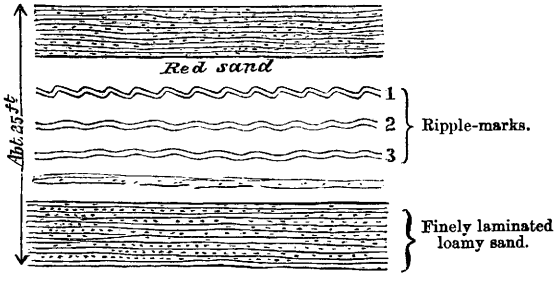
17. Ripple-marks *in* Drift *in* Shropshire *and* Cheshire.

By T. Mellard Reade, Esq., C.E., F.G.S. (Read February 20, 1884.)

Among all the published notices of drift deposits that I have read, I cannot call to mind any description of ripple-marks as forming features in that formation*. Of course if the drift was formed under land-ice we should not expect to see them; but if, as I maintain, a very large part of it has been laid down in water, then, under favourable conditions, they should be found.

I was much pleased on examining, in the early part of 1883, a section in the Old-Park-Field sand-hole, at Ketley, near Wellington, Shropshire (to which I had been directed by my friend Dr. Callaway), to notice in a stratified deposit of drift-sand three distinct beds of ripple-marked laminæ, most beautifully displayed in section. The following is a sketch of the deposit (fig. 1). The position of this sand-pit is

Fig. 1.—*Section at Ketley, near Wellington, Shropshire.*



on the south side of Watling Street. I measured one of the ripple-marks in bed No. 1, and found it was 9 inches from crest to crest, and $1\frac{1}{4}$ inch high; the fall of the wave indicated that the wind producing it was from the N.W. The figure below (fig. 2), drawn to a scale of $\frac{2}{3}$ inch to the foot, will more fully explain its form.

* *Note* (March 1884).—Mr. Mackintosh, describing a section of Boulder-clay (Low-level Boulder-clay) at Egremont, Cheshire, says, "The surface of this bed ['Middle sands' according to him, but an included sand bed according to my classification] presents the appearance of having been finely ripple-marked immediately before the tranquil deposition of an inch in thickness of leaf-like laminæ, which within the vertical space of a few inches graduate into typical upper clay."

Mr. Jukes-Browne informs me that there is at South Ferriby, in Lincolnshire, a bed of indurated sand a few inches thick beautifully ripple-marked on the upper surface, which underlies the Boulder-clay and overlies a thin bed of gravel resting on the chalk. It was previously described by Mr. Searles Wood (Q. J. G. S. vol. xxiv. p. 150), who states that there is a similar bed below the Hessle clay in the Hessle quarry.

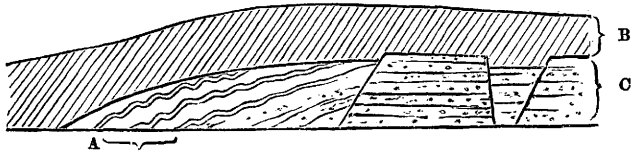
Mr. Lamplugh, in reply to an inquiry, says, "Ripple-marks are by no means uncommon in our cliff sections [about Bridlington], being generally in beds of sand and sandy clay, interstratified with the Purple Boulder-clay." He has given an example of one of the best of them in the Geol. Mag. for Sept. 1879.

Fig. 2.—*Ripple-marks at Ketley.*

In July 1883 I had the further pleasure of seeing in a cutting in Low-level Boulder-clay and Sands at Tranmere, Cheshire, in one of the approaches to the Mersey Tunnel, ripple-marks in hard fine loamy brown sand, forming the flank of what must have been a submarine bank, and *covered* with a compact mass of Boulder-clay many feet thick*. These also were displayed in section, in a perfectly distinct and unmistakable manner, though, through being formed on a sloping bank, they did not possess the perfect regularity and symmetry of form of those previously described †.

The following (fig. 3) is a sketch-section.

Fig. 3.—*Ripple-marks at Tranmere, Cheshire.*



A. Ripple-marks in brown loamy sand. B. Boulder-clay.
C. Yellow sand, containing shell fragments.

The sand was faulted, as shown, with throws of from 2 to 4 inches. I found shell fragments in the bed of sand, among which I could distinguish *Turritella terebra*, *Cardium edule*, *Tellina balthica*, and a *Pholas*.

The position of this section being in an embayment between higher lands must have been favourable for the preservation of such markings. The clay was remarkably free from stones, and no doubt this arose from the same cause, viz. the protecting embayment. The beds are undoubtedly of the same series as those to which I have given the name of the Low-level Boulder-clays and Sands.

These ripple-markings would not be seen except when developed by weathering. From the nature of the material they could not be displayed except in section.

Discussion.

Mr. Clement Reid said that he believed similar phenomena had been often observed before, and he did not exactly see the bearing

* See 'Drift Beds of the N.W. of England,' part ii.

† *Note* (March 1884).—I have not the least doubt that these are genuine ripple-marks, and that the faulting of the sand has no connexion with them. They are distinct phenomena, and not due to any common cause. They were also observed by several members of the Liverpool Geological Association.

of the paper. On the east coast of Norfolk ripple-marks were of common occurrence in drift deposits.

Dr. WOODWARD, on behalf of Prof. Lapworth, suggested that these were not all true ripple-marks, but due to pressure, especially in the example adduced at Tranmere, where the drift sands were faulted close by.

Prof. T. RUPERT JONES thought that the facts observed by the author at Ketley might very well indicate ripple-marks, and that ripple-marks and the effects of pressure could hardly be mistaken one for the other. He thought that it was just as interesting to find ripple-marks in the drift on the west as on the east coast.

Mr. LAMPLUGH corroborated the remarks of Mr. Clement Reid with regard to the common occurrence of ripple-marks in the drifts of the Yorkshire coast.

The PRESIDENT suggested that the idea which Mr. Mellard Reade wished to convey was, that if the phenomena observed by him were ripple-marks, they could hardly have survived the passage of land-ice over the district, as implied by extreme glacial theories.