NOTICES OF MEMOIRS.

I.—British Association for the Advancement of Science. List of Titles of Papers read in Section C, and in other Sections bearing upon Geology, September 3rd to 9th, 1908.

Presidential Address by Professor John Joly, M.A., D.Sc., F.R.S.

Professor G. A. J. Cole.—The Geology of the Dublin District. (Lantern.)

R. J. Ussher, H. J. Seymour, E. T. Newton, F.R.S., & Dr. Scharff.—On the Cave of Castlepook, near Doneraile.

Professor G. A. J. Cole.—On Probable Cretaceous Outliers off the Coast of Kerry.

R. Carruthers & H. G. Muff.—The Geology of the Leenane District, Co. Galway.

H. Bolton.—On a Section of the Lower Coal-measures at the Emerald Pit, Dungannon.

G. H. Kinahan.—On the Raised Beaches of the Liffey Valley.

Professor J. Joly, F.R.S.—On the Igneous Rocks of the Outer Blasket Islands.

Professor G. A. J. Cole.—The Laterite and Bauxite Zone of North-East Ireland.

Professor S. H. Reynolds & Mr. C. I. Gardiner.—The Igneous and associated Sedimentary Rocks of the Tourmakeady District, Co. Mayo.

Dr. W. F. Hume.—Notes on the Petrography of Egypt. (Lantern.)

Dr. A. Hutchinson.—Dolomites from Algeria.

Dr. A. Hutchinson.—On a new method of drawing Stereographic Projections of Crystals.

Dr. H. A. Bemrose.—Notes on the Microstructure of Derbyshire Limestone. (Lantern.)

Professor J. Joly, F.R.S.—On the occurrence of Native Iron in the Deccan Basalt.

W. G. Fearnsides.—The Tourmaline Rocks of Cwm Dwthwc.

H. Brodrick.—Notes on the Formation of Cave Pearls.

Professor W. Boyd Dawkins, F.R.S.—The Derivation of Sand and Clay from Granite.

Dr. T. T. Groom.—Report on Charnwood Rocks.

Professor W. M. Davis.—Glacial Erosion in North Wales.

Dr. J. Milne, F.R.S.—The Duration and Direction of Large Earthquakes.

Professor C. Lapworth, F.R.S.—Report on Excavations through critical Sections in Shropshire and North Wales.

Dr. Tempest Anderson.—Changes in Soufrière of St. Vincent. (Lantern.)

Professor W. H. Hobbs.—Recent Changes in Level within the Basin of the Laurentian Lakes.

Professor W. W. Watts, F.R.S.—Report of Geological Photographs Committee.

Dr. Dwerryhouse.—Reports on Erratic Blocks.

Professor J. W. Gregory, F.R.S.—Report of South African Correlation Committee.

Dr. F. H. Hatch.—Report on South African Topographical and Geological Terms.

W. G. Fearnsides.—Report on Place-names.

Discussion on Mountain Building. Opened by Professor Joly, followed by Sir A. Geikie, Professor Lapworth, Professor Sollas, Professor Cole, Dr. Teall, etc.

E. Greenly.—Report of Committee on Anglesey Rocks.

W. Whitaker, B.A. Lond., F.R.S.—On the finding of Silurian Beds in Kent.

Dr. Woolacott.—On a case of Thrust and Crush Brecciation in the Magnesian Limestone, Co. Durham.

Dr. G. W. Grabham.—Well-water Supply of the N.E. Sudan.

H. Bolton.—Contemporaneous Erosion in the Lower Series of Coal-measures of the Bristol Coalfield.

Professor S. H. Reynolds.—Report on Pre-Devonian Rocks of Mendips and Bristol area.

J. W. Stather.—Report on Kirmington Deposits.

Professor H. G. Seeley, F.R.S.—On a Fossil Reptile with a Trunk from the Upper Karroo of Cape Colony.

Professor H. G. Seeley, F.R.S.—On the distinctions between the dentition of the fossil Reptilia classed as Cynodontia and Gomphodontia.

H. Brodrick.—Reptilian Footprints from the Inferior Oolite of Whitby.

J. Lomas.—Report of Trias Committee. (Lantern.)

Dr. A. Vaughan.—Report on Carboniferous Succession.

R. Welch.—On Dopplerite from Sloggan Bog, Co. Antrim.

Titles of Papers read in other Sections bearing upon Geology;—

Section B.—Chemistry.

Professor W. N. Hartley, F.R.S.—Lithium in Radio-active Minerals.

Discussion on Peat, in which Dr. Woltereck, Captain Sankey, Professors Ryan, Johnson, and Lyon, Dr. Adeney, Mr. K. B. Elles, and others took part.

Section D.—Zoology.

Presidential Address by Dr. S. F. Harmer, F.R.S.

Discussion on "The abuses resulting from the strict application of the rule of priority in zoological nomenclature, and on the means of protecting well-established names." Opened by Mr. G. A. Boulenger, F.R.S.

Professor Cossar Ewart, F.R.S.—Wild Ancestors of the Domestic Horse.

Lantern Lecture by Dr. A. Smith Woodward, F.R.S.—The Evolution of Fishes.

Section E.—Geography.

Presidential Address by Major E. H. Hills, C.M.G., R.E.

Professor W. M. Davis.—The Physiographic Subdivisions of the Appalachian Mountain System.

Rev. W. Spotswood Green.—Ireland: her Coasts and Rivers.
Dr. W. S. Bruce.—Scientific Results of the Voyage of the "Scotia."
Captain H. G. Lyons.—The Longitudinal Section of the Nile.
Rev. G. Furlong.—Unique Experiences at the Birth of a Volcano.
H. Brodrick.—The Marble Arch Caves, Co. Fermanagh.
Dr. C. A. Hill.—Mitchelstown Cave.

SECTION H.—ANTHROPOLOGY.

Presidential Address by Professor William Ridgeway, M.A., LL.D., Litt. D., F.B.A.
C. T. Currelly.—A Sequence of Egyptian Flint Implements.
Professor G. Elliot Smith, F.R.S.—Anthropological Work in Egypt.
Rev. Dr. Bryce.—The Mound Builders of North America.
Rev. W. A. Adams.—Some Ancient Stone Implement Sites in South Africa.
Dr. N. Gordon Munro.—Prehistoric Archæology in Japan.
Dr. R. F. Scharff.—Some Remarks on the Irish Horse and its early History in Ireland.

SUBSECTION.—PHYSICAL ANTHROPOLOGY.

J. Gray.—Who Built the British Stone Circles?
Miss Nina F. Layard.—An ancient Land Surface in a River Terrace at Ipswich and a Palæolithic Site in the Valley of the Lark.
Report of the Committee to conduct Explorations with the object of ascertaining the Age of Stone Circles.
Report of the Committee on the best means of Registering and Classifying systematically Megalithic Remains in the British Isles.
G. Clinch.—On the Classification of the Megalithic and analogous Prehistoric Remains of Great Britain and Ireland.
Report of the Committee to Investigate the Lake Village at Glastonbury.
W. J. Knowles.—Perforated Stone Hammers and Axes.

II.—ON THE CAVE OF CASTLEPOOK, NEAR DONERAILE, CO. CORK.[1] By R. J. USSHER, H. J. SEYMOUR, E. T. NEWTON, and R. F. SCHARFF.

CASTLEPOOK Cave, north of Doneraile, leads into an extensive series of deep parallel galleries in limestone. Most of them are narrow, with vertical sides up to a certain level, where the walls recede with a wide sweep, forming an arched tunnel. Near the top of this the galleries are still spanned in places by an ancient stalagmite floor. Some of the sand on which the latter was formed is still adhering to it underneath. Beds of sand filled the lower parts of many galleries. This sand contained, sometimes down to 12 feet, numerous remains, chiefly of reindeer.

The geological evidence as to the age of the cave is unsatisfactory. Only rolled and unstriated pebbles have yet been discovered in the cave and no foreign erratic. This would seem to indicate that the material now in the cave, and hence the cave itself, is pre-Glacial in age, for otherwise a pebble of the granite known to be widely

[1] Read before the British Association, Section C (Geology), Dublin, September, 1908.

distributed throughout the overlying boulder-clay might reasonably have been expected to occur amongst the large number of boulders found in the various passages. No such pebble has, however, been found. The inference, therefore, on more or less negative evidence, is that the cave was formed in pre-Glacial times.

The bird remains found in the cave call for no special remarks. More than half are referable to the domestic fowl, turkey, and duck, though some of the latter may belong to the wild form. Like the bones of the rook, which are also numerous, they may have been brought in recently by foxes. The remainder all belong to such species as are now found in the neighbourhood.

The mammalian remains are of a very different character. It is true that the bones of the rabbit, sheep, ox, horse, pig, fox, cat, and rat seem mostly of comparatively recent origin. By far the greatest number of the bones found belong to the reindeer and bear. The exceedingly numerous bone splinters, the gnawed bones of reindeer, and the presence of many bones of old and young hyænas seem to indicate coexistence in Ireland of the latter and the typically Arctic species. The hyæna, which had not previously been known to have ever inhabited Ireland, is closely related to that now living in South Africa. Other animals, whose remains were probably dragged into the cave by hyænas, are the mammoth, Gigantic Irish deer, red deer, and wolf. Among the smaller mammals the bones and teeth of the Arctic Lemming (*Dicrostonyx torquatus*) and of the Scandinavian Lemming (*Lemmus lemmus*) are very abundant. They may have been brought in by the Arctic fox.

No human remains or implements were found except parts of modern iron tools and charred wood, indicating the presence of man only within quite recent times.

In so far as Ireland is not generally believed to have been joined to England by land in Glacial or post-Glacial times, the presence in the country of the mammoth, Gigantic Irish deer, and hyæna apparently confirms the opinion, arrived at from geological evidence, that Castlepook Cave must be a pre-Glacial one. This view is supported by the absence of many animals from Ireland which seem to have made their first appearance in England during the Glacial period.

III.—Probable Cretaceous and Cainozoic Outliers off the Coast of Co. Kerry.[1] By Professor Grenville A. J. Cole, F.G.S.

The dredgings made since 1901 by the Fisheries Branch of the Department of Agriculture and Technical Instruction for Ireland have amply supported the conclusions then put forward,[2] to the effect that the geological structure of the sea-floor off western Ireland can be deduced from a study of the stones lying on it from point to point. The most interesting recent results are the discovery of abundant flints, chalk, glauconitic chalk, and two specimens of Milioline limestone in dredgings off the coast of Kerry. Mr. Worth's observations in 1908 on similar materials in the English Channel thus receive

[1] Read before the British Association, Section C (Geology), Dublin, Sept. 1908.
[2] Cole and Crook, Report on Fisheries of Ireland for 1901.

confirmation from areas much further west, and it is clear that both the Cretaceous and Eocene seas extended to an unknown distance in that direction, though we can trace their boundaries fairly on the north-west. Many of the flints of southern Ireland may have been derived from local strata rather than from ice-borne drift.

IV.—On a Section of the Lower Coal-measures at Emerald Pit, Dungannon.[1] By H. Bolton, F.R.S.E., F.G.S.

A SHAFT was sunk in 1894–5 some little distance to the north of the old Drumglass colliery, and was carried to a depth of 197 yards, penetrating five coal-seams before reaching the Main Coal, which was known to the miners as the 'Congo' seam. During the course of the sinking a measured section was obtained of the strata passed through, and a collection of fossils brought together. After work had commenced on the deeper coal-seams, water broke into the colliery on two occasions, causing its abandonment. A generalised section of the measures passed through is as follows:—

				yds.	ft.	in.
	Strata			46	2	7
1.	Coal (inferior)				1	10
	Strata			3	2	2½
2.	Coal					½
	Strata			65	2	3
3.	Coal (in thin partings with shale)			2	0	5
	Strata			44	0	11
4.	Coal					3
	Strata			25	0	5
		ft.	in.			
5.	Coal: Top Coal	1	0	1	0	10
	Brown Shale		7			
	Coal	1	3			
	Inferior Coal		3			
	Coal		9			
	Strata			5	0	6
6.	Coal				3	3

Down to the level of the fourth coal, the strata consisted mainly of red, yellow, and grey sandstones, with grey bind partings. Below the fourth coal, black and grey shales predominated. At a depth of 133 yards from the surface occurred a black shale containing a typical Lower Coal-measures marine fauna.

The following species have been determined:—

Brachiopoda.
Discina nitida.
Lingula squamiformis.
Spirifera trigonalis.
Camarophoria isorhyncha?
Chonetes sp.

Pelecypoda.
Sanguinolites plicatus, Portlock.
Nucula gibbosa.
Nuculana attenuata.
Protoschizodus axiniformis.
Parallelodon cf. *Verneuillianus*, de Kon.

Gasteropoda.
Pleurotomaria cf. *gemmulifera.*

Cephalopoda.
Orthoceras Koninckianum ? d'Orb.

Vermes.
Serpulites membranaceus.

Fishes.
Palæoniscid scale and tooth.

[1] Abstract of paper read before British Association in Section C (Geology) Dublin, September, 1908.

V.—NOTES ON THE PETROGRAPHY OF EGYPT.[1] By W. F. HUME, D.Sc.

1. The ancient core of the North-East African Continent consists of the Cataract and Sudan Banded Gneisses, which may represent a very ancient igneous magma. They are usually much veined by granitic dykes.

2. In certain places in the Arabian Desert, Cataracts, etc., these underlie highly metamorphosed Schists (the Mica-Schists of Sikait, the Calcareous Schists of Um Garaiart and Haimar and of the Amara Cataracts, also the Dolomites of the latter region), which are sharply separated from the Banded Gneisses, and are possibly the oldest sedimentary representatives in Egypt.

3. The greater part of the mountainous regions of the Eastern Desert and Sinai is occupied by two types of rock, (*a*) a schistose constituent overlying or surrounded by (*b*) an acid member. The first-named (*a*), the Dokhan Volcanic Rocks and Schists, are partly volcanic in origin and partly sedimentary, the former being represented by lavas of various types, while the latter are clearly altered sedimentary strata (grits, conglomerates, etc.). No fossils have yet been found, but they have their nearest analogues in the latest Pre-Cambrian and Cambrian series. Here are included some of the most interesting rocks of Egypt, such as the Imperial Porphyry and the Breccia Verde Antico.

(*b*) The igneous member intruded into these ancient sediments, etc., includes a great diversity of igneous rocks, varying from highly basic to acid types. Contact phenomena of complex nature occur at the junctions of *a* and *b*.

4. Red Granite and Dyke Rocks, whose parallelism and extent of distribution present one of the most conspicuous features of the Eastern Desert of Egypt, mark the final eruptive action before Carboniferous times.

5. Three periods of volcanic activity have been subsequently noted.

(*a*) In Western Sinai in late Carboniferous times.

(*b*) An undated series of eruptions interbedded with the base of the Nubian Sandstone or intrusive into it with marked contact alterations.

(*c*) The Basic intrusions near Cairo and the Fayum, etc., which are intimately associated with the Oligocene Continental Period in Egypt.

VI.—THE TOURMALINE ROCKS OF CWM DWYTHWC, NEAR LLANBERIS (NORTH WALES).[1] By W. G. FEARNSIDES, M.A., F.G.S.

SOME years ago, when examining sands from the neighbourhood of Caernarfon, I found that both the river sands of the Seiont and the beach sands of the Menai contain tourmaline. In order to trace the mineral to its source I have since examined the heavy mineral residues of the sands of nearly all the tributaries of the Seiont, and find that all those which flow across the Cambrian Slate Belt contain either needles or broken grains of brown tourmaline. The sand from

[1] Read before the British Association, Section C (Geology), Dublin, Sept. 1908.

the Afon Arddu (whose delta parts the two lakes of Llanberis) is exceptional, and is very rich in well-formed trigonal prisms of blue tourmaline. The sand from the Afon Hwch, its tributary from between Moel Eilio and Moel Goch, is even more surprising, and in the sand from the spits along the flatter reaches of this burn tourmaline can generally be distinguished with a pocket lens.

I have therefore mapped the Cwm Dwythwc on the 6 inch scale and in mapping have found the tourmaline rocks *in situ*. They are mostly coarse grits, grits, flags, and slaty flags, and occur along the horizon of the unconformity between Cambrian and Ordovician rocks. The tourmaline is not clastic, but has been formed *in situ* from the felspathic ground-paste of the grits or flags, and clustered new-formed needles enter and pierce the quartz pebbles of the grit or the chloritoid ground-mass of the slate in a most fascinating manner. There has been thrust-faulting along the unconformity, but no large intrusive mass of igneous rock has been observed within five miles of the locality. Tourmaline new-formed in the slate and the remains of tuning-fork graptolites can be found within 3 or 4 inches of each other. The tourmaline is a soda-bearing variety.

VII.—The Derivation of Sand and Clay from Granite.[1] By Professor W. Boyd Dawkins, D.Sc., F.R.S.

THE decomposition of granite by the attack of carbonic acid in the rain-water on the soluble crystalline constituents of the granite results in the formation of a surface covering more or less complete over the solid rock which can only be studied in non-glaciated regions. It is conspicuous by its absence from the ice-swept granite areas of the Lake country, of Scotland, and of Ireland, and of Middle and Northern Europe.

The quartz in the granite has resisted decomposition, and where the finer products of decomposition have been swept away it forms a coarse sand, each grain presenting an irregular surface indented by the felspars and micas as they cooled from the heated magma. These are traceable more or less through a large number of sandstones, and more especially through those of the Millstone Grits and Coal-measures of Middle and Northern England.

The attack of the rain-water containing carbonic acid on the micas results in the decomposition of the biotite and to a lesser degree of the muscovite, while the soluble felspars, such as orthoclase, are completely dissolved, constituting hydrated silicates of alumina and new minerals such as kaolinite and secondary minutely crystalline muscovite. All these occur in the china clay of Cornwall and Devon, and are invariably associated with grains of quartz, primary mica, and tourmaline present in the unaltered granite. These constituents occur in all the samples ranging from the purest china clay through the whole series which have as yet been examined, with the addition of others of local derivation.

[1] Read before the British Association, Section C (Geology), Dublin, Sept. 1908.

These facts indicate that granite has been one of the chief sources, not merely of the arenaceous, but also of the argillaceous rocks. It is not improbable that both may ultimately be proved to have been derived from the siliceous acid layer believed by Durocher and Haughton to have been the first to become solid in the cooling globe.

VIII.—Glacial Erosion in North Wales.[1] By Professor W. M. Davis.

THE mountains of the Snowdon district are believed to represent a group of monadnocks which surmounted the peneplain to which a large part of the region was reduced in Tertiary time. The valleys between the monadnocks were somewhat deepened by normal erosive processes, in consequence of a general elevation of the region in late Tertiary time. As a result, the topography of the Snowdon district in immediately pre-Glacial time may be described as exhibiting a group of well-subdued mountains, drained through valleys of somewhat sharpened form. The difference between the forms thus described and the forms seen to-day in the Snowdon district is very great, both in amount and in kind, and cannot be accounted for by normal erosion during Glacial and post-Glacial time. But the difference is, in amount and kind, just what might result from glacial action, if it be postulated that glaciers are effective eroding agencies. The depth of glacial erosion in certain cwms and valleys is believed to have been 400, 600, or 800 feet; the breadth of glacial erosion must have been of even greater measure.

IX.—The Duration and Direction of Large Earthquakes.[1] By Dr. John Milne, F.R.S.

SMALL earthquakes, as for example those which occur in this country, have a duration of a few seconds near to their origin. At places 50 or 100 miles distant they may not be recordable. The duration, therefore, has varied between a few seconds and zero. With many large earthquakes, however, this decay during transmission is not appreciable, and duration near to their antipodes may be as great as it is near to their origin. Duration as one of these disturbances travel, rather than decreasing, at times appears to increase. The greatest duration is at about 90° distance from an origin. That which occurs may be compared with what we observe after a flask of water has been tilted. The contents oscillate like a pendulum, and any one part of the fluid comes to rest about the same time as any other part.

Another observation in connection with recent seismological observations is that large earthquakes travel farthest in particular directions. I have taken seventy-nine large disturbances with fairly well-known origins south of the Caucasus, north of India, and to the east or south of Japan. These earthquakes have travelled farther to the west than to the east, and there has only been a small percentage of them that have found their way across the equator to observatories in the southern hemisphere.

[1] Read before the British Association, Section C (Geology), Dublin, Sept. 1908.

https://doi.org/10.1017/S0016756800122435 Published online by Cambridge University Press

X.—The Soufrière of St. Vincent: The Changes subsequent to the Eruption of 1902.[1] By Tempest Anderson, D.Sc., F.G.S.

In 1902 the author visited St. Vincent, along with Dr. Flett, after the then recent eruption. In 1907 he revisited the island and examined the changes that had taken place in the new deposits.

In 1902 an incandescent avalanche descended into the valleys which occupy the great transverse depression across the island to the south of the Soufrière, and in particular the Wallibu Valley was filled for a great part of its course to a depth of at least 100 feet, but less near its mouth. In this deposit of red-hot material the secondary phenomena of re-excavation of the valley by the river, the falls of hot ash, the steam explosions, and the flows of boiling mud took place, and are described in the Report, Part I.[2] In 1907 almost the whole of this ash had been washed away, but a fragment remained in the shape of a terrace, 60 to 80 feet high, situated on the north side of the valley. The ash of which it is formed is unstratified, and contains very few ejected blocks or fragments of any kind. The floor of the valley is all composed of water-sorted material, chiefly gravel and coarse sand, but with a good many blocks as big as a man's head. They represent ejected blocks and fragments of lava derived partly from the ash of 1902 and partly from older beds, the fine ash in each case having been washed away. The surface of the gravel-bed showed marks of quite recent running water, and during the last Winter (1906–7) the river ran along the foot of the north bank of the valley. When examined in March, 1907, it ran along the south side of the valley, and had already in those few months excavated a new channel about 30 feet in depth. The stratification, as exposed in this new valley, is very distinct, and the sorting by water, mentioned above, is very evident. Further up the mountain the remains of the avalanche became more abundant in the valley bottoms, and here they were also better preserved, so that traces of the feather-pattern erosion, so noticeable in 1902, were still visible on the surface. This was mainly due to the surface of these ash deposits, like those to be presently mentioned on the plateaux and on the ridges, having consolidated into a crust, almost like a cement pavement, which resists the action of the rain.

Another interesting point was observed with regard to these massive beds of recent material. Instead of one stream re-establishing itself along the centre of the deposit, the tendency is for a new stream to form on each side at or near the junction of the new ash with the old valley slopes; and as these streams deepen their beds two new valleys are formed where only one previously existed, and the walls of each are composed on the one side of the new ash and on the other of older tuff, with occasional terraces.[3]

An account was also given of a visit to Montagne Pelée, in

[1] Abstract of paper read at the British Association in Dublin before Section C (Geology), September, 1908.

[2] Anderson & Flett, Phil. Trans., 1903, Series A, vol. 200; Anderson, Geographical Journal, March, 1903.

[3] See, further, Anderson, Report, Part II, Phil. Trans., Series A, vol. 208, pp. 275–300; Flett, Petrology, ibid., pp. 304–33.

Martinique, with a discussion of the phenomena of the extrusion of and subsequent destruction of the spine which have been described by Lacroix and others, and a comparison of the eruptions of the two islands.

XI.—On the Finding of Silurian Beds in Kent.[1] By W. Whitaker, B.A. (Lond.), F.R.S.

A BORING has lately been made, to a great depth, at Messrs. Curtis & Harvey's works, on the Thames Marshes at Cliffe, for the purpose of getting a supply of water, firstly from the Chalk and then from the Lower Greensand. It has failed in this, the water from both formations being too salt to be of any use; but it has succeeded in adding a geologic formation to the Kentish list, and that the oldest yet found in the county.

Details of the section will be given in a forthcoming Geological Survey Memoir on the Water-supply of Kent. It should be noted that the division between some of the formations is doubtful, but any error from this cause is immaterial in the following abstract:—

	Feet.	
Alluvium and River Gravel . .	77	
Upper, Middle, and Lower Chalk .	656 (or more)	
Gault	208 (or less)	1,074 feet.
Lower Greensand	96 (or less)	
Dark-grey clayey rock . . .	37 (or more)	

Nearly the whole of the Chalk has been pierced, the topmost part only being absent. The thickness given to the Gault is a little more than in the borings at Chatham, Frindsbury, and Strood eastward, and still more than at Erith (Crossness) westward. The thickness given to the Lower Greensand is also more than at Chatham, whilst at Erith there is none of this formation.

The chief interest of the boring, however, lies in the facts that the floor of the older rocks, which has been proved in many places in Kent, was reached at a level of about 1,030 feet below Ordnance Datum, and that the Palæozoic formation found is of Silurian age, nothing older than Devonian having been hitherto recorded from the deep borings of the county, and that only at Brabourne, unless the red rocks at Crossness should turn out to be of like age.

The proof of the Silurian age of the lowest beds is given by the occurrence of fossils at the depth of 1,063 feet, *Atrypa reticularis* and *Plectambonites* having been determined at the Palæontological Department of the Geological Survey by Mr. H. A. Allen, from samples of the cores sent by Mr. Baldwin Latham. There are traces of other fossils.

The practical value of the boring is that it puts a northern limit to the Kent coalfield in its neighbourhood.

XII.—On a case of Thrust and Crush-brecciation in the Magnesian Limestone, Co. Durham.[1] By David Woolacott, D.Sc., F.G.S.

ALONG the two miles of cliff between South Shields and Marsden the breccias that formed so marked a peculiarity of the Magnesian Limestone of North-East England are best exposed. The rocks seen are

[1] Read before the British Association, Section C (Geology), Dublin, Sept. 1908.

the yellow sands, marl slate, and Magnesian Limestone, but the effect of the thrust on the first two cannot be observed. The limestone, although much disturbed, has a general low dip to the south. It consists of a series of rocks of different flexibility, rigidity, brittleness, and compressive strength, and the uniqueness of the section is due to the action of a thrust from the north, which has caused some of the beds to move laterally upon the others, with an associated production of folding, minor-thrusting, and fissuring, and a consequent development of dynamic brecciation.

In Frenchman's Bay the lower limestone (40 feet thick) is a brownish-yellow, regularly bedded rock of relatively high compressive strength and rigidity. Its lower layers are gently folded, but its top layers are considerably disturbed, being fractured, tilted up, and laterally displaced. Resting on this is about 50 feet of brecciated limestone, consisting almost entirely of a cemented mass of broken fragment, which have here and there been dissolved out from the cementing matrix, the rock becoming cellular. In places the bedding, unfolded but fractured, is still preserved. It was originally a finely laminated granular limestone, and is of low rigidity and compressive strength. Experiments performed by Dr. Morrow give the following results:—Compressive strengths (tons per square inch to break rock), lower limestone, 5·7 tons; brecciated bed (lower middle), 1 ton.

The junction of the brecciated beds with the lower limestone is a thrust-plane, which does not always coincide with the line of demarcation between the two strata; and the disturbance of the upper layers of the latter rock, together with the smashing up of the former, is due to the thrust movement.

The brecciated beds occupy the top of the cliff for over a mile. Their upper surface, which is seen at the north end of Marsden Bay, is very irregular and hummocky, the breccia having been forced up into the base of the beds above. These consist of about 200 feet of rock differing much in flexibility and compressive strength (specimens tested vary from 1 ton to 37 tons per square inch). They have been thrust against a 'Horst,'[1] and consequently folding, thrusting, and dynamic brecciation have taken place. The flexible beds have been deformed without being much broken, while a harder, more brittle, wedge-shaped limestone has been highly brecciated. The latter has also had a coarse cleavage structure impressed on it, and part of it has been torn off and thrust into the beds above. Breccia gashes and vertical fissures filled with breccia, which has fallen into them, occur on both sides of this folded and broken area. The amount of lateral displacement at this point has probably been about 100 yards, and the experiments indicate that the magnitude of the thrust was about 300 tons per square foot.

[1] 'Horst,' see Suess, "Antlitz der Erde," 1st ed. (1885), vol. i, p. 167, and also Maria Ogilvie, Quart. Journ. Geol. Soc., 1893, vol. xlix, p. 77, for explanation of term.

XIII.—The Laterite and Bauxite Zone of North-East Ireland.[1]

By Professor Grenville A. J. Cole, F.G.S.

THIS paper was merely explanatory of an exhibit of the types of rock formed during the interval between the basaltic eruptions in the north of Ireland in Eocene times. It was urged, in agreement with the views of Richardson and Tate and Holden, that the red lateritic zone represents basalt altered *in sitû* even down to depths of 40 feet, the so-called 'volcanic bombs' in the layer being residual lumps of less altered basalt. Such a type of alteration is clearly connected with the climatic conditions of Eocene times. Some of the pisolitic iron-ore may have accumulated on the surface of the laterite in pools formed during the rainy seasons. The pale bauxites are derived from sporadic eruptions of rhyolite, and the bi-pyramidal crystals of quartz in them prove this over a wide area. The thin bauxitic layer, occurring as it does above the pisolitic iron-ore, may be in part formed by wind-borne material.

XIV.—On some Fossil Shells from Comparo Road, Trinidad.[2]

By R. J. Lechmere Guppy.

AMONG the fossils submitted to me for determination at different times by Mr. E. H. Cunningham-Craig, F.G.S., lately Government Geologist, was one collection of peculiar interest consisting of fresh-water shells of genera and species not now found in Trinidad, and forming a fauna completely distinct from any now existing here. The locality given me was Comparo Road. I furnished Mr. Craig with the names of the shells and notes on them, but I think it as well to put on record the names of these fossils.

1. *Hemisinus sulcatus*, Conrad.

Amer. Journ. Conch., 1870.

Conrad considers *H. tenellus* to be a near ally of this shell. It is, however, very closely akin to *H. bicinctus*, Reeve, an existing species of South American rivers. *Melania cingulata*, Moricand (Journal de Conch., 1860, pl. xii, fig. 6), and *M.* (*Melanopsis*) *brasiliensis*, Mor. (ibid., pl. xii, fig. 7), are also very near.

2. *Leptoxis crenocarina*, Moricand.

An inhabitant of Brazilian rivers. A remarkable and aberrant form of *Melania*.

3. *Anodon batesii*, H. Woodward.

Ann. Mag. Nat. Hist., 1871–4 ser., vol. vii, p. 103, pl. v, fig. 10.

There is no need to go to Asia for the nearest analogue of this bivalve, which is related to the *Anodon leotaudi* of our rivers and equally so to *A. sirionos*, Orb., and *A. puelchana*, Orb., of South America. The African shell figured under the name of *Margaritana pfeifferiana* by Bernardi (Journal de Conch., 1860, pl. xii, figs. 1, 2) bears much likeness to the species named, which are all closely related.

[1] Read before the British Association, Section C (Geology), Dublin, Sept. 1908.
[2] Bulletin Botanical Department, Trinidad, July, 1908, Article No. 1005.

4. *Cyrena semistriata*, Desh.

I had attached the manuscript name of *craigiana* to this shell, but a closer comparison of the numerous specimens contained in a slab presented by Mr. Craig to the Victoria Museum caused me to feel doubtful whether it ought to be accounted distinct from the *C. semistriata* of the European Tertiaries (Pictet, Paléontologie, pl. lxxvi, fig. 10; and Forbes, Isle of Wight, pl. iii, fig. 2). It is akin to *C. solida*, Phil., of Central American rivers.

5. There is also a very remarkable bivalve whose fragmentary condition prevents determination.

The collection indicates fluviatile or estuarine conditions, and has resemblances to the Tertiary deposits of the Amazons valley, whose fauna has been described by Conrad (Amer. Journ. Conch., 1870) and H. Woodward (Ann. Mag. Nat. Hist., 1871). I am of opinion that a Pliocene age is denoted.

Note.—In addition to the papers referred to by H. Woodward in the place above cited, there is a paper by Etheridge in the Quarterly Journal of the Geological Society of London, 1879, vol. xxxv, pp. 82–8, on fossils collected by Barington Brown in the Amazons valley.

XV.—On the Cement-producing Materials of Naparima, Trinidad.[1]

By R. J. Lechmere Guppy.

When I retired from office under Government at the beginning of 1891, I undertook an examination of the rocks of Naparima in Trinidad. These formations had occupied my attention at intervals ever since 1859, when I first studied them. The discovery of the wonderful series of Foraminifera, of which I had previously gained only a glimpse in 1872, was the first reward of that examination; but as a collateral result I found that we had here a very extensive series of deposits apparently suitable as material for the manufacture of cement. I inquired of the Public Works Department if this information would be of any use to them, more especially as the beds passed through and were developed on Government lands. The reply I got was that all the cement wanted could be furnished by the Crown Agents for the Colonies and there was no need of any local supply.

The results of my examination of the Naparima rocks were embodied in a paper read to the Geological Society of London and published in their Journal, November, 1892, p. 519.[2] In that paper I casually mentioned the occurrence of cement materials in these rocks in these words (p. 530): "I think it highly probable that in some of the marls we have a material suitable for the manufacture of cement." It was not until this paper was before the Geological Society that I was aware that Messrs. Harrison and Jukes-Browne had been working at the geology of Barbados and had read a paper thereon before the Society. These gentlemen were good enough to forward to

[1] Bulletin Botanical Department, Trinidad, July, 1908, Article No. 1006.
[2] See Geol. Mag., 1892, p. 331, and a further paper in Geol. Mag., 1900, pp. 322–5.

me a copy of their highly interesting and elaborate paper (Journal Geological Society, London, 1891, p. 198, and 1892, p. 170), which showed that there was a remarkable similarity between the rocks of Barbados and those of Naparima. But it was not even then, but a couple of years later, that I became aware of the existence of cement-producing materials in the oceanic rocks of Barbados similar to those of Naparima. Professor Harrison had the kindness to send me, what I had not seen before, a copy of the report prepared by him in conjunction with Mr. Jukes-Browne on the geology of Barbados for the Government of that island. In this they say:—

"The lowest chalky beds of the oceanic series possess a value which is derived partly from their chemical composition and partly from the fact of their lying immediately upon the dark clays. In these deposits we have the materials for the manufacture of cement. We believe the cement-making will be, if the suggestion is followed up with energy, one of the most promising of the industries of the island. We may mention that there are other beds of chalky earth which would be equally suitable for the manufacture of cement, and, further, that there are beds of dark-grey earth consisting partly of chalky earth and partly of fine mud, which have a chemical composition that seems to indicate their suitability for making cement without any admixture of clay."

Beds of the identical composition of those referred to in the foregoing extract occur in the Naparima district. It is matter for trial and experiment merely which of them is best for the manufacture of cement. My own opinion is that the softer beds will be the best, but some of them may require to be mixed with more argillaceous material, which can easily be obtained from the other beds in the neighbourhood. It is probable, however, that a material will be found which will give the right proportions without any admixture.

During my investigation of the Naparima rocks, particularly in 1891, I was struck by the remarkable resemblance in composition between these rocks and those from which cement was manufactured as described by various authorities. I have not at present by me all the works I have consulted on the subject, but it will suffice to refer to the United States Geological Reports, namely, the 20th Annual Report (1898–9), the 21st Annual Report (1899–1900), p. 402, and the 22nd Annual Report (1900–1), p. 728. According to these the average composition of the material for the best quality of cement is practically the same as found in the Naparima deposits.

REVIEWS.

I.—Catalogue of Minerals in the Technological Museum of the South Australian School of Mines and Industries. Compiled by Herbert Basedow, Honorary Curator. pp. 200. Adelaide: C. E. Bristow, 1907.

It is evident from the Catalogue which has been carefully prepared by Mr. Basedow that the South Australian School of Mines possesses a collection of minerals well adapted to the purposes of