

THE PLATEAU AND VALLEY GRAVELS OF THE ISLE OF WIGHT.

BY G. W. COLNUTT.

At several meetings of the Club in the Island opportunities of making cursory examinations of some of our post-tertiary gravels have been afforded to the members, and short accounts of these deposits have been given. At a Field Meeting, however, it is impossible to go so deeply into the subject as one could wish to do, and it has been suggested that a more exhaustive account of the Island gravels might with advantage be included in the Papers of the Club, especially as the kindred subject of post-tertiary denudation as affecting the formation of the Hampshire valleys and water-sheds has already been dealt with.

The geologist who is something more than a mere fossil collector, and who endeavours to get from his favourite study some indication of the operations of nature in the past ages, cannot fail to be interested in the gravels and in the lessons they teach as to their origin and the causes, which we must conclude, led to their formation. It is very rarely that we can arrive with anything like satisfaction at such conclusions, because, as a rule, we have only very meagre data furnished us by such sedimentary strata as we may be examining; we study the strata and their embedded organic remains, and from these arrive at some hazy conclusion as to their formation and mode of deposition. With the gravels, however, matters are somewhat different, for they constitute the last of the important sedimentary deposits in this part of the country; and, as we judge by the shavings and chips on the floor of the carpenter's shop in what materials the artificer has been working, so from the constituents of the gravels we

can obtain a fairly good idea of the changes which have taken place and the quality of the work done by nature in the age which may be generally described as post-tertiary. We must not fall into a common error by forgetting that nature is still at work now as in the past, nor must it be forgotten that nature abhors cataclysms. To the ordinary effects of denudation—vast in extent and of long duration, effecting great and important changes both in the extent and in the configuration of the dry land—must we look to account for the formation of our gravels. Before going into what is somewhat of a speculative enquiry under this heading, some account of the deposits as they now are will not be out of place.

The wayfarer journeying eastward or westward along the main roads leading from Cowes towards Yarmouth, or from East Cowes towards Ryde, and thence on to St. Helens, will notice that he has to make many ascents on his way, leading him over ridges running north and south, and descents into the intervening valleys. These latter have usually a *small stream of water running northward into the Solent, and readily accounting for their formation.* If it be early summer when our imaginary traveller is on his way, he will no doubt notice that the gutters by the roadside are dry on the tops of the hills, but as he descends into the valleys the ditches soon become damp, and within a distance of a few yards there may possibly be found quite a respectable flow of trickling water, which finds its way to an ultimate level in the stream in the valley below. In several places it has been noticed that this has been the case even in the driest summer. The reason for this soakage is not far to seek, for nearly all the elevations or ridges in that portion of the Island lying to the north of the central range of chalk hills have a capping of what, from its position, has been named plateau gravel. These patches are the isolated remains of what was at one time a great sheet of gravel covering at least the whole of our tertiary—and a great part of our secondary—area, but which has been cut through and washed away by the action and influence of the streams that now flow along the bottoms of our valleys. The wayfarer too will have noticed that the water flowing by the roadside is strongly tinged with iron oxide, the stones in the ditch being mostly stained a rusty

red colour. This is an interesting fact, and its explanation will be given presently. Our traveller may perchance see on the top of the hill one of many gravel pits, situated usually in a field by the roadside, and being of an enquiring turn of mind he may walk into the pit and examine the nature of the gravel. It is usually about 12 or 14 feet thick, sometimes more and sometimes less, according to the extent of more recent denudation to which it has been subjected. The deposit is composed mostly of waterworn chalk flints, interspersed with sand and miscellaneous small pebbles of flint or quartz, the whole being tinged of a rusty red colour by iron oxide. The amount of this oxide varies, and it increases the further south we get, until at St. George's Down and Bleak Down the amount of iron in the gravel forms a very marked feature. It is a peculiar fact that the plateau gravels are not found at one elevation alone, for they occur about 120 feet above the sea level at St. Helens, and also at St. George's Down at a height of 350 feet above the sea. From these data we may conclude that the gravels at one time covered nearly all the land of the Island with a continuous sheet sloping gradually towards the sea in a northerly or north-easterly direction. Then gradual, continuous and all-powerful denudation acted on this sheet of gravel, a deposit from its very nature forming an easy material on which the streams acted, fed as they were by the copious snow and rain fall of a climate which, there is every reason to believe, was colder than it is now. The streams cut through the gravel and into the underlying marl and clay deposits, and the rainwash of unknown and countless centuries widened the hollows thus formed, until at the present time we find the northern half of the Island furrowed transversely by valleys, each with its stream trickling lazily towards the Solent. To understand the main principle of geological science this operation of denudation must be clearly appreciated, and must be assessed at its true value. Nature's work throughout geological time has consisted of building up and disintegrating—not destroying, be it remembered, for that conveys an idea which finds no place in the geologist's mind. We see this washing-away or denudation going on now on our coast line, the waves ever thundering on the beach and gradually sweeping away the

cliffs. It may be seen in operation too on any wet day, when every runnel and gutter will have its burden of soil-stained water hurrying towards the sea, the solid matter there to be deposited and to help to form lands and continents in ages to come, when man, like so many of the other animals, may possibly have become extinct. In such a runnel or gutter the observer may notice small deposits of coarser gravel, sand or pebbles, left behind by the mud-stained water, and forming accumulations which are in all respects similar to the great plateau or valley gravels, though on a diminutive scale. This is the process then which has given rise to the formation of our gravel deposits, and the matter of our enquiry virtually resolves itself into two questions:—(1) What has been washed away or denuded? And (2) How has this denudation been brought about?

To enable one to thoroughly grasp all that is implied by these questions it would seem necessary to describe in detail the whole of the older strata in the Island, but for the purposes of this paper the matter may be conveniently condensed. The general outline of the geology of the Island will probably be known to most members of the club, and it is therefore sufficient to say that the great upheaval, which took place after the close of the tertiary period and before the great ice age, threw the chalk and the whole of the tertiary strata into a great arch or anticline, the axis of which would be on a line drawn from what is now Compton Bay eastward, to a point a little south of Sandown. As every anticline necessarily entails the formation of a corresponding syncline, so we find the axis of the latter on a line drawn from about Yarmouth, eastwards to St. Helens. The land of the Island at this time extended far away beyond its present southern limits, and we must assume that at this time the whole of this part of England was several hundred feet lower than it is now, and that the valley of the Solent was really a great arm of the sea, or tidal river into which flowed the streams, long since diverted or obliterated, that cut out many of the great valleys of Hampshire. We find evidences of southern tributary streams in the great gaps and hollows between the hills of our central range of chalk downs—streams draining the great expanse of land to the south, long

since swept away by the waters of the English Channel. In the vast deposits of boulder-clay north of the Thames the evidences of ice action are clearly seen, and there is no doubt that, though glaciation or the agency of floating ice may not have operated in the formation of the Island plateau gravels, yet the climate of this region was at that time very cold and inclement. This would not necessarily imply the shifting of the polar axis, but may have been occasioned by the deflection of the Gulf Stream under circumstances which do not now exist. If the Gulf Stream did not impinge on our shores now, the climate of England would be somewhat similar to that of the northern part of the American continent. That the dry land then, representing what is now the Isle of Wight, was subject to great denudation there can be no doubt—denudation brought about probably by frosts and heavy snow and rainfall continued over a great lapse of time. The effect of this, combined with long continued erosion by the sea, was to gradually wash away the summit of the great anticline of the Island—to plane off the top of the arch, in fact—removing in succession the various strata of tertiary age, and then the whole thickness of chalk, and upper greensand, and the gault and a great part of the lower greensand. The result of all this removal is seen now in the way in which the strata of the Island succeed conformably with each other, their upturned edges shewing clearly that they are only the remnants of more extensive deposits. This denudation of course operated to a greater extent on the softer clays than on the harder chalk, hence we find the Island moulded into its present shape, with its chalk hills and its lesser elevations consisting of the more solid strata. The general trend of the land was probably in a northerly direction, and the detritus washed from the land was swept into what we may call the great Solent river, there to form extensive deposits of gravel, composed of flints from the chalk, pebbles of chert from the upper greensand, and small quartz pebbles from the lower greensand, together with a liberal admixture of sand and much iron oxide from the latter beds. In addition, we often find big blocks of "grey wether" sandstone in the gravel, these being the last remnants of those portions of the lower Bagshot Beds, which were swept away in early post-tertiary

times. The period of time which must have elapsed for all these changes to have taken place is simply incalculable; and yet all this happened in an age which, geologically speaking, is recent. While this was going on, a gradual rise in the level of the surface was taking place, our present Island was slowly emerging as it were, and the gravel deposits were being gradually extended as the rise took place and were becoming waterworn by attrition on the shore of the great river, fed in a large measure by important tributaries flowing into it from a southerly direction. It is very difficult to trace the succession of events at this period; to a large extent we must base our deductions on supposition, for the denudation has been so great (affecting even the earlier formed gravels in the later periods) that it is well nigh impossible to correlate the changes that took place. It is obvious that the gravels nearest to the area of the denudation of the lower greensand would be more highly charged with iron oxide than those deposited further away. This we find to be the case; the beds at Bleak Down and those at St. George's Down being loaded with the detritus of the greensand; while those at Osborne and near West Cowes have only a comparatively small admixture of ferruginous matter. From what has been said it is not difficult to answer the questions into which our enquiry resolved itself.

Other deposits of gravel besides those capping the summits of the hills may be noticed in several parts of the Island, and, from the fact that they occur in terraces along the sides of existing rivers, they are called valley gravels. In order to understand their mode of deposition, we must remember that as the land gradually rose the erosive action of the tributary streams naturally increased and cut deeply through the great sheet of plateau gravel and into the underlying strata, and began to form the deposits of alluvium and valley gravels. The Eastern Yar and the Western Yar must have been at this time important rivers draining the southern land, and carrying along with them great quantities of detritus in the form of gravel, sand and mud. These rivers deposited this detritus along their banks and near their outfall into the Solent, through which the sea at this time in all probability flowed, the western entrance to the Solent being about mid-

way between the present Needles and Swanage. The Western Yar had for its tributaries the little streams, which at the present time fall into the sea through the chines cut by them in the cliffs, between Compton and Blackgang, and would naturally bear with it much detritus derived from the lower greensand. This we find to be the case, as the great valley gravels of the Western Yar at Freshwater Gate and Afton are largely composed of the iron sands and sandstones of the lower greensand. These deposits are of great interest, for they lie quite five miles away from the nearest outcrop of the greensand in Compton Bay, and they speak eloquently of the vast changes that have been wrought in the shape of the Island. The sea has long since swept away the land through which the Yar flowed, and we only know of its existence by the evidences afforded by the gravels in the valley—deposits which could not possibly have been formed by the present insignificant stream, which is little better than an arm of the sea. The present Eastern Yar, too, was at this time merely the tributary of a much greater river which cut out the wide gap between Brading and Bembridge Downs, and the hollow in the coast line at Sandown. No doubt this river had for its other tributaries the Shanklin and Luccombe streams, and its work may be seen in the great area of alluvial deposits in the Sandown and Brading marshes, and in the important deposits of valley gravels at Sandford, Horringford, and other places in the neighbourhood; and also, probably, in the gravel deposits at the Foreland.

There is a doubt whether these latter, which are at the sea level, should be classed as valley or plateau; probably they owe their origin to the eastern river, and should therefore be classed with the valley gravels. Truly, the valley deposits of the Eastern and Western Yar are chips on the floor of nature's workshop, for it is only by their help that we can gain a knowledge of the work that nature has been doing. The valley deposits of the Medina are of less extent, consisting, as they do, mostly of brick earth and alluvial mud with some unimportant beds of gravel.

From what has already been said, the observer can form a fairly good idea of the changes that took place in the post-tertiary age. In dealing with the Island, as we at present

find it, the student must not forget that the denudation by rainwash, which is going on now and has been at work for numberless centuries, has been a far from unimportant agency in bringing our pleasant Isle to its present shape. We find many instances of this recent denudation—"slipped gravel" may be named—where the edges of the plateau gravels have slipped downwards towards the valleys; deposits of brick earth, and beds formed by the rainwash of centuries; the angular gravel beds of the chalk downs, which owe their origin most probably to the percolating rainwater dissolving away the chalk and leaving intact the insoluble flints. These and other like instances will occur to the geologist.

In considering its fauna we naturally divide the Post-tertiary age into two periods—the age of great cold, denudation and probable sterility; and the age of lesser cold, and comparative fertility. In our plateau gravels the contemporaneous fauna is unrepresented. We look in vain in the Island gravels for the palæolithic flint tools of early man, which in other parts of the country, and notably in Hampshire, are so characteristic of these deposits.

There is one, and only one, recorded instance of a palæolithic tool being found in the Island: but from the unique nature of this "find," a little scepticism as to its age may be allowed—especially as the tool was discovered in a deposit of "loam" and not in the older gravels.

The reason of this scarcity of palæolithic tools cannot readily be explained. Some may possibly occur in the older gravels and may escape observation; and it behoves those who have the opportunity of doing so, to be on the look out for anything in the nature of worked flints in the older deposits. Teeth of *Elephas primigenus* have been found in the valley gravels at Freshwater, and also at Brook and Grange chimes. In the still more recent alluvial mud of our present rivers the remains of *Bos primigenus* and the red deer are occasionally met with. The hazel nuts and twigs of the gravels at Shepherd's chine are representative of the flora of the later Post-tertiary age.

It would be beyond the scope of this paper to go into all the lesser deposits in the Island which owe their origin to the post-tertiary and subsequent denudation, such as the many

deposits of brick earth, blown sand, river and shore alluvium, and kindred deposits; nor can one go into the subject of the neolithic flint tools which are not rare in the Island.

The economic value of the plateau and valley gravels is very great; for, in most parts of the Island, they are very largely used as road metal. When this is dug in those localities where the iron oxide is abundant, the gravel makes most excellent roads, the "binding" power of the oxide rendering the surface of the road smooth and hard. The quarries at St. George's Down are very extensively worked for road metal, and the finer sifted gravel is in great request for garden paths and carriage drives. It is interesting to note the action of the atmosphere on the gravel, and it is found that freshly dug or "green" gravel does not make nearly such a good road as that which has been exposed to the air for some months. The gravel to be used on the country roads is, therefore, placed in heaps by the roadside in the spring for use in the following autumn. The effect of this exposure is to "weather" the flints, rendering them harder and tougher, and preventing them so readily grinding up into mud.

As a source from which water supplies can be obtained, the gravels are of considerable importance. Until quite recently, the towns of East and West Cowes were wholly supplied by soakage reservoirs in the gravel on the tops of the hills above those towns; while, the houses on the estate of Her Majesty, at Osborne, are supplied from a similar source. It is easily understood, however, that a water supply from the gravel is not to be recommended, for the beds are so porous, that there is great danger of contamination from surface impurities. Many isolated houses in the northern part of the Island derive their supplies from these beds, which, lying as they do on the impervious tertiary clays, act as natural reservoirs for the rainfall, and feed many a small spring and runnel with the iron-stained water. The plateau gravels of the Island have, on several occasions, been the happy hunting ground of our old friend the water diviner, whose task must indeed have been an easy one, with such an essentially water-bearing deposit immediately under his feet!

The sections where the gravels may be examined are very numerous, and it is only necessary to mention some of the

more important. The pits on the summit of St. George's Down have been worked for very many years, and are of very great extent. The gravel is here at its greatest thickness—about 40 feet—and there are plenty of sections in the pits where the deposits may be thoroughly examined. A feature of the beds here is the stratum of conglomerate which forms the basement of the gravel. This is formed by the cementing powers of the iron oxide, and the conglomerate is about two feet thick. It may be seen at the "Dropping Well," and also in the cartway at the eastern end of the down. This "Dropping Well" was visited by the Club, and forms a very admirable illustration of the water-bearing property of the gravel; for the gentle trickle of water flowing out over the basement bed of conglomerate has never been known to fail, even in seasons of protracted drought. We see the same thing too in old disused gravel pits, which nearly always have a pond of water in their lowest hollow.

The plateau gravels can also be examined in cliff and pit sections at Headon Hill, Hamstead, Sticelett, Ruffin's Copse, Parkhurst Forest, Osborne, Lynn Common, Wootton, near Nineham, Westridge, Priory Bay, Bleak Down, and in some places along the cliffs at the southern side of the Island, and other localities.

The chief deposits of valley gravel may be seen in the pits on the Afton Estate, and also at Freshwater Gate; while the Foreland gravels, whether they be classed with the older or newer deposits, are well seen in the cliff sections eastward of Bembridge; also in pit sections at Sandford and Harringford, and at other localities along the course of the Eastern Yar and its present tributaries. It is interesting to note how the present streams in their old age have cut through the deposits formed by them in their vigorous youth, thus leaving the terraces of gravel to shew how great was the work they did in past ages.

From what has been said, it will be admitted that much may be learnt from our gravel deposits. They, indeed, form an eloquent passage in nature's great book. It is to that book that the geologist ever turns with renewed interest, and gathers together the different letters; and from those letters tries to spell out the words which form the story of the past

history of this wonderful world. Even the stones by the wayside have something to tell us of that history—a tale of marvellous change, but not of destruction, wherein all the servant forces of nature have done and are still doing the bidding of their mistress. They are at work now as they have been in the past, and some of nature's great and impressive truths are ever ready to be learnt by those who will give heed to them.

