Variations in Nebulæ.

In observations of nebulæ great differences are induced by atmospheric variations. Last autumn I frequently looked at a small, round nebulosity which I had discovered in R.A. $8^h\ 34^m$, Dec. $85°\ 54'$ N. On certain nights it was quite plain with a power of 60 on my 10-in. reflector, on others I could barely glimpse the object. I felt inclined to believe that real variations occurred in the inherent light of the nebula, but further observation proved the changes were due to the varying transparency of the atmosphere. Another small nebula with a nucleus was examined on different evenings, and it is remarkable that on some nights I recorded it as having a stellar nucleus, while on others it appeared to have an ill-defined central condensation. Its brightness apparently fluctuated as well. But I ascertained that these alterations were also due to the varying condition of the air. Bad definition gave the nucleus a woolly, diluted appearance, and the visibility of the nebula varied with the opacity of the atmosphere.

Fog, haze, smoke, and wind exercise a most perceptible influence on faint, delicate objects. When planetary definition is good the details of a nebula are usually distinct if the sky is dark and no fog or thin cloud is near. There is a prevalent idea that large aperture rather than good definition is required for small comets and nebulæ, but for the perception of minute features the latter quality is most important. Comparatively small telescopes of high excellence will do wonders (as D'Arrest showed) on nebulæ, and will exhibit detail and faint objects that are ordinarily considered beyond their reach. With a small aperture the field of view is relatively darker than in a large one, and the disparity of size certainly does not give the larger instrument a commensurate superiority of power.

It has been alleged that the nucleus of the great nebula in Andromeda undergoes some striking variations in its physical character. These variations have been noted by means of photography as well as by the direct evidence of the telescope. Apparent changes undoubtedly occur, but it is by no means certain that actual changes are constantly affecting the nucleus. The variations appear to be of a fugitive, alternating character, and are very likely to have their sole origin in atmospheric disturbances. An observer who often examines this fine object will be sure to remark differences in its appearance; but when he records the varying state of the atmosphere, as affecting definition, as well, he will pretty certainly find that the former are closely associated with the latter.

Descriptions of nebulæ by various observers are seldom in harmony, because the seeing at the times of their several observations was not equally good. A pretty bright nebula seen in a bad sky is liable to be considered faint. There is a nebula (N.G.C.

6015) 4° W. of η Draconis which Sir W. Herschel described as "very faint," while D'Arrest called it "bright." N.G.C. 1469, near γ Camelopardi, was discovered by Swift and described as "very faint;" but I picked it up on a very clear night in Nov. 1890 and thought it pretty bright, as it was fairly conspicuous with a power of 60. Other discrepancies in the notes of observers might be alluded to. Dreyer says Hind's nebula (N.G.C. 6760), 4° W. of ν Aquilæ, "was suspected of variability, because it was refound by D'Arrest in May 1852 and called a first-class nebula, and subsequently 'pretty faint' and 'diluted,' while Auwers found it once 'pretty bright,' another time of the second class at most. There is, however, no reason for thinking it variable. It has little or no condensation, which probably makes its appearance more depending on the state of the atmosphere than would otherwise be the case." I swept up this nebula on Sept. 9, 1890, and called it "pretty bright, pretty large, brighter in the middle." In this and in many additional cases inconsistency in the records, instead of implying physical change in the objects, point rather to atmospheric variations, which are fully capable of introducing the discordances observed.

Those who have spent entire nights in celestial observation will often have noticed rapid changes in the condition of the atmosphere. It is seldom the air remains equable for a long period. Two nights are rarely alike, and though mere eye-observation detects little difference, telescopic power will often reveal great change. The opacity and pureness of the air vary from hour to hour. Some nights are unusually dark for several hours, the stars are very lucid and sparkling, and faint objects become intrusive. At other times the air is comparatively light, though there is no moon, twilight, or aurora of ordinary kind. The whole sky is occasionally suffused with a gauze of whitish material, seriously interfering with observation of faint objects. This is sometimes remarked as a striking feature. When watching the Perseids on several following nights in August 1880, the firmament glowed with a light that seemed stronger than the twilight of midsummer, but with this distinction, that in the former case the whole sky appeared equally affected. The transition from a dark to a light sky is sometimes quickly produced, and it is rarely that the air maintains a similar degree of transparency during an entire night. These changes are not caused by fog or mere surface phenomena, but are rather due to conditions affecting the upper limits of the atmosphere. I mention the circumstance as one bearing on the visibility of faint objects, which depends in great measure on the darkness of the sky contiguous to them.

Bristol, 1891, April 13. W. F. Denning.