

EXCURSION TO BEDFORD AND CLAPHAM.

SATURDAY, JULY 21ST, 1888.

(In conjunction with the Bedfordshire Archæological and Natural History Society.)

Director : A. C. G. CAMERON, H.M. Geological Survey.*(Report compiled from local papers.*)*

Leaving St. Pancras at 10.10 a.m. the party reached Bedford at 11.16, and were cordially welcomed by the Bedford contingent. From the railway they walked to the Pumping Station on the Clapham road, where they were met by the Borough Surveyor (Mr. J. Lund), Mr. Joseph Miller, and Mr. Charles Franklin, and the Deputy-Mayor (Mr. Jabez Carter) put in an appearance at a later stage. Under the direction of Mr. Lund a full inspection was made of the cut or heading in the limestone from which the town water-supply is derived, and which runs under the roadway leading down to the Pumping Works. By the side of this road are two wells fifty feet deep, at the bottom of which the water can be seen running in a strong stream. The water also trickles from the limestone, which is thirty feet thick, and from the rock to the surface the wells are bricked round. Connected with the heading is a large well or boring, the upper part of which has been enlarged and forms a chamber in the rock. This chamber is below the garden at the Pumping Station, and close to the river. It is about thirty feet long, nearly the same depth, and twenty feet wide; and the average depth of water kept in it is from two to three feet. Mr. Lund explained that as the town developed it was found necessary to extend the heading, which doubled the supply of water, and the daily consumption was now from three to four hundred thousand gallons. Several of the party entered the chamber, and others inspected the engine-house.

The company thence proceeded to the neighbouring brickyards and stone-pits, by the kind permission of Mr. Charles Franklin. Mr. Cameron pointed out the geological features in the various pits, commencing with the stone-pits nearest the river, and working

* 'The Bedfordshire Times and Independent' and 'The Bedfordshire Standard.'

upwards to the Clapham Road, and in ascending order. The first pit visited showed the *Ostrea* beds of the Great Oolite limestone, and clay, beneath which there is apparently a great thickness of Liassic clay. Above the Oolite limestones lay a fine exposure of the purple and black clays of the Cornbrash, locally known as "Pendle rock." There was here an abundance of calcite and oyster shells. The Lower Oxford, consisting of dark clay, with much selenite and race, was next observed. In the upper pits, where brick earth is obtained, there was a fine section of Kellaway's Rock, consisting of a blue loam, which passes upwards into yellow iron sand, enclosing hard masses of calcareous sandstone known as doggers. Mr. Franklin had caused some of these to be bared, so that they could be easily inspected. The uppermost strata examined were those of the Upper Oxford, partly covered by Boulder Clay, which at this point comes down the hill almost to the river's edge. In the brickyards the process of making bricks was observed with great interest, and Mr. Cameron made the following remarks on the brickmaking industry :—

"Digging clay for brickmaking purposes results in a hole, which may be either a shallow excavation of three or four feet, or a pit ten or twelve feet deep. Sometimes, as is the case at Cleat Hill, the clay is worked from the edge of the flat, up the hill slope, until it meets the cap of Boulder Clay above. In this way the whole face of the hill may be laid bare. It would be impossible in a paper such as this, to enter upon the whole art of brickmaking, nor would it add much to our practical knowledge of the subject. The interest to this Association, lies more in the manufacture of brick out of Bedford clay, and on this I am able to offer a few remarks. All Bedford bricks are hand-made or hand-machine-made, there being but one brickwork (as far as I know) in the neighbourhood, where steam-power is employed. The brickearth is the Oxford Clay, prepared alone, or with an admixture of the "mild clay" of the builders, the Kellaway loam and sand, which is usually obtainable in the same brickfield. Boulder Clay is not used. In this particular field in which we are assembled, the Lower Oxford beneath the Kellaways, is the clay dug; this being mixed in the pugmill with the blue Kellaway loam, produces an efficient brickearth. The brickmaking season commences in April, and is carried on with great activity throughout the summer. In October it is practically over, as it seldom happens that any bricks are made at

a later time of year, or during the winter months. Still, winter is a busy time, for it is then that the clay is dug, and stacked, and piled in heaps, and left to weather in the frost, which breaks up and crumbles the lumps. In spring, the heaps are turned over and sufficient water added to give plasticity to the mass; care being taken in stirring the clay to pick out the fossils, or stones, as these, if allowed to remain, crack the clay in drying, and burn into white lumps, making the bricks unsound, for as these lumps weather out, they leave the bricks riddled with unsightly holes—and if a piece of limestone no bigger than a pea be allowed to remain, it will destroy any brick into which it finds its way. Hundreds of *Gryphæa* lie amongst the clay in some brickyards, and where there are so many not a few escape observation, so that unwittingly, the shell of the departed lamellibranch becomes cremated at the last. Scarcely a shell of any kind can be found at other brick-pits—such an unfossiliferous bed being, of course, all the better for brickmaking purposes. Again, there are pits where *Belemnites* can be gathered by the bushel. In April, the clay is ripe or mellow, and in readiness for the moulder. A brick-mould, is a kind of wooden box without top or bottom, into which the clay is dashed so as to fill it. There is a good deal of water or “slop” used in the operations, both the wooden striker to remove the superfluous clay, and the mould, being constantly kept wet. This necessitates well-sinking as a not unusual addition to the general arrangement of a brickwork—i.e., if no natural water advantages are available. Sand, such as that from Flitwick, is used to dust the moulds and keep them from sticking. All these operations are executed with great dexterity, and it is astonishing how great a number of bricks are made in a day. With a well-appointed yard, a man can make from 1,000 to 1,200 a day, of twelve or fourteen hours, and he generally works that length of time. With helpers to wheel away and stack, 5,000 are made. When steam power is used, 50,000 is the output for the day. Here, with ten moulders, 10,000 to 12,000 bricks are made in a day. It is on record, and as not a solitary instance, that “in Cumberland, one Josiah Rush, performed the feat of making 1,000 bricks in an hour, 100 in five minutes, and twenty-six in one minute,” which is, I believe, about a barrowful.* A raw brick has to be dried with great care, as much depends

* ‘Carlisle Journal.’

upon the condition they are in, when placed in the kiln. They must be kept from sun, wind, rain, and frost; exposure being as detrimental now, as beneficial in the earlier stages of preparing the clay. Draughts are very injurious, as they cause the bricks to dry faster on one side than on the other; boards, therefore, are generally to be seen placed round the drying-sheds, to keep these out, and maintain an equable movement of the air. Kilns for burning, are erected in many ways, and scarcely any two are exactly alike. In Bedfordshire, the kiln most often seen is a rectangular one, known as the furnace kiln, having the furnaces running underneath the whole length of the structure. The bricks are placed crossways inside, so as to leave spaces from top to bottom for the heat to circulate throughout. At first there is a good deal of steaming; and when this ceases the bricks are dried. The fires are then increased until the burning is complete. Before removing the bricks, the fires are allowed to go out, and the kilns to gradually cool down. The time allowed in the kiln varies with the weather, the previous drying, the size of the kiln, and to some extent with the demand for bricks; but if put in on a Monday they are usually taken out the following week. The main mass of Oxford Clay, being buried here almost to the water's edge, beneath the Boulder Clay, it is not conveniently available for brickmaking purposes. What is used, being, as I have already said, the Lower Oxford, a clay bed subordinate to the Kellaways. The Cornbrash Clay—the purple clay beneath the limestone—is not used, or only to the small extent of having the upper two feet sometimes mixed in the pugmill with the other beds of clay and loam.

“Brick Colouring is an interesting feature in the art of brickmaking—besides being an important item in its commercial value. The colour of a brick depends not altogether upon the natural colour of the clay, but upon the amount of iron present in the clay, modified in some cases by the firing in the kiln. For the same reason, I suppose, that a lobster is spoken of as being red, when he is really bluish black or black, brickmakers often speak of their clay as red or white, when they really mean that the bricks are these colours, without reference to the colour of the earth employed—which, as likely as not, may be blue or grey. I do not, however, maintain that a raw lobster turns red if boiled, for the same reason that crude clay is red when baked, which is, of course, due to its containing oxides of iron in its composition. The colouring of

clay depends mainly upon the presence of iron, in various proportions and states of combinations. I say mainly, because in some Oolitic and other clays the colouring power of the iron is obscured by carbonaceous matter. The prevailing colours that iron gives to clay are grey and red, according as the iron is present in the form of a protoxide, or hydrated peroxide. Oxford Clay, Gault, and London Clay come under the head of grey clays. Either of these coloured clays will make a red brick. There are only grey clays in Bedfordshire, which weather yellow in their upper part, and from these are produced the red building bricks, mixed bricks, and the pale buff or cream, generally called white bricks. No essential difference exists in the colouring matter or aspect of a clay that burns yellow or pale buff, and those that burn red, the depth of colour depending mainly on the amount of iron present, the buff shades regularly graduating into the deeper shades of red. There is an analysis by the late Dr. Voelcker of Oxford Clay, Brickworks, Chippenham, Wilts, which is as follows :—

“Protoxide of iron 1·12 per cent.

Sesqui oxide „ 3·25 „

Bisulphide „ 1·10 „

Sulphate lime „ 1·37 „

and crystals of selenite distributed through the strata.” It is only a partial analysis, but as far as it goes, it is a typical analysis of Oxford Clay generally. The remainders are principally alumina and silica, say ninety parts, with perhaps carbonaceous matter in small quantities. Here then is about $5\frac{1}{2}$ per cent. of iron, and this quantity of iron in the Bedford Clay sufficiently accounts for the bricks and kindred fabric, ranging in colour from cream or pale buff, to bright and dark red. Had there been more of iron, say eight to ten per cent., the bricks would have been of a blue or almost a black colour.”

On their arrival in the Clapham Road, the party found several conveyances awaiting them, and they were thence driven to Clapham Church, where the Saxon tower was inspected with great interest. The party having seated themselves in the church, Canon Haddock, from the chancel steps, delivered a most interesting address on various points of interest in the church. He stated what was known about the ancient tower, described the more recent additions to the edifice, interspersing his remarks with some criticism, and alluded

at some length to a beautiful marble monument, the work of Grinling Gibbons. The tower, which is eighty-one feet high, is built of native limestone, and is noteworthy for its extreme simplicity and rudeness of construction, and is one of the best and most remarkable of the remaining examples of early Saxon work in the kingdom. The foundations extend only about a foot into the ground; the walls at the base are 3ft. 10ins. thick, the outside is roughly plastered, and the inside remains jagged as constructed.

The party then drove to the New Park at Bedford, passing through Clapham Park, by kind permission of Mr. James Howard. In due time they arrived at the New Park, where they were invited into the Pavilion, where a most hospitable repast had been provided by the Mayor, Mr. Hawkins. After creature comforts had received due attention, the Mayor proposed the health of the Association, expressing his regret that the state of his health had prevented his accompanying them, since as Mayor of that essentially educational town he was naturally much interested in science, especially in so progressive a science as geology, and was very pleased in the name of the town to offer the Geologists' Association a very hearty welcome. The President replied, thanking the Mayor for his very gracious reception, and for his address, marked as it had been by so much common sense and scientific research, and also thanking Mr. Lund, Canon Haddock, Mr. Franklin, and the other gentlemen who had assisted them during a very interesting day. Alderman Carter then proposed the health of Mr. Cameron, Dr. Coombs that of Alderman Hurst as representing the Beds. Natural History and Archæological Society, and Alderman Hurst that of the ladies, to which Miss Forster replied.

The company then proceeded to the Park Gates, which were described by Mr. Joseph Miller, and thence down the De Parys Avenue to the Bunyan Monument, which was duly inspected. A few botanists then walked to the Embankment and Newnham Bridge, others took a boat on the river, while the main body visited the Modern School Museum, where the curator, Mr. Taylor, was in attendance to receive them, and great interest was taken in the geological collections. Next they visited the Museum Room of the Beds. Archæological and Natural History Society, examined the specimens and books belonging to both branches of that Society, and were shown a typical series of fossils from the Chalk by Mr. J. Saunders. The Embankment and New Foot Bridge were

also visited, and one or two engineers in the company examined, with interest, the last-named structure. In this agreeable manner the time was spent until the party departed by the return train to London.

REFERENCE.

Geological Survey Map, Sheet 52, S.E. and S.W.

ON THE LOWER DIVISIONS OF THE CARBONIFEROUS ROCKS
OF THE FOREST OF DEAN.

BY E. WETHERED, F.G.S., F.C.S., F.R.M.S.

(Read July 6, 1888.)

In Gloucestershire we have two coal-fields, that of Bristol and that of the Forest of Dean. These two, together with that of Somersetshire, are regarded as outliers of the great South Wales coal-field. Sir Andrew Ramsay states* that the separation was brought about by long-continued denudation, which has swept away thousands of feet of strata bent into anticlinal and synclinal curves. He further remarks† that "the intervening spaces are anticlinal and the basins synclinal curves, and therefore it is not only possible, but probable, that other coal-basins may lie far to the east beneath the Oolitic, Cretaceous, and Eocene strata of the London basin." These conclusions have generally been accepted, and I am not going to dispute their correctness. I shall, however, show that in the Forest of Dean there are geological features which differ greatly from those of contemporaneous rocks in the Bristol area. As this is important, and to a great extent new, I shall in this paper have something to say as to the correlation of the Carboniferous rocks of the Forest of Dean with those of Bristol. But as this paper is to have special reference to the visit of the Association to the Forest of Dean, I shall confine myself to strata below the Coal Measures, as it will be impossible on that occasion to see more.

As typical of the Lower Carboniferous rocks of the Bristol area, I take the exposure in the gorge of the River Avon at Clifton, which, as Sir Henry De la Beche pointed out,‡ does not

* 'Physical Geology and Geography,' fifth edition, p. 35 (1878).

† *Loc. cit.*, p. 122.

‡ 'Mem. Geol. Survey,' Vol. i, p. 112.