Art. XXX.—*On the Amiens Gravel;* by Alfred Tylor, Esq., F.G.S.* Plates III and IV.

I. Introduction.

The exact position, character, and equivalents of the Quaternary deposits of the valley of the Somme have been frequently discussed. On the authority of certain sections and plans of Amiens and Abbeville, the correctness of which will be examined hereafter, theoretical views concerning the relative ages of different parts of the gravel and of different parts of the valley of the Somme have been promulgated by Mr. Prestwich, and repeated by Sir C. Lyell and others.

These geologists have asserted :—

First, that there were two valley-gravels of distinct age at Amiens and Abbeville, one named by them the upper and the other the lower valley-gravel ;

Secondly, that the upper gravel was the older of the two ; and

Thirdly, that the valley of the Somme was excavated to a depth of 40 or 50 feet since the deposition of the upper valley-gravel, and previously to the deposition of the lower valley-gravel ;

Fourthly, that both gravels were fossiliferous, and contained the remains of man, or rather human implements, and bones of extinct mammalia, the lower gravels having the greater number of species of mollusca, the higher gravels containing the greater number of flint implements ;

Fifthly, that the height of 70 feet, at which fossiliferous gravels now stand above the level of the Somme, is much beyond the limit of floods, and therefore, that these gravels could only have been deposited at St.-Acheul before the river-channel was cut down to its present level.

The general effect of these assertions was to refer the remains of man found in St.-Acheul back to an indefinite date, separated from the Historical period by an interval during which valleys were excavated or deepened 40 or 50 feet.

In a paper read before this Society in April, 1866,† I suggested that there was evidence of very little weathering or atmospheric action since the date of the drift containing human remains, and that the age of these deposits was close to the Historical period,—also that the upper and lower valley-gravels in the Somme were continuous and of one period.

* From the Quarterly Journal of the Geological Society for May, 1867.

† Quart. Journ. Geol. Soc, vol. xxii, p. 463.

I afterward read, in June, 1866, a statement of what I believed to be the correct interpretation of the Amiens and Abbeville sections, reasserting the continuity of the gravel-deposits on gradual slopes from the higher to the lower levels in the valley, except in rare cases or isolated spots, where the continuity was interrupted or prevented by some upstanding piece of the original rock out of which the valley had been cut, in which case the gravel wraps round the base of the upstanding knoll of chalk. I quoted the section at Montiers as one that shows a direct sequence of gravel from above the railway to the Somme, notwithstanding the version of that locality published by Mr. Prestwich, in which chalk is represented in a position where I could only find gravel.

At the same time attention was drawn by me to the probability of the brick-earth terrace sloping down to the Lea Marshes at Clapton being of the same age as the similarly formed Loess terrace sloping down to the Somme at Amiens. I also asserted that there was good evidence in the direction and gradient of the terrace, in the configuration of the gravel and brick-earth and of the London-clay surface at Clapton, of the water having occupied the whole valley of the Lea at the time of the formation of this Clapton terrace, and also of the water of the river Lea or other rivers having reached very much higher levels in the vicinity at that period, while the Stoke-Newington and Highbury gravels and brick-earth were being deposited.

I still hold these opinions, and am prepared to demonstrate their truth; and I ask the attention of the Society to a restatement of the exact geological facts to be seen in the Somme valley, and to evidence quite independent of that which has been previously submitted to the Society, although to a certain extent going over the same ground.

The conclusions that I arrive at are extremely dissimilar to those of Mr. Prestwich and Sir C. Lyell, and are as follows :—

First, that the surface of the chalk in the valley of the Somme had assumed its present form prior to the deposition of any of the gravel or loess now to be seen there, and in this respect corresponded with all other valleys in which Quaternary deposits of this character are met with.

Second, that the whole of the Amiens-valley gravel is of one formation and of similar mineral character, and contains nearly similar organic contents, the La Neuville, Montiers, and St.-Acheul gravels being of the same age, and capped with a covering of loess also of one age and mineral character, the whole deposit being of a date not much antecedent to the Historical period.

Third, that the gravel in the valley of the Somme at Amiens is partly derived from *débris* brought down by the River Somme and by the two rivers, the Celle and the Arve, and partly consists of material from the adjoining higher grounds, washed in by land-floods,—the immense quantity of chalk present in the gravel having been derived from the latter source. It is where the surface of the chalk is concave that the gravel is thickest.

Fourth, that the Quaternary gravels of the Somme are not separated into two divisions by an escarpment of chalk parallel to the river as has been stated. They would have formed an exception to other river-gravels if this had been the case. The St.-Acheul gravels thin out gradually as they slope from the high land down to the Somme, and they pass away into the Loess formation,—and so also at Montiers.

The Loess deposit, on the contrary, forms a distinct escarpment for many miles along the Somme; and this, I believe, is the bank of the ancient river whose floods produced the St.-Acheul and Montiers gravels.

Fifth, that the existence of river-floods, extending to a height of at least eighty feet above the present level of the Somme, is perfectly proved by the gradual slope and continuity of the gravels deposited by those floods upon the sloping sides of the valley toward the Somme, and also by the Loess or warp, of similar mineral composition and color, extending continuously over the whole series of gravels, and finishing with a well-defined bank near the present stream.

Beds of gravel, brick-earth, and loess, having an even sloping surface from the escarpment of the sides of the valley down to the terrace near the river-bank, are often to be observed near other rivers whose channels bear the same proportion to their valleys that the Somme river bears to its valley, and where gravel- and loess-deposits reach to a height of 100 feet above the present river-levels.

Sixth, that many of the Quaternary deposits in all countries, clearly posterior to the formation of the valleys in which they lie, are of such great dimensions and elevation that they must have been formed under physical conditions very different from our own. They indicate a Pluvial period, just as clearly as the northern drift indicates a Glacial period. This Pluvial period must have immediately preceded the true Historical period.

Since June 1866, I have visited Amiens several times, and compared the gravels as accurately as I could, both as to situation and character, with those of other rivers, of which I have had surveys made; and I hoped to have brought the whole subject of valley-gravels before the Society in the early part of

1868. The announcement of the intended absence from England of Mr. Prestwich, has induced me to describe the Amiens gravels first, in order to have the advantage of his presence at the meeting, reserving my account of other river-gravels and general comparison to a future paper.

The plan and sections of the Quaternary deposits at Amiens illustrating this paper will, I hope, make the actual geographical and geological positions of the Amiens beds quite clear.

It should be mentioned that, in August, 1866, after examining the levels myself, I called at the railway office at Amiens to obtain the precise height of the different points on the railway above the sea, and to get the name of a competent surveyor, and was referred to the chief engineer, M. Guillom. That gentleman only saw me for a few minutes, but kindly promised that if all the points on which I required information were laid down on a plan, he would have the sections carefully taken for me in a few weeks. This plan was accordingly sent to him by me a few days afterward, with the lines marked on which I wished the levels.

The work was more tedious than was expected by M. Guillom, and he did not send me the measured sections until May, 1867. The levels of these sections have been taken with the greatest care, and, I believe, are as precise as any that have been taken for geological purposes; and I am therefore indebted to Mr. Guillom for the means of drawing an exact picture of the surface of the chalk prior, as I believe, to the deposition of any of the valley-gravel or loess at Amiens. The value of this communication therefore much depends on Mr. Guillom's survey.

The heights on the maps and sections are in English feet, the datum line being mean tide at Havre. The scale of the plan (Plate III), is $3\frac{1}{6}$ inches to a mile. The vertical scale in Plate IV, is $\frac{1}{2}$ inch to 55 feet, and is three times the horizontal scale. The dotted lines on the plan show the position of five sections, I K, R S, L M, N O P, N Q, nearly at right angles to the river, some of them extending to a height of 200 feet above the sea. The line A B is along the Imperial Road. See Plates III and IV.

II. Description of the Longitudinal Section.

There is also a longitudinal section, divided into three parts on account of the public buildings at St.-Acheul preventing continuous levels being taken. The divisions are C D, E F, and G H; but it will be treated sometimes in this paper as one section, C H. See Plate IV, fig 3, 4, and 5.

It passes through the celebrated pits of St. Acheul, and is bounded by the river Arve, a tributary of the Somme, at its eastern point, C, and by the escarpment of chalk in the Rue de Cagny (700 yards west of the railway-station, Amiens) at its western extremity, point H.

C H is near the Imperial Road, and is parallel to that road, to the railway, and to the river Somme.

Section G H.—The length of G H is 1400 feet. See Plate IV, fig. 5. The highest point is 157 feet above the sea, 79 feet above the river Arve, 3 feet over the highest part of the Imperial road, 61 feet above the rails, and 84 feet above the river Somme at Neuville. The gradient, commencing at point H, 129 feet above the sea, Rue de Cagny, rises to the east 1 in 30, then 1 in 33, 1 in 35, 1 in 61, and 1 in 100, reaching the well-known section of St.-Acheul Pit, with Roman graves, fossiliferous sand, and wavy marls, at a height of 152½ feet above the sea. A portion of this is shown in Plate IV, fig. 12.

The loess in this section is four feet at the highest, and most easterly point, G, gradually thinning to the west, and ceasing when it reaches H.

The gravel is sixteen feet thick at its most easterly point, G, thinning out as it passes to the west a little before the loess disappears.

The surface of the chalk is 133 feet above the sea at G, and 128 feet at H. The surface falls 1 in 280 to the west.

Section E F.—The surface gradient commences at F, at a height of 156 feet above the sea, and it passes the Cemetery road on the level, and rises at a gradient to the east of only 1 in 700, then falls to the east at 1 in 165 and 1 in 701, reaching the point E at a height of 154 feet above the sea (Plate IV, fig. 4).

The loess is 4 feet at F, thickening to 5 feet at the summit-level of the whole section C H, and then thinning out to 4 feet at E. The regularity of the loess is a very important fact.

The gravel is 17 feet thick at F, and 15 feet at E. The surface of the chalk is 133 feet above the sea at both E and F, showing a perfectly horizontal line, while there is only a variation in the level of the surface-loess of 3 feet in this section, which is 1586 feet long.

Section C D (Plate IV, fig 3).—Section C D commences at D with an elevation of 153¾ feet above the sea; and the gradient falls east at 1 in 157, then rises to the east 1 in 80, then falls to the east 1 in 40 and 1 in 300. Here the tramway (Plate IV, fig. 1) crosses the Imperial Road, and some very extensive gravel pits are now being worked for ballast.

The gradient continues falling east 1 in 88, 1 in 180, 1 in 160, 1 in 41, 1 in 33, and rising 1 in 200 to the east, where it reaches the escarpment at a height of 142¼ feet above the sea. The loess is here 5 feet thick, and the gravel 2 feet, according to Mr. Guillom's survey; but I found only two or three feet where I observed it. The loess is 5 feet thick near the tramway, and 4 feet at the point D. The gravel is 13 feet thick at D, and 10 feet thick at the tramway, thinning out as it approaches the escarpment on the east, as it did on the west. The surface of chalk is horizontal throughout this section also up to the escarpment.

At the escarpment, the chalk falls to the east 52½ feet in a distance of 106, or at an angle of 45° and gradient of 1 in 2 nearly. The line of slope of this escarpment is remarkably straight in many places, and quite free from gravel or loess. Then there follows a flat terrace of loess, 60 feet wide, then a slope toward the river, of 1 in 30, and then 1 in 4, until we reach the marsh at a height of 76⅓ feet above the sea.

III. Descriptions of the Transverse Sections.

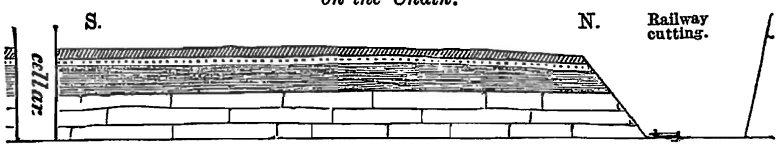
Section I K (Plate IV, fig. 6).—This section commences at the Rue de Cagny, point I, at a height of 200 feet above the sea, and falls to the river and the north at a gradient of 1 in 32, 1 in 28, 1 in 22, 1 in 18, 1 in 54. It then rises to the north at 1 in 162, and crosses the tramway ballast-pit at a level of 153½ feet above the sea, and the Imperial Road at a height of 153 feet above the sea; it then rises to the north at a gradient of 1 in 20, reaching 156 feet above the sea, then falls toward the river at 1 in 42, 1 in 100, rises 1 in 87, falls 1 in 67, 1 in 65, 1 in 50, until in reaches the railway-cutting, at a height of 138 feet above the sea. The cutting happens to be in the escarpment of the ancient chalk valley, in which the valley-gravel has been deposited; and the surface of the gravel follows the contour of the ground, and falls at a gradient of 1 in 8, and then 1 in 7, declining 47 feet in a distance of 360 feet. The surface then falls more gently to the river at 1 in 36, 1 in 34, until it reaches the Somme.

At the point I in the Rue de Cagny the loess is 3 feet thick, and near the Imperial Road it is 8 feet thick; at one point it gradually thins out toward the river and railway, and at the railway-cutting the loess is only 2 feet thick. I do not know the thickness on the north side of the railway; but as the gravel thins out rapidly, the loess is no doubt from 10 to 12 feet thick in some points. The gravel at the point I is 5 feet thick; it increases to 10 feet thick as it approaches the Imperial Road, and after passing that at a height of 148 feet above

the sea, it gradually thins away until it is only 3 feet thick at the south side of the railway-cutting, and soon merges into the loess on the steep incline on the north side of the railway.

The surface of the chalk at the Rue de Cagny near the point I is 195 feet above the sea; it falls to 136 feet above the sea where it passes under the Imperial Road, and then becomes nearly horizontal, only falling 3 feet until it reaches the railway-cutting.

Fig. 1.—*Section at La Neuville, showing the Loess resting immediately on the Chalk.*



The slope then becomes rapid again, and it probably falls at a gradient of 1 in 4 for some distance, and then becomes horizontal again at the river Somme.

The loess is clearly seen in the railway-cutting and at one cellar (Plate III, C)* in Neuville (fig. 1), resting on chalk without any intermediate gravel, C on the plan; but I have left the junction between the loess and gravel undefined in the lower part of the section I K, as I could not put the junction in accurately.

If a straight line be drawn from point I on the Rue de Cagny to K on the Somme, it will pass 32 feet below the top of the railway-cutting along the line I K, and it will pass over the chalk at the Imperial Road at a height of 17 feet, showing that the surface of the chalk between those two points is concave.

Section L M.—(Plate IV, fig. 7.)—This section commences at the point beyond the Rue de Cagny, at a height of 187 feet above the sea; the gradient dips northward toward the river, and falls 1 in 37, until it passes the Rue de Cagny at a height of 160 feet above the sea. It passes through a part of the great St.-Acheul pit, with a gradient of 1 in 15, 1 in 40, 1 in 70, 1 in 130. Here it crosses the Imperial Road and falls to the north with a gradient of 1 in 600, 1 in 300, 1 in 40, 1 in 688, 1 in 43, to the La Neuville Railway ballast-pit close to the railway workshops, where it reaches a height of 132 feet above the sea. The ground is quarried out; but the surface apparently dipped north at a gradient of 1 in 12, then rose 1 in 33, then fell 1 in 7, horizontally crossing the railway-cutting at a height of 107 feet, 11½ feet above the rails.

* The letter C in La Neuville must be distinguished from the letter C in Longueau on the same Plate III.

The ground then falls north, at a gradient of 1 in 21, forming the top of the loess terrace, at 95 feet above the sea. The escarpment of the loess terrace is here at a very steep angle, falling 12 feet in a horizontal distance of 14 feet, then at a gradient of 1 in 71 to the first brook, then level to the Somme.

The loess is 4 feet thick at the Rue de Cagny, in the section L M and the same thickness at the Imperial Road. At the escarpment of the chalk it is only 2 feet thick, and seems to appear again at the terrace in considerable thickness, at a height of 95 feet above the sea.

The gravel is 13 feet thick at the Rue de Cagny, nearly 20 feet thick in the St.-Acheul pit, and runs out to 6 feet at the Railway-works ballast- and chalk-pit at the escarpment. I have no section of gravel further north than this pit.

If a straight line be drawn from the Rue de Cagny to the Somme, along the line L M, it passes the Imperial Road on the level, and is 15 feet below the surface at the Railway-works ballast-pit; so the surface is convex at that point.

The convexity of the chalk on the same line is 14 feet at the ballast pit.

Section N O P.—Plate IV, fig. 8.)—This section commences at the Ferme de Grâce, point N, at a height of 201 feet above the sea, and goes along the road to Montiers by the line N O P as far as O. The first gradient is 1 in 33, north; 1 in 90, 1 in 100, 1 in 105, 1 in 110, 1 in 110, 1 in 110, 1 in 57, 1 in 60, 1 in 70, 1 in 60. Here it crosses the junction of two roads at a height of 155 feet above the sea. Then follow on north 1 in 60, 1 in 27, 1 in 40, 1 in 60, to the point O, at a height of 120 feet above the sea; then 1 in 30 and 1 in 75 to the railway, 1 in 33 to the Imperial Road, then 1 in 56, 1 in 50, 1 in 231, and it crosses the top of the escarpment of loess at a height of 81 feet above the sea. Then the face of escarpment falls 16½ feet in 18 feet, then is horizontal to the river.

If a line be drawn from the Point N to the river Somme along the line N O P, it will pass under the junction of two roads at a height of 142 feet above the sea, or 15 feet under the roads. It will pass 10 feet above the rails, and 2 feet above the Imperial Road; so that the extreme convexity of the surface at any point of the line of 7458 feet is only 15 feet. This is important, as the section has been represented as enormously convex by previous writers.

The surface of chalk at the junction of the two roads is 142 feet above the sea, and is therefore only 6 feet above a straight line drawn through N O P. The surface of the chalk at the railway is 23 feet below a straight line drawn from the Ferme de Grâce 201 feet above the sea to the Somme (at a height of 61

feet above the sea); a straight line from the Ferme de Grâce, 201 feet above the sea to the Somme, 61 feet above the sea, passes over the railway 8 feet above the rails, and 23 feet above the surface of the chalk at that point, so that the surface of the chalk is concave to the extent of 23 feet. At the Imperial road the surface of the chalk is concave to the extent of 22 feet, although on the upper part it is convex to the extent of 15 feet.

IV. Characters of the Chalk, Gravel, and Loess.

I will not trouble the Society with the details of Section N Q (Plate IV, fig. 8), but will now proceed to describe the characters of the chalk, the gravel, and the loess, as I have observed them near Amiens.

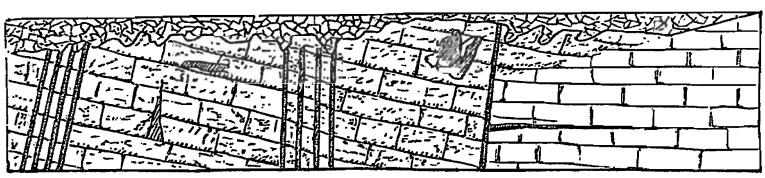
1. *The Chalk.*—The condition of the chalk itself near Amiens is remarkable in some places.

In a railway section near Pont de Metz, about three miles from Amiens and Montiers, the chalk surface slopes northward at an angle of 20°, and is overlain by 20 feet of drift sands dipping 10° N. where they touch the chalk, but filling up the concavities of the chalk, and having their upper surface sloping northward at an angle of 3°.

At Pont de Metz the chalk is covered with a drift chalk-marl, and with beds of chalk rubble and chalk pellets, with very little mixture of sand or clay, 15 to 20 feet thick.

Near Guigencourt, a quarry in the chalk on the plateau, about four miles south of Montiers, the chalk is very much split up by joints lying at an angle of eighty degrees, or very nearly vertical, and also nearly at right angles to the planes of bedding of the chalk. (Fig. 2.)

Fig. 2.—*Section exposed in a Chalk-quarry near Guigencourt.*

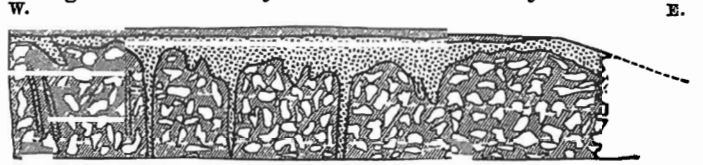


These joints are now in many cases fissures two or three inches wide, and extending to a considerable depth; but they are filled up with a fine brown loess, which seems as if injected into them; for I observed in one or two cases that a vein of two or three inches thick had entered a horizontal joint, and passed along that in a horizontal direction, thining out to only half an inch. I give a sketch of this chalk-quarry. This sys-

tem of joints would very much facilitate the formation, or rather the separation, of the chalk into rectangular and imperfect spheroids, such as are seen in the quarries behind St.-Acheul and Longueau, where some decomposing agency has acted upon the chalk itself with considerable effect.

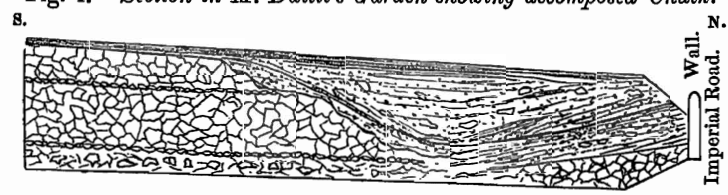
In the drawing (fig. 3) made of the condition of the surface

Fig. 3.—*Section along the St. Acheul and Longueau Road.*



of the chalk (and to a depth of 20 feet) along the Saint-Acheul and Longueau road, running east and west, I found the sand-pipes in the chalk very close together, and filled with brown loess and gravel. There are some large pipes in the eastern escarpment in M. Dailli's garden, close to the road; but they decrease toward Cagny on the escarpment of chalk trending southward there exposed, and also in the escarpment of chalk trending northward. (See fig. 4.) I did not observe any de-

Fig. 4.—*Section in M. Dailli's Garden showing decomposed Chalk.*



composed chalk in the railway-cutting or quarry between Longueau and La Neuville, nor at the ballast-pit in the chalk near La Neuville at the railway workshops, Amiens. The surface of the chalk, however, is irregular, and covered with gravel, but without deep pipes.

The drawings of the chalk-quarry, fig. 2, and in M. Dailli's garden, north of C, fig. 4, will explain the remarkable character of the decomposition that has affected the chalk. Not only has chalk been removed by the chemical action which bores pipes in it, but the loess appears to have followed closely, penetrating through the mass for many feet, occupying the vacant space made by the destruction of the calcareous matter in many places, or uniting with it, and making a kind of Combe Rock.

The harder pieces of chalk are left, often in a boulder-like form (as drawn), with slightly rounded or abraded corners, the chalk between large pieces then being loose and friable, and

marly in color, often mixed with loess, and with ferruginous stains. When the chalk is quarried, the large masses fall down like boulders, and are used for purposes of masonry, untouched by the quarryman. The hard pieces of chalk project beyond the soft matrix in which they are inclosed, like the flints upon the Brighton cliff, making a serrated face. The largest piece that has fallen out is only about three feet long, according to M. Dailli, who has quarried thousands of tons of chalk without meeting with a larger mass. There is a pipe, ten feet in diameter, in M. Dailli's garden, and the depression in the chalk at the north-east corner has a pipe-like form.

The lines of large flints which traverse the whole of the escarpment horizontally are perfectly *in situ*.

That this decomposition of the chalk *in situ* has some relation to the physical circumstances following the deposition of gravel at St.-Acheul is, I think, probable, as some part of the drainage from above St.-Acheul would pass through the escarpment in question in order to get to the marshes, and the action which has caused the removal of the chalk must have acted with great intensity on the high land adjoining, so that the current was from above downward. About one-eighth of the St.-Acheul gravel consists of chalk in the form of large pieces averaging 4 inches diameter, of chalk pellets from $\frac{1}{8}$ to $1\frac{1}{2}$ in diameter, and of chalk finely divided and mixed with clay.

Where we can see the chalk near C, it is so perforated by pipes and separated into small pieces that it seems prepared for a rapid denudation if attacked by water with any vigor; and if this was the condition of the chalk also at higher levels near St.-Acheul and Montiers, we can account for the large quantity of chalk contained in the Amiens gravels.

The fall of the Somme from Longueau to Montiers is fifteen feet, the river flowing from southeast to northwest nearly, at a gradient of only 1 in 1520. The rails are 96 feet at La Neuville, and 99 feet at Montiers, above the sea-level.

By referring to the sections, C D, E F, G H, which are parallel with the river Somme and the Imperial road, it will be seen that on a line from east to west, 1644 yards long, from the eastern escarpment of the chalk east of St.-Acheul to the western escarpment of the chalk near the northern termination of the Rue de Cagny, the surface of the chalk is extremely regular and horizontal.

The highest point of the chalk on the line C H is only three feet higher than the lowest point on that line.

There is a steep escarpment, 50 feet high, at Longueau, of bare chalk facing the east, and an escarpment 30 feet high, near

the Rue de Cagny, of bare chalk facing the west. The outcrop of chalk is marked on the plan, in order to be well seen.

The contrary is the case with the sections from south to north. The escarpment of the chalk facing the river Somme

Fig. 5.—*Section of decomposed Chalk exposed in a quarry in the escarpment near* **C**, *with bank of Loess at the base.*

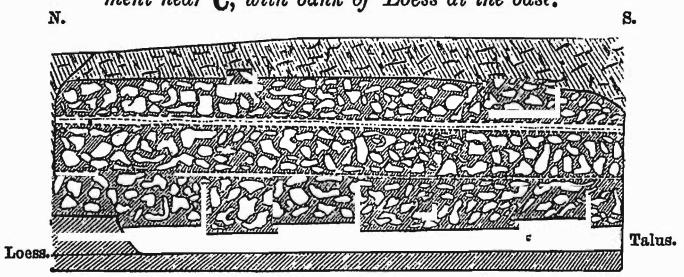
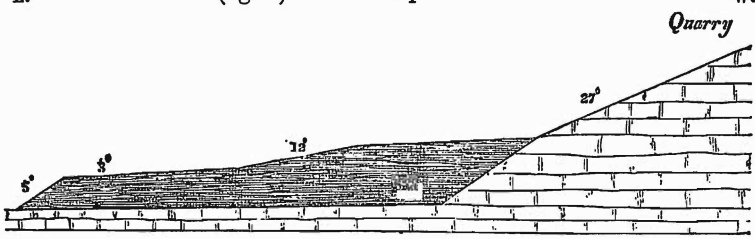


Fig. 6.—*Section showing the escarpment of Loess between the Quarry* (fig. 5) *and the Imperial Road.*



is not so steep and is therefore nowhere bare, being covered with a Quaternary deposit.

The slope of the chalk from south to north is considerable when compared with the almost perfect horizontality of the chalk in an east and west direction.

Thus we have a slope or gradient of 1 in 33, or of $2\frac{3}{4}°$, beginning at the point L on the line L M, 175 feet above the sea, to M on the Somme, at a height of 76 feet above the sea. The distance is 3342 feet between L and M. These escarpments are evidently the sides of lateral valleys, and are not due to the action of the river Somme, but to that of smaller lateral and more rapid streams running into the Somme. The river Arve still approaches closely to the eastern escarpment of St.-Acheul. The western escarpment of St.-Acheul is the side of a valley now dry, but which evidently contained a rapidly flowing stream when the western escarpment was formed.

The gradient of the river Arve is much steeper than that of the Somme ; but the valley at the west of St.-Acheul formerly contained a stream which must have fallen with great velocity,

as the slope af the bottom is 1 in 40, nearly equal to the slope of the chalk itself at St.-Acheul, which is 1 in 33. This river is now dry.

I ask particular attention to the position and level of this dry valley, which is similar in character to those occurring on all chalk-downs and plateaus.

The chalk surface at St.-Acheul is also hollowed out into a valley situated north of the Imperial Road, widening out as it approaches the Somme, after the ordinary manner of valleys.

By the sections through the St.-Acheul pits, we know this valley did not extend south of the Imperial Road; but the eastern boundary of this small valley, only 400 or 500 yards long, is well seen at the La Neuville Eastern Bridge, where the chalk is well exposed in the railway cutting, at a height of 20 feet above the rails, and slopes westward, passing under the rails near the point C in the map, between the lines of section I K and L M.

The surface of chalk is shown in a very clear section on the railway here, covered with twenty feet of loess (fig. 11). The chalk is nowhere naturally exposed. The force of water from St.-Acheul originally hollowed out this small valley in the chalk, which has been partly filled up with gravel and loess; and the surface-drainage of St.-Acheul flows to the river Somme down this valley, over a bed of gravel and loess of some thickness.

There is a very small lateral valley in the chalk, running from St.-Acheul into the now dry valley at the western escarpment, also covered with loess and gravel. The slope of the side of this valley is as much as 6°.

Crossing over from the east of Amiens to the west, we come to the section N O P, which gives us a correct view of the surface of the chalk at Montiers, where fossiliferous gravels were discovered by Mr. Prestwich. (Plate IV, fig. 7.)

The gradients have been already described. Between N and O the surface of the chalk is slightly convex; but between O, a point 120 feet above the Somme, and the Somme itself, the surface of the chalk is concave.

In an elevation of 60 feet, between O and P, the concavity of the chalk is as much as 20 feet, or one-third of the total height. It is in this basin of the chalk that the great gravel-beds of Montiers may be seen, in which 30 feet of gravel and loess is well exposed, south of and close to the Imperial Road.

The fossiliferous gravel extends above the railway; and Mr. Prestwich found shells in a pit which appears to be about 50 feet above the river at Montiers.

The chalk is nearly horizontal beneath the rails for a distance

of 1077 yards between the line of the section N O P, and N Q; at least it is 15 feet below the rails on the line N O P, and 9 feet below the rails at N Q (fig. 12, p. 123). As at St. Acheul, the slope of the surface follows the chalk to some extent, and falls toward the river. The average gradient is $2\frac{1}{4}°$, or 1 in 43, along the line N Q, against a gradient of $2\frac{3}{4}°$, or 1 in 33, at St.-Acheul, along the line L M; but the chalk is convex on the average at L M, and concave on the average at N Q. This, however, requires more explanation.

The surface of the chalk between the line of 200 feet and of 120 feet above the sea is convex on the line N O P, at the maximum to the extent of 14 feet out of 80 feet perpendicular height; and we see very little gravel reposing on the convex surface. On the contrary, in L M, between the 200-feet and 135-feet levels, the maximum concavity is 15 feet; and the great mass of the St.-Acheul gravel is deposited in this hollow.

But when we examine the surface of the chalk between O and P, between the 120-feet and 60-feet levels, we find the chalk surface is concave to the extent of a maximum of 29 feet, out of a total of 60 feet; and, singularly enough, this 29 feet is almost exactly the maximum thickness of gravel and loess in the great pit at Montiers, where a section several hundred yards long is exposed.

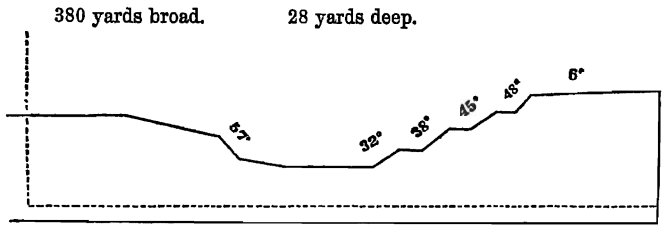
On the contrary, between the 130-feet and 76-feet levels on the lines L M and I K, where the surface of the chalk is convex, there is no gravel of any importance.

In the section (Plate IV, fig. 1), between L M and I K the chalk is nearly a straight line, falling $2\frac{3}{4}°$ between the 130-feet and 90-feet levels; we have 9 feet of gravel and loess exposed in this favorable position for its accumulation.

When we see the gradual slope of the surface from the point O to the river Somme at P, we are indeed surprised to find the sudden change in gradients in passing southward from O to Renancourt, across the now dry valley leading from Ferrières, (passing by Saveuse) to Amiens, a distance of four or five miles. These escarpments commence near Ferrières, and increase as the bottom of the valley falls in a northeasterly direction toward the river Cette. I measured a section near the Ferme de Grâce, where the side of the dry valley slopes at an angle of 20° to the bottom.

These escarpments are better shown in a section taken from the point O, toward Renancourt, and giving gradients from 30° to 50°, representing flood-lines of former periods, but so sharp in definition that they look like the work of the last winter. (Fig. 7.)

Fig. 7.—*Section across the Saveuse valley.*



It is obvious that any theory of excavation of the Somme valley, at Amiens, must take into account the condition of the dry Saveuse valley, which is only a type of hundreds of other dry valleys, which formerly were filled with water falling into the Somme and swelling it into a river capable of overflowing St.-Acheul.

In the same way no argument can be satisfactorily applied to the formation of the Somme valley, without considering the relation of the chalk-valleys generally, which resemble each other in so many important respects, and are alike in general features as well as in the mineral composition of their strata and their superficial contents.

On some other occasion, after the Society has heard my account of some other valleys, and seen my measured sections, I shall venture to lay before them the views of the formation of the Somme valley which I hold. I shall now only remark that the bottom of the valley of Saveuse opens into the valley of the Cette, between Montiers and Renancourt, at a height of 92 feet above the sea, and is 140 feet high above the sea near the Ferme de Grâce, and 187 feet above the sea near Saveuse, and that there are continuous terraces of loess, varying in form and elevation, sometimes with the configuration of the chalk-valley on which they repose from one end to the other, but evidently the consequence of water filling the Saveuse valley on its passage from Ferrières to Montiers.

2. *The Gravel and Loess.*—From the fine or coarse character of the gravel, and from the thickness of the loess, we may infer some of the physical circumstances which occurred at the period of deposition. The loess is in some places sandy, and in others is a fine loam, but it varies little in coarseness. At the same height above the river I have observed great discrepancies in the thickness of the true loess: thus, at a pit 200 yards east of the line N Q, 15 feet of loess was well exposed in a new pit from which a good quality of brick-earth was being removed and carried a long distance to the brickfields at Montiers; and I was informed there was a depth of 16 feet more before the gravel was reached. There was a gravel pit on the

same level, a little to the west. On the edge of the Saveuse valley, 400 yards south of O, the loess was only from 1 to 2 feet thick. At St.-Acheul it was only 5 or 6 feet thick; but there were intermediate beds of marl and sand between the true loess and the true gravel there.

There seems to be a line of thicker brick-earth or loess running south and north between the lines O P and N Q. This would indicate that the water was more tranquil at that point. Such differences in currents are very apparent in rivers at the present time; and the warp of our rivers approaches very nearly to the character of loess. The fossiliferous gravels at St.-Acheul extend to a height of 70 feet above the river, or much higher than the corresponding fossiliferous gravels in the valley of the Thames. The shells are found in false-bedded fine sand, and not in clay, at St.-Acheul, and in precisely the same condition as at Crayford.

The Cyrena shell-bed at Crayford, however, is only 38 feet above the sea; but both the St.-Acheul and Crayford gravels extend upward and join the plateau beds, while they pass downward as far as the river in both cases.

The chalk is capped in some places with Tertiary sands at Crayford; but the gravel lies on the concavities of chalk and sand quite indifferently.

The river Cray falls into the Thames much as the river Arve falls into the Somme. The Crayford gravel is 100 feet thick, and confined to a space between two valleys, the eastern valley occupied by the river Cray, and the other and western a dry valley, like that southwest of St.-Acheul.

Bounded by valleys east and west, the Crayford and St.-Acheul gravels lie against escarpments of the chalk parallel to the rivers Thames and Somme.

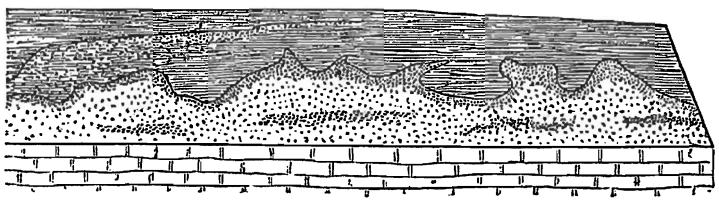
I have not presented more than a few varieties of the gravel sections to be observed in Amiens, for want of room (Plate IV, figs. 12 and 13, and fig. 8 below), and I propose to make some remarks upon the peculiarities of deposition to be observed there at some future time. I will now only observe that the character of the sections, I think, clearly shows us that a large quantity of the gravel material now exposed in the quarries opened for ballast near Amiens had its source in the hills or plateau immediately adjoining and above St.-Acheul and Montiers, and was washed into the valley of the Somme in a direction from south to north, and mingled with the materials brought down by the Somme, flowing from east to west.

The quantity of chalk-detritus is about one-eighth of the whole mass of gravel and loess, and makes the Amiens deposit second in importance to the Brighton gravel, as far as the pres-

ence of chalk is concerned. The unrolled condition in which the large pieces of chalk in the gravel generally occur proves the local origin of the chalk, and that it has been brought down from the high lands and not thrown up by the river.

We might expect an important difference in mineral character between the gravel and loess at the respective heights of 150 and 75 feet above the sea. I have compared the gravel of St.-Acheul, 140 feet above the sea, with that at Montiers, from 70 to 80 feet above the sea, as carefully as I could, in order to find some marked distinctions, but up to the present time without success. I have sketched a piece of gravel at St.-Acheul, 140 feet above the sea (Plate IV, fig. 12), and a piece in La Neuville, 105 feet above the sea, and immediately north (fig. 8).

Fig. 8.—*Section in La Neuville Ballast-pit. Loess and Gravel.*



There is a great deal of variation between these two sections; but there is still more variety in the gravel section of a part of St.-Acheul, 200 yards to the east, at a height of 145 feet above the sea (Plate IV, fig. 13). Similar species of shells have been discovered and named by Mr. Prestwich and others at Montiers and St.-Acheul, at very different levels; but there are none characteristic of any particular elevation above the river. Bones and flint implements are said to be found throughout the Amiens gravels; but as I have never found any myself, nor seen any found, I cannot speak on this point from observation; and it does not appear that these remains, any more than the shells, would enable us to distinguish any particular level.

The large stones of Grès are abundant in all the quarries. I made notes of the numbers and sizes of all I observed, and found that they are also distributed as much in the gravel above the railway as below it, and range up to 4 feet long. There are as many and as large blocks of Grès in the Montiers northern pits as in those at St.-Acheul. I observed one Grès at La Neuville partly covered by loess, the rest of the stone being on gravel; but elsewhere the Grès stones were always in the gravel.

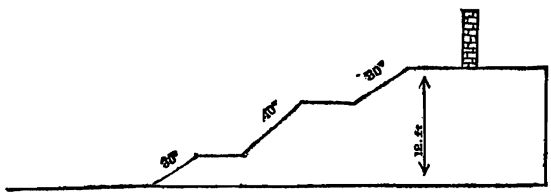
I have mentioned the loess being a very good brick-earth at a point 120 feet above the sea in Montiers. The color and material of the loess is generally a dull brown, varying in propor-

tions of clay and sand and in the amount of angular flints contained in it throughout the whole area. I have, however, remarked a reddish friable brick-earth on the terraces fringing the Somme at Longueau, ninety feet above the sea. This is probably of the same character as that in the similar terrace at Neuville and Montiers. This brick-earth is very similar to that of the river Lea; indeed at Clapton there is a well-marked terrace of brick-earth bounding the marshes, which are composed of gravel. The Clapton terrace is higher than that of the Somme at Amiens, and reposes on London clay, instead of chalk as at Amiens.

This low escarpment of loess is to be seen for a great many miles eastward along the Somme; and, from the angle at which it faces the river, with its flat top, it so resembles a military earthwork that it is often regarded as artificial. I have measured the escarpment at five or six points; and the angles vary from 20° to 40°, the average being 35° (figs. 9 and 10.)

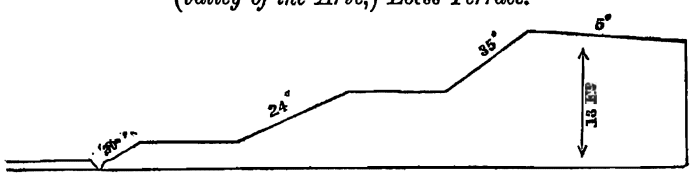
In the Saveuse valley the angles are also various. I have often remarked similar escarpments in England. I made a note

Fig. 9.—*Section near Cagny, in the valley of the Arve. Loess Terrace just above the level of Marsh.*



of a series of terraces, seven in number, one over the other, on the chalk hills, on the north side of the Somme valley, about nine miles from Amiens, on the Paris line; and, indeed, in the space of ten miles you may see twenty small lateral valleys

Fig. 10.—*Section three-quarters of a mile south of M. Dailli's house (valley of the Arve,) Loess Terrace.*



opening into the Somme, with escarpments as distinct and well marked as those drawn of the Saveuse valley.

These were steps cut in the brick-earth of the Saveuse valley by the peasants to enable them to get up the steep sides; but

that was the only information I was enabled to get as to the structure of parts of these terraces, except at Longueau, where a pit was open and good brick-earth visible; so I do not know their relation to the chalk. At Camilla Lucy House, West Humble, near Dorking, I saw a terrace cut into, sloping to the valley at 25°. The gravel was 5 feet thick on the face of chalk, and 7 feet thick 30 yards from the escarpment.

These terraces are of great importance to any one investigating the geology of the Somme, but are not noticed by any other writer as far as I am aware.

V. Conclusion.

What the sections described in this paper plainly tell us is, that the chalk valley of the Somme was excavated exactly to its present form prior to the deposition of any of the gravel now lying in it. Perhaps many layers of gravel may have been deposited and removed again in this ancient chalk valley before the present gravel was deposited; but of this we cannot be certain; so that we must take the first layer of gravel covering the chalk from the higher part of the section to the lower as the oldest in the section, and infer that the remainder of the gravel-series was deposited in regular sequence. The most delicate shells are fossilized in the river-sand of St.-Acheul and Montiers, just as they have been in that of Crayford and Erith.

This is a proof of the peaceful character of the deposition of some part of the Amiens beds, just as the large flints and blocks of Grès, which are so abundant among the gravel, are a proof of the power of the floods which brought the coarse gravel from the plateau, or down the rivers. If the sections near Amiens show the valley-gravel continuous from a height of 200 feet, at St.-Acheul and the Ferme de Grâce, to the river Somme (coated over by a nearly uniform warp of loess), and laid at a low gradient not exactly parallel to the surface of the chalk, but rather in its concavities, then we must necessarily admit that the water of the Somme has at times flowed over the whole surface in question from top to bottom in one flood. This is not an exceptional case at all, as I should have been able to demonstrate, had I been able to bring forward my sections of other river-gravels this evening. We are all agreed that a state of meteorological phenomena existed during the glacial period very different from any now to be met with in these latitudes; therefore there is no *prima facie* improbability in supposing a pluvial period even of longer range in time than the glacial epoch.

The existence of such a pluvial period is demonstrated by the size, constitution, and level of the fluviatile gravel and loess deposits at Amiens and other well-known localities. Large rivers certainly existed to a later date than the glacial period, as they formed such large terraces of loess over the glacial gravels. If we were to judge of the age of these later deposits, such as the loess escarpments at Amiens and Clapton, by their modern appearance and by their being unaltered by weather and not cut into by streams, we should place them almost in the historical period. The Amiens sections of loess accord with those of the Rhine and other rivers. The difference between this loess deposit at Amiens and the present warp of the Somme ought to be an index of the rainfall in the pluvial period, when the loess was deposited, as compared with that falling at the present time; and we may look at these gravels and loess beds as registering rain-gauges.

In the same manner, the comparative rainfall at the epoch of the deposition of gravels might be estimated approximately by comparing the dimensions of the blocks of Grès and large flints moved by fresh water in the gravel-period with the size of the materials moved in the same valleys at the present time.

The existence of a glacial period almost necessitates that of a pluvial period, commencing prior to the glacial, and continuing after it, occupying a region south of that occupied by the ice and snow.

We should have had no cause for surprise if, when the theory of a period of ice and snow in these latitudes was first broached, the probability of a rainy period south of the Thames had been also deduced from a consideration of the effects of so large a mass of ice and snow on the country and atmosphere bordering on the ice-land, but possessing a warmer climate.

We have the evidence in almost all wet valleys of the river merely occupying a small groove cut in the ancient valleys, which valleys I believe, were shaped to their present configuration in such a rainy period as I have inferred. Every wet valley has a number of dry valleys opening into it, which bear the marks of having been shaped by water and continual showers during the pluvial period.

The points of difference between other authors who have written respecting the Somme Valley and myself are as follows :—

In the appendix to Mr. Prestwich's paper in the 'Philosophical Transactions,' M. Pinsard gives the height of the railway at La Neuville as 83 feet above the mean tide at Havre. In the survey made for me by M. Guillom, Principal engineer of

the Chemin de Fer du Nord, the height is 96 feet. (Mr. Prestwich has marked this same level as 76, in his drawing, plate 10. Phil. Trans. 1860.)* This is just 13 feet below the real height. Again, in Mr. Prestwich's section, page 257, Phil. Trans. 1864, the height of the rails at Montiers is marked 130 feet; it should be 99 feet, according to M. Guillom.

It is to be regretted that Mr. Prestwich was supplied with incorrect figures of the relative levels of the ground about Amiens, as the introduction of such errors in the section must have materially affected Mr. Prestwich's theoretical views, as he says, "The upper section at Montiers, which I discovered in 1861, was conclusive as to the relative ages of the gravel" (p. 248, Phil. Trans. 1864.)

In the plan, Plate V, Phil. Trans. 1864, accompanying Mr. Prestwich's memoir, the bare chalk is shown as invariably separating the upper and lower gravels all the way from Amiens to Abbeville; but I have never seen a case of the kind.

It must be remembered that so much gravel has been removed during the last four years, that the sections are now much clearer; and, with the assistance of the accurate measurements of M. Guillom, present examiners have a great advantage over their predecessors, in examining the structure of the gravel near Amiens.

I cannot suppose that Mr. Prestwich would now separate the Montiers gravels, seen in and above the railway-cutting at Montiers, from those in the Great Montiers pit, and into two horizons, as there is only a difference of twenty-two feet between the height of the gravel on the top of the railway-cutting and that in the Imperial road. As nearly the whole space between these two points has now been excavated, the continuity of the gravel is now proved.

When Mr. Prestwich supposed that there was a continuous bare band of chalk separating the gravel in the railway-cutting at Montiers from the gravel near the Imperial road, and that the top of the railway-cutting was (according to the measurement in his section, page 257, Phil. Trans. 1864) sixty feet above the Imperial Road, he very naturally took a different view of the relations of the gravels from what we must take at the present time, with the additional information we possess.

The section on Plate IV, therefore, appears to destroy Mr. Prestwich's argument, on which he has constructed a division of the gravels at St.-Acheul and at Montiers into upper valley-gravels and lower valley-gravels, of different ages, and situated on different horizons, separated, as he supposed, by a band of bare chalk from each other,—the upper valley-gravel being

* This is calculated from the mean tide at St. Valery, which differs 7 feet from that at Havre.

supposed to have been deposited before the excavation of the last fifty feet of the Somme valley, which excavation, he considered, preceded the deposition of the gravels near the Imperial road, Montiers.

The character of the surface of the chalk at Montiers has been discussed at full length in this paper, and shown to be concave at the pits; while it is represented as highly convex at Montiers by Mr. Prestwich and Sir C. Lyell.

In the long section C D (Plate IV, fig. 3,) the St.-Acheul gravel, at a height of 140 feet above the sea, is shown to be separated from the loess at Longueau, at a height of ninety feet, by an escarpment of bare chalk. The tramway (Plate IV, fig. 1), passing from the Imperial road to the railway, crosses one of the supposed bands of chalk marked by Mr. Prestwich. But, instead of chalk, there were nine feet of good gravel and loess exposed in this cutting. The La Neuville ballast-pit, exposing ten feet of gravel and loess, is also on the supposed outcrop of bare chalk (Plate IV, fig. 2: R S on the Plan).

The outline of the sections C D and I K would at first sight seem to confirm the opinions advanced by Mr. Prestwich, that the gravel at the 140-feet level might be of a different age to that 50 feet below it.

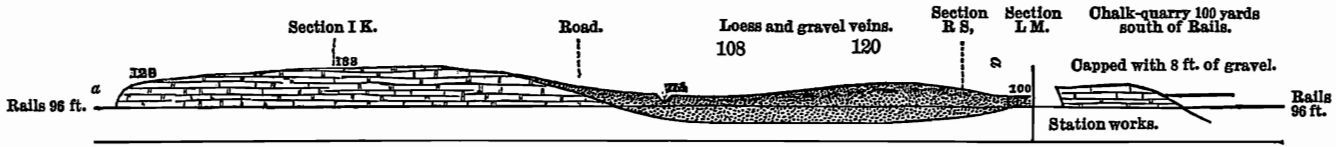
The loess, also, at Longueau, at the 90-feet level, near C, can be traced to La Neuville, and then up to the St.-Acheul pits continuously. The railway-cutting in La Neuville for half a mile is in loess, with veins of gravel (fig. 12); and this is seen to be continuous with the St.-Acheul gravel to the north, by a number of old pits, and in the tramway. The surface of the chalk is concave in this part of the La Neuville valley, between R S and I K, so that gravel and loess would be retained on it; while along the lines C D and I K there is a very steep escarpment, on which no gravel would lie. This escarpment would be swept by the stream of the river Arve and the Somme, flowing at its base, when swollen by large floods, such as must have happened in the gravel-period.

The only inference, I believe, that can be fairly drawn from the sections on Plate IV, is, that all the gravel and loess of St.-Acheul and La Neuville is of one period, and that it remained spread over the valley of the Somme where the ground was concave enough to retain it. The absence of gravel on the steep escarpments and near the river channels is a proof of great floods and rapid currents during the Quaternary period.

I saw the railway-cutting at Montiers, soon after Mr. Prestwich's visit; it was sloped and very much in the state it is at present. (Fig. 12).

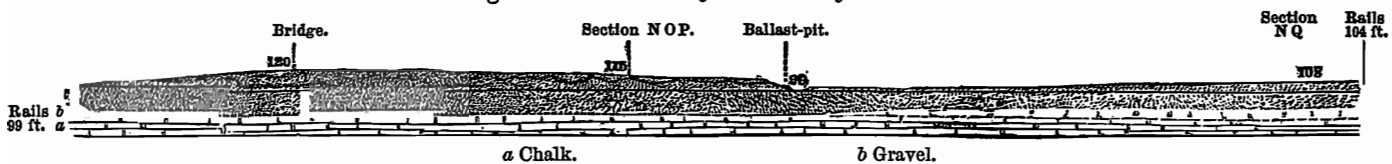
By M. Guillom's section the depth of the chalk below the rails has been accurately determined at two points, where the

Fig. 11.—*Section along the Railway from Longueau, through La Neuville to the Station works.*



Figs. 11 and 12 are only approximative, as this was not included in the part of Amiens kindly surveyed by M. Guillom.

Fig. 12.—*Section along the Railway at Montiers.*



But as the Quaternary beds below the escarpment at Longueau and La Neuville consist only of loess with thin veins of gravel and without fossils, these sections do not support the view taken by Mr. Prestwich that there is a low-level fossiliferous gravel completely separated by an escarpment of chalk from the St.-Acheul gravel.

The veins of gravel in La Neuville thicken toward the west, and the gravel in the La Neuville ballast-pit may continue beneath the Station-works; if so, this gravel is part of the stream of gravel which has descended from St.-Acheul down the La Neuville valley into the Somme, and can be traced from St.-Acheul continuously to the La Neuville ballast-pit, and passes (in thickness unknown) under the rails, as represented in the Section, fig. 11. The La Neuville deposits are not really separated from St.-Acheul by a bare band of chalk, but they wrap round the base of the high stratum of chalk which is seen in L M and I K, and which forms the east and west side of the La Neuville valley.

sections N Q and N O P cross the railway (see figs. 8 and 9, Plate IV). In fig. 8, M. Guillom found the chalk 8 feet below the rails; in fig. 9, 14 feet below the rails. Mr. Prestwich has represented this railway-cutting as on one of his bands of chalk, dividing the valley-gravels into two horizons; and in consequence, I had the section N O P taken, as nearly as I could, on the same line as Mr. Prestwich, because I had always remarked gravel in the Montiers railway-cutting, and not chalk. I also give a section along this railway (see fig. 12, page 324). By the French survey, the chalk is 14 feet below the rails. In Mr. Prestwich's section of the same place, it is 20 feet above the rails. This difference of 34 feet added to the error in the height of rails, before mentioned, of 31 feet, makes a total difference of 65 feet in the height of the chalk between Mr. Prestwich and M. Guillom, supposing I am correct in placing Mr. Prestwich's section on the line N O P.

Mr. Prestwich has recently informed me that he considers his section was intermediate between the lines N O P and N Q. As the railway-cutting ceases at the ballast-pit (fig. 12,) and there is an embankment to the west of that point for some distance, it is difficult to place Mr. Prestwich's section at any other point than where I supposed it was taken, on account of the configuration of the ground. Whether there was chalk, or not, at any one point, is quite immaterial to my argument. I do not find the Montiers section at all as represented by Mr. Prestwich and Sir C. Lyell. (See fig. 12, p. 324.)

The Montiers section appears to be the one adopted as a type of the Somme district, first by Mr. Prestwich and afterward by Sir C. Lyell. Both authors represent, in several sections of the Somme, a great extent of chalk, separating highly inclined beds of gravel, which they have distinguished in age by its position above or below this outcrop of chalk, as upper- and lower- or high- and low-level gravels. The sections which I place before the Society appear to me, on the contrary, to show that this distinction is not a real one, but that the deposit of gravel is one and continuous, deposited in concavities of an ancient chalk valley, and is not highly inclined as represented in the 'Antiquity of Man' and the 'Philosophical Transactions.'

In page 264, Phil. Trans. 1864, Mr. Prestwich gives a theoretical account of the view he takes of the deposition of the gravels. Part of the upper-level gravels are represented as remaining untouched, while the valley is cut down 50 feet, and a newer set of gravels deposited at lower levels; my sections show that there is no evidence of any such action.

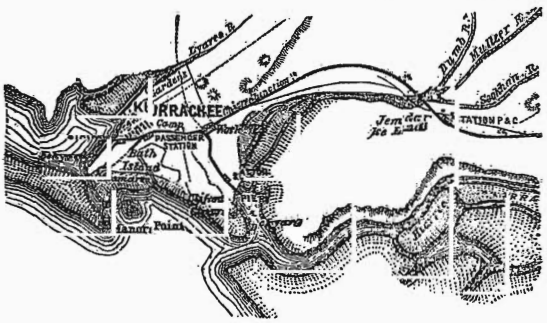
The same views are extended by Mr. Prestwich to the loess deposit; the loess of St.-Acheul is considered a much older deposit than the loess at Montiers.

Mr. Prestwich lays great stress, in his paper in the Society's Journal, p. 500, on the valley being too large to admit of the possibility of its being filled with water up to a height of 100 feet above the present water-level.

I have already submitted the argument that we ought to judge of the height of a flood by means of the *debris* it has left, and not by any theoretical notions of our own.

In 1866, twenty inches of rain fell in Scinde in twenty-four hours, in a flat country intersected by rivers. Nine girders, weighing nearly eighty tons each, were washed off the piers by the Mulleer river from the Railway bridge, situated sixteen miles above Kurrachee (fig. 13). This bridge consisted of eighteen girders (see Plate IV, fig. 10). They were not box girders, but made of wrought iron on Warren's system. The bottoms of these girders were sixty-five feet above high-water mark, spring tides, Kurrachee harbor, and seventy-four feet above low-water spring tides. They fell in the course of six hours; and one girder of the weight of eighty tons was carried two miles down the river and nearly buried in sand.* The section of the river bridge is represented (Plate IV, fig 10). The fall of the Mulleer river only averaged ten feet per mile for fifteen miles above the bridge; and as rain rarely falls, there is generally less than a foot of water in the river-bed. This bed was nearly dry

Fig. 13.—*Map of the district near Kurrachee.*



the day after, as well as the day before this excessive rainfall. Other instances of the same kind have been reported from India. The river first banked up wood and grass against the bridge and then threw the girders over. The weight of these girders moved in a river-bed of the dimensions given (Plate IV, fig. 11)† is an index of the rainfall in Scinde, just as the

* Mr. John Brunton, F.G.S., Chief Engineer of the Scinde Railway, was present at the Meeting, and confirmed this statement, which he had previously given me.

† Figs. 10 and 11, Plate IV, are from drawings supplied by Mr. W. A. Brunton, C. E.

fluviatile beds at Amiens are an index of the current of the Somme, of its flood-level, and the force of its stream. We cannot determine the rainfall at Amiens in the Quaternary Period except by its results in the form of gravel-deposits; and these appear to give as good indications as the fall of the Mulleer bridge girders does of the flood in that river.

PLAN OF AMIENS

AND ITS VICINITY,

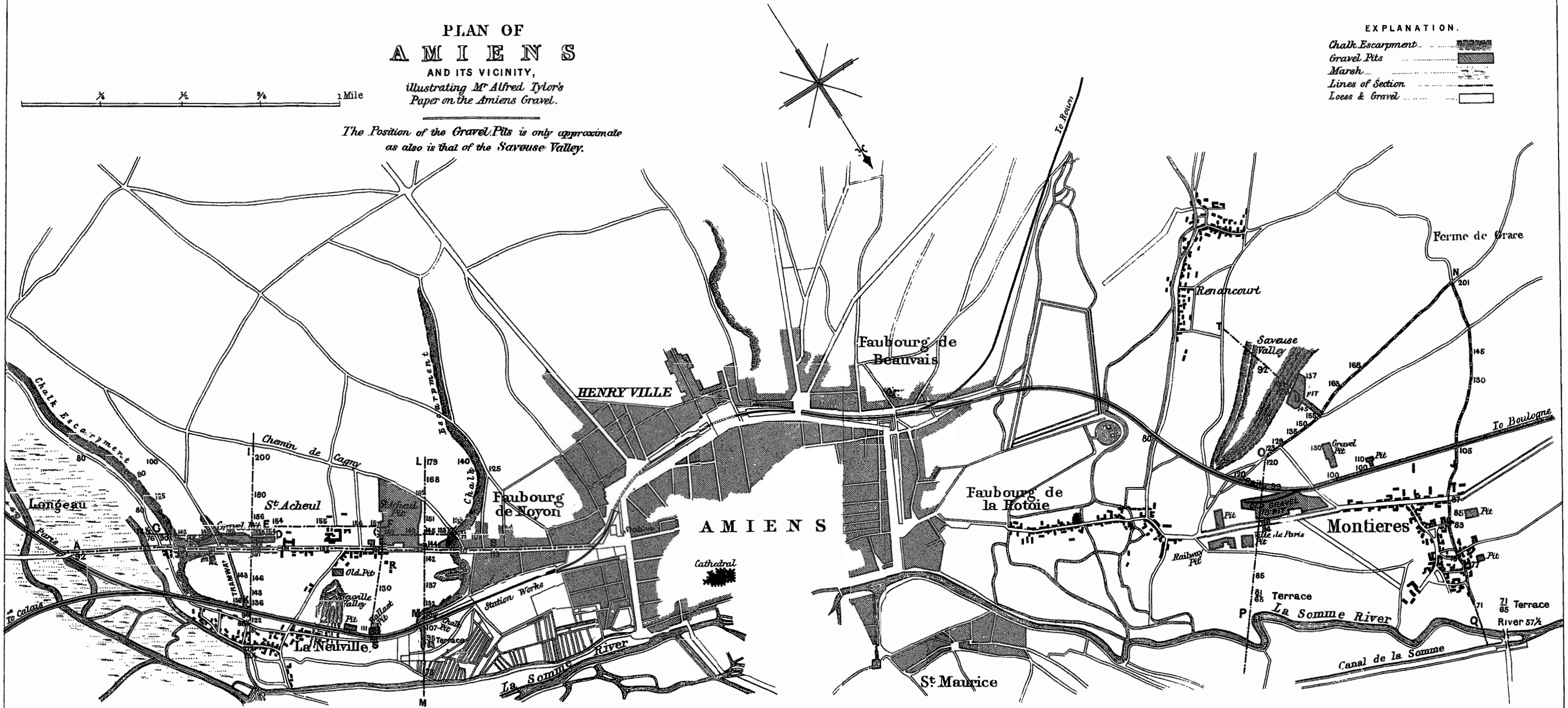
illustrating Mr Alfred Tylor's Paper on the Amiens Gravel.

¼ ½ ¾ 1 Mile

The Position of the Gravel Pits is only approximate as also is that of the Saveuse Valley.

EXPLANATION.

- *Chalk Escarpment*
- *Gravel Pits*
- *Marsh*
- *Lines of Section*
- *Loess & Gravel*



F. Dangerfield lith. 22 Bedford St. Covent Garden.

SECTIONS IN THE ENVIRONS OF AMIENS, PRINCIPALLY SURVEYED BY M. GUILLOM CHIEF ENGINEE THE CHEMIN DE FER DU NORD.

To illustrate Mr Tylor's paper on the Gravel of Amiens

Fig 1 *Section along the Tramway, from the Imperail Road east of St Acheul to the Railway* R. S.

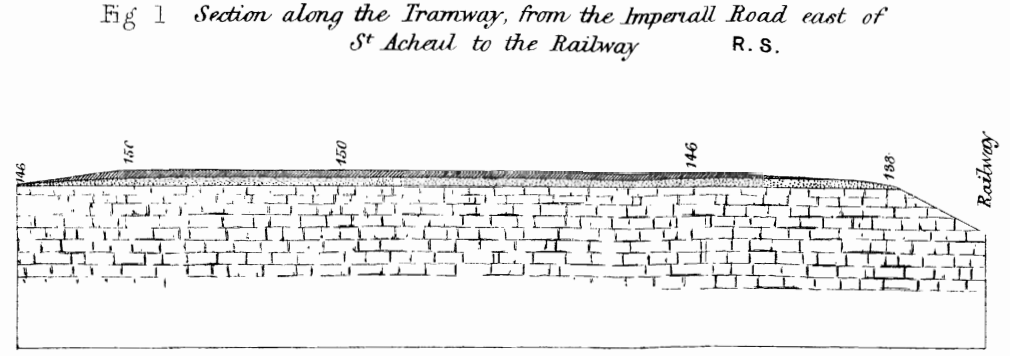


Fig 2 *Section from the Imperial Road to la Neuville Ballast Pit, along the line.*

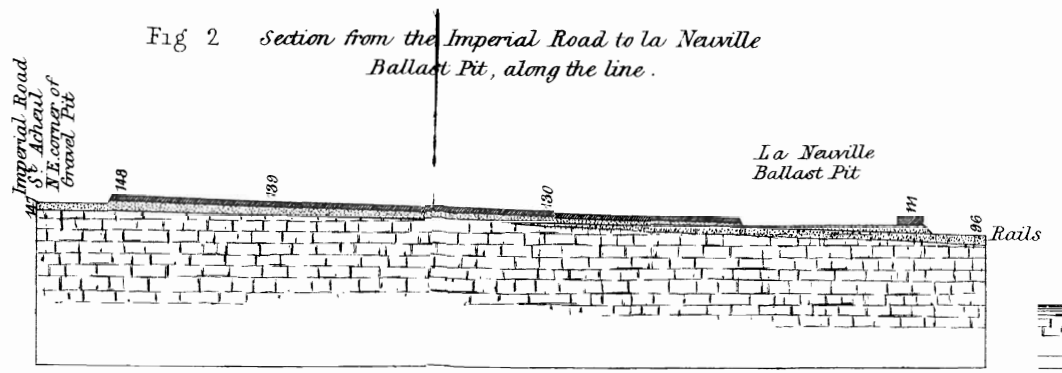


Fig 3 *Section along the line* D.

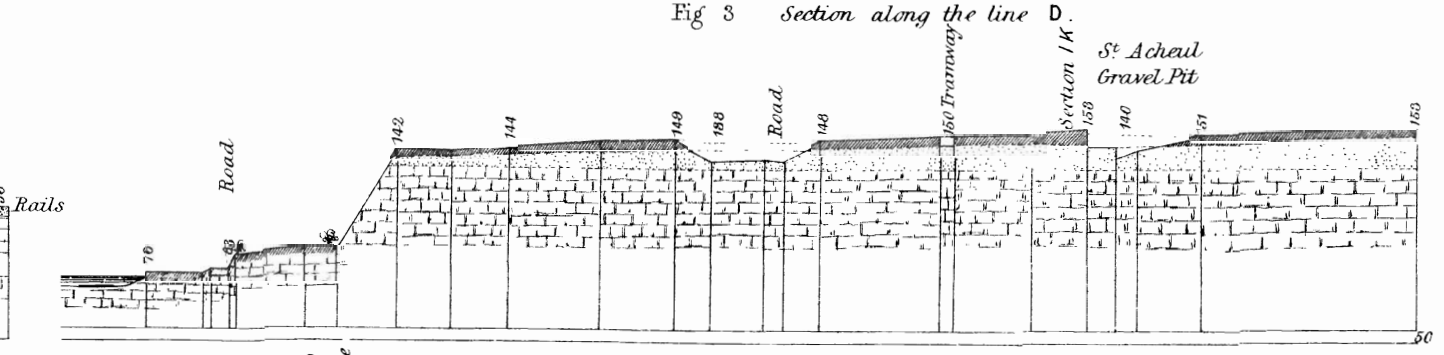


Fig 4 *Section along the line* E F

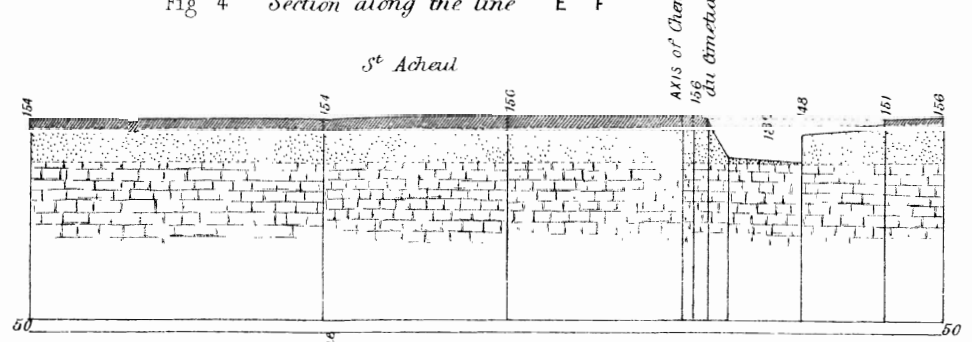


Fig 5 *Section along the line* C. H.

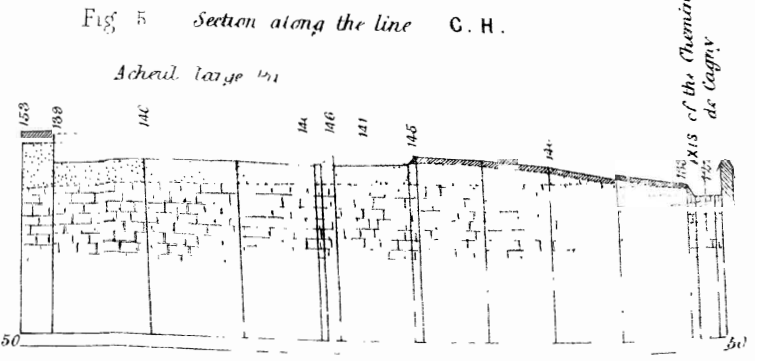


Fig 6 *Section along the line* I. K.

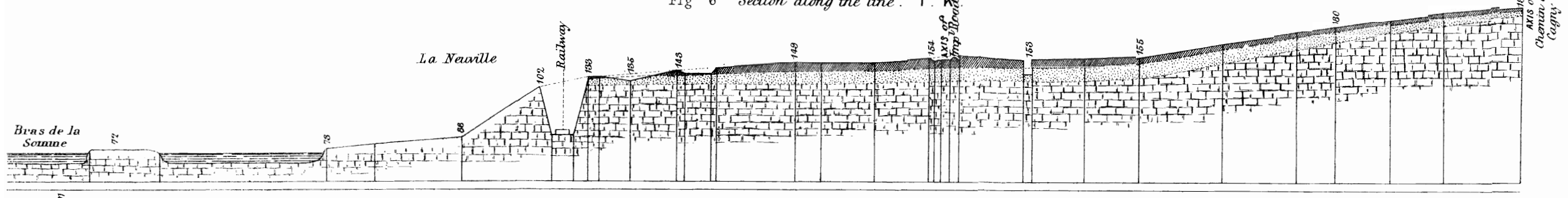


Fig 7 *Section along the line* L. M.

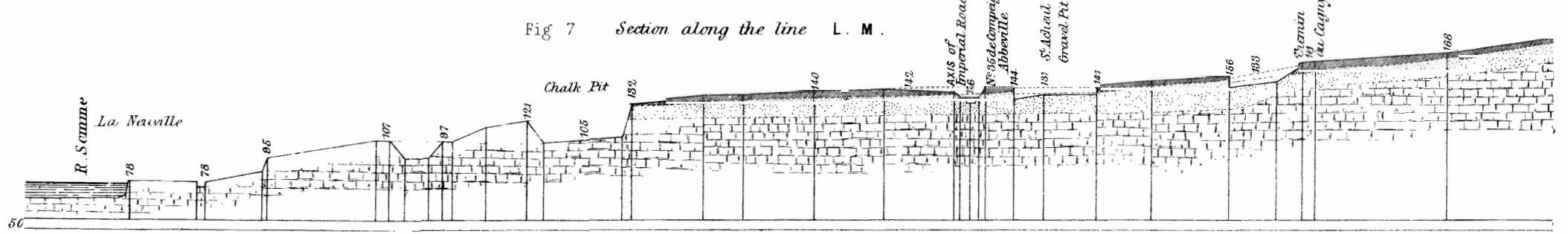


Fig 8 *Section along line* N O P

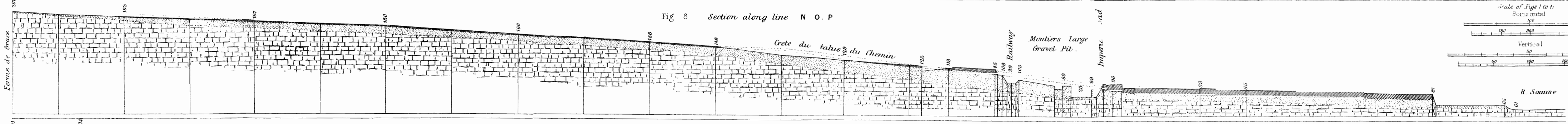


Fig 9 *Section along the line* N Q

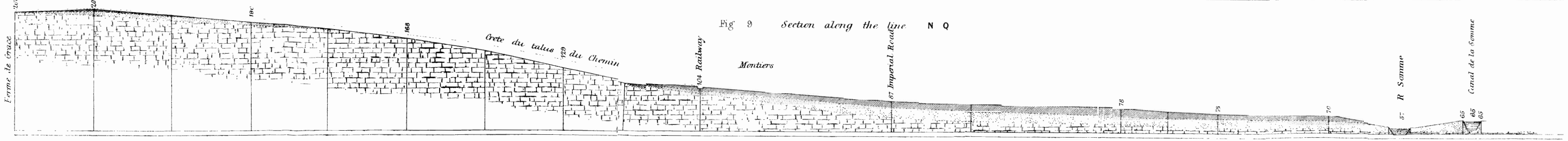


Fig 10 *Detail of one span*

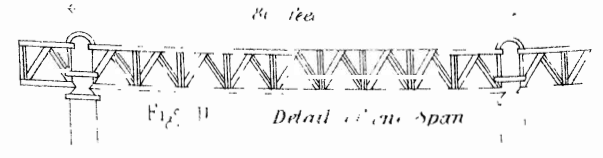


Fig 11 *Section of an Iron Bridge 16 Miles and of Rairuches on the Sinde Railway.*

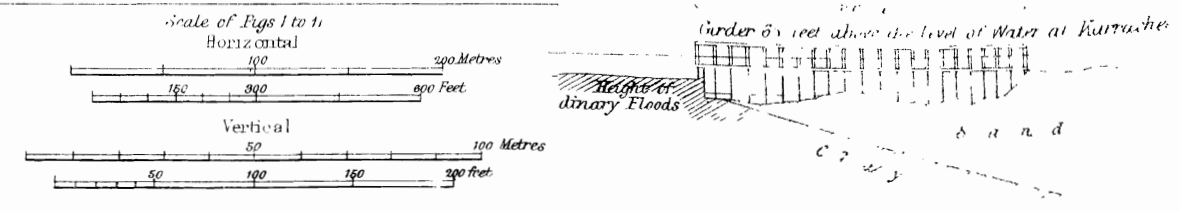
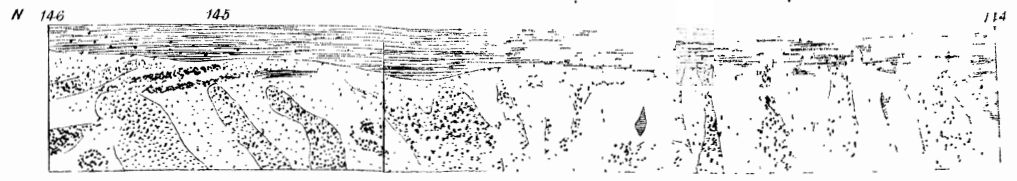


Fig 12. *Section exposed on the N. W. Face side of the St Acheul Gravel Pit*

Fig 13 *Section along the South bank of the Imperial Road between the Rue de Cagny and St Acheul, and parallel to it at right*



Loess
Gravel
Chalk