

ATMOSPHERIC FORCES.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—I am grateful to Professor Jukes for his handsome acknowledgment of the influence exercised on his “views of the amount of atmospheric forces,” by my argument of thirty years back, drawn from the volcanic region of Central France. I may mention that another distinguished geologist, Mr. A. Geikie, has also, in his paper on Auvergne, printed in “Notes of Travel by Vacation Tourists,” 1861, borne similar testimony to the “enlarged views” he obtained there of the “enormous potency of rain and rivers in effecting the degradation of the land.”

With regard to any difference still existing between Professor Jukes and myself as to the amount of influence exercised by “internal” or subterranean force upon the external configuration of the earth, I think with him that it can amount to little more than a question as to the meaning of the words he employs, since I now understand him to explain that by the phrase “form of the ground” he only means the latest touches given to the surface, such for example as are seen in “the abrasion of a volcanic cone by winds or rain in the course of a few years” (p. 332), not the grander superficial inequalities of mountain and valley, dry land and subaqueous hollow, which alone I intended to refer in a large degree to the agency of subterranean forces.

Some little misunderstanding may yet remain under cover of the Professor's use of the word “direct,” as when he says (p. 332) “The direct effect of earthquakes in cracking, or bending the surface are surely very insignificant, etc.” Now, if by “earthquake” is meant (as of course must be meant) those oscillations of level which have in some localities carried up beds of recent sea-shells to heights of hundreds of feet, and Tertiary marine strata to that of thousands, above the sea level, while portions of the same beds, once continuous with these, and even now at no great horizontal distance, have remained unmoved, or have been proportionately depressed, I cannot understand how such effects can be styled “insignificant,” or be considered of little moment in an inquiry as to the causes of the “form of the ground.”

The paramount influence exercised by subterranean energy in determining the configuration of the earth's surface, might indeed be inferred *à priori* from the considerations, (1) That no upheaval or depression of surface-rocks could take place without leaving proportionate inequalities of superficial level; and (2) That the inequalities so produced must have always largely determined both the direction and the force of the external denuding agencies. That such changes of level have been taking place throughout all time down to the present day, and upon the largest scale, though probably never on the large scale “*per saltum*,” but rather by slow continuous movements, or frequently repeated jerks, such as are characteristic of

recent earthquakes, Mr. Jukes will not of course deny. All geologists, indeed, recognise as a natural law the tendency of all the external denuding forces to reduce the surface of the earth to one uniform level, so that but for the opposing agency of the subterranean forces no dry land could long exist. It seems, therefore, like a paradox to deny to the latter power any "direct" or considerable share in the external configuration of the earth.

But there is something more than this to be said. Mr. Jukes, as I before remarked, makes the large admission that all volcanic hills and mountains are superficial protuberances "directly" produced by internal force. Now, on examination of any map of the globe showing the position of the known volcanos and volcanic formations, it will be seen that they are for the most part arranged in linear bands bearing a remarkable parallelism to the nearest non-volcanic mountain ranges. Must there not be some common cause for this remarkable correspondence of direction? May we not presume that while the volcanic mountain ranges have risen by means of the eruption through linear fractures of the earth's crust of subterranean matter in a liquified or gaseous condition, the non-volcanic mountains have been contemporaneously rising through parallel fractures, in consequence of the upward pressure of subterranean matter, which, not being able to find an issue in a liquified or gaseous form, has forced itself, in a more or less solid or pasty state, into and through the overlying rocks, carrying them up with it, or shouldering them off on either side,—and thus bringing up to or near the surface those bulky crystalline masses and corrugated metamorphic strata of which the axial portions of such mountain ranges are so often seen to consist? It seems certain, for example, that the Alps and Pyrenees were rising by degrees from below the sea while the intermediate granitic plateau of Central France remained stationary in level, but gave birth to a series of volcanic eruptions which deluged its surface, and that of the lacustrine strata, that filled its hollows with lava-beds. A similar series of eruptions were about the same time taking place along a band of country north of the Alps and nearly parallel to their main direction, reaching from the Rhine through Central Germany to Hungary. If we are ever to acquire any definite notion of the changes that have taken place in the crust of the globe, and the causes of its varying external configuration and internal structure, we must not lose sight of considerations such as these, or undervalue the internal forces which have unquestionably contributed quite as much, if not more, than external denuding agencies to produce the results in question.

It was simply to remind Professor Jukes and geologists in general of this, and not to go more deeply into a subject of such importance, that I ventured to challenge his apparent negation of the "internal forces" of the globe as one of the "direct" causes of its superficial configuration.

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CASTLE COMBE, CHIPPENHAM, *July 10th*, 1866.