THE OPTICAL SYSTEM OF THE MT JOHN ONE METRE TELESCOPE

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The telescope will be used at the Cassegrain focal plane only. Two interchangeable systems of secondary optics are required to give relative apertures of:

(a) f/13.5 for spectroscopy and photometry over a small field.

(b) f/8 for photography over as wide a field as practicable.

Requirement (a) is met by using a Dall-Kirkham system (Kirkham, 1938), ie the primary mirror is an ellipsoid and the secondary mirror is strictly spherical. The f/8 system uses the same primary mirror, but the secondary mirror is replaced by another which, although spherical, is longer in radius of curvature and closer to the primary mirror. A pair of field correcting lens elements with spherical surfaces is placed between the secondary mirror and the focal plane. This f/8 system closely resembles one first suggested by Wynne (1949; see also Harmer & Wynne (1976) for a detailed design) for use with a paraboloid primary mirror. Schulte (1966) reported that S Rosin had worked out that if the primary mirror is an ellipsoid the correcting lens elements move down to a much more convenient location than in the original Wynne-type system. The Mount John telescope is probably the first to use this modification.

Because the secondary mirrors are spherical, they are much quicker and easier to make and align than those of classical Cassegrain or Ritchey-Chrétien telescopes. The f/13.5 system has a relatively large amount of coma in the images away from the centre of the field. This will restrict the field of apparently good definition to about 12 minutes of arc when the seeing is 4 seconds of arc (very common at Mount John), or to a smaller field when the seeing is unusually good. The photographic f/8 system has fairly uniform definition over a field of 1.6 degrees diameter. Most of the light in each star image falls within a circle of one second of arc diameter. This is not as good an image sharpness as other systems have achieved, but is entirely adequate under the conditions usually found at Mount John and permits the wide field considered of importance in this case.

The material used for the mirrors is "Zerodur" which has a coefficient of thermal expansion very close to zero. This speeds up manufacture by eliminating waiting time for thermal equilibrium before

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testing, and prevents warping of the mirror from temperature changes during observations.

The primary mirror was worked on the machine built by Waland for working the optics of the 15 inch and 30 inch Schmidt-Cassegrain cameras of the University of St Andrews, Dundee, (King, 1955). The grinding tools were faced with square ceramic tile facets stuck down on aluminium alloy bodies with a beeswax and rosin mixture. The fillet of wax around each facet was given a rounded concave profile so that there would be no re-entrant angles where abrasive grains could lodge. The tools performed extremely well.

After coarse grinding, during which the mirror blank was brought to its final shape (apart from figuring), the hole in the primary mirror was trepanned out. The material so removed has been sliced up and test plates for the correcting lenses are being made from it.

During the early stages of figuring, the profile of the mirror was checked by the conventional zonal Foucault test. Once the profile was close to its correct shape a null-testing Offner compensator (Offner, 1978) was inserted. This permitted small irregularities to be seen easily that would have been difficult to detect with the conventional test. The compensator was made from two identical, centrally perforated, concave spherical mirrors facing each other, with their separation established by carefully machined rods.

The working of the primary mirror is described in detail by Nankivell (in press).

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