How the US influenced Mount Stromlo

Ragbir Bhathal continues the story of Australia's Mt Stromlo Observatory, charting the role of US astronomers in establishing it as a world-class institution.

In the early years of its existence, British influence was key to the establishment and running of Mount Stromlo Observatory (see Bhathal 2014, last issue). But with the departure of Richard Woolley as director in 1957, the imperial influence slowly declined. It was during Woolley's tenure that the American influence began, with the arrival of Gerald Kron and Olin Eggen from the Lick Observatory on extended visits beginning in 1951. They brought up-to date instrumentation (photometers) and new ideas, such as Baade's work on stellar populations and its implications for the chemical and dynamical evolution of galaxies. Their arrival marked the beginning of photoelectric photometry as a major research programme at Mount Stromlo. Standards for photometric systems became an area of intensive study in the 1970s by Mike Bessell, who was to become an international authority (Bessell 2005). The development of instrumentation by the Americans who went to work there became one of the mainstays of the observatory.

According to Harvey Butcher (2014), a former director of the observatory: "The mindset, at least among Australian government and most Australian academics, does not value engineering and technology enough to invest adequately to really advance the observational art independently … So here one has to get advanced technologies from overseas … In any case, our astronomical community does seem to want to join foreign projects rather than develop its own."

Historian Daniel Boorstin (1987) believes that geographical distance from Britain and the frontier were conducive to invention and innovation in America. But that distance did not have a similar effect in Australia, at least in the early days. It remained a cultural outpost of the British Empire, accepting, for example, the British offer to help pay for the Anglo-Australian Telescope rather than going it alone.

1: Under the guidance of director Bart Bok, the International graduate school at Mount Stromlo Observatory became a great success. (National Library of Australia)

One of the early beneficiaries of the American influence was Ben Gascoigne. Kron had brought his Lick photometer and, with Gascoigne, established the first red and near-infrared photoelectric magnitudes in the southern hemisphere (Kron *et al.* 1953a,b, 1957). Gascoigne's collaboration with Kron led to new insights into the nature and properties of the Magellanic Clouds. In particular, they found that the distances of the Clouds and the extra-galactic distance scale had been under-represented by a factor of two. According to Kron, "Gascoigne and I found the so-called blue Cepheids in the Small Cloud and that caused a real flap in the astronomical world," (De Vorkin 1978). Gascoigne wrote: "This work … established lines of work which have been followed at Mount Stromlo ever since," (Gascoigne 1984).

"Bok released the first photograph of Sputnik and became the public face of astronomy"

Leaning towards the US

With the departure of Woolley, the Australian National University was left to decide who to appoint as the next director of the observatory. This time, it did not turn to Britain, but to the US.

New director Bart Bok arrived at Mount Stromlo Observatory from Harvard University in March 1957. His arrival marked a turning point in Mount Stromlo's programmes, in its profile in international astronomy, and in its relations with the Australian government and public. Bok, with his wife Priscilla Bok, established a very successful international graduate school along the lines of Harvard University. There were hopes that the observatory would help the ANU become the Harvard of the Southern Hemisphere. John Whiteoak, one of Bok's students, wrote: "Bok was their Godfather and they were trained to become scientists in Bok's own image," (Whiteoak 1984).

Bok established Siding Spring Mountain as the site for Australia's major astronomical facilities. He released the first photograph of Sputnik (1957) as it passed overhead and became the only astronomer in Australia to address both Houses of Parliament and to have the ear of the prime minister (De Vorkin 1978). He became the public face of Australian astronomy. He also brought the observatory international attention by organizing the first symposium on the Milky Way at Stromlo in 1963. The IAU and the URSI symposium on "The Galaxy and the Magellanic Clouds" attracted well-known American astronomers such as Maarten Schmidt, Halton Arp and Olin Eggen from Mount Wilson and Palomar, and Jan Oort from Leiden.

Gascoigne also benefited from the Bok years. An expensive photometer bought from funds provided by Bok, Gascoigne said, "enabled [Gascoigne] to study Cepheid stars to find the distance to the Magellanic Clouds. The photometer really made me," (Bhathal 1996). Alex Rodgers, Colin Campbell and John Whiteoak published an *Atlas of H-α Emission in the Southern Milky Way*, which became a standard reference.

Bok's directorship of the observatory was highly successful, but ended on a sour note. He was a strong advocate for

2 Director Olin Eggen focused on the intellectual and instrumental work of the observatory, ramping up the output of papers, especially in US publications. (Mount Stromlo Archives)

3 Institute of Scientific Information 2001 Citation Laureates, from left to right: Jeremy Mould, Michael Dopita, Ken Freeman, Mike Bessell, Bruce Peterson and Matthew Colless. (Mount Stromlo Archives)

the establishment of the Anglo-Australian Observatory (AAO) at Siding Spring Mountain. His vigorous advocacy for the AAO came into direct conflict with the British establishment in the Australian Academy of Science led by president (Sir) Thomas Cherry. According to Bok, Cherry wrote to him: "You should realize that you have outlived your usefulness to our country, and the sooner you go back to where you came from, the better it will be for all concerned," (De Vorkin 1978). In March 1966, Bok left Mount Stromlo Observatory to join the University of Arizona where a future Nobel Prize winner from Stromlo, Brian Schmidt, was to spend his undergraduate days.

Olin Eggen succeeded Bok in 1966, continuing the US influence. He came to the observatory after having written with Donald Lynden-Bell and Allan Sandage their influential paper on galaxy formation (Eggen *et al.* 1962). Rather than chasing new and larger telescopes, he built up the intellectual and instrumental capacity of the observatory. During his years the number of papers published per year jumped from 18 to 44 and continued to rise. There was also a shift away from publishing papers in British and European journals.

As director, Eggen appointed Ken Freeman, Mike Bessell, Don Faulkner, Harry Hyland, John Norris, Bruce Peterson, Agris Kalnajs, Mike Dopita, Peter Wood and Natarajan Visvanathan – an extraordinary group of highly productive astronomers. They raised the profile of the observatory by publishing significant papers mainly in American journals. Freeman, especially, was a beneficiary of the American presence at the observatory. "My career got a great boost from working with Allan Sandage here in 1969," he noted. "Sandage became a mentor and a patron and really helped my career greatly through his support," (Bhathal 1996).

On the instrument front, Kent Ford from the Carnegie Institution of Washington developed a new image-tube spectrograph for the 1.9 m telescope. Another new arrival from America was young Harvey Butcher, who had come to the observatory on the recommendation of Sandage. With Bessell and Alex Rodgers he put together in the Coude one of the first high-resolution echelle spectrographs in astronomy (Butcher 1975). It was also during the Eggen years that heavy-element enrichment processes in the formation and evolution of galaxies led to the active involvement of Bessell, Freeman, Norris and Rodgers in this area. Abundance analysis became and continues to be a core activity.

"American influence surfaced once again with the MACHO project"

Australian interlude

When Eggen left, Australians Don Mathewson (1979–1986), Alex Rodgers (1992–1993) then Jeremy Mould (1993–2001) took charge. Mathewson, a "true blue Aussie", brought the observatory international prestige with his discovery of the Magellanic Stream. He was also an astronomical entrepreneur par excellence, responsible for building the highly innovative alt-azimuth Advanced Technology Telescope in a building which rotated with the telescope. Mathewson was succeeded by Alex Rodgers, an instrumentalist who enjoyed nothing more than spending time in the workshop. He designed and built a double-beam spectrograph and imager for the 2.3 m telescope at Siding Spring. He was also responsible for moving the observatory into the electronic era by designing and constructing photon-counting arrays – following US designs. He had the vision of building a 14 m telescope to challenge the US dominance of astronomy, but it never came to fruition.

Advanced US instrumentation

With Rodgers in charge, American influence once again surfaced with the MACHO project, on which Rodgers worked with American astronomers Charles Alcock and Chris Stubbs to try to solve the dark matter problem. In fact, John Bahcall from the Institute of Advanced Studies in Princeton gave Freeman the credit as being "the first person in print to say this was actually a problem" within galaxies (Bhathal 1996, Freeman 1970). According to Alcock: "Rodgers clearly recognized the potential for MACHO to be very important and he acted on this judgement decisively. He did it at a career stage when most of our colleagues are much more risk averse," (Freeman 1997). The Americans brought new advanced instrumentation to the observatory for the project. Stubbs built the detector which was one of the first cameras to use mosaic CCDs. The Australian team consisted of Freeman, Bruce Peterson, Peter Quinn and Alex Rodgers. The observatory again hit the headlines of international astronomy when the first-year observations of the MACHO project made the front page of *Nature*. However, the problem of dark matter remains.

Big science

The years from 1993 to 2001 were crucial for the emergence of the observatory as a player in the international astronomical stakes, under the directorship of Jeremy Mould. He had spent 18 years in the US after completing his PhD at Mount Stromlo Observatory and brought the "big science" culture to the observatory and to

Brian Schmidt won the Nobel Prize for Physics in 2011, cementing Stromlo's international reputation. (Belinda Pratten)

Director Penny Sackett steered the observatory towards a new beginning: the decision to join the Great Magellan Telescope Project was her visionary decision. (Mount Stromlo Archives)

Ninth director Harvey Butcher will be remembered for achieving full participation of Mount Stromlo Observatory in the International Giant Magellan Telescope project. (Rood/Uni. Virginia)

Australian astronomy. He was unsuccessful in his bid for Australia to join the European Southern Observatory, but was able to secure 4.76% of the observing time on the twin 8.1 m telescopes of the Gemini Observatory for Australian astronomers. By the early 1990s, the observatory had an exceptionally strong team of internationally recognized astronomers, including Freeman, Mike Dopita, Bessell, Peterson, Matthew Colless and Mould himself. This group of astronomers were recognized in 2001 as Citation Laureates by the Institute of Scientific Information. Freeman went on to be recognized by the award of the prestigious Henry Norris Russell Lecture by the American Astronomical Society and in 2014 the Gruber Cosmology Prize.

Three major discoveries and programmes propelled the observatory to the forefront of international astronomy. Mould's collaboration with American astronomers to determine the value of the Hubble constant and the age of the universe was one – truly big science. Mould was co-leader of the team with American astronomers Wendy Freedman and Rob Kennicutt; they produced a value for the Hubble Constant of 72 (±10%) (Freedman *et al.* 2001). Almost two-thirds of the team were from America; Mould was the only Australian.

Using redshift surveys of galaxies, Geller & Huchra (1989) were the first to show large-scale structure in the universe. Matthew Colless followed this up with an international team (mainly British and Australian) to produce the 2dF Galaxy Redshift Survey, one of the largest surveys undertaken of its time (Peacock *et al.* 2001).

American influence returned in the form of Brian Schmidt – in a big way. On arrival at Mount Stromlo Observatory in 1995 at the age of 27, Schmidt formed the international High-Z Supernova Search Team. It was big science and a large-scale international collaboration including Americans, Europeans and Chileans. In 1998, Schmidt and his colleagues announced their result that the universe is accelerating (Garnavich *et al.* 1998, Riess 1998, Schmidt *et al.* 1998). Schmidt and his American colleague Adam Riess won the 2011 Nobel Prize for Physics. The award secured Stromlo's international reputation.

When Mould left the observatory, the American influence continued with the arrival of Penny Sackett in 2002, then Harvey Butcher in 2007. They gave the observatory a grand vision. Sackett had to rebuild the observatory after the devastating fire in 2003. She rebuilt the observatory from ground zero, calling on the American frontier spirit to overcome adversity. She involved the observatory in the Great Magellan Telescope (GMT) project, a far-reaching step for the future of the observatory and Australian optical astronomy.

As part of the rebuild, she supported Brian Schmidt's highly innovative SkyMapper, a 1.35 m very wide field telescope with a 268-megapixel digital camera. Its goal is to map the southern sky to discover new transient sources and other rare objects. The Wide Field Spectrograph initiated by Mike Dopita (Dopita *et al.* 2010) was also designed and built at the observatory to operate on the 2.3 m telescope.

Butcher was familiar with large projects, having himself been involved in the design phases of the ESO VLT and LOFAR. He obtained full financial and technological participation of the observatory in the GMT. This was Sackett's and Butcher's legacy to the Australian astronomical community, fulfilling original director Duffield's dream: "It is my earnest desire that we should take our place among the great observatories of the world," (Duffield 1996).

To the future

In 2013, Matthew Colless was appointed the new director. The observatory is back in Australian hands and looks forward to a new and exciting future. The days of imperial science and being on the periphery have long been forgotten. The new generation of Australian astronomers has hardly an inkling of this period in the affairs of the observatory. Today, the observatory is a significant player and contributor to international astronomy. ●

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REFERENCES

Bessel M 2005 *Ann. Rev. Astron. & Astroph.* **43** 293
Bhathal R 1996 *Australian Astronomers: Achievements at the Frontiers of Astronomy* (National Library of Australia, Canberra)
Bhathal R 2014 *Astron. & Geophys.* **55** 6.33
Boorstin D J 1987 *Hidden History: Exploring Our Past* (Harper and Row, New York)
Butcher H R 1975 *Pub. Ast. Soc. Aus.* **2** 21
Butcher H R 2014 Email to Ragbir Bhathal dated 25 July 2014
De Veridin D 1978 Interviews with Bok (17 May) and Kron (20 May) in Steward Observatory and Flagstaff, Arizona respectively (Am. Ins. Phy.)
Dopita M et al. 2010 *Ast. & Sp. Sci.* **327** 245
Duffield J D 1996 *Recollections of an astronomer's daughter* (Duffield Papers, Aus. Acad. Sci.)
Eggen O J, Lynden-Bell D & Sandage A R 1962 *Astrophys. J.* **136** 748
Freedman W L et al. 2001 *Astrophys. J.* **553** 47
Freeman K C 1970 *Astrophys. J.* **160** 811
Freeman K C 1997 Eulogy for Alex W Rodgers, 16 October (Ken Freeman Collection)
Garnavich P M et al. 1998 *Astrophys. J.* **493** L53
Gascoigne S C B 1984 *Proc. Ast. Soc. Aus.* **5(4)** 397
Geller M & Huchra J 1989 *Science* **246(4932)** 857
Kron G E et al. 1953a *Astrophys. J.* **118** 502
Kron G E et al. 1953b *Astrophys. J.* **118** 511
Kron G E et al. 1957 *Astron. J.* **62** 205
Peacock J A et al. 2001 *Nature* **410 (6825)** 169
Riess A G 1998 *Astron. J.* **116** 1009
Schmidt B et al. 1998 *Astrophys. J.* **507** 46
Whitford J B 1984 *Pub. Ast. Soc. Aus.* **5(4)** 608