2 The Year in Review

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Director of the AAO

Review by the Director

Purpose and Impact

Each semester the AAO telescopes typically provide observing time to between 50 and 60 research programs. These programs involve between 150 and 250 astronomers, of whom about 40% are Australian, 40% are British and 20% are from other countries. Time on the AAT is currently over-subscribed by a factor between 2 and 2.5, and this is likely to rise when the new AAOmega spectrograph becomes available in early 2006.

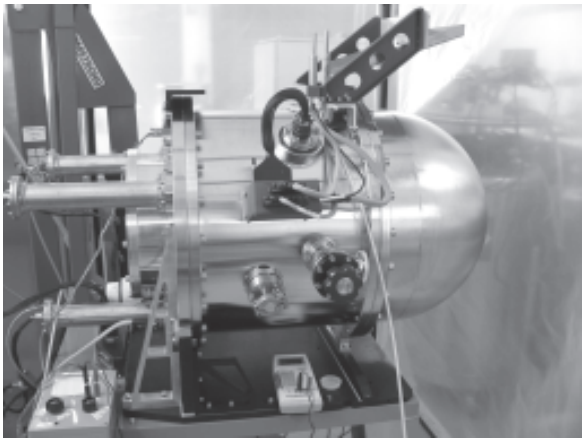
Over the last five years an average of 140 papers have been published each year from observations with the AAT or UKST. A review in 2000 by the European Southern Observatory showed that the publication rate from the AAT was among the highest of all the 4-metre class telescopes in the world. Many of the papers based on AAT or UKST data are highly cited in the scientific literature. For example, of the 300 most-cited papers produced by the international astronomical community over the last three years (the top 0.5% of all papers), 17 made use of the AAO's telescopes.

An analysis of the outstanding scientific impact of the AAO highlights the contributions of three critical elements.

First, the AAO provides top-quality service to the users of its facilities at reasonable cost. User feedback indicates high levels of satisfaction with most aspects of the AAO's service, and responsiveness to problems when they arise. This service is based on a relatively small but highly expert and dedicated group of support astronomers and technical staff. The recent streamlining of AAT operations has trimmed the staff lean while maintaining the high quality of support to users.

Second, the AAO's highly innovative instrumentation program keeps the telescopes on the crest of the technology wave. 2dF, 6dF and IRIS2 are all examples of instruments that have been successful because they have delivered performance advantages over the competition. This tradition will continue with AAOmega, the $3.7M successor to the highly productive 2dF facility. AAOmega will be the

"The most powerful instrument in the world for survey spectroscopy". AAOmega under construction (photo: Jurek Brzeski)



most powerful instrument in the world for survey spectroscopy when it begins observations in early 2006, and for several years thereafter. AAOmega will be used for several large observing programs and an array of smaller programs involving large numbers of astronomers. Effective exploitation of its capabilities during the coming decade will maintain the AAO's strong impact in survey astronomy.

Third, the AAO as an organization provides independence and diversity to the community it serves. As a bi-national institution it is outside the university systems, and can maintain a tight focus on delivering facilities for optical/infrared astronomy, a field in which Anglo-Australian astronomy is historically strong, which involves a large fraction of the research community, and which has a very exciting future.

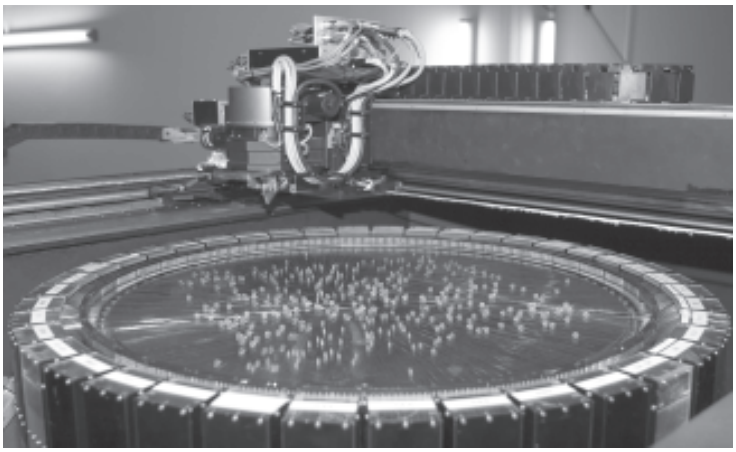
Science

In simultaneous press conferences sponsored by the American Astronomical Society and the Royal Astronomical Society, the teams carrying out the 2dF Galaxy Redshift Survey (carried out with the AAT) and Sloan Digital Sky Survey (using a telescope in the USA) announced on 12 January 2005 that they had both obtained clean detections of acoustic oscillations in their maps of the galaxy distribution. Although the two teams used different datasets and different analysis techniques, their results agreed remarkably well. The detection of acoustic oscillations, produced by the interaction of gravity, light, and ordinary matter less than 300,000 years after the Big Bang, is important scientifically because it confirms a strong prediction of the standard cosmology and because it provides a new 'standard rod' for measuring the geometry of the universe and probing the nature of the mysterious dark energy.

These results, and the manner in which they were obtained and announced, are also significant as an indication of one way in which the research culture of astronomy is evolving. Each of the two teams is a large, multi-researcher, multi-institution collaboration; both projects have been based on purpose-built instrumentation; both have taken a decade or more from conception to completion. Moreover, while the two groups have worked in competition at one level, at another there has been cooperation, as exemplified by the joint press releases. This trend towards larger and more collaborative research programs is an obvious feature of recent years, and has significant implications for how major observing facilities are run.

The importance of such large-scale research projects in addressing major scientific questions is apparent in the recent analysis of the productivity and impact of optical telescopes by Trimble et al. (2005, PASP, 117, 111). For the year (2001) studied by Trimble et al., the AAT and SDSS garnered by far the most citations of all the world's optical telescopes below the 8-metre class – a factor of two more than their nearest rivals. Indeed, together they generated more citations than the 10-metre Keck telescope. While the AAT generated marginally more papers in 2001 than any other 4-metre class telescope, the telescope's huge impact was mainly due to the very high citations per paper obtained by the 2dF Galaxy Redshift Survey and the 2dF QSO Redshift Survey. Of the 16 most-cited papers published in 2001 (jointly accounting for 10% of all citations), four came from 2dF while another three came from SDSS.

Results like these demonstrate clearly that medium-sized telescopes can have a major impact if they attack fundamental questions with cutting-edge instrumentation and generous allocations of time.



"Cutting edge instrumentation" like the 2dF field plate, has addressed major scientific questions (photo courtesy Shaun Amy)

Operations

Recognising this fact, the AAO is currently seeking to provide opportunities for exploiting the AAT's unique capabilities in large observing programs targeting major scientific questions. These programs can use any instrument, or combination of instruments, on the AAT, although the AAOmega spectrograph is clearly ideally suited to this mode of operation. AAOmega is expected to be available on the AAT from early 2006, and will be the world's most efficient instrument for large-scale survey spectroscopy for some years thereafter.

In early 2005, the AAO asked for expressions of interest in large observing programs and received 18 responses proposing programs requiring more than 2600 nights of AAT time. Most of these proposals sought to use AAOmega, but there were also programs asking for large amounts of time with other AAT instruments, including UCLES, IRIS2 and even UHRF. The topics addressed by the proposals ranged from planet-finding to high-redshift cosmology. The first large programs are expected to start on the AAT in early 2006, at the same time that the AAO is changing over to a single, unified time allocation committee.

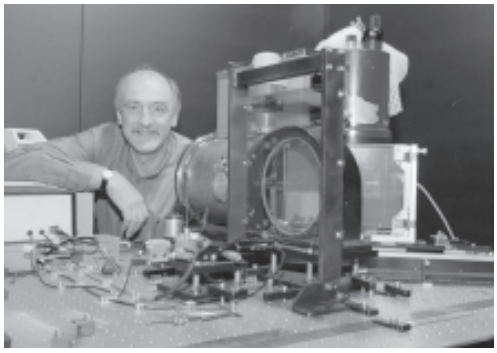
The proposed new Supplementary Agreement between Australia and the UK mandates the formation of a single Anglo-Australian Time Allocation Committee (AATAC) that will assign all time on the AAT in proportion to the partners' funding contributions. One of the major benefits conferred by a unified TAC is that it simplifies collaborative observing programs: there is no longer the double jeopardy involved in attempting to obtain time from both an Australian and a British TAC.

This will be a real boon for those proposing large programs, but should also encourage more collaborations between Australian and British astronomers across the board, ensuring that the best science programs are awarded all the time they require. Astronomy has long been an international undertaking, and this small step towards its globalisation will be of real value to all AAT users.

While large observing programs are just part of the mix of programs supported by the AAT, from the end of semester 2005A the UK Schmidt Telescope is reverting to something like its original role as a single-purpose telescope. Originally conceived to carry out photographic surveys of the southern sky, the UKST has in recent years carried out a varied mix of large surveys (such as the H-alpha photographic imaging survey and the 6dF spectroscopic galaxy survey) and smaller programs utilizing photography, fibre spectroscopy and CCD imaging.

Beginning in September 2005, however, the UKST will be largely dedicated to the RAVE (RAdial Velocity Experiment) project, which aims to measure the radial velocities, metallicities and abundances for hundreds of thousands of stars over a 5-year period. RAVE will be carried out on a user-pays basis, and is funded by grants obtained by

"Performance advantages over the competition". The 6dF spectrograph camera, a successful part of the AAO's highly innovative instrumentation program, pictured here with Dr Fred Watson, Astronomer in Charge (photo courtesy Shaun Amy)



members of the RAVE consortium. RAVE has already measured more than 50,000 stellar radial velocities (significantly more than the entire previous total) and will provide a superb map of the kinematical and chemical distribution of stars in the Milky Way, with a sample large enough to detect substructure in both the disk and the halo. Based on experience from previous large programs on the AAO telescopes, RAVE is expected to have a major impact.

Instrumentation

The AAO made a strong showing at the SPIE meeting on *Astronomical Telescopes and Instrumentation* held in July 2004 in Glasgow. AAO scientists and engineers presented 24 papers on topics ranging from the KAOS concept for a wide-field multi-object spectrograph on Gemini to novel designs for giant telescopes optimised to take advantage of the remarkable site characteristics found on the Antarctic plateau, and innovations in focal plane re-imaging using the AAO's Echidna, Starbug and Honeycomb concepts.

One AAO innovation is likely to have dramatic consequences for near-infrared ground-based observations. The near infrared is a crucial part of the spectrum in many fields of astronomy, but ground-based observations are severely hampered by the forest of strong atmospheric airglow emission lines that boost the effective background light by factors of a few tens. Over the past few years a lot of effort has gone into developing spectrographs and imagers that are capable of suppressing or avoiding these sky lines, but the various methods used all have significant disadvantages. Now a new approach, developed by the AAO, solves the problem by filtering out the narrow OH lines at high spectral resolution *before* their light enters the spectrograph or imager and is scattered. The technique, which uses aperiodic Bragg gratings imprinted in optical fibres, has the potential to revolutionize our ability to extract information from this important spectral domain. Although significant further development is needed, it is hoped that soon we will be able to see the universe in the near infrared with as little background as in the visible.

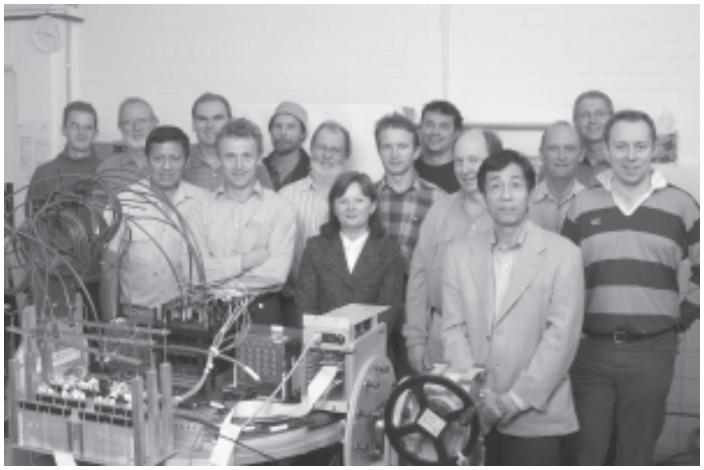
The AAO's major internal instrumentation project this year has been the new AAOmega spectrograph for the AAT, which is now well into the final stages of manufacture and assembly. AAOmega will be fed by both the 2dF fibre system and the SPIRAL IFU system, and offers very substantial gains over the existing 2dF spectrographs. The main gains are in throughput and resolution, with AAOmega being in all cases at least twice as efficient as the 2dF spectrographs (and up to a factor of six at high resolution and red wavelengths) and offering spectral resolving powers ranging from about 1500 to about 10,000 without compromising spectral coverage.

AAOmega is therefore a very powerful facility for survey spectroscopy. Taking the appropriate figure of merit to be survey speed (proportional to system efficiency times telescope aperture times field of view), AAOmega will be at least twice as good as 2dF, and significantly better than all other existing MOS systems, including 6dF on the UK SchmidtTelescope, GMOS on Gemini and FLAMES and VIMOS on the VLT. Moreover, AAOmega offers a wider range of spectral resolutions than most of these systems.

Strategic Outlook

The outstanding publication and citation rate from AAO astronomers, the high quality of service provided by AAO telescope staff, and the innovative ideas developed by AAO instrument scientists, all highlight the fact that an institution's main assets are the skills and abilities of its people. Although major new facilities such as Extremely Large Telescopes and the Square Kilometre Array will be important for the future, the most critical element will always be people: people who build innovative instruments for such facilities, people who use them to make scientific breakthroughs that allow us to better understand the universe, and people who by their teaching and research inspire students to take up science and engineering. Measured by its people the AAO is wealthy indeed, and has much to contribute in the coming decade.

"An institution's main assets are the skills and abilities of its people." Pictured here the AAO staff who designed and built the Echidna fibre positioner for FMOS on Subaru with Prof. Toshinori Maihara, left to right: Scott Smedley, Peter Gillingham, Dwight Horiuchi, David Correll, John Dawson, Neal Schirmer, Greg Smith, Gabriella Frost, Jurek Brzeski, Reuben Barnes, Sam Barden, Prof. Toshinori Maihara, Ed Penny, Rolf Muller, Scott Croom. (photo: David James)



The AAT Board has six members, three appointed by each country, and the role of Chair and Deputy chair alternates between the two countries. Further details of Board members, special responsibilities and Board meetings are included in Appendix D. Pictured here are the current members of the AAT Board along with some members of the AAO Executive (from left) Mr Neville Legg, (Executive Officer), Mr Graham Brooks, Dr Mike Irwin, Dr Fred Watson (Astronomer in Charge), Dr Pat Roche (Chair AAT Board), Dr Matthew Colless (Director AAO), Dr Brian Schmidt, Prof Warrick Couch and Mr Greg Harper. Photo: Stuart Bebb, (Physics Photographic Unit, Oxford)

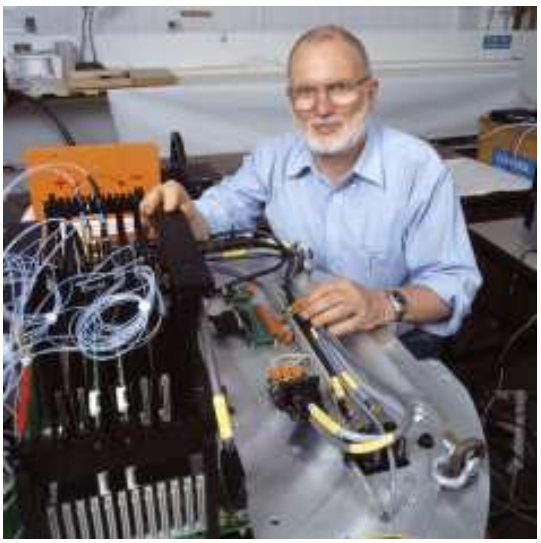
Review by the Chairman of the Board

Our view of the Universe has been transformed again over the last few years as results from space missions and ground-based telescopes have revealed new and unexpected twists in topics from cosmology to exosolar planetary systems. The contributions from the AAT to both of these fields, and many others, have been outstanding and demonstrate the excellence that has always been the hallmark of the observatory.

The expertise developed at the AAO through the early fibre-fed instruments, and especially 2dF and the innovative Echidna fibre positioner for FMOS, is a key ingredient of the proposal for the WFMOS instrument being designed for the Subaru 8-m telescope in Hawaii in a collaboration between the Gemini partnership and Japan. We congratulate the instrumentation group at AAO who,

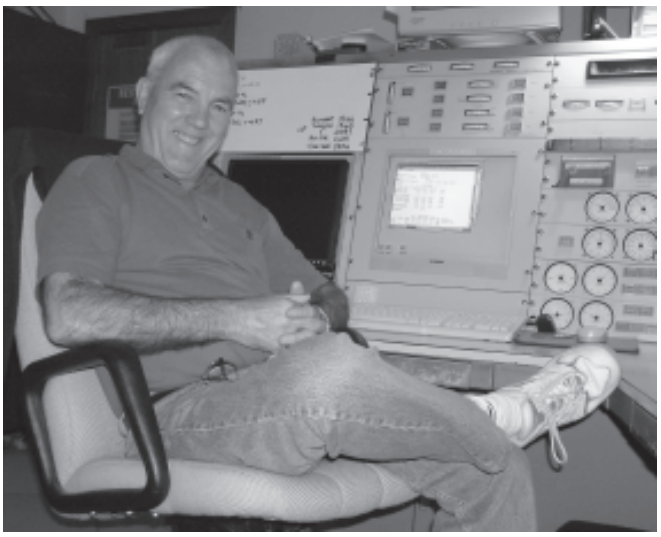
with their collaborators in the US and UK, have convinced the Gemini board of the potential and feasibility, and have driven WFMOS forward to the conceptual design phase. A number of other instrument programs are showing great promise and we are looking forward to the delivery to Coonabarabran of the AAOmega spectrograph later this year.

When the UK acceded to the European Southern Observatory in 2002, it was recognised that this would require significant changes to the funding of UK astronomical facilities. As part of this restructuring, PPARC announced that the UK would withdraw from the AAO in 2010. In order to allow an orderly transition from a jointly operated Australian-UK Observatory, to a wholly Australian operated facility, a supplementary agreement to the Anglo-Australian Telescope agreement has been agreed by the Board and is now being processed by the Australian and UK governments. The supplementary agreement will allow a gradual withdrawal of UK funding, with observing time to be shared according to the financial contributions of the two countries.



Peter Gillingham former optical engineer at the AAO, above, has retired after many years of telescope and instrument development. Pictured here with Echidna (photo: David James)

In response to these plans, the Australian astronomical community has set out its vision for the next decade in a report 'New Horizons: A Decadal Plan for Australian Astronomy 2006-2015', with a clearly defined role for the AAO, and we anticipate that DEST will convene an international review of the AAO to help plan its future. These changes make the exact form and role of the future AAO uncertain. However, the skills and expertise contained within the AAO are widely recognised both within Australia and internationally, and the AAO will undoubtedly continue to play leading roles in astronomy



Frank Freeman, above, former night assistant at the AAT has retired after 27 years (photo: Chris McCowage)

and astronomical instrumentation. This optimism is confirmed by the award of a substantial grant from the Australian and UK agencies, DEST and PPARC, to upgrade the fabric of the AAO buildings and bring them up to modern building code regulations.

The AAO staff have recognised this uncertainty and have agreed amendments to their working practices in the form of a new enterprise agreement; we are grateful for the cooperation of the whole observatory in this.

2005 is a pivotal year, where the structure that has served so well over the last 30 years is beginning to change. The operation of the UK Schmidt telescope is now funded by the RAVE consortium, an international collaboration to obtain spectra of many thousands of stars in our Galaxy, but it is still managed and operated by the AAO.

I end by noting some other very significant changes. A number of long-serving staff members, some of whom have worked at the AAO since observing began have retired or moved to other positions over the last year: Peter Gillingham has retired after many years of telescope and instrument development; Frank Freeman has retired after 27 years and many hundreds of nights; Joan Wilcox has retired as Executive Officer and Jeremy Bailey has moved full time to Macquarie University. To all the staff who have left in the last year we say farewell and thank you. The Board too has seen some changes; Profs Ron Ekers and Mark Birkinshaw have rotated off, and Brian Schmidt and Mike Irwin have joined, while Neville Legg has been appointed as Executive Officer.

Anglo-Australian Telescope Board 30 June 2005

Appointed by the UK Government

Chair
Dr P Roche, Reader, Department of Astrophysics, Oxford University; appointed 1 January 2003 till 31 December 2006

Dr M Irwin, Director, Cambridge Astronomical Survey Unit, Institute of Astronomy, University of Cambridge; appointed 1 January 2005 till 31 December 2007

Mr G Brooks, Head of Astronomy Division, Particle Physics and Astronomy Research Council; (Indefinite appointment)

Appointed by the Australian Government

Deputy Chair
Professor W Couch, Head, School of Physics, University of New South Wales; appointed 5 November 2004 till 4 November 2006

Dr B Schmidt, ARC Professorial Fellow, Research School of Astronomy and Astrophysics, Australian National University; appointed 1 January 2005 till 31 December 2006

Mr G Harper Deputy CEO, Australian Research Council; appointed 5 November 2004 till 4 November 2006

Photos: Stuart Bebb (Physics Photographic Unit, Oxford)