

profit may sometimes indirectly arise from some branches of astronomical work or investigation; but the only sound and honest reason that can be given for such work is, that it stimulates the highest form of intellectual activity, widens the already broad field of investigation, and increases the sum of human knowledge. Whoever pleads the cause of astronomy on a lower plane discounts the intelligence of himself or of his audience. Why should the astronomer stoop to select a less noble theme, or consider it from a lower point of view? He who leads an intelligent and thoughtful life must feel himself in daily touch with those phenomena that are involved in the most important astronomical problems of the present and the immediate future. The figure and motions of the earth which he treads; the constitution and translation of the sun that invigorates his life and lights his days; the movements and structure of the moon and planets that beautify his nights; the proper motions and distances of the countless stars that nightly set before his eyes the highest types of rigorous law and of boundless space that the mind can grasp; all of these, and more, tend to convince him that the constantly growing demand for broader and more exact knowledge is ample warrant for the time and expense involved in the most profound astronomical investigation. In this direction lies the justification of astronomical research; on this basis the astronomer is sure of the stimulating support of every cultivated mind as long as the questions "why" and "how" are constantly reiterated and still are unanswered. On this ground, and on this alone, rest the valid reasons for the expenditure of corporate, municipal, or national funds for the establishment of expensive observatories and the prosecution of astronomical investigations; and in the closing years of this century the conscientious astronomer can in no way more thoroughly vindicate the highest claims of his science than by holding the standard of work well above the popular fancies of the hour, and by devoting his time and energy to that class of fundamental work that shall not only satisfy the rigorous demands of the present time, but shall make the last decade of the nineteenth century an important epoch in the real progress of astronomy.

GEOLOGY AT THE BRITISH ASSOCIATION.

NEARLY fifty papers were contributed to Section C during the meeting of the British Association, and although no new facts or theories of startling interest were brought forward, the record of the year's geological work was decidedly above the average. Owing to Professor Lapworth's regrettable illness his address could not be delivered until Monday, and the chair at the meetings had usually to be taken by one of the vice-presidents.

Glacial and local papers occupied the first two days, the most remarkable being the pair by Messrs. Peach and Horne on the Radiolarian Chert of Arenig age, once probably a deep-sea ooze, which covers 3000 square miles in the southern uplands, and passes like the Moffat shales into sediment when traced towards the north. When the chert is traced to within half a mile of the Loch Doon granite the quartz has become quite granulitic, the radiolaria being still recognizable in the matrix although there is a faint development of mica; close to the granite the rock is completely recrystallized, and consists entirely of large quartz particles full of liquid cavities and rounded inclusions of biotite. Dr. Hicks claimed as pre-Cambrian some tender gneisses, schists, quartzites, and limestones, of the central Highlands, of which he gave microscopic descriptions, and Prof. Blake argued that the discovery of *Olenellus* of the type of *O. Thompsoni*, in beds above the Torridon sandstone, did not necessarily parallel these beds with those containing *Olenellus* beneath the Paradoxides zone of America. Amongst the other papers dealing with Palæozoic rocks may be noted Prof. Blake's discovery of a felsite like that of Llyn Padarn, apparently intrusive into the Llanberis slates, seen in a new section in the Penrhyn quarries; Prof. Sollas's discovery of bodies like radiolaria in the slates of Howth, and the limestone of Culdaff; and Prof. Bonney's comparison of the pebbles of the English Bunter with those in the old red conglomerates in Scotland.

Several important glacial papers were read. Dr. Crosskey reported on the recording of new erratics chiefly in the north of England. Mr. Lomas traced Boulders of the Ailsa Craig, Riebeckite Rock, on Moel Tryfaen, in Anglesey and the Vale

of Clwyd, at Liverpool and Birkenhead. Mr. Bell considered that the evidence from the shell-beds of Clava and Chapelhall was less consistent with the theory of submergence than with that of transportation by land ice. Messrs. Peach and Horne adduced evidence to show that in Sutherland and Ross-shire, at the time of greatest glaciation, the ice-shed was to the east of the present watershed, and the lofty mountains of Assynt and Loch Maree were glaciated by ice travelling westward. Mr. Clement Reid gave a list of twenty-eight species of Arctic plants from a series of silted-up tarns at Corstorphine and Hailes, near Edinburgh. Prof. Axel Blyth exhibited and described a beautiful set of plant remains preserved in calcareous tufas from Gudbrandsdal, in central Norway. The investigation of the Elbolton cave will probably be completed this year, and it has so far failed to reveal any trace of occupation by Palæolithic man. Messrs. Peach and Horne have studied one out of a group of caves in the Assynt limestone of Sutherlandshire, and found charcoal with split and calcined bones of reindeer, fox, and grouse in the upper layers, and a finely preserved canine tooth of brown bear at a depth of about five feet from the surface. Mr. Coates gave a description of the cuttings, chiefly in boulder-clay, in the Crieff and Comrie railway. And Mr. Kendall attributed the glacial period to variability in the heat of the sun.

Foremost amongst the palæontological papers stands that of Mr. E. T. Newton, in which was given an account of several remarkable skulls obtained from the Elgin sandstone and probably belonging to two or three species related to the African dicynodonts; together with these occurred the skull of a reptile allied to *Pareiasaurus* of the Karoo beds, but with no less than thirty horns varying from a quarter of an inch to three inches in length. Mr. M. Laurie described two new species of *Eurypterus*, two of *Stylonurus*, and one of a new genus, *Drepanopterus*, of Eurypterids from the Silurian rocks of the Pentland Hills. The work of the type committee still continues, and lists have been received from several museums and private collectors. Reports were also presented on Cretaceous Polyzoa and Palæozoic Phyllopora, and a paper by Mr. Bullen Newton recorded the discovery of *Chonetes Pratti* in the carboniferous rocks of Western Australia.

The petrological papers included a note on the Malvern crystalline rocks, by Mr. Irving, one on the felsites, andesites, and diabases of Builth, by Mr. Woods; and a short note on the Limerick Traps, by Mr. Watts. Mr. Usher endeavoured to prove that there must have been a rigid mass occupying the position of the Devon and Cornwall granites at the time when the stratified rocks were folded, in order to account for the deviations in their strike. Mr. Goodchild argued that the junction of the granite of the Ross of Mull was best explained by the absorption of sedimentary rocks in the granite. Mr. Harker explained the presence of porphyritic quartz in basic igneous rocks by supposing that it had formed in the upper layers of a magma basin, and sunk to its present position by gravity. Mr. Teall gave a sketch of the succession of rocks in an area of gneisses, which accorded with the succession from basic to acid types in plutonic masses; and Mr. Somervail endeavoured to explain the chief rocks in the Lizard area by segregation from a single magma.

Finally must be mentioned Professor Hull's paper on the Physical Geology of Arabia Petrea; a very interesting paper by Miss Ogilvie, on the landslips in the South Tyrol, in which she showed how much the mapping of that region was complicated by the constant repetition of portions of the strata by landslips; a new classification of the New Red Sandstone of Northern England, by Mr. Goodchild; and papers on the Green sand and Fuller's Earth of Bedfordshire, by Mr. Cameron.

Dr. Johnstone Lavis's report on Vesuvius chronicled the phases of eruption in the past year, and was illustrated by a beautiful series of photographs, chiefly of fumarolles and spiracles in the streams of lava. Mr. De Rance's report on underground water was continued. Mr. Davison's earthquake report dealt chiefly with new forms of seismic apparatus, and the photographic committee recorded that the collection of geological photographs now numbered 700, amongst which half the English counties and Scotland were, however, poorly represented. An excellent exhibition of the photographs was held in a room provided for the purpose, where also the Geological Survey of Scotland showed a fine series of views illustrating the scenery and structures of the ancient gneisses and schists of the Highlands.