# PRELIMINARY RESULTS OF AN RR LYRAE STAR SURVEY WITH THE LICK 20-INCH ASTROGRAPH*

The RR Lyrae stars, on account of their brightness and characteristic variability, are readily detected at large distances in our Galaxy. Also, since their spectral peculiarities show some correlation with their periods (Preston 1959), information about the distribution of stars of different population types is given by measures of their magnitudes and periods alone. Statistical studies based on the data in the *General Catalogue of Variable Stars* are of limited usefulness because of uncertainties in the photometry and completeness of past surveys. Such considerations led Baade (1955) to propose the Palomar-Groningen variable-star survey, which is largely concerned with exploring the regions near the galactic nucleus. The variable stars in the directions of the galactic poles and the anticenter have, however, received rather little attention since the pioneering surveys of Shapley (1957) to a limiting magnitude of about $m_{pg} = 16$. In these directions the number of RR Lyrae stars is small (of the order of one per square degree brighter than $m_{pg} = 18$), so that a considerable area of the sky must be searched in order to obtain results of statistical significance. The 20-inch Lick astrograph is a suitable instrument for such a survey, combining a wide field with the large image growth with magnitude necessary for detecting small-amplitude variables.

Variables with periods in the range 0.2–0.8 day are conveniently detected photographically if exposures are made at about 3-hour intervals—e.g., with the field 3 hours east, on the meridian, and 3 hours west. It was found to be practicable to put all three exposures on a single plate, shifting the plate about 0.5 mm (or about 30″) between exposures. Sufficiently rigid plateholders were made so that they could be removed from the telescope between exposures and more than one field could be observed each night. Kodak 103*a*-O emulsion on 14 × 14-inch plates (covering 5.5° × 5.5° in the sky) was used, which reaches to about $m_{pg} = 18.5$ in the 30-minute exposures employed. In order to detect the variables, two such three-image plates were examined in the blink-comparator, a more efficient procedure than normal two-image blinking. Figure 1 shows the image variation obtained for a small-amplitude (~0.8 mag.) Bailey type *c* variable of fourteenth magnitude, which was discovered by this method.

Some thirty exposures were made of each of two fields at the north galactic pole in 1961 (see accompanying table). Field 2 is centered on SA 57, for which photoelectric

| | (1960) | |
|---|---|---|
| | $\alpha$ | $\delta$ |
| Field 1 | Center at $12^h16^m.6$ | +33°.7 |
| Field 2 | Center at $13^h06^m.8$ | +29°.6 |

magnitudes have been given by Stebbins, Whitford, and Johnson (1950). Preliminary reduction of both fields has yielded thirty-two variables with mean magnitudes in the range $12 < m_{pg} < 18$, only two of which (TU Com and RR CVn) were known previously. Periods have been found for all but two of these variables; all those with asymmetrical light-curves (Bailey type *ab*) have periods greater than $0^d.44$, in agreement with Preston's (1959) result that those of shorter period belong to a disk population.

Figure 2 shows a plot of the logarithm of the number of RR Lyrae variables per 80 square degrees per unit magnitude interval plotted against apparent photographic mag-

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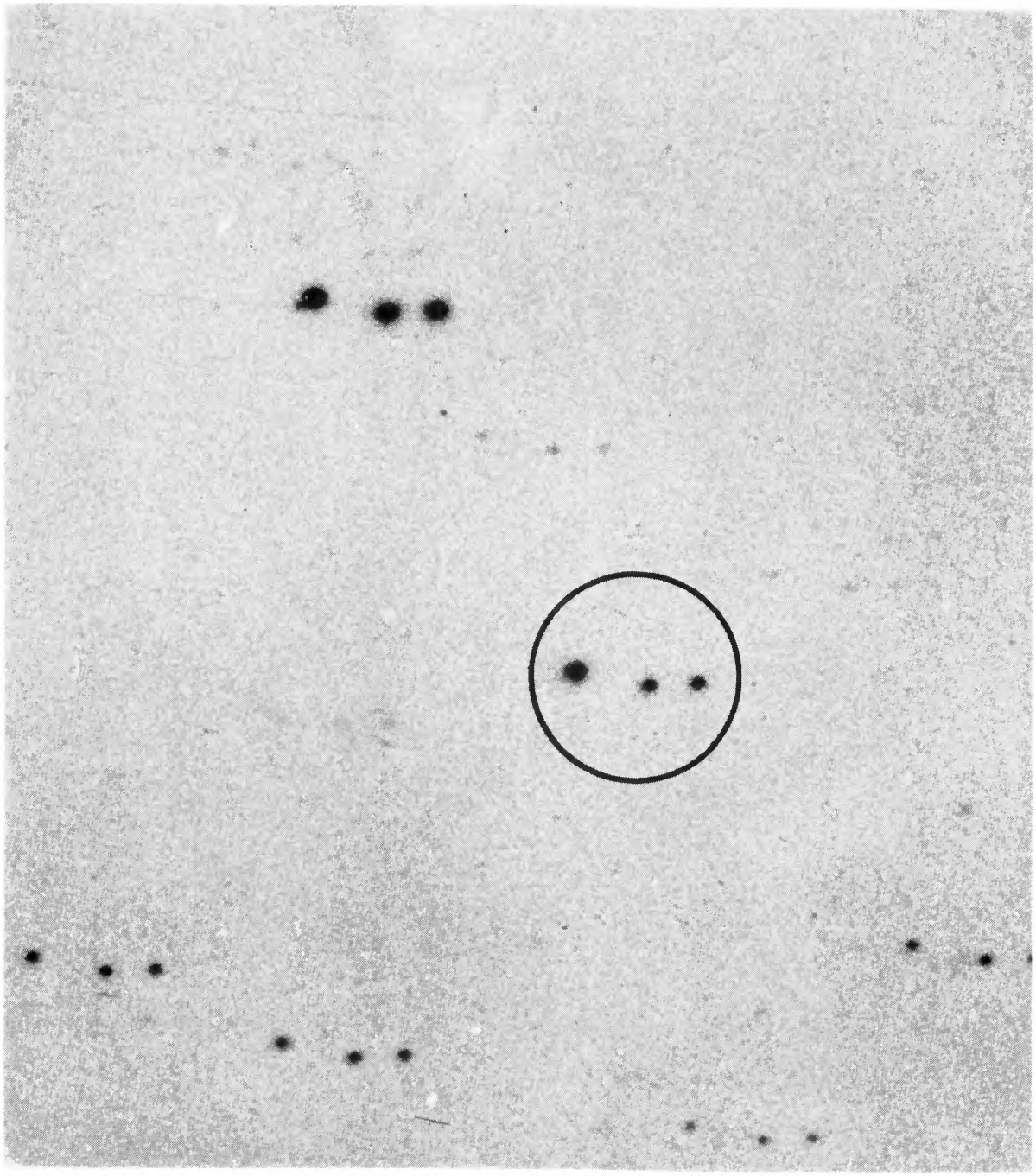

FIG. 1.—Three 30-minute exposures at 3-hour intervals of a Bailey type *c* RR Lyrae variable of fourteenth magnitude (Lick 20-inch astrograph).

nitude. The curve is Kukarkin's (1954) analysis of Shapley's observations, and the filled circles are the present results. A considerable density of RR Lyrae variables fainter than Shapley's plate limit is indicated. The mean photometric distance of the faintest group of variables in the present observations is 25 kpc on the assumption that they have an absolute magnitude of $m_{pg} = +0.5$ and there is no absorption.

Far more information from other fields is required, however, for a reliable analysis of the distribution of the RR Lyrae stars in the outer halo as a function of their period. Three other fields—one at the north galactic pole and two others toward the anticenter —have been photographed (40 exposures each) and are in process of reduction. An exten-

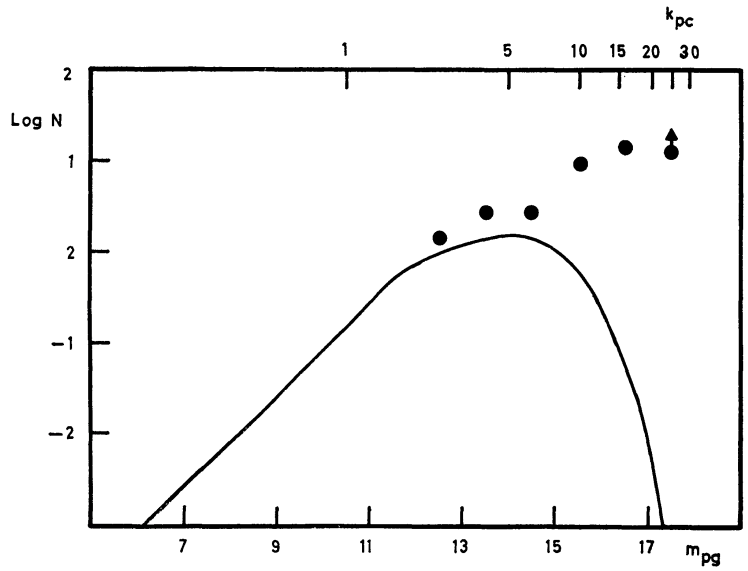


FIG 2.—The logarithm of the number of RR Lyrae variables per 80 square degrees per unit magnitude interval versus apparent magnitude in the direction of the galactic poles *Curve:* Kukarkin's (1954) analysis of Shapley's observations *Filled circles:* Lick survey. The arrow on the last point indicates a possible correction for incompleteness The distances (*upper abscissa*) are computed for an absolute magnitude $M_{pg} = +0.5$ for the variables and no absorption

sion to other fields is planned. Photometric standards for these fields are being obtained with the 120-inch reflector. It is also planned to search for blue halo stars in the same fields by comparing simultaneous exposures taken with the blue and visual astrographs.

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