A low temperature, acting gradually, during an indefinite age — such as geology proves to have been required for many of the great changes in the earth's history — would produce results that could not be otherwise brought about, even through greater heat.

The lower limit of temperature is sometimes placed much below 300° F.; and for consolidation it may be rightly so. But there is definite evidence that it generally exceeded this. In the great faults of the Appalachians, 10,000 feet or more in extent, Lower Silurian limestones are brought up to view, containing their fossils, and not metamorphic; and in Nova Scotia the coal formation, though 15,000 feet thick, is not metamorphic at base. Taking the increase of temperature in the earth's crust at 1° F. for 60 feet of descent, 10,000 feet of depth would give 220° F. as the temperature of the limestone before the faulting; and 1° F. per 60 feet of descent must be short of the rate that obtained in the Carboniferous age.

Regional metamorphic rocks are upturned rocks, rocks that have been subjected to the faulting, crushing, and flexing, attending mountain-making. Hence, in accordance with the explanations on page 385, they are rocks which have been subjected to pressure and movement on a vast scale, and thereby to heat made just where it was needed for metamorphic work. Mountain-making movements might be so slow that the heat would become mostly dissipated instead of accumulating. But the rocks upturned were generally 10,000 to 30,000 feet thick or more, and great pressure and high temperatures should be expected from movements so vast over regions exceeding sometimes a thousand miles in length.

The heat for metamorphism appealed to is heat of a dynamical source, and the conditions are those that will produce its maximum effects.

The movement of rocks along fracture-planes in faulting produces heat; but only occasionally, in connection with the greater upthrust or onthrust faultings, is it sufficient, unless reinforced from accompanying upturnings, for metamorphic action in the walls of the fracture. The changes will seldom, if ever, extend so far as to obliterate the plane of faulting, or to disguise the fact that the heat has a local source along this plane, provided the faulting is not attended with extensive crushing of the adjoining rock. As such a fracturing of the rocks is commonly of the shearing kind, the altered band along the fault-plane is called a *shear-zone*.

The earth's internal heat has always been a contributor to the heat of the earth's crust, and much more so formerly than now, and would, therefore, have supplemented largely the heat generated by friction. But the alteration of sediments by the heat coming up from the earth's interior alone is proved by many facts to have been inadequate for much more, even during the later Paleozoic, than the solidification of the rocks. Besides those mentioned above, it may be added that in the South Wales coal-field the Carboniferous limestone, although covered by other rocks to a depth of 10,000 to 12,000 feet, is unaltered. (Geikie.)

The great agent of metamorphic change is *heated moisture;* and for the