GEOLOGISTS' ASSOCIATION,

1869.

REPORTS

OF THE

EXCURSIONS

TO

OXFORD.

GUILDFORD.

CATERHAM JUNCTION & CROYDON.

HUNSTANTON.

TOTTENHAM.

CRAYFORD.

GEOLOGICAL EXCURSIONS.

EXCURSION TO OXFORD.—MAY 17TH, 1869.

By JAMES THORNE, Esq.

(Read at the July Meeting of the Association.)

VISITS to places of geological interest have always formed a special feature in the working arrangements of this Association. From various causes, however, the number of members taking part in them had diminished during the last year or two, and the Committee became anxious so as to arrange those of the present session as to render them more generally interesting. It was thought best to proceed, so to speak, tentatively: not to decide on too many places at the outset, and to have a few whole day excursions, and a somewhat larger number of short afternoon runs; to select places of easy access, but at the same time of distinctive geological character, and above all to secure, whenever practicable, the assistance of an efficient leader. This last was the most difficult part of the problem, but it was happily overcome. Our President, entering into the project with characteristic zeal, volunteered himself to join or to conduct the excursions as often as possible, and the result has been that all the excursions have been successful; varying of course in the attendance, but always full of interest and always thoroughly enjoyed.

As to the enjoyment derivable from these excursions, all who have participated in them are agreed. Of their value, if judiciously conducted, there can be no doubt. Geology is essentially based on field observation; and though the excursions are necessarily somewhat hurried, and imperfectly connected visits to a few leading localities may not in themselves add much to our store of knowledge, incidentally they render great assistance to a student when made, as these have been, under the direction of one who is at the same time a good geologist and well acquainted with the district, whilst to those among us who are rather lovers of the science and learners, than accomplished geologists, they are particularly instructive and suggestive. We are taken to spots of especial geological interest, and receive at once a lesson in the theory and the practice of the science: are shewn both how to observe and how to set to work, alike with the pencil, the hammer, and the pick. We have been shewn, too, how to extend our observation beyond the mere examination of particular sections

and the collection of fossils. In each instance our President has led us to consider carefully the great physical features of the district, and pointed out how far they have been due to, and how modified by, geological agency.

Having shared in all the excursions of this summer, I have ventured, however irregular the procedure may be, to preface the report I have to make of the first excursion of the season, by a few words on these excursions generally, in the hope of inciting some of the members who have not hitherto taken part in them to join us in such further opportunities as may occur of enjoying at once pleasant scenery, social intercourse, and a practical lesson in our favourite science.

Some twenty-four members of the Association and their friends, mustered at the Oxford Railway-station on Whit-Monday morning. The Museum being the first place to be visited, little time was lost in proceeding thither: but those of us to whom Oxford was of old more or less familiar could not help noting on our way the changes that have been lately made, and are still making in the architectural appearance of the venerable city. The new buildings at Balliol; the new Keble College; the well-known Angel demolished to make way for the new examination schools; the Parks, and the Clarendon laboratory and additional buildings at the Museum; the last especially a pleasing evidence of the growing interest in science-studies in the old university.

At the Museum, the members were received with great courtesy by Professor Phillips, who after a general glance at the noble structure and its contents—so abounding in interest to the geologist—conducted them to the chief objects of geological interest, and pointed out the principal recent additions made to the palæontological collections. In a rapid but lucid and pleasant manner, he explained the general and peculiar characters of some of the more remarkable and interesting reptiles lately acquired, drawing attention first, however, to the structure, size, and forms of certain bones in a skeleton of the recent crocodile, with the view of comparing them later with the corresponding bones of the fossil saurians in the Museum. Among the creatures thus elucidated, was the *Cetiosaurus*, an enormous and very perfect femur of which has been recently added to the treasures of the Museum, and from which by a cautious and suggestive train of reasoning, Professor Phillips showed that this the most gigantic of all the fossil reptiles, must have been an animal of immense muscular strength, vast bulk, some 60 feet long, and much better fitted for active movement on the land than in the water. The huge femur, the largest fossil bone known, the *Magnum Bonum*, as Professor Phillips jocularly termed it, of the Museum, was found in a quarry at Enslow Bridge, a few miles north of Oxford, in a clay bed of the Oolitic rocks, is five feet four inches long, and of proportionate breadth and thickness, it far surpasses in size the less perfect specimen described by Professor Owen many years ago, and from which he determined that the animal could not have belonged,

as Cuvier supposed, to the *Cetacea*, but was reptilian. The *Plesiosaurus*, *Teleosaurus*, and *Megalosaurus* were in like manner commented on, and their structure explained; and the swallow-like capacity for flight of the *Pterodactyle*, and its bat-like power of suspension by the hooked extension of the finger when sleeping or hibernating, were strikingly shown. Professor Phillips then called attention to the interesting series of lower jaws of marsupial animals from the Stonesfield slate, gave an account of their original discovery, and explained their peculiar character and recent affinities. Lastly, he succinctly noticed the more characteristic fossils illustrative of the geology of Oxford, and which in part had been obtained from the different deposits of the Oolitic series, which the members of the Association were about to investigate, under the direction of Professor Morris in their ascent to the summit of Shotover. The freshwater shells *Unio* and *Cyrena*, and a fossil fern from the iron sands of Shotover, were examined with interest.

Professor Morris gave expression to the general feeling, by moving a vote of thanks to Professor Phillips for the very able and kindly manner in which he had instructed the party in a lecture of more than an hour's duration; to which the Oxford Professor good-naturedly replied that the visits had given him great pleasure, and he should always be ready to welcome any similar gathering of geological friends, and as far as he could to facilitate their inquiries.

Professor Morris now resumed the direction, and, after the indispensable lunch, the party made for Shotover, by way of Headington Hill. On the way, the road-side stone-heaps were occasionally examined, and once and again an interesting specimen turned up, affording to our President the text for one of his always seasonable and suggestive sermons in stones. Lumps of coral (*Isastræa*) were plentiful, and in the field walls large weathered examples showed well their peculiar honey-comb appearance and columnar structure.

In the course of the ascent, the successive geological formations were examined and illustrated in reference to their physical features. The Vale of Oxford is composed of Oxford clay, which, in boring for water at St. Clements, has been penetrated to a depth of 400 feet. Overlying the Oxford clay is the Coralline Oolite. Above this is the Kimmeridge clay, about 100 feet thick; and this is succeeded by beds of Portland sands, 70 feet thick. Thus the upper Oolite has for its base Kimmeridge clay; the middle Oolite for its base Oxford clay; while the lower Oolite rests upon Lias. The alternation of beds of clay and limestone determining, as Professor Morris pointed out, the general direction and character of the wide valleys, and the picturesque aspect of the surface of the district.

The lower portion of the Oxford clay, which is seen but rarely near Oxford, contains *Ammonites calloviensis*; the upper beds yielding *Am. vertebralis*, *Gryphæa dilatata*, and other fossils. Bones of *Plesiosaurus* occur in both the upper and lower beds.

The overlying Coralline Oolite was carefully examined in the

quarry near the windmill, on the ascent of the hill. In this district, the lower portion is a calcareous grit with cherty and shelly beds, containing *Am. vertebralis*, *Pinna*, and the usual fossils, overlain by the Coralline Oolite, the lower beds of which consist of shelly ragstone with many fossils, a fair number of which were obtained by the party, including some beautiful specimens of the corals, (*Isastræa*, *Thamnastræa* also *Lima rigida*, and *L. læviscula*, *Pecten vagans*, *Cidaris*, *Nucleolites*, *Belemnites abbreviatus*, and others. The mode of deposition of the beds, and the peculiar growth of the masses of coral, were well seen. The stone is not sufficiently coherent to be worked for building-purposes, coming out in rough irregular lumps. These, however, serve for field walls, which, as already noticed, furnished the party with some excellent illustrations of coralline structure. Professor Morris, I believe, considers that the coral strata represent a condition of clear water, and the shelly layers a time when the waters were thickened by muddy currents.

The upper bed, seen in a quarry on the left of the road nearer Shotover, is more truly oolitic in structure, and is extensively worked for a building stone, yielding freely to the saw. This is more or less thick-bedded, and, where well exposed in the quarry, is seen to have been eroded or water-worn on its upper surface previous to the deposition of the Kimmeridge Clay, which overlies it.

The Kimmeridge Clay is here about 100 feet thick, with an intercalated limestone band, more or less nodular. Some of the characteristic fossils were obtained here, as *Exogyra virgula*, *Ostrea deltoidea*, *Thracia depressa*, and *Rhynchonella inconstans*. Bones of several saurians are also occasionally found here. The Kimmeridge Clay is being converted on the spot into bricks and drain pipes. A bituminous shale occurs in the Kimmeridge Clay, which has been mistaken for coal: in Wiltshire it resembles peat.

The open air chemistry in this quarry is very interesting. When newly exposed, Kimmeridge Clay is nearly black, being coloured by iron bisulphide. A small quantity of calcic carbonate is commingled with the clay. By the action of air and rain, the iron sulphide is converted into sulphate, which, in the presence of carbonate of calcium, is decomposed to form calcic sulphate. As this is gradually formed it crystallizes out as selenite in oblique rhombic crystals, called by the quarrymen diamonds. They, of course, only occur on or near the surface of the clay, which has been for awhile laid bare. At the same time hydrated sesquioxide of iron is being formed, and also being washed down by the rain on to the building stone below, which is stained by it of a rusty red colour.

In farther ascending the hill, the Portland Sands, about 70 feet thick, were seen in a quarry reached by a gate on the left of the road. The upper part appears as a more or less green sand, the lower part includes large nodular and rounded calcareous masses, full of shells characteristic of this deposit, as *Trigonia gibbosa*, *Cardium dissimile*, *Perna quadrata* (pierced by *Lithodomus*), *Terebra*

Portlandica, *Pecten lamellosus*, and *Buccinum naticoides*, specimens of which and other shells were obtained. The nodules, called from their shape cannon-balls, or potatoe-stones, are a very hard blue stone in the main agglutinated by carbonate of lime. Prof. Morris explained the formation of these nodules as arising from causes similar to those which produce flints in chalk. Here we have a great quantity of sand, and a small quantity of calcareous matter. The calcareous matter, as it were, separates out from the sand, segregates together and forms the nodules. In the chalk the conditions are reversed. The calcareous matter is in excess, and the silica segregates out or replaces it.

Above these beds the summit of the hill is capped by Ferruginous Sands, about 80 feet thick. These beds vary in character, and comprise white, yellow, brown, and occasionally nearly black sands, sometimes very ferruginous, and having irregular and branching veins of ironstone, presenting a very peculiar appearance. Beds of grey and light-coloured clay, useful for the manufacture of pottery, also occur. Intercalated in the lower portion are the beds of ochre, for which the pits are occasionally worked, and for which the locality is celebrated.

Near the summit of the hill, Prof. Morris briefly, but very clearly, explained the general nature and bearing of the facts seen during the excursion, ranging them under two different heads :—

1st. The nature and mode of accumulation of the strata of the district.

2nd. The physical features as dependent on their geological structure, and the agencies that have subsequently operated in modifying the surface.

The Vale of Oxford, observed Prof. Morris, is composed of Oxford Clay, a member of the Middle Oolites, and an argillaceous deposit of from 400 to 500 feet in thickness, rich in fossil remains, deposited in what was an ancient sea bed. The great extent of the Oxford Clay was forcibly illustrated, reaching, as the Professor showed, quite across the country from the coast of Dorset by Portland, on the south-west, to the Yorkshire coast by Scarborough, on the north-east, and spreading over Europe into Russia, and even farther eastward, and characterized by many peculiar fossils. The influence of the Oxford Clay in producing the fens of Lincoln, Cambridge, and Norfolk was also alluded to.

Over this clay a change took place characterized by the incoming of shelly and oolitic beds of some thickness, also marine in character, and indicating a period during which certain forms of Coral slowly grew on the old sea bottom. These, together with many species of Mollusca, formed a tolerably thick deposit, to which the name *Coral Rag* was given, from its comprising, as its chief mass, abundant forms of ancient coral life. These beds have been largely quarried around Oxford for building, and it is of this stone that most of the Oxford colleges have been constructed; unfortunately, however, whether from inherent defects in quality, unskilful selec-

tion, or bad placing, it has undergone much decay, as may be seen in too many of the unrestored buildings of the city.

Again a change took place. The limestone strata were succeeded by another argillaceous deposit, the Kimmeridge Clay, containing a nearly distinct assemblage of fossils, among which are remains of great reptiles, as the *Pliosaurus*, *Plesiosaurus*, and *Steneosaurus*, and of which some fine specimens had been seen by the members of the party during the morning visit to the Museum.

Overlying the Kimmeridge Clay was deposited a series of sandy beds, with interspersed green grains of silicate of iron and some calcareous matter, which, however, is now segregated out into large nodular masses, full of the usual marine shells of the Portland beds. To these succeeded a variable formation of sand, clay, loam, and ochre, more or less largely charged with iron, and which in their lower part have yielded to the researches of Prof. Phillips and others, certain forms of shells, which would indicate them to be of fluviatile origin, and thus related to the Wealden, as *Unio*, *Cyrena*, *Paludina*, with remains of Cyprides and fragments of ferns, indicating an entire change in the area from the beds below. These ferruginous beds, however, as Prof. Morris remarked, though here apparently fresh water, when examined near Aylesbury, where they also overlie the Portland beds, are found to contain a few blocks of sandstone, with *Unio*, etc., at their base, but to abound with marine shells of Lower Greensand types, as *Exogyra sinuata*, *Lima*, *Pecten*, *Rhynchonella*, and some others.

Prof. Morris then adverted to the physical features of the district, and pointed out how the varied scenery was entirely due to the geological structure and influences, to the effects of elevation, subsidence and denudation. The harder rocks had to some extent resisted the denuding agencies, such as frost, rain, streams, and rivers, which had affected the softer strata, and thus were produced the hills, and dales, and broad valleys of this picturesque district.

At the close of his address a hearty vote of thanks was accorded to Prof. Morris, to whom everyone felt that the thorough enjoyment of the day was mainly due. The party then divided: some returned to Oxford in order to catch an early train to London, others went on to Wheatley, and thus had an opportunity of observing on their way the outcrop of the beds on the east side of the hill, at a somewhat different level from that at which they had before seen them on the west.