



granophyres appear to be closely related to the extrusive rhyolites among which they are intruded. This fixes an upper limit to the age of the diabases in this district.

The various beds strike more or less east to west, and dip steadily southwards at about 40° until the Talylyn Mudstones are reached, when folding and rolling of the beds immediately begin. Two N.E.–S.W. shatter faults—the Dolgelley and Talylyn faults—cause a certain amount of repetition, and give rise to the Dolgelley-Llyn Gwernon and to the Talylyn Valleys, the former to the north and the latter to the south of the escarpment. A strike-fault between Mynydd Gader and Cader Idris cuts out the whole of the Bifidus Beds, bringing the Lower Acid and the Lower Basic Volcanic Series against one another. The intrusive rocks frequently cause local variations in the dip and strike.

All the softer strata are strongly cleaved, so that fossils are difficult to obtain. The slates within the Lower Acid Series have yielded a few extensiform graptolites, while from the Bifidus Beds the characteristic fossils were obtained at numerous localities. The *D. murchisoni* zone has not been recognized by the authors, its place presumably being occupied by a part of the Lower Basic Series. The dark mudstones among which the pisolitic iron-ore is developed have yielded rather obscure graptolites, which, however, indicate a fairly high horizon in the Llandeilo Series. The presence of *Anplexograptus arctus* and *Glyptograptus teretiusculus* var. *euglyphus* in the lowest beds of the Talylyn Mudstones indicates a high horizon in the Glenkiln, or, in other words, a low horizon in the Caradocian, and suggests that the immediately underlying Upper Acid Series is at approximately the same horizon as the Snowdonian volcanic rocks of Conway. This youngest of the four volcanic series on Cader Idris is therefore considerably higher in the Ordovician than has been previously supposed. The position of the boundary between Caradocian and Llandeilian has not yet been established, owing to the unfossiliferous character of the blue-grey mudstones of Llyn-y-Gader and Llyn-Cau.

One of the authors (A. H. Cox) is indebted to the Government Grant Committee of the Royal Society for a grant which has partially defrayed the expenses involved in the investigation. The area is being mapped on the 6 inch scale.

II.—THE CORROSIVE ACTION OF CERTAIN BRINES IN MANITOBA.<sup>1</sup> By  
Professor R. C. WALLACE, M.A., Ph.D., B.Sc.

BRINE springs issue from Middle and Upper Devonian limestones and dolomites at the foot of the Manitoba escarpment. At least eighty brine areas are known, with a total flow—during the dry season—of approximately 500 gallons per minute. The water circulates in the Dakota Sandstone, the basal member of the Cretaceous series, and extends laterally into the Devonian calciferous formation, from which it leaches sodium chloride, disseminated through certain dolomite horizons. The composition of the brines,

<sup>1</sup> Read before the British Association, Section C, Manchester, 1915.

expressed in percentages of total solids, is very similar to that of sea-water. It is a somewhat purer solution of sodium chloride, and also a more concentrated solution, than sea-water, the percentage salinity being 5-7 (sea-water 3.5).

The salt-flats where the springs reach the surface are devoid of vegetation and studded with ice-carried boulders. These are representative of the pre-Cambrian igneous series of North-Central Canada—granites, gneisses, and epidiorites. They have suffered intense chemical disintegration, large boulders having been reduced to half their original size. Different minerals have been affected to different extents, but not even quartz or garnet has escaped corrosion. Ferromagnesian have been most intensely affected; and gneissose structures, hardly noticeable on unweathered surfaces, stand clearly revealed. The striking difference between the action of these brines and that of sea-water calls for explanation.

Thin crusts of salt gather, during the summer months, on the flats and around the boulders. The salt is somewhat deliquescent; and thin films of brine are drawn, by surface tension, over the surface of the boulders. Water in contact with the atmosphere is a powerful disintegrant. Alkalies are removed as chlorides or carbonates, and silica and alumina are precipitated as gels, separately or in combination. The gels exercise selective adsorption on the salts of the brine, alkali being taken up and the brine being left richer in the acid radicals. The brine is thereby rendered a more active disintegrating agent, and the process goes on continuously. The function of the dissolved salts is considered to be twofold: (1) they provide a thin film of liquid in contact with atmospheric oxygen; (2) owing to partial adsorption by colloids, they provide an acid residual solution, which is a powerful corrosive agent.

The evidences of the corrosive action of sea-water on beach boulders are no doubt obscured by mechanical attrition due to wave action. Such corrosion cannot, however, be compared in intensity with that of the brines. Boulders between high- and low-water mark are alternately submerged and dry to the base—a state of affairs inimical to the persistence of thin films of liquid on the surface of the boulders. The initial conditions are consequently wanting; and the relative immunity of beach boulders from chemical corrosion is due, not to any inability of sea-water to act as a corrosive, but to the absence of favourable conditions for the activity of the solution.

#### REVIEWS.

I.—THE ANTIQUITY OF MAN. By ARTHUR KEITH, M.D., F.R.S. pp. 519, with 189 text-figures. London: Williams & Norgate, 1915. Price 10s. 6d. net.

THE subject of the antiquity of man seems naturally to fall to the geologist, with such aid as he can obtain from the human anatomist and archæologist. The value of the evidence which has to be considered can only be estimated by one who has a practical acquaintance with geological problems in the field. From Lyell onwards, therefore, all the most important works dealing with the