Astronomy at the University of Canterbury Department of Physics & Astronomy and at the Mt John University Observatory

Observatory Director: Dr M.D. Albrow
Report compiled by Dr William Tobin

Report 2002–3

Report for the period 2002 January 1 to 2003 December 31

Staff

At the begining of 2002 the Observatory directorship rotated to Dr Michael Albrow who continued as Mt John director throughout the period covered by this report. In 2003 his permanent half-time position was extended to a full-time appointment for a period of three years.

Alan Gilmore continued as Resident Superintendent at Mt John. Stephen Barlow, Nigel Frost and Pam Kilmartin continued as other Mt John staff.

Turning to Christchurch staff, Professor John Hearnshaw continued on the Board of IAU Division IX and as chair of the Royal Society of New Zealand's Committee on Astronomical Sciences. In 2003 July, while attending the IAU General Assembly in Sydney, he joined the Organizing Committee of IAU Commission 46. In the same month he was appointed chairperson of the that Commission's Advance Development Program Group. This group was subsequently renamed the Program Group for the World-Wide Development of Astronomy. Its goal is that its members should visit developing countries, make recommendations to the IAU on promoting astronomical teaching and research in those countries, and offer advice and assistance to the local astronomers.

Hearnshaw enjoyed a visiting fellowship at the Solar-Terrestrial Environment Laboratory at Nagoya University for the three months from 2002 September. He spent much of his stay editing the proceedings of the previous July's IAU Asian-Pacific Regional Meeting in Tokyo, which he had attended, but he found time to visit Gunma Observatory and to attend a meeting of the Japan Physical Society in Tokyo. He began a year's study leave in 2003 August. He spent September–November as a visitor at the Vatican Observatory in Castelgandolfo (near Rome), where he continued work on a monograph on the history and theory of astronomical spectrographs.

Associate Professor Peter Cottrell was on a year's study leave from 2002 July. He spent a substantial part of this leave developing the University of Canterbury's share in the Southern African Large Telescope project (SALT; see separate section below). He served as the University's director on the SALT Foundation Board, attending two Board meetings in Cape Town during 2003.

Dr William Tobin was on study leave 2002 April–July, and devoted most of his effort to completing his biography of the 19th-century French physicist Léon Foucault. The French version of this work, entitled 'Léon Foucault: Le miroir et le pendule' was published in October to coincide with the exhibition of the same name which was held at the Paris Observatory (where Foucault was 'physicist' from 1855). This exhibition was organised by Dr James Lequeux of the Paris Observatory (Erskine Visitor to Canterbury in 1997), who also adapted Tobin's book into French. Tobin acted as *commissaire adjoint* to the exhibition and assisted in myriad ways. The biography later won the *Prix spécial du jury* of the *Prix du livre de l'astronomie–Haute-Maurienne/Vanoise 2003*.

In 2002 August, Tobin sent a poster paper to the Antique Telescope Society's meeting in Dublin. It treated Foucault's presentation of his new silvered-glass telescope to the 1857 meeting of the British Association for the Advancement of Science, which was also held in Dublin. Three months later, Tobin presented an invited talk in Marseilles at the colloquium in that city marking the tercentenary of the Observatoire de Marseille. His subject was Foucault's Marseilles telescope. As part of the same trip, he also visited the Haute-Provence and Nice observatories. In December he presented a seminar on Foucault at the Paris Observatory.

Tobin was on study leave again for April–July in 2003. He spent much of April and May at the European Southern Observatory headquarters in Santiago de Chile, working with Dr John Pritchard on analysis of the light curves of eclipsing binaries discovered in the Large Magellanic Cloud by the French EROS microlensing project. Later in his study leave he dealt with proofs of the English version of his book, 'The Life and Science of Léon Foucault: The Man who Proved the Earth Rotates', which was published by Cambridge University Press in October. In July he attended the XIXth annual colloquium

at the Institut d'Astophysique de Paris entitled 'Extrasolar Planets: today and tomorrow' where he presented a poster paper on Mt John spectroscopy of β Pictoris (coauthors Stuart Barnes and Pollard). During the year, he gave seminars on Foucault at ESO-Santiago, ESO-Paranal, the Open University, the Institute of Astronomy (Cambridge) and the Université Tous Ages in Vannes, France.

Albrow attended the New Horizons in Globular Cluster Astronomy conference in Padua in 2002 June.

Dr Jovan Skuljan continued until mid-2003 as a postdoctoral researcher working with Hearnshaw on high-precision stellar radial velocities using the HERCULES spectrograph. He developed a software package, HRSP, for the reduction of HERCULES images and the determination of radial velocities. He observed a number of radial-velocity standard stars and wide binaries suitable for the calibration of an absolute radial-velocity scale depending on the spectral type. In 2002 July, he attended the IAU Asian-Pacific Regional meeting in Tokyo; and in September, the Monte Rosa Conference 'GAIA: Spectroscopy, Science and Technology' in Gressoney Saint Jean, Italy. The following month, he attended the 13th National Conference of Yugoslav Astronomers in Belgrade, as did Dr Ljiljana Skuljan. J. Skuljan was also involved with the MOA project.

In 2003, Teaching and Research Fellowships were awarded to L. Skuljan (March–November, part-time) and J. Skuljan (July–November).

In 2002 Albrow was promoted to Senior Lecturer, Hearnshaw and Cottrell received regradings, and Gilmore and Kilmartin were awarded progression in salary bands above the merit point. Karen Pollard was promoted to Senior Lecturer in 2003.

Students

Stuart Barnes (supervisor Hearnshaw) continued his Ph.D. project on the design of high-resolution astronomical spectrographs. In 2002 he was awarded the Michael Kidger Memorial Scholarship in Optical Design and the William Price Scholarship in Optical Design. He received these awards in person at the annual meetings of the Optical Society of America in Tucson in June, and of the SPIE in Seattle in July. The following month he attended the SPIE conference on Astronomical Telescopes and Instrumentation held in Waikoloa Village, Hawaii, where he presented two poster papers.

For some months of 2003 Barnes was enrolled part-time in order to work on the design of the high-resolution spectrograph for SALT (see separate section below).

Glenn Bayne (supervisors Tobin, Pollard & Pritchard) received the Dennis William Moore Scholarship for 2002. He submitted his Ph.D. thesis on eclipsing binary stars in the Magellanic Clouds in 2003 December and successfully defended it a few months later. He presented preliminary results in 2002 February at IAU Colloquium 191 held in Merida, Mexico, and ten months later in Santiago de Chile at the ESO workshop 'Stellar candles for the extragalactic distance scale'.

John Bentley completed the requirements for his M.Sc. degree in 2003 May with a thesis entitled 'Short-term instabiities in γ Velorum: A search for strange modes in variable stars' (supervisors Cottrell & J. Skuljan).

Malcolm Cropp obtained his M.Sc. degree in 2002 with a thesis entitled 'Spectroscopic analysis of southern δ Scuti-type variable stars' (supervisor Pollard). He then enrolled for a Ph.D. involving time-sequence photometry of open clusters (supervisors Albrow & Tobin).

Dane Kent (supervisors Hearnshaw & J. Skuljan) attended the Western Pacific Geophysics Meeting in Wellington in 2002 July. He suspended his Ph.D. enrolment in 2003 March.

Ceridwen Livingston (supervisor Hearnshaw) completed requirements for an M.Sc. in 2002 August with a thesis entitled 'An analysis of the light curves of 20 novae and their use as distance indicators'. Her degree was conferred the following April.

Jennifer McSaveney (supervisors Pollard & Cottrell) obtained her Ph.D. in 2003 with a thesis entitled 'Type II Cepheids: line formation and hydrodynamics'.

Orlon Petterson (supervisors Cottrell & Albrow) was awarded his Ph.D. in 2002 for a thesis entitled 'Binary Cepheids'.

In 2003 Daniel Pooley (supervisors Cottrell, Albrow & Pollard) obtained his Ph.D. with a thesis entitled 'Spectroscopic and photometric monitoring of southern post-asymptotic giant branch stars'.

Andrew Rakich (KiwiStar Optics, Industrial Research Ltd., Lower Hutt) enrolled for a Ph.D. as an extra-mural student in 2003 March (supervisors Hearnshaw, Tobin, Norman Rumsey (Lower Hutt) & Craig Smith (EOS, Australia)). He will search for general analytical solutions for 4-mirror anastigmatic telescopes with one mirror aspherized.

David Ramm (supervisors Hearnshaw & J. Skuljan) continued observation and analysis of precise radial velocities for a score of visual and astrometric binary systems. The observations were made with HERCULES. The aim is to obtain mass ratios, and if possible, individual masses. Ramm was funded through a Bright Future Top Achiever Doctoral Scholarship in both 2002 and 2003.

Duncan Wright (supervisor Cottrell) obtained his M.Sc. in 2003 with a thesis entitled 'A spectroscopic study of two non-radially pulsating stars: HD160641 and FG Virginis'.

In 2002 Stage-4 student Liz Wylie completed a project under Cottrell's supervision on line-splitting in the Cepheid X Sagittarii. In 2003 she began a Ph.D. under Cottrell's supervision. She will analyse s-process abundances in Asymptotic Branch Stars using HERCULES spectra. The

ultimate goal is to understand trends in the dredge-up phase which brings these elements to the stellar surface. She attended the Vatican Observatory Summer School in June-July and spent some time working with the stellar atmospheric modelling group at Monash University in November. She was awarded the Dennis William Moore Scholarship for 2003.

In 2002 January, Saskia Besier & Pollard organised an Astronomy and Physics Summer Camp, including a trip to Mt John. Eleven high-school students participated.

An anonymous donor has kindly provided trial funding for a scholarship for a young, first-year student. The first such Aurora Scholarship was awarded for 2003 to Alan Williams from Wairarapa College. Funding from the same donor permitted the running in Christchurch and Tekapo of an Aurora Summer School for high-school students in 2003 January (organiser Pollard).

Visitors

From 2002 February–April, the Group welcomed Professor Larry Marschall of Gettysburg College as an Erskine visitor. His expertise is as an astronomy educator, and while in Christchurch he interacted with Stage 1 students. Drs Gilles Chabrier and Isabelle Baraffe (École Normale Supérieure, Lyon) were joint Erskine visitors from 2003 July–October. They taught on stellar variability in the ASTR323/423 course. A third visiting Erskine Fellow was Professor Jayant Narlikar (Indian Inter-University Centre for Astronomy & Astrophysics) from 2003 July–September. He lectured in the Stage 3 cosmology course.

Sabbatical visitor Dr Bob Nelson (College of New Caledonia, Canada) joined the Group for 2002 February–June. He used the Optical Craftsmen 0.6-m telescope for photometry of southern eclipsing binary stars and other objects.

Denis Sullivan (Victoria University of Wellington) made three observing trips to MJUO in 2002 (April, August & September) and two in 2003 (July & September). In 2002 April he was accompanied by Professor Steve Kawaler of Iowa State University, who is also director of the Whole Earth Telescope collaboration (WET), of which Sullivan is a member. Sullivan's observational programme utilizes the McLellan 1-m telescope and a portable 3-channel photometer to carry out high-speed photometry on two southern pulsating white dwarfs (EC 20058−5234 and L19-2) as part of a seismological investigation of their internal structures and compositions. Both targets are regularly observed at MJUO in an endeavour to ascertain the period stability of the different pulsation modes in each object. Electro-weak interaction theory predicts that the slow cooling of the hotter helium atmosphere star (EC 20058−5234) is dominated by neutrino emissions from the core, and a principal science goal of this work is unambiguous detection of the impact of this energy loss on the pulsation periods.

Aarno Korpela (part time Ph.D. student at VUW) made several visits to MJUO to observe for the MOA project and to work on some of his data reduction routines.

Other visitors with astronomical interests during 2002 included Drs Robin Catchpole (RGO) and Marc Moniez (Orsay). Dr Martha Hanner (JPL) and Petre Pecina & Jaroslav Bocek (Ondrejov Observatory, Czech Republic) visited in connection with Professor Jack Baggaley's dust and meteor studies. Other visitors in 2003 included Drs John Cunniffe (Dunsink Observatory), Winston Sweatman (Massey University, Albany Campus), Ben Oppenheimer (American Museum of Natural History), Bill Sheehan, David Beach (KiwiStar Optics), Alan Martin (Durham) and Professor Maurice Van Putten (MIT).

Numerous school and other visitors were received on Mt John, as well as certain university classes. Open nights were held on 2002 April 18-20 and 2003 March 6-8.

Other Conferences

This section outlines some conferences that were attended by several members of the astronomy group.

The RASNZ annual conference in Invercargill (2002 July) was attended by Bentley, Cottrell, Gilmore, Kilmartin & Wright, as well as the Department's Dr David Wiltshire. Most of these people gave talks.

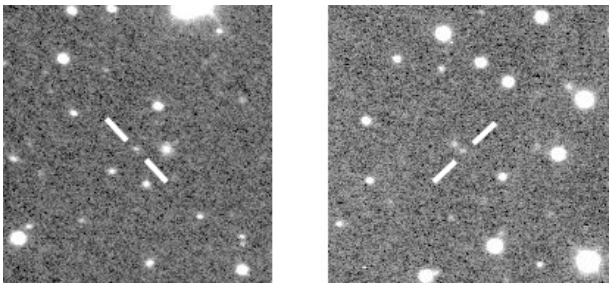
Albrow, Gilmore, Kilmartin, McSaveney & Pollard travelled to Nelson in 2002 August to attend the Photometry 2002 meeting.

The RASNZ conference for 2003 was held in Christchurch July 4–6 and was attended by numerous members of the group. This conference was followed immediately afterwards by IAU Colloquium 193 on Variable stars in the Local Group, which was held July 6–11 at the University of Canterbury. Members of the astronomy group were heavily involved in the scientific and local organisation of this conference. The IAU gave special permission to hold this Colloquium just prior to its XXVth General Assembly in Sydney July 13–26. As a result, no doubt, the Colloquium was very well attended, with some 120 participants from around the world.

Instrumentation

The HERCULES high resolution échelle spectrograph was in routine operation throughout 2002–3, and was the principal instrument used on the McLellan telescope. Frost redesigned and rebuilt the fibre feed to incorporate a beam splitter into the guiding system. He has considered the design of a remote focussing mechanism for the CCD. Geoff Graham provided new guiding and control software.

At the end of 2001, Kilmartin and Gilmore were lent an SBIG ST-9e thermo-electrically cooled CCD system (Kodak KAF0261E chip) and $BVRI$ filters by the American Association of Variable Star Observers (AAVSO), as part of their High Energy Network. Frost incorporated



Mt John discovery images of the optical afterglows of Gamma Ray Bursts GRB 030323 (left) and 030429 (right). The fields are ∼3.5 arcmin square

the camera and filter wheel into a unit containing a focal reducer based on a lens system donated by the late Garry Nankivell. On the Optical Craftsmen 0.6-m telescope the system has an effective focal length of 3840 mm (f/6.4) covering a $9' \times 9'$ field at $1.1''$ per pixel. Barlow installed cabling internal to the telescope and under the floor, connecting the CCD to the control room. He also rebuilt the automatic dome tracking controller, which is invaluable for extended photometric runs.

The prime purpose of the AAVSO CCD was to identify optical transients of Gamma Ray Bursts (GRBs). On 2003 March 23 Gilmore & Kilmartin were successful in this, managing to image the short-lived optical afterglow of GRB 030323. This was only the 7th GRB to be imaged optically. Only a month later, they succeded in imaging a second of these difficult events, GRB 030429. The AAVSO camera was also used by Nelson for variable star photometry, and by Gilmore & Kilmartin for astrometry of near-Earth asteroids.

Southern African Large Telescope

In 2002 May, members of the Group were saddened by the sudden death of Dr Bob Stobie, Chair of the SALT Board.

Construction of the telescope continued, and by the end of 2003 the dome was complete, and 2 of the 91 hexagonal mirrors were in place on the telescope structure.

Locally, the beginning of 2002 saw Albrow, Barnes, Cottrell, Kershaw & Hearnshaw working on the optical and mechanical design of a high-resolution spectrograph (HRS) as part of the University of Canterbury's contribution to SALT. Soon after, Cottrell became Principal Investigator for this project, with Albrow as Project Scientist, Barnes as Optical Designer, Graeme Kershaw as Mechanical Designer, and Graeme Hodge (of Unilogix Ltd., Christchurch) as Project Manager. Phillip MacQueen (McDonald Observatory) also contributed to the design, as did Peter Connor, Rakich and Dave Cochrane (all of KiwiStar Optics).

The HRS design comprised an R2 échelle spectrograph with prism cross-dispersion and a catadioptric cam-

July 2002: The girderwork for the SALT dome has just been lifted into position and awaits panelling

era. In 2003 April, Albrow, Barnes & Cottrell attended various SALT meetings in Cape Town to present details of the design. In September they attended Preliminary Design Review (PDR) in Southampton, UK, where they were asked to consider an alternative design based on an R4 grating, volume phase holographic gratings for the cross-dispersion, and fully refractive camera optics. Work began on this with a view to a future PDR in mid-2004.

The MOA Project

Observations of gravitational microlensing continued throughout 2002–3 using the Boller & Chivens 0.6-m telescope.

In 2002 May, Professor Yasushi Muraki obtained funding from the Japanese Ministry of Education, Culture, Sports, Science & Technology to build a 1.8-m telescope at Mt John for the MOA project. The overall optical layout (by Rakich) was finalised during the year.

The mechanical design was completed during 2003 and construction commenced at the Nishimura Company in Kyoto. The contract for the 1.8 m Astrosital mirror

Working on the MOA Telescope mirror cell at the Nishimura Company

blank went to Litkarino Ltd in Moscow, with mirror figuring and polishing by the Lomo Company in St Petersburg. Rakich completed the design of the prime-focus aberration corrector for the telescope, comprising four lens elements. The contract for their manufacture was let to Industrial Research Ltd. The CCD camera is being built by the Solar-Terrestrial Environment Laboratory, Nagoya University.

Weather at Mt John

(Compiled by Pam Kilmartin)

The table compares conditions in 2002 and 2003 with the averages of the previous decade.

Year(s)	Nights fully photometric		Nights partly photometric		Nights spectroscopic		Nights unusable	
1992-2001	76	21%	66	18%	91	25%	129	35%
2002	56	15%	69	19%	136	37%	104	29%
2003	94	26%	80	22%	80	22%	111	30%

The following tables detail the monthly photometric conditions in 2002 and 2003.

Month (2002)	Nights fully photometric	Partly photometric	Hours photometric	Percentage photometric hours
Jan	2	4	17	9%
Feb	8	15	74	35%
Mar	8	11	73	25%
Apr	7	11	84	27%
May	5	12	79	21%
Jun	2	10	61	16%
Jul	7	15	124	32%
Aug	5	13	98	28%
Sep	2	8	47	16%
Oct	6	11	75	29%
Nov	1	10	34	17%
Dec	3	5	25	16%
Total	56	125	791	23%

Month (2003)	Nights fully photometric	Partly photometric	Hours photometric	Percentage photometric hours
Jan	3	5	36	19%
Feb	10	9	112	53%
Mar	6	8	81	27%
Apr	13	5	164	52%
May	5	8	94	25%
Jun	11	7	152	39%
Jul	12	11	207	53%
Aug	8	9	132	37%
Sep	6	4	87	29%
Oct	11	7	126	48%
Nov	4	3	42	21%
Dec	5	4	42	27%
Total	94	80	1275	37%

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