6. *Summary.*—With what appears to be a homogeneous system of magnitude standards, the light curves of forty classical Cepheids in the Large Magellanic Cloud have been determined from estimates made on plates with the 24-inch Bruce refractor. The whole range of known periods, from 2.5 to 118 days, is represented, but special attention has been paid to stars with periods between four and twenty days.

Light elements have been found for six of the variables, and the earlier values of the periods for the other thirty-four have been revised.

Abnormally small amplitudes for three variables are attributed to the influence of close companion stars.

Throughout intervals of median magnitude and period that include most of the classical Cepheids in the Large Cloud, the amplitude increases with period and therefore with absolute magnitude.

The variation of the form of the mean light curve with the period is summarized in Section *5*.

[1] Ludendorff, *Astr. Nach.*, **209**, 217 (1919), and *Sitzb. Preus. Akad. Wiss.*, No. 5 (1929).

[2] Hertzsprung, *B. A. N.*, **2**, 83 (1924), and **3**, 115 (1926); cf. Sohon, *B. A. N.*, **3**, 204 (1926).

[3] Lundmark, *Lund Obs. Circ.*, No. 5 (1932).

[4] Gaposchkin, these PROCEEDINGS, **24**, 1 (1938).

[5] For a discussion of the magnitude system, see J. Mohr, *Harv. Ann.*, **105**, No. 11 (1937), and Shapley, *Harv. Circ.* 255 (1924).

[6] For example, see Lundmark's discussion, *Lund Medd.*, Ser. I, No. 128 (1931).

FURTHER REMARKS ON THE COSMOLOGICAL TIME SCALE

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Recent investigations on clusters of nebulae with the 18-inch Schmidt telescope on Palomar Mountain suggest that many large clusters of nebulae such as the Coma cluster represent *statistically stationary* configurations.[1] Calculations show that, if one starts from originally random distributions of nebulae, the formation of stationary large clusters requires periods of time exceeding 10^{18} years.[1] Consequently, if the process of clustering of nebulae has actually reached a stationary state, it follows that the short-time scale demanded by the hypothesis of an expanding universe is untenable.

Objections to the considerations just sketched have recently been advanced by M. S. Vallarta[2] on the ground that G. Lemaitre's theory[3] of the formation of clusters in an expanding universe was not taken into account.

The following lines are intended to show that Lemaitre's considerations in no way affect the calculations which I have advanced[1] in order to demonstrate that a stationary state of the process of clustering of nebulae can be reached only in periods longer than 10^{18} years. Indeed, the *speed* with which stationary clusters are formed has nothing whatever to do with Lemaitre's theory.* The problem of the speed of clustering is entirely of a *statistical nature* and the results obtained depend solely on the number of effective encounters among nebulae—that is, on those encounters during which appreciable amounts of the linear momenta of the involved nebulae are exchanged. Since the number and the effectiveness of such encounters depend only on the number of nebulae per unit volume, on the average velocity of these nebulae and on the law of interaction between nebulae (for which I assumed Newton's law of attraction), Lemaitre's considerations, which are also based on Newton's law of interaction between nebulae, cannot contribute anything to shorten the period necessary to achieve *statistically stationary* conditions in a large cluster of nebulae. As long as the law of interaction among nebulae is assumed to be Newton's law or any law of force not radically different from this law, a large cluster of nebulae can reach a stationary state only in a period far in excess of the time available in an expanding universe. The conclusion, therefore, remains intact, that the existence of statistically stationary configurations among clusters of nebulae is in contradiction with the hypothesis of an expanding universe.

[1] F. Zwicky, these PROCEEDINGS, **25**, 604 (1939).

[2] M. S. Vallarta, these PROCEEDINGS, **26**, 116 (1940).

[3] G. Lamaitre, these PROCEEDINGS, **20**, 12 (1934).

* Lemaitre's theory as far as I can see merely attempts to delineate the size and the material content of clusters of nebulae which may be formed in an expanding universe. It is not at all concerned with the question how long it takes for a large cluster to reach statistically stationary conditions.