# Andrew David Thackeray at the Radcliffe Observatory

I.S. Glass
South African Astronomical Observatory
and Centre for Astronomy, James Cook University,
Townsville, Queensland, Australia
e-mail: isg@saao.ac.za

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Though established in the nineteen-thirties, the Radcliffe Observatory in Pretoria was only able to make use of its main instrument from 1948 onwards. At the start of this period, Andrew David Thackeray was appointed Chief Assistant. In 1950 he became the Radcliffe Observer, in which post he remained until the closure of the establishment in 1974. For these twenty-four years he directed its science and was responsible for many of its most interesting achievements. In this year, the International Year of Astronomy, it is appropriate to remind ourselves of his important contributions to the field.

Key words: Andrew David Thackeray, Radcliffe Observatory, Pretoria

## 1 Origins of the Observatory

The Radcliffe Observatory was founded in Oxford in 1771 by the trustees of the legacy of Dr John Radcliffe (1652?-1714), a highly successful medical practioner in London. His name is also associated with the Radcliffe Camera and the Radcliffe Infirmary. The first Radcliffe observatory, which existed for a century and a half, was devoted in the main to positional astronomy (Thackeray, 1972).

In 1924 Harold Knox-Shaw (1885-1970) became the Radcliffe Observer. With an interest in astrophysics and, having worked in Egypt, he campaigned successfully for a move to a better site. The southern hemisphere was the obvious choice as the southern sky contains several of the most important objects of interest to astronomers: the centre of our own galaxy, the Milky Way, which passes overhead at about 29 degrees south latitude, and the Magellanic Clouds, the nearest external galaxies. The latter provide samples of stars at equal (and welldefined) distances from us; they are of extreme importance in evolutionary

Figure 1: The turret housing the 74-inch telesope in Pretoria (photograph SAAO archives).

studies and as stepping stones in the cosmic distance scale. It was clear to him that a large telescope in the southern hemisphere, operated efficiently, might yield important new insights.

## 2 The Radcliffe in Pretoria

After some investigation of possible sites, the Waterkloof Ridge in Pretoria was chosen. By 1934 the necessary funds had been raised through the generosity of Lord Nuffield and the Trustees had overcome various legal obstacles placed in their way by Oxford University. Even Albert Einstein had been so ill-advised as to protest against the move! By 1938 a 74-inch (1.9m) telescope (Figure 1) and suitable buildings had been erected in Pretoria but delivery of the main mirrors was delayed until 1948 (Glass, 1989).

The 74-inch reflecting telescope was to be for a few years the largest in the Southern hemisphere and the joint 5th largest in the World. Unfortunately, it lacked proper accessory instruments, direct photography being the sole technique available during its first year of operation. Only in 1951 did an up-to-date spectrograph become available.

In its earlier years the Observatory was seriously under-funded. In 1951, the situation was alleviated by an agreement with the UK Admiralty by which one-third of the observing time was allocated to their South African establishment, the Royal Observatory, Cape, in exchange for an annual grant. This led to

Figure 2: Andrew David Thackeray (Photograph: Martin Gibbs).

an improved infrastructure and a degree of technical support. In addition, a number of temporary assistants could be engaged, some seconded from the Royal Greenwich Observatory. In 1967 the UK Science Research Council (SRC) took over the operation of the Observatory, with 50% of the observing time going to visiting British astronomers and the remainder to the resident staff. Many other astronomers from around the world visited and made observations from time to time. Several of the young astronomers who spent time at the Radcliffe went on to play leading parts in South African astronomy.

## 3 Andrew David Thackeray (1910-1978)

For most of its productive years in Pretoria (1948-1974), Andrew David Thackeray (Figure 2) was the director of the Radcliffe Observatory (Radcliffe Observer). He was born in Chelsea, London, on 19 June 1910 and was educated at Eton and King's College, Cambridge. As a youngster an interest in astronomy had been stimulated by his uncle, the solar astronomer John Evershed, and his aunt, Mindie Orr, the writer of a popular book on stars of the southern hemisphere.

His research career started at the Solar Physics Laboratory in Cambridge. While working towards a PhD, he spent two years (1934-6) at the Mount Wilson Observatory in California, USA, where he was exposed to the ethos and methods of what was then the most productive astrophysical observatory in the world. His thesis, in theoretical stellar spectroscopy, concerned a Bowen-type fluorescence mechanism operating in Mira variable stars. Following his Cambridge PhD in 1937, he worked at the Solar Physics Laboratory where he interacted with his mentor Arthur Eddington until his death in 1944 (see e.g., Feast, 1979).

Thackeray was appointed Chief Assistant of the Radcliffe in 1948. He succeeded Knox-Shaw as Radcliffe Observer in 1950, following the latter's retirement. The only other astronomer on the staff at the time was David Stanley Evans (1916-2004), the Second Assistant. Following the appointment of Michael William Feast (1926 - ) as Chief Assistant in 1951, Evans left for the Royal Observatory in Cape Town and was replaced by Adriaan Jan Wesselink (1909-1995).

On arrival in Pretoria, Thackeray, like most of the other scientific staff, resided in an official house in the Observatory enclave. The very small operating budget of the institution had at least one positive effect, namely that administrative affairs were kept to a minimum. In its corridors, enthusiastic discussions of scientific matters were quite the norm. Though he could be rather conservative in his comments on papers produced by his colleagues, Thackeray's judgment was regarded as thoroughly sound.

# 4 Direct photography

Thackeray soon found he had almost unlimited time on the 74-inch, the only other observer at first being Evans. Somewhat at a loss for programmes that were suited to his limited equipment, he made contact with a former Mt. Wilson colleague, Walter Baade, who, during the Second World War, had become perhaps the world's leading astrophysicist with his discovery of different 'Stellar Populations', a manifestation of the age, chemical composition and kinematical behaviour of stellar systems. This led to a study of globular clusters in the Magellanic Clouds to determine whether they were similar to those in the Milky Way or more like the latter galaxy's open clusters (Feast, 2000). It was, in fact an inspired choice of programme that made full use of the large size of this telescope.

The Magellanic cluster programme soon led to others that were also of great interest. In determining the distances of galaxies, certain types of easily recognisable variable stars play a crucial role. Early workers had assumed that all pulsating variables of the class called Cepheids were of identical intrinsic luminosity if their periods were the same. By 1948, the suspicion had arisen that this might not be true if they belonged to different Baade populations. A number of anomalies were beginning to disturb the received picture that had been established in the 1930s. Another type of pulsating variable, the RR Lyraes, with periods around 12 hours, seemed to be better defined and to belong to a single population only. Though they were promising as distance indicators, they were much fainter than Cepheids and therefore harder to detect in other galaxies.

In 1952, Baade announced at the International Astronomical Union meeting in Rome that the distance of the Andromeda Galaxy had to be about twice the accepted value because he had been unable to detect RR Lyrae variables there, even using the newly completed 200-inch telescope on Mt. Palomar. Either the calibration of the Cepheids or that of the RR Lyraes had therefore to be in error. Indirect evidence suggested that the problem lay with the former. Thackeray was able to follow his paper with the spectacular announcement that he had in fact detected them at the expected level in a cluster (NGC 121) of the Small Magellanic Cloud. This work had been carried out in collaboration with Wesselink and in their subsequent publication (Thackeray and Wesselink 1953) they were able to announce that RR Lyraes had also been found in the Large Magellanic Cloud. The implication of this result was that all galaxies were actually twice as far away as had been calculated by Lematre, Hubble and others. In popular terms, the size of the Universe was now double its previous value (Oosterhoff, 1954) [In subsequent years, many of Hubble's distances have been further increased by a factor of 3.5].

Thackeray later determined that the variable stars of the Sculptor dwarf galaxy are of RR Lyrae type, confirming Baade's classification of this system as pure' Population II (old and weak in heavy elements).

Also associated with the name of Thackeray are 'Thackeray's Globules', small regions of high extinction that are seen against the bright HII region IC 2944 (Thackeray, 1950). They are fine examples of a phenomenon first observed by the Harvard astronomer, Bart J. Bok, in 1947. An image of them, taken by the Hubble Space Telescope, is shown in Figure 3.

Thackeray began other noteworthy photographic programmes designed to find variable stars in parts of the Magellanic Clouds and in some relatively unobscured fields near the centre of our own galaxy. In one of the latter, Sergei Gaposchkin (Harvard) had found a number of RR Lyrae and some shorter-period Mira variables. Thackeray's initiative was afterwards continued by others, particularly Tom Lloyd Evans, who increased its usefulness by taking in addition near-infrared (I-band) plates. This programme resulted in the discovery of a number of Miras in the Magellanic Clouds and many more in the Baade's Window clear fields (Lloyd Evans, 1976). Later, infrared observations of the LMC sample by Glass and Lloyd Evans (1989) led to the establishment of the first satisfactory period-luminosity relation for Mira variables.

# 5 Medium-resolution Spectroscopy

The main auxiliary instrument of the 74-inch telescope was a Cassegrain two-prism spectrograph which made its appearance in early 1951. In the 1930s, when the decision to move the Radcliffe Observatory was taken, the case for a southern hemisphere location had been made on the basis of studying the southern early-type (hot) stars to flesh out similar surveys made in the north. A great deal of the observing time and effort in the first Pretoria decade and

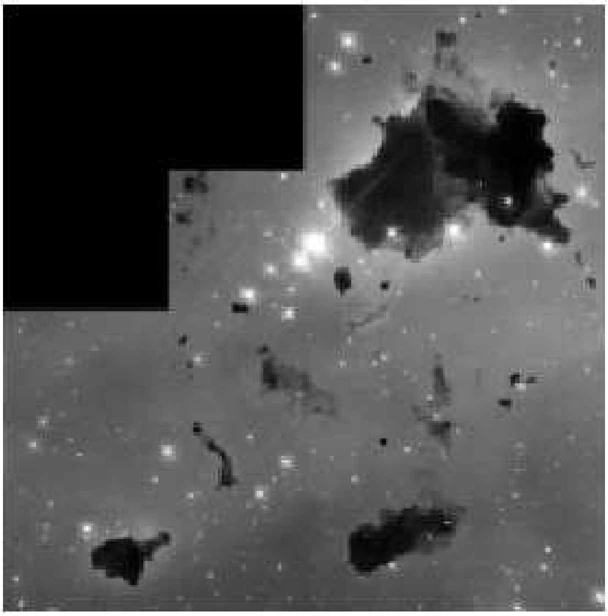

Figure 3: Thackeray's Globules (courtesy NASA/JPL-Caltech).

even later was devoted to this programme, which refined the picture of the Milky Ways spiral arms in our vicinity. This work also yielded the first kinematically-based distance to the Galactic Centre.

A classical study of about 150 bright stars in the Large Magellanic Clouds was carried out by Feast, Thackeray and Wesselink, showing that they possessed extremely high masses of order 50 times solar. In fact, this study established the maximum masses and luminosities attainable by stars. The paper that resulted (Feast, Thackeray and Wesselink, 1960) remains the most frequently-cited output of the Radcliffe Observatory. The stars that they found included supergiants, Be stars and emission-line objects, later identified in the infrared as being of VV Cephei type. Many of the stars described have been investigated individually by later observers.

## 6 High-resolution spectroscopy

Around 1960 a high-resolution coud spectrograph came into use. Thackeray, by training a spectroscopist, made a speciality of deciphering certain Rosetta-stone-like southern objects such as RR Telescopii, a slow nova, and Eta Carinae, a peculiar eruptive variable of high luminosity, both of which are of great interest due to their complex emission lines. Some of the lines were identified for the first time by him. He continued to follow these objects, which are variable, over many years. His papers on them have been cited widely (e.g., Thackeray, 1953, 1967, 1977).

## 7 Later years of the Radcliffe Observatory

Ultraviolet observations became possible in 1959 through the acquisition of a plant for aluminizing the telescope mirrors, which had previously been silvered. The equipment of the observatory was by others further enhanced by the arrival of an image-tube spectrograph (constructed at the Royal Greenwich Observatory) in 1970, allowing fainter objects to be observed with a two-stage image tube (with final registration on photographic plates) or a McGee Electronograph, which accelerated photoelectrons and passed them through a Lenard Window for final recording on nuclear emulsions.

SRC support for the Radcliffe ended in 1974 following the opening of the Anglo-Australian Telescope and the transfer of their funding thereto. The Radcliffe Observatory was then closed and the income of the Foundation was afterwards devoted to "Craft and Music Education". The telescope was sold to the South African CSIR (Council for Scientific and Industrial Research) and moved to Sutherland. The Pretoria site is now occupied by Military Intelligence.

Following the closure of the Radcliffe Observatory, Pretoria, David Thackeray remained on the books of the Radcliffe Foundation and became an honorary professor at the University of Cape Town. He had intended to resume observing with the 74-inch telescope but died unexpectedly in an accident on 21 February 1978 while returning from his first working visit to Sutherland. Had he survived a few more days, he would have seen a letter from the Royal Astronomical Society informing him that he had been elected an Associate of that Society, the first British subject to be so honoured.

## 8 Acknowledgments

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