Apparent Clustering of Galaxies

A CONSIDERABLE amount of material on the distribution of external galaxies has become available through the publication of the Harvard and Mount Wilson surveys. Shapley and Hubble have both discussed the observed irregularities in the distribution of these galaxies. Shapley emphasises the non-uniformity of the distribution of matter in the metagalaxy. Hubble finds that "statistically uniform distribution of nebulæ appears to be a general characteristic of the observable region as a whole", and hesitates to admit the reality of clusters or groups of galaxies with the exception of the few that are readily recognised as such. Statistical analysis of the available material is now possible; and as the comparison between the observed distribution curves, corrected for the effect of dispersion in the limiting magnitudes, and the theoretical frequency curves, computed on the assumption of random distribution, has yielded some rather definite results, it seems worth while to communicate them in advance of publication in more detail.

The Shapley-Ames catalogue of galaxies brighter than the thirteenth magnitude[1] exhibits conspicuous deviations from a random distribution. Both galactic polar caps were divided into a number of equal areas (well-known clusters being excluded), and the number of galaxies was counted in each area. The observed frequency curve had a much larger dispersion than the theoretical curve, computed on the assumption of random distribution. The accompanying table shows conclusively that the irregularities in the distribution cannot have been caused by galactic or extragalactic absorption.

North Galactic Polar Cap

No. of galaxies (Shapley-Ames)	$\overline{\log N}$ (Hubble)	No. of galaxies (Shapley-Ames)	$\overline{\log N}$ (Hubble)
½	1·92	15	1·79
1½	1·99	17	1·85
4	1·86	18½	1·87
5½	1·90	22	1·96
6½	1·88	24	1·95
10	1·87	26	1·87
10½	1·88	29½	1·86
12½	1·87	31	1·88
14	1·83	31½	1·86
14½	1·95	36	1·94
14½	1·93		

The first column of this table gives the number of galaxies counted for one of the areas in the Shapley-Ames catalogue. The centres of 9–13 survey fields used by Hubble in his study of the distribution of faint galaxies (down to mag. 19·5) fall within the limits of each area, and the second column of the table contains the mean value of log N for these faint galaxies. The absence of any progression in the values of $\overline{\log N}$ shows that the deviations from random distribution are due to a real clustering of galaxies and are not caused by the absorption of light in space.

Both the Mount Wilson[2] and Harvard[3] surveys of faint galaxies show evidence of clustering. The diagram (Fig. 1) gives a comparison between Hubble's observed distribution curve (dots), corrected for a dispersion of $\pm 0{\cdot}15$ mag. in the limiting magnitude of the Mount Wilson plates, and the theoretical curve (crosses) computed on the assumption that the galaxies are distributed at random.

Similar deviations from random distribution are found in the Harvard material. The observed frequency curve in log N has, for the north galactic polar cap, a dispersion of $\pm 0{\cdot}25$, and as the maximum value of the error dispersion amounts to only $\pm 0{\cdot}15$ (most probable value $\pm 0{\cdot}09$), the true dispersion must be of the order of $\pm 0{\cdot}20$ in log N. The dispersion computed theoretically for random distribution is not larger than $\pm 0{\cdot}03$ in log N. For the south galactic polar cap the discrepancy is even greater. We should in addition consider Shapley's elegant and definite proof for the presence of clustering in nine regions[4].

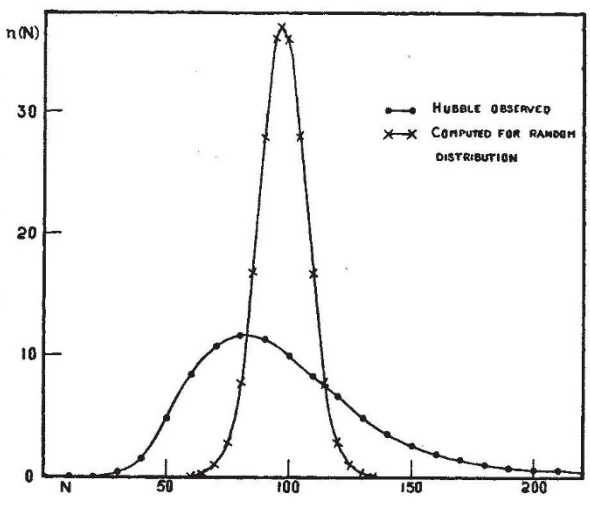

FIG. 1.

We can scarcely escape the conclusion that a widespread tendency towards clustering among galaxies is one of the chief characteristics of our universe.

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[1] *Harv. Ann.*, **88**, No. 2; 1932.
[2] *Astrophys. J.*, **79**, 8; 1934.
[3] *Harv. Bull.*, 889; 1932. Harvard Reprint 90; 1933.
[4] *Harv. Bull.*, 890; 1932.

An Arithmetical Prodigy in Egypt

A BOY of unusual arithmetical ability named Mohammed Ismail Turki El Attar has recently died in a Government asylum in Cairo. He was the son of a grocer in a small country village near Teh el Barud in the Delta, and when first discovered used to make a precarious living by exhibiting his powers as a calculator in cafés in Cairo. He was unable to read or write and was obviously a boy of poor general intelligence. His powers were tested on various occasions. The following is a summary of some of the calculations he performed mentally.

The squares of numbers of two digits were given correctly, almost instantaneously, but there was occasionally hesitation in giving the products of pairs of two digit numbers. Products and squares of 3 digit numbers were given in times varying from eight to forty-five seconds. Cubes of 2 digit numbers were worked out in from two to three minutes, while the product of two numbers of 10 digits was worked out correctly in twenty minutes.