rocks, the presence of phosphoric acid has been indicated by several chemists. The author found the proportion of phosphoric acid in graptolite, from the neighbourhood of Cirencester, amounting to 0·124 per cent., equal to 0·260 of bone-earth, and in Stonesfield slate from the same locality amounting to 0·117, equal to 0·244 per cent. of bone-earth. As water, charged with carbonic acid, is capable of dissolving bone-earth, this important fertilizing substance is found in many natural waters, percolating rocks which contain phosphoric acid. Such waters, therefore, may be applied with advantage for irrigation. The advantages derived from this too often neglected natural source, are strikingly exhibited in the irrigated meadows in the neighbourhood of Cirencester; and it is the opinion of the author that one of the chief causes of the beneficial effects which follow the application of the water for irrigation in this locality, is to be found in the phosphate of lime it contains. In a tea-kettle incrustation formed in a short period by this water, the proportion of phosphoric acid was found to amount to 1·25 per cent., showing a considerable quantity of this acid present in the water. A very hard water from Edinburgh likewise proved to contain phosphoric acid, but its proportion was not so large as that in the Cirencester water, the quantity of phosphoric acid in a boiler incrustation formed by this Edinburgh water being only 0·427 per cent. Sea water also contains phosphoric acid, but the proportion of the latter amounts to mere traces. A quantitative determination of phosphoric acid in the boiler deposit of a Canada steamer gave only 0·0306 per cent., and that in a boiler incrustation of a steamer plying between Dublin and Liverpool 0·0424 as the per-centage of phosphoric acid. In conclusion, the author recommended Swanberg's test, molybdate of ammonia, as a ready means for deducing the presence of phosphoric acid in natural waters.

THURSDAY.

SECTION C.—GEOLOGY AND PHYSICAL GEOGRAPHY.

President—Sir RODERICK I. MURCHISON.
Vice-Presidents—Prof. JAMESON, Sir PHILIP DE GREY EGERTON, Mr. C. M LAREN, Prof. SEDGWICK.
Secretaries—Prof. NICOL, Mr. HUGH MILLER, Mr. A. KEITH JOHNSTON.
Committee—The Duke of Argyll, Capt. Sir G. Back, Messrs. R. Allan, Binney, Dr. Black, Mr. J. Bryce, Count Breunner, The Earl of Cathcart, Mr. R. Chambers, The Earl of Enniskillen, Sir C. Fellows, Prof. E. Forbes, Prof. Hitchcock, Messrs. Hopkins, J. Hogg, J. B. Jukes, Sir C. Lemon, Sir C. Malcolm, Mr. M'Adam, Dr. Mantell, Mons. Martins, The Marquis of Northampton, Mr. J. B. Pentland, Prof. Oldham, Prof. Philips, Messrs. S. P. Pratt, G. W. Ormerod, Prof. Owen, Prof. Ramsay, Major Rawlinson, Mr. Smith.

'On the Gradual Subsidence of a Portion of the Surface of Chat Moss, in Lancashire, by Drainage,' by Mr. G. W. ORMEROD.—This was the continuation of a paper read at the Swansea Meeting. It was shown by a series of levellings made in the last four years, over an extent of about 200 acres, where drainage was carried on, that a subsidence had taken place to the amount of one foot per annum.

'On the Succession of Strata and Distribution of Organic Remains in the Dorsetshire Purbecks,' by Prof. E. FORBES.—These observations were made in the autumn of 1849, in conjunction with Mr. Bristow. The formation had been previously described in various memoirs by Prof. Webster, Dr. Fitton, Dr. Buckland and Dr. Mantell, but not very minutely; and only twelve species of mollusca and crustacea had been determined,—whereas more than seventy were now enumerated. The strata examined occur along the coast between Weymouth and Dorchester, at Durlstone Bay, near Swanage, and in the quarries at Swindon, Wilts, where the bar of the Purbeck series is exposed, and corresponds exactly with the Dorsetshire beds. After describing these strata, Prof. Forbes says:—It is very remarkable that, whilst the Purbeck can be divided into upper, middle, and lower, each with its peculiar assemblage of organic remains, the lines of demarcation between them are not lines of disturbance, or physical or mineral change. The features which attract the eye, such as the dirt-beds, the dislocated strata at Lulworth, and the cinder-bed, do not indicate any breaks in the distribution of organized beings. The causes which led to a complete change of life three times during the deposition of these freshwater and brackish strata must be sought for, not simply in a rapid or sudden change of their area into land or sea, but in the great lapse of time which intervened between their epochs of deposition. A most striking feature of the mollusca Fauna of the Purbecks is this, so similar are the generic types to those of tertiary freshwater strata and those now existing, that had we only such fossils before us and no evidence of the position of the rocks in which they are found, we should be wholly unable to assign them a definite geological epoch.—A comparison of these fossils with the collections from the Hastings sand and Weald clay leads the author to believe that the Fauna of the middle and upper Wealden series is almost entirely distinct, as far as species are concerned, from those of the lower or Purbeck division. Some of the species reputed identical prove to be distinct; and others are derived from certain anomalous beds near Tonbridge Wells, believed to be true Purbeck strata by the author. The excellent monograph on the Wealden of N. Germany by Dunker and V. Mayer, affords the strongest confirmation of these views, showing that the Fauna of the German Wealden essentially corresponds with the British, and that the organic contents of the Purbecks of the Continent correspond with ours, and differ almost entirely from those of the upper beds.

Sir R. MURCHISON remarked on the small physical extent of the Purbeck strata compared with their palæontological importance, confirming the belief that a whole epoch may be represented by a few feet of deposit.—Prof. OWEN confirmed the inference of Prof. Forbes respecting the connexion of the Wealden with the oolites; of the large Wealden Reptilia, all except the Iguanodon were oolitic and not cretaceous.—Prof. RAMSAY stated that the whole oolitic series had been deposited in a diminishing area, with the land rising to the west, and the last of the series, the Wealden, had been deposited in the estuary of a great river, which must have flowed from the north-west at a time when what is now Wales and Derbyshire was very high land.—Prof. FORBES observed, that no inference as to the age of the Purbecks could be drawn, without the evidence of geological position; the freshwater mollusca and Cyprides differ less from living British species than the living species differed from those of other countries; the Wealden of Scotland was not identical with that of England, but probably belonged to an older period.

'On the Discovery of Palæozoic Fossils in the Crystalline Chain of the Forez, in France, and on Lines of Dislocation between the Lower and Upper Carboniferous Deposits of France and Germany,' by Sir R. I. MURCHISON.—The chain of the Forez (Allies) consisting of slate, schistose and quartzose rocks, has been hitherto considered unfossiliferous; but in a visit made this summer Sir R. Murchison discovered on the banks of the Sichon, remains of Encrinites, Trilobites (*Phillipsia*), shells (*Chonetes* and *Productus*), and corals, all of lower carboniferous forms. These lower carboniferous deposits in many parts of France and in the Rhenish provinces are conformable to the older palæozoic strata, and unconformable to the small overlying patches of true coal-measure,—a fact contrary to the former theory of M. Beaumont, that lines of dislocation afforded good systematic divisions of the strata;—a view which could not be carried out in Russia or the British Isles.

Prof. PHILLIPS stated that in the north of England and south of Scotland the passage of lower carboniferous into coal-measure strata was so gradual, and attended with alternations of rocks and fossils also, that any lines of distinction must be arbitrary. He was not disposed to measure geological time by the evidence of fossils only, since changes in organic life must have depended on changes of physical condition, and these on time; the progress of research had shown that the interruptions in a series were not the most important elements for classification, as M. Beaumont believed, nor the mineral characters the most constant, as Jamieson had formerly taught.—Mr. PAGE said that in the Scotch coal series there was an apparent line of disturbance caused by the intrusion of the trap-rocks, but no real separation; he also remarked that the trap-rocks connected with the lower carboniferous were much less bituminous than those produced after the formation of the coal, and that in this district there were not only alternations of freshwater and marine strata, but also there were true sub-aerial sandstones accumulated by the wind.

'On the Lesmahagow and Douglas Coal Field, near the Head Waters of the Clyde,' by Mr. BRYCE—who exhibited maps and sections.—This coal-field forms a distinct barrier from all the rest, being separated by a barrier of old red-sandstone; it measures about 10 miles by 5 or 6, and contains twelve or fourteen beds of coal, amounting in all to 65 feet, one bed being 15 feet thick, and another 9. In some of the deep valleys the coal is worked on a level. Several beds of clay-ironstone occur, averaging 8 inches thick, and one black band (bituminous ironstone) 11 inches thick, is found throughout the northern part. Fire-clays have been noticed under some of the coal-beds; the largest fault is one of 25 fathoms, running north-west and south-east.

Mr. LANGLAND was of opinion that this coal-field was connected with the Ayrshire coal-field and not separated by old red sandstone as described; throughout the Scotch coal-fields the carboniferous limestone was split up into a number of beds and intercalated with the coal.—Mr. BRYCE, in reply to a question, stated that he considered all the Scotch coal-fields had once been continuous, but had become more or less separated by the outburst of the trap, and in this one instance by an upheaval of the old red sandstone.—Mr. HUGH MILLER said that there were beds of *red* sandstone with coal fossils overlying the coal, and that it was extremely difficult to determine the exact line of junction of the two systems, but such a line did exist, and he believed Agassiz was right in asserting that no species of fish was common to the old red and carboniferous series.—Prof. NICOL stated that Mr. Bryce's sections were exceedingly like Mr. Mills's Berwickshire sections; he thought that all the red sandstone on the north flank of the Lammermuir hills might with more propriety be referred to the carboniferous series.—Dr. FLEMING described some instances in which there were true old red sandstone, with scales of the Holoptychius, followed by numerous alternations of very thin coal seams with carboniferous limestone; some of the trap rock after its ejection appeared to have been arranged by water.

'On the Gold Mines of Darien, Emigration to New Granada, and Canalization of the Isthmus of Darien,' by Dr. CULLEN.—1. The Isthmus is a territory of the Republic of New Granada; its most important part, and that which appears naturally best adapted for communication between the Atlantic and Pacific lies between the Gulf of Darien and the Gulf of San Miguel. Numerous rivers flow into the Bay of Panama on one side, and into the Atlantic on the other; the principal stream is the river Santa Maria, forty miles long, and falling into the Gulf of San Miguel, unobstructed by sand-banks or bars. A few estates are still occupied by the Spanish, but most of the old towns and villages and forts have been long since deserted. About eight miles up the river Santa Maria (or Tuyra) is the village of Chapigana, with a corregidor and about 100 inhabitants, mostly Sambos and Negroes; Mr. Hossack, a Scot, and Don Pepe, a Portuguese, are settled here. A few miles above this village gold occurs abundantly, and about thirty miles above is the town of Yavisa, the capital of the territory and residence of the prefect Don Antonio Baraya. The population is scarcely 100, and the large fort is in good condition, but not garrisoned. The largest vessels can ascend nearly to the Chuquanaqua, a branch of the river Tuyra, a few miles below Yavisa, and up to which the tide extends. This country has been the scene of successful gold-mining under the Spaniards, and of much buccaneering and futile attempts at colonization on the part of the British, from the days of Sir Francis Drake and Basil Ringrose (1680) to Macgregor (1819). In the archives of the treasury of Panama is an account of former mining operations at the Mina Real, on the river Cana (a source of the Tuyra), in the Cerro del Espiritu Santo; the royal quinto or 5 per cent. on this mine averaged for a number of years 3½ millions of dollars per annum, which would give seventy millions per annum for the whole produce; the mining was performed by negroes (never more th n three or four hundred) who hewed out the rock, ground it in mortars by means of oxen, and washed it by a stream of water whilst grinding. The mines were closed in 1685 by command of the king of Spain, although in full operation at the time, on account of the numerous incursions of the buccaneers; they have never been re-opened, and the neighbouring mountains, though rich in gold, have never been worked. Dr. Cullen found the soil on the banks of the streams very fertile, and himself