IV.—On the Connexion of Certain Phenomena with the Origin of Mineral Veins. By J. Arthur Phillips, F.C.S., M.Inst.C.E., etc. *Phil. Mag.*, Dec., 1871.

THE Certain Phenomena referred to by the author are the *Solfataras*, fissures giving off steam, which occur in most volcanic districts. The most remarkable are those known as the Steamboat Springs in the State of Nevada, where some of the crevices are over 1000 yards in length, and are often entirely filled with boiling water, containing various mineral salts in solution. In the course of time incrustations (sometimes to the thickness of several feet) are formed on each side of the fissures, composed chiefly of hydrated silver, but containing also oxides of iron and manganese, traces of copper, minute crystals of iron-pyrites, etc.

The author thinks that these phenomena tend to show that the Theory of Ascension, which teaches that veins are the result of deposits of mineral substances which have been introduced into fissures from below, is the most rational method in which to view this formation. For further corroboration he gives analyses of water issuing from lodes in some of the deeper Cornish mines which were found to hold mineral substances in solution.

## REPORTS AND PROCEEDINGS.

Geological Society of London.—I.—January 10, 1872.—Joseph Prestwich, Esq., F.R.S., President, in the Chair.—The following communications were read:—1. "On *Cyclostigma, Lepidodendron,* and *Knorria* from Kiltorkan." By Prof. Oswald Heer, F.C.G.S.

In this paper the author indicated the characters of certain fossils from the Yellow Sandstone of the South of Ireland, referred by him to the above genera, and mentioned in his paper "On the Carboniferous Flora of Bear Island," read before the Society on November 9th, 1870 (see Q. J. G. S., vol. xxvii., p. 1). He distinguished as species *Cyclostigma Kiltorkense,* Haughton, *C. minutum,* Haught., *Knorria acicularis,* Göpp. var. *Bailyana,* and *Lepidodendron Veltheimianum,* Sternb.

Discussion.—Mr. Carruthers was glad that he had made the observations which he did on Professor Heer's former paper, as it had caused the Professor to give the reasons on which his opinions were based. He was doubtful whether the success which had attended Professor Heer's determination of species from leaves justified the application of the same principles to mere stems. He could not accept the difference in size or distance of leaf-scars as a criterion of species, inasmuch as they were merely the result of the difference in the age and size of the parts of the plants on which they were observed. Even Professor Heer himself had united together specimens presenting greater differences in this respect than those which he distinguished. He considered *Cyclostigma Kiltorkense, C. minutum,* and *Lepidodendron Veltheimianum* to be founded on different parts of one species. In the Kiltorkan fossils the outer surface of the original stems was often broken up into small fragments, the phyllotaxy on which proved them to be portions of large stems, and not entire branches. As to *Knorria,* it was certainly the interior cast of the stem of *Lepidodendron,* with casts of the channels through which the vascular bundles passed with some cellular tissue to the leaves; and the specimen figured showed that it belonged to a branch similar to

that represented as *C. minutum*. He considered that the four supposed species belonging to three genera were only different forms of the same plant.

2. "Notes on the Geology of the Plain of Marocco, and the Great Atlas." By George Maw, Esq., F.G.S. etc.

The author described first the characters presented by the coast of Marocco, and then the phenomena observed by him in his progress into the interior of the country and in the Atlas Chain. The oldest rocks observed were ranges of metamorphic rocks bounding the plain of Marocco, interbedded porphyrites and the porphyritic tuffs forming the backbone of the Atlas Chain, and the Mica-schists of Djeb Tezah in the Atlas. At many points in the lateral valleys of the Atlas almost vertical grey shales were crossed; the age of these was unknown. Above these comes a Red Sandstone and Limestone series, believed to be of Cretaceous age, and beds possibly of Miocene age, which occupied the valleys of the Atlas and covered the plain of Marocco, where vestiges of them remain in the form of tabular hills. The probable age of these beds was determined on the evidence of fossils. The author noticed the sequence of denuding and eruptive phenomena by which the arrangement and distribution of these rocks has been modified, and described the more recent changes resulting in the formation of enormous boulder-beds flanking the northern escarpment of the Atlas plateau, and of great moraines at the heads of the valleys of the Atlas, both of which he ascribed to glacial action. An elevation of the coast line of at least 70 feet was indicated by raised beaches of concrete sand at Mogador and elsewhere, and the author considered that a slight subsidence of the coast was now taking place. The surface of the plain of Marocco was described as covered with a tufaceous crust, probably due to the drawing up of water to the surface from the subjacent calcareous strata and the deposition from it of laminated carbonate of lime.

Discussion.—Mr. Ball, as an Alpine traveller who had also visited the Atlas in company with Dr. Hooker and Mr. Maw, offered a few remarks. The plane of Marocco was not, in his opinion, a level, but an inclined plane, rising gradually in height up to the foot of the mountain, so that the base of the boulder ridges was at some height above the level of the plain near Marocco. He did not think that the boulder deposits could be safely attributed to glaciers, but thought rather that they had been carried into and deposited in a shallow sea. He thought also that Mr. Maw had somewhat over-estimated the thickness of some of the boulder deposits; and though there was one instance of an undoubted moraine in one of the higher valleys of the Atlas, yet he could not agree in the view that the glaciation of the Atlas was general. He could not accept such a great thickness of beds as that represented by the vertical shales in Mr. Maw's section.

Prof. Ramsay was pleased that the author, though giving so many interesting details, had not assigned any definite age to many of the beds. He agreed with him as to the cause assigned for the great tufaceous coating of the country. He had already assigned the same cause for the existence of certain saline beds, and would attribute the existence of the great coating of gypsum at a slight depth below the surface of the Sahara to the same cause. As to the existence of moraines, he was not surprised to find them in the Atlas, as they were already known in the mountains of Granada. As to the escarpments, it was now well known that, as a rule, they assumed a direction approximately at right angles to the dip of the strata; and he felt inclined to consider that the bulk of the mounds at the foot of the escarpment of the Atlas were rather the remains of a long series of landslips from the face of the cliffs than to an accumulation of moraine matter.

Mr. D. Forbes commented on the similarity of the rocks to those of the Andes in South America. In the Andes the porphyritic tuffs appeared to belong to the Oolitic age; and the igneous rocks associated with them were of the same date. He thought that, so far as the author's observations had gone, the structure of the Atlas was much the same as that of the Andes.

Mr. W. W. Smyth mentioned that in the district to the east of the Sierra Nevada, in the south part of Spain, where there was great summer heat, and also heavy occasional rainfall, the same tufaceous coating as that observed in Marocco was to be found. He had been led to much the same conclusion as to its origin as that arrived at by Mr. Maw. The upper part was frequently brecciated, and the fragments re-cemented by carbonate of lime.

Mr. Seeley, though accepting Mr. Etheridge's determination as to the Cretaceous age of Mr. Maw's fossils if found in England, could not accept it as conclusive in the case of fossils from Marocco. The genus *Exogyra*, for instance, which ranges through the secondary to existing seas, might well belong to some other age; and even the fossils presumably Miocene might, after all, date from some other period.

Mr. Maw, in reply, stated that he agreed with Mr. Ball as to the rise in the Marocco plain as it approached the Atlas, having taken it in one direction at 400 feet in 25 miles. He pointed out the resemblance between the moraines in the valley of the Rhone and those which he regarded as such on the flanks of the Atlas. As a proof of their consisting of transported blocks, he mentioned the fact that the red sandstone rock of which they were composed did not occur in the adjacent escarpments, but was not to be found within seven or eight miles. There was, moreover, a mixture of different materials in the mounds.

II.—January 24, 1872.—Joseph Prestwich, Esq., F.R.S., President, in the Chair. The following communications were read:—1. "On the Foraminifera of the Family Rotalinæ (Carpenter) found in the Cretaceous Formations, with Notes on their Tertiary and Recent Representatives." By Prof. T. Rupert Jones, F.G.S., and W. K. Parker, Esq., F.R.S.

The authors enumerated the Rotalinæ which have been found in the Cretaceous rocks of Europe, and showed by tabular synopses the range of the species and notable varieties in the different formations of the Cretaceous system. For the comparison of the Tertiary Rotalinæ with those of the Cretaceous period the following Tertiary formations were selected:—The Kessenberg beds in the Northern Alps, the Paris Tertiaries, the London Clay, the Tertiary beds of the Vienna Basin, and the English and Antwerp Crags. The authors also enumerated the recent Foraminifera of the Atlantic Ocean.

The authors stated that of *Planorbulina* several species and important varieties of the compact, conical form occur throughout the Cretaceous series, and that those of the Nautiloid group are still more abundant. The plano-convex forms are represented throughout the series by *P.* (*Truncatulina*) *lobatula;* but the flat concentric growths had not yet come in. *Planorbulina* extends down to the Lias and Trias. *Pulvinulina repanda* is feebly represented in the uppermost Chalk, but forms of the "*Menardii*" group abound throughout the series. Species of the "*elegans*" group are peculiarly characteristic of the Gault, and some of the "*Schreibersii*" group are scattered throughout. These two groups extend far back in the Secondary period. The typical *Rotalia Beccarii* is not a Cretaceous form, but the nearly allied *R. umbilicata* is common. *Tinoporus* and *Patellina* occur at several stages; *Calcarina* only in the Upper Chalk.

The above-mentioned types are for the most part still living, but

the "*auricula*" group of *Pulvinulina* is wanting in the Cretaceous series, as also are *Spirillina* and *Cymbalopora*, except that the latter occurs in the Maestricht Chalk. *Discorbina* and *Calcarina* make their first appearance in the uppermost Chalk. The chief distinction between the Cretaceous and the existing Rotalinæ was said to consist in the progressively increasing number of modifications. The authors concluded by disputing the propriety of regarding the Atlantic ooze as homologous with the Chalk.

Discussion.—The President suggested the possibility of some of the minute Foraminifera being transported fossils derived from earlier beds than those in which they are now found.

Dr. Carpenter observed that the mode of examination to be adopted with Foraminifera was different in character from that which was applicable to higher organisms. The range in variation was so great that an imperfect examination of Nummulites had sufficed to make M. d'Archiac reduce the number of species by one half; and all the speaker's subsequent studies had impressed upon him the variety in form and in sculpturing of surface on individuals of the same species. When out of some thousands of specimens of *Operculina*, say, a dozen pronounced forms had been selected, such as by themselves seemed well marked and distinct, it might turn out that after all there was but one species present with intermediate varieties connecting all these different forms. He thought the same held good with Rotalinæ, and that there were osculant forms which might connect, not only the species, but even the genera into which they had been subdivided. This fact had an important bearing on their genetic succession, especially as it appeared that some of the best-marked types were due to the conditions under which they lived. The temperature in tropical seas differed in accordance with the depth so much, that when 2000 fathoms were reached, a degree of cold was attained such as was to be found in high latitudes; and in consequence the deep-sea forms in tropical latitudes assumed the dwarfed character of those in shallower seas and nearer the Pole. He suggested caution in drawing inferences from forms so subject to modification, both spontaneous and due to the depth of the sea, especially as connected with abundance of food.

Prof. Ramsay remarked that geologists would be pleased to find Foraminifera exhibiting, like other organisms, changes in some degree connected with the lapse of time. These low forms, however, could hardly afford criteria for judging of the age of geological formations, while at the same time such ample means were afforded by the higher organisms for coming to a conclusion. He cited, for instance, the Cephalopoda, as proving how different were the more important forms of marine life in Cretaceous times from those of the present day. He thought that no one who had thoroughly studied the forms of ancient life would be led to ignore the differences they presented, as a whole, from those now existing.

Mr. Seeley, Dr. Murie, and Mr. Hicks also made some remarks on the paper.

Prof. Jones, in reply, observed that the question of whether the Foraminifera in a given bed were derived or not was to be solved partly by their condition and partly by their relative proportions, but that in most cases sufficient data existed on which to found a judgment. He agreed with Dr. Carpenter as to the existence of extreme modifications, and it had been his object to ignore such as seemed due to ordinary and local causes, and to group the forms in accordance with certain characteristics. Whether the classification was right or wrong, it was necessary, for the sake of increasing knowledge, that fossils of this kind should be arranged in groups; and whether these were to be regarded as truly generic was a minor consideration. In forming their types and subtypes the authors had carefully avoided minor differences; but they still thought that the modifications which were capable of being substantiated were significant of a great lapse of time. A variation once established never returned completely to the original type. In *Globigerina*, he stated that there were in Cretaceous times 8 forms, in Tertiary 12, at the present time 14; and these modifications he regarded as equivalent to the specific changes in higher animals.

2. "On the Infralias in Yorkshire." By the Rev. J. F. Blake, M.A., F.G.S.

The Infralias, *i.e.* the zones of *Ammonites planorbis* and *Am. angu-*

*latus*, have been recorded hitherto only from Redcar, to the beds at which place the author referred; but the chief object of the paper was to describe some sections at Cliff, near Market Weighton, where these and lower beds are well exposed, and have yielded a numerous suite of fossils. He considered, however, that these beds did not belong to the typical Yorkshire area, but were the thin end of the series which stretches across England. He supposed there had been a barrier in Carboniferous times, which had separated the coal-fields of Yorkshire and Durham, prevented the continuity of the Permian beds, and curved round the secondary rocks to the north of it, to form the real Yorkshire basin, while these beds at Cliff were immediately to the south of it.

The sections described were six in number, the first pit yielding the great majority of the fossils, and the third showing best the succession of the beds. The fossils could be mostly identified with known forms, and showed a striking similarity to the Hettangian fauna. In all the clays of the Infralias Foraminifera were numerous and varied.

The section in pit No. 3 showed, commencing at the top:—1. Stone bed with *Am. angulatus* (the fossiliferous bed of pit No. 1). 2. Thick clays, with bands of stone characterized by *Am. Johnstoni*. 3. One band of clay with *Am. planorbis*. 4. Thin-bedded stones and clays, some of them oyster-bands. 5. Clays without Foraminifera, and with impressions of *Anatina* (White Lias).

The *Avicula-contorta* series is not reached, nor are there any signs of the bone-bed, as the junction with the Keuper marls, which are found three miles off, is not seen.

The paper was followed by references to the fossils mentioned, including the description of those that are considered new.

Discussion.—Prof. Duncan remarked that English geologists had been backward in receiving the term Infralias, which he had suggested with respect to the Sutton Down beds some years ago, and the propriety of which was shown by the term having been applied to the same beds by French geologists at a still earlier period. As to the White Lias, he regarded it as a mere local deposit, not to be found out of England. He traced the existence of the Infralias from Luxembourg through France into South Wales, where Corals were abundant. In Yorkshire, though one fine Coral had been found, the Ammonites seemed to point to a difference in condition.

Mr. Hughes remarked that the lithological character of the beds, as described by the author, did not agree with that of the Infralias in the S.W. of England or the N. of Italy. That the palæontological evidence which had been laid before the Society did not confirm the view that they were Infralias, the author having especially noticed the absence of *Avicula contorta* where he expected that it should occur. Also, by reference to the author's section, Mr. Hughes pointed out that below what he described as Infralias he drew other beds which were not Trias, the author having explained that some beds which had been called Trias were only stained beds of Liassic age.

The Rev. J. F. Blake, in reply, acknowledged the difference between the Yorkshire section and those of the neighbourhood of Bath, but insisted on the similarity of the fossils.

III.—February 7, 1872.—Joseph Prestwich, Esq., F.R.S., President, in the Chair.—The following communications were read:—1. "Further Notes on the Geology of the neighbourhood of Malaga." By M. D. M. d'Orueta. Communicated by the President.

In this paper, which is a continuation of a former note laid before the Society (see Quart. Journ. Geol. Soc., xxvii., p. 109), the author commenced by stating that his former opinion as to the Jurassic age of the rocks of Antequera is fully borne out by later researches upon their fossils. They apparently belong to the Portlandian series. The author made considerable additions to his description of the Torcal, near the foot of which he has found a sandstone containing abundance of *Gryphæa virgula* and *Ostrea deltoidea*. This he regards as equivalent to the Kimmeridge Clay. In the Torcal he has also found a soft, white, calcareous deposit, overlying the limestones of supposed Portlandian age, and containing a fossil which he identifies with the Tithonian *Terebratula diphya*. The author discussed the peculiar forms assumed by the rocks of the Torcal under denudation, which he supposed to be due originally to the upheaval caused by the rising of a great mass of greenstone, portions of which are visible at the surface on both sides of the range.

2. "On the River-courses of England and Wales." By Prof. A. C. Ramsay, LL.D., F.R.S., F.G.S.

The author commenced by describing the changes in the physical conformation of Britain during the Jurassic and Cretaceous periods, and the relations which the deposits found during those periods bore to the Palæozoic rocks of Wales and the north-west of England. He stated that the Miocene period of Europe was essentially a continental one, and that it was closed by important disturbances of strata in central Europe, one effect of which would be to give the Secondary formations of France and Britain a slight tilt towards the north-west. To this he ascribed the north-westerly direction of many of the rivers of France; and he surmised that at this period the rivers of the middle and south of England also took a westerly course. The westerly slope of the Cretaceous strata of England was also, he considered, the cause of the southern flow of the Severn, between the hilly land of Wales and the long slope of chalk rising towards the east. The Severn would thus establish the commencement of the escarpment of the Chalk, which has since receded far eastward.

The author believed that after the Severn had cut out its valley the Cretaceous and other strata were gradually tilted eastwards, causing the easterly course of the Thames and other rivers of southern and eastern England. In these and other cases adduced by the author, the sources of these rivers were originally upon the Chalk near its escarpment and it is by the recession of the latter (which was followed by the formation of the Oolitic escarpment) that its present relation to the river-courses has been brought about. The author also referred to the courses followed by the rivers of the more northern part of England, and indicated their relations to the general dip of the strata.

Discussion.—Mr. Hughes pointed out that in Wales and the Lake-district, which in this question might be considered as one, there were two plains of marine denudation, the one referred to by Prof. Ramsay averaging a little over 2000 feet, and the other about 3000 feet above the sea. Such plains get eaten back and cut up into valleys,

but their general level does not get much lowered by subaerial denudation. Therefore, in considering the western drainage area of the ancient Severn, it was important to fix the age of these plains. He did not agree with Prof. Ramsay that the 2000 feet plain was pre-Carboniferous, as the Carboniferous and Old Red hills of S. Wales and, in a more marked way, those of West Yorkshire and the Lake-district were evidently cut down by the same denudation that planed off the top of the Silurian area, and their tops formed part of the same plain. He did not think that this plain could be even pre-Oolitic; for the shingle beach of the Trias, which might be considered as the basement-bed of the Oolitic series, was evidently formed round the margin of that old land, whereas had this plain existed there would not have been land sufficiently high to have arrested the Oolitic sea during the period of greatest submergence; and a conglomerate implies a near shore. The absence of a coarse shore-deposit at the base and the character of the Cretaceous deposits also would lead him to infer that the Chalk-sea probably washed no land so near as Wales; but it was quite possible that the chalk was removed from the Welsh area when the 2000-feet plain was formed; and so we should refer the initial Severn to the time when the deposits of the sea that formed that plain were being eaten back, and not to the time when the Chalk was being removed. He asked where were the Chalk valleys when the drainage of the eastern area ran west into the Severn, as there was considerable difficulty in supposing that the main westerly drainage was along the same lines as that of the modern easterly streams. He pointed out that the great W.N.W. disturbances—many, if not all, of which were in part Post-tertiary—must be taken into account in this inquiry; *e.g.*, the synclinal of central Devon running into the English Channel near the Isle of Wight; the anticlinal of the Bristol Channel and the Weald, which we know was a barrier in pre-Carboniferous times, from the different character of the Coal-measures of Wales and Culm-measures of Devon; Mr. Godwin-Austen's ridge bringing up the old rocks under London; the barriers which caused the Lower and Upper Silurian of S. Wales to differ so much from those of N. Wales and the Lake-district, and were the indirect cause of the bosses of Silurian rocks which project through the newer rocks in Central England; the barriers that divided the northern coal-fields; the Craven Faults and the great valley which runs along them,—these and many others have obviously affected recent denudation. A slight tilt to the west would send the drainage again to the west along some of them; and the question involved the consideration of all traces of such changes of level.

Prof. Duncan observed that one important point in the paper was the hypothetical dip of the Chalk, on which the existence of the Severn was made to depend; and commented on the denudations which must have taken place during the Glacial and Pliocene period. He differed from the author in his view of the character of the Oolitic period, which he regarded as one of great oscillation. As to the amount of Palæozoic land-surface in Cretaceous times, he maintained that the purity of the Chalk deposits and their freedom from any terrestrial waste bore evidence of the distance of the land at that time. The depth of the sea in which they were formed was immense; and in the Upper Cretaceous period the oscillations were also great. He disputed the fact of the Miocene period of Europe having been continental in character, especially as regards the upper and middle parts of the deposits, in which Corals abundantly occurred. The elevation of the Alps was, he maintained, of a slow progressive character, which could hardly have effected so great an area as supposed by Prof. Ramsay.

Mr. Evans called attention to the relation of the present flow of many rivers to the last elevation of the land at the close of the Glacial period. The deposits of the Severn valley, he thought, proved its preglacial origin, and consequently supported Prof. Ramsay's argument; but the condition of the land at the close of the Glacial period was also to be fully taken into consideration, as the previously existing channels had in many instances been obliterated during that period. To a great extent Mr. Evans agreed with Prof. Ramsay, but he would wish to see the explanation carried down to a later date.

Mr. Green remarked, in illustration of the retrogression of escarpments, that he had had some opportunity of observing the process while still in progress. In the Carboniferous rocks of the north of England, where the dip of some hard rock was in a certain direction and it was overlain by softer strata, it was constantly the case that a brook ran along the line of junction, undermining the softer beds, bringing them down into the stream, and then removing them. It was thus that escarpments receded.

Prof. Morris remarked that at an early period the Alps on the south, and the Cumberland mountains on the north, formed the boundaries of a sort of trough, and that this to some extent must have influenced the flow of the rivers both in Britain and on the Continent. He considered that the series of elevations in pre-Permian

times had also much to do with the configuration of some parts of the country, and therefore of its river-basins. The evidence of the Oolite series was that it was deposited in an area of gradual depression, which was subsequently again elevated; and there was no doubt of the existence of a large amount of land over a great part of central England during the deposition of some of the later Oolitic beds. Then again came a depression during the period of the White Chalk. With regard to the Severn valley, he recalled the observations of Sir H. de la Beche as to its having been an ancient marine channel, connecting the estuary of the Ribble and what is now the Bristol Channel. He cited Prof. Phillips to account for the presence of the Lecky quartz pebbles in the valley of the Thames by the existence of ancient lochs in the Glacial sea.

Mr. Whitaker remarked on the probable extension of the Chalk as far as the Scilly Islands, which was evinced by the flints there found on the surface. He attributed the fact of so many of the streams breaking throught the Chalk escarpment on the south and so few on the north, to the difference of the dip in the two cases.

The President could not give in his adhesion to Prof. Ramsay's opinion. To establish so general a view as that propounded, he thought that a more extensive array of facts with regard to the conditions of the river-valleys should have been adduced. He wished for evidence as to the existence of old river-gravels at a greater elevation above the present river Severn, for instance, than that afforded by the author. The elevation of the Alps he regarded as not sufficient to account for the lines of drainage in Britain. It was to be borne in mind that during the Quaternary period the excavatory force of the rivers was much greater than at the present day. He thought there was still much to be learnt as to the causes which led to the direction and extent of the present river-valleys, the original rudiments of which were probably due to other causes than river-action.

Prof. Ramsay, in reply, was inclined to restrict himself to the immediate subject of his paper. With regard to the so-called Straits of Malvern, he accepted the view so far as it assumed that an ancient river-valley had, by submergence, been converted into a strait. He had purposely omitted in his paper all consideration of the Glacial period, for the simple reason that the initial direction of the river-valleys had been given in Preglacial times. His object was merely to show the causes of the initial direction of the rivers; and he could not be expected, in a paper before the Geological Society, to take these minor points into serious consideration. The Trias he had always regarded as a great freshwater deposit, which of course involved such terrestrial conditions as those which had been pointed out. He could not agree that some intercalations of marine beds destroyed the generally continental character of the Miocene beds of the northern half of Europe. He repudiated the idea of an immediate connexion between the elevation of the Alps and the flow of the Severn, though such a general tilting of the strata as that of which the last elevation of the Alps was one of the principal results, produced its effects upon a wide area in western Europe. The volume of the rivers in former times had nothing to do with his subject; but the cutting back through escarpments was, he thought, best explained in the manner he had suggested.

IV.—Annual General Meeting, February 16th, 1872.—Joseph Prestwich, Esq., F.R.S., President, in the Chair.

The Secretary read the Reports of the Council, of the Library and Museum Committee, and of the Auditors. The general position of the Society was described as satisfactory, although, owing to the number of deaths which had taken place among the Fellows during the year 1871, the Society did not show the same increase which has characterized former years.

In presenting the Wollaston Gold Medal to David Forbes, Esq., F.R.S., Sec. G.S., for transmission to Prof. Dana, of Yale College, Connecticut, the President spoke as follows:—

Mr. Forbes,—I have the pleasure to announce that the Wollaston Medal has been conferred on Prof. Dana, of Yale College, Newhaven, U.S.; and in handing it to you, in the absence of our Foreign Secretary, Prof. Ansted, for transmission to our Foreign Member, I beg to express the great gratification it affords me that the award of the Council has fallen on so distinguished and veteran a geologist.

Prof. Dana's works have a world-wide reputation. Few branches of geology but have received his attention. An able naturalist and a skilful mineralogist, he has studied our science with advantages of which few of us can boast. His contributions to our science embrace cosmical questions of primary importance—palæontological questions of special interest—recent phenomena in their bearings on geology, and mineralogical investigations so essential to the right study of rocks, especially of volcanic phenomena. This wide range of knowledge he brought to bear in the production of his excellent Treatise on Geology, one of the best of our class books, embracing the elements as well as the principles of Geology. His Treatise on Mineralogy exhibits a like skill in arrangement and knowledge in selection. In conveying this testimonial of the high estimation in which we hold his researches to Prof. Dana, may I beg also that it may be accompanied by an expression of how strongly we feel that the bonds of friendship and brotherhood are connected amongst all civilized nations of the world by the one common, the one universal, and the one kindred pursuit of truth in the various branches of science, before which special nationality is lost in that general nationality which groups all things and all men under one banner in the study of God's works!

Mr. David Forbes, in reply, said that it was to him a great pleasure to have, in the name of Prof. Dana, to return thanks to the Society for their highest honour, and for this mark of the appreciation in which his labours are held in England. It had rarely if ever occurred in the history of the Society that the Wollaston Medal had been awarded to any geologist who had made himself so well known in such widely different departments of the science; for not only was Prof. Dana pre-eminent as a mineralogist, but his numerous memoirs on the Crustaceans, Zoophytes, coral islands, volcanic formations, and other allied subjects, as well as his admirable treatise on general Geology, fully testify to the extensive range and great depth of his scientific researches.

At a moment when political troubles threaten the amicable relations so long existent between the two countries, it was a further source of gratification to see, in this award of the Council, not only a token of scientific amity, but also a proof that in science at least no other considerations than those of true merit are allowed to sway.

The President then presented the Balance of the Proceeds of the Wollaston Donation-fund to Prof. Ramsay, F.R.S., F.G.S., for transmission to James Croll, Esq., and addressed him as follows:—

Prof. Ramsay.—The Wollaston Fund has been awarded to Mr. James Croll, of Edinburgh, for his many valuable researches on the glacial phenomena of Scotland, and to aid in the prosecution of the same. Mr. Croll is also well known to all of us by his investigation of oceanic currents and their bearings on geological questions, and of many questions of great theoretical interest connected with some of the great problems in Geology. Will you, Prof. Ramsay, in handing this token of the interest with which we follow his researches, inform Mr. Croll of the additional value his labours have

in our estimation, from the difficulties under which they have been pursued, and the limited time and opportunities he has had at his command.

Prof. Ramsay thanked the President and Council in the name of Mr. Croll for the honour bestowed on him. He remarked that Mr. Croll's merits as an original thinker are of a very high kind; and that he is all the more deserving of this honour from the circumstance that he has risen to have a well-recognized place among men of science without any of the advantages of early scientific training; and the position he now occupies has been won by his own unassisted exertions.

The President then proceeded to read his Aniversary Address, in which he discussed the bearings upon theoretical Geology of the results obtained by the Royal Commission on Water-Supply and the Royal Coal Commission. The Address was prefaced by biographical notices of deceased Fellows, including Sir Roderick I. Murchison, Mr. William Lonsdale, Sir Thomas Acland, Sir John Herschel, Mr. George Grote, Mr. Robert Chambers, Mr. C. B. Rose, and M. Lartet.

The Ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year:—*President:* The Duke of Argyll, K.T., D.C.L., F.R.S. *Vice-Presidents:* Prof. P. Martin Duncan, M.B., F.R.S.; Prof. A. C. Ramsay, LL.D., F.R.S.; Warington W. Smyth, Esq., M.A., F.R.S.; Prof. John Morris. *Secretaries:* John Evans, Esq., F.R.S.; David Forbes, Esq., F.R.S. *Foreign Secretary:* Prof. D. T. Ansted, M.A., F.R.S. *Treasurer:* J. Gwyn Jeffreys, Esq., F.R.S. *Council:* Prof. D. T. Ansted, M.A., F.R.S.; The Duke of Argyll, K.T., D.C.L., F.R.S.; William Carruthers, Esq., F.R.S.; W. Boyd Dawkins, Esq., M.A., F.R.S.; Prof. P. Martin Duncan, M.B., F.R.S.; R. Etheridge, Esq., F.R.S.; John Evans, Esq., F.R.S., F.S.A.; James Fergusson, Esq., F.R.S.; J. Wickham Flower, Esq.; David Forbes, Esq., F.R.S.; Capt. Douglas Galton, C.B., F.R.S.; Rev. John Gunn, M.A.; J. Whitaker Hulke, Esq., F.R.S.; J. Gwyn Jeffreys, Esq., F.R.S.; Sir Charles Lyell, Bart., D.C.L., F.R.S.; C. J. A. Meyer, Esq.; Prof. John Morris; Joseph Prestwich, Esq., F.R.S.; Prof. A. C. Ramsay, LL.D., F.R.S.; R. H. Scott, Esq., M.A., F.R.S.; Warington W. Smyth, Esq., M.A., F.R.S.; Prof. J. Tennant, F.C.S.; Henry Woodward, Esq., F.Z.S.

Geologists' Association.—A special general meeting was held on the 2nd February, when a revised code of laws was adopted. Subsequently, at the annual meeting, the report for 1871 was adopted, and the officers for the ensuing year elected.—At the ordinary meeting, which followed, the Rev. T. Wiltshire, M.A., F.G.S. etc., President, in the Chair, a paper was read by T. G. Bonney, M.A., F.G.S., Tutor of St. John's College, Cambridge, "On the Chloritic Marl or Upper Greensand of the neighbourhood of Cambridge."—The author commenced by a brief sketch of the geology of the Cam Valley, and the position of the seam, barely a foot in thickness, which rests upon the eroded surface of the Gault, and is full of green grains and dark nodules, rich in phosphate of lime. He

described the matrix as a fine chalky marl, full of Foraminifera, and minute fragments of organisms, with a considerable mixture of mud, insoluble in hydrochloric acid. The composition of the green grains (commonly called Glauconite) was then discussed, and it was shown that they differed considerably from the typical mineral of that name; he had not satisfied himself that any were casts of Foraminifera. After a few words on the phosphatic nodules and some erratic rocks in the bed, he gave a sketch of the palæontology of the deposits; calling attention to the condition of the various fossil remains, and to the number and size of the Pterodactyles and Turtles. He then gave his reasons for considering this deposit as formed during the Upper Greensand Epoch, but as containing many fossils which had been derived from the Upper Gault by slow denudation. The nodules he considered as mainly of concretionary origin; for they were too pure to be regarded as clay saturated by phosphate. He concluded by sketching out his conception of the physical geography of the East Anglian district in the Neocomian and lower part of the Cretaceous epoch.—Professor Morris, after some remarks on the value of the paper, spoke of the composition of the green grains, and then traced the range of the deposit, which he agreed with Mr. Bonney in thinking was the formation of a very long period of time.—Mr. Lobley remarked upon the mineralogical and palæontological differences existing between the Cambridge deposit and the Chloritic Marl of Dorsetshire.—Mr. Bonney, in his reply, having referred to the great scarcity of fossils in the Gault of Cambridge, the Rev. T. Wiltshire stated that the Gault of Kent was in some places devoid of organisms.—At the next meeting of the Association, Friday, 1st March, a paper will be read "On the Geology of Hampstead, Middlesex," by Caleb Evans, Esq., F.G.S.

## CORRESPONDENCE.

### NEW BRITISH CRUSTACEAN.

Sir,—Will you allow me to record the occurrence of *Gastrosacus Wetzleri*, which I have found in the so-called Coral Rag of Upware, Cambridgeshire. This, the only species of its genus, is found in the White Jura of Bavaria, and has not hitherto been met with in Britain.

St. John's College, Cambridge, 27*th December*, 1871. W. Johnson Sollas.

### CALCAREOUSLY-INCRUSTED STONES IN DRIFT.

Sir,—As your obliging statement, at the close of my last article, relative to the inorganic origin of incrustations on stones found in the Upper Boulder-clay of Cheshire, might by some readers be regarded as bearing on the general arguments contained in the article, would you allow me to say that my reference to these stones (on which I did not venture to express a *decided* opinion) was extraneous to the main subject of the article, and that my object in making it was not to prove the marine origin of the Upper-clay (which is now admitted by all geologists), but to try to discover some resemblance between this clay and the brick-clay of Scotland, in which, in some places, organically-incrusted stones are common, according to Mr. Jamieson. I hope Mr. James Geikie will soon be able to correlate the Scotch and English drifts. I have no doubt that my *Pinel* is the equivalent of his *Till*.

D. Mackintosh.