

FRESHWATER BAY, ISLE OF WIGHT.

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The questions of erosion and denudation must necessarily appeal to and claim a good deal of attention from the geologist who is something more than a mere collector of fossils, and who gives due consideration to the wonderful problems which a thoughtful pursuit of geological studies will certainly present to him if his work in the field be at all extensive. A great deal of the interest in such studies is lost if our work is to end with the acquisition of a number of rock specimens, as we then deal only with effects, and take no heed of the probable causes which, we must assume, have led to those results. We have such a confirmed habit of measuring periods by our own lives, and of looking at nothing beyond the narrow limits of our immediate surroundings, that it is necessary to insist on our taking a less circumscribed view of Nature's work and operations. To human minds the enormous lapse of geological time is beyond understanding; but, after all, there is no reason why our energies should be wasted in a futile effort to grasp mentally that which is admittedly beyond our conception. Of course, we cannot do more than attempt to reconcile probable causes with certain effects, but we can see what is now before us, and, by deductive reasoning, we can try to lift the veil of the long-forgotten past and peep into the secrets of bygone ages. In this pursuit the reflective student will find much to attract and interest him. Let it be understood that there is no reason for assuming that the processes of Nature are carried on more slowly now than in the past, for the forces which are in visible operation at the present time in various parts of the world are quite sufficient to accomplish the stupendous results which geologists see before them, provided that due allowance be made for the inconceivable lapse of geological time.

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Erosion and denudation by the action of rain, wind, frost, rivers, and the sea, have been going on for all time—changing but never destroying the land surface, and resulting in the laying down of fresh sedimentary deposits to form the fossiliferous strata which claim so much attention from the palæontologist. The two most potent agencies are river denudation and sea erosion, but in our present enquiry we shall notice the combined effects produced by all the various forces which have been enumerated. It is advisable in the first instance, however, to consider for a moment the mechanical effect of the sea waves which in stormy weather are hurled on the coast with such stupendous force. It will be noticed that each wave rushes up the beach, and, as its force is expended, retires, to be again followed by other waves. This alternate motion has the effect of grinding together the sand, stones, and pebbles of which the sea beach is composed, and hence is formed the water-worn shingle with which all visitors to the seaside are familiar. Wherever strata are exposed in cliffs they are acted on by wind, rain, and frost, and disintegration takes place, and whenever strata are directly accessible to the sea waves there we find a combination of all the erosive forces in active operation. The particles of matter dislodged from the cliff face fall downwards to the shore, and are there subjected to a mechanical sorting by the waves, the smaller and lighter particles being carried away in suspension, and the harder fragments ground and rolled together to form sand of varying coarseness, while the larger bodies (offering more resistance to the waves) remain at or about high water mark, and there in course of time form those deposits which we know by the general term of a sea beach. The ordinary erosion is so slow that on most coasts the accumulation of shingle is very gradual, but as it acts as an ideal buffer on which the force of the waves is expended, the preservation and conservation of such a beach should be a matter of paramount importance—more especially where the adjoining cliffs are of such a nature as to be easily eroded by direct wave-action. The mistaken policy of allowing interference with, and the promiscuous removal of, the shingle beach is answerable for the serious erosion which is now taking

place at Freshwater Bay, and some account of that district, and of the probable effect of the inroads which the sea is now making there, and the suggested remedies for preventing a continuation of the damage, may be of interest to the members of the Field Club.

There are three rivers in the Island—The Medina, taking its rise near Chale, and flowing in a northerly direction to Newport, and on to Cowes, where it joins the Solent; the Eastern Yar, rising near Niton, and flowing through the valley carved out by it, and in which Godshill and Newchurch stand, and falling into the sea at St. Helens; and the Western Yar. This latter is but a ghost of its former self, being merely a ditch through which very little water now flows; but its former importance is evidenced in many ways, particularly by the wide valley extending northwards from Freshwater Gate and the broad tidal estuary at the mouth of which is situate the old-world town of Yarmouth. The tide does not flow over the southern half of this valley as the embankment near Freshwater Church prevents its so doing, but the whole of the marsh land between the embankment and Freshwater Gate is well below the level of high water of ordinary spring tides. Other streams there are, at Newtown, King's Quay, Wootton, etc., but these do not possess the same interest as do the two Yars and the Medina. The Island is but a fragment of land separated from the adjoining County of Hampshire by the old valley now occupied by the waters of the Solent, but through which in bygone times flowed eastwards an important river draining the southern part of the County of Hampshire. In past times the Island must have been of much greater extent than it is at present, as the erosion along its exposed coasts has been, and is now, continually going on; more especially is this the case along the southern coasts which are open to the direct action of the winds, rains, and seas of the English Channel. Away to the south-east, and also to the south-west, the land in bygone ages extended—a land in which the watersheds of the Eastern and Western Yars were situated. The action of these rivers, then flowing with a full body of water, effected the cutting of gaps between the hills of the central chalk range at Brading and at Freshwater respec-

tively. There is no evidence at all that the sea ever flowed through from Sandown to St. Helens, or from Freshwater to Yarmouth, but, on the contrary, there is ample geological proof that by river action alone these important valleys have been carved out. It is only necessary to point to the composition of their valley gravels in support of this statement. At Freshwater Gate in particular the gravels of the Western Yar are largely composed of the detritus of the lower greensand—the subsoil of the old land which was drained by the Western Yar in the days of its vigorous youth. In the same way the Eastern Yar must have been only a tributary of the much greater river which, rising in the old south-eastern land, cut out the wide valley between Brading and Bembridge Downs, and also the gap in the coast just north of the town of Sandown, and flowed into the Solent at St. Helens, the flat marshy district now known as Sandown Level and Brading Harbour being in reality the tidal estuary of this old river.

The erosion which has gone on for untold centuries, after washing away the lower deposits of greensand of which the south-western land was composed, has made inroads into the western part of the central range of hills, eroding and removing the upper greensand and, to a large extent, the lower chalk, so that we now have a splendid section of the upper chalk extending from Scratchells Bay away towards Compton Bay. The section along the escarpment shews chalk with bands of flint dipping at a high angle to the north. Cutting directly into this line of cliffs, and forming a charmingly picturesque spot, is the inlet which forms the subject of this paper.

Watcombe Bay is a small hollowed recess in the coast—a recess of irregular shape and of great beauty, with its cliffs eroded irregularly, and forming caves and jutting pinnacles of chalk rock. On its eastern side is a headland (on which is constructed a fort), forming the western side of the adjoining inlet known as Freshwater Bay—the distance from the western side of Watcombe Bay to the eastern end of Freshwater Bay being only about two thousand five hundred feet. The geology of these two bays is simple but instructive—the cliffs of Watcombe Bay, and at either side of

Freshwater Bay, shewing chalk with flints; in the latter bay the cliffs have an easy slope upwards from the site of the old bed of the Yar, and shew an extensive capping of valley gravel, brick earth and sands. The chalk with flints is really the lower part of the upper chalk, the basement bed of which is of a much harder nature, and is known as the chalk rock. We find this rock more successfully resisting the erosive forces, and forming isolated blocks and pinnacles at the point below the Redoubt, and also stretching eastward thence in the form of a ledge of weed-covered rocks out to low water mark. A similar ledge of rocks is visible at low tide on the eastern side of the bay, where further isolated masses are recognised in the well-known Stag Rock and the Arched Rock. The centre of the bay is occupied by the alluvial deposits of the old river Yar, capped by a bank of shingle which has been heaped up by the gradual advance of the sea, and this bank protects the low-lying marsh land behind from being flooded at each high tide. On the western side of the bay the capping of pleistocene deposits is neither so extensive nor of such thickness as that on the eastern side, these sands and fine gravels attaining their greatest thickness below the garden of "Glenbrook," where they present a marked contrast to the loose rubbly chalk which they overlie.

The shingle in the bay has been derived from two sources, being composed firstly of waterworn flints washed directly out of the chalk; and secondly of flints, etc., from the capping of valley gravels and pleistocene deposits, and it is apparent that most of the shingle which is now or has at any time been in the bay, has been accumulated by the disintegration of the strata in the immediate locality. An examination of the shore at low water does not furnish any evidence from which one may assume that any great quantity of shingle has been introduced by a movement of the shore deposits along the coast. From this being the case one's common sense would suggest that the conservation and preservation of the shingle beach should have been a matter of the greatest concern to all parties, and that no body or authority having control of the foreshore should have permitted or have been concerned in the removal of the shore deposits under any pretence whatever. So far from this

being the case, in former years the beach at Freshwater Bay seems to have been regarded as a sort of "No-man's-land" from which any person, or public body requiring shingle for any purpose could remove as much of the shore deposits as was required. This was a most short-sighted policy to pursue, and its lamentable results are now apparent. Instead of exercising its prerogative in forbidding any interference with the natural defences of the Bay, the Crown seems to have been the chief participator in the depredations which have taken place, for many hundreds of tons of shingle have from time to time been carted away from the shore for use in the making of concrete in connection with the construction of the various forts and batteries in the Freshwater peninsula. These removals naturally gave rise to some amount of "scouring," and thereupon an esplanade was, some years ago, constructed in front of the shingle bank by the owner of the adjacent land, care being taken (as is generally the case in ill-conceived works of this kind) to thwart Nature as much as possible, and to ignore the fact that a sea-wall built below high water mark greatly increases the scour of the sea. Nature ordains that the coarsest shingle shall lodge at or about the limit of high water, and it is impossible to induce such deposits to remain permanently anywhere else. Local Authorities are not in the habit, however, of putting up with any nonsense of that kind, and having constructed their esplanades below high tide mark they express astonishment that the sea will not allow any beach to accumulate in front of the walls; then groins of divers shapes and sizes are constructed, some shingle and more sand is caught, but the whole arrangement of deposits is hopelessly interfered with, and the beauty of the sea shore is of course entirely destroyed. The esplanade at Freshwater, built on the slope of the beach (the shingle on the spot being of course used for the purpose of making the concrete for the walls), greatly facilitated and increased the erosive power of the heavy swell, which, in times of south or south-west gales, sets in along this part of the coast of the Island. The works consisted of two flat promenades divided by a way left for the purpose of getting boats down to the water. Behind the esplanade is a vacant

plot of land, and again behind this, and at a lower level, is the public highway forming part of what is known as the Military Road. A good deal of shingle has been driven up the boatway, and now forms a beach on the vacant land behind the esplanade.

To the eastward of the esplanade very little interference with the shore has taken place, and we have a line of low chalk cliffs with a capping of gravels, and in front of these cliffs lies all that now remains of the original shingle beach. This accumulation does not however always remain in this position, as, after south-easterly winds have been blowing for some time, it is frequently shifted further along the bay towards the fort. Immediately to the west of the esplanade, and on a projecting piece of land, stands the Albion Hotel, the garden of which has long since been washed away, but the hotel itself has been saved from collapse by the construction of a sea wall, and this has been maintained only by the exercise of constant care and attention. To the westward of the hotel a few groins, of an indifferent character, have been erected, and these have caused a small accumulation of sand. Beyond this as far as the corner of the bay there is practically an entire absence of shore deposits, the floor consisting of chalk *in situ* covered with brown seaweed, and forming ledges dry at low water.

A few years ago, however, a change (which might have been foreseen) of a very disturbing and dangerous nature came over the state of affairs in the bay. A succession of gales caused the undermining and partial collapse of the greater portion of the eastern half of the concrete esplanade, the damage commencing at the end furthest away from the boatway. In succeeding winters the damage was greatly increased, and the underlying earth and shingle being licked out by the sea the greater part of the half of the esplanade collapsed entirely, and the rough masses of concrete now lie strewn about on the foreshore in a state of confusion, which is eloquent of the great lifting power the sea possesses. Some of the masses must weigh many tons, but these have been shifted bodily and hurled about in all directions. The adjoining land having changed hands, and there being no

Local Authority in which the care and responsibility for the up-keep and maintenance of the esplanade was or could be vested, it appears to have been regarded as a case of "what is everybody's business is nobody's business," and nothing was done to stop the demolition of the esplanade, the whole of which is now shewing signs of being in danger of collapsing. I have already suggested that these works were not well conceived, but they arrested for a time the inroads which the sea, after the removal of the greater part of the original shore deposits, would certainly have made, and there can be no question that the esplanade did good service in a way. Now, with the partial demolition of these works, the erosive forces have, during the last two winters, been in full and active operation, and immediately behind the ruins of the promenade a great breach has been made in the cliff of loose chalk and its thick capping of fine sandy gravel. The sea last winter eroded back nearly fifteen feet into the low cliff at this spot, and part of the garden attached to the house known as "Glenbrook" was swept away by the sea. The cliffs below the garden of the Freshwater Hotel, on the western side of the bay, have also shewn signs of being actively eroded, but the "Glenbrook" erosion was that which called attention to the dangerous state of affairs prevailing, as it was obvious to all persons of ordinary intelligence that if the sea continued unchecked to eat into this cliff it would ultimately drive its way into the road behind, and thus flood, at high tide, the whole valley of the Yar, and convert the Freshwater peninsula into a separate island. People taking an alarmist view of the situation pictured the disconnection as being imminent, but it was quite clear, at all events, that the erosion, even if not entailing immediate separation, would, in any case cause considerable damage, and that it would be a much more expensive and difficult matter to deal with later on than now. Urgent representations being made by the people of Freshwater to the Isle of Wight Rural District Council that there was a possibility of the roads in the neighbourhood being damaged, the Council considered the matter, and, at its request, I carefully examined the locality and drew up a report dealing with the whole condition of affairs at the bay from a geological point of view, and

suggested certain remedies for the evil which will, if unchecked, be a very troublesome one to deal with.

In the first place, I came to the conclusion, from a careful examination of the bay, that there was an appreciable danger that the sea might, at some unusually high tide, scour away the crown of the beach at the boatway, and possibly cause the flooding of the road behind; should it do so it would entail a considerable amount of damage to the low-lying properties and houses in the immediate neighbourhood. I believe that it is at the boatway rather than at "Glenbrook" that a breach may be made, and I say this because the "undertow" which accompanies a heavy sea at high water is a dangerous feature; in a confined space like this boatway such an "undertow" might be very destructive, and it is quite likely that it might draw the shingle down and drag away the crown of the beach; this would leave a breach through which the waves at the top of the next tide might pass, and the gap would speedily be dangerously enlarged. To prevent this, the Council have been recommended to raise the roadway so that it should be higher than the crown of the beach at the boatway, and it would also seem desirable that the Council should acquire the vacant plot of land between the esplanade and the road, and treat this land as being an adjunct to the beach, which in reality it is. On this land the shingle and sand, which in times of storm, is often driven up over the esplanade, should be allowed to accumulate and should on no account be removed. The erosion at "Glenbrook" can be materially lessened by stacking up the loose masses of concrete against the base of the cliff here, so as to form a sloping "apron" on which the force of the breaking sea may be expended. It is questionable whether it would not be advisable to demolish the whole of the esplanade, and to use the masses of concrete to form such an "apron" right across the shore in front of the roadway. At present a curious mode of protecting the cliff at "Glenbrook" has been adopted. A number of scaffold poles have been sunk into the talus and then fastened to the cliff by plugs, the poles being kept in position by two sets of timber battens nailed along the line of poles. Behind the poles faggots have been closely packed. This

erection, covering up and concealing the entire cliff, would seem to answer fairly well for the purpose of arresting rain and wind erosion, but it can hardly be relied on as being an efficient sea defence. The rough apron of concrete blocks should materially arrest the inroads of the sea at this point.

These suggested works do not, however, go to the root of the matter, and the only means by which the source of the evil can be dealt with is by taking steps to stop the south-westerly swell from sweeping into the bay. This can be done only by the construction of a breakwater built out on the ledge of rocks below the fort on the western side of the bay. The breakwater should be built of the roughest material (the loose concrete blocks would do well for this purpose), its top should be at the level of high water, and it should run out from the base of the cliff in an east-south-easterly direction to low water mark. Such a breakwater would stop the direct swell; it would materially abate the accompanying "scour," and it would prevent any shingle washed into the bay by a south-easterly storm from being scoured out again. It may be considered that there is no Public Authority in the Island endowed with powers which would enable it to undertake the construction and maintenance of such a breakwater, but I have suggested that the Rural District Council should represent to the Government that the work should be undertaken by the Crown, as Government property is jeopardised through the erosion of the cliff below the fort, and, furthermore, that the Crown, having participated largely in the wholesale removal of shingle from the bay, should take on itself the duty of preventing a continuation of the damage which has ensued from its original wrongful act. It is to be hoped that the Rural District Council will be able to get the Government to appreciate the gravity of the situation, and to understand that the longer the adoption of remedial measures is postponed the more difficult the matter will be to deal with. The Rural District Council has not yet decided in what way the state of affairs at Freshwater Bay can best be remedied, and it will be interesting to note whether the Government will offer or consent to help the Local Authority in any way. It is to be feared that the Crown Authorities will hold themselves aloof, and will declare that it is a matter

which must be settled locally. If this should be so, then there will be delay in dealing with the question, and delay in this case will assuredly prove very expensive and dangerous.

At no place on the coast of the British Isles would it be easy to find a more instructive example of the danger arising from the wanton and thoughtless interference with the natural features of a foreshore than is now to be seen at Freshwater Bay. It is a welcome sign of the times to know, however, that the general questions affecting coast-erosion and sea defences are being taken up and studied in authoritative quarters, and that observations are being made and data collected. The necessity for the protection and conservation of our coast-line is one of national importance, and the intelligent appreciation of the mode in which the forces of Nature operate is one which should be encouraged to the greatest possible extent. The removal of shingle from any part of the coast should be absolutely forbidden, excepting where there is a rapid accretion of shore deposits going on, or where, by the removal of shingle, no accentuation of erosion will be caused. Local Authorities should be most careful to preserve the natural formation of the shingle beaches, and they should understand that the construction of esplanades or other works below high water mark necessarily leads to the scouring away of the beach, and nearly always entails results which are most undesirable. With the careful study of the subjects of coast-erosion and the formation and arrangement of shore deposits, it may be hoped that Nature will not be so often defied, and that future generations will not be called on to remedy our mistakes, as we have, at the present time, to deplore and rectify those of our predecessors.

POSTSCRIPT :—The Manuscript of the foregoing paper was sent to the Editor on the 5th December, 1904. A succession of gales from the southward has recently been experienced, causing a large breach to be made in the western portion of the esplanade and entailing the partial foundering of that structure. A heavy gale blew on Wednesday, the 15th March, 1905, and at high tide great quantities of sea water were hurled through the breach in the esplanade and over the adjoining land and roadway and into the marsh land, causing considerable injury, more especially at the sewerage ejector station. Fortunately this gale blew at a period of neap tides, otherwise greater damage would doubtless have ensued. One may anticipate that, with a southerly gale blowing at a period of spring tides, the breach in the esplanade will be enlarged and that all the low-lying properties and land as far north as the embankment at the head of the tidal estuary will be flooded at high water, and that great damage will be done.—G. W. C., 28th March, 1905.