In this connection I may perhaps be allowed to refer again to the occurrence of apatite in slag, alluded to above. This still remains the only recorded case in which that mineral has been observed to crystallize from an artificial silicate magma, analogous to its occurrence in eruptive rocks. After first noticing it I had opportunity of seeing the slag in question formed almost continuously for many months. It would frequently happen that for days at a time no crystals of apatite could be seen in the cavities, and then again they would reappear in great quantity. Although much attention was given to the subject, nothing could be observed to account for either disappearance or reappearance, no change taking place in composition of the slag, or in conditions of formation and cooling.

Attempts were made by Dr. Cohen, of Owens College, to obtain apatite in small fusions in the laboratory. Pieces of the slag rich in apatite were melted in crucibles; similar fusions were made of mixtures of the constituents of the slag in the proportions shown by analysis, and both were subjected to a prolonged "récuit," as in the experiments of Fouqué and Lévy, but no apatite was ever formed.

The crystals of Fayalite formed in slags so very rich in iron show very strongly developed cleavages. Rosenbusch alludes to the fact that the cleavages are more distinct in olivine containing much iron, and this observation is fully borne out in thin sections such as those above alluded to.

NOTICES OF MEMOIRS.

I.—On the Manufacture of Serpentine in Nature's Workshop. By Major-General C. A. McMahon, F.G.S.[1]

THE rocks from which serpentine is mainly derived by an aqueous process are called peridotites though there are several varieties which receive distinctive names. They are all characterized by the predominance of the mineral peridote or olivine. Some meteorites exhibit a marked affinity with peridotites, containing, like the latter, olivine, rhombic and monoclinic pyroxene, and occasionally some basic felspar. Peridotites are not commonly found on the earth's surface, one reason being that olivine is an unstable mineral that readily absorbs water and passes into serpentine.

General McMahon detailed the various ways by which water finds its way into minerals; namely, by cracks; by planes of cleavage and of "chemical weakness"; and by capillary flow through the interspaces between molecules. In connection with the latter branch of the subject he gave a sketch of the kinetic theory as applied to solids, and of Boscovich's theory which helped to elucidate the kinetic hypothesis; and he stated that whether we accept these theories or not, we must give up the idea that the

[1] Abstract of a Discourse delivered before a Meeting of the Western Microscopic Club, London, on the 4th November, 1889.

https://doi.org/10.1017/S0016756800146151 Published online by Cambridge University Press

molecules of which crystalline bodies are composed are compacted tightly together, like the cells of a honeycomb, without interspaces between them; and he referred to some experiments by Professor Heddle on the absorption of water by granites and greenstones, and to his own observations on the practical porosity of some basic igneous rocks. Allusion was also made to the fact that the application of the undulatory theory to the optical phenomena exhibited by transparent bodies involved the assumption of molecular interspaces.

General McMahon then alluded to the law that governs capillary flow, and mentioned that pressure gauges set up in the Severn tunnel 190 feet from the surface, showed that the actual pressure of the water in the rocks at the tunnel exactly corresponded to the calculated pressure, being about 80lbs. per square inch; a fact that proved that the water permeating the rocks acted in one unbroken head. He then alluded to the experiments of Poiseulle, who had shown that capillary flow was increased by heat; water at 45° Centigrade flowing through capillaries three times faster than water at zero Centigrade.

The capacity of water to hold carbon dioxide and oxygen in solution was next alluded to. Water at 60° is capable of taking up rather more than its own volume of carbon dioxide, and meteoric water contains two cubic inches of oxygen and one cubic inch of carbon dioxide per gallon. As rain-water passes downwards into the earth the percentage of oxygen is reduced and that of carbon dioxide increased. He explained how this fact, as pointed out by Prof. Heddle in a paper read before the Royal Society, Edinburgh, accounted for the ferrous oxide in olivine being removed as carbonate, when rocks were acted on at some depth, but converted into magnetite, or ferric oxide, when subjected to aqueous agencies nearer the surface.

Carbonated water is capable of decomposing the silicate of magnesia, and of carrying off some of the magnesia in the form of carbonate, as proved experimentally by Bischof. Profs. W. E. and R. E. Rogers further showed that digestion in simple water for three days was sufficient to remove an appreciable amount of magnesia from such minerals as hornblende. General McMahon stated that he obtained a similar result by the digestion of powdered olivine in distilled water heated to about 100° F.

The formula for olivine is $2MgO, 2FeO, SiO_2$, and it was explained in detail how the removal of the ferrous oxide, a portion of the magnesium silicate, and the absorption of water converted olivine into serpentine. The formula for the latter is $3MgO, 2SiO_2, 2H_2O$.

Taking enstatite and malacolite as types of the rhombic and monoclinic pyroxenes, and tremolite as that of the amphiboles, he explained how the lime was removed and the percentage of magnesia was increased. Whilst olivine, the predominant mineral, was parting with some of its magnesia, the silica set free in the pyroxene by the decomposition of the silicate of lime combined with this surplus magnesia on its exit from the olivine and a gradual conversion of pyroxene into serpentine was the result.

II.—The "Manure" Gravels of Wexford.[1] By Alfred Bell.

SINCE the last report the explorations carried out in the area of the gravels, in Ballybrack, Balscaddin, and Balbriggan Bays, in Larne Lough and the vicinity, and Portrush, have much augmented the material previously accumulated.

The exigencies of building and road-making have practically obliterated the most prolific portion of the drifts in Ballybrack (or Killiney) Bay and the deposit at Portrush, the only traces of the shell-bed at the latter place occurring between the rocky masses on the shore above high-water mark. Fortunately, previous to these operations a quantity of material was obtained by the reporter, and a list of about 120 species will be given in the sequel, wherein a brief notice of the principal deposits will be found, with lists of fossils obtained by the writer and previous observers. The line of research to which an examination of the fossils has led is to the effect (1) that the so-called Lower, Middle, and Upper drifts in Ballybrack Bay have no connection whatever with the equally so-named deposits in the English and Welsh areas, but are a continuation northward of the Cotentin—St. Erth-Wexford sea-bed referred to in the second report, 1888, further traces of this extension obtaining in the glacial clays of the Isle of Man, *Nassa reticosa*, among other Pliocene mollusca, occurring in the northern portion of the island.

Coeval with the Pliocene fauna of Wexford, Ballybrack, and the Isle of Man are numerous species of northern origin, and examination of these suggests a Scandinavian rather than an American or Greenlandic origin—a suggestion intensified by the presence of a true Scandinavian fauna in several parts of the Scottish lowlands from the Clyde to the Forth and the eastern side of Scotland; and it is not perhaps too improbable to suppose that the Pliocene shells obtained by Mr. T. F. Jamieson in Aberdeenshire came by this route rather than from the Suffolk crag-beds. From the absence of the Pliocene fauna northward of the before-quoted localities on the Irish coast and Manxland, the writer is of opinion that the Irish Channel was closed when the strata at these places were being accumulated, and

(2) That the Severn drifts from Worcester northwards into Lancashire are of much later date, not originating till the south of Ireland was separated from the continent. And lastly, that the faunas obtained both in England and Ireland, near Dublin and Wicklow, at elevations of 1000 feet and more, are "remanie" and not in their original habitat.

An examination of the gravelly and shelly sand dredged from the Turbot bank in the Irish Sea has long convinced the writer that the accumulation is in the main of post-glacial age, intermixed with a few recent forms, easily distinguished from the older species by their appearance. The material is very rich in other groups than the molluscan, catalogued already by Mr. Hyndman. Of all these he purposes giving a list.

[1] Third Report read in Section C., Geology, at the Meeting of the British Association, Newcastle-upon-Tyne, 1889.

It may be well to say that the matter first examined was sent to the writer some years back by Mr. E. Waller, who worked with Mr. Hyndman on the mollusca; and, secondly, from a quantity of Mr. Hyndman's own washings, placed at his disposal by Mr. S. A. Stewart, of Belfast.

REVIEWS.

I.—Report on the Geology of the Rainy Lake Region. By Andrew C. Lawson, M.A., Ph.D. Annual Report of the Geological and Natural History Survey of Canada for 1887. Part F.

THE progress of knowledge with reference to the foliated crystalline rocks has been very rapid of late years, and accompanied by incidents that may almost be described as sensational. One such incident was the announcement by Mr. Lawson at the meeting of the International Geological Congress, held in London, that the Laurentian rocks in the neighbourhood of Rainy Lake were intrusive into a series consisting of schists, diabases, felsites, agglomerates, and greywackes.

Up to the time of the announcement of Mr. Lawson's discoveries it had been supposed that the Laurentian rocks were always older than the rocks in contact with them, and the hunters after that geological Will o' th' wisp, the primitive crust of the earth, were beginning to feel tolerably satisfied that they had at last caught the object which had hitherto eluded their grasp. It was seen at once that Mr. Lawson's discoveries reopened the whole Laurentian question, and made it possible if not probable that the so-called Laurentian system was a complex, and that the most characteristic rocks of the system—the gneisses—were plutonic igneous rocks, actually of later date than rocks which have been formed by such agencies as are now in operation at the surface of the earth.

We have in the Memoir before us the details of Mr. Lawson's work, illustrated by an admirable map of the Rainy Lake region, and by photographs of actual junctions. A study of this Memoir will leave no doubt in the mind of any geologist that Mr. Lawson has fully established his main point, which is this—that over an area of several thousand square miles the gneisses hitherto[1] regarded as Laurentian have consolidated as such from a plastic magma long after the formation of the rocks which encircle them. As this point is one of great importance we will give a somewhat detailed account of Mr. Lawson's work.

The rocks into which the Laurentian is intrusive are divided by the author into two series—the Coutchiching and the Keewatin. The earlier or Coutchiching series consists mainly of mica-schists and granulitic gneisses. The dominant constituents of the mica-schists are granulitic quartz and biotite. The gneisses differ from

[1] The term Laurentian is still retained for these rocks in this Memoir.