Proceedings of the ASSA Astronomical Symposium, 1999 March 29–30, South African Museum, Cape Town *

Alexandrian Astronomy

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The advent of a lunar eclipse in April 1996 seemed an opportune time to develop an exercise to calculate the size of, and distance to, the Moon as part of the South African Astronomical Observatory's Science Education Initiative.

This in fact turned out to be a re-discovery of some aspects of early Greek astronomy as practised by astronomers who worked in the Great Library of Alexandria from about 300 BC to about AD 150. Aristarchus used a lunar eclipse to estimate the size of the Moon and later Hipparchus improved on this. The same geometry was again used much later by Copernicus in "De Revolutionibus".

If the size of the Earth is calculated using Eratosthenes method and an eclipse of the Moon is observed/photographed, then the distance to, and the size of, the Moon can be found using some simple equipment, some straight forward geometry, some mathematics, basic trigonometry and a little ingenuity.

[The full text of this paper appears in the *Centrepiece* of this issue.]

Living Inside the Cosmic Egg

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Imagine waking up one morning and finding yourself trapped inside a hollow easter egg! You cannot see out - and you cannot get out. It seems a weird analogy, but, on a cosmological scale, it is true.

Our view of the entire observational universe is a sphere. We are at the centre and the radius is about 15 billion light years. As we look outwards through the sphere, we look back in time. But the sphere is contained within an opaque shell, because the very early universe was opaque, not transparent- as it has been ever since. The shell exists in time, not in place. It is a horizon, not a physical structure. Nevertheless we can never see through it, or go through it. We appear trapped inside this cosmic egg!

* *This is the first instalment in a series of abstracts of papers delivered at the national Symposium. Full versions of available papers appear separately, elsewhere in this issue.*

The inside surface of the egg reveals a snapshot of an almost featureless early universe. The COBE satellite and others have revealed the weakest of fluctuations.

Today, those fluctuations have developed into large-scale structures that form an interconnecting labyrinth. All galaxies appear contained within these large-scale structures. (In the live presentation, a sequence of three-dimensional visualisations of nearby large-scale structures was shown.)

Digital Encoding of Co-ordinates on a German Equatorial Telescope Mount

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A digital system has been designed to replace mechanical setting circles for RA and declination on a German equatorial mount. The system comprises two modules: a Digital Encoding Unit (DEU) and a Display Unit (DU). Angular position and direction of movement of the slow motion controls are sensed by means of two separate shaft encoders with a resolution of 500 pulses per revolution. These signals are processed in the DEU and transmitted to the DU in serial form together with sidereal time information. The DU features a simple key-pad for operator interface and RA and declination are displayed on a 16- digit dot-matrix LCD. Modes of operation of the DU include locating objects in offset and absolute modes, as well as a manual tracking mode for imaging applications. Both modules have been designed around 8-bit microcontrollers, and the DU provides 48 Kbytes of non-volatile memory (Serial EEPROM) for storing co-ordinates of frequently viewed objects.

Relating the Infrared to the Visual Sky

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The Infra Red Astronomy Satellite (IRAS) surveyed almost the entire sky with a 16-inch telescope at wavebands of 12, 25, 60 and 100 microns in 1983. The main results of this American–Dutch–British project were a catalogue of over 200 000 sources, the Point Source Catalog (PSC), and the LRS Catalogue of low resolution spectra of over 5 000 objects. Subsequent processing of the basic data has revealed much additional information on these and other sources.

Most of the optically-bright stars which appear in the PSC have very similar colours constructed from photometry to 25 microns: this corresponds to the Rayleigh-Jeans limit and expresses the fact that stellar photospheres of whatever temperature have similar energy distributions in the mid infrared. A minority, most famously Vega and Beta Pictoris, have excess radiation at 60 and 100 microns which comes from cool dust in circumstellar disks or shells which may be larger than our solar system. Most of the stellar sources in the PSC have much redder colours in the mid infrared and these are mainly long period variable stars. A search for new RV Tauri variables, which have relatively distinctive infrared energy distributions, involved identifying over 1000 sources to find about 12 of the type being sought.

The certain identification of a source becomes difficult for faint stars in crowded regions of the sky. The IRAS positions are generally remarkably good, better than those of many optical catalogues such as those of the variable stars and cool stars which are the primary identifications for the IRAS sources, but confusion between several stars bright in the infrared and the numerous optical stars which fall within the IRAS error circles create ambiguity. The R and I sky survey pairs of photographs, which are unfortunately available only for Milky Way fields, proved invaluable in detecting the red R–I colour which is a signature of TiO absorption in the commonest type of identification, the Mira variables of spectral type M. Several recalcitrant cases, where an optically-invisible star was suspected to have combined with a visible one to create composite infrared colours as seen by IRAS and the 36 arcsecond aperture of the infrared photometer on the 0.75m telescope at Sutherland, have now been satisfactorily resolved into two images using the new PICNIC camera which Ian Glass constructed to work at wavelengths of 1 - 2 microns on the 0.75m telescope.

POSTER PAPERS

The Visual Light Curve of R Lep

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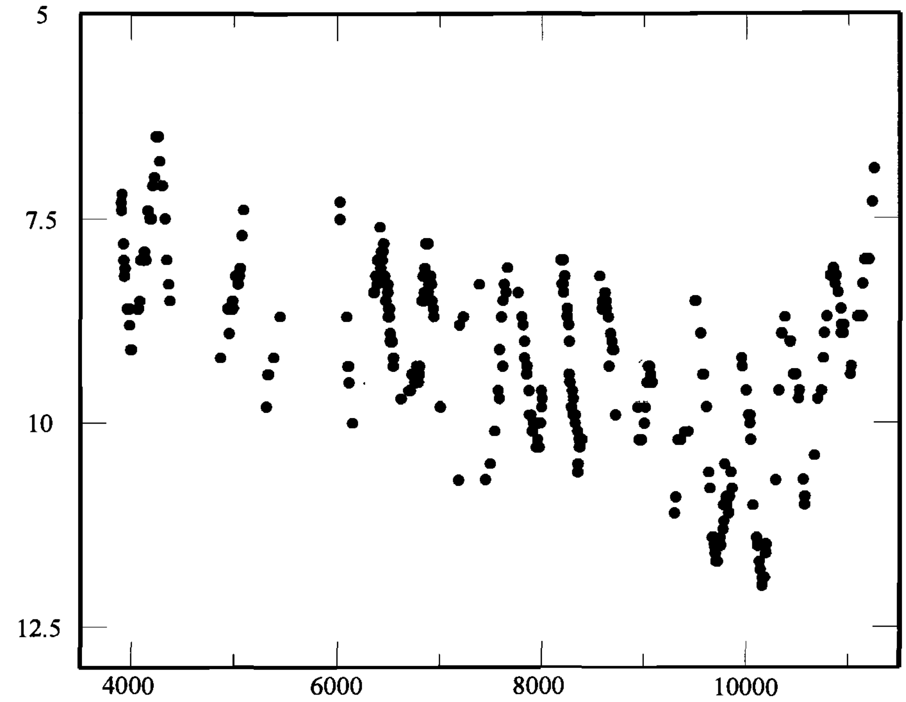
The visual light curve of R Lep, obtained principally by amateur astronomers working for the AAVSO, shows typical LPV variations with superimposed fading episodes at intervals of about 50 years when the 420 day period persists but the whole light curve is fainter by 2 mag or more. R Lep had been fading slowly for some years but a sharper deep fading lasted from 1994 to 1998; the 1999 maximum was the brightest for some years. The writer covered this five year period with observations using a 6-inch reflector at his home in Rondebosch. R Lep reached about mag 12 at minimum, beyond the limit of the AAVSO comparison star sequence which was extended by photometry of 3 fainter stars by Francois van Wyk using the 0.5m telescope at Sutherland. Concurrent spectroscopic observations with the 1.9m telescope show that in both R Lep and V Hya, which fades by over 3 mag every 19 years, the normal absorption in the Swan bands of diatomic carbon is replaced by emission. (Lloyd Evans, T. (1997) *MNRAS,* 286, 839)



The visual light curve of R Lep, based on ASSA VSS measures to April 1994 and observations by T. Lloyd Evans from May 1994 to date. TLE used new faint standard stars determined at Sutherland for the faint minima around JD 2450000.