

VI.—EXAMINATION OF A CALCULATION OF THE AGE OF THE EARTH
BASED UPON THE HYPOTHESIS OF THE PERMANENCE OF OCEANS
AND CONTINENTS.

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SOME views in theoretical geology are held so vaguely that when one attempts to grasp them it is like clutching at shadows. To any one who will put his ideas into figures our thanks are therefore due.

Mr. Wallace, in "Island Life,"¹ has treated us to a calculation of the Age of the Earth based upon the hypothesis now becoming fashionable of the "Permanence of Oceans and Continents." It is my intention now to examine into the validity of the figures he gives and the light they throw upon the idea he so strenuously maintains.

The nature of the calculation is this:—He accepts Prof. Haughton's estimate of the maximum thickness of the sedimentary rocks at 177,200 feet, assumes that all the denuded matter from the land area of the world, taken at 57 million square miles, is laid down upon a coast-line 100,000 miles long and 30 miles wide, and infers that as the area of deposit to that of denudation is in that case as 1 to 19, that the vertical accumulation of sediment will be nineteen times as rapid as its removal from the land. The denudation he takes at the

¹ *Island Life*, pp. 214—216. He says: "If therefore we take a width of thirty miles along the whole coast-line of the globe as representing the area over which deposits are forming, corresponding to the maximum thickness as measured by geologists, we shall certainly over—rather than under—estimate the possible rate of deposit. Now a coast-line of 100,000 miles with a width of 30 gives an area of 3,000,000 square miles on which the denuded matter of the whole land-area of 57,000,000 square miles is deposited. As these two areas are as 1 to 19, it follows that deposition, as measured by maximum thickness, goes on at least nineteen times as fast as denudation—probably very much faster. But the mean rate of denudation over the whole earth is about one foot in three thousand years; therefore the rate of maximum deposition will be at least 19 feet in the same time; and as the total maximum thickness of all the stratified rocks of the globe is, according to Professor Haughton, 177,200 feet, the time required to produce this thickness of rock, at the present rate of denudation and deposition, is only 28,000,000 years."

rate of 1 foot in 3,000 years. He finally concludes that the time required to produce this thickness of rock, at the present rate of denudation and deposition, is only 28 million years.

That there is a considerable amount of confusion of ideas pervading this estimate, I think is pretty plain; but let us try and see by reversing his calculation in what conclusions we are landed.

It is evident, if the figures mean anything at all, that 3 millions of square miles 177,200 feet thick represent the whole of the rock removed by denudation in all forms since the geological history of the Earth began. Spread this over 57 million square miles of land, and we get a deposit 9,326 feet thick, deposited in all geological time. But we must not lose sight of the fact that these hypothetic sediments represent rocks made and destroyed over and over again, how often it would be difficult to determine; but taking the proportion of igneous rocks exposed on the surface at $\frac{2}{5}$ of the total area of land,¹ we may safely put it down as at least 12 times; that is, each particle of rock on the average has been denuded and laid down at least 12 times. From this it follows that the *actual* thickness of the sedimentary crust of the earth, if there were no sedimentary rocks except on site of the present land areas, would be $\frac{1}{12} \times 9,326 = 777$ feet. But even Mr. Wallace has to provide for fluctuations of his continents in some degree, and I believe he will admit that a considerable additional area has been alternately land and sea. If he will reason it out, mark its boundaries and estimate its area, I think he will find it cannot even on his own hypothesis be less than double the present land surface of the globe. The average thickness over this increased area would therefore be but 388 feet. If Mr. Wallace can prove that the average thickness of the sedimentary crust of the globe is no more than this, we shall be a long way on the road towards accepting both his hypothesis and his ideas of the Earth's age.²

It so happens that I have but just read "Island Life," and I find my views on the subject of Oceans and Continents characterized as "hasty and superficial." Perhaps they are, and if Mr. Wallace will but just put me right in my analysis of his own calculation, I may be rapidly converted to profounder geological ideas.

¹ See Chemical Denudation in Relation to Geological Times, p. 57.

² Dana, who, it seems (see Continents always Continents, "Nature," March, 1881; p. 410), preceded Mr. Wallace in many of the views expressed in "Island Life," estimates the average thickness of the sedimentary rocks in continental areas at 5 miles = 26,400 feet.