actually seen, but at points where the base of the Folkestone sands has been marked on the Geological Survey map, depressions in the ground were noticed, and some of these held up water. The feature was, however, too small to be indicated on a one-inch map.

After leaving the Park the party walked to Sevenoaks Station, and then returned by train to Charing Cross.

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EXCURSION TO CULHAM AND WALLINGFORD.

JULY 11TH, 1903.

Director : H. J. OSBORNE WHITE, F.G.S.

Excursion Secretary : HENRY KIDNER.

(*Report by THE DIRECTOR*)

THE majority of the members who took part in this excursion assembled at Culham Station shortly before 11 a.m.

The first section visited was one exposed in a shallow pit about a quarter of a mile north-east of the station, where two to three feet of moderately fine river-gravel, containing many worn fragments of fossils derived from the Jurassic rocks of the higher parts of the Thames basin, was seen resting upon the coarse brown sands of the Lower Greensand. A tufaceous encrustation was noticed on some of the stones. The gravel here forms a well-defined terrace, from 30 to 40 feet above the Thames.

Returning to the station, the party proceeded westward, along the Abingdon road, to Culham College, whence a short walk southward brought them to the interesting sections in the low river scarp near the lock.

The first of these showed about ten feet of the coarse, ferruginous sands of the Lower Greensand, with an apparent dip of 30°, or more, to the south-east, due to current bedding, and concreted, here and there, by calcium carbonate, into hard, tabular, and dogger-like masses exhibiting a similar inclination. Here the Director, after pointing out the principal features of the section, and the lithological similarity of the sands to the Faringdon and Bargate Beds, read a short paper on the Lower Greensand of the Culham district and its somewhat puzzling

FIG. 14.—DIAGRAM SECTION THROUGH CULHAM AND CLIFTON HAMPDEN.

relations to the older and newer rocks of the surrounding country.

In this note it was observed that the beds about Culham and Nuneham Courtenay, mapped as Lower Greensand by the Geological Survey, presented two fairly distinct types. In the more southern parts of their exposure, about Culham and Clifton Hampden, near their outcrop, they were generally pebbly, iron-stained, more or less strongly current-bedded, and formed a reddish, sandy soil; further north, about Nuneham and the Baldons, they were fine, argillaceous, glauconitic, evenly stratified, had yielded the Aptian fossils, *Ammonites (Hoplites) Deshayesii*, and *Terebratula sella*, and weathered into a dark grey loam. Owing to the scarcity of sections, it was hard to say whether this northward change in texture and other characters was mainly a vertical, or mainly a lateral one, but it seemed probable that the fine grey beds of Baldon were older than the brown sands to the south; their absence at Culham being attributable to the south-eastward thinning noticeable in the local Greensand as a whole. The Baldon Beds had a decidedly less littoral aspect than the Culham and Clifton sands, and this, and other considerations of a more general character, led one to infer that the shore-line nearest this part of the Aptian sea lay to the south or south-east.

The precise age of the Lower Greensand of this district had still to be determined, but the occurrence of *Hoplites Deshayesii* at Baldon suggested that it might be, in part, of Hythe, or Atherfield Clay date. Messrs. Teall and Jukes-Browne had correlated the Lower Cretaceous marine sands which appeared at intervals from beneath the Gault between Wilts and Norfolk with the Folkestone Beds of the Wealden area. Mr. Keeping, however, had insisted that they were also, in places, of earlier date, and there was now a decided tendency to look upon them as representing practically the whole of the Lower Greensand of south-eastern England.

The interesting relations of the Lower Greensand Beds of Oxon and Bucks to the underlying rocks having been briefly described, and some arguments adduced for regarding the freshwater iron sands of Shotover and Brill as older than these marine deposits, it was stated that the junction of the Culham sands with the Gault exhibited irregularities which proved that the floor of the early Selbornian sea in this district was of an uneven or undulating character. The outliers and spurs of Gault which occurred within, and projected into, the Lower Greensand area, appeared, in every instance, to occupy parts of north-west to south-east depressions in this floor, and it was interesting to notice that these old depressions had, in one or two cases, been partially revealed by the removal of their Upper Cretaceous infilling, and now, in a much modified form, served

as channels of the local surface drainage. The abundance of the polished quartz and lydite grains and pebbles characterising the local Lower Greensand in the basal layers of the overlying clay formation, proved that the former rock had suffered a certain amount of erosion before it was entirely covered by the grey muds of the Lower Gault; but it was doubtful if the inequalities in its upper surface were rightly attributable, in any large measure, to this cause. Having regard to the general character and behaviour of the Lower Greensand along its north-western outcrop, it seemed more probable that these undulations were mainly constructional features incidental to the current-built, sandbank-like origin of its constituent beds.

The next section, in the brickyard, at a spot about 200 yards to the south-east of the last, showed the following succession:

DRIFT.	{ Fine-grained gravel, pocketed into beds below	1 to 4 feet
LOWER GAULT.	{ (4) Dark grey clay; lower beds laminated; with brownish band about 2 feet thick near middle	about 20 „
	{ (3) Tough, greenish-grey, argillaceous sand; with small quartz and other pebbles, pieces of compact ironstone, brown and black phosphatic nodules, and phosphatic casts of Ammonites, <i>Panopæa</i> , <i>Thetis</i> (?), saurian bones, etc.	13 inches
UPPER KIMERIDGE CLAY	{ (2) Band of light brown and greenish-brown, sandy, nodular limestone, traversed by small tubular, clay-filled hollows, and stained red in joints	6 to 8 „
	{ (1) Compact, grey, sandy and calcareous clay, with scattered nodules of pyrite, and brittle, iridescent fossils	shown 10 ft.

The Director remarked that the Lower Greensand seen in the pit just visited was here entirely wanting; the Gault resting directly, and with seeming conformability, upon the stony cap of the Kimeridge Clay. The Gault worked in this brickyard formed part of a north-westwardly projecting tongue of the main mass underlying the low ground on the south side of the Thames, and had evidently been deposited in a trough-like hollow, of which the sides consisted of Lower Greensand, and the bottom, in part, of Kimeridge Clay. The reappearance of the Greensand from beneath the Gault, on rising ground, a short distance to the northward, showed that the trough shallowed fairly rapidly in that direction; to the eastward, clay soon gave place to sand in the river-bluff. The strong dip of the current-bedding in the Lower Greensand towards this hollow suggested that it marked a temporarily bared area of the sea-bed, on which the enclosing sand-banks were actively encroaching when the important physical changes leading to the deposition of the Gault took place.

It was further stated that the sections exposed in Culham brickyard had undergone a considerable change during the past forty years, as the main working-face had been extended south-eastward. The section figured by Prof. Phillips in 1860 showed about two feet of "*pebbly and ferruginous Lower Greensand*" resting on nine feet of "*fine-grained green sand*," between the base of the Gault (3) and the Kimeridge Clay (1). The "pebbly" bed was, doubtless, the rapidly thinning, wedge-like end of the bank of Lower Greensand on the eastern side of the Gault-filled hollow. The disappearance of the much thicker "green" bed, which Phillips classed with the Kimeridge, or even the Hartwell Clay, was less easy to explain. It was suggested that this stratum was represented in the present excavation by the thin band of sandy limestone (2), but Mr. James Parker (who had joined the party with a local contingent at this spot) stated that he had examined the old section with Prof. Phillips, and believed the "greensand" of that author to have been nothing more than a mass of material which had slipped from the higher parts of the pit.

Owing to the heat of the day the search for fossils was carried on with but little energy. The discovery of *Hoplites interruptus* and a few other Gault fossils just above the limestone (2) and of several fragments of *Perisphinctes biplex* (or *Olcostephanus pallasianus*, d'Orb.)* a little below it, however, sufficed to demonstrate the widely different ages of the clays in the upper and lower parts of the section.

Quitting this pit, the party followed the towing-path on the left bank of the river, to Clifton lock, noticing on the way many signs of recent erosion and deposition at the bends of the stream. The water-meadows traversed exhibited some typical flood-plain features, such as (a) the slope of the ground away from the stream, (b) the elongate depressions marking the site of old back-waters or former meanders of the river, and (c) a good example of a deflected tributary; while the attitude of the flattened, mud-coated grass showed, in a most instructive manner, the positions of the outward and return currents of the main stream in the sheet of water which had covered the ground during the late, exceptionally high, summer flood.

After a short stop for luncheon, at the lock, the members continued their walk to Clifton Hampden, where some minutes were devoted to the examination of the red-brown, evenly-bedded sandstone of the Lower Greensand, containing pebbles (up to about one inch in diameter) of quartz, lydite, argillite, and dark, flinty chert, and laced with veins of ironstone, which is exposed in the natural cliff below the churchyard.

Crossing the river by Clifton Bridge, the next objects of interest were the "Barley Mow" and its associated gravel-pit—

* Vide M. Healey, *Quart. Journ. Geol. Soc.*, vol. 1x (1904), p. 60.

the latter, situated but little above river-level, showing a shallow section of fine-grained, cross-bedded material, consisting very largely of local Greensand *débris* and rolled Oxfordian fossils.

The route now lay south and south-eastward, by the picturesque village of Long Wittenham, and across the shadeless Gault plain to Little Wittenham, where the roadside spring, thrown out near the junction of the Gault and the Upper Greensand marls, received a good deal of attention. Hence, a short climb up the steep northern slope of the Sinodun Hills brought the party to the welcome shelter of the beech "Clump" on the summit of Harp Hill.

The day being an exceptionally clear one, the members enjoyed a fine panoramic view, including some thirty miles of the Chalk escarpment between Uffington Castle on the south-west, and Crowell Hill on the north-east; the isolated Lower Greensand and Portlandian hills of Cumnor, Shotover, and Brill to the north, and the intervening tract of Gault and Kimeridge Clay lowland in the vales of Whitehorse and Aylesbury.

The Sinodun Hills, whose graceful, mammillary form and isolated position, render them the most conspicuous feature of this part of the country, consist of Upper Greensand, capped by two outlying masses of the Lower Chalk. Their northern slope forms part of the Upper Greensand escarpment, here much accentuated by the recent lateral erosion of the Thames. On the top of Harp Hill—their highest summit—about 400 ft. O.D., a small patch of flint and quartzite gravel remains as a memorial of the time when the Thames ran about 250 ft. above its present level in this neighbourhood, and the Chalk still extended over the low ground now separating these hills from the nearest spurs of the Berkshire Downs.

The Director observed that the preservation of the above-mentioned Chalk outliers was probably due to the influence of some one, or more, of the numerous small flexures affecting the Upper Cretaceous rocks in the vicinity of Goring Gap, evidence of which was seen in the undulation of the strata exposed in the Great Western Railway cuttings, and in the existence of the Gault inlier (marked on the Index, but not on One-inch. Geological map) near Brightwell. It was possible that these flexures had helped to fix the position of the transverse passage of the Thames through the Chalk escarpment, but he was disposed to think that the general course of that river, between Wallingford and Reading, had been determined, at a remote date, by a much larger, but less apparent, disturbance. Topley had shown that the river-valleys breaching the North and South Downs were situated in very wide and shallow synclines, whose existence could be detected only by a comparison of the heights of a given stratigraphical horizon at distant points along the line of strike;

and the transverse section of the Upper Thames, and of certain other rivers in the South of England, appeared to occur in a similar position. The perceptible fall in the height of the Berkshire Downs and Chilterns towards the Goring Gap, which seemed to bear out this view, was not, however, to be taken as an index to the form of the inferred transverse syncline, as this decline was largely attributable to the obliquely-dipward course assumed by the Chalk escarpment as it approached the river.

The principal objects of archæological interest in the neighbourhood having been pointed out and briefly described by the Director, Mr. A. Morley Davies gave a short account of the physiography of the Thame Valley.

The party then crossed the saddle between Harp and Castle Hills, and after examining the well-preserved British earth-works encircling the higher part of the latter eminence, and the section of Upper Greensand malmstone—consisting of a light, greenish-grey, micaceous, sandy limestone—in the hollow lane to the south, proceeded south-eastward by the high road, down the gentle dip-slope, to Wallingford.

Here, a substantial tea at the "George" Hotel was followed, on the motion of Mr. A. E. Salter, by a cordial vote of thanks to the Director, and after a short tour through the town most of the members left for London by the 7.5 p.m. train.

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