blocks of choice rare marble were seen in the yard ; those of *Verde Antico* from the ancient quarries in Thessaly were cut with a wire saw from the solid rock from which the monoliths in Santa Sophia, Constantinople, were extracted in the time of Justinian. Also large slabs of the *Breche Universelle*, a siliceous conglomerate of green and red jasper boulders, the quarries of which are in the Desert north-east of Luxor, on the Nile.

Then mounting the stairs to the "Museum," a bewildering variety of marbles met the eye. Here were beautiful examples of the rich red porphyry from Mons Porphyritus in Egypt; *Green porphyry* from near Sparta ; a number of varieties of *Verde Antico* Greek carystian cipollino from the ancient quarries of Stura, Greece ; varieties of *Rosso Antico* from Laconia, including a new bed, recently discovered and used in St. Mark's, Venice ; Campan marbles from the Pyrenees, and endless others. Mr. Brindley here pointed out examples of *cipollino* from buildings in Rome and Pompeii, illustrating the mellowing effect of time and exposure, whereby the cruder colouring of the raw new marble is softened and improved.

The party then passed through rooms full of ecclesiastical and monumental statuary, and through the oak-carving workshops, and finally entered the modelling studio, of historic interest, for here it was that Sowerby worked on his wonderful, but now almost forgotten, volumes on mineralogy and conchology.

The President then proposed a very hearty vote of thanks to Mr. Brindley for the trouble he had taken in arranging for the visit of the Association (the works being closed as a rule on Saturday afternoons), and for the lively and interesting discourse he had given.

EXCURSION TO HERTINGFORDBURY AND HERTFORD.

SATURDAY, MARCH 20TH, 1909.

Director : G. BARROW, F.G.S.

Excursion Secretary : A. C. YOUNG.

(*Report by THE DIRECTOR.*)

THE members left King's Cross by 1.15 train for Hertingfordbury, where they were joined by others, bringing their numbers up to 27.

Under the guidance of the manager, Mr. Knight, the large gravel pit near the station was visited first. The section at the
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working face shows 20 ft. of dark-grey Boulder-clay resting on well-bedded sands and gravels, the latter about 25 ft. thick at this point. The Boulder-clay is composed of a mixture of clay and chalk. In addition to ground-up material it contains a great number of more or less rounded fragments of hard chalk, which vary in size; many are mere white specks in the clay, and from this they increase up to two or three inches in length. Blocks of this material are distinctly rare. The origin of the clay can be best inferred from the fossils found in it; much of it is from the Oxford or the Kimeridge Clay, and small slabs of the latter can at times be picked out containing a great number of the small shell *Lucina minuscula*. In addition to its exceptional thickness the clay is remarkable here for the great number of fossils that occur in its lowest 5 ft. Unfortunately at the time of our visit, the repeated alternation of frost and thaw, aided by the heavy snow-fall, had set the upper part sliding down the face of the workings, so that the most interesting part of the section was buried under slip material. Few fossils were obtained at the time of our visit; but in any case it should be remembered that this clay when first exposed is distinctly tough, and specimens take some trouble to find and extract. The manager had collected a large number, most of which he had given away, and the following list represents merely a small residue which he kindly forwarded to me.

FOSSILS FROM THE BASE OF THE BOULDER-CLAY AT THE
HERTINGFORDBURY PIT.*

From the Carboniferous Limestone, Crinoidal Limestone (1 Spec.). From the Lower Lias, *Gryphaea arcuata* (18 Spec.). From the Oxford or Ampthill Clay, *Gryphaea dilatata* (5 Spec.). From the Oxford or Kimeridge Clay, *Thracia depressa* (1 Spec.). From the Ampthill Clay, *Serpula tricarinata* (1 Spec.); *Gryphaea dilatata* (2 Spec.). From the Lower Corallian, *A. (Cardioceras) excavatus* (3 Spec.); *A. (Cardioceras) suessi* (2 Spec.); *A. (Cardioceras)* sp. (3 Spec.); *A. (Perisphinctes)* sp. (2 Spec.); *A. (Perisphinctes)* sp. (1 Spec.). From the Corallian or Kimeridge Clay, *A. (Perisphinctes)* (1 Spec.). From the Kimeridge Clay, *Lucina minuscula*, abundant in shale; *Astarte mysis* (?) (1 Spec.) From Jurassic Beds, Fossil wood (1 Spec.). From the Chalk, *Conulus albogalerus* (1 Spec.); *Echinocorys scutatus* (2 Spec.); *Holaster* (?) sp. (1 Spec.); *Micraster* sp. (2 Spec.); *Spondylus spinosus* (1 Spec.); *Inoceramus* sp. (1 Spec.). In addition, specimens were obtained of *Serpula*, *Astarte*, and *Gresslya* or *Pleuromya*, of which it was not possible to distinguish the species or origin.

A great number of Belemnites have been found, but they

* The fossils were determined by Mr. Pringle, of the Geological Survey.

were broken in extraction and the pieces not kept together ; more, however, can be obtained, and some of these will probably be determinable.

The general aspect of the fossils and the matrix in which they were found points to some special area for their origin, and the idea at present held is that they came from the neighbourhood of the Wash. More will be collected and care taken to keep distinct the specimens from the lower part of the Boulder-clay.

This band has not yet been hunted for pebbles of Scandinavian origin, but they are clearly not common here. It is important to ascertain if they are more common at the top of the clay, which is possibly not exposed in this section.

The pebbles in the well-rounded gravels are rarely large, but they are extremely varied, and a considerable time will be required to obtain a representative set. It is not yet clear if these have been derived from the washing of a boulder-clay, nor whether they contain the same general assemblage of rocks as the upper gravels. These beds rest directly on the Chalk, but the nature of the floor is not sufficiently well exposed in continuous section to show whether the floor is markedly uneven. It keeps on the whole at a fairly uniform level till the working face is reached, when this floor begins to dip rapidly towards the River Lea, as though approaching the early glacial or pre-glacial edge of the valley, now largely buried under these drift-deposits. The uppermost beds of the gravel are often firmly cemented by lime dissolved from the base of the overlying Chalky-Boulder-clay. This basal part of the clay having been decalcified and lost its dark colour, it is now reddish-brown, and closely resembles the part that immediately underlies the natural ground surface. Mr. Whitaker pointed out that this cementing of the top of the sand and gravel is a common phenomenon ; in some parts of East Anglia the rock thus formed has been used for building-stone.

The party then drove some two miles west-south-west to another gravel pit. Here the gravels are on the whole coarser ; Bunter pebbles of large size are common, and in the spoil heaps several fragments of Red-chalk were found. This gravel lies at a lower level than those hitherto described, and this may partly account for its coarser character.

The party then drove through Hertford and eastwards to the famous Chadwell spring, where they were met by Mr. J. M. Wood, representing the Metropolitan Water Board, who had kindly made arrangements for the visit.

Leaving Chadwell spring, the party drove to the large gravel pit on the south side of the road about half a mile east of the town. There are two gravel deposits at this pit, separated by a bed of Boulder-clay of variable thickness. The higher sands and gravel are at least 25 ft. thick, and vary considerably in composition from point to point. The uppermost beds are rarely

coarse, and often contain a great number of chips or splinters of Chalk-flint; indeed, at times a thin band may be almost entirely composed of this fine fragmental material. The stones in the gravel are of all shapes; many of the Chalk-flints show little sign of rounding; others are well rounded and have a black skin, being clearly derived from the pebble beds of the Reading Sand. The Bunter pebbles are also rounded, but like the Reading pebbles they acquired this character before they were introduced into these glacial gravels.

Near the base of the upper gravels there is a rather persistent bed of fine loamy sand containing two seams of laminated clay. This occurrence is important as tending to show a sequence in the order of formation of these glacial deposits in different areas, though this does not imply that they are of exactly the same age at localities far apart. At the base of the deposit we found a number of considerably larger stones apparently belonging to the gravel, but the manager explained that they belong strictly to the underlying Boulder-clay; they were evidently being washed out when they were covered by the later sands and gravel. The clay itself is about 8 ft. thick, but the thickness varies slightly in different parts of the pit. The top and base are reddish and clearly decalcified, the main portion being of the same dark colour as that at Hertingfordbury, containing a great quantity of chalk. This occurs partly ground up with the clay and partly as pebbles of very variable size, a few being as much as 18 in. long. This deposit has not yet been hunted for fossils, but a number of blocks or stones have already been obtained from it. The most interesting are some of Scandinavian origin, and include hornblende-gneiss and a considerable number of basaltic rocks of variable texture and composition. A few blocks of grey granite (granitite) have been found, the origin of which has not yet been determined; it is of some importance as it has a wide distribution and has been found in Bedfordshire by Mr. Lamplugh. Fresher specimens are much wanted. The more important rocks of British origin that occur in the clay are as follows: Millstone-grit, Spilsby-sandstone, Estuarine-sandstone (Lower Oolite), Chalk of Lincolnshire or Yorkshire type, and Hertfordshire-puddingstone. Very large flints are abundant, and it seems probable that the majority were derived from the curious band of flints that intervenes between the base of the Tertiary-beds and the Chalk over a very wide area, and are constantly recorded in well sinkings and borings.

The number of loose pebbles from the Reading or Woolwich beds is considerable, and this suggests that many small outlying patches of the lower Tertiary beds existed when the country was invaded by ice, and that they were incorporated in the ice, for the number of outcrops now left to the north of Hertford is small. Both the clay and the gravels in this area differ considerably from

the glacial deposits near London. At Enfield for example the number of Bunter-pebbles is quite small and have to be searched for, while the rounded pebbles from the Woolwich-beds are almost the dominant component of the glacial gravels. At Hertford the Bunter-pebbles are often more numerous than the Woolwich-pebbles.

The lower sands and gravels are on the whole finer than those above the clay, though coarser bands occur locally near the base. The beds often occur as lenticles, and fine sand will often replace a considerable thickness of gravel. One of the lowest gravel bands is composed entirely of pebbles, without any interstitial sand, as though the currents were too powerful to allow of the deposition of any finer material. These lower sands and gravel rest on a sloping surface of the Chalk, and are clearly banked against the south side of the old valley, just as in the first pit they are banked against its north side.

These glacial deposits are worth careful searching, and their contents should be tabulated to show both the extent of the area over which the stones in them are distributed and their source of origin. Much work has already been done in carefully collecting from the pits in the Hertford area by Mr. Andrews, keeper of the Hertford collections, but no list has yet been published as many of the specimens await identification. My colleague, Mr. Lamplugh, has already added an interesting find, viz., a boulder of laurvikite, 2 ft. long, from a pit on the north side of the Lea, near Ware. This rock is likely to play an important part in glacial research, owing to its wide distribution. A boulder of this easily-identified stone has been found as far north as Aberdeen; it was met with in cutting a sewer or large drain, and was identified by the Rev. Mr. Milne, who kindly sent me a fragment of it.

The Members then walked back to Hertford, where tea was provided at the Salisbury Arms, and after a hearty vote of thanks to the Director the party returned to London by the 8.20 train.

REFERENCES.

- Old Series 1-inch Geological Maps, 46-47.
 Topographical Map, New Series, 239.
 Papers in *Quart. Journ. Geol. Soc.* by Profs. HUGHES, PRESTWICH and others deal with the gravels in these or adjacent areas. Papers bearing on this subject have been published from time to time in the *Transactions of the Herts Nat. Hist. Soc.*; and see also reports of former excursions of the Association.