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ART. XXI.—*On the Testimony of the Spectroscope to the truth of the Nebular Hypothesis;* by Professor DANIEL KIRKWOOD, of Bloomington, Indiana.

IN March, 1846, the partial resolution of the great nebula in Orion was announced by Lord Rosse. In September of the following year, the late Prof. W. C. Bond, of Harvard University, stated, in confirmation of this interesting discovery, that the part of the nebula about the Trapezium "was resolved into bright points of light" by the great refractor of Cambridge. "It should be borne in mind," continued Prof. B., "that this nebula and that of Andromeda have been the last stronghold of the nebular theory; that is, the idea, first thrown out by the elder Herschel, of masses of nebulous matter in process of condensation into systems."

These grand achievements were regarded by the majority of astronomers as fatal to the claims of the nebular hypothesis. It is not to be denied, however, that this celebrated theory has more than recovered from the shock which it then received; that it has, in fact, been materially strengthened by the researches and discoveries of the last twenty years. The truth of this remark is strikingly exemplified by the revelations of the spectroscope. The man who at the middle of the nineteenth century would have been bold enough to predict the discovery of the physical constitution of the heavenly bodies, or the determination of the elements of which they are composed, would have been generally deemed a scientific enthusiast. This, however, and more than this, has been actually accomplished. In

the hands of Huggins, Secchi, Young, and others, the *spectroscope*, that marvel of modern science, has yielded satisfactory testimony not only in regard to such stars as are reached by our unassisted vi ion, but even respecting the telescopic nebulæ, apparently on the outskirts of the visible creation. A detailed account of these wonderful achievements would not comport with our present purpose. Such *results*, however, as bear directly upon the theory of Laplace will be briefly noted.

1. The ring nebula in *Lyra*, the Dumb-bell nebula, the great nebula in *Orion*, and others which might be named, are not, as was but recently believed, extremely remote sidereal clusters; but *their light undoubtedly emanates from matter in a gaseous form.*

2. "According to Lord Rosse and Professor Bond the brighter parts near the trapezium [in the nebula of Orion] consist of clustering stars. If this be the true appearance of the nebula under great tele copic power, then these discrete points of light must indicate separate and probably denser portions of the gas, and that the whole nebula is to be regarded rather as a system of gaseous bodies than as an unbroken vaporous mass."*

3. Progressive changes in the physical condition of certain nebula are clearly indicated by the fact that nuclei have been established which, as shown by their spectra, are not wholly gaseous, but have passed, at least partially, to the solid or liquid form.

4. The spectroscopic analysis of the light of several comets reveals a constitution similar to that of the gaseous nebulæ.

The spectroscope, then, has *demonstrated* the present existence of immense nebulous masses, such as that from which Laplace supposed the solar system to have been derived. It ha shown, moreover, a progressive change in their physical structure, in accordance with the views of the same astronomer. In short, the evidence afforded by spectrum analysis in favor of the nebular hypothesis is cumulative, and of itself sufficient to give this celebrated theory a high degree of probability.