

me that the illustration is not apt. The amount of work to which I refer must be expended on bending and breaking the *particular mass* of rock under consideration, and in shearing the parts of it past one another, and not on the rock outside of it. Hence the energy which is its equivalent has been introduced into the mass; and, energy being indestructible, none of it is lost, and there is now more energy in the mass than there was before. The question which I proposed was simply, what form does that energy take? Is it heat? or is it, as I (perhaps rashly) enquired, chemical energy?

Dr. Irving says that both Mr. Harker and myself have overlooked the one great factor of metamorphism, viz. superheated water. I do not think we either of us proposed to discuss all the causes of metamorphism, but only the mechanical.

O. FISHER.

HARLTON, CAMBRIDGE, 11 July, 1891.

DYNAMO-METAMORPHISM AGAIN.

SIR,—A short space will suffice for what I have to say in reply to Dr. Irving (p. 296). I am sorry to have misunderstood, or, as he phrases it 'misrepresented,' him as assuming that the whole of the work passes into heat. I am not sure that even now his position is clear to me. His dictum "chemical combination must generate heat" is intelligible, though, as Mr. Fisher has pointed out, by no means universally accepted by chemists; but simple combination does not cover any of the chemical changes that characterize the metamorphism of rocks. These are "much more complex," and if Dr. Irving believes that in these cases there is always, on the balance, a positive amount of heat generated, he believes that for which no proof whatever is offered.

It is possible that some of the differences between Dr. Irving and myself would resolve into a question of words, if his language were more intelligible to me; but unfortunately his usage of physical terms often bears no relation to the definitions in use among physicists. "Intensity of heat" seems to mean temperature, but what are we to make of the expression (used in taxing another correspondent with confusion of thought) "the energy is presented in the mechanical form of pressure"? The simple word 'deformation' also appears to be employed in some occult sense.

The experiments of Cailletet and Pfaff which I cited are the same as those referred to in the "Report on Slaty Cleavage" mentioned by Dr. Irving. They seem to establish that increased pressure retards chemical changes involving a diminution of density, while Spring's researches tend to show that pressure assists changes involving an increase of density. The two conclusions appear to me not contradictory, but complementary parts of one law. As regards Spring's experiments, Dr. Irving has ludicrously misunderstood me when he implies that I deny the generation of heat by friction during the compression. What I said was that the heat so generated was carefully removed (by conduction). As Major-General McMahon points out (at p. 90 of this volume), M. Spring himself seems to have changed his views as regards the significance of his work, but

the published details of his experiments leave others free to draw their own conclusions from them. Kroustchoff's interesting synthetic production of hornblende and other minerals do not seem to throw any new light on the problems in hand.

ALFRED HARKER.

OBITUARY.

DANIEL MACKINTOSH, F.G.S.

BORN 1815. DIED 19 JULY, 1891.

WE regret to announce the death of Mr. Daniel Mackintosh, F.G.S., who was born in the memorable year 1815, at Blairgowrie, in Perthshire, where his father had a mill worked by water-power. Imbued with an early love of Natural Science, he left Scotland when about 30 years of age. For many years he was a lecturer on Scientific subjects and well known in the south of England, where he lectured at various public institutions and schools on Astronomy, Geology, Physical Geology and Ethnology with considerable success. His manner as a lecturer was clear and spirited, and aroused an interest in the subjects of which he treated.

Mr. Mackintosh was elected a Fellow of the Geological Society in 1861, and contributed his first paper on "Terminal Curvature" in 1867, and afterwards numerous papers to the Society on Surface Sculpture, Denudation, Drift Deposits and the Dispersion of Erratic Blocks. Many of his papers are in the "Reports of the British Association," and the "Proceedings" of Societies of which he was a member. He was a frequent contributor to the *GEOLOGICAL MAGAZINE*, and other scientific publications.

In 1869 Mr. Mackintosh produced his work on "The Scenery of England and Wales," in which he favoured the action of the sea as the greatest denuding agent, and it is illustrated by 86 sketches of geological interest. He received four successive grants in aid of Original Scientific Research, from the Government Grant of the Royal Society. In 1881, he was presented with the Kingsley Memorial Medal of the Chester Society of Natural Science, and in 1886 was awarded the proceeds of the balance of the Lyell Fund by the Geological Society, in recognition of his studies of the Glacial and other Superficial Deposits of the north-west of England.

About 20 years ago Mr. Mackintosh went to reside at Chester, but a few years after he settled in Birkenhead, and was president of the Liverpool Geological Society during 1881-3. In recent years he devoted much time to the examination of the Drift Deposits and Boulders of North Wales, and during his last exploration ascended Cader Idris when nearly 70 years of age. Soon after he began to fail in both mind and body, and died on the 19th of July last, and his remains now rest in Flaybrick Cemetery, Birkenhead, close to the glaciated areas he so frequently visited and described. His papers on the Glacial Deposits will hold a permanent place in geological literature, and he will be remembered for his kind and gentle disposition by all who came in contact with him.—G. H. M.