The Perseid Meteor Shower.

WITH reference to the letter of Mr. Monck in NATURE of July 24 (p. 296), I would remark that his attempted explanation of the displacement in the Perseid radiant point is altogether futile. If your correspondent were better acquainted with the facts in detail, I think he would readily admit this.

My observations in this branch have been effected in the hope that they might prove useful, and I am sorry to see that Mr. Monck has so thoroughly misapprehended them. The shifting radiant of the Perseids is fully proved, and anyone who will take the trouble to watch the sky at the proper season may readily observe the fact for himself. W. F. DENNING.

Bristol, August 2, 1890.

COMPARISON OF THE SPECTRA OF NEBULÆ AND STARS OF GROUPS I. AND II. WITH THOSE OF COMETS AND AURORÆ.

I.

THE first step towards my present views as to the evolutions of the various groups of cosmical bodies was taken when one day I was attempting to trace the origin of the absorption flutings in stars of Vogel's Class III.*a*. So far, no one had endeavoured to trace their origin, all the work having been confined to the absorption *lines*. It is true that both Dr. Huggins and Vogel, as well as others, had published maps of the spectra of these stars, showing the absorption flutings as well as the lines, but the origins of the former were not inquired into.

It was at once perfectly obvious that among the chief absorption flutings were the most prominent of those seen in the spectrum of manganese at the temperature of the oxy-coal-gas flame—a temperature at which only one *line* is visible, while in the sun all the lines of manganese are visible. In order to investigate this further all the flutings seen when the principal metals were exposed to this temperature were mapped, with a view of determining whether any others besides those of manganese were visible in the stellar spectra. Several others, notably one of lead, were found to be present.

Here, then, was proof positive of low temperature: from solar absorption to the absorption of these stars of Class III.*a* we passed from phenomena which we can reproduce at the temperature of the arc to those visible at the temperature of the oxy-coal-gas flame.

It was next found that identical absorption phenomena are seen in comets long before they reach perihelion. This was a striking result, considering the vast difference in the way in which the phenomena of distant and near meteoric groups are necessarily presented to us; and bearing in mind that in the case of comets, however it may arise, there is an action which drives the vapours produced by impacts outward from the swarm in a direction opposite to that of the sun.

It must be a very small comet which, when examined spectroscopically in the usual manner, does not in consequence of the size of the image on the slit enable us to differentiate between the spectra of the nucleus and envelopes. The spectrum of the latter is usually so obvious, and the importance of observing it so great, that the details of the continuous spectrum of the nucleus, however bright it may be, are almost overlooked.

A moment's consideration, however, will show that if the same comet were so far away that its whole image would be reduced to a point on the slit-plate of the instrument, the differentiation of the spectra would be lost; we should have an integrated spectrum in which the brightest edges of the carbon bands, or some of them, would or would not be seen superposed on a continuous spectrum.

But another revelation still more startling was in store for me, when my assistants and myself had exhausted all the flutings then known to us as origins for the so-called dark bands which remained, and found that none would fit, and we seemed at the end of our tether.

My ten years' work on carbon made itself quite unconsciously felt at this juncture. It suddenly flashed upon me that the 517·2, 516·7, 516·6, 516·7, 517·1, &c., recorded by Dunér in his observation of α Orionis as the edge of a dark band, *could be nothing but the edge of the brightest band of carbon*, the bright cometary band *par excellence*, and therefore that these so-called stars not only resemble comets in their absorption flutings, as we now learn, but in their radiation flutings as well; in short, these stars *were* comets, with the difference—a trifling one from my then point of view—that they were not moving round our sun.

This surmise has since been abundantly confirmed. The dark band of Dunér is a *contrast band*—the spectrum looks dark there on account of the extreme brilliancy of the carbon fluting. The other carbon flutings were next sought for and easily found.

These "stars," then, instead of being like our sun, consisted of swarms of meteorites. We have in these bodies a spectrum integrating the *radiation* of carbon and the *absorption* of manganese and lead vapour, as in the case of some comets.

The law of parsimony compels us to ascribe the bright fluting of carbon in these "stars" to the same cause as that at work in comets, where we know it is produced by the vapours between the individual meteorites or repelled from them. Hence we are led to conclude that the absorption phenomena are produced by incandescent vapours surrounding individual meteorites which have been rendered intensely hot by collisions, while the carbon light comes from the interspaces.

I propose in the present paper to give a summary of the evidence of cometary kinship, so to speak, among the other cosmical bodies; and I shall follow this by an historical statement showing how previous observers have suspected the presence of carbon in "stars."

First as to cometary kinship.

The discussion of cometary spectra which I communicated to the Royal Society in November 1888 (Roy. Soc. Proc., vol. xlv. pp. 159–217), contained, among other matters, conclusions which have a special bearing on the relations of their spectra to those of other bodies.

It is obviously desirable to compare this material with the more complete lists of lines which I have now obtained from a very thorough search after all the observations hitherto made of other groups of celestial bodies, since such a comparison—a much more complete one than was possible in the first instance—would strengthen or weaken my hypothesis according as the increased area of observation increased or decreased the number of coincidences in the spectra of the various groups.

The more the coincidences are intensified the greater is the probability that comets, nebulæ, stars with bright lines, stars with mixed flutings, and the aurora have a common origin, independent of the chemical origins which have been assigned to the various lines by laboratory observations.

In the tables which follow, the individual observations are not given, but under each heading all the lines or flutings which have been recorded find place.

I. *Comparison of Comets and Nebulæ.*

We may conveniently begin with a comparison of comets and nebulæ. The Great Comet of 1882 and Comet Wells, when near perihelion, are excluded from the list of cometary lines and flutings, as their temperature was too high for fair comparison with most of the nebulæ and other low temperature phenomena.

In cases where any of these higher temperature lines correspond to lines in the comparison spectrum, however, they have been added to the list of cometary lines, in