

IV.—*Sketch of the Drift Deposits of Manchester and its Neighbourhood.* By E. W. BINNEY, Esq.

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(Read January 12, 1847.)

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INTRODUCTORY REMARKS.

IN other communications,\* the author has endeavoured to give to the public what information he possessed relative to the older stratified rocks lying under the town of Manchester, as well as the superficial deposits which hide such rocks from our view. Both these papers were mere outlines, and were intended to be worked out in detail, when the completion of the Ordnance survey should furnish him with accurate maps and correct levels. Good maps are of the utmost importance to geologists, in all their investigations, but more especially in the examination of the Drift, as the superficial

\* Vol. i. p. 35 of the Transactions of the Manchester Geological Society.

beds of clay, sand, and gravel, are now termed ; and it is only by a series of correct levels that the phenomena of that deposit can be well studied, and their origin correctly ascertained. Although he has not yet been so fortunate as to obtain the assistance required, to enable him to give such an account of the Drift as he designs, yet he will give what particulars he has collected.

The examination of the older fossiliferous rocks, rich with the remains of organic life, has generally attracted the attention of geologists, to the exclusion of the Drift, which has been but too often considered as a dry and uninteresting study. My intention is to attempt to dispel this delusion. However delightful it may be to the human mind to examine the "medals of creation," as Cuvier aptly denominated fossil organic remains, and to trace back through countless ages the successive races of beings that have formerly peopled this globe—performed the parts for which they were designed, and then ceased to exist ; to investigate the various forms of vegetable life that deprived the atmosphere of its surplus carbon, for the double purpose of forming our invaluable beds of coal, and at the same time fitting the air for the respiration of animals of a higher order ;



and to examine the wonderful chemical agencies that have been in operation in the great laboratory of nature, in order to prepare our metallic and mineral treasures; still, the last great physical causes which have operated on the face of the globe, and adapted it for the habitation of man, deserve our attention in an equal, if not more pre-eminent degree.

It is to this last and finishing stroke of the Creator, that the earth chiefly owes its present arrangement of land and water, its beautiful variety of hill and dale, and its different kinds of soils for the support and nourishment of the vegetable kingdom—that wondrous agent for the conversion of brute into organic matter, which fits it for food for the use of the animal creation, and man himself.

At present, it is not intended to go into the numerous advantages to mankind which the various deposits of Drift afford in dry soils, beds of brick-clay, and surface springs of water; I shall confine myself to the consideration of the formation of soils for the support and nourishment of plants.

In the memoirs before alluded to, it was shown



that the chief part of the district around Manchester, before it was covered with Drift, consisted of upper new red sandstone rock, with slight portions of lower new red sandstone, magnesian marls, and upper red marls, and the hard sandstone and limestone rocks, and cold clays and shales of the coal-fields of Manchester and Pendleton—all deposits in their primeval state, capable of supplying little nourishment to vegetation.

It is to the period when the Drift was formed that the greatest part of the soils of this and other countries owe their formation, admixture, and arrangement. Then it was that the earth, to use an agricultural term, underwent the process of a long fallow. During Professor Agassiz's Glacial Epoch, intense frost and cold split and rent the hardest rocks asunder, immense glaciers ploughed up the sides of the mountains, huge icebergs, freighted with countless varieties of stones, floated on the waters, and torrents scattered and dispersed the *debris* over the plains. Rocks of all ages were thus brought together for the purpose of furnishing the various elements required by the vegetable world. A period of wintry desolation for a time existed, when this part of the earth's surface, from the evidences left, must have been



nearly destitute of living inhabitants, whether of animals or plants. Sterile it might be for a time, like the furrowed field exposed to the winter's frosts, but it was for the purpose of ultimately rendering it more fertile. For, most probably, the luxuriant vegetation at present existing on the globe, in a great measure owes its origin to the Drift epoch, in the same manner as the rich crop of wheat may be traced to the previous fallow.

In the Edinburgh New Philosophical Journal for January, 1847, Charles M'Laren, Esq. F.G.S. states the following as probable Causes of the Cold of the Glacial Epoch:—"Poisson, an eminent French mathematician, proposed an ingenious theory to account for the more intense cold which anciently prevailed in several parts of Europe, as evinced by the phenomena I have described, and many others. It has been deduced from observations made by the late eminent Prussian astronomer, Bessel; that our sun, with the planetary system attached to him, is moving through the celestial spaces, in a determinate direction, at the rate of three million eight hundred thousand miles per day. (Humboldt's Cosmos, p. 152, Eng. Ed.) Now, as the stars,



which are the sources of heat, are very unequally distributed in the heavens, Poisson thought that the solar system, in its journey towards the constellation Hercules, might pass through spaces of very different temperatures ; and that, at some ancient and remote period, it might have passed through a region of the heavens much colder than that in which it is now moving.

“ A much simpler explanation of the change has been proposed by Mr. Lyell. Founding on principles developed by Humboldt, he observes that the climate of any part of the globe depends, in a great degree, on the distribution of sea and land. The east side of all extensive continents, in the extra tropical regions, has a warmer summer and a colder winter than the western. The extremes of heat and cold, for instance, are incomparably greater in Lower Canada than in the Oregon territory, though they are both in the same latitude. Now, if North America, at one time extended much farther eastward ; if, for instance, it occupied all the portion of the Atlantic between Newfoundland and Britain ; in that case it is certain that Britain would have had the inhospitable climate of Labrador, or even one still more severe, like that of Greenland. There are



various facts which point to the state of things here put hypothetically. Thus the fresh water strata of the Wealden group of rocks, from their extensive range and great thickness imply that a river, as large as the Mississippi, had its estuary in England; and such a river could not exist, unless a tract of land one thousand, or two thousand miles in breadth, in connection with the British isles, had occupied the eastern part of the Atlantic. (See Lyell's Elements, Vol. i. p. 431.) Again: the same able geologist found evidence in the carboniferous rocks of North America,—that the coarser materials composing them came from lands lying to the eastward, and now covered by the Atlantic. (Travels in North America, Vol. i. p. 86.) Finally, Professor Edward Forbes, in a most interesting memoir recently published, has shown, from the relationship between the Fauna and Flora of the British Isles and of North America, that either the one has derived a certain portion of its animals and plants from the other, or that both have derived them from land now sunk in the intervening ocean." (Memoirs of the Geological Survey of Great Britain, Vol. i. p. 336-402.)

In other publications my endeavours have been to show the great value, to all classes of society,



which the study of this deposit is calculated to yield ; and, having now shown that it is equally full of proofs of the wisdom and goodness of our beneficent Creator, in preparing the world for its present inhabitants, let us investigate the appearances which this deposit presents in the neighbourhood of Manchester. It is only by carefully observing the phenomena, and comparing them with the effects now being produced, that we can arrive at the true causes which have been in operation.

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#### SLIGHT DESCRIPTION OF THE DRIFT OF MANCHESTER, AND ITS NEIGHBOURHOOD.

IN the following remarks the *foreign* Drift, will alone engage our attention, without any mention being made of the *local* Drift ; and it is intended, for the most part, to confine our observations to the townships of Manchester, Ardwick, Beswick, Bradford, Chorlton-on-Medlock, Hulme, Salford, Pendleton, Cheetham, Crumpsall, and Broughton. In describing the different deposits, we will con-



sider their permeability by water, a property which is generally noticed even by the most superficial observers, and of great importance to the health of a large town.

Generally speaking the older strata, in the vicinity of Manchester, both carboniferous and new red sandstone, are so thickly covered with Drift, as to affect, only in a small degree, the hydrometrical state of the subsoils on which the town and its suburbs are erected. The first named deposit has scarcely any houses erected immediately upon it; and although the latter, in the lower parts of the boroughs of Manchester and Salford, has a considerable number resting upon it, they are very few in comparison with those situated on the Drift. Both formations present irregular surfaces, much abraded, and rising up into the Drift, higher in some situations than in others, as shown in the section No. 2. It, no doubt, is owing to this irregularity of surface that the lowest bed of gravel and sand, hereafter described, is so uncertain in its occurrence, and so very variable in its thickness. The valley-gravel (No. 1) is never found beyond a certain height above the level of the Irwell; and its exact height being once determined, it is very easy to trace through the town.



THE DRIFT IN AND ABOUT MANCHESTER MAY BE CONVENIENTLY DIVIDED INTO THE FOLLOWING DEPOSITS, IN THE DESCENDING ORDER.

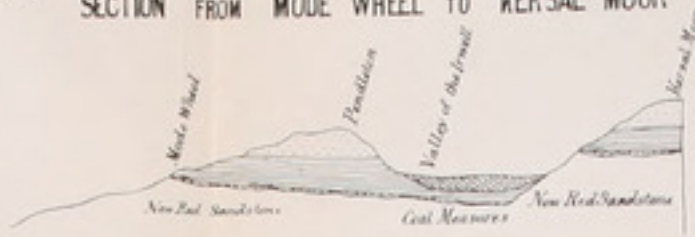
CHARACTERS OF DEPOSIT.	THICKNESS.	LOCALITIES.
<p>No. 1.—A bed of coarse gravel, composed of various sized Azoic, Palæozoic, and Triassic rocks, well rounded, parted with layers of fine sand, and sometimes beds of sand, without pebbles; exhibiting every appearance of having been deposited by water; most frequently stratified, but sometimes unstratified. On the top of this is generally found about three or four feet of silty loam.</p>	0 to 12 Yds.	<p>In the valley of the Irwell, Lower Broughton, and, generally, more or less, in the beds, and on the sides of the three great valleys near Manchester.</p>
<p>No. 2.—A deposit of sharp forest sand, parted with layers of gravel of same rocks as No. 1, and having every appearance of a regular deposit by water, distinguishable only from No. 1 by its being found at greater elevations, containing more sand, and being, generally, more regularly stratified. It sometimes contains thin beds of Till lying in it.</p>	0 to 25 Yds.	<p>Irlams-o'th'-Height, Pendleton, Kersal-moor, Higher Broughton, Prestwich, Cheetham-hill, Harpurhey, Crumpsall.</p>
<p>No. 3.—“Till:” a mass of strong brown clay, in which are mingled the same kinds of rocks as those in Nos. 1 and 2; of sizes from six tons in weight, to small pebbles; some rounded and partly rounded, and others quite angular—especially coal measure, and magnesian limestone rocks, without any order of deposition—great and small stones being mixed together indiscriminately;—quite impervious to water, and well known as valuable brick-clay, and from its being the deposit which yields <i>striated</i> or <i>scored</i> stones. Several beds of fine laminated silt and patches of sand are found in it.</p>	0 to 30 Yds.	<p>The brick-clay of Manchester, Salford, Strangeways, Cheetham, Beswick, Bradford, Ardwick, Openshaw, and Longsight.</p>
<p>No. 4.—A bed of sand, or coarse gravel, having the pebbles (consisting of the same kinds of rocks as Nos. 1, 2 and 3) well rounded, sometimes, but not always, occurring under the brick-clay, often stratified, and at other times unstratified. It affords good springs of bright water.</p>	0 to 11 Yds. but seldom above 2 or 3 Yds.	<p>In the valley of the Irwell at Pendleton Colliery, Cheetham-street, George's - Road, Beswick, Victoria Park, and under the Till in the higher part of King-street and Spring Gardens.</p>











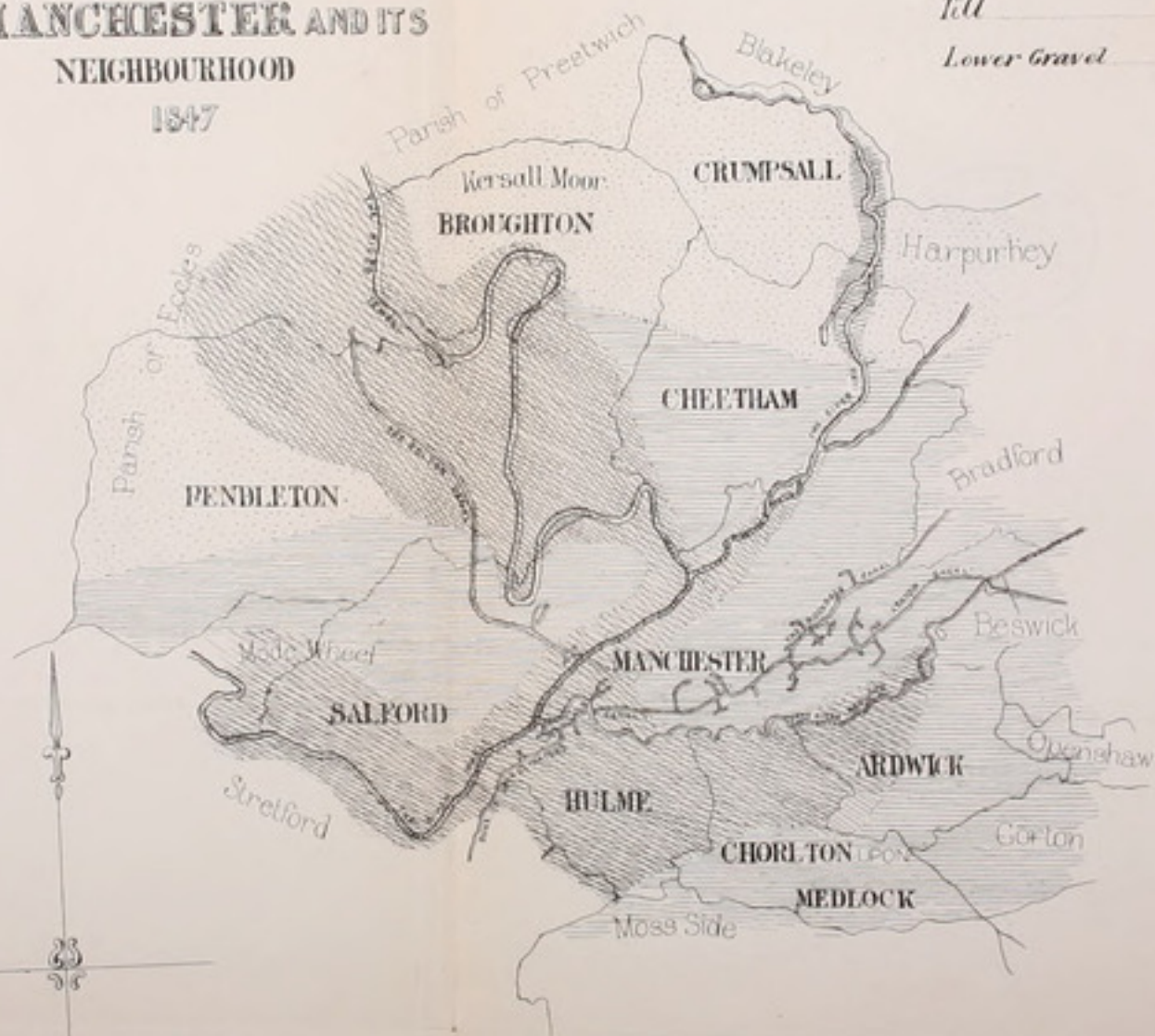
S.S.W. SECTION FROM MODE WHEEL TO KERSAL MOOR N.N.E.



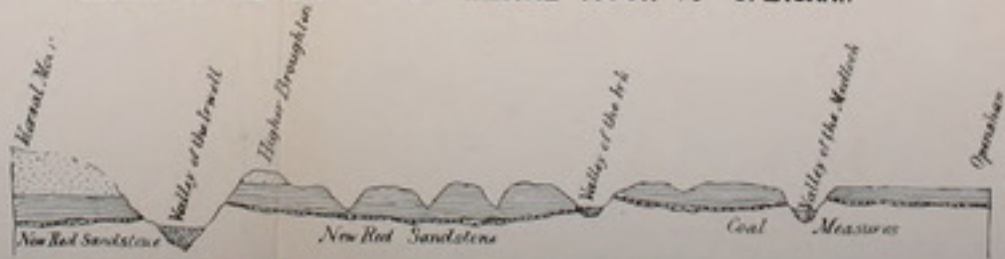
**MAP**  
 Shewing the  
**Drift Deposits**  
 OF **MANCHESTER** AND ITS  
 NEIGHBOURHOOD  
 1847

Reference.

- Valley Gravel 
- Forest Sand & Gravel 
- Till 
- Lower Gravel 



N.W. SECTION OF THE DRIFT FROM KERSAL MOOR TO OPENSHAW S.E.





Probably the deposits mentioned above will not always be found in the perfect order there laid down; no doubt some of them may be wanting, at places; especially Nos. 4 and 2, which have often been removed; but whatever objections are made to it, this must be taken as the first attempt to describe the Drift Deposits of the neighbourhood. It will afford facilities for describing the relative permeability by water of the upper deposits in the neighbourhood of Manchester. The different townships will now be described:—

## MANCHESTER.

(SEE MAP.)

The site on which this township stands is nearly all strong brick-clay (No. 3,) quite impervious to water; varying, generally, in thickness, according to the height of the town above the level of the river Irwell. Along the banks of the Medlock, from near Mr. Barlow's dye-works, below Every-street, to near Ardwick Bridge, there is a small portion of upper new red sandstone and gravel (No. 1). From above Scotland Bridge, on the Irk, in a line running a little south of Long Millgate and Todd-street, above Corporation-street, and part of Cross-street, to below the town-hall in King-



street; and then along the slightly-rising ground through part of Brazennose-street, across Deansgate, to the east end of St. John's church; and then through Camp-field, in a curve, to the bottom of Deansgate, and the tract of land lying between these parts and the Irk, Irwell, and Medlock, down to Castle-field, it is upper new red sandstone on the river banks, and a deposit of gravel (No. 1) in the higher portion; both forming good dry subsoils. With the above exceptions, the surface of the township of Manchester consists of Till, and must be considered as placed on a stiff clay, and its drainage effected entirely from the undulatory character of the ground, and not from the porous nature of the soil. At St. George's Colliery, which is the highest part of the township the following section was found:—

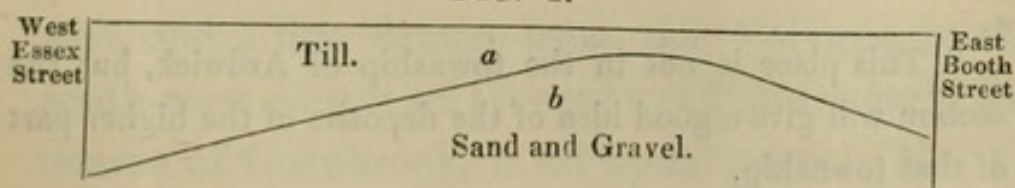
	Yds.	Ft.	In.
Till (No. 3) .....	15	0	0
Sand, Gravel, and Loam (No. 4)...	3	1	6
	<hr/>		
	18	1	6

Generally speaking (as before stated) the thickness of the Till in Manchester and its vicinity is pretty clearly ascertained by the height of that deposit above the level of the river Irwell; and it is very often found under No. 1, in the low



parts of the town. The only exception to this rule of estimating the thickness of the Till, to my knowledge, is a district lying between the Buck Inn, in Booth-street, and the south end of Essex-street. Near the first-named place the Till ought to be about ten yards in thickness, according to the height of the locality above the Irwell; but it is only about a yard. After going through the Till, the sand is reached, and afterwards beds of gravel occur. The two last-named deposits appear to occupy the position of No. 4, and may be considered as an extraordinary development of that deposit in the neighbourhood of Manchester—although Mr. William Lancaster informs me that in boring, at Barton Moss, he found under fifteen yards of Till, eight yards of sand and gravel. The excavations for the new Branch Bank of England, in King-street, showed the occurrence of the sand and gravel under the Till, and caused considerable difficulty in getting a foundation for that building. The following sketch will best explain the position of the deposits, *a* representing the Till and *b* the sand and gravel:—

FIG. I.





## ARDWICK.

The surface of the south-eastern portion of this township, for the most part, consists of gravel No. 1. The tract, bounded by the river Medlock on the north, Chorlton-upon-Medlock on the west, and a line from near the bridge in Fairfield-street, round past the cemetery to the Polygon, on the south, comprising the most populous part of this township, is dry gravel, often resting on upper new red sandstone, having two or three feet of silty loam at the top. The south eastern part of the township, towards Openshaw, Longsight, and Victoria Park, consists of strong brick-clay (No. 3) of variable thickness. On the whole, the greater part of the houses in this suburb, being built on No. 1, must be considered as located upon a dry soil, which will much assist in the drainage of the water. In a section at Dibb-place, Victoria Park,\* the following beds were met with:—

	Yds.	Ft.
Till.....	17	2
Sand and gravel.....	1	0
	<hr/>	
	18	2

\* This place is not in the township of Ardwick, but the section will give a good idea of the deposits of the higher part of that township.



## BRADFORD.

This township is upon No. 3, with the exception of a little strip of land in the valley of the Medlock, below the Phillips' Park, which consists of No. 1. The section at St. George's Colliery, before mentioned, will give a good idea of the Drift deposits in this township.

## BESWICK.

The whole of this township is upon No. 3. At Mr. Williams's Fire Clay Pit the following section occurred :—

	Yds.	Ft.
Till .....	16	0
Sand .....	0	1
Gravel .....	1	1
	<hr/>	
	17	2

## CHORLTON-UPON-MEDLOCK.

The area, bounded by the river Medlock, and Hulme on the south-west, Ardwick on the north-east, and a line drawn from the Polygon to the south-west corner of Greenheys Field, nearly the course of Cornbrook, is all upon gravel (No. 1),



but the ground to the south-east of that line, including the upper portion of Brook-street and Greenheys, is brick clay (No. 3). The following section was met with in Oxford-road, near the Town Hall :—

	Yds.	Ft.
Gravel and sand (No. 1) about .....	4	0
Till and No. 4 gravel, about .....	8	0
	<hr/>	
	12	0

### HULME.

The whole of this township may be considered as being upon gravel No. 1, resting, in some places, on Till, and at other places on upper new red sandstone, affording fine dry land for building purposes. The greatest thickness of the Drift in this township, which has come to my knowledge, is near the New Church in Stretford New Road, where the gravel and Till reached sixteen yards. The loamy clay on the surface is about three to four feet thick, the sand and gravel under it varies from twelve to fifteen feet, and the Till and No. 4 from twenty to thirty feet. In the valley of the Medlock is an interesting deposit of later origin than any other alluded to in this paper, one evidently formed



by the present river. When the new gas pit was being excavated, in River-street, on its south side, a good deal of gravel (No. 1) was met with before the upper red sandstone rock was reached, but on its north side, just below Messrs. Birley and Co.'s Mackintosh works, a bed of silty clay occupied the place of the gravel, and the sandstone was not seen at so high a level. On the north side of the excavation, a fine oak tree was met with, having its under side embedded in blue clay, and its upper part covered with silt. It was about eleven yards in length, and measured two feet seven inches in diameter at its middle. The roots lay towards the south-west, and its top to the north-east, at a depth of twelve feet from the surface. The lower part of the trunk was decayed, and filled with silt, but its top was quite sound. Oak branches, and portions of pine and hazel were found lying beside the trunk. From all the appearances presented, it was evident that the place where the tree was found had once been the bed of the Medlock, and that the tree had either been brought into the position in which it was found by a flood, or, having been first undermined by the current of the river, it was



then precipitated into its bed, and subsequently buried in silt.

### SALFORD.

The lower portions of this township, skirting the banks of the Irwell, from Broughton Bridge to the New Bailey Bridge, are either on the upper new red sandstone or on gravel (No. 1), but the higher parts of the town, about King-street, St. Stephen's-street, Shaw's-brow, Adelphi, the Crescent, Oldfield-lane, and the greater part of Regent-road and Cross-lane, are on brick-clay (No. 3). The whole of the flat tract of land lying in the valley of the Irwell, from below Ordsall Hall to Mode Wheel, is on No. 1. At Messrs. Ashton's, near Broughton Bridge, the following section occurred:—

	Yards.
Soil and clay, about .....	2
Quick-sand and gravel, Nos. 1 and 4 ?.....	12
	<hr style="width: 10%; margin-left: auto; margin-right: 0;"/>
	14

At Mr. Thomas Bury's, near the Adelphi Baths, the beds of Drift were as follows:—

	Yds.	Ft.	In.
Till .....	6	0	0
Sand and Gravel No. 4 .....	10	1	6
	<hr style="width: 10%; margin-left: auto; margin-right: 0;"/>		
	16	1	6



The Till about Cross-lane, according to the opinions of the well-sinkers who have been employed in the neighbourhood, varies from twenty-five to thirty yards in thickness.

### PENDLETON.

The land near Windsor Bridge, as well as that adjoining Cross Lane, is brick-clay, (No. 3;) but all the higher parts of the township are composed of light dry sand, and fine gravel, (No. 2,) both admirably adapted for drainage; whilst the lower part in the valley of the Irwell is composed of gravel (No. 1,) permeable by water.

At Mr. Fitzgerald's Balance Pit, in the valley of the Irwell, the following section was met with:—

	Yds.	Ft.	In.
Soil and Loam .....	2	0	0
Coarse Gravel .....	2	0	0
Fine Laminated Brown Clay (Book Leaves) .....	0	2	3
Till .....	6	0	0
Sand and Gravel .....	1	0	0
	<hr/>		
	11	2	3



This section proves that the Till underlies the deposit No. 1, in the valley of the Irwell below Pendleton. In sinking a well at the Industrial School, Swinton, a section of the higher part of the Drift was obtained, which although not in Pendleton, but an adjoining township, it is thought right to give :—

	Yds.	Ft.	In.
Dry Sand .....	4	0	0
Marl .....	1	0	0
Quicksand .....	9	0	0
Clay (Book Leaves) .....	1	2	0
Dry Sand .....	14	0	0
Marl, with Stones .....	2	0	0
	<hr/>		
	31	2	0

### CHEETHAM.

The houses in Strangeways, on the flat part of land adjoining the Irwell, built on No. 1, form the only exception in the southern and midland portions of this township—comprehending Strangeways, Red Bank, Stocks and Cheetwood—to the thick deposit of brick-clay, (No. 3,) on which the greater number of the houses of this township are erected. All the district north of a line running a little south of a new street, below the



Zoological Gardens, through Temple Toll-bar to Smedley Vale, is upon fine sand, (No. 2.)

In cutting the new line of road from the end of Halliwell-lane to the New Bury Road, at the end of Broughton-lane, an interesting section, showing the relation of the sand, (No. 2,) to the Till, has been met with. In excavating the rising ground, about four hundred yards south of Halliwell-lane, after sinking through two or three feet of clay, twenty-one feet of fine sand, having thin seams of drifted coal in it, was met with; at the south end the clay thickened, and the sand could not be seen for a distance of about fifteen yards; after this interval the sand again appeared, and was seen gradually diminishing in thickness, and resting on the main deposit of Till into which it finally passed.

The general character of the subsoil of the thickly built portion of the township, with the exception of the low part of Strangeways, in the valley of the Irwell, which is chiefly on gravel, (No. 1,) is decidedly unfavourable to natural drainage. In the highest parts of the township in Cheetwood, and near Mount Pleasant, the Till is supposed to reach full twenty-five yards in thick-



ness. In sinking the foundation for the Leeds Railway Station, near the Workhouse, the following section was met with :\*—

	Yds.	Ft.	In.
Till of a Bluish Colour .....	3	0	0
Ditto of a Brown Colour .....	0	2	0
Brown Gravel, resting on Upper New Red Sandstone .....	0	2	0
	<hr/>	<hr/>	<hr/>
	4	1	0

### CRUMPSALL.

The whole of the higher part of this township may be considered as being upon a very dry bed of sand (No. 2) most admirably adapted for drainage. As you proceed down to Lower Crumpsall the Till is met with on the hill-sides, coming out from under the sand ; and in the valley of the Irk is gravel, (No. 1.)

Mr. W. S. Williamson has been so good as to inform me that the sand (No. 2) was penetrated fifteen yards, in searching for water, by Mr. Andrew Mayor, near the 'Staff of Life' public house, in Cheetham Hill, without its entire thickness being proved.

\* Strictly speaking, this is in the township of Manchester.



## BROUGHTON.

The lower part of this township, in the valley of the Irwell, is situate on sand and gravel (No. 1,) and the higher and more northerly portions on fine sand (No. 2). The only place where the brick-clay (No. 3) occurs, is a strip of land running by the side of the Bury New Road, from the end of Broughton-lane to Mount Broughton, and extending over the rising ground about Stony Knolls. With this exception, the district is on a dry bottom, and well drained by the nature of its subsoils.

The following is a section of one of the highest hillocks on Kersal Moor :—

	Yds.	Ft.	In.
Sand and Gravel .....	1	0	0
Clay, with pebbles (Till) .....	0	2	6
Fine Sand, containing much drifted coal, upwards of.....	20	0	0
	<hr/>		
	21	2	6

The entire thickness of No. 2, on the highest parts of Kersal Moor, must amount to full twenty yards before the Till is reached. That the latter deposit does underlie the sand, is proved by the



strata met with in the valley, just below the moor, where Messrs. Bleackley, at their works, bored a considerable depth some years ago. The kindness of these gentlemen has enabled me to give the following section :—

	Yards.
Sand and Gravel .....	21
Till .....	26
New Red Sandstone.....	2
	—
	30

The range of the deposits is entirely from my own personal observations, without having received assistance from surveyors, or parties engaged in sewerage; and, from the great extent of the space, thickly covered with buildings, examined, it cannot be expected to be particularly exact. It is given as an outline, and can only be completed by careful levelling of the whole district.

#### ON THE STRUCTURE OF THE VALLEYS AND BROOK COURSES.

The valley of the Irwell (which is of much the greatest extent) will, on reference to the map and sections, show that it has been cut through the



elevated lands of Kersal and Broughton on the one side, and those of Pendleton on the other, composed of Nos. 2 and 3—and through the rising grounds of Manchester and Salford, composed of Nos. 3 and 4, into the upper new red sandstone rock; and that the latter has afterwards been, more or less, covered by No. 1, which extends over nearly the whole of Hulme, and the lower south-west portion of Salford.

The valley of the Irk between Crumpsall and Harpurhey, is cut through Nos. 2 and 3, into red sandstone, and between Collyhurst and Smedley into the coal-measures; and in Newtown and Cheetham, through No. 3, into the new red sandstone formation. As it enters Manchester by Long Millgate, to its junction with the valley of the Irwell, its sides towards the south and south-east, are composed of No. 1. Portions of this deposit are also met with in small patches in its northern part, below Crumpsall; but the main portion of the valley, as it approaches Manchester is almost without it. This is perhaps owing to the valley passing through hard rocks, and being so narrow as to form a gut, which would contract the currents of water that formerly flowed in it,



thereby increasing their force, and causing them to sweep the deposit out.

The valley of the Medlock in Bradford and Beswick, is through Nos. 3 and 4, into the coal measures; and in Ardwick, Chorlton, and Manchester, through the same deposits, into the upper new red sandstone. The beds of gravel and sand found in Ardwick, Chorlton-on-Medlock, and Hulme, like those of the Irk, appear to have been swept out of the upper part of the valley of the Medlock, but some of them may have been derived from the Irwell. By looking at the map, it will at once be seen that the deposit No. 1, extends much further on the eastern than on the western side of the present river courses. All these three valleys bear evidence of having been formed under the sea, for the action of the present streams of water which now flow in them, appears to be unequal to produce the effects observed in any moderate period of time.

The small valleys in which the Cheetham brooks, Shooters-brook, and Corn-brook flow, are all cut through No. 3, and contain little (if any) of deposit No. 1, until they reach the larger valleys.



On every side of the towns of Manchester and Salford, we find "the Till," which can be pretty well traced by the numerous brick yards upon it, on the gently rising grounds adjoining the valleys, and in most parts where the ground rises to a considerable elevation, this deposit is capped by beds of sand and gravel. Thus the brick clay of Windsor Bridge is capped by the sands of Pendleton; those of Stony Knolls, Cheetham, and Collyhurst, by the sands of Higher Broughton, Cheetham Hill, and Harpurhey. The Manchester and Leeds Railway, after passing through the Till of Moston, and reaching the higher land south of the Middleton Station, cuts through sand. The Sheffield and Ashton line, after cutting through the Till of Gorton, reaches the sand of Fairfield; the Birmingham line, after reaching a certain elevation at Levenshulme, between Manchester and Stockport, cuts through a similar deposit. A portion of Till is also frequently found in the valleys lying under the sand and gravel No. 1, as proved in the section of Mr. Fitzgerald's pit, before alluded to, which shows that portions of it have been removed by currents of water during the formation of the valleys.



## ON THE COMPOSITION OF THE TILL.

The phenomena presented by the different beds of gravel and sand forming deposits Nos. 1, 2, and 4, are so like the effects we now observe being produced on the beaches, strands, and water-courses, at the present time, that we can have no doubt as to the manner in which they were formed, any more than of the origin of the shingle beds and sand banks of our coasts. The pebbles contained in them are rounded, and have nearly all lost their angles by attrition, and none of them, to my knowledge, have been met with having their surfaces scored with *stricæ*. These deposits are, in point of fact, nothing more than raised beaches and old sand-banks, cut through by currents of water, which formed the valleys before and during the time of their elevation. The Till however is a deposit very different in its characters to any that we now see being formed; for while its clay and its finely laminated beds of silt would seem to show that it was deposited in still water, the great and small blocks of stone scattered throughout its mass pell-mell, would lead us to believe that violent currents had been in action at the same time that the clay and silt were



being deposited. In former papers this deposit was described, but not with sufficient detail. It is well known as a brownish-coloured stiff clay containing generally about thirty-six per cent of alumina, mixed with variable proportions of sand and carbonate of lime. It effervesces freely when treated with acids.

A series of correct analyses of it is much wanted, and the above statement of its composition is given only as an approximation to truth. As the rocks found in the Till are the most interesting portions of the deposit, considerable attention has been paid by me to them, in order to ascertain their natures, and their external characters. For this purpose one hundred specimens of rocks have been taken from three different brick yards, and after examination the results are given in the following table :—



TABLE OF ROCKS FROM THE TILL NEAR MANCHESTER.

	REGENT-RD Salford.		CHEETHAM.		OPENSHAW.		MEAN.	
	Per Cent.		Per Cent.		Per Cent.			
GRANITES, GREENSTONES, AND OTHER IGNEOUS ROCKS .....		21		15		27		21
Angular .....	3		5		7		5	
Partly rounded .....	12		7		11		10	
Rounded .....	6		3		9		6	
SLATES AND SILURIAN ROCKS .....		19		27		17		21
Angular .....	3		4		4		3.66	
Partly rounded .....	11		8		8		9	
Rounded .....	5		15		5		8.33	
MOUNTAIN LIMESTONES...		5		6		7		6
Angular .....	1		2		0		1	
Partly rounded .....	3		2		4		3	
Rounded .....	1		2		3		2	
COAL MEASURES.....		49		50		49		49.33
Angular .....	22		31		23		25.33	
Partly rounded .....	21		16		20		19	
Rounded .....	6		3		6		5	
NEW RED SANDSTONES ...		6		2		0		2.66
Angular .....	4		2		0		2	
Partly rounded .....	2		0		0		0.66	
Rounded .....	0		0		0		0	
		<hr/>		<hr/>		<hr/>		<hr/>
		100		100		100		100
STRIATED ROCKS .....		2		2		1		1.66

The stones from Openshaw are from the east, those of Strangeways from the north, and those of Regent Road, near the Infantry Barracks, from the west of Manchester ; so the mean of the three will give a fair average of the rocks found in



this deposit, and their present external characters. The specimens were not selected out of the clay, but were picked up promiscuously from the stones thrown out by workmen when they were digging the clay during winter. All the rocks are found *in situ* to the north and north-west of Manchester.

#### ON THE LARGE BOULDERS FOUND IN THE TILL.

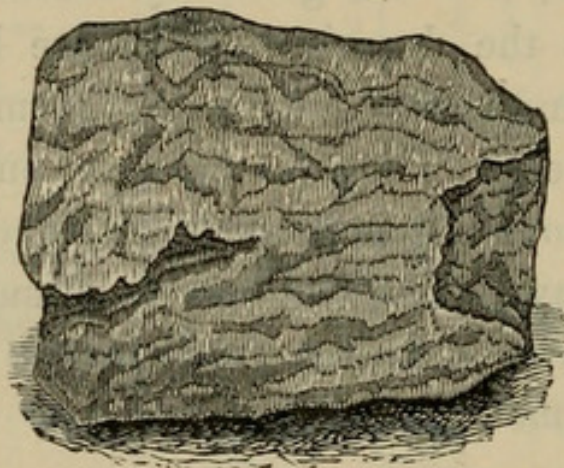
These are well known in the neighbourhood of Manchester, and are generally found dispersed throughout the deposit. They are both more numerous and of much larger size in some localities than in others. Thus, for instance, on the rising ground above Broughton Spout, and at Park Place, Stony Knolls, and near the Vauxhall Gardens, Collyhurst, larger than average specimens have been met with.

The following are the largest and most interesting blocks that have come under my observation. A piece of hard Greenstone, showing many *striæ*, having most of its sides angular, but one smoothed, weighing near a ton, and now lying on the new road above the house lately occupied by Mr. Thomas Swallow.



About two hundred yards from the last described specimen, near Mr. Wm. Sale's house, there is a large block of Ravenglass Granite, (Fig. 2,) measuring seventeen feet one inch in circumference, and about four feet high. It has lost most of its edges, but there are some portions of it which appear to have suffered less from attrition than others.

FIG. 2.

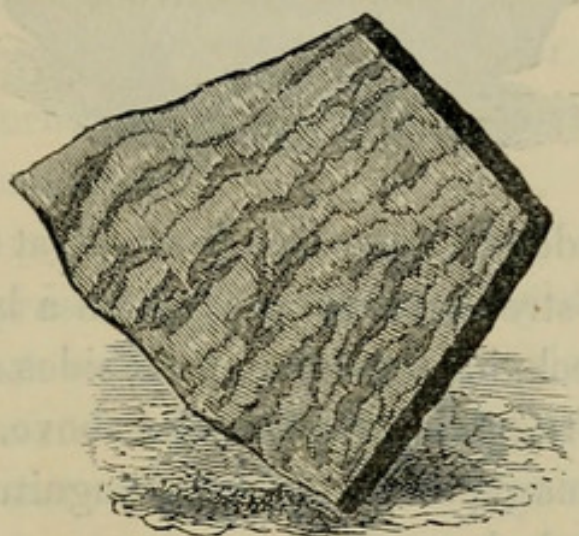


Not far from the last stone, and a little nearer Manchester, is seen a flag of Sandstone, (Fig. 3,) belonging to the upper part of the coal measures. It appears nearly as perfect as if it had been but just taken from the quarry, having lost none of its edges. It has four unequal sides, measuring



respectively 3 feet 10 inches, 3 feet 8 inches, 5 feet 6 inches, and 6 feet 3 inches, and is 1 foot 2 inches in thickness.

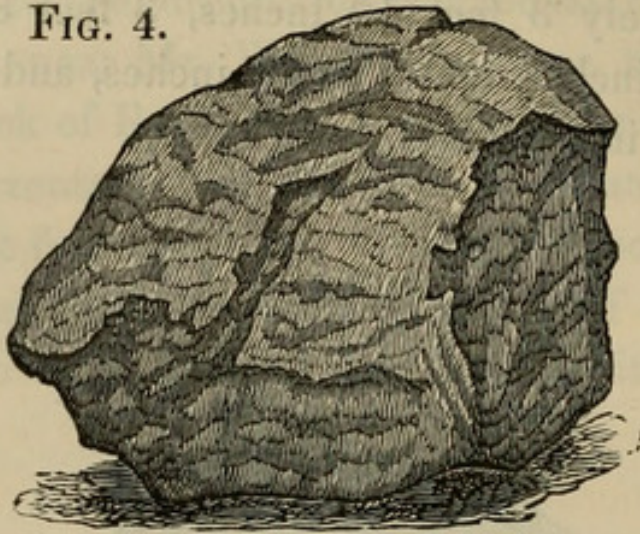
FIG. 3.



Near the road leading up to the inn adjoining the Vauxhall Gardens, is a well-rounded block of Greenstone, weighing about three tons. Above Mr. Edmund Buckley's Sand Delph, not far from the last described stone, is a fragment of Millstone Grit, (Fig. 4,) partly angular and partly smoothed, measuring 4 feet 2 inches high, and 18 feet 8 inches in circumference, being the largest block that, to my knowledge, has been met with in the neighbourhood of Manchester.



FIG. 4.



By the side of Upper Brook-street, at the corner of Hughes-street, was formerly seen a large block of Trap Rock, having some of its sides smoothed, and others rugged. Besides the above, there are no doubt many others of less magnitude which have escaped observation.

#### ON THE ORIGIN OF THE TILL.

When the whole of the Drift phenomena were summarily disposed of by attributing them to the Noachian deluge, little attention had been paid to this deposit, or else its formation could not have been attributed to the same cause that produced the beds of sand and gravel. The action of waves on lines of rocky coast, and the effects now caused by running water, clearly show us how



rounded pebbles have been produced, and we are not now reduced to the strait which the learned author of "Natural Theology," Dr. Paley, was, when in the first chapter of his book he says, "In crossing a heath, suppose I pitched my foot against a stone, and were asked how the stone came there, I might possibly answer, that for anything I knew to the contrary, it had lain there for ever; nor would it perhaps be very easy to show the absurdity of this answer."

At the present day, to most geologists the stone on the heath would tell its own simple story. If its sides were angular, and rocks of a similar character were located in the neighbourhood, it would be pretty clear that it was a native of the district, and had not travelled from afar. But if its angles had all been removed, and it was a rounded pebble of a description of rock not found *in situ* within many miles, then would it tell of its travel by flood, and how it had undergone the buffeting of the waves, and the jostling of its neighbour stones. Should, however, it be composed of iron, nickel and cobalt, in the proportions usually met with in meteorites, it would be supposed to have come *through* the atmosphere, but from whence it is difficult to say.



The effects of large rivers carrying with them the *debris* of the land flowing into estuaries, clearly indicate the origin of sand banks; and the power of mountain streams to move vast masses of rock, when once put in motion, is now well known; but all these agencies are insufficient to account for the phenomena which are observed in the Till; for where do we see a current of water that, at the same time and place, will deposit beds of fine laminated silt, and homogeneous clay, with immense masses of rock, blocks of the same kind of stone, some of which are perfectly rounded, others smoothed only on one side, having the rest of their sides quite rugged, others perfectly angular, and others again grooved or marked with *stricæ*? Such different effects cannot rationally be attributed to one cause. Latterly the action of glaciers and icebergs has been called in to assist us in our enquiries; and it is probably to the conjoint action of these powerful agents and currents of water, that we must look to for the origin of the deposit of Till in the neighbourhood of Manchester.

In my former paper on Drift,\* it was shown that

\* Published in the Report of the Manchester Geological Society, for 1843.



portions of that deposit are now to be met with in Lancashire and Cheshire at elevations of from one thousand to twelve hundred feet above the present level of the Irish sea, and, consequently, that there must have been great changes in the contour of the country, probably even such as to allow of a glacier extending from the lake districts to Manchester ; still, it is most certain, that the Till in our neighbourhood does not present us with phenomena such as now are produced either by lateral or terminal *moraines*. The distribution of the rocks in the clay, the deposit of the clay itself, and, above all, the beds of fine laminated silt seen in the Till at Collyhurst, and other places, consisting of layers thinner than the paper upon which this is printed, and from this circumstance provincially termed *book leaves*, seem to indicate that the rocks were conveyed to the places where they are now found on icebergs, and then deposited in the soft mud, now clay, at the bottom of a sea ; while the partly rounded and scored rocks belonging to the North of Lancashire and the lake district, seem to point out the effects of glaciers—not, probably, such as are now seen in the Alps, but like those of Spitzbergen, which extend to the ocean, and of which vast icebergs are the offsprings.



## CONCLUDING REMARKS.

The deposit No. 1 bears every appearance of having been formed by an ordinary current of water. It was most probably caused by the subsidence of the land beneath the waters of the sea in which the Till was deposited. The rocks found in this deposit, as well as those in No. 2, are the same as those found in the Till, but nearly all of them have lost their angles, and appear water-worn.

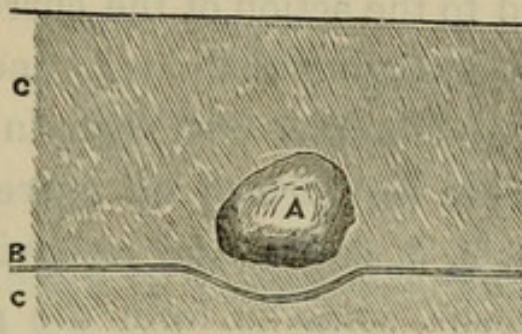
If my opinion, as to the beds of Till having been partly formed by the stranding and dissolving of icebergs, is true, the neighbourhood of Manchester was once the bottom of a deep sea, in the waters of which floated immense masses of ice, freighted with blocks of stone. That these icebergs drifted about until some of them were melted, or arrested in their course by the higher lands of Broughton and Collyhurst, then forming sunken rocks, and it is to these circumstances most probably that we owe the greater number of large stones now found in the Till at those places.

In the bed of Till at Collyhurst, the large block



of millstone grit, before mentioned, was found embedded. About three feet under this stone, the bed of silt exhibited a bend, as shown in Fig. 5, just as if the stone had fallen from above, and thus caused the curvature of the silt.

FIG. 5.



- A—A Block of Stone.  
 B—A Bed of fine laminated Silt.  
 c—Homogeneous Till.

Probably this one fact is not of itself sufficient to show that the stone had been precipitated from a melted iceberg, but, by careful examination of the deposit in other places, more examples of this character may, perhaps, be found to confirm it.

Many of the scored and polished rocks may owe their *marked* characters to the grinding and crushing effects of floating fields of ice, which would cause nearly similar appearances on rocks to those produced by the motion of glaciers. On the ele-



vation of the land, and consequent shoaling of the sea, the icebergs would cease to enter the latter, but strong currents of water, probably produced by the dissolving of neighbouring glaciers and other causes, brought down the beds of sand and gravel (No. 2,) and covered up the Till. On the land continuing to rise, these sand banks would be more exposed to the action of the currents, owing to the waters becoming shallower, and then the valleys and undulations now seen in this neighbourhood would be formed by currents cutting through Nos. 2, 3, and 4, and removing portions of those deposits, so as to form the gravels and sands No. 1. Similar effects, on a small scale, may now be seen taking place in the sand banks of our present coast, on the recession of the tide, where numerous little valleys are excavated, and slight deposits of gravel deposited on their sides and at their extremities. No doubt the action of the streams of water at present flowing in the valleys may have, in some measure, assisted to excavate them; but by far the greater part of the erosion has been done when this part of the country was under the sea.





Binney, Edward William. 1848. "Sketch of the Drifts Deposits of Manchester and Its Neighbourhood." *Memoirs of the Literary and Philosophical Society of Manchester* 8, 195–234.

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