Sec. R. S., J. R. Green, F. R. S.; F. O. Bower, F. R. S.; A. C. Haddon, D. Sc., C.; S. Sherrington, F. R. S.; A. H. Miers, F. R. S.; W. A. Herdman, F. R. S.; S. P. Thompson, F. R. S.; S. H. Vines, F. R. S.; A. G. Vernon Harcourt, F. R. S.; C. Le-Neve Foster, F. R. S.; Mr. J. Scott Keltie, W. H. Preece, F. R. S.; W. H. Gaskell, F. R. S.

It is the intention of the Local Secretaries to issue invitations to a large number of representative foreign men of science to attend the meeting, and it is hoped that a number of these will accept. The presence of foreign scientific men has been a special feature of many of the meetings in recent years, and this has greatly increased the interest of the members and public in the Association, while it has given the latter a semi-international character. The Local Committee desire that the Toronto meeting shall be largely an international one, and they have welcomed the provision made by the Council of the Association whereby the fellows and the members of the American Association are given for 1897 the same standing as old members of the British Association, that is, they will on joining be required to pay $5 only, instead of $10, the amount exacted for new members. The officers of the American Association also have been made Honorary Members of the British Association. The presence of these and the attendence of from forty to fifty Continental (European) men of science will doubtless do much to realize the hopes of those who advocate the formation of an International Association for the Advancement of Science. In any case it will serve to widen the sympathies of the scientific men of the British Empire and of the Anglo-Saxon Republic. The local committee on the other hand will endeavor to make the meeting an extremely pleasant one for all the visitors.

The provisional program of the daily agenda of the meeting will be published in Science in a few weeks.

A. B. Macallum.

GEOLOGY AT THE BRITISH ASSOCIATION.

The address of the President, Mr. J. E. Marr, was an eloquent and powerful appeal for the systematic pursuit of minute stratigraphical investigation. While petrology may be largely claimed by the Germans, paleontology by the French, and physical geology by the Americans, detailed stratigraphy has been much followed in Britain from the days of William Smith to the time of its present exponents, amongst whom we reckon Lapworth, Buckman, and, he might have added, himself.

Apart from the accurate unravelling of physical structure and the consequent correct knowledge of earth history which thus becomes possible, the President referred to a number of almost unforeseen results, which could only have been obtained when the succession of strata was studied in minute detail and the minor divisions of the rocks laid down on maps of sufficient scale. The detection of small faults and their relation to physical features and to denudation, the identity of ancient rocks and modern deposits, the history of coral reefs, the origin of coal seams, the geography of former periods, the distribution of ancient climates, the direction and nature of earth movement and its effect on the position and structure of igneous rocks, even the history of the crystalline schists —all these branches had received or might be expected to receive help from this line of enquiry. Dealing with the more immediate bearing of stratigraphical research on earth history and evolution and the phylogeny of organisms, he referred especially to the work of Barrande, Walcott, and Matthew on trilobites, of Lapworth on graptolities, of Beecher on

brachiopods, and of Jackson on echinids and lamellibranchs. In conclusion he appealed for a consideration of evolutionary geology against both catastrophism and uniformitarianism.

Sir W. Dawson's paper on 'Pre-Cambrian Fossils,' was of so much interest that we give his own abstract in full; the paper was illustrated by a very beautiful series of lantern slides.

The author stated that it was his object merely to introduce the specimens he proposed to exhibit, by a few remarks rendered necessary by the present confusion in the classification of pre-Cambrian rocks. He would take those of Canada and Newfoundland as at present best known, and locally connected with the specimens in question.

He referred first to the 'Olenellus Zone,' and its equivalent in New Brunswick, the 'Protolenus Fauna' of Matthew, as at present constituting the base of the Cambrian and terminating downward in barren sandstone. This Lower Cambrian had in North America, according to Walcott, afforded 165 species, including all the leading types of the marine invertebrates.

Below the Olenellus Zone, Matthew had found in New Brunswick a thick series of red and greenish slates, with conglomerate at the base. It has afforded no Trilobites, but contains a few fossils referable with some doubt to Worms, Mollusks, Ostracods, Brachiopods, Cytideans and Protozoa. It is regarded as equivalent to the Signal Hill and Random Sound Series of Murray and Howley in Newfoundland, and to the Kewenian, and the Chuar and Colorado Canyon Series of Walcott in the West. The latter contains laminated forms apparently similar to *Cryptozoon* of the Cambrian and *Archæozoon* of the Upper Laurentian.

The Etcheminian rests unconformably on the Huronian, a system for the most part of coarse clastic rocks with some igneous beds, but including slates, iron ores and limestones, which contain worm-burrows, sponge-spicules, and laminated forms comparable with *Cryptozoon* and *Eozoon*. The Huronian, first defined by Logan and Murray in the Georgian Bay of Lake Huron, has been recognized in many other localities, both in the west and east of Canada and the United States; but has been designated by many other local names, and has been by some writers included, with the Etcheminian and sometimes with part of the Laurentian, in the scarcely defined 'Algonkian' group of the United States Geological Survey.

Below the Huronian is the Upper Laurentian or Grenville system, consisting of gneisses and schists (some of which, as Adams has shown, have the chemical composition of Palæozoic slates), along with iron ore, graphite and apatite, and great bands of limestone, the whole evidently representing a long period of marine deposition, in an ocean whose bed was broken up and in part elevated before the production of the littoral clastics of the Huronian age. It is in one of the limestones of this system that, along with other possible fossils, the forms known as *Eozoon Canadense* have been found. The author did not propose to describe these remains, but merely to exhibit some microphotographs and slices illustrating their structure, referring to previous publications for details as to their characters and mode of occurrence.

Below the Grenvillian is the great thickness of Orthoclase gneiss of various textures, and alternating with bands of hornblende schist, constituting the Ottawa gneiss or Lower Laurentian of the Geological Survey. No limestones or indications of fossil remains have yet been found in this fundamental gneiss, which may be a truly primitive rock produced by aqueo-igneous or 'crenitic' action, before the commencement of regular sedimentation.

The author proposed, with Matthew, to regard the Etcheminian series and its equivalents as Pre-Cambrian, but still Paleozoic; and, as suggested by himself many years ago, to classify the Huronian and Grenvillian as *Eozoic*, leaving the term Archæan to be applied to the Lower Laurentian gneiss, until it also shall have afforded some indications of the presence of life.

He insisted on the duty of paleontologists to give more attention to the Pre-Cambrian rocks, in the hope of discovering connecting links with the Cambrian, and of finding the oceanic members of the Huronian, and less metamorphosed equivalents of the Upper Laurentian, and so of reaching backward to the actual beginning of life on our planet, should this prove to be attainable.

An extremely interesting paper by Dr. Matthew dealing with a kindred subject and entitled 'Some Features of the early Cambrian Faunas.'

The paper referred chiefly to the larval features of the early Cambrian Trilobites, because in them we may look for points of structure which will appear in the adult condition of their predecessors. But allusion was also made to the early Cambrian Brachiopoda and Ostracoda.

Trilobites.—Except in *Olenellus* and its allies the larval forms of the earliest trilobites are little known, but in those of the *Paradoxides* beds a number of series of the larval forms are known belonging to different genera, so that in these we have fuller data for comparison.

Cambrian time has been called the 'Age of Trilobites,' and their abundance and variety is truly remarkable. The flexibility of the type is indicated by the numerous genera that appeared successively in that early age. They thus become valuable in marking the divisions of the Cambrian rocks as the vertebrates do those of the Tertiary.

The utility of their remains is manifest in the ease and certainty with which different parts of the Cambrian System can be recognized in all the regions around the Atlantic Ocean, where rocks of this age have been found. This being the case, it may be profitable to examine the forms of the earliest Cambrian trilobites and note how they compare with the larvæ of those of the *Paradoxides* beds. The law of development would lead us to expect that in the *pre-Paradoxides* faunas of the Cambrian certain features of the larval forms of the trilobites of the *Paradoxides* beds should appear as permanent adult features in their predecessors. Let us see if such is the case.

In 1892 Dr. J. Bergeron summed up the evidence on this point, derivable from the trilobites of the *Paradoxides* and *Olenellus* faunas in his article 'Is the Primordial the most Ancient Fauna?'* He used the studies of Barrande, Walcott, Ford and others for this purpose, and his conclusion was that there must have been a more ancient fauna.

Discoveries of other faunas beside that of *Olenellus* have been made since Bergeron wrote upon this subject, and we may now place his theory against some additional facts which bear upon it.

To make the application clearer some of the characteristics of the earliest larval stages of the trilobites of the *Paradoxides* beds as shown in the young of *Paradoxides*, *Ptychoparia*, *Conocoryphe*, *Microdiscus* and *Agnostus* may be presented. Among them are the following:

1. Predominance of the cephalic over the caudal shield.

2. A long, narrow glabella, with nearly parallel sides. In these early moults the posterior lobes of the axial rachis (which includes the glabella) are short and weak compared with the anterior and especially the first.†

* Revue generale des sciences, Paris, 1892.

† *Paradoxides* is apparently an exception to this rule, but we do not know its earliest stages.

3. The eyes are absent; when they first appear they are near the lateral margin, and in several genera are elongated.

4. There are no movable cheeks; when these first appear they are narrow and marginal.

5. There is no thorax; this region begins with one segment, and in some genera never exceeds the number of 2 or 4. The pleuræ at first are short.

6. The pygidium at first is quite short and of one segment.

Three local faunas, all older than *Paradoxides*, have been made known since Bergeron wrote his paper referred to above. They all show more or less the increasing prevalence of larval features in the trilobites as we go back in time. J. C. Moberg has described a number of species from Sweden (including two species of *Olenellus*) in which some of the above larval characters are shown.

J. F. Pompeckz has just described a *pre-Paradoxides* fauna from Bohemia, in which are a few trilobites that carry larval characters. Thus his *Ptychoparia* is referred to the subgenus *Conocephalites*, probably because it has a long eye-lobe. It is a primitive form with short pleuræ, if we may judge from the short posterior extension of the dorsal suture. His *Solenopleura* also differs from that genus in its long eye-lobe and long glabella, but these also are larval features.* Another species of *Solenopleura*, however, cited by Pompeckz has shorter eye-lobes.

It is the *Protolenus* fauna of the St. John's group (Cambrian), however, which shows most decidedly larval traits in its adult trilobites.

Among these trilobites all (so far as their remains show it) have prolonged eye-lobes, a peculiarity which marks the early *Olenidæ*. Many of them have longitudinal glabellæ, also a larval character. Many have a short posterior extension of the dorsal suture, indicating the primitive feature of short pleuræ. Many have small and weak pygidia; this is inferred from the rarity of this part of the organism in the collections preserved.

Protolenus (typical), which has a general resemblance to *Paradoxides*, differs from it in the absence of a clavate glabella, and the small anterior lobe of this part of the head-shield, but these are characters found in the larval stages of *Paradoxides*.

A genus of this fauna, almost as common as *Protolenus*, is *Ellipsocephalus;* this genus also abounds with Protaspian peculiarities

Lastly, we may refer to the genus *Micmacca*, which has the following larval features, longitudinal glabella, long eye-lobe and short posterior extension of the dorsal suture. If *Zacanthoides* of the Middle Cambrian were shorn of the long posterior extension of this suture and its long pleuræ it would not differ greatly from *Micmacca*

In the *Olenellus* fauna also are genera such as *Olenellus*, *Protypus*, *Avalonia* and *Olenelloides*, which retain marked larval characters.

Brachiopoda.—If we turn our attention to the Brachiopoda we note that they show a special development in the early Cambrian different from that of the *Paradoxides* beds and the later members of the Cambrian System.

The most notable feature is the large percentage of *Obolidæ* (including *Siphonotreta*). The older Cambrian holds, in common with the *Paradoxides* beds, the small shells of *Acrothele*, *Acrotreta* and *Linnarssonia;* but it also has a series of larger forms peculiar to it. Such are *Obolus Botsfordia*, *Trematobolus* and *Siphonotreta* of the *Protolenus* fauna, and *Schizambon* and *Micwitzia* of the *Olenellus* fauna. This great development of oboloid shells is not re-

* In the larval forms of *Ptychoparia* and *Solenopleura* of the *Paradoxides* beds, however, the eye-lobe is short.

peated in most countries until Ordovician time.

Not only are these old Cambrian faunas remarkable for the peculiar types of Brachiopods which they possess, but they are also remarkable for those they lack. A *Lingula* has not been found, though *Lingulella* is a common genus.

The larval growths of Ordovician and Silurian *Linguloe* carry us back to a form which is oboloid. Thus in *L. quadrata*, *L. Howleyi*, etc., the shell is first circular as in *Obolus*, then oval as in *L. quebecensis*, etc., and finally takes on the sub-quadrate form of the adult shell. But there is a more elementary form of the Brachiopod shell than the circular shell of *Obolus;* this is seen in *Paterina* and the young shell of *Botsfordia*, which is nearly semicircular. Both these shells come from beds which are older than *Paradoxides*.

Ostracoda.—The Ostracoda also gives us definite forms peculiar to the early Cambrian beds. Such are the types represented in *Beyrichonia* and *Hipparicharion;* such also are those with flexible tests represented by *Aluta*. Other Ostracods are present in more varied forms than in the *Paradoxides* beds.

The distinctive features of the animals of the earliest Cambrian faunas may be summed up as follows:

1. The trilobites retain larval characteristics to an unusual degree.

2. The Brachiopods have a large percentage of oboloids.

3. The Ostracoda are plentiful and varied and present some peculiar types.

Another paper which will probably be of considerable interest in America is Dr. H. J. Johnston-Lavis' criticism on the work of Messrs. Weed and Pirsson on the Highwood Mountains. These writers describe Square Butte as a laccolite formed in Cretaceous sandstones and composed of an outer and upper layer of a basic rock that they name *shonkinite*, with a core of syenite. The shonkinite shows a laminated structure parallel to the roof, as was likewise the case with the upper part of the syenite. They consider this variation in the rock to show differentiation by diffusion and separation of the two magmas and that the lamination was due to the isotherms in the cooling mass. Dr. Johnston-Lavis showed that these interpretations were not in accord with the facts; if such differentiation had occurred, the line of junction of the two rocks should be roughly horizontal and not parallel to the roof, and he suggested that the lamination was due to shearing planes. His view was that the shonkinite had been delayed in the volcanic conduit and had been basified by osmotic action between the paste and the limestone or other basic rock-walls. This first filled the laccolite and was followed by the less basic or unaltered syenite from below. The white, dyke-like mass was an insuperable difficulty to the views of Messrs. Weed and Pirsson and only explicable by the theory of the present author.

Sir Archibald Geikie read a very interesting paper in which he recognized that some rocks previously described as volcanic agglomerates in Anglesey were in reality crush rocks, but a great deal of volcanic material had contributed to their original formation. Mr. Greenly also attributed the quartzite lenticles of the same island to a similar action upon beds of grit and sandstone. In a second paper he described the occurrence of Sillimanite-Gneisses in Anglesey. The curious mass of ancient rocks which is half submerged under the Trias of eastern England, at Charnwood Forest, was described in some detail by Mr. Watts, who attributed to it a Pre-Cambrian age. He further pointed out that a landscape at least as old as the Trias was here being gradually exposed to-day by the slow removal of the New Red Sandstone in which it was embeded.

A number of papers on subjects of local interest were read by Mr. Morton, Mr. Mellard Reade, Mr. Beasley and others, on the Trias and its footprints, the boulder clays, submerged forests, and on the advance of the sea upon the coast. Excursions were organized to most of the places mentioned in these papers and a long excursion to the Isle of Man conducted by Mr. Lamplugh and Prof. Boyd Dawkins, the latter of whom read a paper on the geology of the Island in which he described its Ordovician, Carboniferous, Permian, Triassic and Pleistocene deposits, together with the igneous rocks.

Messrs. Howard and Small made a communication on the nodular and felsites and other igneous rocks of Skomer Island, which they had determined to be interbedded lavas, associated with tuffs of Bala or Llandovery age. Mr. Garwood presented a report on the progress of his work on the zoning of the Lower Carboniferous rocks by means of their fossils, in which he showed that considerable progress had been made, but the inquiry was hampered by the variable character of what are at present regarded as species in the brachiopods and other organisms.

Mr. Wethered gave an illustrated lecture on the organisms characteristic of the chief limestones in our scale, and dwelt much on the evidence which tended to prove that oolitic structure was of organic origin.

Prof. Hull proposed a new theory to account for the glacial period. If the West Indian Islands were much upheaved at that period, as appears from Spencer's observations to have been the case, the Gulf Stream would no longer accumulate in the Gulf of Mexico and would in consequence reach the North Atlantic about ten degrees colder than it is at present. The amount of high land in the northern hemisphere at this time would also be a contributing cause.

Mr. Clement Reid gave an account of his excavations at the classic locality of Hoxne, in Suffolk, directed towards ascertaining the age of the Paleolithic implements discovered there. Under the top layer, which has yielded the implements, comes a series of lacustrine deposits, including a bed of lignite; these strata rest in a hollow denuded out of the boulder-clay, which in turn rests on sands and gravels. The estuarine beds indicate that the glacial climate of the boulder-clay was succeeded by a temperate climate and that by a second arctic climate before the implement-bearing beds were laid down. These determinations depend on the evidence derived from the relics of fossil plants, mostly seeds, found in the estuarine beds.

Mr. Kendall read a paper on the changes which many Yorkshire rivers had undergone in their courses since the glacial period. Both the Wharfe and the Nidd have been diverted from their old channels, which are still traceable, and now flow through gorges in the lower part of their courses. Similarly the Swale and the Wishe were once tributary to the Tees, though they now drain into the Derwent, which itself flows west from Scarborough, instead of east and straight to the sea. A vast amount of water has thus been brought to the Humber which did not originally belong to it. The usual discussions as to the origin of various glacial deposits between the advocates of marine action and those of land-ice work were rife on the day devoted to Pleistocene subjects, the battle ground shifting from the Isle of Man to the Vale of Clwyd and back again to Ayrshire and Kintyre.

Mr. Cornish gave the results of his work with the sand-blast and on ripple marks, in which he endeavored to distinguish between the forms caused by waves from those due to streams and wind. Prof. Milne described his seismographic work in

the Isle of Wight, where earth-tremors appear to be of constant occurrence, and stated that he had been able to feel certain tremors at a distance of several thousands of miles. Indeed, he went further and, calculating that one shock had reached his instruments from a distance of not less than 6,000 miles, he stated the extreme probability that a shock had occurred in Japan on August 31st, a prediction which was verified at the close of the meeting.

The Coral Reef Committee had to announce that so far as the boring at Funafuti went it was practically a failure, but that the results brought back by the scientific officers of the ship and by the three naturalists engaged in the investigation, were of very great importance from the points of view of anthropology, zoology, botany, geology and hydrography. The Geological Photographs Committee reported that a large part of Britain was now photographically registered in the collection of 1,400 prints which had been amassed, but there were many areas ill-represented and others almost as yet untouched. In conclusion, a discovery by Prof. Busz must not be omitted. Amongst some remarkable rocks produced by contact metamorphism round the Dartmoor granite mass he had found and isolated corundum in a felsite which had enclosed and metamorphosed a fragment of slate.

W. W. Watts.

London.

Relations of Tarsius to the Lemurs and Apes.

The systematic position of the Lemuroidea has for years puzzled the most eminent naturalists. The French zoologists, including Alphonse Milne-Edwards, Gervais and Filhol, consider the Lemurs as occupying a position entirely apart from the Apes, and moreover some of these observers find in the anatomy of the soft parts of the Lemurs close resemblances structurally to the same parts in the Ungulates. The conclusions of Filhol in regard to the position of the fossil Lemurs have not been generally accepted by paleontologists, and there is no doubt that certain characters of the dentition of *Adapis* which are like those of the perissodactyle Ungulates must be considered as cases of parallelism.

Years ago Mivart ably contended for the close affinity between the Apes and Lemurs, and Cope saw in *Anaptomorphus* the most simian lemur yet discovered. Schlosser, on paleontological grounds, derives the Anthropoids and Lemuroids from the same stem form.

Up to the present time the genus *Tarsius* has been considered to be a member of the Lemuroidea, but the recent investigations of Hubrecht on the placentation of *Tarsius* go to show that this genus has the same type of placenta as in the Apes. Accordingly Hubrecht would transfer *Tarsius* from the Lemuroid to the Anthropoid division of the Primates. In this removal of *Tarsius* to the Anthropoids, he proposes to include *Anaptomorphus*, and if the latter genus is placed among the Apes, why not place *Necrolemur* there too, as it has probably the same dental formula as *Tarsius*, and the modification of the anterior part of the dentition in *Necrolemur* resembles that of *Tarsius*.

It appears to me if this change in the classification of the Primates takes place we shall be little benefited and that it will be exceedingly difficult to discover any characters of the skeleton by which we can separate the Apes from the Lemurs. I hold that the summation of the osteological characters of *Tarsius* brings this form nearer the Lemurs than the Apes, and, moreover, I know of only one Anthropoid character in the skeleton of *Tarsius;* this is the partial closure inferiorly of the orbital fossa, by a lamina of bone extending from the alisphe-