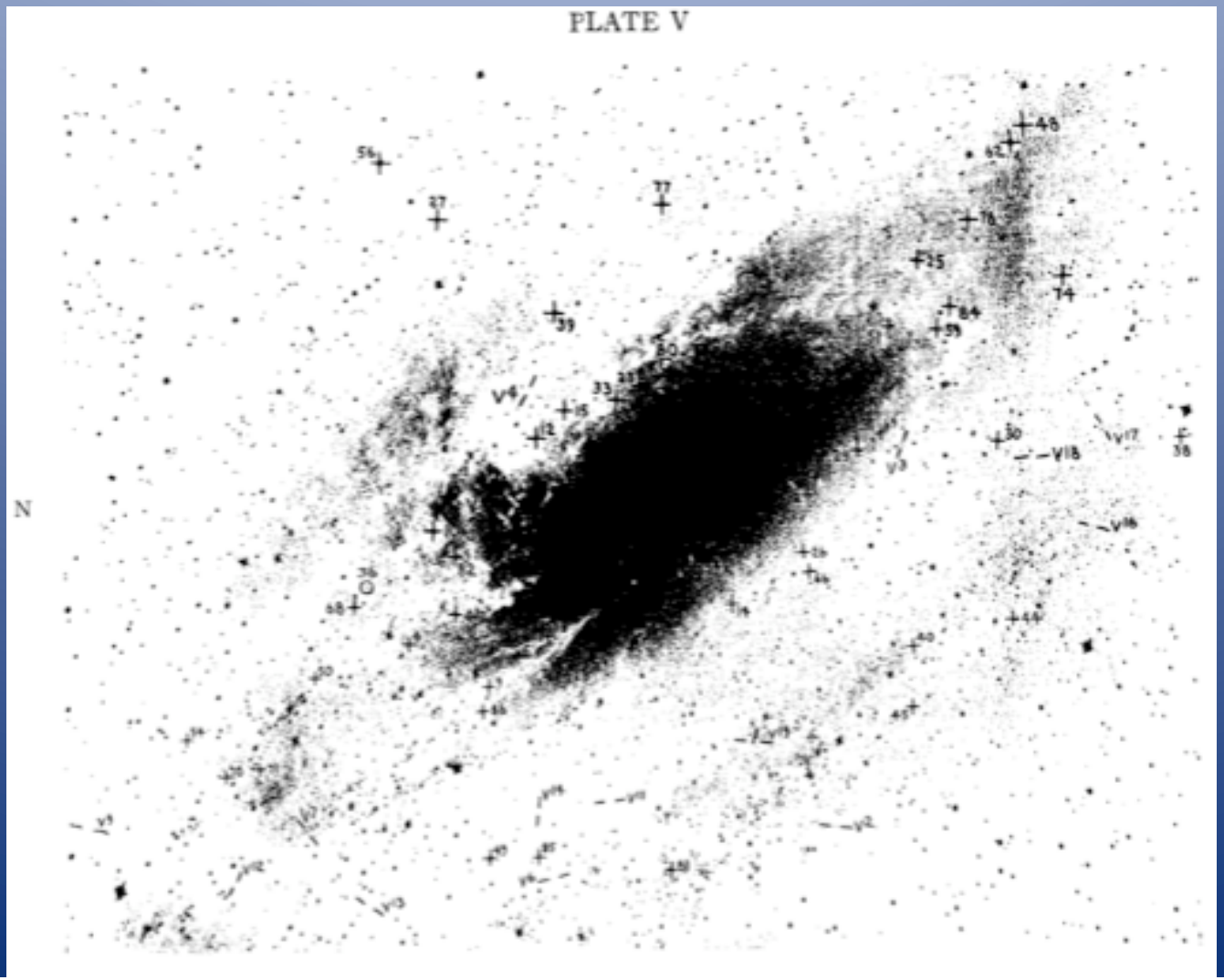

A Spiral Nebula as a Stellar System, Messier 31
By Edwin Hubble

Not So Easy Astronomy



Cepheid Light Curves

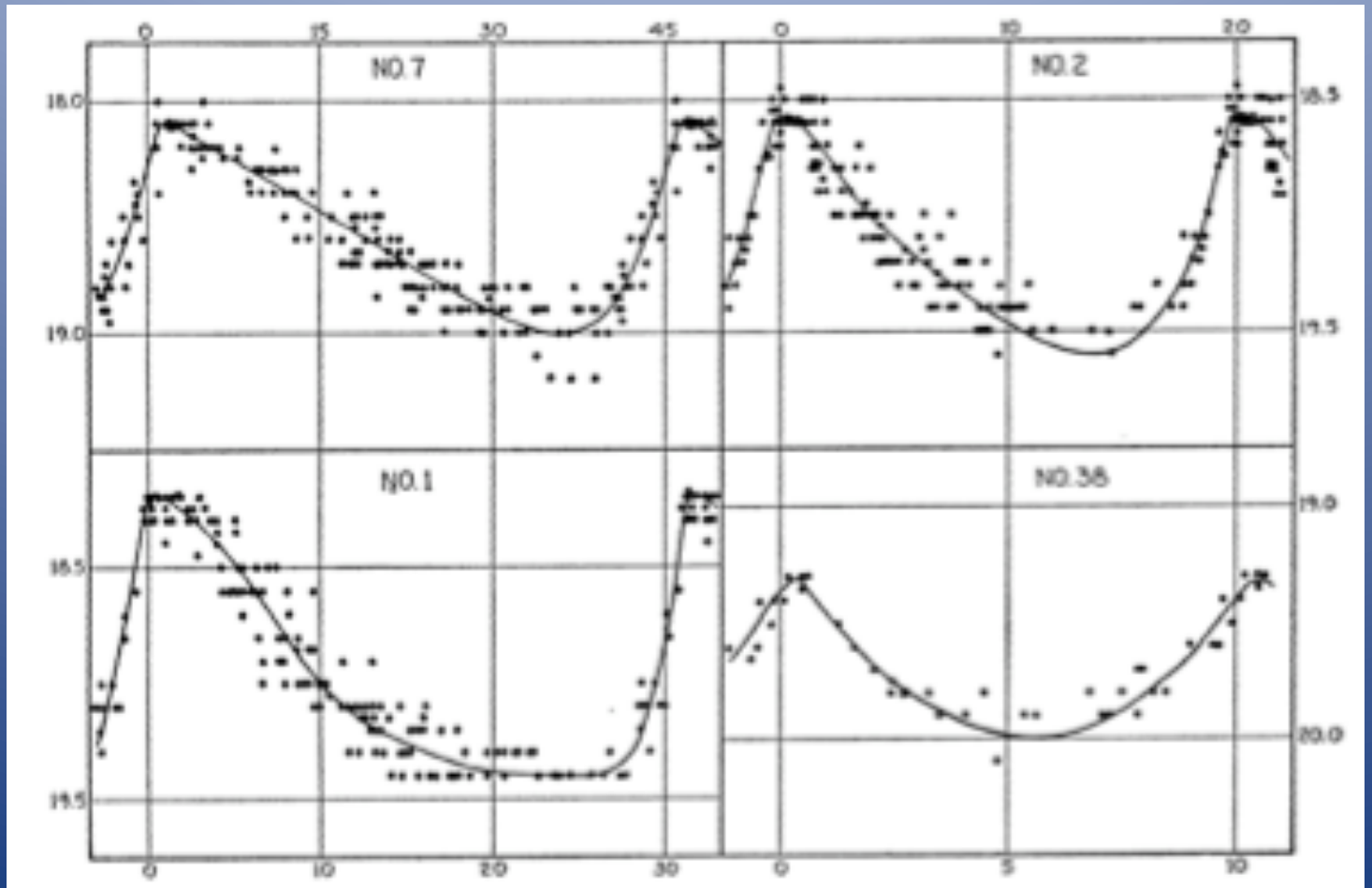


FIG. 1.—Light-curves of four Cepheids in M 31; ordinates, photographic magnitudes; abscissae, days.

Period Luminosity Relationship

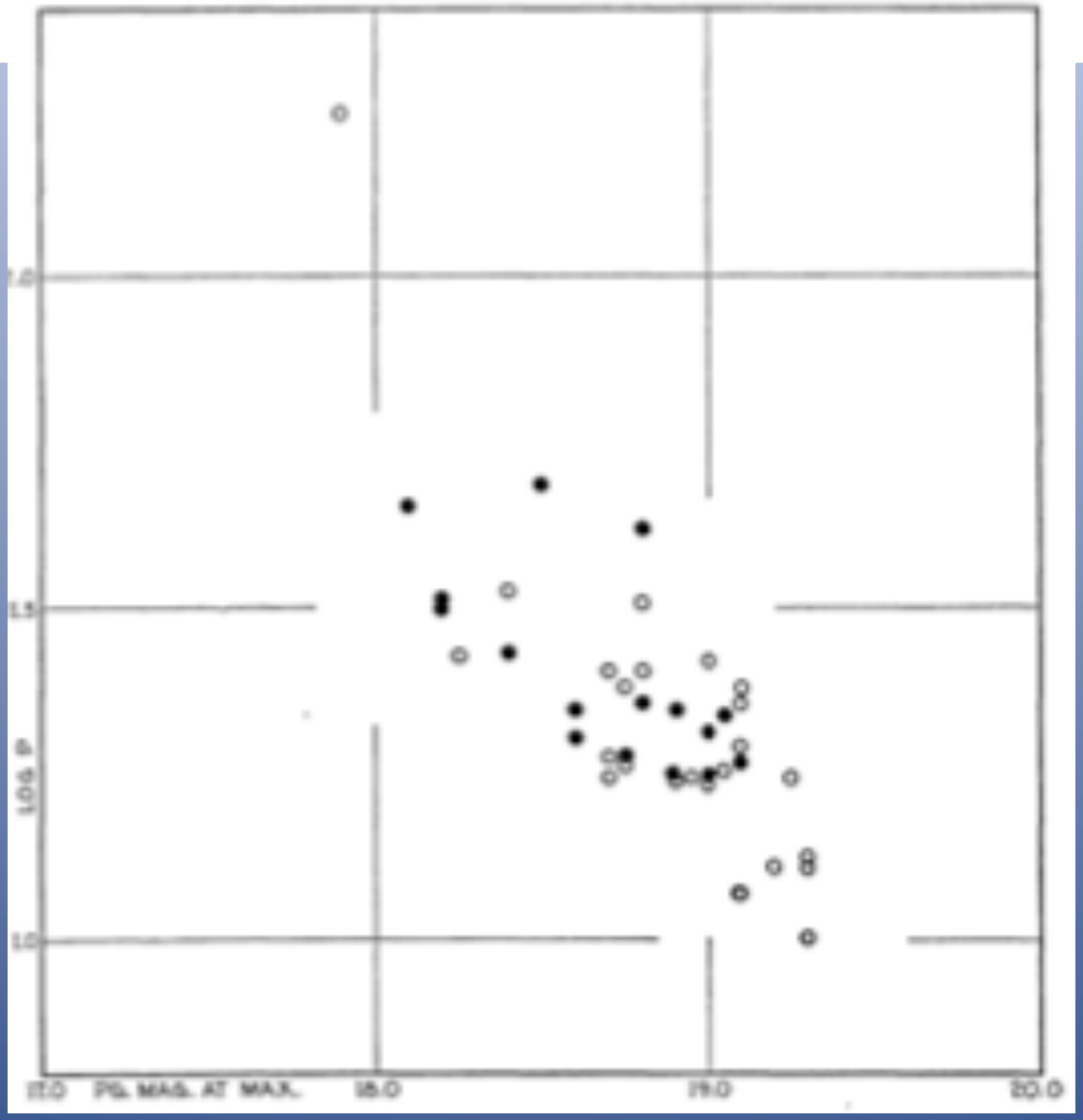


FIG. 2.—Period-luminosity relation among Cepheids in M 31. Photographic magnitude at maximum plotted against logarithm of period expressed in days. Cepheids in Region 4 are designated by circles in order to emphasize the absence of any selective effect due to position in the nebula.

Extra Galactic Cepheids

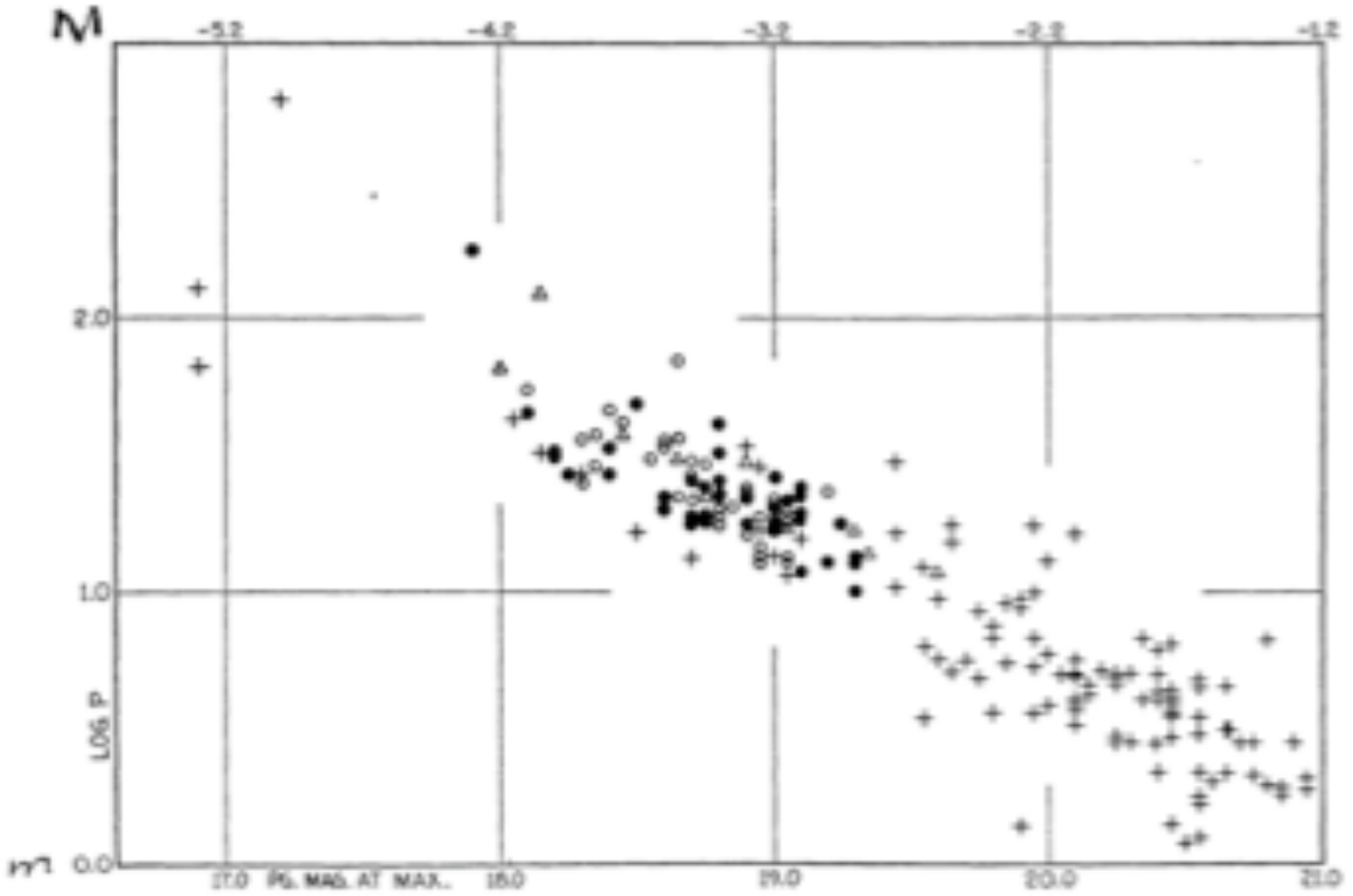


FIG. 3.—Period-luminosity relation among the extra-galactic Cepheids. The crosses refer to 106 Cepheids observed by Shapley in the Small Magellanic Cloud; the black discs, to 40 Cepheids in M 31; the open circles, to 35 in M 33; the triangles, to 9 in N.G.C. 6822. The apparent magnitudes at maxima have been reduced to the distance of M 31 by adding 4.65 to those in the Small Magellanic Cloud, 0.1 to those in M 33, and 0.55 to those in N.G.C. 6822. The absolute photographic magnitudes at the top of the diagram are based upon Shapley's zero point ($m - M = 17.55$ for the Small Magellanic Cloud).

Light Curves of Novae

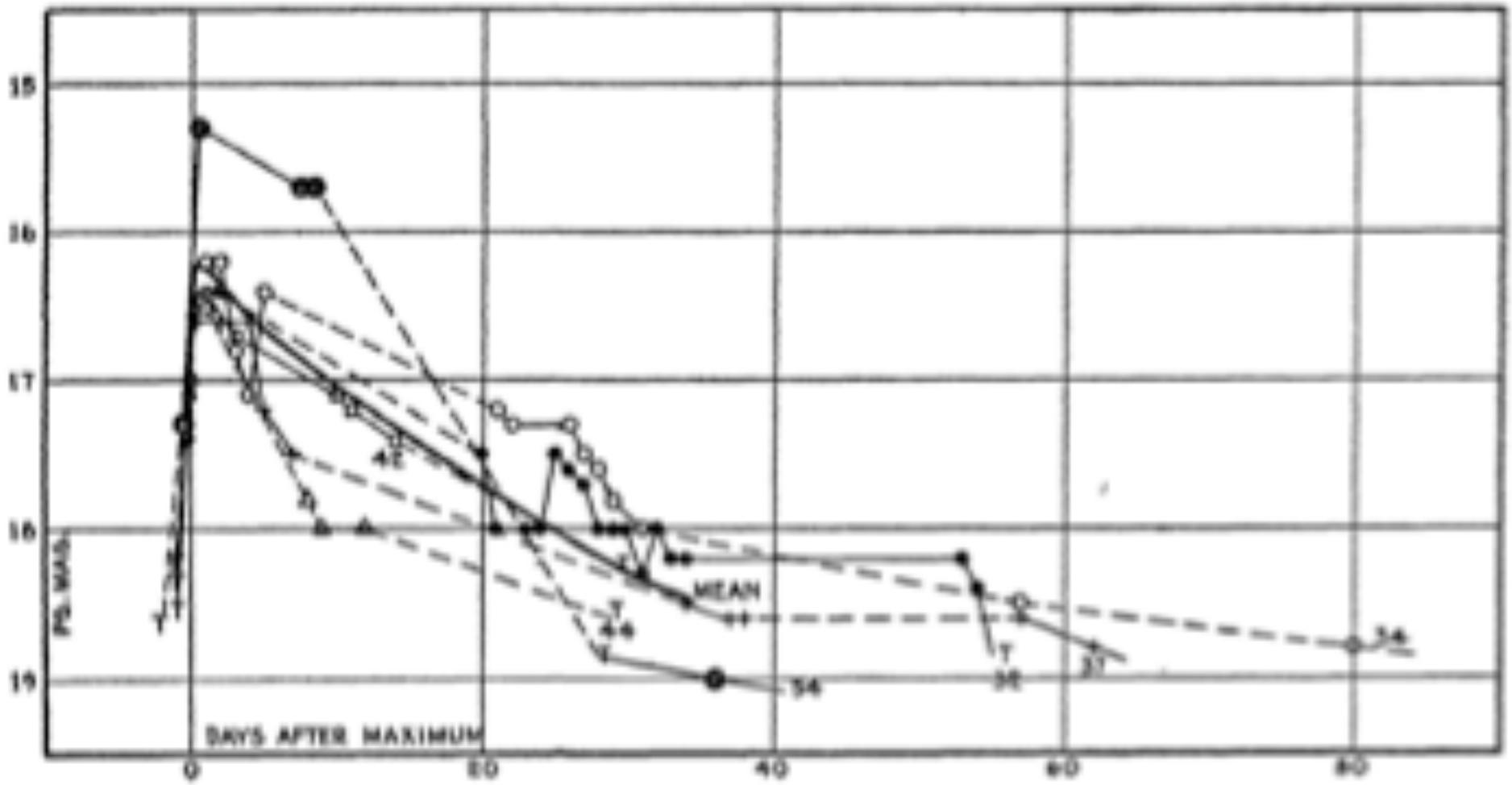


FIG. 5.—Light-curves of six novae in M 31 observed near maximum

Nova and Cepheid Frequency Distribution

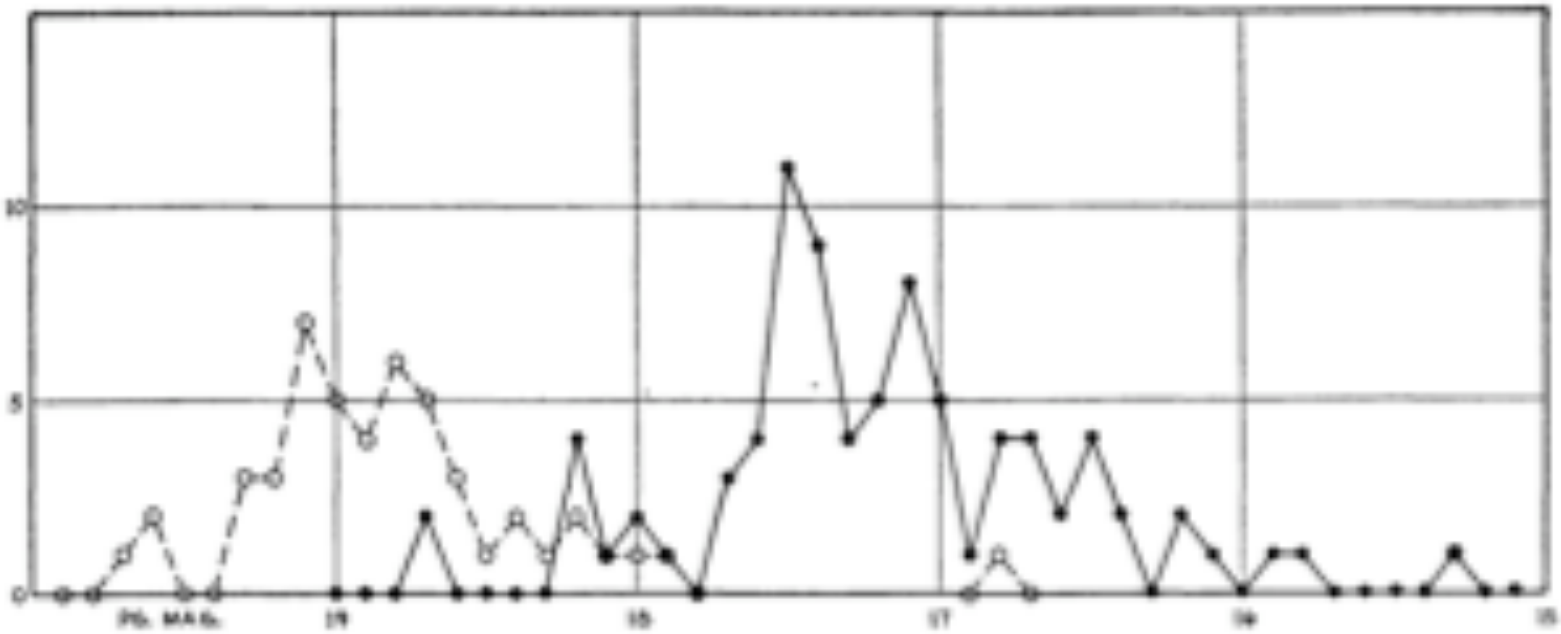


FIG. 8.—Frequency distribution of observed maxima of novae and variable stars in M 31. Black disks refer to novae; open circles, to variable stars. The points indicate numbers for each 0.1 mag. The diagram emphasizes the *completeness* of the data for novae, and hence the reality of the restricted range in magnitudes at maxima indicated by Figures 6 and 7.

Distribution of Novae

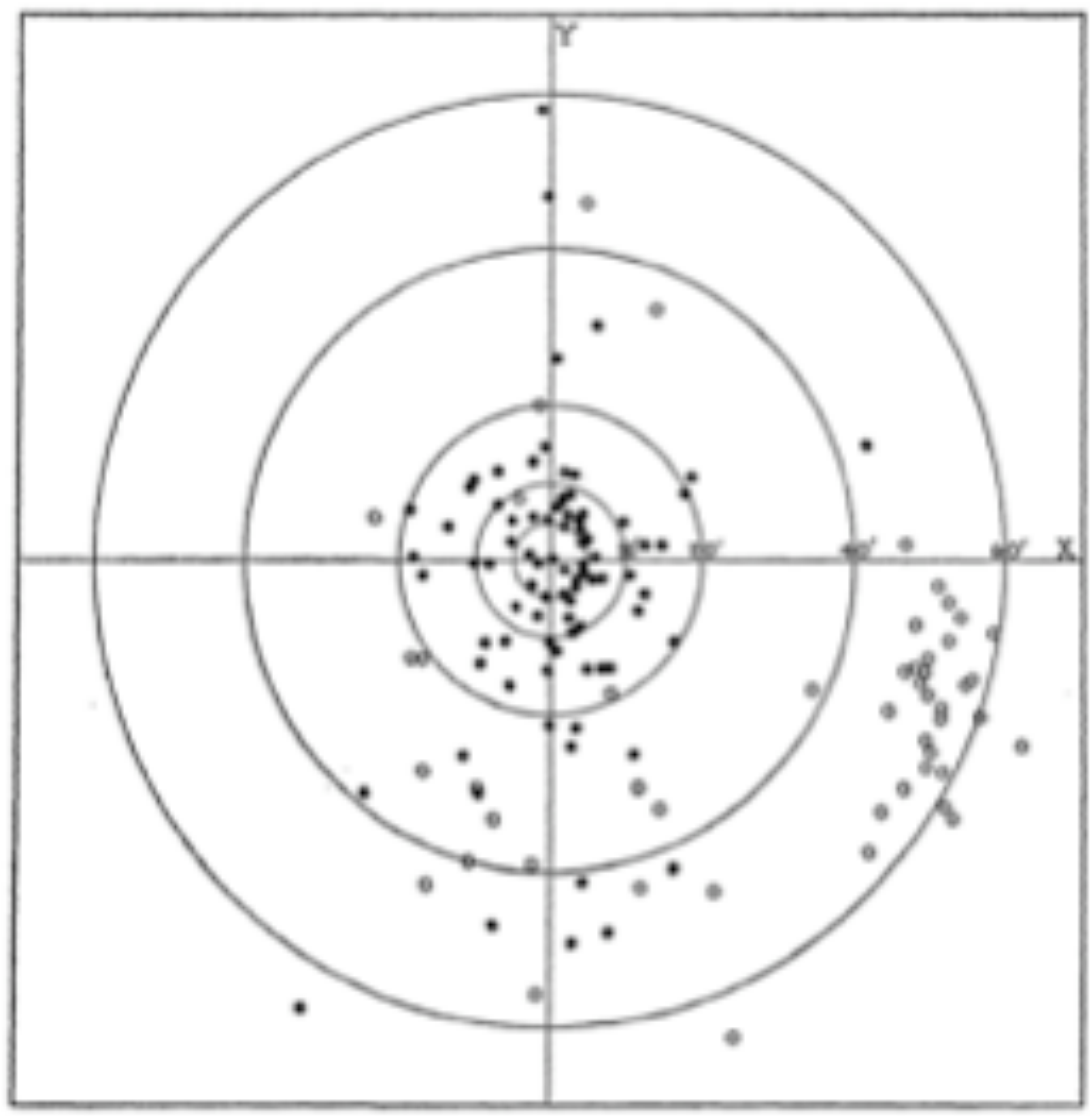


FIG. 9.-

Conclusions

Hubble Found…

- Found distance of M31 to be 275 kpc
- Found the total mass to be 2.4*10^8 solar masses

Today We Find…

- Stanek and Garnavich 1998 found the distance to be ~780kpc
- Wilkinson and Evans 2000 found the total mass to be 1.2*10^12 solar masses