

tend to reduce the practical importance of Mr. Croll's theory, on the other hand they tend to remove one of the greatest objections against it—namely, that founded on the necessity of supposing that glacial periods recur with astronomical regularity in geological time. They cannot do so if dependent on other causes inherent in the earth itself, and producing important movements of its crust.

The third great cause of warmer climates in the past is the larger proportion of carbon dioxide, or carbonic-acid gas, in the atmosphere in early geological times, as proved by the immense amount of carbon now sealed up in limestone and coal, and which must at one time have been in the air. It has been shown that a very small additional quantity of this substance would so obstruct radiation of heat from the earth as to act almost like a glass roof. If, however, the quantity of carbonic acid, great at first, was slowly and regularly removed, even if, as suggested by Hunt, small additional supplies were gradually added from space, this cause could have affected only the very oldest floras. But it is known that some comets and meteorites contain carbonaceous matter, and this allows us to suppose that accessions of carbon may have been communicated at irregular intervals. If so, there may have been cycles of greater and less abundance of this substance, and an atmosphere rich in carbon dioxide might at one and the same time afford warmth and abundance of food to plants.

It thus appears that the causes of ancient vicissitudes of climate are somewhat complex, and when two or more of them happened to coincide very extreme changes might result, having most important bearings on the distribution of plants.

This may help us to deal with the peculiarities of the great Glacial age, which may have been rendered exceptionally severe by the combination of several of the causes of refrigeration. We must not suppose, however, that