

species or genera (or higher groups) to disappear, while, in another subjected to the same conditions or causes of catastrophe, the same species, or at least the same genera (or higher groups), may have continued on through another period. Genera or Families may have become extinct sooner on one continent, or part of a continent, than on another; or in one ocean, or part of an ocean, than in another. Again, catastrophes may affect the shallow borders of an ocean, and not reach to a depth of a hundred fathoms.

5. The absence of fossils from a formation, or their extreme fewness, even when the formation is thousands of feet thick, is no evidence as to the paucity of life in the era. The absences may be owing to local conditions; or to the trituration of fossils to the finest of particles which infiltrating waters could wash out; or to the waters of the region having been fresh.

A case in the later Paleozoic is that of the Devonian Catskill Red sandstone 3000 to 4000 feet thick, whose fossils are very few brackish-water or fresh-water species. When formed, the seas of the world contained as large and varied a fauna as in the period of the great Devonian limestones or that of the Subcarboniferous Crinoidal limestones. Such blanks need explanation; for the *equivalent* fossiliferous can hardly be absent from the whole of a continental area.

6. The inferior value of plants to animals as tests of geological age of equivalency is generally admitted. It appears to be true also that marine fossils are entitled to greater weight than terrestrial or fresh-water species excepting the fossil Vertebrate. But the evidence from Vertebrates is always surest when fortified by that of Invertebrates.

The difficulties are not often sources of final doubt when the conclusions are based on the *general range* of animal types characterizing an era. Should a Trilobite be hereafter discovered in any Cretaceous rocks of the world, it would lead no one to suspect those rocks to be Paleozoic, because the associated species would be sufficient to settle the question of age.

Among metamorphic rocks, the outcrops of the rock should be followed into the region of feeble metamorphism where traces of fossils may possibly be found. By studying the relations of the associated rocks as to bedding, and proving conformability and continuity, the discovery of a few fossils in one stratum of the series at a single locality may settle the question of age approximately for a whole formation hundreds of miles in length.

## SUBDIVISIONS OF GEOLOGICAL TIME.

**General basis of subdivisions.** — In view of the principles explained in the preceding pages it follows that —

1. The grander divisions of geological time should be based, in a comprehensive way, on organic progress, independently of events connected with rock-making and disturbances of the crust. Examples of such divisions are those of the four primary divisions, the Archæan, Paleozoic, Mesozoic, and Cenozoic.