary make the system rather sensitive to collimation errors.

Initial electronic problems both with the drive system and with the control console had to be ironed out before a truly satisfactory performance could be achieved. The telescope manufacturer was of relatively little help here, but thanks mostly to the talents of D.D.O. engineer Anthony Estevens, the operation is now very smooth.

The finder telescope is a 6-inch refractor giving a field of 40 arc min.

2. The X-Y base

The X-Y base consists of a focussing ring (± 2.5 cm travel, resolution 10 microns) on which is mounted a large X-Y table capable of supporting an instrument load of 100 lbs. The X-Y motions of this table are controlled by micrometric screws (± 2.0 cm, resolution 20 microns). The X-Y table and its micrometers can rotate about the optic axis of the telescope. Hence the auxiliary instrument can be conveniently moved in X, Y, ϕ and Z with respect to the telescope.

Instruments are generally bolted onto the back plate of the X-Y table. All threads are 3/8 - 16. There are 6 equally spaced threaded holes on a 10.00 inch diameter circle and 3 equally-spaced threaded holes on a 6.50-inch diameter circle. Both circles are centred on the optic axis when X=Y=0 and the circular opening centred in the X-Y table has a diameter of 5.60 inches.

3. The Offset Guider

The offset guider is a 4-inch high right cylinder which bolts onto the X-Y plate and contains two diametrically opposite guiding probes fed by right-angle prisms.

The back plate of the guider is identical to the X-Y table plate. The guider can be used for blind offset or as an auxiliary off-axis guider for instruments which do not incorporate guiding optics. However, the general use of image-tube eyepieces on our spectrograph and photometer has almost eliminated the necessity for blind offsets at Las Campanas.

4. The Photographic Camera

Our conventional photographic camera is a commercial Boller and Chivens 4" x 5" instrument with incorporated guider. A fused-quartz field flattener may be used to compensate for the steep field curvature but coma and astigmatism contribute nearly as much aberration as field curvature.

The users' consensus seems to be that little is gained by the field flattener over the image quality obtained by simply moving the plate in (by the use of the focussing ring) by 0.4 mm after on-axis knife-edge focussing. Two complete sets of U B V R I Schott filters are available, together with the necessary emulsions. Due to mechanical restrictions the filter frames limit the field to a square, 3.6 inches (34 arc min.) on the side.

Approximate limiting magnitudes on hypersensitized 103a emulsions for one-hour exposure in average seeing are $V = 19$, $B = 20$. A 3-hour B exposure on NGC 5253 by Christine Clement holds the current record, reaching $B = 21.5$. Exposure times twice that long appear possible before sky fog becomes prohibitive.

A "reflecting lens" (Racine and Harris, A.J. 79, 472) is available to use with this camera for photometric calibration of stellar magnitude scales. The lens produces on the plate a displaced secondary image of the field fainter than the primary image by a known magnitude difference. Thus a few bright local photoelectric standards suffice to calibrate the plate to its limiting magnitude.

5. The Image-tube Direct Camera

This newest addition to our equipment was designed and tested by M.Sc. student Richard Gray under Bob Garrison's supervision, machinist Dave Blyth being responsible for the jewell-like appearance of the final unit. The camera uses a magnetically-focussed 40-mm photocathode ITT F-4809 (S20) single-stage image tube, followed by either a 40-mm plate or 35-mm film-holder, the emulsion being contacted to the fibre-optic plate of the output window. The unit is relatively light (about 20 lbs.) and compact. When in use it replaces the filter and plate holder of the B and C camera whose guiding probe remains operational.

The performances of this I.T. camera have proven to be truly exceptional. The gain in speed over direct plates is estimated at a factor of 4.5 in B and more than 15 in R, while the image resolution remains seeing-limited. The tube is exceptionally quiet and exposures up to one hour show a barely-measurable tube background. Iris photometry of calibrated sequences by Gray shows an average scatter of 0.10 mag., which compares well with conventional photography. Although the instrument was primarily intended as a survey device for morphological studies of emission nebulae, it appears that it can also be used for photometric work.

6. The Classification Spectrograph

Bob Garrison's spectrograph is a simple and efficient grating instrument designed primarily for MK classification work. The camera lens works at f/3 and quickly-interchanged gratings give reciprocal dispersions of 67 and 112 A/mm. The spectrograph has an image-tube camera in addition to the standard plate holder. The image tube is the electrostatically-focussed version of the ITT tube used for the direct camera (sec. 5). It is also very quiet but has a somewhat poorer resolution (30 line-pairs/mm). Without the I.T. 0.6 mm-wide spectra at 120 A/mm of B=11 mag. stars are obtained in three hours while a gain of 1.5 mag. is produced by the I.T. Well-exposed, narrow (0.2 mm) spectra of stars as faint as B = 14 have been obtained in four to five hours with intensifier.

The slit width is variable but generally projects 2 arc sec. on the sky. In average seeing this leaves very little light from a 10th mag. star to be reflected from the slit jaws for guiding! A three-stage, electrostatically focussed, 16-mm ITT image tube is then used in the guiding eyepiece of the spectrograph for work on fainter stars. The luminance gain of this tube is so high that individual photonevents are clearly visible on the output phosphor window. This eyepiece, also used on the photoelectric photometer, is truly cherished by our observers. Even on a moonless night one can see reflected skylight on the slit jaws without being dark-adapted!

7. The Photoelectric Photometer

This is a conventional single-channel photometer. Two (dry-ice) cold boxes are currently available, one containing a good old 1P21 and a second one with a S20 EMI photomultiplier.

One of two "snap-in" filter wheels can be quickly inserted in the photometer head, one taking up to 12 circular filters 5/8 inch in diameter and the other eight one-inch square filters. Filters as thick as 1/2 inch can be used. The wheel is manually operated; micro-switches generate a BCD code of the filter position for the data system.

The manually-operated diaphragm wheel has nine locations for interchangeable diaphragm cells of sizes ranging from 7" to 2' in diameter. Sets of single and double (6 mm spacing) apertures are available, the latter being used in the chopping mode. A mechanical chopper (rotating disk) can be installed for dual-beam, single p.m. work on faint stars.

A conventional and an image-tube eyepiece (Sec. 6) mounted on a turret can be quickly interchanged for behind-the-diaphragms viewing and give a field of 2 arc min. Stars of V = 16 are easily seen with the image tube, while reliable centering of 17th mag. stars requires some "mental integration" of the time-varying distribution of photon events seen on the phosphor window.

Although a complete DC system (V to F converter plus counter) is available as a backup unit, the pulse-counting electronics is almost exclusively used. This is a commercial SSR system capable of handling stars as bright as B = 3.0 without appreciable coincidence corrections, the dead-time being 40 nanosec. The data from the SSR console (integration time, counts) and the digital clocks and filter codes are read by a digital data scanner and printed on paper tape. Various configurations and formatting are possible giving data rates up to 5 samples/sec.

UBV photometry of stars to 14 mag. is easy, and V of about 17 can be reach, though with considerable effort.

8. Support facilities

"Casa Canadiense", the U of T residence on Las Campanas, is probably one of the most comfortable and pleasant abodes in the Atacama desert. In addition to its well-appointed living room and its two bedrooms (resident astronomer and a maximum of two visitors), it houses a very complete dark-room (including sensitometric calibration), a small electronic shop and storage area, and a kitchenette (breakfast and midnight lunch). The CARSO dining lounge serves lunch (which the astronomer often skips, having gone to bed at 8 a.m.) and dinner.

The U of T facilities are self-supporting for the vast majority of the requirements encountered. When some major mechanical or electronics work is required the Carnegie personnel kindly assist our astronomers on Las Campanas. After the early pioneering era life and work on clear-sky Las Campanas has for some time now become very civilized. The obvious success of the University of Toronto installation in Chile is due to the dedication and good will not only of U of T individuals, but also of our Carnegie colleages of our visiting astronomers, of our Chilean neighbours at Cerro, Tololo and at ESO and of all our friends in Ottawa, Toronto, Santiago and La Serena. Thanks to all of them, Canadian astronomers can now view the Southern skies with their own eyes.

A Reminder

June 16 - 18 CASCA Meeting at Penticton

Details of the June meeting of the Canadian Astronomical Society have been mailed to all members. The planning committee has arranged a very attractive schedule for this year's meeting, and it promises to be both profitable and enjoyable (profitable in the scientific sense).

Note that a Special Session will be held on The Teaching of Astronomy and papers are solicited on any aspect of teaching astronomy at the university level, in the schools, or in the community. One or two invited papers will also be presented. Abstracts of papers for this session only should be sent to Dr. David L. DuPuy, Department of Astronomy, Saint Mary's University, Halifax, N. S. B3H 3C3, to arrive before May 17.

Abstracts for the Scientific Sessions should be sent to Dr. R. S. Roger, Dominion Radio Astrophysical Observatory, P. O. Box 248, Penticton, B. C. V2A 6K3, to arrive before May 31.

Although recent observing has been only average for this season or a little below, good progress is being made on the data analysis and interpretation of the various projects currently under investigation at the Observatory. Dr. and Mrs. Jorge Sahade are spending two months at the Observatory. He is working with Dr. Alan Batten to complete their analysis of Hα observations of β Lyrae. The following seminars have been given recently:

1975 Dec. 16: W.G. Milne: A Seismologist in China
1976 Jan. 23: E.M. Kellogg: X-Ray Astronomy
1976 Feb. 12: V. Trimble: Cosmology and Man's Place in the Universe
1976 Feb. 18: G. Hill: Proper Motions from Schmidt Plates
1976 Feb. 25: W.P. Bidelman: Objective Prism Astrophysics
1976 Mar. 3: W.H. McCrea: Origin of Galaxies

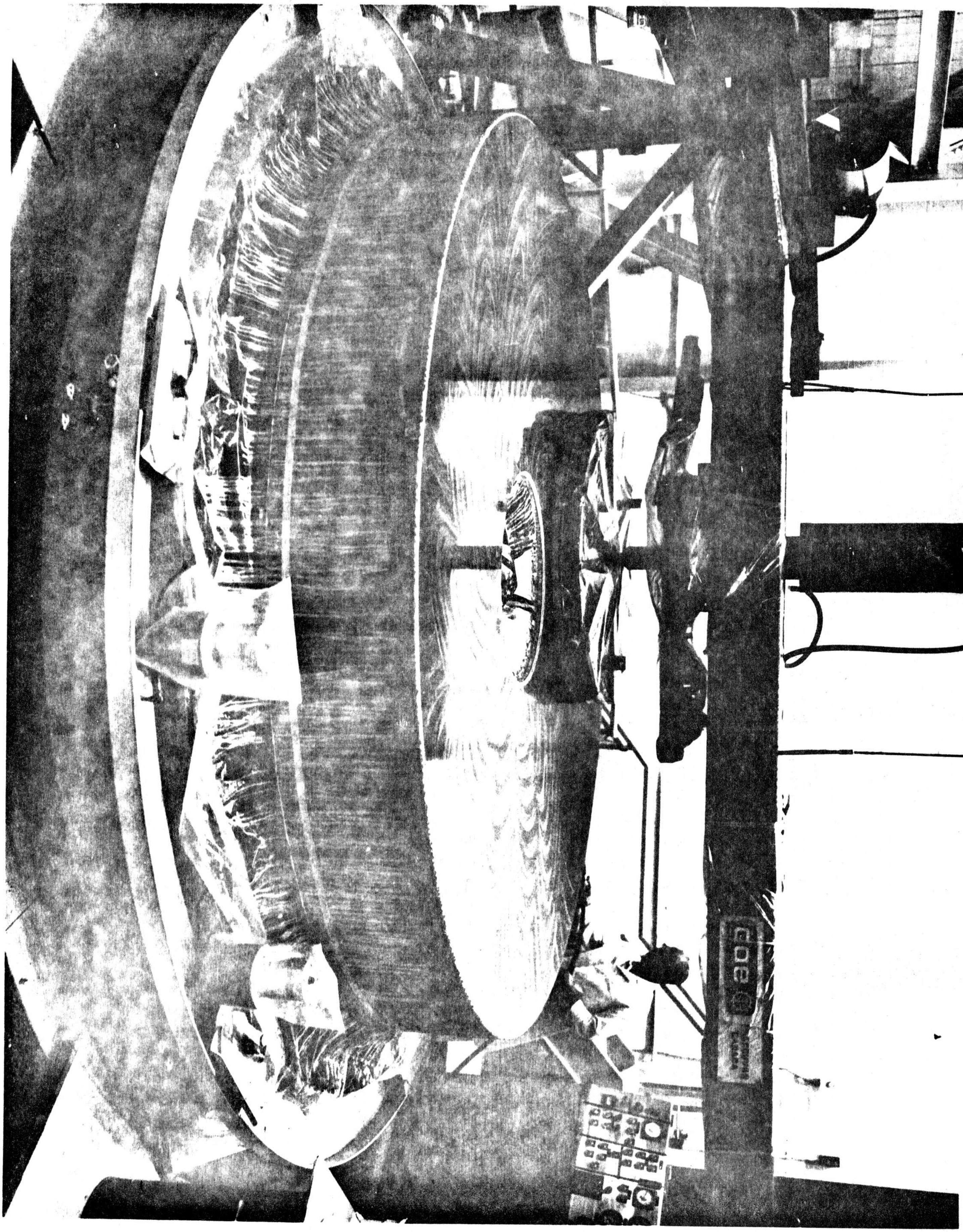
The 72-inch telescope is being dismantled for maintenance and to check the main bearings. This operation is under the direction of J.R. White and is expected to be completed during April.

The detailed designs for the 8-channel photometer and for the C.F.H. spectrograph No. 1 have been almost completed by G.A. Brealey; most of the mechanical parts for the former will be constructed in the D.A.O. shop.

The 3.6 m mirror for the C.F.H. Telescope is progressing very well under the direction of Roy Dancey. As indicated in the December issue, the mirror had been ground to an acceptable sphere early in December. The aspheric correction using the full-size polishing tool was begun on January 20. By February 20, computer output from tests by radial and square-grid Hartmann masks indicated that the mirror shape is within one wavelength (0.5 micron) of the correct paraboloid. The surface is not yet fully polished and the next stage will be to complete the polishing while improving the correction and smoothing the surface. The full-size tool will be used for some time. The accompanying photograph shows the mirror being polished with the small polishing tool in November.

The 40-inch Hindle sphere for testing the smoothness of the secondary mirror is complete, and polishing has begun on the 72-inch spherical mirror used for quantitative testing of the secondary by the Richardson test. The secondary itself is now in the optical shop and is being checked for physical form so that the design of the mirror cell and processing equipment can begin.

(DAO photographs of the CFHT mirror on the following page)



NOTES FROM UNIVERSITIES

UNIVERSITY OF TORONTO

Visitors to the Observatory

Visitors who have recently given colloquia on Campus or at the Observatory are:

A. Bar-Nun, Dept. of Chemistry, Univ. of Toronto on "Thunderstorms on Jupiter".

Kim Innanen of York on "Particle Dynamics in Spheroidal Mass Distributions".

Serge Demers of Laurentian on "The Magellanic Plane".

Francesco Bertola of Asiago on "Rotation of Elliptical Galaxies".

Alan Batten of D.A.O. on "Recent Work on Beta Lyrae".

Staff and Student Notes

Following are Ph.D. theses successfully defended: Dave Hanes, "The Luminosity Distribution of Globular Clusters in Virgo Galaxies" on Dec. 17; Serge Pineault, "Geometrical Optics in Axially Symmetric Spacetimes" on Dec. 17; Austin Gulliver, "A Study of Shell Stars" on Feb. 27. Dave and Serge are on Post Docs at Cambridge, Austin at DAO. Bob Chambers' thesis defence is coming up on March 15.

As most Canadian astronomers must know by now, René Racine has resigned his position at U. of T. as of July 1 to accept appointments as Associate Professor in the Department of Physics of the University of Montreal and Interim Director of the proposed "Quebec Observatory". The tentative site is Mont Megantic (altitude 3700 feet, about 40 miles east of Sherbrooke) where a 60-inch reflector will be installed. Negotiations about the site and the telescope, added to René's duties to such committees as

The NRC Grants Committee, Magnetospheric Studies Committee, Scientific Advisory Committee for the CFHT, plus Radio Canada interviews plus a CAP Lecture Tour ("Astrophysical Problems and Canadian Solutions") have taken him from Halifax to Calgary during February and March.

Don Fernie is really on sabbatical leave this term, although he spends full days at the Observatory - writing a book on some aspects of the history of astronomy.

Don MacRae was in Williamsburg, Virginia on Jan. 21 to 29 attending an International Conference on Space Observations hosted by the Space Science Board of the NRC - National Academy of Sciences of Washington and co-sponsored by the European Science Foundation. Discussion mainly centred around the Large Space Telescope. The following week when our Department was host to the NRC Associate Committee for Astronomy and the National Committee for Canada for the I.A.U. Don chaired the sessions. Later in February (23 to 27) he attended meetings of the Board of Trustees of CFHT in Ottawa and Montreal, the operational phase of the corporation (when the telescope comes into use) being the principal topic of discussion.

Taking advantage of the presence of a number of Canadian Astronomers in Toronto for the NRC Associate Committee, CASCA Council met here on Sat. Feb. 7 and the SAC of CFHT on Feb. 9 and 10.

Sidney van den Bergh has accepted nomination to a six-year term as Vice-President of the I.A.U., beginning in August of this year. He has also been honoured by being chosen 1976 McMillan Lecturer at Ohio State University.

Visits made recently by staff members include: Bob McLaren at the NASA Ames Research Center near San Francisco Feb. 12 to Mar. 1 to collaborate with the Townes Group from Berkeley on Far-infrared spectroscopic observing with the one-metre telescope aboard NASA's C-141 aircraft; Ernie Seaquist in Charlottesville Feb. 11-20 to reduce radio astronomy data; Bob Garrison at the University of Maryland in January as external examiner of the Ph.D. thesis defence of our former student, Peter Jackson, who is a PDF now at University of Waterloo; Jack Heard at U. Vic in March for the Ph.D. thesis defence of Barrow Baldwin who will be coming to DDO as PDF working with Tom Bolton.

John Percy gave a seminar on Jan. 16 at UWO on "The Problem of the Beta Cephei Stars". Helen Hogg addressed the Royal Canadian Institute on Feb. 14 on "Astronomy in Canada - Then and Now".

U of T (continued next page)

A local group within the Department, composed of Bill Clarke, Peter Martin, Bob McLaren (on leave here from U. of Tasmania), Martine Normandin and Ernie Seaquist are proposing to meet from time to time to discuss common interests in the interstellar medium. Any others interested could write to Peter Martin.

The University of Alberta 20-inch Telescope

A preliminary report on this new telescope has been given by Jack Winzer (J.R.A.S.C. 69, 142-43, 1975). The sketch which accompanies this article gives an accurate representation of the completed telescope. The decision to build the telescope was made in November, 1974, construction of optical and mechanical components began early in 1975, and we expect completion this summer. All of the design work and almost all of the construction has been done in-house, although we have benefited from discussions with Rene Racine, Gerry Longworth, and others.

Optics The optical design is based on the classical Cassegrain system. The primary mirror is a paraboloid with a f/3 focal ratio. Interchangeable secondaries, each in its own separately balanced upper end, provide f/8 and f/18 ratios at the Cassegrain focus. A third mirror mounted through the hole in the primary permits operation in the folded-Cassegrain configuration. The tertiary mirror is rotatable to any of six points on the side of the bottom tube section; six of the plates forming this section (the other two are attached to the declination axles) have been pre-drilled with a standard pattern of mounting holes for auziliary instruments. There is provision for photography at the Cassegrain focus: At f/8 two aspheric plates and a field flattener will give images of 1.4 arc seconds at the edge of a $1\frac{1}{2}$ degree field. At f/18 the primary problem is Petzval curvature and a slightly underpowered field flattener reduces images to less than one arc second over a $\frac{1}{2}$ degree field.

For prime focus photography a Baker reflector-corrector system was selected. In a separate upper end, it consists of a 17-inch diameter aspheric plate in the incident beam and an achromatic doublet of slight positive power in the reflected converging beam. Ray tracing at several wavelengths indicates that images smaller than one arc second can be achieved over a six degree field. The positive power of the doublet reduces the f/3 focal ratio of the primary to f/2.65 for the system. The detailed optical design is the work of graduate student David Swadron.

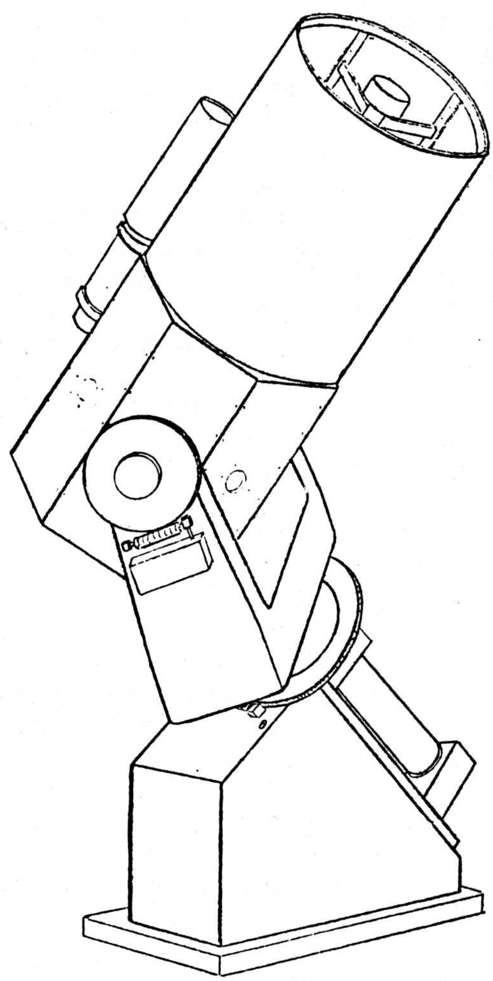
Mounting A fork mounting has been chosen as being particularly suitable for a high-latitude site. It also results in a compact instrument which will fit into the available dome which is only 14-feet in diameter. Except for three outside surfaces, the fork is a single aluminum casting with internal ribs and surfaces typically one to one and one-half inches thick. The fork will be pinned and bolted to a four inch diameter polar axle which has been machined from a specially cast and heat treated steel rod. A 1 $\frac{1}{4}$ inch diameter hole has been bored through this axle to accomodate electrical cables which will then pass through channels in the fork arms to the declination drive motors and auziliary instruments on the tube. The polar axle rides in a pair of precision Timken tapered roller bearings which are separated by approximately two feet. The base of the telescope is constructed largely of 2-inch thick cast aluminum plates.

Tubes The eight-sided bottom section of the tube is constructed of $\frac{1}{2}$-inch and 3/4-inch thick aluminum plates separately pinned and bolted to an internal frome of rings and rods. The use of flat plates facilitates the mounting of instruments at the folded Cassegrain focus. The three interchangeable upper ends for the f/8 and f/18 Cassegrain and Baker systems are constructed of aluminum rods and rings and wrapped in aluminum skins. The upper ends are attached by means of bolts which run the full length of the tube. Each upper end will be individually balanced and the optics prealigned and collimated so that immediately after an end is attached the observations can begin.

The primary mirror is supported on a fairly standard flotation system set in an aluminum cell which has been machined from a single casting. Alignment of the primary is accomplished using an approach suggested by Racine. A brass ring rigidly attached to the bottom of the mirror has a tapered outer face which matches the tapered inner face of a brass ring on the back plate. These tapered surfaces are sections of a sphere centered at the centre point on the front surface of the primary mirror. Hence, relative displacements over these tapered surfaces allows for alignment of the mirror without any translational motion.

Drive The R.A. drive employs a 20-inch diameter, 480 tooth worm gear, matching worm, and a set of differential gears obtained from E. R. Byers. The worm and differential are mounted on a plate located on the top-north face of the base. This plate is spring loaded toward the worm gear to reduce backlash and maintain uniform contact between worm and gear regardless of thermal expansion or contraction, or other mechanical factors. A separate worm and motor mounted on the base of the fork provide for slewing through a 12-inch diameter gear. Between these gears is a bronze slip-clutch. (This clutch serves as a mechanical breaking point to prevent damage to the main gear in the event that the telescope is driven into an obstacle.) Slew, set and guide motions are available on the declination axis using a 12-inch diameter worm gear, matching worm and differential.

Present Status (March 1) The major mechanical components have been completed. The base, polar axle, fork and tube will be assembled next week for preliminary testing. We do not anticipate any difficulties since great rigidity has been built into the system and mechanical tolerances have been kept extremely small. The back plate/mirror cell is complete. Secondary mirror supports are nearing completion. The tertiary mirror support and declination drive system are still to be constructed. The power supplies have been designed but not yet assembled. Two 20-inch mirror blanks of Bourns E-6 low expansion glass have been rough ground. (One will have an f/1.5 spherical surface and be used to test the secondaries.) The central hole in the primary will be cut next week to within $\frac{1}{2}$ inch of the front surface prior to final figuring. The optical work is being done by Barry Arnold, an optician in the Department of Electrical Engineering, who is also President of the Edmonton Centre of the R.A.S.C. The f/18 system will be completed within a few months and before the other optical systems are begun.



All machining and assembling of the mechanical parts is being done in the machine shop in this department under the supervision of Nick Riebeek, who is also responsible for most of the detailed design. The final cost, including the cost of renovations at the observatory site but excluding machine shop labour, will be approximately $25,000. These funds have come entirely out of the university budget.

In-house construction of this instrument has been possible because the Physics Department at the University of Alberta possesses one of the best-equipped machine shops in any Canadian university, and because the shop is manned by very skilled individuals who have developed a deep interest in the project. When completed, we will have an extremely versatile instrument which, at least in terms of the quality of its construction, will be far superior to any commercially available instrument.

Dr. Douglas P. Hube
Department of Physics
University of Alberta

Grote Reber

by Bob Watson*

What do astronomers do when they retire? If Grote Reber is an example, then they uproot themselves from the urban civilization of North America and travel to the nether regions of the globe to do astronomy!

You will recall that Grote Reber was a radio engineer who was sufficiently intrigued by Karl Jansky's original detection of cosmic radio noise to begin his own experiments by building a 31-foot parabolic reflector in his backyard at Wheaton, Ill. His employment in the electronics industry made the finest and most advanced equipment available to him. From the mid-thirties until after the second World War he was, in effect, the only radio astronomer in the world. His maps of galactic radiation at 160Mc, which appeared in 1944, represent probably the most significant contribution to science made by an "amateur" in this century.

During much of the decade to which I have been referring Grote Reber was something of a voice crying in the wilderness. Convinced that the distribution of radio noise coming from the galaxy offered very important information to astronomers, he visited a number of observatory directors to try to persuade them to devise and carry out their own radio astronomy observing programs. His importuning had little success; even those directors who were convinced by Reber's results pleaded lack of funds or lack of personnel with the necessary skills. It was only after the conclusion of World War II that astronomers began to follow Reber's lead.

Jansky's observations were at 20.5Mc. Reber reasoned, on the assumption that the emission obeyed Plank's black body curves, the signal would be stronger at shorter wavelengths. Not one for doing things by halves, Reber attempted his first observations at 3,300Mc. He was not deterred by the fact that technology of receivers at this frequency was

** Bob Watson, Assistant Professor in the Department of Physics at the University of Tasmania in Hobart, is spending a sabbatical half-year in the Department of Astronomy, University of Toronto, collaborating with John Percy in the field of variable stars. When I discovered that Bob had several times met Grote Reber, the famous radio astronomy pioneer, I asked him to write a piece about him for Cassiopeia.*

J.F.H.

virtually non-existent at that stage - he set about to create his own technology. It took two years work from 1937 to 1939, and the re-building of his receiver a number of times to move to lower frequencies before he finally achieved his first detection of galactic radiation at 160 Mc. Having gone to one extreme in frequency it is not surprising that Reber later turned his attention to the other extreme. Thus it was that in the late fifties he began to look for a site to conduct a 2 Mc sky survey.

At 2 Mc transmission through the ionosphere is possible only under exceptionally favourable conditions. There are apparently bands on the earth's surface, at high geomagnetic latitude, above which the ionosphere is particularly transparent. This led Reber to consider Tasmania. Although only at a geographical latitude of -42°, it is favourably placed at -65° geomagnetic. Other suitable geomagnetic locations tend to suffer from being inhospitably ice-bound, subject to excessive man-made radio interference, or being simply on the wrong side of the then very "iron" curtain. His selection made, Reber settled into the sleepy hamlet of Bathwell in the Tasmanian midlands and started to build his own large dipole array. The array is of filled aperture type, with dipoles strung between telephone poles. It was completed in time for the 1965 solar minimum. His enthusiasm undamped by his age (he is 64), he has resurrected the array for the current solar minimum. During winter his chart recorders run continuously at nights so that on those few nights when the ionosphere opens up, no data will be missed.

Over the years Grote Reber has become a well known "character" on the local Tasmanian scene. Anyone who has met him cannot but be impressed by his extraordinary enthusiasm and his active enquiring mind. His interests are by no means confined to just one discipline. He has undertaken experiments on the helical growth patterns in plants. He has been involved in studying local aboriginal artifacts. In this regard he instigated some of the first carbon datings done on material taken from ancient Tasmanian aboriginal campsites. The local potato farmers have also profited from his advice. In talking to them he often had to listen through their complaints about knobbly potatoes. The farmers had been selling the smoothest potatoes from their crops because they brought the highest price. The knobbly ones from their crops had been kept for seed potatoes. Over a period of years this had produced what should have been predictable results. It is a measure of Reber's breadth of interest that at the 1968 ANZAAS meeting (an Australian and New Zealand science congress) which was held in Tasmania he presented three papers - one in radio astronomy, one in botony and one in archeology.

Currently his interests have turned to electric cars. He has accumulated a number of small German-made three-wheeled "bubble" cars, in varying states of disrepair. With a little cannibalization he hopes to salvage at least one vehicle and modify it to run on batteries. As well as this, he has come up with a plan for re-organization of the traffic flow on the streets of downtown Hobart, the state capital. The present system of one-way streets is illogical in a number of respects. So far his suggestions have fallen on deaf bureaucratic ears, but being Grote Reber, he will keep plugging away.

Editor's Note: Bob Watson has referred to Reber's research on the helical growth of plants. This brings to mind one of my favorite anecdotes. Reber at one point believed that he had demonstrated that when a certain kind of bean vine was forced to coil in the direction opposite to its normal inclination it produced a more copious crop of pods. At an international meeting he buttonholed a venerable old botanist and began describing his experiments and his remarkable conclusion. The old man listened for a while and then interrupted to say, "My dear chap, I am not at all impressed by your experiments. I suggest you leave this sort of thing to the professionals who understand about controls and statistics".

J.F.H.

Where Was the First Astronomical Observatory in Canada?

Astronomical observations have been made in Canada since the early 17th century, but permanent oberservatories did not appear until the mid-19th century. When we try to establish which of these small institutions was first, we find that there at least three contenders. As a result of his archival researches, Otto Klotz, the second director of the Dominion Observatory, unearthed the histories of the small observatories at McGill, Queen's, Fredericton, New Brunswick and Quebec. Later, Ed Kennedy's thorough researches made a strong case for the priority of William Brydone-Jack's observatory at Fredericton. As a result, that observatory was designated by the Canadian Government as the first astronomical observatory in Canada. But was it?

Two other candidates must be considered: the observatory of Dr. Charles Smallwood and the Quebec Observatory. Smallwood, an English physician and accomplished amateur meteorologist, built a meterological observatory equipped with home-built instruments - at St. Martin, Isle Jésus, north of Montreal in the late 1840's. The actual date of its establishment stated as 1849 by Klotz, is not certain and the observatory's records at the McGill Archives give no clear indication. We do know, from contemporary journal accounts, that by the mid-1850's, the observatory had a slit in the roof for transit observations, a transit instrument, and a portable equatorial with a 7-inch Fraunhofer objective, which was used outdoors. Unfortunately, there is no evidence as to whether these instruments were in place as early as 1849. Smallwood's observatory, then, might have been the first in Canada.

A better candidate is the Quebec Observatory. For some reason, the date 1854 has attached itself to this observatory as a foundation date. The observatory papers and correspondence in the Public Archives show otherwise. The observatory's construction was approved by the Executive Council of the Legislative Assembly of Canada in 1848, and in 1849, £1,000 was appropriated for the work. The construction was essentially finished in the autumn of 1850. The designated astronomer, Lieutenant E.D. Ashe, R.N., took charge of the observatory on 27th November, 1850. The instruments were placed in the building at the same time, but further renovations were carried out during the winter of 1850/51. By September 1851, all instruments and equipment except the time-ball machinery were ready for operation.

The records of the College Council of King's College, Fredericton, suggest that Brydone-Jack's observatory was completed by early March, 1851. In terms of construction, then, the Quebec Observatory pre-dates the Fredericton Observatory by a few months. In terms of when the respective observatories were ready for observations, we have nearly a dead-heat.

Since Klotz's papers in the R.A.S.C. Journal are still the only comprehensive survey of 19th-century Canadian observatories, and there are few errors in those papers, I will summarise the history of observatories in tabular form:

Observatory	Control	Founded	Notes
St. Martin	C. Smallwood	1849(?)	Closed 1863
Quebec	Govt. Canada	1850	Relocated 1864; rebuilt 1874
Brydone-Jack	King's College	1851	
Kingston	City of Kingston	1855	Deeded to Queen's 1861
Queen's	Queen's University	1861	Rebuilt 1862; relocated 1881
McGill	McGill University	1863	Successor to Smallwood's
Toronto	Govt. Canada	1840*	Equatorial 1881

*Magnetic and Meteoroligical Observatory only: astronomical capability from 1881.

The conclusions are still not clear-cut: Smallwood's observatory may have been the first. Further research may elucidate the problem. The Quebec Observatory was essentially completed and under direction of its astronomer slightly before the completion of the Brydone-Jack Observatory. Nonetheless, the Brydone-Jack Observatory remains the oldest university observatory in Canada as well as the oldest existing observatory in Canada.

R.A. Jarrell
Atkinson College
York University.