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**A description of the principal picturesque beauties, antiquities, and geological phenomena, of the Isle of Wight**

**Englefield, Henry Charles**

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Letter XII. Freshwater formation.

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## LETTER XII.

FRESHWATER FORMATION.

DEAR SIR,

*Isle of Wight, February 11, 1813.*

YOU will, no doubt, be a little surprised at receiving a letter from me, dated from this place, and at this season of the year. But I could not resist the pleasure of communicating to you an account of the discoveries I have been making here, and the occasion which led to them.

I mentioned in my last letter on the subject of the Isle of Wight, the opinion which I entertained, that the north side of the island, consisting of a series of horizontal strata, had been deposited in an immense basin; and that it was not an improbable circumstance, since they were of later formation than the chalk, that they might be found to correspond with some of those in the basin of Paris lately described.

I feel assured that you will participate in my satisfaction, on finding this conjecture confirmed by the opportunity I have since had of viewing a series of specimens of the French strata; a comparison of which with those of the Isle of Wight renders their identity no longer problematical.

These specimens had been presented by M. Brongniart, in illustration of his Memoir, to the Count de Bournon, who had deposited them in the Museum of the Geological Society.

A circumstance promising so much interest demanded a careful

examination; and I have undertaken another journey to this place, with the view of studying with some attention the contents of the Isle of Wight basin, for the purpose of instituting a comparison between them and those of the basin of Paris.

The hill called Headen, adjoining to Alum bay, I recollected as the place where this is best examined; the lofty cliffs affording the finest natural sections, and exhibiting a great variety of strata. Thither, therefore, I directed my first inquiries; and the following is a more minute enumeration of the strata which compose this hill.

I formerly described the lowest of them to be a very white sand which is employed in the manufacture of glass. Immediately over this is one of very dark blue clay without shells.

On this rests a series of beds of sand and sandy marl with a good deal of a brown coaly substance. These contain vast quantities of shells, chiefly in fragments, but which prove to have been entirely of freshwater origin. They belong to the *Planorbis*, and *Lymneus*, of Lamarck.

Over these beds is a very thick stratum of a greenish marl, which contains an immense quantity of fossil shells, many of which are in perfect preservation. These are entirely marine.\*

The stratum over this consists of the calcareous rock which I formerly mentioned to have been employed here in building, together with a friable calcareous marl; both of which contain prodigious numbers of fossil freshwater shells. Many of these are

\* Since my return to London, I have, by the kind assistance of Mr. Parkinson, been enabled to describe these shells. They are various species of the *Cerithium*; viz. *plicatum*, *lapideum*, *semicornatum*, *mutabile*, *turritellatum*, and *tricarinatum*: various *Ostreae* approaching to *Ost. deltoidea*, *Cyclas deltoidea*, *Cytherea scutellarea*, *Ancilla buccinoides*, *Ancilla subulata*, *Ampullaria spirata*, &c.

quite perfect. They consist of several species of the *Lymneus* and *Planorbis*, exactly corresponding to those described by Lamarck in the basin of Paris; and they agree, in genera, at least, with the recent freshwater shells of this country. It is with the casts of these shells that the stone of Bembridge and Gurnet are filled.

Over this considerable stratum of calcareous rock and marl, there is a thin bed of blue clay with many fragments of shells; and also one of calcareous sandstone without any shells. This is covered by another bed of calcareous concretions, containing a few freshwater shells; and this last bed, which is the termination of the series, is extremely hard and dense, and some parts have even a porcellanous character.

A very thick bed of flint gravel forms the top of the hill.

All these strata may be distinctly traced along the cliffs of Headen, and quite to Totland bay, which, together with Colwell bay, is covered by the lowest bed of fine sand. The whole series, however, can only be seen at Headen. In the other parts of the western, as well as the northern parts of the island, only portions of the series remain; so that, to understand them, it is necessary first to learn their characters at Headen.

The stratum filled with marine shells, interposed between two strata containing only those of freshwater, is an extremely curious phenomenon; and corresponds to what we are told of the Paris basin.

The strata exhibiting the remains of freshwater animals render it probable that this place was the situation of a lake, in some former state of the earth; and the alternation of marine strata with these appear to shew, that the same place has been a lake, and a part of the sea in succession.

Singular as these conclusions may seem to be, it is impossible to withhold our assent to them. To deny them, would be to refuse the recognition of causes from their effects; and the evidence of these formations in fresh water, rests upon the same ground as that of the rest of the strata in the bosom of the ocean, viz. the exuviæ of animals which they contain.

At the same time that our judgment must be convinced by such proofs, our astonishment must be excited, on considering the changes that must have taken place.

The bottom of our Isle of Wight basin, we have seen, was the clay and sand over the chalk, or the London clay. These strata are of marine origin, as is evident from the fossil organic bodies found in them: and we have also seen that the subversion of the chalk, and such a change of position as gave rise to the basin, took place at a period subsequent to the deposition of the clay stratum.

If it be safe to speculate on a subject so difficult of explanation, it would seem not improbable, that this hollow was at first a gulph, communicating with the sea on the east, where it is still open. From the same or similar causes which at present often produce the same effects, this gulph or arm of the sea, might have been converted into an extensive lake of fresh water; in which a series of strata was formed, enclosing an infinity of *Planorbes* and *Lymnei*. This is the first mentioned series seen in the lower part of Headen, and may be called the oldest or lower freshwater formation.

Another alteration afterwards took place in the relative level of the land and sea in this part of the globe. The ocean again resumed its dominion, and the site of the lake was covered with

salt water. Numerous shells, many of which were different from those left by the former sea, were produced, and buried in newly formed strata.

Again this spot must have been subjected to other changes; the former state of things returned: another freshwater lake was formed, and was destined to commemorate its existence by the petrification of the animated beings contained in it.

When we compare this succession of events with what has been so ably described by MM. Cuvier and Brongniart, we cannot but be struck with their correspondence; nor entertain a doubt, that the gulph and the basin of the Isle of Wight were influenced by a part of the same causes that operated in forming that extraordinary series of strata still existing in the basin of Paris.

Some differences between them are, however, to be noticed. The plastic clay and sand is mentioned as the first deposition in the French basin; whereas our basin was not formed till after the deposition of these strata.

In the Parisian series we find also vast beds of gypsum, and nodular concretions and beds of siliceous matter. It was in vain, however, that I looked for these in the Isle of Wight. Instead of beds of gypsum I could only find crystals of selenite; and of siliceous concretions, I met with no trace in any of the strata.

In Colwell bay, portions of the alternations of freshwater and marine strata are to be seen; and in the cliffs of this bay is a remarkable bank of fossil oyster shells belonging to the latter.

The western shore of the island, from this place to Gurnet point, presents less interest; being generally flat, and composed

of slopes of marl or clay produced by the mouldering of the banks.

At Gurnet bay, however, we find again a rock containing freshwater shells, which I consider as belonging to the lower freshwater formation; although more calcareous and more indurated than that of Headen. There were several beds of this stone alternating with clays.

Here I found in great abundance the small fluted globular fossil bodies called by Lamarck, Gyrogonites, and considered by him as a minute shell. I have since observed them in the walls of that ancient Saxon ruin in Southampton, which, in your description of that place, you have conjectured was formerly a palace; a circumstance which shews that at a very remote period this stone was extensively employed.

At West and East Cowes there are no vertical cliffs, but the shores are composed chiefly of mouldering slopes. The strata of these appear to belong to the lowest freshwater formation; although occasionally are found alternating beds of marine shells, produced probably by this more ancient lake having been subject to encroachments of the sea. Over this may be distinguished, though in ruins, the upper marine formation, by its numerous fossil shells.

In the grounds of Lord Henry Seymour, these strata assume a new character; consisting of a siliceous limestone, or a limestone containing a great quantity of siliceous matter in the state of sand. This is called Rag, and is an extremely durable stone. His Lordship has employed it as the chief material in the erection of his mansion; and also in a fine wall and terrace which he has constructed to prevent the farther encroachments of the

sea. Many parts of this stone were filled with casts of shells resembling *Helix vivipara* Linn. and other freshwater turbinated shells.

Above this lie several beds of stone, composed solely of the hollow moulds of the fragments of shells cemented together by sparry matter. It is singular that the shells themselves seem to have disappeared, leaving cavities in their stead, as if they had been absorbed into the substance of the rock.

The quarries here were extremely interesting, and afforded a good opportunity of observing some of the effects of the last revolutions to which the country has been subjected. For ten or twelve feet below the surface, the stratum consisted of sand containing imbedded in it large detached blocks of the siliceous limestone I have mentioned, which lie in a very irregular manner, and had evidently been rounded by the action of water.

From Cowes to near Ryde, the shore presents little geological interest. It is flat, and consists of blue clay, sometimes containing fossil shells which are usually marine; such as *Cerithia*, oysters, and *Cytherea*.

The quarries of Binstead, once so famous, are on the road from Ryde to Newport; but are now scarcely worked. They exhibit, however, proofs of their ancient importance, in the extensive vestiges of the pits which are filled up. They afforded a good section. The lowest stratum is a white sand, in which are numerous springs. Over this is a bed of about a foot thick, of the same siliceous limestone which I had seen at Lord Henry Seymour's; then a thin bed of sand; another of limestone; and a bed of a few inches, of a very white marl, wholly composed of fragments of shells, too much comminuted to ascertain their

species. Next follow several considerable beds of the sparry stone with the hollow moulds of shells, similar to what I have described at Cowes; and on the top, detritus consisting of blue clay intermixed with large blocks of calcareous stone filled with casts of the *Lymneus* and other freshwater shells, which appeared to be analogous to the rock forming the upper freshwater formation at Headen.

The fragment stone of Binstead, therefore, probably belongs to the lower freshwater formation.

It was this last stone that had been employed for the mouldings in the abbey of Quarr, the ruins of which are near to this place; and, although at first sight, it would seem to be very unfit for such a purpose, yet it has proved extremely durable; the angles of the mouldings being nearly as sharp as on the day in which they were cut. The other stone with the *Lymnei*, &c. had been used in the walls. The fragment stone is at present burnt for lime.

This rock may be traced along the shore eastward; and at Bembridge, the rock with *Lymnei* occurs. It is the bent stratum that comes up near to the vertical clay.

Having now traced this freshwater formation round the edges of the island, I endeavoured to ascertain whether it could be found in the interior.

It is evident, from what has been said respecting the construction of the country, that it could only be expected on the north side of the middle range of hills. Considerable quarries of this stone are accordingly worked in the neighbourhood of Calbourne; and the rock may be frequently seen, in the roads between this place and Yarmouth. In these quarries, I found the

Planorbes of very great size, being full two inches in diameter. The Lymnei and Ampullariæ also were numerous and large.

This probably belonged to the upper freshwater formation, which, I have little doubt, is met with in several other places; but it would require much time to ascertain all its localities.

When we reflect upon the proofs we have just seen, of the successive changes that have taken place in this basin, from salt to fresh water, it is probable that these were not confined to this spot. The causes, whatever they were, no doubt extended their influences to some distance. Hence it will be highly interesting to trace the vestiges of the same effects in other parts of England.

In all the strata over the chalk, particularly in the counties of Hampshire, Sussex, Kent, Essex, Suffolk, Norfolk, Lincolnshire, and Yorkshire, circumstances may perhaps be observed that may extend the analogies I have described.

Permit me to add, that under your auspices I have prosecuted this inquiry: and, if by the hints I have furnished, should any thing be permanently added to the general stock of science, it must chiefly be attributed to the spirit which prompted you to begin the investigation, and the liberal manner in which you have enabled me to pursue it.

I am, &c.

T. WEBSTER.

P. S. The following table exhibits a general view or abstract of the whole series of observations which I have lately made; and contains the order of superposition of the strata of the south-east part of Great Britain, of which the above Letters may be considered as furnishing the proofs.

*Order of the Upper Strata of the South-East Part of England, deduced from a Series of Observations made for Sir HENRY ENGLEFIELD in the Years 1811, 1812, and 1813, by THOMAS WEBSTER, M. G. S.*

Alluvium.	<p>THE ruins or detritus of regular strata, formed either by the present existing causes, or by some extraordinary and unknown agents. It is composed chiefly of water-worn fragments of flints, mixed with sand and clay in various proportions.</p>
Upper Freshwater Formation.	<p>This, in the Isle of Wight, consists of a calcareous rock, in which numerous fossil freshwater shells are imbedded. See Letter 12th. It agrees in character and situation with the corresponding formation in the basin of Paris, and other parts of the continent of Europe.</p> <p>Traces of a freshwater formation are to be observed also in the London basin, between the alluvium and London clay, consisting of marl with freshwater shells, and containing also numerous bones of land animals, as the elephant, hippopotamus, buffalo, elk, ox, &amp;c. These have been found chiefly at Sheppey, Brentford, Essex, Suffolk, and Norfolk. In other places, as at Sheppey, Emsworth in Sussex, &amp;c. vast quantities of the fruits of tropical countries have been found in a corresponding situation.</p>
Upper Marine Formation.	<p>This bed consists of bluish or greenish marl and clay, containing a great number of fossil marine shells, which, in general, are different from those found in the London clay. It is known in this country, with certainty, only in the Isle of Wight.</p>
Lower Freshwater Formation.	<p>This formation is ascertained in the Isle of Wight. It is placed under the last, and consists of clay, marl, and sand, with vegetable matter resembling an imperfect coal, or peat, and contains numerous fragments of freshwater shells. At the bottom is found a mixture of marine with freshwater shells. As the alternation of marine with freshwater strata has not been observed in any other part of this country except the Isle of Wight, the traces of a freshwater formation in the London basin, cannot perhaps be referred to this.</p>

## ORDER OF THE UPPER STRATA.

Sand without Shells.	In the Isle of Wight this sand is extremely pure ; it is dug at Alum bay, and is used for making the best glass. The Bagshot sand, perhaps, belongs to this ; and, possibly, the Greyweathers ; but the positions of these have not yet been accurately determined.
London Clay.	This is the blue clay of London, Highgate, Brentford, Sheppey, Portsmouth, Stubbington, Hordwell, Southend, Harwich, &c. It is distinguished by its septaria, and its beautiful and numerous organic remains. In Alum bay, it is the most northerly of the vertical strata. Bognor rocks are subordinate to this bed. It agrees in its fossils, and geognostic situation, with the lower beds of the calcaire grossier of the Paris basin.
Plastic Clay and Sand.	The clay in this formation is often extremely pure, and fit for the potter. It is much employed in the potteries in Staffordshire. It is seen in Alum bay, the trough of Poole, and at the bottom of the blue clay in many parts of the London basin. An imperfect coal, or lignite, also frequently occurs in it. This formation corresponds to the French plastic clay, which lies over their chalk.
Chalk with Flints.	This formation in England extends from Flamborough head in Yorkshire to a little beyond Lyme Regis in Devonshire, and, where it is not covered by the beds above, forms chalk hills or downs. It is distinguished by the regular layers of flint nodules.
Chalk without Flints.	The inferior bed of chalk in the south-east part of England is always without flints. When the chalk with flints is wanting, it forms the surface. The relations of both may be seen at the Culver and Compton bay, in the Isle of Wight, Handfast point, Beachy head, Guildford, Dorking, &c. It differs from the former only in the absence of flints, in the beds being thicker, and the chalk being sometimes a little harder.
Chalk Marl.	This bed consists of chalk and an intimate mixture of clay ; it is always found below the two last strata. It may be readily distinguished from chalk, by its falling to pieces on being wetted and dried again. Some varieties of it, when burnt, form an excellent cement for building. It is also a valuable manure.

Green Sand-stone.	<p>The formation to which I have given this name, consists of silicious sand united by calcareous matter, and contains also mica and green earth. From the variety in the proportion of the latter ingredient, it is by some divided into the green sand and grey sand, a distinction which cannot always be made, since these alternate and pass into each other. It is found in the wealds of Kent and Sussex, at the foot of the chalk downs, and is dug at Rygate and Measham for firestone. It is seen also at Folkstone, Beachy head, the Culver and Compton bay, in the Isle of Wight, Pewsey in Wiltshire, &amp;c. Alternating with it, are often beds of limestone, as at Maidstone in Kent where they are called Kentish rag, also in the Undercliff Isle of Wight. Beds of chert occur in it. It abounds in organic remains.</p>
Blue Marl.	<p>This bed may be seen under the former very distinctly in the Isle of Wight, as at Sandown bay, many parts of the Undercliff, Niton, and Compton. It contains very few fossils.</p>
Ferruginous Sand.	<p>This denomination is given also to an alternating series of silicious sand-stone, clay, and lime-stone. The sand-stone contains always more or less oxide of iron, sometimes in such quantity, as in the wealds of Kent and Sussex, that it was formerly employed as an iron ore. The clay tracts of the wealds belong to it. This formation may be also seen at Sandown bay, Blackgang and Compton chines, Swanwich bay, Hastings, Tunbridge Wells, &amp;c. Fossil shells are rarely found in it: but carbonized wood is met with in abundance.</p>
Purbeck Shell Limestone.	<p>This formation consists of numerous beds of shells and fragments of shells, cemented together by calcareous spar, and alternating with shell and marl. The Purbeck, and perhaps the Petworth marbles, form part of this series: and it is farther remarkable for containing numerous freshwater shells, and bones of the turtle: hence it is not improbable, that part of it may have been formed in fresh water.</p>
Clay with Gypsum.	<p>At Swanwich in Dorsetshire, this is dug under the shell limestone. The gypsum does not occur in great quantity, but is employed for plaister.</p>

## ORDER OF THE UPPER STRATA.

Portland Oolite.	This includes the stone of Tillywhim and Windspit quarries, called the Purbeck Portland, and that from Portland island. It is entirely calcareous, and is formed of small grains or concretions adhering together. It is the only stone used for the fronts of public buildings in London. Some of its beds contain many marine fossils, also fossil wood and chert.
Bituminous Shale containing the Kimmeridge Coal.	This may be seen at Kimmeridge, Encombe, and the isle of Portland. It is the lowest stratum visible in that part of the country to which the above observations have extended.

*Table of the Heights of Places mentioned in the Work, which have been geometrically or barometrically ascertained.*

	Feet.
Culver Cliff, Isle of Wight - - - - -	259 B
Top of Bembridge Down, I. W. - - - - -	355 B
Top of Shanklin Down (or Dunnose), I. W. - - - - -	792 G
St. Boniface's Well, I. W. - - - - -	355 B
St. Catherine's Lighthouse, I. W. - - - - -	830 B
————— Brow of the Cliff, - - - - -	591 B
Guard-house on Blackgang Headland, - - - - -	400 B
Mottiston Down, I. W. - - - - -	698 G
Handfast Cliff, Dorsetshire. - - - - -	352 B
Handfast Down, Dorsetshire, - - - - -	584 B
Nine Barrow Down, Dorsetshire, - - - - -	642 G