$$I(0, \mu) = \frac{2\epsilon}{2 - \pi_0(\alpha_0 - \beta_0)} [X(\mu) - Y(\mu)]$$

where ϵ is the constant source function for the emitters, and α_0 and β_0 are respectively the zero moments of the X and Y functions. The X and Y functions are defined with respect to the characteristic function $\Psi = \pi_0/2$. For case (b) the same form is obtained for the solution; however the X and Y functions are defined with respect to the characteristic function

$$\Psi(\mu) = \frac{\pi_0}{2} [1 + x(1 - \pi_0)\mu^2].$$

It is also shown how the exact intensity at any optical depth may be obtained.

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Hossack, W. R. An oscilloscopic microphotometer and plate measuring machine.

An oscilloscopic microphotometer has been designed and built to study stellar spectrograms. Radial velocity and absolute magnitude determinations are being compared with those made by present methods with regard to accuracy, speed, and personal error. The microphotometer has been found useful for the examination of spectral variations and should be usable for accurate spectral photometry.

A Hartmann spectro-comparator¹ has been turned into a projection engine for the project. Two spectrograms are placed in the comparator: one, a standard, in a fixed position; the other, the plate to be measured, in a movable carriage whose position can be obtained from the micrometer screw. An array is projected consisting of two stellar spectra and their two comparison spectra. Scanning is performed by a rotating mirror (60 cycle) which sweeps the array past a slit in front of a 1P21 multiplier phototube. A slotted disc is rotated in front of the slit at quarter speed in order to mask all but one of the four spectra. A different spectrum is let through during each quarter cycle of the disc.

The signal from the 1P21 is fed through amplifiers to an oscilloscope, giving four traces of intensity against wave length upon the screen. Each trace corresponds to 50Å of one of the four spectra. Four amplifiers, cut on and off in a cyclic manner by a ring circuit, give separate vertical positioning and amplification controls for each trace. Frequency response must be high for good response to the narrower spectral lines. Hori-

zontal synchronization is from a separate phototube pulsing from an independent light beam reflected from the rotating mirror.

Tests of the microphotometer are being carried out and results will be forthcoming in a short time. Radial velocity determinations for early-type stars are good and very fast. For examination of spectral variation, the standard plate is replaced by a second one of the varying star. In accurate spectrophotometry, a scan for sensitizer spots is obtained by a suitable motion of the plate in the carriage. Response is linear from the multiplier phototube to the screen.

The author is greatly indebted to the late Dr. F. S. Hogg, who directed the research until his death one year ago. The author wishes to thank the Research Council of Ontario for financial assistance during the research.

1. *Report of the Chief Astronomer 1909*, Department of the Interior, Canada, p. 177.

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Irwin, John B. The direction of rotation of the spiral nebulae.

Suitable short exposures with the 36-inch Goethe Link reflector have made it possible to locate the position of the centers of approximately forty spiral nebulae with nearly astrometrical accuracy. When these positions are transferred to plates of twenty minutes exposure by the usual techniques, it has been discovered that for sixteen spirals the position of the central point is asymmetrically located with respect to the brighter regions of the nucleus. These sixteen spirals are NGC 1068, 2683, 3169, 3190, 3623, 4216, 4258, 4527, 4826, 5005, 7331, 3627, 4565, 4594, 5033 and 5746.

Another feature is also evident in all sixteen cases: one edge of the nucleus is always sharper or less diffuse than the other edge. Four of these sixteen spirals, NGC 3190, 4565, 4594 and 5746, are so nearly edgewise that there is no question as to which is the nearer side; but whether these four are used as controls or not, the evidence is exactly what one would expect it to be under the very reasonable assumption that each nucleus is partially obscured by heavy, sharp-edged absorbing material associated with the spiral arms in, or very close to, the nebular plane.

These two mutually corroborative criteria for the determination of the direction of tilt independently confirm Hubble's criteria.¹ Radial velocity data kindly supplied by Dr. N. U.