All settings of the mirrors have thus far been made by hand, and considerable time is consumed between measures. Two screws are now being mounted on the beam, driven by a single motor, which for any separation will keep the outer mirrors equidistant from the fixed inner mirrors, and thus greatly facilitate the operation of the interferometer.

[1] These PROCEEDINGS, 7, 1921 (143–146).

CHANGES OBSERVED IN THE CRAB NEBULA IN TAURUS

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Changes in the structure of the Crab nebula (N. G. C. 1952, M. 1) have recently been detected by Lampland[1] from a comparison of seventeen photographs made with the 40-inch Lowell reflector during a period of eight years. An excellent negative of this nebula had been made by Ritchey with the 60-inch Mount Wilson reflector, 1909, October 13, using a Seed 27 plate and giving an exposure of three hours with the aperture stopped down to 54 inches. For comparison with this plate, the writer made a negative with the same instrument, 1921, April 7, using full aperture and a Seed 30 plate and giving an exposure of 1 hour 20 minutes. Though the exposure of this plate was necessarily shorter than that of Ritchey's because of the proximity of the object to the sun, the larger aperture and the faster plate made the photograph comparable in density with the earlier one.

The two plates were compared in the stereocomparator, and it was seen at once that changes in the relative luminosity of different parts of the nebula had occurred, particularly in the bright region north-west of the center; and also that certain filaments and condensations had apparently moved, the motion in general being away from the center, though not always exactly along a radius.

Measures in two coördinates were made with the micrometer of the stereocomparator upon twelve nebulous condensations and thirteen comparison stars. The nebulous points chosen are sufficiently symmetrical to permit measures of about equal accuracy in the two directions. They were chosen in the outer, faint parts of the nebula because of the difficulty of seeing isolated points in the bright portions. One comparison star is the north component of the double star that lies near the center of the nebula; each of the others lies near one of the measured nebulous points. The plate constants were derived from the measures of the comparison stars by a least-squares solution; with these constants the motions of the nebulous points were then referred to the mean of the comparison stars.

The resulting displacements of the nebulous points during the $11^1/_2$ year interval are as follows:

Point	$\Delta\alpha$	$\Delta\delta$	Point	$\Delta\alpha$	$\Delta\delta$
1	+0.22	+0.70	7	−0.22	+0.11
2	+0.43	+1.24	8	+0.32	−1.56
3	−1.24	+2.05	9	+1.78	−1.78
4	−1.67	+1.24	10	+2.05	−0.27
5	−1.12	+1.59	11	+1.78	+0.70
6	−2.16	+1.19	12	+1.02	−0.05

The probable error of a measurement of a comparison star is ±0.23 in right ascension and ±0.25 in declination. The points measured and the observed motions are shown in Plate I, in which the lines represent the displacements that would take place in 500 years if the motion should continue at the rate indicated by the measures. The illustration shows at a glance the random distribution of the motions of the stars and the systematic character of those of the nebulous points. The mean displacements, projected upon radii drawn from the estimated center of the nebula are:

For the comparison stars,	−0.06
For the nebulous points,	+1.54

The large positive value for the nebulous points clearly indicates an outward motion, but it would be premature to suppose that this result necessarily applies to the nebula as a whole. There is some indication of a rotation in the counter-clockwise direction, but this can hardly be regarded as trustworthy.

It may be readily shown that, for a displacement of 2″ in the interval between the two plates, the number representing the velocity in kilometers per second would be about one-fourth the number of light-years in the distance of the nebula from the solar system; for example, if the velocity were 25 km./sec. the distance would be 100 light-years. Thus it is necessary to assume neither an extraordinary distance nor an extraordinary velocity in the nebular particles in order to believe that the observed motions are real.

[1] *Harvard Observatory Bulletin, Boston*, No. 743, 1921; *Publications of the Astronomical Society of the Pacific, San Francisco*, **33**, 1921 (79–84).

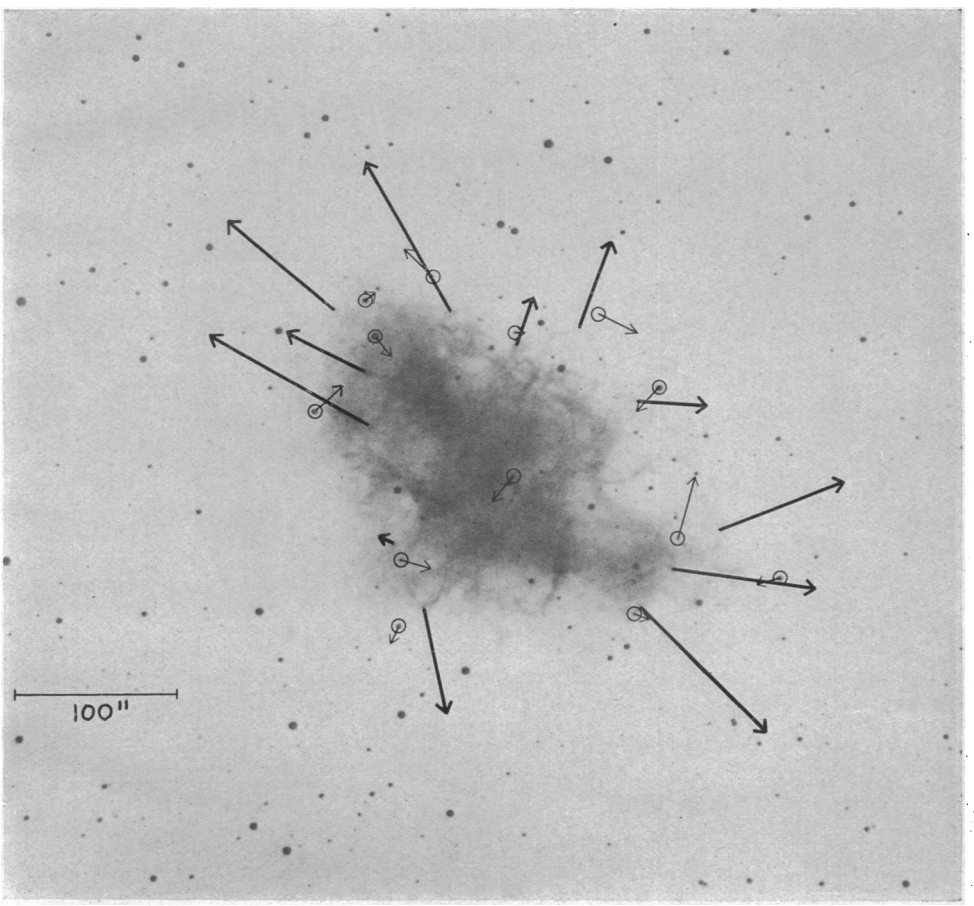

PLATE I