facts as to the rate of downward increase of heat and the rate of loss of heat into space; that if the earth had cooled less than 20,000,000 years since, the internal heat would have been greater than now; and if more than 400,000,000 years, there would have been no sensible increase of heat downward; and he suggested a probable length of 100,000,000 years. The bearing of the facts as to tidal retardation, and his hypothesis with reference to the origin and age of the sun's heat, gave him other arguments on the question; but the conclusions are less well based than that from rate of cooling.

Tait, arguing from the effect of tidal retardation on the figure of the earth and the rate of cooling, concluded, that the time which can be allowed to geologists is something less than 10,000,000 years; and, in view of the supposed origin of the sun's heat (by the falling together of masses of matter), that the time the sun has been illuminating the earth is not more than about 15,000,000 or 20,000,000 years; and, again, that the supposed concussion would have made heat enough to last the earth 100,000,000 years. Croll has some speculations on this subject in Chapter xxi. of his *Climate and Time.*

Newcomb says: "If we reflect that a diminution of the solar heat by less than one fourth its amount would probably mean an earth so cold that all the water on its surface would freeze, while an increase of much more than one half would probably boil all the water away, it must be admitted that the balance of cause which would result in the sun radiating heat just fast enough to preserve the earth in its present state has probably not existed more than 10,000,000 years."

The first of Kelvin's methods mentioned above has been adopted by C. King (*Am. Jour. Sc.*, 1893), with new data, derived from experiments by C. Barus, with regard to the latent heat of fusion of the rock diabase, its specific heat when melted and when solid, and its volume expansion between the solid and melted state, besides other points bearing on the subject. The conclusion reached is that the earth's age is probably 24,000,000 years.

The safe conclusion from all the Geological and Physical facts is that Time is long, very long; long enough for the development of all the earth's rocks, mountains, continents, and life. Geologists have no reason to feel hampered in their speculations, while the extreme results of calculation are 10,000,000 and 6,000,000,000 years.

CLIMATAL DEVELOPMENT.

A globe that has slowly cooled from fusion, and has had in the past, as now, a sun that is losing heat like itself, must have been a globe also of cooling climates. But its orbit has wide variations, and the sun, it is supposed, its varying phases. Moreover, the present era is a time of mild climate compared with that of the Glacial period which preceded it; and hence the cooling of the climates has not been continuous and regular, but one by oscillations, in which refrigeration was real, though often passing through extremes in both directions.