

to the production of artistic stoneware, which soon acquired celebrity, due especially to the spirited designs of animals incised in the ware by Miss Hannah Barlow. Other modes of decoration were rapidly introduced; leaves, flowers, dots, discs, and borders were stamped in clay and sealed on the body; while colour was also introduced, though the high temperature necessary for firing stoneware renders the range of pigments very limited, and gives rise to great difficulty in producing definite tints. The production of this ornamental pottery, now known as "Doulton ware," offers employment to a large staff of female artists.

Of other art products which in recent years have characterized the Lambeth works, mention may be made of the *pâte-sur-pâte* on stoneware, the *impasto* on faience, and the body known as *silicon ware*, which is described as "an uncoloured body resembling both stoneware and jasper." The manufacture of most of these ceramic products was witnessed by the Members of the Association.

Since the production of all kinds of pottery and porcelain is primarily dependent on natural clays, the industry cannot fail to interest geologists who study the economic side of their science. During the excursions of the Geologists' Association the Members have frequent opportunity of observing the occurrence of different kinds of plastic clay in the field; and on the occasion of their visit to Lambeth they had an opportunity of seeing these clays applied to purposes of use and ornament, ministering to the wants of man and contributing to his enjoyment.

EASTER EXCURSION, 1887.

PRELIMINARY EXCURSION TO SOUTHAMPTON.

(In conjunction with the Hampshire Field Club.)

Director: WILLIAM WHITAKER, B.A., F.G.S.

(*Report by* THE DIRECTOR.)

Members arrived at Southampton on Thursday evening, April 7th. On the next day they went by rail to Shawford, where they saw the lynchets, etc., of the Chalk Downs, and examined a pit in the uppermost part of the Chalk, with an abundant supply of *Holaster pillula*, and at top some pipes of clay, the filtrate from water that had sunk through the Chalk.

Before again descending into the valley of the Itchen attention

was drawn to the features of the country : the dip-slope of the Chalk to the south ; the wooded ridge of the Tertiary beds, which soon come on in that direction ; and the rise of the Chalk to the north, with the prominent St. Catherine's Hill, near Winchester, encircled by a British earthwork.

The party then walked along the right bank of the Itchen, and saw the tufa-terrace, a mass of calcareous earth deposited by the river, but at a slightly higher level than the rest of the alluvium, and, therefore, not liable to floods. This tufa consists chiefly of carbonate of lime, and sometimes contains many land and fresh-water shells of recent species.

The new Southampton Waterworks having been reached, the Director described the site, close to the line of outcrop of the Chalk, in relation to the question of getting large supplies of water from the Chalk. He remarked that where a large supply was needed there were various points to be considered. Of course the works should be as near the town to be supplied as possible (having due regard to other points). They should be, however, as a rule, where the Chalk was not thickly covered by Tertiary beds, giving preference, indeed, to a site where it was bare or nearly so. They should be at a low level ; away from sources of contamination ; and so placed as to be at, or near, a point where the underground water-level is low, or, in other words, where that water tends to flow naturally. The site of these new works fulfils these requisites, being at the outcrop of the Chalk nearest to Southampton, besides having a railway alongside. The water-level is 20 feet down, and pumping, from trial-borings, showed that there was a large amount to be got. Further pumping, some time after the Excursion (done whilst fixing the permanent pumps), has shown an increase in the yield.

Mr. W. Matthews, the engineer, after welcoming the visitors on behalf of the Mayor and Corporation, described the works, which at present have two wells, six feet in diameter and 100 feet deep, in the uppermost part of the Chalk, here mostly very soft and with few flints. These wells were made throughout by boring,* and the water will be pumped from them to the softening-works, the largest in the kingdom (the process adopted being that of Atkins),

* Only eleven days afterwards Mr. Matthews gave a detailed description of these wells to the Institution of Civil Engineers. See 'Proc. Inst. C.E.,' Vol. xc, pp. 33-39, plate 1.

and then forced up to the reservoir, on Otterbourne Hill. Mr. Matthews took the party through the works, as yet unfinished, and explained the engineering details.

Passing through Otterbourne a visit was paid to one of the pits in the sand which there forms the top part of the Reading Beds, that formation in this neighbourhood consisting generally of mottled plastic clay.

The Tertiary escarpment having been ascended, after drooping energy had been freshened by lunch, the new reservoir was reached. This had been lit up for the occasion, and each visitant was also furnished with a taper, so that, on descending, a strange, weird view was seen, the impressiveness of which was added to by the reverberating echoes, making it somewhat difficult for Mr. Matthews to explain the structure.

On again outcropping to daylight the Director remarked that the excavation for the reservoir had shown a most interesting and unique section, the Bagshot Pebble-beds resting somewhat irregularly on the sandy top London Clay, in the absence of the Lower Bagshot Sand. A rash offer of a bronze medal to anyone who could find anything else than a flint-pebble in these pebble-beds in the adjoining pit might have ruined the Director had its acceptance been insisted upon, as he had forgotten to provide himself with a supply of the medals in question, never dreaming that there would be so great a demand for them as occurred. It was strange, indeed, how the idea of reward stimulated geologists to find small quartz pebbles where none had been found before! No one, however, found an angular stone.

Tracks were then made southward, and a brickyard near Allbrook was visited, with pits in London Clay and in the sand of the Reading Beds. Thence, descending to a still lower level, the railway was reached, north of Bishopstoke Station, and a cutting, opened for ballast, was seen. This is in the gravel-flat of the Itchen, which must have been formed when the river was larger and swifter than now, and the land at a higher level. On the north, London Clay was seen beneath the gravel; whilst southward, Bagshot Sand came up in places along the lower part of the cutting. Farther south, a little brick-earth occurs over the gravel.

The return to Southampton was made from Bishopstoke, and in the evening the museum, art-galleries, and laboratories of the Hartley Institute were specially opened by the courtesy of the

Council. The visitors were received by the Executive Officer, Mr. T. W. Shore, who also described the collection, calling particular attention to flint implements found at and near Southampton, to some elephants' teeth from the local gravel, and to London Clay fossils from the outskirts of the town. A vote of thanks, proposed by the President, to the Council and to Mr. Shore was acknowledged by Mr. M. Miles and that gentleman.

On Saturday, the 9th, a start was made from Southampton by train to Netley, where, on arrival, about 9.30, the muster of the combined societies was found to number between 40 and 50. The day was almost wholly given up to the examination of the railway then being made from Netley to Fareham, and the following remarks on the sections along that line must be understood to refer to their state at that time, much work having been done since.

At the first convenient halting-place, the Director addressed a few words to the members of the Hants Field Club regretting the absence of their President, Prof. De Chaumont, and expressing, on their behalf, sympathy with him in his long-continued illness. Mr. Rudler then took the opportunity of supplying an omission in the proceedings of the day before (caused by the sudden and mysterious disappearance of Mr. Matthews) by expressing the thanks of the party to that gentleman for conducting them over the Waterworks and explaining the construction thereof.

At first, near Netley, the cuttings of the railway are in gravel, belonging to a high terrace of River Drift. Underneath this, however, the Bracklesham Beds, consisting of clays, loams, and sands, are soon touched. The gravel rests irregularly on these, showing in section a set of scoops or festoons. In one cutting the Director called attention to a "Prehistoric Ink Manufactory," alluding to a black layer in the gravel following the aforesaid junction, which was caused by water containing vegetable matter (from the soil) sinking through the permeable gravel and dissolving some of its iron-colouring, until stopped by the impermeable clay beneath, when the black matter, produced by the mixture of vegetable solution and iron-salt, was deposited.

Before reaching Bursledon the remains of an old saltern in Badnam Creek (Hamble River) were pointed out, and Mr. Shore gave a short account of the manufacture of salt in Hampshire, showing that this industry was of ancient date, 20 works in the county being mentioned in Domesday, and some in Hayling Island

having been used in Roman times. The latest was in Newtown Bay, where salt was made in 1858. These works were always in estuaries, which the Director suggested was due to the facts that they would be less expensive in construction and less liable to destruction in such sites than by the open sea.

At Bursledon the Lower Bagshot Sand seems to rise up from beneath the Bracklesham Beds, but the junction could not be seen.

At this village, on the right bank of the Hamble, a good example was seen of the effect that is likely to result from making an embankment over soft alluvial beds. So yielding was the ground that the embankment had sunk as much as 20 feet, forcing the alluvial earth not only upwards, but also out into the tidal river-channel. It seemed likely that the embankment would have to be abandoned and some sort of viaduct made instead.

Mr. Shore here spoke of the remains of the Danish galley that had been found in one of the creeks on the other side of the river, and was still to be seen at low water of spring-tides.

At the viaduct over the Hamble the Director gave the word "Engineers and such-like to the front," and handed over the resultant select committee to Mr. Anderson, the contractor's engineer, who kindly took the temporary secessionists over the work and explained its construction. In driving one of the cylinders many nuts were found in the marsh-clay beneath the river.

There being nothing to see just east of the Hamble River a short cut was made which conveniently led through the brickworks north of Sarisbury Green, where a good section of London Clay with fossiliferous septaria was seen on the south, and on the north a junction of that formation (with a pebbly base) and the sand of the Reading Beds.

The party returned to the railway, a little to the eastward; but little was to be seen until reaching a small cutting more than three-quarters of a mile east of Sarisbury, which showed a junction of London Clay and Reading Beds much like that of the brickyard.

Some way beyond this begins a long cutting, not then open throughout, but which will reach to the Titchfield Valley. At first a thick deposit of gravel was seen over the Bagshot Sand, the former containing, in its bottom part, included masses of the latter, so that care is sometimes needed to fix the junction. Higher up, south-eastwards, clayey Bracklesham Beds come on beneath the gravel; and farther on the junction of the former with the Lower

Bagshot Sand, marked by a thin pebbly bed at the base of the Bracklesham Series, was seen for some distance until the sand alone occurs beneath the gravel. The farther end of the cutting was in the base of the Bagshot Sand, just reaching, at last, to the sandy top London Clay, and much water flowed out here, so that a miniature cañon was formed in the sand at one side, ending in a little water-fall. The rise of underground water-level in a permeable bed as one goes into a hill away from springs was also shown on a small scale. This part will have to be deepened.

Descending into the Titchfield Valley, which the line will cross by, a huge embankment, an unusual opportunity was afforded for inspecting a section in a river-bed laid open in the works for the culvert under the railway. Marsh-clay and peaty earth with stumps of trees in places was seen, and some pieces of Samian ware were found which were afterwards given to the Hartley Institution. Beneath was a little irregular gravel, and then the London Clay was touched.

The Director drew attention to the tips being made for the embankment on the eastern side of the river, in order to use them in illustration of the theory that the position of one deposit next above another did not always prove that the whole of the upper deposit was newer than the lower one; the processes of deposition may have gone on together, though successively. The cutting from which came the earth that was being tipped consisted of London Clay with layers of septaria, some of which were large masses, and all more or less round. It followed, therefore, that on a truck-load being tipped the heavy roundish stones rolled down the slope to the bottom, ahead of the more broken-up, more sticky, and more irregular-shaped lumps of clay, as was appropriately shown at the moment of discourse by some stones rolling down towards the comfortably seated party, the largest of them going for the Director, and just succeeding in reaching the truck on which he rested, without, of course, disturbing him. This process going on continuously the geologist of the future, in making a section of this embankment, would find a layer with big stones along the base and little else than clay above. If, however, he concluded that the stone-bed was everywhere the older deposit he would go wrong, for that part of it in the deeper and newer-formed part of the bank was deposited after even the top of the overlying clay at the shallow landward end. That the stone bed is older than the immediately overlying

clay is all that can be said. It was from such reasons that Godwin-Austen had suggested that Upper Greensand was not all newer than all Chalk ; but that the former might be the shore-deposit of the latter.

On going eastward into the next short cutting, the occurrence of a piece of ironstone in the clay gave Mr. Shore the chance of referring to the old ironworks at Fontley near by.

The cutting just eastward will be a long one ; but its western part was almost all that was to be seen. This, however, was of considerable interest, for the more or less sandy London Clay contained many, though mostly very fragile, fossils ; the discolouration of the upper part, from dark grey to brown, by peroxidation of the ferruginous colouring-matter, was plainly seen, and Londoners were probably much astonished at the occurrence of two continuous pebble-beds, each about a foot thick, in the midst of their own particular clay, no such occurrence having been noted in the London Basin. These beds consisted of flint pebbles with fossils (chiefly oyster-shells) in a loamy matrix ; they were about two feet apart, and in one of them Mr. E. Westlake found a specimen of a large *Terebratula*, the first of its sort in the formation ! This turned out to be *Terebratula bisinuata*, a species that has very rarely been found in Barton and Bracklesham Beds, though plentiful sometimes in the Calcaire grossier of France. Since the excursion a great number of specimens have been found by Messrs. Westlake, W. Dale, J. W. Elwes, Shore and Whitaker. They seem to occur in nests like miniature mussel-banks.

Then the two societies parted, the Hants folk making their way homewards, whilst the detachment of the Association firstly had tea at Fareham, and then went on by rail to Bognor, where the Members stormed the Norfolk Hotel and were made comfortable by Mr. Barber.

The next morning, whilst some Members remained at Bognor, the greater number drove out to Pagham Church, close to which is the site of a palace, formerly belonging to the Archbishopric of Canterbury, and in the afternoon found themselves at Selsea, still under Mr. Whitaker's guidance. The chief object of this visit was to see the extraordinary coast-changes that have taken place. There are records of great loss of land along this coast, from the cutting-back of the very low cliffs (if that name can be used for such slight features) and the driving inwards of the beach by the

sea. Selsea was formerly the head-quarters of the Bishop's See, since removed to Chichester, the anchorage still known as "The Park" marking the site of former land. The most interesting change, perhaps, is also the latest, having occurred since the new Ordnance Map was made (1875). On the old Ordnance Map, on the scale of an inch to the mile, made many years ago, the entrance to Pagham Harbour is shown as half-a-mile due south of the church, and it is known that at still earlier times it was further south-westward (towards Selsea). On the new Ordnance Maps (25 inches and 6 inches to the mile) this entrance is shown as more than half-a-mile east of the church, a shift north-eastward of about three-quarters of a mile. This north-easterly shifting of the entrance has been brought about by the gradual pushing forward of the shingle ridge in that direction, by reason of the general set of the currents along the coast being from west to east. When the entrance was pushed eastward of Pagham it became a narrow channel near to and parallel with the low coast, and the continuance of the change has led, of late years, to the total extinction of the channel, the power of the tidal stream on the land side having become unequal to cope with the powerful action of the sea in piling up shingle, so that at last the shingle has swept, in a continuous mass, across the channel. From this it has come about that what was formerly Pagham Harbour, with a spread of water at high tides about $1\frac{1}{2}$ miles long, by from half-a-mile to a mile broad, is now dry marsh-land, the extent of reclaimed land being about 750 acres, across which the water of the small stream now finds its way to the sea by a sluice through the shingle.

The sea has therefore exercised what may be called an automatic closure against itself, cutting off its tidal access inland by its own beach. Politicians might perhaps note this process with profit. From this gradual shifting of the entrance one is entitled to reason backwards, and to infer that, like conditions having held, the entrance must have been at the southern point of the harbour, whence it would gradually move northwards by the increase of shingle from Selsey Bill. On reaching the north-western edge of the marsh, the Director pointed out what he thought to be good evidence of the entrance having once been in such a position. Near what remains of the old Selsea Church the party rested on the old earthwork, of which, alas, but half is now left. The Director here put it to the Members whether they were inclined to consider

their remote predecessors in the land as idiots, a question that met with a negative, both unanimous and instantaneous, it being held to be impossible that any process of development could lead to the evolution of geologists from such a race. He then remarked that no people who were not idiots would have made such a fortification without an object. A fort is meant to command something, and as things now are this fort would command nothing, for on the western side there is a tolerably perfect flat, at the same level as the earthwork, and on the eastern side only the marsh, at a slightly lower level, which, but a few years ago, was covered by shallow water at high tide only. He suggested that the only possible object for such a work was to command the entrance to the harbour, and he inferred, therefore, that when the fort was made the deep-water channel into the harbour must have been close by, so as to pass by the eastern side of the fort. From the round shape of the fort, and from the character of what remained of the work, it seemed likely that it was of British age; but whether it is British, Roman, mediæval, or modern matters not to the general deduction. Given the age of the fort, we have the date when the channel into the harbour flowed close by. The church, which is of Early English character, seems to have been built on ground that must once have formed part of the "intrenchment," as it is cautiously named on the Ordnance Map (without any attempt to fix its date).

At Selsea village the collection of Bracklesham fossils made by Mr. Woodland was examined, and many specimens were procured therefrom. At the Bill the Director remarked that this name was given to parts of the coast which projected beyond the rest, and he alluded to the fact that, even on paper, bills were prominent objects, often, indeed, too much so. The name, too, in its uncontracted form, is conspicuous in our history, as evidenced in early times by William the Conqueror, in later times by the Divine William, and in the present day by the People's William. Moreover both the late and the present Presidents of the Geologists' Association gloried in the name, and the party was then under the guidance of one who was not ashamed to bear it. He then noticed that from the low flat nature of Selsea (a tract consisting of a thin loam or brickearth, beneath which gravel was seen here and there) one was at first puzzled to understand how it could have withstood the ravages of the sea at all. The explanation of

the occurrence of the Bill lay in the fact that in the Bracklesham Beds, which were laid bare at low tide, there is a thin bed of foraminiferal limestone, forming an extensive ledge, and hard enough to break the onslaughts of the sea. Specimens of this bed had been found plentifully on the Pagham beach earlier in the day.

On the return, along the coast of Selsea, the shingly gravel beneath the brickearth was seen, and the Director remarked that this gravel, which contained marine shells in places, seemed to be continuous with the gravel of Portsmouth, etc., which was a river-gravel; and he suggested that they had here reached the tract where the former river had joined the sea. The height of the tide prevented any examination of the Bracklesham Beds, but the great amount of glauconite grains, derived therefrom, in the sand of the beach, was noticed.

EXCURSION TO BRIGHTON AND NEWHAVEN.

EASTER MONDAY AND TUESDAY, APRIL 11TH AND 12TH, 1887.

Directors : H. WILLETT, F.G.S., AND W. TOPLEY, F.G.S.

(Report by W. TOPLEY.)

The party met at the Free Library and Museum on Monday morning, and were received by Mr. E. Crane, Chairman of the Museum Committee, Mr. Lomax, the Curator, and by Mr. Pankhurst, Hon. Sec. of the Brighton Nat. Hist. Soc. After a short time spent in examining the Museum, and in enjoying the luncheon, kindly provided by Mr. Willett, the party started along the cliff eastwards, making its first halt at the large groyne at the east end of the town. Descending to the shore an examination was made of the ancient beach and overlying "Elephant Bed" or Coombe Rock. The beach (composed of rounded flint shingle, and exactly resembling the modern beach) lies eight or ten feet above the present high-water mark. The old beach was formerly exposed at many places along the shore, but west of this point it has been built over by the sea-wall, and to the east the cliffs are rapidly wearing back by the action of the sea, thus destroying the old beach. The action of the sea on the coast was here explained, and the influence of groynes pointed out. The shingle along this coast, under the influence of the prevailing south-westerly winds, travels from west