Brought forward.	87½
Woolwich Beds	14
Thanet Sands	32
Chalk	646½
Upper Greensand	12
Gault Clay	148
Total	<hr/> 940

"There is every reason to believe," says Mr. Prestwich, "that the base of the Gault will be reached by prolonging the boring another forty or fifty feet."

Cores of the various deposits obtained during the boring were exhibited by the Engineer, and inspected by the visitors. The bearing of the enterprise upon the question of the proximity of the Palæozoic rocks to the Gault was explained, and particulars of the results of similar borings were given, including those at Kentish Town, Harwich, Ostend, Calais, Hames (near Calais), Valenciennes, Flines Nord, and Mons. The company then returned to Abbey Wood Station for town.

EXCURSION TO MALVERN,

JULY 21ST, 1873, AND FIVE FOLLOWING DAYS.

Directors—R. B. GRINDROD, Esq., M.D., LL.D., F.L.S., F.G.S.; the Rev. W. S. SYMONDS, M.A., F.G.S.; and the Rev. ROBERT DIXON, M.A., LL.B., F.G.S.

(*Report by J. Logan Lobley, F.G.S.*)

The Members having assembled in the Museum of Townshend House, Dr. Grindrod described his well-known collection of the rocks, minerals, and fossils of the Malvern District. The palæontological collection, although a very large one, consists almost entirely of palæozoic fossils, and is arranged in stratigraphical order. The student is accordingly at once made acquainted with the characteristic species of each formation in the district. Above the cases containing *Cænterata*, *Echinodermata*, and *Mollusca*, each of which groups is abundantly represented, a glass-covered case extends along the whole length of the room, and is filled with, perhaps, an unrivalled collection of British Trilobites. Most of the specimens

in this, and indeed in most of the other cases, are marvellously beautiful, and many of great value.

Dr. Grindrod, having concluded his descriptive lecture, conducted the party to the hills. The stones of which the road-side walls are built were, however, so attractive that slow progress was made, the Doctor and his interested followers stopping ever and anon to examine some more than usually fine specimen of syenite or epidote, which had been regardlessly used by the builders, who have unconsciously made these walls answer the purpose of a museum of rock specimens. Gradually ascending, the visitors were charmed with the splendid views they obtained, but they were not thereby allured from the observation of the rocks and the configuration of the hills, the peculiarities of which were noted and discussed. At St. Ann's Well the geologists duly stopped and drank of the pure water of the hills, and soon after they stood on the summit of the Worcestershire Beacon. There, with their geological maps of the district stretched out before them, they surveyed the grand expanse of country around, extending from the Cambrian and Silurian country of the Longmynd and the Ludlow promontory to the Oolitic Cotteswold Hills. Dr. Grindrod pointed out the physical features of the surrounding country, and explained that the Malvern range, consisting of metamorphic syenitic rock, extended N. and S., with, on one side, Triassic strata stretching away to the east, while against the western slopes lay Upper Cambrian and Upper Silurian Rocks, dipping to the west under the Old Red Sandstone, which forms the greater part of the county of Hereford. Though the shades of evening were rapidly darkening, the enthusiasm of the geologists led them to the conglomerate of Miss Phillips, at West Malvern, specimens of which, by the aid of their well-used hammers, they quickly obtained. Thence the way was led round the northern end of the hills until Great Malvern was gained, and welcome rest and refreshment found at Townshend House.

LEDBURY AND EASTNOR.—The train was taken to Ledbury, where the Rev. W. S. Symonds, M.A., F.G.S., of Pendock, assumed the directorship; and, without delay, led the way to the ascending path at the side of the railway. There, Mr. Symonds pointed out that Walls Hill, which was little more than a mile to the west, was capped by the "Cornstones" of the Old Red, the highest strata that would be seen during that day; and that the intermediate vale consisted of the Lower Old Red, the

lowest bed of which they were then standing upon, since, in the adjoining tunnel mouth, the Passage Beds at the top of the Silurians were cut through. The thickness of the Old Red had been ascertained to be in Hertfordshire 10,000 feet. In the lowest beds of the formation at this place *Cephalaspis Lyellii* and *Auchenaspis Salteri* had been found as in the corresponding beds near Ludlow. A little farther onwards an exposure of Aymestry Limestone was seen yielding *Lingula Lewisii*, but the principal characteristic species of the rock, the *Pentamerus Knightii*, is extremely rare at this place. Passing over Dog Hill, a lane section of the Lower Ludlow Shales, exhibiting a decidedly nodular and concretionary structure, was seen, and here Mr. Symonds introduced to the party Henry Brooks, the clever fossil collector of Ledbury. The large quarries in the Wenlock Limestone, on the eastern side of the hill, were next visited; but the heat of the weather was so great and the time so limited that the work done at this fine section was less than under other circumstances would have been accomplished. The *Strophomena depressa*, *S. euglypha*, and fragments of *Phacops caudatus* were, however, found. The director explained the peculiarities of the Wenlock formation, and compared, or rather contrasted, the Wenlock Limestone with the Denbighshire Grits, which he had been lately examining near Llangollen. Continuing eastward past Eastnor, with its stately castle and magnificent park, and traversing Lower Ludlow, Wenlock Limestone, and Wenlock Shale, and crossing a narrow band of Woolhope Limestone, the lowermost formation of the Upper Silurians, the Upper Llandovery, was reached. This formation, called also the May Hill Sandstone, lies unconformably on whatever rocks may be below. Sometimes it overlies one formation and sometimes another, and in this locality the whole series of the Lower Silurian is wanting, the Upper Llandovery being found reposing on, in one place, the Malvern syenitic rocks, and in another the "Black Shales" and trap rocks of Upper Cambrian age. Near Rowick is a roadside exposure of a mass of true igneous rock, one of the outworks, as it were, of the volcanic Ragged Stone Hill, which rears its summit a little to the east; and at the foot of which, in the Valley of the White-leaved Oak, the geologists gladly sought the grateful shades of a thickly-wooded and secluded dell. But rest and shade were not all that were found, for the liberal and kindly Mr. Symonds had provided a luncheon with, what was most appreciated

on this tropical day, abundant cooling drinks. The claims of Science did not, however, admit of long delay, and the fine neighbouring section exposing the inmost rock of the hill, with the "Hollybush Sandstone," of Cambrian age, super-imposed, was speedily examined. The Ragged Stone Hill was, Mr. Symonds said, the roots of a volcano of probably great elevation, which, in the Cambrian period, and while Cadir Idris was similarly active, poured forth lava and ejected ashes as do the volcanoes of the present day. These ancient volcanoes ceased to be active in the Llandeilo period and previous to the activity of the great Snowdonian volcanoes which commenced in Caradoc times. Now proceeding southwards and skirting Chase End Hill, with Howler's Heath on the west, the Members were brought to an exposure of the Permian Breccia, which lies against the Llandovery of Howler's Heath. A little further south a fine lane section of the Bunter rocks of the Trias, inclined at a considerable angle, reminded the party of the many and great changes and alterations of land and sea conditions, through which the district had passed since the Malvern range first lifted its crest above the waters. The Rev. Reginald Hill had kindly invited the party to visit him at his rectory of Bromesberrow, and accordingly the geologists made their way to his charming and secluded residence, where fruit, wine, and tea, and better still sympathetic friends, awaited them. Leaving Bromesberrow Rectory, the road by Clencher's Mill, where Mammalian Drift was seen, and thence through Eastnor to Ledbury was taken, and the latter place reached in time for the train to Malvern, where the party arrived weary, no doubt, with the excessive heat and the labours of the day, but delighted with the extreme beauty and abounding geological interest of the country they had examined.

BERROW, PENDOCK, AND TEWKESBURY.—A pleasant drive of ten miles through the Triassic plain at the base of the Malverns brought the party to Berrow Church, where they alighted and found the Rev. Mr. Symonds, the director for the day, together with the Rev. Reginald Hill, awaiting them. A visit was first paid to the old church, which Mr. Symonds briefly described. James Parker, Esq., F.G.S., then gave a very interesting lecture on the archæology of the sacred pile, preceded by some remarks on the etymology of the word "berrow," which, he thought, was derived from the same Saxon words from which we got "berry" and "wood." The original church was probably

very plain, since very little of an ornamental character remains. The most noteworthy peculiarity of Berrow Church is the absence of a chancel arch, though it is not probable that this almost universal feature was always wanting. Leaving the church, the way was led to a quarry in the Upper Keuper Sandstone, which here abounds with plant remains as well as with fragments of *Ichthyodorulites*, or spines, of the fish *Lophodus*, together with the crustacean *Estheria minuta*, at one time thought to be a mollusc, and called *Posidonomya minuta*. The great number of remains of organisms seen here was a pleasant surprise to the geologists, who, knowing the general palæontological sterility of the Keuper, did not expect to find fossils in the "New Red Sandstone." Mr. Symonds drew the attention of his hearers to the fact that the previous day they had been examining Palæozoic rocks, while to-day they were on Mesozoic or Secondary strata, deposited since the dislocation which had produced the great fault running north and south along the eastern side of the Malverns, and extending to the Bristol Channel. But that all the Triassic land around them had been covered by the Liassic sea, and by Liassic strata, was attested by the Lower Lias outlier of Berrow Hill, not a mile from where they stood. James Plant, Esq., F.G.S., of Leicester, who has specially studied the Trias, described the Upper Keuper Sandstones, which are here quite similar to the beds of Leicestershire. They have a maximum thickness of from 90 to 100 feet, and contain casts of worm tracks, ripple marks, and footprints of *Cheirotherium*, besides the fossils previously mentioned. Some small black spots found in these sandstones, Mr. Plant thought might be particles of coal derived from the Coal Measures, and not of direct vegetable origin as has been supposed. The Upper Keuper Sandstones, though not continuous, have been found over a large area, and they overlie the Keuper Marls above the Lower Keuper Sandstones or "Waterstones." At a very short distance from this highly interesting quarry, the Upper Keuper variegated marls were seen cropping out. These dip towards Berrow Hill, the lower portion of which they form. Mr. Symonds pointed out an old house, Morton Court, at which the famous Cardinal Wolsey, when a young man, lived as chaplain, and then proceeded to relate the legend of the Ragged Stone Hill, whose shadow is said to bring disaster and ruin upon whomsoever it may fall. That shadow had fallen on Wolsey when asleep in the

garden, and hence his last hours were darkened by cruel misfortunes.

Turning from the Keuper with its facts and the old house with its fables, Mr. Symonds led the way to Pendock Rectory, at which he presented his visitors to Mrs. Symonds, Miss Strickland, the sister of the lamented geologist Hugh Strickland, and Miss Jardine, the daughter of the eminent naturalist Sir William Jardine, and after the luncheon which had been hospitably provided for his guests, Mr. Symonds expressed the pleasure he felt in receiving the Members of the Geologists' Association, who were doing work of no small value. A visit was then paid to the ancient church of Pendock, when Mr. James Parker's fund of archæological lore was again drawn upon, and a highly instructive and learned lecture was the result. He rejoiced to find an unaltered church, such as this one was, for modern restorations frequently impair the archæological interest of ancient edifices. Pendock Church, Mr. Parker considered, was of the time of Henry I., and the pointed chancel arch was of the same age as the Norman pillars by which it was supported. The font was probably of the same period, but the tower of the church was of the reign of Edward III. or Richard II., and the woodwork of the seats of the time of Henry VII.

From Pendock Church an easterly route was pursued across the Triassic vale; and after a visit to Pull Court, at which the Members were received by Mr. and Mrs. Dowdeswell, the sections of High Level gravel in the park of Pull Court were examined. In these gravels the tusk of a mammoth had been found; and here Mr. Symonds briefly spoke of the period when the Straits of Malvern existed, and a yacht might have sailed from the mouth of the Severn to the mouth of the Dee. The party then rapidly proceeded through the richly timbered old park to the Tewkesbury road, by which the Severn with its fine section of Upper Keuper Marls was reached. Time did not permit of a detailed examination of the section, the principal features of which are, however, well seen from the bridge crossing the Severn at this point. The coloured bands of the Keuper Marls forming the cliff, at the foot of which the Severn flows, are very conspicuous and in striking contrast to the rich green of the alluvial meadows on the opposite side of the river. After taking leave of their director, the Members returned by train to Malvern.

THE WOOLHOPE VALLEY. — The fourth day was devoted to the Woolhope Valley of Elevation, which, from the time when Sir Roderick Murchison first wrote of "Siluria," has been classic ground to British geologists. The Rev. R. Dixon, M.A., a master of the geology of the district, and the director of the day's proceedings, met the Association party at Stoke Edith Station. At the neighbouring Foley Arms, the room used by Murchison while exploring the Woolhope Valley, was visited with interest, and then the road past Stoke Edith House was taken until Perton was reached. Here the first section was seen. The base of the Old Red is found resting on the Passage Beds representing the Tilestones, Downton Sandstones, and Bone Bed, which overlie the true Upper Ludlow Shales, exposed to a depth of four or five feet, all conformable and dipping to the north away from the centre of the Woolhope Valley. The significance of this section will be subsequently apparent. Following the lane to the south, and ascending to higher ground, a fine exposure of Aymestry Limestone containing *Pentamerus galeatus* and *Cardiola interrupta* was met with. Passing onwards, and still ascending, the Lower Ludlow Shales are seen to form the banks of the lane, followed by the Aymestry Limestone. Crossing the high ground of Tower Hill the umbrageous woods of Backbury Hill were entered, and presently emerging from their dense shade, the geologists stood on the summit of a precipice commanding the whole of the Woolhope Valley. After stopping perforce to gaze on the magnificent landscape so strikingly and so suddenly opened to their view, they disposed themselves around a space covered with maps and sections, and listened to their director's lecture on the geology of the Valley of Woolhope.

This remarkable valley is elliptical, or rather pear-shaped, and has a dome-like centre higher than the surrounding ground, and the whole is enclosed by two almost complete roughly concentric ridges of higher and newer rocks. It is therefore inferred that the whole has been uplifted by a force acting along the major axis of the ellipse, and that subsequent denudation has removed the rocks which covered those now forming the inner elevations and the centre. All the rocks exposed in the valley are Upper Silurian, while the country outside the exterior rim is composed of Old Red Sandstone, which has been uptilted all around by the uplift of the underlying Silurian rocks. At the Perton

section, previously mentioned, the edge of the encircling Old Red is seen with the uppermost Silurian strata beginning to appear. This section, therefore, gives a clue to the interpretation of the geology of the district. The outer and loftier rim of the valley is formed of the Aymestry Limestone, with an outside slope of Upper Ludlow Shales, and an inside slope of Lower Ludlow Shales. The inner of the two rims is composed of the Wenlock Limestone, with an inside slope of Wenlock Shale extending to a broad band of Woolhope Limestone which nearly encircles the centre dome of Upper Llandovery or May Hill Sandstone, the oldest formation seen. Thus it will be noted that, proceeding from the outer rim to the centre, older formations are met with in regular geological sequence, the hard limestones forming the ridges and the softer shales the intermediate valleys, with a central dome of siliceous rock. There is a prolongation of Ludlow rocks to the south-east, giving to the whole of this Silurian district an elongated pear-shaped form, and as on that side of the valley the strata dip at an angle of only 20° , while at the opposite or north-west side they have a dip of 50° , and even more, Mr. Dixon thought the upheaving force may have acted with less intensity at the south-east, and with increasing violence as it gradually approached the north-west. The symmetry of the valley is not perfect in consequence of a S.W. and N.E. fault occurring below Backbury Hill, and which is suggestively parallel with a line connecting a boss of igneous rock at Lowes Hill and the uplifted Silurian Shucknell Hill. Mr. Dixon stated the summit of the Llandovery central dome covered by Haugh Wood to be 9000 feet above the position it would have had if no upheaval had taken place. The elevation of Haugh Wood above sea level is 570 feet, while the highest points of the outer rim at Ridge Hill, Seager Hill, and Marcle Hill are considerably higher.

Little time was allowed for luncheon, after which the steep Backbury Hill was descended, and passing through the dense plantations of Dormington with their bowery paths, the great Wenlock quarries of Dormington were reached by Mr. Dixon and his followers, who without delay vigorously used their hammers, and soon found themselves in possession of fine specimens of corals, including *Halysites catenulatus* and *Favosites gothlandicus*. Leaving with regret the Dormington quarries, the geologists quickly made their way to the side of the Pentelw Brook, running between

banks of Wenlock Shale, to a point at which is seen a remarkable contortion of Woolhope strata, and thence by the Mordiford Road, past exposures of Llandovery rock to the gorge at the village of Mordiford. From this place the ascent of the central dome was made. A brief examination of the Woolhope Limestone of Scutterdine on the slope of the hill conclusively showed its distinction from the Wenlock Limestone; and at a little greater elevation the Upper Llandovery rock was found cropping out, and thus the centre of the valley of elevation and the geologically lowest rock of the district was reached. Descending the hill, Mordiford was again passed through, and emerging by the gorge from the Woolhope Valley, the party entered the beautiful vale, where the Wye is wedded to the "more lovely Lugg," and the road along the outer slope of the exterior rim and through the fertile vale of the Frome brought the gratified geologists again to Stoke Edith Station, whence, after Mr. Dixon had been duly thanked for his admirable guidance, the train was taken for Malvern.

THE WYCHE AND COLWALL.—The weather hitherto, though warm, had been exceedingly favourable for geological explorations, but now came a change, for on the morning of the fifth day of the visit the rain fell so heavily and continuously that departure from the friendly shelter of Townshend House was out of the question. In Dr. Grindrod's museum, however, geologists need not pass time unprofitably; and certainly that wet morning will be remembered as a time when much instruction was given and received. In addition to an attentive study of Dr. Grindrod's splendid collection of fossils, an opportunity was afforded for a meeting of all the Members of the Geologists' Association then in Malvern, presided over by James Plant, Esq., F.G.S., for the purpose of urging the General Committee of the Association to undertake the publication, for the benefit of the scientific world, of the valuable series of palæontological diagrams by the late Mr. Salter, which now adorn the walls of Dr. Grindrod's museum. Soon after mid-day the weather improved, and Dr. Grindrod and his visitors sallied forth to examine The Wyche and the western side of the hills. When the Wyche Pass was reached the rain again fell heavily; nevertheless the ardent geologists continued on their way and, after observing the Upper Llandovery resting against the central ridge of syenite, examined the Wenlock Limestone of the Colwall Copse quarries, which

yielded some good specimens of the usual Wenlock species. The continued downpour of heavy rain necessitated, however, a return to Great Malvern, where the interesting section at the back of the Belle Vue Hotel, showing Bunter Sandstone resting at a high angle against the Malvern syenite, occupied attention for a little time. The party then repaired to their hotel, the Imperial, and after dining together proceeded to Townshend House to attend

THE CONVERSAZIONE.—This meeting had been arranged by Dr. Grindrod for the purpose of bringing together the residents of Malvern and the Members, and a large assembly testified to the interest taken in the visit of the Association. A more appropriate place could scarcely be found for such a gathering than the Winter Promenade of Townshend House. Containing, as it does, both a palæontological and a petrological collection illustrating the geology of the district, and having its walls hung with Mr. Salter's famous diagrams, and other scientific adornments, little was required to adapt the spacious hall to the occasion, but its usual attractions were added to by the exhibition of a botanical collection of great value, which had been brought together by Mr. A. A. Maclean, while, to render the *soirée* still more complete, microscopic objects were displayed in the Library. The contents of the cases having been explained by the Members to the less scientific of the assembly, the visitors were most hospitably entertained in the Great Dining-room by Mr. and Mrs. Grindrod. Subsequently all reassembled in the Winter Promenade, and the chair having been taken by the Vicar of Malvern, the Rev. I. Gregory Smith, M.A., the objects of the Association were explained by Dr. Grindrod, who said he had requested two of the Members to speak on subjects of Geological interest.

Matthew Moggridge, Esq., F.G.S., then described to the meeting from personal observation, the cave at Mentone in which a fossil human skeleton had recently been found. The cave was at considerable height on the hill side, and in it were found the bones of bears and hyænas and other animals now extinct in Southern Europe. What was even more remarkable in the case was that flint implements, undoubtedly made by man, were found, thus showing that man was at least coeval with the animals whose bones had been found in the same deposits as the instruments themselves.

J. Logan Lobley, Esq., F.G.S., was called upon to address the assembly on the Teachings of Geology. He said the task assigned

to him was to give the history of the earth, a somewhat difficult one in the short time at his disposal, but he would attempt what must be but the merest outline of this wondrous history. On the walls of Dr. Grindrod's noble museum there was displayed the injunction "Speak to the Earth, and it shall teach thee." Let us obey this, and question the rocks around the Malverns. But how shall we get answer? Stratified structure and organic remains will reply to interrogatories, and reveal as surely as written language the history of the past. These "records of the rocks," when read aright, will tell us what that old Worcestershire Beacon, possibly some of the oldest land now existing, has seen of the changes on our globe since the crest of the Malvern range first rose above the waters. He then described the origin of one formation after another in ascending order, showing how we are able to establish the relation of rocks to each other in point of time by comparison of the fossil plant and animal remains discovered in their layers. This exposition afforded an opportunity of depicting the succession of animal life from molluscs and crustaceans to fishes, reptiles, and still higher forms of life, which were compared with existing species of the same classes, and illustrated by fossils obtained from the immediate neighbourhood.

The Rev. I. G. Smith, expressed the hearty thanks of the gathering to Dr. Grindrod for his invitation, and to the gentlemen who had delivered such instructive addresses. Marvellous as the revelations of science were, and logical as its conclusions seemed, he hoped they would always look at its teachings with a reverent eye, not leaping hastily to opinions, but waiting for further confirmation, knowing that theories were always changing, and that science viewed aright could not be other than the true handmaid of religion.

THE SOUTHERN MALVERNS.—The last day of the Malvern meeting was occupied with an inspection of the geological museum of Malvern College, and a re-examination of the southern hills and the Cambrian rocks of the district, under the guidance of Dr. Grindrod. The Rev. J. A. Panter, Hon. Sec. to the Malvern College Natural History Society, met the party in the Museum attached to the College, which contains a choice, though as yet not large, collection of the fossils of the district. From the College, carriages were taken by way of Malvern Wells to the Herefordshire Beacon. The hill was ascended,

and standing on the ancient British Camp which crowns the summit, the visitors surveyed the hilly and richly-wooded country to the north and west, and then traversed the ridge to the south, passing "The Hermit's Cave," and turning westwards at the head of the beautiful vale opening to Eastnor Park. Soon the Upper Llandovery rock was seen in a lane section, and with a right good will the hammers were used, and not without success, for very speedily *Lingula crumena*, *L. parallela*, and *Ctenodonta Eastnori* were found, and a little perseverance put the workers in possession of many good specimens of these characteristic Upper Llandovery species. With the Obelisk of Eastnor Park on the right hand, the path along the western side of Midsummer Hill was followed until the volcanic hill of the Ragged Stone was gained, when the section near the White-leaved Oak Valley was re-visited, and the "Holly-bush Sandstone," the probable equivalent of the Lingula Flags, closely examined. This is the lowest and oldest unaltered rock of the district, and contains worm tracks and *fucoïdes*, several specimens of which were quickly found. Descending the hill, a field road was taken, when presently the darkened colour of the soil indicated the proximity of the "Black Shales," the geological position of which has been a subject of dispute. Four species of trilobites—*Olenus humilis*, *O. bisculatus*, *O. scarabæoides* and *Agnostis pisiformis*—have been found in these shales, which have been by different authors correlated with the Llandeilo and with the Lingula Flags. After specimens of the shales for future examination had been procured by each, the geologists left the section and re-assembled in an excavation in a boss of igneous rock near Fowlet Farm, when the thanks of the party were cordially given to the director, who had given much time and attention to the object of their visit, and who had unreservedly opened his most valuable museum during the week. Dr. Grindrod said he had regarded the visit of his brother geologists with great interest, and should always have the most pleasant recollections of the week they had spent together. The Members then returned to Malvern, and, during the evening, departed for their several homes, thus bringing to a close the first visit of the Geologists' Association to the Malvern District.