

ocean; but their effect, he says, has become feeble, although originally, when the fluidity of the globe was perfect, "the rise and fall of these ancient land tides could not have been less than from thirteen to sixteen feet." Now, granting for a moment, that these tides have become so feeble as to be incapable of causing the fissured shell of the earth to be first uplifted and then depressed every six hours, still may we not ask whether, during eruptions, the lava, which is supposed to communicate with a great central ocean, would not rise and fall sensibly in a crater such as Stromboli, where there is always melted matter in a state of ebullition?

Whether chemical changes may produce volcanic heat.—Having now explained the reasons which have induced me to question the hypothesis of central heat as the primary source of volcanic action, it remains to consider what has been termed the chemical theory of volcanos. It is well known that many, perhaps all, of the substances of which the earth is composed are continually undergoing chemical changes. To what depth these processes may be continued downwards must, in a great degree, be matter of conjecture; but there is no reason to suspect that, if we could descend to a great distance from the surface, we should find elementary substances differing essentially from those with which we are acquainted.

Playfair has, indeed, attempted to deduce, from an observation of Pallas, that we can, by the aid of geology, see, as it were, into the interior as far as thirty miles or more; for Pallas had described, in the peninsula of Tauris, a series of parallel strata as regular as the leaves of a book, inclined at an angle of 45° to the horizon, and exposed in a continuous section eighty-six English miles long. The height of the range of hills composed of these strata does not exceed twelve hundred feet; but if we measure the thickness of the stratified mass by a line perpendicular to its stratification, the height of the uppermost bed above the undermost must have been originally more than sixty miles; and even allowing, says Playfair, that the strata had shifted during their elevation, we may still suppose a thickness of thirty miles. But, if a deception to the extent of one half is allowed for, on the score of shifting, it may well be asked why the same cause might not have produced a much greater amount of error? It is, moreover, an established doctrine with geologists that strata have, in many situations, accumulated originally on an inclined plane, as must now take place wherever sand, mud, and gravel are thrown into deep water by rivers and torrents. When the beds have been deposited in this manner on a slope they may easily be mistaken for horizontal strata which have been tilted by subsequent movements, and in that case a very exaggerated estimate would be formed of the vertical depth of the original deposit.

Nevertheless, since we discover in mountain chains strata thousands of feet thick, which must have been formed at the bottom of the sea, but are now raised to the height of three or four miles above it, we may fairly speculate on the probability of rocks, such as are now on the surface, existing at the depth of several leagues below; and there