III.—ON THE PLEISTOCENE DEPOSITS OF NORTH SHROPSHIRE.]

By MISS CHARLOTTE EYTON.¹

IN Professor Harkness's very interesting paper "On the Middle Pleistocene Deposits," he alludes to the beds described by Mr. George Maw, "in the valley of the Severn, between Bridgenorth and Shrewsbury, which seem to accord with the shell-bearing beds of Ireland."²

The Pleistocene deposits of Shropshire (of which I have attempted a brief description in my little work on the Geology of North Shropshire³) are of much greater extent and importance than the Severn valley beds (which, however, represent a very interesting portion of them). They cover a large part of the North Shropshire plain, both on the east and west, and are found both north and south of the Wrekin and the adjacent Carboniferous anticlinal. The lowest of these beds is a stiff blue clay, containing rounded, not striated pebbles, with Lias-fossils, which covers the country for some miles west of Shrewsbury. It lies upon the upper Bunter Sandstone, between the base of the Keuper beds, as seen at Pimhill and Harmer-hill, and on the Severn. A section obtained by a well-sinking at Dunn's Heath, about three miles from Shrewsbury, gave a thickness of 104 feet before water was reached. Similar sinkings in different parts of its extent give about the same thickness, varying only by a few feet, though in one instance, at Leaton, a very short distance from Dunn's Heath, water was found at a much less depth.

The clay is visible on the surface at Leaton brickfield, the Old Woods, Fennymere, and Petton.⁴ It is difficult to determine its exact boundary, as much of it is concealed by the overlying drifts, but it seems to extend westward up to the base of the small Keuper hills of Nesscliffe and the Clyffe, and then, following the low ground west of Grinshill and Hawkestone, to continue northward in the direction of Ellesmere, before reaching which it is thickly overlaid with drift. A portion of the clay near the Hayes Farm was found to be loaded with crystals of perfectly clear calcareous spar. The only shell which I have been able to obtain from this bed is a small but very perfect specimen of *Fusus antiquus*, from the Old Woods clay-pit, very different from the shattered remains of the overlying bed. Mr. Gwyn Jeffreys does not consider it a glacial form.⁵

¹ It seems right to say that this paper was written before the publication of the article by Mr. Searles Wood, Jun., otherwise, perhaps, the opinion of Prof. Harkness might not have been adopted quite so implicitly, although it coincides with the idea I had previously conceived. The key to the problem in Shropshire lies in the position of the blue clay, and confirmatory evidence may be found in the many still undetermined fragments of shells which abound in the overlying beds. Next summer's work may add *Tellina obliqua* or *Nucula Cobboldia* to our fauna.—C. E., Jan., 1870.

² GEOL. MAG., Dec., 1869, p. 546.

³ Notes on the Geology of North Shropshire, chap. 6.

⁴ The Geological Surveyors give a thickness of 120 feet to the drift near Petton.

⁵ See a section given by Mr. G. Maw, south of Workington, Lancashire, where a lower blue clay is exposed, overlaid by reddish, silty clay. GEOL. MAG., Vol. VI. Feb., 1869, p. 72.

Lying upon this bed are mounds of drift, assuming the rounded contour described by Professor Harkness as "the outline of many of the deposits of 'manure gravel' in the county of Wexford," and also of Stretchill.

One of these mounds occurs at Merrington Green, about six miles from Shrewsbury, and one mile from the base of Pimhill. It consists of very coarse unstratified gravel, rounded but not striated, containing Silurian and Carboniferous limestone fossils, mixed with a dark-coloured clay and with sand. I do not remember to have ever seen any flints in this bed. It contains abundance of shells in a very fragmentary condition.

Section 1. From Merrington Green to the river Perry, showing the relative positions of the older and re-assorted drifts.

- a. Blue clay, Old Woods, etc.
- b. Clayey gravel of Merrington Green.
- c. Re-assorted gravel, Yeaton, etc.

Section 2. Showing the relation of the Werf stream to re-assorted gravels.

- a. Bunter sandstone.
- b. Channel of the Werf.
- c. Re-assorted gravels.

The above are not drawn to scale, being merely intended to show the relative positions of the beds.

The species I have been able to determine are, *Tellina solidula*, *Astarte arctica*, *Cardium edule*, *Cardium echinatum* and columellas of *Fusus antiquus*. *Cyprina Islandica*, and *Turritella communis* or *terebra*, both so frequent in the beds near the Wrekin, seem to be entirely absent. On the whole it possesses, I think, sufficiently distinguishing characteristics to mark it as older than the gravels on the east of the plain, and than most of the middle drift deposits described by Professor Harkness. I do not know the altitude of this mound above the sea level, further than that it over-tops the spire of St. Mary's Church, Shrewsbury. A similar gravel may be seen in the ballast hole west of Baschurch station. Towards the north the mounds increase in number, forming in many places ridges, and, as has been previously stated, concealing the underlying clay, while the hollows are occupied by small meres and peat mosses.

At Leaton, three miles from Shrewsbury, there occurs another of these mounds, not quite so high as that of Merrington Green, and nearer the Severn. The material of this bed, however, differs so much from the preceding, consisting of finely stratified sand and gravel, with an entire absence of shells, that, notwithstanding the contour and the elevation at which it occurs, there seems no choice but to consider it provisionally as an Esker drift.

We now come to the shell-bearing gravels, which are so well developed in the Severn Valley and on the north and east of the Wrekin chain, and which appear to correspond, with considerable exactness, to the "manure gravels" of Wexford, and elsewhere in Ireland, and the marine drifts of Wales and Lancashire, on the western coast of Britain, and with those of Aberdeenshire, Caithness, and the middle sands and gravels of Norfolk on the eastern.

These gravels (I am speaking more especially of the beds on the north and east of the Wrekin, with which I am best acquainted; but I believe the same facts apply generally to the Severn Valley) contain a great variety of materials: Silurian, Carboniferous limestone and Lias fossils, granite, both pink and grey, coal and lignite, Permian sandstone and flints, enter into their composition.¹ The fragments are always rolled, except in the case of syenite and greenstone, brought from the neighbouring hills, which are generally angular. I do not think that any of the material is derived from the local Triassic beds. Boulders of granite and dark-grey Silurian limestone are common in association with these drifts, the latter sometimes veined with quartzite. The presence of these and of the rolled pebbles of granite and Lias surely indicate a current from the north, as the Lias must have been brought from the Cheshire border, and the granite from Cumberland. The Silurian and Carboniferous fossils may have been brought from Flintshire or Denbighshire, on the north-west; though it certainly seems more reasonable, at first sight, to consider them as derived from the neighbouring beds of South Shropshire, in which case it must have been a current, probably local, from that direction which bore them to their present position.

By far the richest locality in shells to be found in Shropshire is the Severn Valley drift, exposed between the Union and the Welsh bridge, above the quarry walk, Shrewsbury. Here is a large gravel-pit, where the beds are seen to be composed of stratified sand and gravel, layers of shell-sand occurring at intervals of two or three feet, loaded with comminuted fragments, and frequently containing perfect valves. The base is not seen. This deposit bears the strongest resemblance in character to the description of the Wexford manure gravels of any of the Shropshire drift-beds. The same gravel appears in the cutting of the Shrewsbury and Wellington Railway, and also of the Shrewsbury and Hereford Railway, south of the Severn; but I have never searched these localities for shells. A bed of similar character occurs in a ploughed field above Brian-hill turnpike, between Shrewsbury and Eaton Constantine; indeed the deposits seem continuous along the Severn Valley. The higher part of the town of Wellington is built upon a bed of dark-red clay, used for brickmaking, containing rounded pebbles of the usual materials, but no shells, it corresponds, probably, to the clayey gravel of Merrington-green. Against this, but not upon it, there rests a

¹ It should be observed that although flints certainly occur sometimes in these beds, north-east of the Wrekin, they are by no means a marked feature. Of the transported rocks, grey granite is perhaps the most abundant.

thin bed of rather coarse gravel mixed with sand. I have seen a similar but still coarser gravel resting upon fine sand, in a newly-opened gravel-pit belonging to W. Moyley, Esq., near Buildwas, in the Severn Valley. There I only obtained a few fragments of *Cyprina Islandica* and *Tellina solidula*, but the Wellington deposit, besides these and other bivalves, is, notwithstanding the roughness of the material, the best place I know of for small and delicate univalves. It seems as if their minute size enabled them to lie more safely concealed in the interstices of the gravel, and better to resist the grinding process to which they have been subjected. This gravel is only seen in one place—on the right-hand side of the Haygate-road, west of the town of Wellington. I have to thank Mr. D. Jones for drawing my attention to it. About a mile and a half to the east of the town, extending for some distance on either side of Ketley Brook, there occurs another bed of sand and gravel, resting upon clay, containing the same materials, with a much larger proportion of sand, and most of the commoner species of shells belonging to these drifts. According to a level taken from the top of the Wrekin to the Severn at Coalport, Ketley Brook is 190 ft. above the latter with 6 ft. water; and this, I think, will be very nearly the base of the range of altitude at which the shell-bearing gravels are found, as the next-mentioned bed will give an approximation to their greatest elevation in Shropshire above the present sea-level. This bed lies nearly five miles to the north-east, at Lilleshall, in a field belonging to the New Lodge Farm. It assumes a mound-like, rounded contour, and rests against the Permian sandstone. It contains, I believe, all the materials above enumerated. Mr. C. J. Woodward, Curator of the Birmingham Museum, has described this deposit, in a paper read before the British Association at Birmingham,¹ and I have to thank Mr. Henry Woodward for pointing out his communication to me, and also for his kind assistance in naming some of my specimens. Mr. C. J. Woodward states the summit of the mound to be 463 ft. above mean sea-level.

Although these beds are only visible in places, and sometimes assume locally the form of mounds, they are, in reality, portions of terraces of which the intervening parts have either been denuded or are concealed by overlying beds. The latter is the case at Orleton, less than a mile to the west of the gravel-bed in Haygate-road, Wellington, where a bed of sand and gravel, containing shells, was cut through in making a drive, many years ago, and is now grown over. The same bed was found at Hadley, lying between Ketley and Lilleshall, where, in digging the foundation of the church in 1854, specimens of *Turritella communis* and *Tellina solidula* were procured. They are, in fact, raised beaches, as well marked in all their chief characteristics as any recent beach; and in this they seem to differ somewhat from deposits of the same age in Wexford and Norfolk, the former of which are described as "occupying an area forty miles in length by from eight to nine miles in breadth."²

With regard to the distribution of the shells found in these beds,

¹ Brit. Assoc. Rep. 1866.

² GEOL. MAG., Dec., 1869, p. 542.

Fusus antiquus appears to be characteristic of the whole series, from the Blue Clay upwards; *Tellina solidula*, *Astarte arctica*, *Cardium edule*, and *Cardium echinatum* range upwards, from the clayey gravel of Merrington-green. Not that there may not be some other species in a very fragmentary state in that bed, but the chief point to be noticed is the total absence of *Cyprina Islandica* and *Turritella communis*—both so characteristic of the sandy gravels—the coarse, strong fragments of the former of which could hardly escape attention; while the latter, from its shape, is peculiarly formed to resist destructive influences. In Norfolk, the range of *Tellina solidula* commences much lower down, at the base of the whole glacial series.¹ Mr. C. J. Woodward gives a list of twenty-two species of shells, from the sandy gravel of Lilleshall, of which two species—*Natica clausa* and *Scalaria communis*—have not been found, I believe, in any other locality in Shropshire. Of another species in his list—*Lutraria elliptica*—I have found some doubtful fragments near Ketley Brook. Mr. G. Maw, in the list appended to his paper,² enumerates thirty-nine species found by him in the Severn Valley beds, of which the greater number are also common in the other localities mentioned in this paper—or at least fragments of them, for perfect specimens are somewhat rare. To these I have to add the following, collected from the sandy gravels in the different localities above named:—*Astarte elliptica*, *Cardium Norvegicum*, *A. compressa*, *Nucula nucleus*, *Macra subtruncata*, *Trophon clathratus*, *Lucina borealis* (?), *Mangelia rufa*—making 50 species from these beds at present known. The authority used is Messrs. Forbes and Hanley's work on British Mollusca.³ Mr. C. J. Woodward mentions *Trophon Banfferius* (? *Banffius*) among his collection, but the specimens of *Trophon* that I have found do not, I think, belong to that variety.

By placing these sands and gravels on the horizon of the Middle Drift, another point is decided, namely, the age of the Boulder-clay on the Welsh coast. Although this formation does not extend so far south as Moel Tryfaen, it is very well exhibited in the neighbourhood of Abergele, as a dark-red clay, containing numerous subangular and striated blocks of limestone and other rocks.⁴ Near the village of Colwyn, west of Penmaen Rhos mountain, there is exhibited a section where the clay has been removed, and the middle sands and gravels deposited in its place. I do not remember any locality where the actual contact is seen, but there can be no doubt, to any one who carefully examines the relative position of the beds, that such is the case. As in the section described at Howth,⁵ the Boulder-clay rests immediately upon the Carboniferous Limestone. This position definitively decides it to be the early, not the later, Boulder-clay.

At a range of altitude, the higher elevations of which correspond

¹ GEOL. MAG., Oct., 1868, p. 452.

² Quart. Journ. Geol. Soc., 1864.

³ These shells are all drifted specimens, washed up by the waves, in a dead state, with the sand and shingle of the beach. They are most frequent where the deposit is bedded, and both valves are never found joined.

⁴ See "Drift-beds of Llandrillo-bay," GEOL. MAG., August, 1868.

⁵ GEOL. MAG., Dec., 1869.

with the lower parts of the marine terraces, while the base is situated, generally speaking, about 20 ft. above the present stream and river system, there is another series of drifts, so closely resembling the former, that in some situations it is difficult to avoid confusing them, as they contain all the materials of the older drift, and often assume the same rounded contour. The principal distinguishing characteristics are, 1st: The presence of quartzite pebbles from the Triassic conglomerate, generally in considerable numbers. 2ndly. The entire absence of any trace of shells. These drifts are principally composed of the re-assorted and degraded materials of the marine beds, so thoroughly "washed and sifted" as to destroy all organic remains, with the addition of the round quartzite pebbles, pink, white, and yellow. They correspond in many particulars to Mr. Kinahan's "Esker Drift,"¹ but they differ in one respect—the presence of a large number of flints in some of the beds. Boulders of grey granite sometimes occur in connection with them. They do not occur generally in terraces, but are spread out over most of the flat country, though they sometimes form mounds and banks on the sides of river valleys. They are, I think, the remains of an older and more powerful stream and river system than that now in existence, aided, probably, by extensive floods, occasioned by melting snows, and possibly by the action of land ice.² Had they been arranged by marine currents, we could hardly fail to find some traces of marine organisms, considering how abundant these are in the older drift, and how invariably they fringe the courses of such currents, tidal or otherwise, in the present sea.

The Werf, a small tributary of the Severn, flowing from a few miles east of Shifnal, through Ryton and Beckbury to Bridgenorth, cuts its way through high banks and mounds of drift, assuming all the outward contour of marine terraces, but composed principally of materials from the neighbouring Trias, and—at least between Cosford and Beckbury—without shells.³ The beds occur on both sides of the valley, from 50 to 100 ft. above the stream; and one of the most striking facts connected with them is the way in which the stream cuts into them, forming its own bed of mud and silt—not gravel. Some of the mounds between Ryton and Beckbury lie end-ways to the stream.

On the banks of the river Tern, near Crudgington, there occurs a gravel bed, containing numerous flints, crushed and chipped, having evidently been exposed to some grinding process.

In the neighbourhood of Merrington Green the re-assorted drifts are found occupying the valley of the Perry, where they likewise contain flints, and also lying upon hill-sides, and occupying many positions to which no stream now in existence could possibly have borne them. Those deposits near the Perry are easily distinguished from the older gravel by being bedded. In one place, near Yeaton,

¹ *GEOL. MAG.*, Dec., 1869, p. 569.

² See Rev. O. Fisher's "Denudations of Norfolk," *GEOL. MAG.*, Dec., 1868.

³ Marine drifts do occur, I am told, on the banks of this stream, nearer to Bridgenorth.

they are blackened by an impregnation of lignite. I have already mentioned the doubtful example at Leaton.

Occasionally, but very rarely, mammalian remains occur in these beds. I am indebted to Mr. Blunt, of Shrewsbury, for two teeth of an ox, found in gravel in the Abbey Foregate, Shrewsbury, and a horse's tooth, perfectly blackened with age, was found in sand in digging the foundation of a bridge between the villages of Bratton and Eyton, near Wellington.

There appear to have been two distinct periods of denudation in Shropshire during the formation of this whole series of beds. First, the denudation of the Lias; and secondly, that of the Triassic conglomerate. The former of these must have been effected by a current from the north, bearing with it northern materials, granite, etc. Indeed, its course across the plain of Cheshire seems well marked by the clays, sands, and gravels which it deposited. Crossing the Lias, of which the remains still exist on the Shropshire and Cheshire border, overlying the Keuper Marls, it proceeded southward across the plain of North Shropshire, leaving its traces in the deposits, from the Blue Clay, upwards, to the sandy gravels, behind it.

The Silurian ridges of South Shropshire seem to have acted as a check to its progress, which was diverted to the south-east, whence it proceeded down "the ancient Straits of Malvern" (weakened, however, in force, and bearing a very diminished number of recognizable species of shells) into the Irish Sea. This, at least, was Sir Roderick Murchison's opinion, and there scarcely seems sufficient reason, in any of the modern discoveries, much as they have increased our general knowledge of these beds, to weaken its force. While, therefore, we thankfully accept a position for our ancient sea-beaches on the horizon of the Middle Drift, we cannot yet give up our right to their old title, bestowed upon them by the father of Shropshire Geology, that of "Northern Drift."

The denudation of the Triassic conglomerate took place, as we have seen, at a later period and under different auspices. The reasons which render it doubtful whether this could have been the effect of marine agency, have been already stated, while on the other hand the very large amount of material removed (for this bed, like the Lias, remains a mere wreck of what it has been), and its even distribution over the plain, show it to have been the work of far more powerful and widely-spread forces than any now in action; and again, as the materials of these re-assorted drifts are all derived from local sources, the presumption is that they owe their origin to local agents.

Between these two periods, one apparently of general, the other of local denudation, there was an interval of which we have in Shropshire no traces—that of the later Boulder-Clay. I am not aware of any instance in which the marine drift is overlain by clay, nor have we any beds in any part of North Shropshire that can be assigned to this formation. It is difficult, sometimes it seems well nigh impossible, to correlate any series of beds with those corresponding to them in another series, known only by description, how-

ever lucid and exact such descriptions may be. The idea throughout this paper has been to place the Pleistocene deposits of Shropshire, especially those underlying the Middle Drift, to which Professor Harkness has satisfactorily assigned its true position, on horizons corresponding to some of the beds on the eastern coast; but, aware of the very unsatisfactory nature of the evidence afforded by the few species of shells found in our lower clays and gravels, I have refrained from applying to them any of the terms by which Messrs. Harmer and Searles Wood have designated their lower glacial deposits, which might prove to be entire misnomers. I should be most grateful for lists of species found in glacial deposits in any locality, and would gladly exchange specimens from our middle drifts for shells from those beds. Collecting these specimens, and making lists of them, is a work peculiarly suited to lady geologists, on account of the small amount of manual labour involved, and the quickness of eye and delicacy of touch demanded.

ETTON, NEAR WELLINGTON, SALOP, 1869.

IV.—ON THE SITUATION OF THE IRON-ORE FOSSILS IN THE WATER BLAIN MINES, SOUTH CUMBERLAND.

By Miss E. HODGSON.

AT a meeting of the Literary and Philosophical Society of Manchester, December, 1867, a paper was read by Mr. E. W. Binney, "On the Age of the Hæmatite Iron Deposits of Furness," when he exhibited and described some iron-ore fossils brought by me from the Water Blain mines, west of the Duddon.

Without pretending to the knowledge of Fossil Botany that enabled Mr. Binney to refer these, without hesitation, to *Lepidodendron* and *Stigmaria*, I would, on introducing the subject of their situation, or mode of occurrence, say that the frequent careful investigations made, on every opportunity afforded me by visiting in the neighbourhood, together with the daily study for a time of a good selection of specimens, have tended to confirm a belief in their vegetable origin, and to train the eye, as it were, into a recognition of ligniform structure, which, on account of their highly mineralized state, is liable (except by those well practised in the science) to be either overlooked or misinterpreted.

The excavations for iron ore at Water Blain are on the band of Coniston Limestone to the east of Millom Park. The geology of the tract is noticed by Professor Sedgwick. After describing a series of faults which dislocated the entire region—"tore the whole system of Millom Park bodily from the other rocks of the same age, and carried them full two miles to the south-east of their original strike" (the succeeding Coniston Limestone group likewise), he says:—"From the marshes south-east of Wander-hill¹ to the pastures south-west of Beck Farm, a distance of full two miles, the Coniston Limestone group is magnificently developed."

¹ Wander-hill, of the old Cumberland Maps—Under-hill of the Ordnance Survey.