lungs. The best antidote is the inhalation of oxygen. Rapid motion almost always produces collapse when more than 30 per cent. of the blood has been saturated with the gas.

Chemical education formed the subject of no less than three communications to the Section, almost the whole of one sitting being devoted to this important question.

Sir H. E. Roscoe, in opening a discussion on "Chemical Education in England and Germany," laid emphasis on the necessity for a training in the methods of research for those who were to be the leaders of industry. He also pointed out that, although great industries have in the past arisen and are now developing in England, our manufacturers do not show the same appreciation of the value of a thorough scientific training as those of Germany. A further difficulty is offered by the inefficiency of many of our secondary schools. A number of speakers took part in the discussion, agreement with Sir H. E. Roscoe's position being generally expressed. Some difference of opinion existed, however, as to where the reform was to originate; many speakers being in favour of calling in parliamentary aid, whilst others advocated the gradual training of public opinion on the point.

The subject of "Science Teaching in Elementary Schools" was dealt with by Dr. J. H. Gladstone, on behalf of the Committee appointed to investigate this question. Continued progress is being made in the teaching of science subjects in elementary schools. The Committee is strongly of opinion that the time has come when the educational authorities should lay down a scheme of elementary experimental science to be taken by every scholar before he is allowed to specialise into the various branches of science. An all-important point is to train teachers to regard science teaching as a means of mental culture, and to teach accordingly.

In practical illustration of the requirements laid down in the last sentence of the report, Miss L. Edna Walter read a paper, in which she recounted her experience of the teaching of science in girls' schools. The system of instruction is practically a continuation of the kindergarten system, applied to elementary scientific notions. The children are taught by being made to perform, and even to originate, simple physical measurements and experiments, and are encouraged to form their own notes into books of reference. After passing through such a preliminary course, the children are introduced to a course in practical chemistry such as that suggested by Prof. Armstrong, or that adopted by the Association of Head Masters.

Several of the Committees of the Association presented important reports of the work carried out during the past year. Mr. C. F. Cross read the report of the Committee on "The Constituents of Barley Straw," The results obtained make it appear probable that the furfuroid constituents of the cereals are not, as has hitherto been supposed, secondary products of assimilation, but are directly built up by the plant. The furfuroids appear to form a very large group, comprising a number of different substances, which differ in their susceptibility to yeast, and yield osazones of different melting-points. The cereal plants are distinguished by the great proportion of grain which they produce, the amount being no less than 40 per cent. of the weight of the entire plant. It appears probable that during the period of production of seed, part of the necessary material is derived from the tissues of the stem and leaves.

Prof. Bedson presented the report of the Committee which has been engaged in the examination of the "Proximate Constituents of Coal." Ordinary coal is practically insoluble in all reagents, but can be converted by treatment with dilute hydrochloric acid and potassium chlorate into soluble products, the composition of many of which has been ascertained. By repeated treatment, no less than 75 per cent. of the coal can be dissolved. Brown coal appears to behave in a similar manner.

The Committee on "The Isomeric Naphthalene Derivatives" reports that work has now been begun on the important subject of isomeric change, especially in the sulphonic acids and other derivatives of the naphthols.

The report of the Committee on "Quantitative Methods of Electrolysis" is of very great practical value, and comprises four distinct papers. One of these deals with a very convenient arrangement of the necessary electrical instruments, whilst the others treat of the determination of bismuth, antimony, and tin. The separation of the last two can only be satisfactorily accomplished when there is less tin than antimony present.

The Committee on the "Action of Light on Dyed Fabrics" has also been active during the past year, a large number of dyed fabrics having been tested in this respect.

Advantage was taken of the favourable position of Liverpool to inspect several of the more important chemical works in the district.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE President of this Section devoted his address mainly to stratigraphical geology, and we may well follow his example, and consider the papers presented to the Section in a similar order. Beginning with the oldest rocks, the first paper to claim attention is that by Sir W. Dawson, on pre-Cambrian Fossils. A valuable portion of this paper summarised our knowledge of the succession of Canadian rocks of high antiquity. He regards Matthew's *Protolenus* zone of New Brunswick as the equivalent of the *Olenellus* zone, and beneath this occurs a mass of greenish slates and conglomerates with a few doubtful fossils, such as brachiopods, ostracods, and protozoans. These Etcheminian rocks rest on the Huronian rocks, which contain worm-burrows, sponge spicules, and laminated forms comparable to *Cryptozoon* and *Eozoon*. Under these comes the Grenvillian system, or Upper Laurentian rocks, with *Eozoon* in the limestones, and at the base the orthoclase gneiss and hornblendic schists, which constitute the Lower Laurentian. The author exhibited a series of lantern slides showing the structure and composition of *Eozoon canadense*, amongst them being many very beautiful decalcified specimens, which none of those who criticised the paper attempted to explain.

Dr. G. F. Matthew's paper, which followed, endeavoured to recognise the larval characters of entromostraca, brachiopods, and trilobites in those faunas which preceded that of *Paradoxides*. He showed that in the young of trilobites from the *Paradoxides* beds the following larval characters were striking: (1) the predominance of the cephalic over the caudal shield; (2) the long, narrow, parallel-sided glabella; (3) the absence of eyes; (4) absence of movable cheeks; (5) absence or smallness of thorax; (6) the pygidium is at first small and of one segment. Such larval characters are to be observed in pre-Paradoxidian trilobites, and the author particularised *Ptychoparia*, *Solenopleura*, and the trilobites of the *Protolenus* fauna, such as the type-genus, *Ellipsocephalus*, and *Micmacca*. Similar conclusions were arrived at with regard to the Obolidæ, and to such ostracods as *Beyrichonia* and *Hipparicharion*.

Sir Archibald Geikie referred to some rocks, hitherto described as volcanic agglomerates, in Anglesey. Although the material of which the rocks were composed is volcanic, he now regards the brecciated and conglomeratic structure as due to earth-movement. The hard bands have been broken and rounded into fragments, the softer crushed and stretched out into a broken slate or phyllite.

Mr. Greenly dealt with a similar subject, and he referred to the quartzite lenticles, which about Beaumaris vary from one-quarter of an inch to one foot in length, but at Pen-y-parc attain a length of 700 feet, to the action of earth-movement. They were originally beds, but had been crushed and pinched off till they formed mere lenticles. The same author announced the discovery, in Central Anglesey, of bands of Sillimanite gneiss occurring where the gneiss is traversed by sills and bands of granite, to which there are no chilled edges. These Sillimanite gneisses are like those described by Mr. Horne and the author from Eastern Sutherland, where they are also associated with hornblendic gneiss of Hebridian aspect.

Ancient rocks of a very different character were dealt with by Mr. W. W. Watts, who gave some notes on his recent work in Charnwood Forest. The volcanic rocks had been mapped in detail on the six-inch scale, and the divisions correlated from one part of the country to another. Their age was still in doubt, but was not likely to be newer than Cambrian, while the unlikeness to the Cambrian system is shown at Nuneaton, and the direction of movement in the anticline pointed to a greater antiquity. A set of views was shown to illustrate the remarkable character of the scenery produced by the old rock, whose features dated back to pre-Triassic, and probably pre-Carboniferous, times. The old hills and valleys were beautifully preserved under a mask of Triassic marl, which was only now being slowly removed in places.

Messrs. Howard and Small made a very interesting communication on the rocks of Skomer Island, likewise illustrated

by views of the coast and microscopic slides shown by means of the lantern. Indeed, it is to be hoped that the use of the lantern will in future be encouraged by the Section; so many of the papers gained new interest and importance from the bringing into the room, so to speak, of the sections described by authors. Both igneous rocks and sediments were described; the former appeared to include rhyolites, often with magnificent nodular structure, and basalts, both occurring as lava flows with accompanying beds of tuff and ash. The age of the rocks appears to be about equivalent to the Bala or Llandovery rocks of the mainland. The microscopic aspect of the felsites, basalts, porphyrites, and clastic rocks was also described.

In his paper on the "Geology of the Isle of Man," intended as an introduction of the subject to those members who journeyed thither on the following Thursday, Prof. Boyd Dawkins dealt first with the Ordovician massif, its crush-conglomerates, slates, and grits; next he passed to the Carboniferous Limestone, which in the south is associated with lavas, ashes, and intrusive dykes. The red sandstone and conglomerates to the east of Peel he regarded as Permian, and not of Lower Carboniferous or Old Red Sandstone age. Four borings through the drift of the north part of the island were next described: one of these reached Triassic marls with salt, of which a total thickness of 33 feet had been penetrated; the other three reached Carboniferous Limestone at depths varying from 168 feet to 947 feet, two of them passing through Permian strata, and one through Yoredale sandstones and shales.

Mr. Garwood presented a report on the work on Carboniferous zones, containing a plan of campaign and a list of observers who had undertaken to collect carefully from each horizon of the rock, in order to ascertain whether it was possible to break up this great division on palæontological lines. Mr. G. H. Morton, in his paper on the distribution of Carboniferous fossils, did not give much encouragement to this Committee, for he showed that, taking what are at present regarded as species of brachiopods and mollusca, they appear to have a very wide range through the four main divisions of the limestone in Llangollen, Flintshire, and the Vale of Clwyd. In this paper he dealt with rare and common species, and showed that it was only the latter which would be of any real use in identifying zones, on account of the rarity and sporadic distribution of the former.

Passing to newer rocks, Mr. H. C. Beasley referred to footprints from the Trias in the neighbourhood of Liverpool. A slab of sandstone in University College contains about ninety-five prints in an area of about three square feet. Prints of webbed feet appear to be rare; a recently discovered footprint may belong to a chelonian. Other forms have been recently described by the author in a paper published by the Liverpool Geological Society. Mr. Morton described a boring near Altcar, which showed that the New Red Marl in this district was not less than 971 feet thick, but no salt or saline springs were met with. Another boring, on the west of Bidston Hill, showed only 454 feet of Red Marl, and 244 feet of Keuper sandstones; it then passed into a fault, and penetrated the upper soft sandstone of the Bunter from 133 feet.

Mr. Montagu Browne described the true bone-bed of Aust Cliff, and the *Pullastra arenicola* bed which occurs above it; the latter he considered to be the equivalent of the so-called bone-bed of Westbury and Penarth, but the bone-bed of the Spinney Hills in Leicester he considered to be the same as that of Aust, a suggestion which was strengthened by the occurrence of *Ceratodus* in both. *Sphenonchus*, hitherto recorded from the Lias, has now been found in the bone-bed at Aust Cliff and at the Spinney Hills. The third and final report of the Committee on the Stonesfield Slate gives the following corrected section through these beds:—

		ft.	ins.
Great Oolite	Limestone with corals	17	3
	Limestone and marls (oyster beds)		
	Stonesfield Slate	5	3
Fullonian ...	Fawn-coloured (Chipping Norton) limestones, about	18	0
Inferior Oolite	Sandy limestones with some marl	11	0
	Lower limestones with vertical plant markings (Lower Estuarine Series		
	Clypeus grit zone of *A. Parkinsoni*	13	0

About 12 feet of inferior Oolite strata can be made out below.

Mr. H. B. Woodward communicated some notes on sections along the London extension of the Manchester, Sheffield, and Lincolnshire Railway between Rugby and Aylesbury: Lower, Middle, and Upper Lias, Estuarine Beds, Great Oolite, Oxford Clay, and Boulder Clay are exposed in different cuttings; the agent which produced the last, had evidently been forced over a Great Oolite surface.

A large number of papers dealing with Glacial Geology were presented, and Monday was devoted to the discussion of them. The Erratic Blocks Committee reported that the Yorkshire Boulder Committee, and the Committees of Lincolnshire and of the Belfast Field Naturalists' Club had continued their systematic work. Special attention had been paid to the distribution of the Ailsa Crag rocks around the Irish Sea, to the Shap boulders down the Yorkshire coast into Lincolnshire and about Doncaster, and to the Norwegian erratics south and east from Staithes. A block of Shap granite had been found in the estuary of the Mersey. Mr. A. Bell described the Tertiary deposits of North Manxland, and attributed the shells in them to the period represented by the gravels of Wexford, Aberdeen, and Iceland; these are probably of Weybourn Crag age, and belong to the Pliocene period. Mr. Kendal gave an illustrated account of certain river valleys in Yorkshire which have changed their direction in part since the Glacial period. The Derwent flows west instead of east, the Swale and Wiske appear to have been formerly tributary to the Tees. The Nidd flows through a new gorge at Knaresborough and Plumpton, its old valley from Ripley past Brearton into the Vale of York having been dammed by drift, while the Wharfe has been similarly diverted into a gorge from Wetherby to Tadcaster; these diversions appear to have been due to drift deposited on the flank of a great eastern glacier. The same author, in conjunction with Mr. Lomas, described the glacial phenomena of the Clwyd Valley. There appears to have been no glacial submergence. The earlier drift seems to have been formed by Welsh ice, which was powerful enough to flow over even the Moel Fammau range; this was afterwards overpowered by ice bringing northern erratics, and compelled to divide into two streams, one of which escaped westwards by the Menai Straits; the other eastwards into the Midlands. Clay and shells like those of Lancashire occur in the northern part of the vale. Mr. J. Smith dealt with the marine shells in high-level drifts in Ayrshire, describing the order of succession, and giving a list of the shells, most of which are fragmentary. The Clava Committee described the shell-bearing clays in Kintyre, which had been investigated by borings carried out by the aid of grants from the Royal Society and the British Association. The wide extent of the clay was proved, a list of the shells given, and the composition and character of the deposit ascertained and accurately described. Dr. Callaway adhered to that interpretation of the superficial deposits of Shropshire, which attributes to them a marine origin. He laid special stress on their similarity to littoral deposits, their abundant marine fauna, and the ripple-marking so common in the sands. Chalk flints are abundant, and the author had found a Cornbrush fossil in the sands of Wellington. The hills and crags of the area do not present a glaciated outline.

The Hoxne Committee dealt with the very full exploration, undertaken by Mr. Clement Reid and his colleagues, into the palæolithic deposits of this place. They succeeded in establishing, by borings and excavations, that the boulder clay had been cut out into a valley of which no signs now appeared at the surface, as it had been filled with some remarkable lacustrine deposits in which plant remains had been found. The earliest of these indicated a temperate climate, the plant beds culminating in a bed of lignite. Succeeding these beds comes a black loam with the remains of arctic plants, and on the top of this is the sand, loam, and gravel in which palæolithic remains occur. No traces of human workmanship have yet been found beneath this upper layer, and hence the known human relics in this area are separated by two important climatic changes from the period of the boulder clay; the first from arctic to temperate, and the second back from temperate to arctic conditions. The work of this Committee appears to be well worthy of imitation, for it was undertaken and completed with great energy and a good deal of hard work within a year, and its results appear to admit of but one interpretation, that the human relics found here have nothing whatever to do with the Glacial period, with which they were once supposed to have been connected.

The last Glacial paper that we need notice is that by Prof. Hull, who suggested that the great uplift of the West Indian Islands might have contributed to cause the cold of the glacial

period by compelling the Gulf Stream waters to flow directly into the North Atlantic without passing into the Gulf of Mexico. By thus shortening its journey, the author calculated that the water would be delivered into the North Atlantic ten degrees colder than was at present the case. The author also referred to the amount of high land in the northern hemisphere as another contributing cause; and in both these suggestions he was supported by Sir William Dawson, who spoke in the discussion on the paper.

Mr. Mellard Reade gave evidence of land oscillation near Liverpool, derived from river-channels buried in drift, which itself often has an eroded surface covered by estuarine deposits, in turn overlaid by forest-beds made up of the remains of oak, Scotch fir, and birch; the latter are now just at the sea-level, or even a little below it. Three land surfaces appear to be present—one pre-glacial, the second post-glacial, and a third, still later, represented by the peat beds and submerged forests. Mr. Morton, dealing with the sea-coast of Wirral, showed that near the Leasowe embankment the sea had encroached 85 yards between 1871 and 1896, and at Dove Point the erosion was about 4 or 5 yards per annum from 1863 to the present. Mr. H. N. Ridley has not yet been able to begin excavations in the Singapore caves, but he has seen the white snake which inhabits them and is said to feed on bats; it is not blind, but has large eyes.

On the subject of Palæontology there is little to record, and in that of Petrology still less. Short interim reports were presented by the Eurypterid, Phyllopod, Moreseat, and Type Specimen Committees. Prof. Seeley described a skull of *Diademodon*, brought from Wonder Boom by Dr. Kannemeyer. The reptile possesses ten molar and premolar teeth, and its post-frontal bone differs from that of *Ornithorhynchus* in its different relation to the small brain cavity, and in contributing to form the circular orbit of the eye. Mr. Seward announced that *Glossopteris* and *Vertebraria* had been found near Johannesburg, associated with specimens of *Lepidophloios*. A similar association has lately been recorded by Prof. Zeiler in Brazilian plant-bearing beds.

Dr. Johnston-Lavis criticised the interpretation placed by Messrs. Weed and Pirsson in an igneous mass in the Highwood Mountains, Montana. Square Butte is a laccolite in Cretaceous sandstone, composed of an outer and upper layer of basic rock, called *Shonkinite* by them, and a core of syenite. Dr. Johnston-Lavis gave several reasons for supposing that the interpretation of this by differentiation on the spot was an error. Such differentiation would not result in a curved plane of separation, nor in the denser rock occurring at the top. He preferred to think the two rocks were separate intrusions, perhaps from the same magma originally, but that the upper part had been intruded first, and had acquired its basic character by absorption in passing through limestone or other basic rock walls. By the time the later intrusion of the syenitic magma took place, the rock walls had absorbed so much silica that little further change in its composition occurred. Dr. Busz recorded the discovery of corundum as a product of contact metamorphism on the southern flank of the Dartmoor granite, and amongst other minerals described the occurrence of cassiterite inside crystals of andalusite similarly produced.

A number of papers dealing with problems in physical and dynamical geology were presented. Prof. Seeley described the occurrence of false bedding in clays of Reading age, and also in similar rocks of Wealden date. Mr. Logan Lobley gave evidence to show that lava could not be derived from any great depth down in the earth's crust, and also that the shrinking of the globe since Cambrian times was a practically negligible factor in the contortion of rocks. Dr. Walther inquired, in general terms, whether evidence of fossil deserts was not likely to be obtained in the geological record. The Coral Boring Committee had to record that, in spite of two attempts, the site chosen for the operations, Funafuti in the South Pacific, had proved unsuitable; a mixture of quicksand with great coral blocks resisted all attempts made to bore through it. Time had not allowed of the transfer of apparatus and observers to another island, and consequently the project had been abandoned. Much good observational work in zoology and anthropology had, however, been carried out by the members of the expedition.

Mr. Vaughan Cornish illustrated the different types of ripple-marking produced by the sea (symmetrical and knife-edged), by streams (symmetrical and rounded), and by wind (unsymmetrical). Mr. Wethered gave an account of the general character of the ocean depths at different geological epochs, alluding mainly to the chief types of lime-secreting organisms found in each great limestone mass. He described with lantern illustration many of the encrusting organisms, such as *Girvanella* and *Mitcheldeania*. Mr. Kendal pointed out the effects of solution on organisms with aragonite, and on those with calcite shells; he concluded that the readier solution of the former was the cause of the bathymetrical limit defining the extent of Pteropod ooze. In a separate communication the same author concluded that the disappearance of aragonite shells from the Upper Chalk, and the preservation of calcite organisms, argued that this rock was deposited at a depth of at least 1500 fathoms, a conclusion supported by Dr. Hume and Mr. Jukes-Browne from entirely different standpoints. Prof. Milne gave a minute report on his seismological observations during the year in the Isle of Wight. His instruments enabled him to feel the larger earthquakes at great distances, even right through the earth. From his observations on August 31, he concluded that there must have been a violent earthquake at some spot about 6000 miles distant from his observatory; a distance which probably indicates that the site of the earthquake was Japan. News of such a shock has been received, but of its intensity we at present know nothing.

It only remains to notice that the Photographs Committee recorded about 200 new geological photographs as received during the year; but that still many portions of the British Isles are woefully ill-represented in the collection which, although now lodged at Jermyn Street, still hopes to receive marked increases during the next few years.

GEOGRAPHY AT THE BRITISH ASSOCIATION

THE Geographical Section was perhaps more largely attended at Liverpool than at any previous meeting of the Association, a result due in some measure to the convenient situation and beautiful construction of the large hall set apart for its meetings, and also due in part to the numerous lantern exhibitions of photographs of little-known regions. The number of papers and reports read was thirty-four, considerably more than usual, and meetings were held on five days. It was impossible, owing to the private arrangements of the gentlemen who read papers, to arrange for a proper classification of the work of the various days, and, therefore, in the following notes the strict order of the papers is not followed.

The presidential address, by Major Darwin, dealing with the scientific principles by which the development of Africa for commercial purposes should be directed, was particularly adapted for the place of meeting, on account of the very close relations between Liverpool and West Africa. Mr. G. F. Scott Elliot, in a communication on the influence of African climate and vegetation on civilisation, made an effort to generalise on the same subject from a different side. He divided Africa into four regions: (1) *The wet jungle*, which is marked roughly by the presence of the oil or coconut palm, numerous creepers —especially the Landolphia (rubber vines)—and such forms as Sesamum, *Cajanus indicus*, and Manihot as cultivated plants. This region is characterised by great heat and continuous humidity, without a season sufficiently dry to leave a mark on the vegetation. (2) *The deserts*, characterised by xerophytic adaptations, by Zilla, Mesembryanthemum, *Capparis sodada*, &c. The climate is distinguished by possessing no proper rainy season whatever. (3) *The acacia and dry grass region*, characterised by acacias, tree euphorbias, giant grasses, or frequently grassy plains in which each tuft of grass is isolated. The climate is marked from all the remaining regions by distinct dry and wet seasons; the dry season occupies from five to nine months, and leaves a distinct mark on the vegetation. This region occupies practically all Africa between 3000 feet and 5000 feet, and also extends below 3000 feet wherever the above climatic conditions prevail. (4) *The temperate grass and forest area* is distinguished by having at no season of the year such drought as leaves a permanent mark on the vegetation, by a moderate rainfall, by moderate heat, &c. The grass resembles the turf of temperate countries, and the forest shows the same sorts of adaptation as occur in temperate countries. This region is found between 4600 feet and 7000 feet. Of these regions the wet jungle is everywhere inhabited by small tribes of a weak enfeebled character, and in the lowest stage of civilisation. The desert, on the contrary, is the home of exceedingly healthy and vigorous tribes. The Acacia region is everywhere rather densely populated, but no emigrations in