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of displaying a little erudition frequently retard the propagation of the most important facts.

XX. *An Inquiry into the Terrestrial Phænomena produced by the Action of the Ocean.* By JOHN CARR, Esq., of Manchester.—No. II.

To Mr. Tilloch.

SIR, **T**HE several facts and reasoning in my two last papers have been chiefly directed to show, that the exterior of our earth has been moulded into all its infinite variety of inequality by the sole action of moving water; and I am now to inquire into those internal characters which are more immediately the object of geological research, and which have doubtless been effected by the same plastic and potent agency.

The two most inexplicable phænomena in geology, and which, beyond all others, have tempted the inquirer to wander out of the limits of natural operation into hypothetical regions of invention and surmise, are the various inclinations of the strata from horizontal up to vertical, and the elevation of the ocean up to those astonishing heights on our mountains, which bear the most unequivocal testimony of its former action. To get over the latter and greater difficulty, Dr. Hutton, whose extensive personal researches and discriminating powers merit the highest eulogy, has lighted up internal fires in the lowest regions of the earth, whose expansive forces have elevated our continents from the lowest beds of the sea up to their present heights, and, of course, thrown the seas which covered them over the existing continents which had become impoverished and worn out, and which are to undergo a due season of renovated pickling in the briny deep, when the instinctive fires are to withdraw their support from us, shifting their buoyant powers to the submerged lands; and these, kicking the beam, are to deluge our worn-out hills and valleys with the grand restorative specific—dilute muriate of soda. A glance at the map will show how strangely capricious are the operations of these internal ignitions, forcing up in some cases continents extending from pole to pole; and in other instances, in the

pitals, by M. Parmentier; the circular letters of the minister of the interior to the prefects, of 30 Nivose and 15 Messidor, an. xiii.; the reports made by M. Desgenettes, inspector-general of the military hospitals; of professor Pinal; the programmes of the medical jury under the superintendance of M. Chaussier, &c. &c.

midst

midst of vast seas, popping up the bald point of a peaked rock, with scarcely surface enough of hatching room for one of mother Carey's chickens.

Mr. Kirwan, whose various chemical and mineralogical researches have added so extensively to the acquirement and spread of natural science, reprobating these internal fires, as chronologically heathenish and pagan, has let in upon them an orthodox ocean, which has chained off our present seas to fourteen thousand feet below their former depth, leaving countless myriads of bivalved, univalved, and other marine animals, gaping in helpless anguish for their briny beverage, on the summits of our highest mountains. Whether there is more of ingenuity in providing or in filling up such enormous cavernous excavations in the profound bosom of our consolidated globe, I shall not stop to inquire.

To account for the great elevation and other anomalous irregularities in the strata, Mr. Farey, whose indefatigable personal researches have already added, and are yet likely to add, so much to our practical acquisitions, has announced his intention of employing an extinct erratic satellite, whose near approach to our globe is to reverse the direction of gravity, and excite by its attractive force rebellious movements in the upper strata, heaving them up in successive and doubtful movements, whither to continue attached to their parent planet, or, yielding to the usual and dangerous seductions of novelty, to fly off to the evanescent stranger. Nay, it should even seem that some of the undutiful progeny have actually made this most singular elopement, and that the denudated tops of our eminences exhibit naked proofs of these paternal derelictions. As, however, the vertical strata and other anomalies which this luration lever is made to heave up are disseminated in local patches all over the earth, the movements of the heavenly visitant, unlike the even and equable progression of all its ærial prototypes, must have been strangely vagarious, and made in every latitudinary direction, by occasional dips and irregular snatches, like the plunderous dash of a hungry hawk at a flight of passing pigeons.

It is in itself farcical to apply any serious argument to such hypothetical reveries as these; and this consideration, I trust, will apologize for departing altogether from the decorous gravity of philosophical disquisition.

As far as we have yet made any successful discoveries into the operations of Nature, we find them all the result of permanent laws, which, acting with provident wisdom and rotative perpetuity, give a precision, a stability, and a du-
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ration, to every natural system, wherein no human calculation can trace out either a beginning or an end. Chance, mischievous irregularity, or accidental violence of action, have no place in the execution of these undeviating laws; they are only the blind applications of our blind and partial views of things.

The prolonged preservation of the ephemeral species, whose buzzing progeny commence and terminate their existence on the same day, is, as far as we can see and judge, as effectually provided for and secured, as that of the solar system.

And shall we look upon the stupendous and massive effects which the exterior and interior survey of our globe every where displays; and search for their causes amongst temporary and extinct agents? Shall so mighty an occurrence, in the scheme of terrestrial existence, as the stratified conformation and transition arrangements of the vast materials of our earth, have no permanently established laws for their regulation and governance, while the fluttering insect of an hour is provided with its peculiar rules of formation and perpetual duration? It was the impressive conviction that all geological phænomena have resulted from systematic and permanently operating laws, which are now in full activity, and the reprobation of all fortuitous hypothesis in their investigation, that first induced me to offer my sentiments on a subject which had previously occupied my attention only in common with other branches of natural history: and I will now proceed with the sketch of that outline, which I offer with the utmost diffidence, as a remote approximation towards a theory of the geology of our earth.

The submersion of our present continents for an indefinite duration, and the formation of all their strata by marine action, are no longer questions in modern science; but it is yet an unascertained, and perhaps the most important of all geological queries:—Whether the present conformation of the interior of our earth has been derived from one, or from many successive immersions of the same country? and until a specific and decisive answer can be given to this most interesting interrogatory, the multifarious phænomena of geological discovery will continue to be, as they have hitherto been, the prey and the sport of ingenious sophism and delusive hypothesis.

There are, I conceive, several distinct circumstances, which will authorise a probable decision on this most important question of singular or plural immersion. All stratified rock, not evidently the produce of marine shells

in their native beds, has been formed from the consolidation of strata previously derived from aqueous deposition. The Vulcanists triumphantly assign the consolidation, and in many cases maintain the actual fusion of the strata, to internal fires, alleging that a mere hardening by evaporation of the moisture, in the stony matter, would necessarily leave the rock in a state of porosity, which observation everywhere contradicts. The truth however is, that the assumption of internal fires is as superfluous as it is visionary, and the desiccation of solidifiable strata, under an incalculable pressure of the superincumbent strata, aided by the agglutination of stony matter in solution, during a period of indefinite extent, is amply sufficient to account for the highly indurated and dense state in which we now find all stratified rock.

The absolute completion of the solidifying process seems however to require an emersion above the level of the ocean; for it is difficult to imagine how many of the species of rock with which we are acquainted, could have been both precipitated and consolidated under one and the same immersion. If there is any truth in this observation, it would decide the question of more than one submersion; for there are numerous instances of rock which bear conclusive evidence of the attrition of marine action after their induration. The rock of Table Mountain at the Cape of Good Hope may be given as one of these instances. It is repugnant to all rational belief, to admit that the materials of that vast rock experienced an aqueous deposition, a subsequent consolidation, and a final destructive denudation to its present state, all under one and the same immersion.

The numerous breaks and separations which traverse the strata, designated faults, throws, heaves, troubles, and other names expressive of their effects in mining, are also, I think, evidence of distinct immersions. Their frequent rectilinear direction, and their worn and abraded angular asperities, fully prove that they were formed after the consolidation of the strata in which they occur, and also, I conceive, establish them to have been originally chasms, gullies, ravines, valleys, channels, and other land excavations, clefts and fissures, and to have been filled up in a subsequent immersion.

Mineral veins in extensive fissures which traverse stratified rock, can, I imagine, only be referred to the same origin, and therefore testify the same result. The minerals have assuredly obtained their present situation in an immersion entirely distinct from that in which the strata were formed.

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The monstrous opinion that all minerals and their beds have been forced up from below, and in their ascent have produced the enormous dispartations of rock wherein we now find them, is rapidly declining; and the rational and far more natural conclusion, that all minerals and their heterogeneous matrices have arrived at their situations by a descending process, is daily establishing itself; and it can be maintained on no other reasoning than that the separations in the strata were originally land fissures, clefts, rocky valleys, and other excavations, such as all countries now more or less abound with; and that they were filled up with diversified materials in a subsequent immersion. In fact, numbers of these fissures bear palpable indication of a stratified form in their contents; and those sparry and other incrustations which are so usually found adhering, in many distinct layers over each other, to the rocky sides of mines, and which have been deemed certain proofs of actual fusion, are, on the contrary, the most decisive evidence of an aqueous process down the perpendicular side of the rock, the distinct layers of different materials concreting and passing over each other in regular succession.

Perhaps the most irrefragable proofs of the distinct immersions of the same country are to be found in those singular instances, sufficiently frequent, of the formation of secondary horizontal strata over vertical strata of primary granite and schistus.

This rectangular formation of strata contains in itself a physical impossibility, as to its being the produce of a single immersion.

Other proofs of separate submersions of the same country are to be found in the extensive beds of sand and pebbles, whose present situation can only be referred to former shores of the ocean. All granular sand and loose stone are derived from the detritus of rock, the desiccated strata of former marine deposition; and all pebbles have acquired their smooth and rounded forms from the attrition of agitated water in the streams of rivers or on the shores of the sea. Immense beds of such sand and pebbles are found in every varying situation, from the tops of the highest mountains to the bottoms of the lowest valleys, either in loose masses, or in vast formations of pudding-stone and breccias, which are merely the indurated beds of sand and intermixed pebbles. Now if we trace these numerous and extensive beds from the first marine precipitation of the materials, through the subsequent desiccation of the strata, the after disintegration

disintegration of the rock, the period of aqueous attrition and rounding of the pebbles, their subsequent consolidation into breccia, and the after disintegration from pudding-stone again into sand and gravel, as occurs in thousands of instances, it will, I think, compel an acknowledgment that this wonderful history of material transformation includes a duration of time, in which we can perceive no commencement, and a distinct diversity of marine submersions of the same country.

Indeed, to pursue this most astonishing transition of matter from one state to another, without even approximating the limits of rational probability, it may be truly asserted, that there is not a cubic foot of material in any natural bed within the range of human inspection, that is not strictly derivative, having obtained its present form from its destructive dissolution in a former state; and that all our present continents have been constructed from the numberless remnants and fragments of other more ancient countries, evincing altogether periods of duration, systems of transition, and alternations of land and ocean, to which we can assign neither commencement nor termination.

What has been said, and much more that might be offered, afford, I think, as much of probable evidence as the nature of the case might be expected to furnish, that the different portions of our globe have been subjected to an indefinite number of marine immersions, and that it is in the infinite diversity of alterative effects which such alternating changes of land and sea would operate on local portions of the earth, that we are to look for the only natural illustration of the principal phænomena of geology. Strictly guiding our researches by the laws which we now find in action, we shall discover in Nature neither infancy nor old age, and the operations of the past and of the future will be found to human scrutiny equally illimitable. Every waste will have its compensation, and every decomposition its reconsolidation, and an endless succession of decay and reproduction will be found revolving through the whole in circular perpetuity.

The geologist who enters on his pursuit without these enlarged views, will be measuring the pyramid by the fragment of its apex. Every rock will be an obstacle, and every chasm a barrier to his progress; and calling hypothetical invention to his aid, he will fancy he is advancing, when, like the dog in the wheel, he is only scrambling against a bank.

I have, Mr. Editor, a great deal more to say on the diversified

versified inclinations of the strata, and on the probable cause which effects the alternating changes of land and sea ; but having already trespassed so far on the periodical bounds of your limited and select publication, I shall decline troubling you further with my crude remarks. Their object has been not to offer new facts, but new views of the subject ; and to point out, however imperfectly, the most probable channel through which we are likely to arrive at any rational theory of the diversified conformation of our globe.

I am, sir, your obedient humble servant,

JOHN CARR.

Princess Street, Manchester,
August, 1809.

XXI. *Proceedings of Learned Societies.*

FRENCH NATIONAL INSTITUTE.

Analysis of the Labours of the Class of Mathematical and Physical Sciences of the French Institute, for the Year 1807.

[Concluded from p. 76.]

M. BOUVARD has made a most useful addition to astronomy by his tables of Jupiter and Saturn. It will be recollected that the inequalities of these two planets have long perplexed astronomers, and would have still continued to do so, if the analysis of M. La Place had not discovered equations of a long period, which, by being confounded with the mean motions, had apparently accelerated the motion of Jupiter, and proportionally retarded that of Saturn. By the help of this theory, compared with the best observations made for more than one hundred years, M. Delambre succeeded in reducing to half a minute, under the most unfavourable circumstances, the errors of the tables, which formerly were from 15 to 20 times greater for Jupiter, and more than 40 times for Saturn. The errors would have been still less if modern observations were more numerous, and admitted of our rejecting every thing that preceded 1745 : but the author had disposed his work in such a way as to be able to resume it, either of himself, or by means of another astronomer, as soon as some good observations were at hand. There remained besides a trifling inaccuracy respecting the mass of Saturn, and consequently the inequalities of Jupiter—M. La Place has revised and perfected his theory—M. Bouvard has been able to acquire a clearer idea of the doubtful mass ;—and from all these changes, partly owing to good observations made since the printing of the first tables in 1789,

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