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HARVARD COLLEGE OBSERVATORY

BULLETIN 838

On the Relative Diameters of Spiral and Elliptical Nebulae. — In a paper on "Double Spiral Nebulae and the Law of the Variation of the Absolute Dimensions of Anagalactic Nebulae," Dr. Lundmark notes that the mean of the apparent dimensions for the thirty-eight largest spirals over the whole sky is eight times the mean for the thirty-four largest elliptical nebulae. He takes this to indicate a correspondingly large difference in the absolute dimensions. Also from a consideration of double nebulae, where elliptical and spiral types sometimes form physical systems, he reaches the preliminary conclusion that "the elliptical nebulae are in the mean ten times smaller than the nebulae where the spiral arms are plainly shown" (Upsala Medd., No. 8, 1926).

The determination of the relative dimensions of the two main types of extragalactic nebulae is clearly important in all studies of the development of these objects. Some recent work on nebulae at Harvard bears on this question. It qualitatively supports Lundmark's result, but indicates that the difference found by him may be three or four times too large.

Various factors of selection affect all results of this kind; telescopic resolution, optical doubling, and sufficiency of data are involved. The surprisingly large average difference in the diameters given by Lundmark probably would be very appreciably diminished if the exceptional Andromeda Nebula, which is about thirty times the size of its elliptical companion, were omitted from the census.

In the Coma-Virgo cloud of nebulae, measured for magnitude and dimensions at Harvard (H. C. 294, 1926), the angular diameters can be safely taken, it is believed, to represent closely the absolute dimensions; that is, this nebular cloud appears definitely to be a physical system, and since it includes nearly all sub-types of the extra-galactic nebulae, it is especially suited for comparison of differences in dimensions of spiral and elliptical forms.

Of the one hundred and three bright nebulae measured in this cloud, fifty-nine fall in the area covered by good plates of four hours exposure with the 24-

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inch Bruce telescope. These plates, because of their longer exposures and greater scale, naturally are better suited than the Franklin-Adams plates for the comparison of dimensions. For nebulae of this magnitude, in fact, the Bruce plates give practically the same angular dimensions as may be derived from photographs with large reflectors. On Harvard plates made with smaller photographic telescopes (16-inch, 10-inch, 8-inch), the classification is difficult, except for the brightest objects, and the comparison of relative dimensions is uncertain.

For fifty-seven representative nebulae classified on Bruce plates by Miss Ames, in accordance with the scheme proposed by Lundmark (Upsala Medd., No. 7, 1926), the mean angular diameters and integrated photographic magnitudes are as follows:

Type	Number	Diameter	Magnitude
Elliptical	27	1.3	12.15
Spiral	30	3.0	11.98

The classification of twelve of the nebulae was doubtful on these plates. Omitting them, we have

Type	Number	Diameter	Magnitude
Elliptical	21	1.4	11.99
Spiral	24	3.4	11.98

This last result shows that the doubtful objects, as might be expected, are, on the average, both smaller and fainter.

It appears from the tabulations above that in the Coma-Virgo cloud, at least, the average diameter of the spirals is not more than 2.5 times the average diameter of elliptical nebulae. If the spirals were taken to be ten times as large as the elliptical nebulae, we should need to make the improbable assumption that they are systematically four times as distant as the elliptical nebulae of the same region, and absolutely three magnitudes fainter. But we find that the mean magnitudes of the two types are approximately the same — a natural result, since extended spiral arms, which contribute directly to angular dimensions, are essentially negligible in the integrated brightness.

If fainter objects in this region were included in the means, they would of necessity be listed mostly with the elliptical objects, and the computed average difference between spiral and elliptical forms would be increased. The same source of error no doubt exists for double nebulae, and may have been duly considered by Lundmark.

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