Departments of the Research School

# Astronomy

The story of the rather lengthy transfer of the Commonwealth Observatory on Mt Stromlo to a Department of Astronomy in the Research School of Physical Sciences has been told by Susan Davies in an article in the journal *Historical Records of Australian Science* (volume 6, number 1). The department left the School to become a separate reporting unit of the ANU in January 1986. Major instrument developments and selected highlights from the department's enviable research record during the intervening years are outlined below.

**Instrumental Developments**

Establishment of Siding Spring Observatory (SSO), 1958-64:

The development of an alternative field observing station for the Mt Stromlo Observatory (MSO) became necessary because of the poor rate of clear weather at Mt Stromlo, where only 30% of nights are clear of cloud. MSO began a national site-testing program to find a good site in eastern Australia for its field station and to find the best site nationally for the mooted 4m Anglo-Australian Telescope (AAT). Siding Spring was chosen for a 40-inch telescope, and later the Anglo-Australian telescope was also placed there. SSO is clear about 60% of the time.

The Anglo-Australian Telescope, 1964-72:

During this period, MSO contributed substantially to the collaboration team building the AAT; for example, four to five staff worked full-time on design issues. However, the bid by MSO and its Director to have the AAT controlled by MSO created divisions between Australian astronomers and within the Research School of Physical Sciences, and the bid failed. The AAT became autonomous on Siding Spring, with headquarters in Sydney.

The STARLAB project, 1979-83:

This project arose as a US-Canada-Australian project to put into orbit a Shuttle-launched 40-inch telescope with comprehensive imaging and spectroscopic facilities. The MSO input was crucial as it had the best detector system available at the time, developed in-house; the engineering team subsequently became the AUSPACE space engineering company. The project failed through a budget blowout, however; it was costed at about $M450 and the Canadian government pulled out. Inherently, the STARLAB project was valuable because it was equipped to work over a wide range of the research interests of Australian astronomers and gave lasting interactions with space astronomers in the USA. About four academic and ten technical people from MSO worked for four years on the program.

Construction of 2.3m telescope at SSO, 1981-85:

The most important development for MSO since the establishment of Siding Spring came with ANU funding of the 2.3m telescope. The telescope was big enough to be competitive with the 4m telescopes around the world, and it has made a great contribution to Australian astronomy. The engineering was done in-house and produced a telescope that is very

▻ *Mount Stromlo Observatory (June 1957).*

◅ *Richard Woolley, the foundation head of Astronomy (1950-1956) with the Astronomer Royal Sir Harold Jones at the right (1947).*

▽ *Siding Spring Observatory after completion of the buildings for the 16" and 40" reflector telescopes (1963).*

efficient in operation and in throughput. It has an optical design that allows low background operation in the near infra-red wavelength region and that ensures its productiveness for many years to come.

**Research Highlights**

1955 — de Vaucouleurs measured the surface brightness profiles of elliptical galaxies using the 30 inch telescope on Mt Stromlo and found that they could all be described by the one relation, i.e. $SB \sim r^{-1/4}$. This power law has been shown to reflect the rapid relaxation towards dynamic equilibrium in the formation of elliptical galaxies and has had a profound influence on work on elliptical galaxies since then.

1958 — S.C.B. Gascoigne made a major contribution to understanding the formation history of the Magellanic Clouds through his photometry of star clusters in these galaxies. He found that the old globular clusters were outnumbered by clusters that had ages that were only half the canonical 15Gy age of the Galaxy. The much more uniform star formation rate of the Magellanic clusters was finally found to be the result of the continual tidal shocking as these galaxies have orbited the Milky Way over the last 15Gy.

1971 — Our own galaxy, like many others, is a saucer-shaped disc, with circular stellar orbits. K.C. Freeman found that there was a universal dependence of surface brightness in such discs on the distance from the galactic centre, which took the form of an exponential decrease. Additionally, the projected central surface brightness of all spiral galaxies was found to be the same, independent of their total brightness. No real explanation of these results has yet been found, and the data have generated a large amount of modelling of the dissipative collapse in disc formation and critical analysis of the selection effects present in disc galaxy surveys.

1974 — The Magellanic clouds are satellite galaxies of the Milky Way. They are very rich in atomic hydrogen, which is detectable at GigaHertz frequencies by radio telescopes. D.S. Mathewson found that associated with them is a large loop of neutral atomic hydrogen that lies on a great circle passing through the Clouds and the Galactic nucleus (see figure). The velocities of the gas in the Magellanic Stream indicate that gas has been stripped tidally from the Clouds as they orbit the Galaxy. The Magellanic Stream has been crucial to the determination of the orbits of the Clouds and has given much data on the gravitational potential of the outer Galaxy.

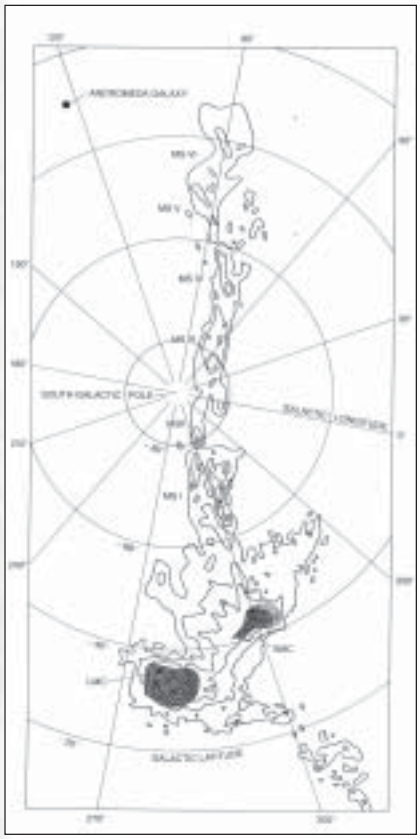
1975 — The sites of star formation in the Galaxy are frequently hidden because of the presence of concentrations of interstellar dust grains around the star-forming objects. M.A. Dopita found that in

such objects the excitation of gas emission in these dust cocoons was largely due to shock heating of the gas in highly turbulent environments. This discovery has led to the idea of strong dissipative cooling of the star-forming clouds, which allows rapid transfer of the angular momentum of the clouds to their outskirts and to the formation of stars. The observations of these objects has transformed notions of the conditions and processes that are dominant in star-forming regions.

1980 —The outer regions of the Galaxy, the Galactic halo, are generally composed of the oldest (~ 15Gy) stars and clusters in the Galaxy. They have compositions which are far weaker in metals than the stars in the solar neighbourhood, and motions that do not reflect the high angular momentum of the nearby disc of the Galaxy. A.W. Rodgers found that there was nevertheless a population of young solar composition stars with similar kinematics to the halo stars. He concluded that they were formed by the collision of a gas-rich satellite galaxy, similar to the Magellanic Clouds, with the Galactic disc. The ideas of disc galaxies growing by the accretion of satellites, and even the formation of elliptical galaxies as the products of the accretion of disc galaxies, is now central to modern cosmogony.

1985 — There are two main types of galaxies, elliptical and disc-like: elliptical galaxies were long thought to have less spin and to have formed stars in a rapid non-dissipative collapse of the proto-galactic cloud, while disc galaxies were of high spin and formed stars in slow dissipative time scales. P.J. Quinn examined the faint outer light distributions of nearby elliptical galaxies and found that many of these showed faint arcs, shells and ripples centered on the galaxy. By dynamic modelling of self-gravitating systems, he was able to show that these structures arise as a result of the merger of two galaxies. Since then, it has become apparent that most elliptical galaxies are the result of these merging processes, sometimes leaving shell structures and other clues to the merging process. The likely fate of the Milky Way is to become part of an elliptical galaxy following our collision with the Andromeda galaxy!

***Alex Rodgers***



*A contour plot of the distribution of neutral hydrogen that follows a great circle path. The shaded areas indicate the optical extent of the two magellanic clouds (LMC & SMC).*

*Christmas Lawn Party at the Bok's (1959). Bart Bok is the second on the right in the foreground group. Mark Oliphant is chatting with Ted Dunham, and Rosa Oliphant is at third left.*