GALAXIES, STATISTICS AND RELATIVITY

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Any investigation of the cosmological problem is bound to entail statistical considerations of some kind because of the immense number of the units of matter that are under consideration. Each such unit is itself a galaxy comparable in size with our own galaxy and populated by perhaps two or three billion stars and there are scores, possibly hundreds, of millions of such objects within range of our largest telescopes. If cosmology is the study of the entire system of galaxies, of their spatial distribution and of their relative motions, it is clear that each individual specimen cannot be observed and discussed separately. We must content ourselves with sampling procedures and attempt to deduce from the character of samples what the mechanical behaviour of the whole system may be. Nor indeed can we pick samples at random throughout the entire system, but only from that part of it which is accessible to our instruments. It appears that, even with the 200-inch telescope, the number of galaxies does not show any signs of coming to an end, countless millions lying at the extreme limit of the plates, too faint to be usefully observed but indicating that we are dealing with a part only of some unknown larger system.

As examples of the more rudimentary applications of statistics we can consider the questions of the luminosity-function of the galaxies and of the relation between red-shift and apparent magnitude, the so-called velocity-distance relation. In principle, the first question resolves itself into the determination of absolute magnitudes and the establishment of a frequency relation of absolute magnitude against numbers of galaxies. Clearly, selectivity can easily vitiate the result: if we simply pick all the brightest specimens that we can see, a completely artificial frequency distribution will result. One way of overcoming this difficulty is to adopt Bigay's method [1] which consists in selecting those galaxies that can be resolved into stars, irrespective of whether they are conspicuous or not. From the apparent and absolute magnitudes of identifiable stars in it, the absolute magnitude of a galaxy can be deduced, provided that its apparent magnitude has been measured. This is a slow and difficult process, much more difficult than is the determination of the apparent magnitude of a stellar object. However, Bigay has measured 64 galaxies that are resolvable and he concludes that their absolute magnitudes lie very closely on a Gaussian distribution curve; though a conclusion based on so small a sample is not conclusive, it can be provisionally accepted until further work, as careful and detailed as Bigay's, gives sound reasons for modifying it.

Turning now to the red-shift and apparent magnitude relation, it appears to be true that the red-shift can be measured to a much higher degree of accuracy than can the apparent magnitude of a galaxy. But to draw any conclusions of value in cosmology from this relation, the absolute magnitudes of the objects whose red-