

parison with the astronomical eras of her history, may be regarded as present, let us consider, so far as known facts permit, the probable future of the earth after astronomical eras comparable with those which were presented to us when we considered her past history.

One of the chief points in the progression of the earth towards her present condition was the gradual passing away of the heat with which formerly her whole globe was instinct. We have now to consider whether this process of cooling is still going on, and how far it is likely to extend. In this inquiry we must not be misled by the probable fact, for such it seems, that during hundreds of thousands of years the general warmth of the surface of the earth has not appreciably diminished. In the first place, hundreds of thousands of years are the seconds of the time-measures we have now to deal with; and next, it is known that the loss of temperature which our earth is at present undergoing chiefly affects the interior parts of her globe. The inquiries of Mallet and others show that the present vulcanian energies of the earth are due in the main to the gradual withdrawal of the earth's nuclear parts from the surface crust, because of the relatively more rapid loss of heat by the former. The surface crust is thus left to contract under the action of gravity, and vulcanian phenomena—that is, volcanoes and earthquakes,—represent the mechanical equivalent of this contraction. Here is a process which cannot continue for ever, simply because it is in its very nature exhaustive of the energy to which it is due. It shows us that the earth's nuclear regions are parting with their heat, and as they cannot part with their heat without warming the surface-crust, which nevertheless grows no warmer, we perceive that the surface-heat is maintained from a source which is being gradually exhausted. The fitness of the earth to be the abode of life will not only be affected directly in this way, but will be indirectly affected by the loss of that vulcanian energy which appears to be one of its necessary conditions. At present, the surface of the earth is like the flesh clothing the living body; it does not wear out because (through the life which is within it) it undergoes continual change. But even as the body itself is consumed by natural processes so soon as life has passed from it, so, when the internal

heat of the earth, which is its life, shall have passed away, her surface will "grow old as doth a garment;" and with this inherent terrestrial vitality will pass away by slow degrees the life which is upon the earth.

In dealing with the past history of our earth, we recognized a time when she was a sun, rejoicing as a giant in the strength of youth; and later we considered a time when her condition resembled that of the planets Jupiter and Saturn, whose dense atmospheres seem to be still loaded with the waters which are to form the future oceans of those noble orbs. In considering our earth's future, we may recognize in the moon's actual condition a stage through which the earth will hereafter have to pass. When the earth's inherent heat has passed away and long ages have elapsed since she had been the abode of life, we may believe that her desert continents and frost-bound oceans will in some degree resemble the arid wastes which the astronomer recognizes in the lunar surface. And yet it is not to be supposed that the appearance of the earth will ever be closely similar to that presented by the moon. The earth may part, as completely as the moon has, with her internal heat; the rotation of the earth may in hundreds of millions of years be slowed down by tidal action into agreement with the period in which the moon completes her monthly orbit; and every form of animal and vegetable life may perish from off the face of the earth: yet ineffaceable traces of the long ages during which her surface was clothed with life, and instinct with inherent vitality, will distinguish her from the moon, where the era of life was incomparably shorter. Even if the speculations of Stanislas Meunier be just, according to which the oceans will gradually be withdrawn beneath the surface crust and even the atmosphere almost wholly disappear, there would for ever remain the signs of changes brought about by rainfall and snowfall, by wind and storm, by river and glacier, by ocean waves and ocean currents, by the presence of vegetable life and of animal life during hundreds of millions of years, and even more potently by the fiery deluge poured continually on the primeval surface of our globe. By all these causes the surface of the earth has been so wrought upon as to no longer resemble the primary igneous rock which we