HAMPSHIRE MUDLANDS AND OTHER ALLUVIUMS.

By T. W. Shore, F.G.S., F.C.S.

As we look at the mudlands along Southampton Water and other parts of the Hampshire coast, they appear at first sight to be areas devoid of interest. Most people are glad to see as little of them as possible, and welcome the returning tide which hides them from their sight and gives the landscape a more pleasing appearance. If, however, we observe these areas of mud more closely, they will present to us a miniature geological picture, for they are not great extents of perfectly flat mud, but are intersected by numerous channels, some of the largest of which, called "lakes," are sufficiently large and deep to have water in them at low ebbs. There are also other smaller channels which extend from the larger ones over the mud in all directions. These channels are the water courses by which, at the ebb of the tide, water drains off the surface of the mud, and by which the rain, when it falls upon them, also runs away.

The channels are formed by the erosive action of the streamlets on the soft mud, and illustrate the same geological action as that which rain and rivers exert on all the land surfaces of the county. The difference is merely one of degree and time, for if the mudlands could be artificially levelled, the miniature valleys in them would be again formed by the streamlets after a few tides, while the hills and land surfaces of the county have been gradually wearing away, and the valleys have been in process of formation from similar causes, for as long a time as Hampshire has been above the sea. As Tennyson says:—

> The hills are shadows, and they flow,
> From form to form, and nothing stands,
> They melt like mist, the solid lands
> Like clouds, they shape themselves and go.

The mudlands and other alluviums may consequently be regarded as a complement to our valley scenery, for as these valleys have been formed by the action of water, we may see in the mudlands and marshes some of the accumulated detritus of the waste of the hills and the erosion of the valleys by that long continued action, a small part indeed of that detritus, for the greater part of it has been carried out to sea.

Most of the streams in Hampshire have their origin in the chalk, and are only discoloured after much rain, when the parting of the waters is a phenomenon which may be seen in the upper part of Southampton Water in calm weather, while the Test and Itchen are discoloured by suspended muddy matter.

Under such circumstances, as the tide flows up the main channels the discoloured river water may be seen spreading over the mudlands, while the salt water is in the channels.

Fresh water, even with the fine sediment it brings down, is lighter than salt water, and hence the flow of discoloured water which the rivers bring down into the tidal water, instead of falling beneath the water into which it flows, and depositing the mud at the bottom, as is usually the case in fresh water lakes, is spread out over the mudlands in calm weather, or is carried seawards on the surface of the sea water.

This helps to explain the existence of wide areas of mudland in the estuaries of the Test and Itchen on both sides of a deep tidal channel.

Owing to the friction of the water on the mud, its outflow is not so rapid over the shallow mudlands as it is in the deep channels, and consequently as the water stops longer over the banks the sediment has more time to settle. The newly-deposited sediment is, however, subjected to the denuding action of rain, while the mudlands are above the water and exposed to its effects, so that fine sediment is not only gradually deposited but also gradually removed. At the upper part of Southampton Water the mud forms a spit between Redbridge Channel, which is the course of the Test, and a lesser water way known as Eling Channel. Between the channel and the shore opposite Millbrook old church the mud is about half a mile wide. It is about two-thirds of a

mile in width opposite Blechynden, and also on the opposite side of the river between the Gymp Channel and Dibden Beach. From Dibden to Fawley it is from a half to two-thirds of a mile in width. At Ower Lake, inside Calshot, it widens to about three-quarters of a mile across.

The mud is unusually thick off Fawley, where the great mud bank is called by local fishermen the "garry ground." Mr. Burbage, the Harbour Master at Southampton, has informed me that the chain of the harbour buoy on this bank close to Dean Lake has had to be lengthened three times, owing to the sinking of the mooring stone in the mud, and the chain is now 25-ft. long.

The widest mud banks on the east side of Southampton Water are at the mouth of the Itchen, opposite Hythe, and at the mouth of the Hamble, where the bank, known as Hamble Spit, stretches out for about four-fifths of a mile from the land.

From the mouth of the Itchen to Hamble the mud-bank varies in width from a half to one-third of a mile, and below Hamble to Hill Head from one-third to one-sixth of a mile.

The beach eastward of Hill Head, under the cliffs of Stubbington and Stokes Bay, is of a different character from that along the north of the Solent west of Calshot.

There is a wide extent of mudland extending from Hurst Castle along the Hampshire coast eastward. Between the Castle and the coast it is about a mile wide, and from Hurst eastward, about two-thirds of a mile in width, as far as the mouth of Lymington River, where it is about a mile wide on each side of that channel. Further eastward, it is half a mile wide at Tanners Lake, but much narrower near Sowley. Beyond Needs Ore Point, at the mouth of Beaulieu River, the mud is about half a mile across on each side of the river channel. Near Stone Point, and in Stanswood Bay, there is less of it, but a deposit containing more sand exists about half a mile wide south of Calshot. The channels through the mud along this coast from Hurst to Needs Ore Point, are Danes Stream, flowing from Milford into Mount Lake, near Hurst Bank, Pennington Lake, Oxey Lake, Long Reach, the channel of Lymington River, Pylewell Lake, Tanners Lake, and Pitts Deep Lake. Some black oak and other indications

of bog and land growth have been found beneath the mud in Pylewell Lake, and probably peat exists below the mud more or less all along this coast.

The mud banks near Hurst Castle, Needs Ore Point and Calshot, have been preserved to a great extent from marine action by the shingle banks which exist at these places. Shingle travels along the Hampshire coast from west to east, as is shown by the way in which it moves over the groins which have been made at various places to protect the beach. It has been noticed when a groin has been made that the shingle accumulates on its western side until it rises high enough for the gravel and pebbles to pass over it and move on to the eastward.

One of the largest areas of mudland along the coast is that just eastward of Hurst Shinglebank. This bank is about 70 yards wide and ten feet above high water, presenting an incline plane to the westward. It consists mainly of rounded chalk flints resting on a submarine base of clay, which probably was a cause of its original formation. The protection which this shinglebank affords to the mudland on the east of it is well seen by comparing the sea beach west of the bank with the mudlands on the east. This great mudland must be as old as Hurst Shinglebank. The sea in its long continued action of erosion in Christchurch Bay has entirely swept away any alluviums which at a remote time the River Avon probably formed, before the time when the barrier between the Needles and Hengistbury Head or the coast of Dorsetshire was eroded. This inroad of the sea, into what is now called Christchurch Bay, must have occurred at a very distant time, although geologically speaking comparatively recent. The mouth of the largest Hampshire river has no alluviums now, but we have only to look at the great marshes of the Avon higher up, near Fordingbridge and Ringwood, to realise the probability, that before the erosion of the barrier referred to the river had also other alluviums lower down, near its present mouth, which have since been swept away by the sea. During calm weather, at certain states of the tide, the fresh water of the Avon may be observed near the cliffs in Christchurch Bay upon the salt water, and moving eastward as far as Barton Court, four miles from the mouth of the river.

Perhaps that great subsidence which occurred along the Hampshire coast when the peat now found beneath the mudland was submerged, was also concerned with the inroad of the sea into Christchurch Bay or some part of it.

Hurst Shinglebank is mainly formed of gravel and pebbles from the waste of the cliffs in this bay.

A great accumulation of mud exists near another shinglebank at the mouth of the Ex or Beaulieu River, more than is found either eastward or westward of it. This accumulation of shingle at Needs Ore appears to have been favourable to the accumulation of the mud there.

In the same way the shinglebank at Calshot, although it has at times been breached by the sea, has been favourable to the accumulation of mud north of it in Southampton Water.

The marine alluviums and salt marshes of the Isle of Wight occur along its northern shore, its rocky coast on the south being swept by the sea. Part of the extensive mudbanks of Portsmouth and Langstone Harbours have resulted from more recent subsidences than those which submerged the river marshes in the neighbourhood of Southampton.

In Portsmouth Harbour the main water channels lead to Porchester, and to Fareham, and there is a lesser channel on the north of Horsea Island. Wide extents of mud lie between and near these channels.

In Langstone Harbour the chief channels are Langstone Channel, Broom Channel, and Broad Lake, south west of Havant and Langstone. The water course across which the bridges into Hayling Island are built is known as Sweare Deep, and connects Langstone Harbour with Emsworth Channel in Chichester Harbour. Emsworth Channel is the county boundary, and the chief mudland inlets into it from Hayling Island on the Hampshire side are Sinah Lake, and the Mill Rithe, which is a flow of water through the mud from the tidal mill pond there.

Some large muddy inlets or creeks exist on the west side of Portsmouth Harbour, and are known as Forton Lake, Haslar Lake, and Stokes Lake.

The mud which was removed in making the Empress Dock at Southampton showed that its character was some-

what changed the deeper it extended. At a depth of twelve feet or more below the surface it became dark bluish in colour and sticky like plastic clay.

Wherever any considerable excavations have been made in the tidal mudlands, peat has been found lying beneath it, usually resting on beds of gravel, and in some instances lying between ridges of it. Several subsidences or inroads of the sea which can be traced, or of which we have historic record, have occurred along the Hampshire coast.

As far as I know, no articles of the Bronze Age have been found in the peat below the mud in Southampton Water or elsewhere along this coast; but a fine stone hammer head,[1] of the Neolithic or Newer Stone Age was found, with worked articles of bone. These articles were discovered embedded in the tufa and the peat below the tidal mud. A bronze spear head has been found in the more recent river gravel at St. Denys. A subsidence certainly took place after the growth of the peat which is now below the mud, and the discovery of the Neolithic implement and the negative evidence of the absence of bronze articles point to that subsidence as having occurred during the Neolothic Age and before the Bronze period, the beginning of which in Britain has been assigned by Sir John Evans at about 1400 or 1200 B.C. It certainly occurred after the district was inhabited by the extinct species of bos, the red deer, the wild boar, and the small species of horse. If in the future bronze implements should be found in the peat below the tidal mud the date of this subsidence will have to be placed later. From the evidence at present available it appears to have occurred during the Neolithic Age, when the long skulled people of the Iberic race, who constructed the long barrows, lived in this part of England.

An inundation of the sea and great destruction is said to have occurred near Southampton during the Romano-British period about A.D., 419.

A considerable submergence of the land or inroad of the sea can be traced on the south east of Hampshire in the eleventh century, when the ancient site of Selsea was submerged. Off

[1] Engraved in Vol. 1, Part 3, of the Papers and Proceedings of the Hampshire Field Club.

the south coast of Hayling is a site known as "Church rocks," supposed to be the site of the Saxon church of that island, and from which an old font, now preserved in South Hayling church, and apparently of Saxon work, was dredged up.

In the fourteenth century an encroachment of the sea or subsidence occurred on the south eastern part of the Hampshire coast. The Prior of Hayling presented a petition to the Crown concerning the inundated land there. An inquisition was ordered to be held in 18th Edward II., 1324-5, to ascertain the truth of this, and a report was made that 206 acres of pasture and 80 acres of arable land were submerged, comprising nearly all the hamlet of Estoke and part of the hamlet of Northwood.[1] These submerged acres, anciently called the Manwode, now lie beneath the mudland in Chichester Harbour, between Emsworth Channel on the east and the present limits of Hayling Island on the west.

Between 1290 and 1341, when an inquisition was held at Winchester, the sea had also encroached on 50 acres of arable land at Alverstoke.

At the time of the Domesday Survey Hugh de Port held a manor called Aplestede in Portsdown Hundred. This manor is supposed to have been situated on the west side of Portsmouth Harbour, as it was in the eleventh century, and that part of it appears to have been submerged in the middle ages and now lies beneath the mudland on the west side of the harbour.

The growth of peat is closely connected with the deposit of alluvium. Peat is found in the marshes along the courses of the Hampshire rivers, and also beneath the mud of Southampton Water and other parts of the coast. As it must have grown above the water, its occurrence beneath the mud shows that these areas, while it grew, must have been at a higher level.

During the progress of the dock excavation at Southampton it was met with at varying depths, some of the beds being 50-ft. below the level of the water at high tide. This shows that a considerable subsidence, apparently a gradual one, took place. What is now a tidal mudland must have

[1] See Nonæ Rolls, 19, Edward III., and Extents of the Alien Priories in the office of the King's Remembrancer of the Exchequer.

been an alluvial marsh, like the marshes higher up the rivers, while the peat plants were growing, and after the land subsided, the tidal river in Southampton Water cut a wider and a deeper channel for itself, and the mud over the peat was deposited.

The subsidence must have occurred since man settled in this neighbourhood. Our earliest predecessors in South Hampshire must have wandered over the marshes to the water meeting, to that remarkable spot, the site of the entrance to the Empress Dock, where the two rivers meet, and there in the marsh, unfortunately for themselves, but fortunately for our knowledge, they lost some of their tools in the peat bog.

Some of the animals which lived in the neighbourhood at that time, the Bos primigenius, Bos longifrons, the wild boar, the small horse, the red deer, lost their lives by being mired in the same bog, and some of their bones are now exhibited in the Hartley Museum.

The examination of any thick section of a peat bog shows that its surface is covered with living plants. A few inches below the surface a brown spongy mass, consisting of fibres of the dead plants, occurs. Below this is a compacted brown mass in which the vegetable tissue gradually disappears, and if the bed is very thick that at the bottom has commonly a black appearance, and shows no remains of vegetable structure.

Peat was formerly dug in the north-east of Hampshire, on the commons of Cove, Farnborough, and Aldershot. That which was dug at Cove was in demand at the beginning of the present century for burning the coarse pottery which was made there, as well as for fuel.

It was also dug rather extensively for fuel in the valley of the Itchen, in the New Forest, and in the valley of the Test, near Longstock and Stockbridge. The name of the peat pits still survives at Longstock, and the sign of an inn there still bears the significant name of "The Peat Spade."

Peat was dug on an extensive moor south-east of Bishopstoke, where a large quantity of it was raised for fuel in the neighbourhood, until within the last 50 years. Peat was commonly burnt in many old Hampshire cottages within the

last half century. In the middle ages it was doubtless more extensively used for fuel than in the centuries nearer our own time. We know what its value was in Hampshire about 650 years ago, for there is documentary evidence to show that in the year 1248, 2,600 peats brought from Bramshete Móor, near Crondall, cost 3s. 4d.

The most compressed bed of peat in Hampshire is that which underlies the lower part of the City of Winchester. By the weight of the material which has been placed on it since the first use of this site for human habitations, and by the increasing pressure on the superincumbent layers, from the *débris* of old buildings and the weight of new ones, the peat has been so pressed as to have become in many spots impervious to water. This compressed peat layer prevents the water rising through it from below, if it is not cut through.

A small peat bog of much interest was formerly to be seen at Bournemouth, where the bourn entered the sea. In 1831, peat with the wood of fir embedded in it, occurred for 50 yards along the shore and between it and a sandbank about 200 yards out. This submarine peat was in a direct line with the valley of the bourn, along which was much boggy and heathy ground. One of the trunks of fir found in this peat showed seventy-six rings of annual growth. This peat rested on a bed of gravel and pebbles, and Sir Charles Lyell was of opinion that it became submerged through the action of the stream on the sand beneath the gravel, assisted by the sea water at the ebb of the tide, which caused the superstatum of vegetable matter above, matted and bound together, to become undermined and so to sink below the level of the sea, after which the waves washed sand and shingle over it. Peat on gravel is the usual substratum of the marshes in all the Hampshire river valleys, and the tufa or shell marl which occurs among it, and which was formerly dug for agricultural purposes, was known a century ago by the names of white malm and black malm, according to whether it was a pure calcareous tufa, or much mixed with peaty matter. The soil of the marshes above the peat commonly contains fine mud which has been deposited during land floods after much rain.

The growth of peat is one of the most interesting subjects connected with the alluviums. The chief peat forming plants

of this county are the bog mosses (various species of Sphagnaceæ), the bullrush (Scirpus lacustris), the common sedges and other species or varieties of carex, the bog myrtle (Myrica gale), the willow herb (Epilobium angustifolium), heath (Erica), and cotton grass (Eriphorum). The compressed bog rush (Blyssmus compressus), Cladium mariscus, Hynum cuspidatum, and other plants, also occur in the Hampshire bogs. Bog moss has the property of throwing up new shoots in its upper part, while its lower extremities are decaying. In addition to these plants there are others, such as rushes and water lilies, which grow in marshy pools and assist in the spread of vegetation over the pools or shallow ponds. These aquatic plants may in some places be observed to accumulate mud and decayed vegetation about their roots, upon which the bog plants finally advance, and so a growth of peat gradually extends over the pools of a marsh.

The trees which are commonly found imbedded in the peat of Hampshire are the oak, stained dark in colour and known as bog oak, the white beach (Betula alba), the hazel, and pine. Fir cones, hazel nuts, and acorn cups are commonly found well preserved. The occurrence of trees *in situ* in the peat shows that there must have been pauses in the growth of the bog sufficiently long for the trees to have been enabled to grow.

The rhizomes of some ferns have also been detected in the peat, such as that of the common bracken (Pteris aquilina), and the royal fern (Osmunda regalis).

Some accumulations of decayed vegetable matter, which may be observed in the alluviums along the courses of some of the smaller streams, are caused partly by the annual fall of the leaf; for layers of decomposed leaves and small twigs of trees covered over with mud brought down by the streams, occur in places.

The greatest thickness of peat observed in the Southampton Dock excavation was that which was found near the junction of the rivers, close to the entrance of the new dock. The greatest thickness of peaty alluvium which has been recorded in the Hampshire valleys is that near Michelmersh and Mottisfont, where the Test is joined by the Dean stream from the west, and where it was necessary to drive piles into it for

nearly forty feet before a sufficient support could be obtained for the railway which is there carried over the marsh.

The origin of the shell marl or tufa which occurs beneath the mudlands and in the marshes along the courses of the rivers in Hampshire and the Isle of Wight is probably not due to any one cause alone. Some of this tufa contains no shells, but appears to be concretions of amorphous carbonate of lime. Other specimens of the marl are full of shells. This fresh water formation may have had its origin in some instance mainly from chemical, in others mainly from organic, causes, and in others from both sets of circumstances combined.

The evaporation of hard chalk water from the shallow pools on the surface of a marsh in hot weather when the water in the pools is calm, will, if the carbonate of lime is abundant, cause some of it to form concretionary little masses round vegetable particles in the bottom of the pool. The prolonged exposure of such water to air, and especially to sunshine, deprives it of its excess of carbonic acid, and by the removal of this gas the insoluble carbonate of lime separates from the water and so produces a deposit of particles of marl.

Fresh water shell mollusca abound most where the materials for the construction of their shells, as well as the food they require, are best supplied. This is usually the case in pools and ditches whose water is highly charged with carbonate of lime, from which the mollusca can extract what they require from the water, and there these shells accumulate and form shell marl. Such water also commonly contains infusoria, and the fine chalky mud at the bottom of the pools commonly contains minute forms of animal life.

In the Avon valley an extensive formation of tufa is found between Bickton and the mill at Fordingbridge, and another occurs in the upper Test valley, a little north of Fullerton railway station.

Its occurrence in knolls or patches above the surrounding marshes along the courses of the Hampshire rivers, leads to the important consideration of the present height of these marshes in comparison with their former levels. This tufa was formed by organic and chemical agencies in water. It could not have been formed above the water where we now find it, elevated some feet above the level of the marsh.

The sections of old peat exposed in the Southampton Dock excavation showed examples of tufa imbedded in and covered by peat, so that after its formation the peat must have spread over it. Its occurrence in the Itchen and Test valleys some feet above the level of the marshes points to the sinking or compression of these alluviums.

The sinking of a marsh may be caused in several ways, such as by the removal of some old obstruction to the water lower down, its drainage by artificial channels causing greater dryness and the compression of the peat, the denudation of the surface of the marsh itself by the action of rain and flowing water, after the removal of some old obstruction, and perhaps also by the continued erosion of the bottom of the valley on which it rests through the flow of water beneath the boggy matter, such as was seen in the Itchen valley above Shawford, when the foundations for the railway viaduct were made there.

The largest marsh and pond alluviums are the result of the action of rivers, but smaller ones may be formed by lesser streams.

The geological student may find in Hampshire many illustrative examples of the relation which ponds and marshes bear to the courses of rivers and streams. A marsh, pond, or lake, occurs on a stream course where some obstruction to the flow of water exists: if a ridge of rock, harder than that in its vicinity, stretches across a river valley, it commonly forms such an obstruction, and causes the stream to rise in a pond until the water is high enough to flow over it. A slight obstruction may also cause an accumulation of river gravel. These impediments to the flow of the water in the Hampshire streams are, owing to the usual soft character of the Cretaceous and Tertiary beds which occur in this county, only slight obstructions now. It is probable that some of them were formerly higher, that the ponds and marshes were more extensive, and that these areas have been partly drained by the natural obstructions having been worn down in the course of time, or artificially removed; consequently the Hampshire ponds are comparatively shallow ponds.

A pond or lake may have many inflowing streams, but it can only have one outlet, viz.: where the water flows over

the obstruction. This general character of lakes was clearly shown by the late Colonel George Greenwood,[1] a close observer of Nature, and a resident in this county, whose grave, appropriately marked by a greywether sandstone, may be seen in the churchyard of Hinton Ampner.

The deposit of mud in a pond or marsh is the means by which Nature enables the stream to form an alluvium, which raises its bed and enables it to flow over the obstruction.

This silting process is assisted by the growth of peat and the general formation of marshes, many of whose sites along the courses of our streams mark the situations of former ponds.

The sites of the natural obstructions to the uniform flow of water in the Hampshire streams and rivers, may be commonly observed where the valleys are narrower than elsewhere. One of the best examples of this may be seen in the Test valley at Fullerton, where the valley becomes contracted, and the stream has a more rapid flow. Extensive marshes occur above this site, and also below it, and perhaps the removal of the obstruction here was assisted by artificial means.

When the Roman road was made from Cirencester to Winchester, which crossed the Test a mile above the village of Wherwell at a place formerly known as Welford, the Roman engineers who were skilled in draining marshes, probably made their ford more secure, by removing some obstruction to the flow of the water lower down the stream.

The sites of former shallow ponds or marshes may be observed along the courses of many of the smaller streams in this county. Such sites consist of flat coarse meadow land, where rushes, sedges, and other marsh plants still grow. The drainage of these alluviums has been commonly brought about by the removal of obstructions to the flow of the water.

Economic changes which have led to the disuse of the majority of the ancient corn mills in Hampshire, combined with the accumulation of mud in the mill ponds, have caused the sites of many mill ponds to become partly or wholly obliterated.

At the time of the Domesday Survey two hundred and ninety eight mills existed on the mainland of Hampshire,

[1] Rain and Rivers, by Colonel George Greenwood.

and thirty-three in the Isle of Wight.[1] The mills on the rivers, where the flow of water is constant and abundant, required no ponds, but on the smaller streams, and especially in the upper courses, these ponds for the accumulation of the water, such as may be seen at the present time at East Meon, were necessary. The occurrence of patches of alluvium here and there along the courses of these smaller streams, still indicate the old mill sites. In some instances however, where the mill itself and the barrier which held back the water have been removed, the alluvium which the stream deposited has been removed again by it, assisted by the action of rain, for all ponds, unless the mud on them is periodically removed, undergo two changes by the natural action of the stream: 1. The bottom of the pond is raised by the accumulation of mud; and 2. The surface of the water is lowered and the mud is gradually removed by the stream after the erosion of its barrier.

The natural barriers to the flow of water form a very interesting subject of study in connexion with the physical geology of our Hampshire valleys, for they show us that although water cannot flow uphill, it can by ponding, cut channels through opposing ridges, and if these ridges were higher it could by forming larger and deeper ponds cut channels through hills.

As Goethe, translated, says—

> "Water, its living strength first shows,
> When obstacles its course oppose."

In addition to the permanent ponds there are in this county many sites, marked by patches of alluvium, which are occasional ponds, where the water accumulates and remains until it is absorbed by the porous strata beneath.

One pond, if not more, in Hampshire is a receptacle for the accumulation of a deposit of more than ordinary interest, *i.e.*, an ochreous mud which is found in the bottom of a pond near Liphook, and which is locally used by painters as a pigment. A sample of this was sent to me in May, 1891, by Mr. J. Peake, of Liphook. Its ferruginous matter was found to consist of peroxide of iron, $Fe_2 O_3$, and the tetroxide, $Fe_3 O_4$

[1] See Paper by the author on Ancient Mills of Hampshire, in The Antiquary, August, 1891. No. 20, New Series.

The brown coloured water which is commonly seen in the New Forest streams is derived from the peaty beds from which many of the forest streams flow. Some names of streams have been derived from from the colour peat has given to them, such as the Darkwater stream in the New Forest, and the Blackwater in the north of the county.

In some of the bottoms or valleys of the New Forest there is a thickness of bog sufficient to make such places dangerous to cattle. These deep bogs may in some instances have been partly brought about by water causing the lower stratum of peaty matter to slide down from the higher ground close by. The great thickness of boggy matter near Mottisfont, and at the junction of the rivers in Southampton dock excavation, may have also been partly caused by the action of water in moving some of the beds of peat.

One of the largest New Forest bogs is that known as Denny Bog, or the Bishop's Purlieu. The long continued flow of water from this bog in a dry season, is due to its great size and consequently its water holding capacity. A similar bog exists at Matley, near Lyndhurst, another near Emery Down, and others in various parts of the forest.

Such bogs as these are dangerous to cross after much rain when they become saturated and swollen, and cattle are frequently mired and lost in them. In such cases they sink into the bog and perish.

The bones which have been found so well preserved in many beds of peat in this county, are for the most part the remains of animals which have been mired in ancient bogs.

The Hampshire alluviums, and especially its beds of peat, may be regarded as natural museums, where the remains of many land animals, which have long since ceased to live in this part of Britain, have been preserved, and where numerous relics of pre-historic ages, as well as those of Roman, Saxon, and later medieval time, which were lost in them, have been safely kept and handed down to us. The humic acid in peat preserves animal and vegetable substances imbedded in them.

As previously mentioned, the remains of Bos primigenius, Bos longifrons, (the Celtic shorthorn), Cervus elaphus (the red deer), the tusks of the wild boar, and the bones of a small

species of horse, of about the size of the New Forest ponies, were found in the dock excavation at Southampton.

Similar remains of extinct species of the ox family, and of the red deer, were found during the excavations for the foundations of railway bridges, near King's Worthy and Titchfield.

The remains of the beaver have been found in the peat beds at Nursling and Romsey.

Stone implements of the Neolithic age have been found in alluviums at Southampton, Nursling, Freemantle, St. Mary Bourn, and other parts of the county.

Remains of the Bronze Age have been found in alluviums at St. Denys, Eastleigh, Romsey, Sheet, near Petersfield, in the peat at Bellingham, I.W., and in other parts of the county.

Parts of amphora and other Roman remains have been dredged from beneath the mud in Portsmouth Harbour and Southampton Water. Pieces of Samian ware were found in the alluvium near Titchfield and Badnam's Creek, Bursledon, when the Netley and Fareham railway was being made.

A remarkable pig of lead of Roman date, inscribed with the name of the Emperor Nero, and which is now preserved in the British Museum, was found in a marsh near Broughton.

The remains of an ancient British canoe[1] were found embedded beneath six feet of mud in the Hamble River at Fairthorn, and lower down the same river the keel and some other parts of an ancient Danish galley lie beneath the mud at Swanwick. The remains of another ancient ship believed to have been Danish were found beneath the mud at Southampton in 1849.

Many relics of the middle ages have also been found in the marshes, peat beds, and other alluviums along the courses of the Rivers Itchen and Test.

The most extensive reclamation of a mudland for the purposes of agriculture which has been effected in this county is that of Brading Harbour. A part of this extensive tidal area was recovered as long ago as the time of Edward I. An attempt was made to reclaim another part of it in 1562,

[1] Engraved in Vol. 1, Part 3, of the Papers and Proceedings of the Hampshire Field Club.

and in the 17th century the reclamation of the entire harbour was undertaken by Sir Hugh Middleton, but his work was destroyed by the sea. The final reclamation of this harbour was commenced in 1876 under the direction of the late Mr. Richard Boxall-Grantham, who assisted Brunel in making the Great Western Railway, and under his superintendence Brading Harbour has become valuable alluvial pasture land.

The reclamation of the salt marsh at Southampton was accomplished at about the time when the docks were made. The level of the old salt marsh may still be seen in the patch of low lying land near the Sailors' Home and on the north of Canute Road. Water still finds its way into the basements of houses on this old sea marsh at high spring tides.

Yarmouth marshes were embanked by Sir R. Holmes in the 17th century.

Other sea marshes have been reclaimed at Lepe, in Titchfield Harbour, at Hook, Dibden, Farlington, and many other places along the coast, and in many instances these reclamations have been assisted by the protection from marine currents which has been afforded by the gradual accumulation of shingle banks.

The reclamation of the marsh at Lymington was effected through the construction of the bridge and causeway there, by which the tidal water was kept out. This reclamation was effected at the expense of the harbour, which has since had a less depth of water, owing to the accumulation of the mud, arising from the diminished scour at the ebb of the tide.

The tidal water of the Itchen in ancient times flowed up as far as Mansbridge, and the reclaimed marsh there may be seen on the east side of the canal between that place and Wood Mill.

The construction of the ancient causeway and bridge at Redbridge must have assisted in the reclamation of the marshes above that roadway.

The latest reclamation of mudland in the neighbourhood of Southampton is that which has been effected in recent years between Bevois Valley and the railway embankment from Northam to St. Denys. This alluvium, which was formerly washed by the sea, is now cultivated ground.

All these reclamations in Southampton Water and its branches have, like the reclamation at Lymington, probably been effected at the expense of an additional accumulation of mud, for it appears to be a general experience that if the area of the tidal water is diminished, the scour produced by the outflowing water is lessened, and consequently less mud is carried out to sea. Although the rivers and the larger streams are the channels by which detritus from the hills and higher parts of the county is conveyed to the sea, it is rain and the temporary streamlets it forms, which washes the detritus down the sides of the valleys into the permanent streams and rivers. A great part of the mud and loose detritus which rain so largely helps to produce from the decomposed rocks, does not quickly reach the rivers, but remains on the surface of the ground in the form of soil.

If we examine any part of the cultivated surface of Hampshire during the winter or early spring, after the land has been ploughed, we cannot fail to observe that the thickest accumulation of soil is in the bottoms of the little valleys which occur in many large fields, or at the lower parts of other sloping fields, where it will often be found to have been arrested in its progress by an ancient hedgerow, which has formed a transverse bank of earth. This accumulation of rainwash on the lower levels of arable land, although not an alluvium in its ordinary sense, is an accumulation of muddy detritus on its way to the sea. Such names also as Deluge Hill, near Crawley, and Whiteflood Farm, near Longwood, where no permanent streams exist, tell their own story.

Some small patches of boggy alluviums are often met with on the higher slopes of the valleys, near small land or surface springs, whose water, except after much rain, is chiefly absorbed by the boggy matter, and given off by evaporation.

Some other interesting patches of alluvium occur on the sites of many swallow holes, and in little combes, into which water flows in wet seasons, where it is absorbed by the chalk, the mud being left behind. There it forms an alluvial deposit, which is marked by the growth of rank vegetation, and plants natural to such situations.

The old canals which formerly existed between Winchester and Southampton in the Itchen valley, and between Andover

and Southampton in the valley of the Test, must have helped to carry off some of the water from the marshes along these rivers, and consequently have assisted in draining them.

We have no statistical information concerning the prevalence in olden time of ague, malaria and other diseases arising from excessive humidity, but it is well known that these diseases were formerly more prevalent, and that their diminution must be largely ascribed to the better drainage of the land.

The marine mudlands have had some connexion with several industries. Some of the mud has been used in the manufacture of cement. Formerly, the plants Salsola kali, the prickly saltwort, and Salicornia herbacea, the jointed glasswort, which grow on the mudlands and whose ashes contain much soda, were collected for use in the manufacture of glass.

In addition to the peat and malm which were obtained from them, and in addition to the pasturage they afforded in dry seasons, the marshes also had other economic uses. In ancient time rushes were in demand for the floors of houses, and these as well as sedges were gathered and plaited into mats. Flag baskets also were, and still are, made of the same materials in some parts of the county. As far back as Saxon time the supply of rushes for the floors of houses at certain seasons, was one of the minor services to which the inferior tenants of a manor were in some places liable by custom. Thus the men of Portswood were required in Norman time by a custom ancient at that date, to carry rushes to the house of the Reeve of Hampton on Easter Eve and the vigils of the other chief festivals.

It is worthy of note that the marsh names of three races of ancient inhabitants of Hampshire have come down to us. The common word marsh is derived from the Anglo Saxon 'mersc'; while the word 'rhuime,' the Cymric word for marsh, occurs in the place names Romsey, and Rumbridge, and the Gaelic word 'eannagh,' a marsh, occurs in Anna the name of a marshy district near Andover, mentioned under that name in Domesday Book.

When we survey any of the Hampshire mudlands, or other muddy alluviums, we should remember that mud is not a

useless but a very useful commodity, for without mud in its widest sense there could be no support for human life. Food stuffs of every kind are raised on soils which have been partly formed by mud. The soils of deltas and other deposits of river mud are the richest in the world. The Hampshire valleys contain examples of such rich alluvial soils, as for example that which is found in the valley of the Rother near Petersfield, on whose pasture poor cattle will fatten in a few months. Marshes would be useless as pasturages without mud which accumulates above the peat.

Where no mud exists or can be made to exist, there is a waste. The gravelly heaths and sandy wastes of the New Forest and some other parts of the county, such as those sandy areas near Kingsley and Headley, are without a soil such as rainwash and mud forms, and these wastes have consequently little or no agricultural value.

Mud must, therefore, be recognised as a main cause in the formation of soils, and consequently of the fertility of the hill slopes and valleys of our county. Where this mud has been washed away from the slopes of the chalk hills, as has been the case in some places, in which large fields have been formed by grubbing up the old hedgerows, formed by the wisdom of our ancestors, and which helped to keep the soil from being removed, there the bare chalk has again been exposed to view. The mud produced by rainwash has been of far greater value to Hampshire than all the mineral substances which have ever been dug out of its strata. This rain washed mud, assisted by other agencies concerned in the formation of soils, has been the making of Hampshire as an agricultural county.

In the soils of the upper parts of our hill slopes, we may see the coarse muddy detritus in its first and highest resting places. In the marine mudlands we may view it in its finer condition, and in its lowest and last resting place, until some unusual tide or current carries it away into the sea for ever.