

whole solar system, receives its internal heat from without while passing through hot and cold regions.\*

The question whether the thermal conditions of the celestial regions, and the climates of individual portions of space, have suffered important variations in the course of ages, depends mainly on the solution of a problem warmly discussed by Sir William Herschel: whether the nebulous masses are subjected to progressive processes of formation, while the cosmical vapor is being condensed around one or more nuclei in accordance with the laws of attraction? By such a condensation of *cosmical vapor*, heat must be liberated, as in every transition of gases and fluids into a state of solidification.† If, in accordance with the most recent views, and the important observations of Lord Rosse and Mr. Bond, we may assume that all nebulae, including those which the highest power of optical instruments has hitherto failed in resolving, are closely crowded stellar swarms, our faith in this perpetually augmenting liberation of heat must necessarily be in some degree weakened. But even small consolidated cosmical bodies which appear on the field of the telescope as distinguishable luminous points, may change their density by combining in larger masses; and many phenomena presented by our own planetary system lead to the conclusion that planets have been solidified from a state of vapor, and that their internal heat owes its origin to the formative process of conglomerated matter.

It may at first sight seem hazardous to term the fearfully low temperature of the regions of space (which varies between the freezing point of mercury and that of spirits of wine) even indirectly *beneficial* to the habitable climates of the earth and to animal and vegetable life. But in proof of the accuracy of the expression, we need only refer to the action of the radiation of heat. The sun-warmed surface of our planet, as well as the atmosphere to its outermost strata, freely radiate heat into space. The loss of heat which they experience arises from the difference of temperature between the vault of heaven and the atmospheric strata, and from the feebleness of the counter-radiation. How enormous would be this loss of heat,‡ if the regions of space, instead of the

\* See Poisson, *Théorie Mathém. de la Chaleur*, p. 438. According to him, the consolidation of the earth's strata began from the center, and advanced gradually toward the surface; § 193, p. 429. Compare also *Cosmos*, vol. i., p. 176, 177.

† *Cosmos*, vol. i., p. 83, 84, 144.

‡ "Were there no atmosphere, a thermometer freely exposed (at sun-