

the green porphyry being specially noted, as were the monolith columns of Languedoc, Greek cipollino, and verde antico passed while proceeding through the south transept and aisle. The Chapel of SS. Gregory and Augustine, the decoration of which is complete, was viewed with interest, the *Opus Sextile* panels above the altar attracting considerable attention. The marbles used are, with the exception of *bardilla fiorita* and *brèche violette* (Seravazza, Italy), of similar character to those elsewhere described.

A view of the baptistery, with its handsome Byzantine font and marble flooring, brought an interesting visit to a close.

The thanks of the members were tendered to the administration for the facilities afforded for viewing the Cathedral, to Father Sheehan for his kindly offices as cicerone, and to Mr. Renwick for information respecting the decorative mediums employed in the edifice.

EXCURSION TO PONDER'S END AND CHINGFORD.

SATURDAY, MARCH 11TH, 1911.

Directors : S. HAZZLEDINE WARREN, F.G.S., AND
A. A. ATKINS.

Excursion Secretary : A. C. YOUNG.

(*Report by MR. HAZZLEDINE WARREN.*)

By the kind permission of the directors of the Great Eastern Railway, for which we have to thank the Chief Engineer Mr. H. Jones, a party numbering about 20 (which later increased to about 40) assembled in the Board Room at Liverpool Street Station. This was the first time the Board Room Museum had been visited by a scientific society.

Here Mr. Atkins exhibited the Mammoth remains which have been found in the Great Eastern Railway Company's ballast pit at Pickett's Lock, Ponder's End. These include several tusks, molar teeth, and various limb bones. The largest of the tusks measures 5 ft. 6½ inches in length. Among the other bones may be mentioned a scapula 2 ft. long, the condition of which shows that it had been buried within the Arctic bed presently to be described. These remains have all been found during the last two years. The work of preserving the bones, which in the case of the tusks is a matter of great difficulty, has been done by Mr. Atkins, who has entered into the task with enthusiasm. He hopes that they will form the nucleus of a Railway Company's Museum.

Mr. Atkins has previously brought his discoveries before the

notice of geologists. The members of the Association saw some of the bones on a previous excursion to Ponder's End, on April 3rd, 1909, and he has taken several members privately to see the pit at Ponder's End where they have been found.

Upon reaching Ponder's End, the party walked from the station to the Pickett's Lock ballast pit at the creosoting works of the Great Eastern Railway Company. Here they were met by Mr. Guy Leonard, the resident engineer of the works. The method of creosoting the timber for the sleepers of the line was explained by Mr. Atkins and Mr. Leonard.

The position of the deposit in the general succession of the River Drifts of the Lea Valley was then entered into by Mr. Warren. He stated that they were standing on a gravel terrace, if such it could be called, at about 44 ft. above the Ordnance Datum. This is less than 3 ft. above the present surface of the Alluvium. At the lowest corner of the pit, the Alluvium is seen coming on at the top of the section, and this low-level gravel passes beneath it. The junction between the two was an eroded one, and a good section of this junction would shortly be inspected.

River Drift implements that are contemporary with the deposits are found only at, or above, the 100 ft. contour. Below this level they are always, in this part of the Lea Valley, derived and very scarce. There is of course no reason why implements of the Later Palæolithic series should not occur in the gravels at lower levels, but they are generally scarce and have not yet been found in this district.

A fine section of gravel and sand, reaching a maximum thickness of about 20 ft., was exposed. The speaker said that upon first visiting the pit, some nine months previously, he noticed that there was a dark-coloured bed containing vegetable débris, at an average depth of about 17 ft. from the surface. This bed varies greatly in lithological character, passing from clay to sand, and frequently containing many peat-stained flints. In some places the vegetable débris was scarce, in others extremely abundant, but it never reached the character of a true peat. The deposit was often finely laminated, and distinctly water-laid. It was seldom more than about 1 ft. or 18 inches in thickness.

This was the Arctic bed that they had come to see. It extended over the whole area of the large excavation, and some evidence had been obtained of its extension three or four miles farther down the valley. It is much broken up and disturbed, probably by the displacement of frozen ground by torrential action, assisted by river ice. It is seldom seen in unbroken continuity for more than 20 or 30 yards along the sections, and usually is more broken up than this. Detached blocks, a few yards long, are frequently seen inclined at a considerable angle, having apparently had masses of gravel forced beneath one end.

The Arctic bed must have been in a frozen condition to have been moved in such large masses without becoming still further disintegrated. These inferences from the physical characters of the bed are fully supported by the Arctic facies of the flora and fauna it yields.

The remains of the Mammoth are found directly associated with this Arctic bed ; that is to say, they occur under, over, and more rarely within it. Besides the larger bones of the Mammoth, which are found in the course of the excavations, Mr. Warren had also found Rhinoceros, Ox and Horse. One of the members of the party, Mr. Kennard, was so fortunate as to find the skull of a shrew within the Arctic bed. This is the first discovery of one of the smaller mammalia. Further discoveries may be anticipated.

Mr. Warren had spent a large amount of time, all through the past winter, in the preliminary examination of the Arctic bed. The method adopted has been to wash the material in water, no special method of disintegration being required, to strain it through wire gauze, and then to pick out everything determinable, the last operation being conducted by spreading the washed material out under water in white porcelain photographic dishes. The different classes of remains are being submitted to specialists in the several departments.

Mr. F. J. Lewis has undertaken the general botanical material, Mr. H. N. Dixon the mosses, and Mr. A. S. Kennard the mollusca. There were also other classes of material to be dealt with. The botanical material was in unusually good preservation.

Full reports had not been received, but the general results indicated a decidedly Arctic climate. The Arctic plants identified by Mr. Lewis were ; *Betula nana*, L., *Salix herbacea*, L., and *Sibbaldia procumbens*, L. *Betula nana* was extremely rare, but the remains of the *Salix herbacea*, whose climatic range is about the same, occur in the greatest profusion. No remains of the wood of any larger tree have yet been found. In certain places, masses of the twigs of *Salix herbacea* are found matted together. Mr. Dixon has identified several mosses, such as *Hynum molle*, Dicks., *H. vaucheri*, *Timmia norvegica*, and *Tortula aciphylla*, which are now confined to one or two of the highest summits of the Scottish Highlands. A letter was read from Mr. Dixon saying that the nearest equivalent at the present day to the assemblage found here would be in the northern part of Lapland. This is well within the Arctic Circle, and represents a difference of 17 or 18 degrees of latitude.

Mr. Kennard emphasised the importance of the discovery, saying that the mollusca fully bore out the evidence of the plants. It was the first time that land and fresh-water shells of distinctly Arctic varieties had yet been found in the southern parts of England. The assemblage might be compared with the present

conditions of Iceland or Greenland, and was strikingly similar to the molluscan fauna of the Loess of Germany.

Many plant remains, shells, and some Mammoth bones were found by various members of the party, all of whom entered into the hunt with great enthusiasm.

Upon reaching the exposure of Alluvium,* Mr. Warren drew attention to the few feet of brickearth which overlies the Drift gravel. It was pointed out that this was cut off, equally with the gravel, by the Alluvium. It therefore appears that the Brickearth must be classed as belonging to a later stage of the Low Level Drift.

The Alluvium contains shells, of the usual species, and drifted masses of peat. At its base some remains of *Bos longifrons* have been found. Mr. Warren alluded to a possible source of confusion in dealing with the bones handed into the keeping of the Company by the workmen. There is no difficulty in the case of those found in the gravel, as these are light-coloured, or more or less ochreous, and friable. The bones found within the Arctic bed itself, however, are dark in colour, and comparatively hard. The bones from both the Arctic bed and the Alluvium vary in their condition, within certain limits; in some cases it is not easy to distinguish the one from the other when they have been removed from their beds and mixed together.

Some remains of wood, associated with leaves, both of which appeared to belong to the oak, were pointed out by one of the workmen. These were found in the gravel, not far from its junction with the Alluvium. It was generally agreed that this had no connection with the Arctic bed, but that the upper part of the Drift gravel had here been redistributed in the bed of a stream during Holocene times. In this conclusion the writer concurs.

After the geological features had been inspected, Mr. Atkins conducted the party over the other departments of the works. He explained the method of washing the gravel, and the purposes for which it was used—the coarser material for concrete, the finer sand for making cement blocks for building purposes. These are cast in specially designed moulds, very little water being used in the mixing of the material. These blocks possess great strength, and, it is anticipated, equal durability. In the process of washing, small jets of water are thrown upon the gravel as it passes down an inclined plane. Mr. Leonard has found by experience that it is necessary to have a certain proportion of sand mixed with the gravel, or the water merely filters through it; it becomes blocked and will not move.

After taking a somewhat reluctant farewell of the pit with its

* The eroded junction between the Alluvium and the underlying gravel was seen at this place.

fascinating Arctic bed, a walk of about a mile brought the party to the extensive excavations of the Chingford Reservoir works belonging to the Metropolitan Water Board. Here Mr. Warren explained that only so much excavation was being made in the interior of the reservoirs as was needed for obtaining clay for the puddle trench, and material for the banks. Even this, however, in a work of such magnitude, entailed excavation of a very extensive nature. The speaker said that it was a matter of great difficulty to correlate the beds seen in different parts of the area. It was for the most part Holocene Alluvium, and included peat beds and shell marl. It had been the theatre of shifting stream courses, constantly becoming silted up and re-excavated in new directions. Remains found at the same depth, and at short distances apart, might be of very different age. In the absence of direct association with archæological remains, it was impossible to say anything more definite than Holocene. The remains which had been discovered included, Romano-British pottery, human skulls, a very fine skull of *Bos primigenius*, antlers of *Cervus elaphus*, numerous bones of other Recent mammalia, and a molar tooth of the Mammoth. Flint implements were scarce. The mammoth molar had doubtless come from the underlying Drift gravel. Mr. Kennard also referred to the absolute difference in the Molluscan fauna of the Alluvium and of the Arctic bed which they had previously been examining.

At the south-east corner of the works, and near the eastern side of the valley, an interesting section was seen. This showed ochreous gravel, about ten feet in thickness, resting on the London Clay. This gravel is on the same level as that seen in the Great Eastern Railway's pit, and very probably belongs to the same stage, although no trace of the Arctic bed has been found. At one spot it nearly reaches the surface, which is about 42 feet above O.D., and is only overlaid by a thin capping of brick-earth. It is soon cut away by the Alluvium, as in the Great Eastern pit on the other side of the valley.

The walk was then continued to Chingford, where tea was taken at the "Bull and Crown" Inn.

Upon the motion of Mr. W. H. Dalton, seconded by Mr. G. Barrow, a special vote of thanks was passed to Mr. H. Jones, engineer to the Great Eastern Railway Company, to the other officials concerned, and to the Board of Directors of the Company for permission granted to the Association to visit the section. Special mention was also made of Mr. Guy Leonard, the resident engineer at the works, for arranging that the pit should be kept open and free from water for the inspection of the party. The interest of the sections seen in the Reservoir works was perhaps somewhat overshadowed by the more exceptional discoveries which have been made at the Great Eastern Railway's pit, still the gratitude of the Association was no less due to Mr. W. B. Bryan, engineer

to the Metropolitan Water Board, for the necessary permission, and to Mr. Deverell, the resident engineer in charge of the works, for the arrangements made for their visit. A vote of thanks was also passed to the Directors for their respective parts in the excursion.

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EXCURSION TO DARTFORD HEATH.

SATURDAY, MARCH 18TH, 1911.

Directors: R. H. CHANDLER AND A. L. LEACH, F.G.S.

Excursion Secretary: MISS M. S. JOHNSTON.

(*Report by* THE DIRECTORS.)

A PARTY of thirty-six met at Crayford Station at 2.30 p.m. and examined first a small disused chalk pit opposite Wansunt Cottage where brown loamy drift, corresponding in level with the Crayford or “Middle Terrace” brick-earth, was seen banked against a low ridge of Thanet Sand, forming the north-west side of the dry valley of a former tributary of the Cray. The Thanet Sand, here only a few feet thick, rests on a very irregular surface of chalk at approximately 40 ft. above O.D.

In Wansunt gravel-pit the Directors indicated the general position, arrangement and composition of the drift terrace of Dartford Heath, which forms part of a wide-spread sheet extending from the neighbourhood of Bexley to Greenhithe and Swanscombe. The whole of this great gravel-spread rests either