

II. *A Letter from Mr Samuel Dale to Mr Edward Lhwyd, Keeper of the Ashmolean Repository in Oxford, concerning Harwich Cliff, and the Fossil Shells there.*

Braintree, Feb. 1703.

S I R,

THAT I have been so long before I answer'd your kind Letters, I shall only offer one reason in excuse, which is my being desirous of making another *Tour* to *Harwich, &c.* before I wrote, that I might accompany this with some Fossils, and make my observations more perfect: The account therefore you desire, take as follows.

Harwich Cliff is a sort of *Promontory*, which divides *Orwel Haven* from the *Æstuarium* contained between that and *Walton Nase*; it is situate on the Southern part of the Town, about a quarter of a mile distant or not so much, and contains many acres of Land. The height of it from the Strand or Beach to the top, where its highest is 40 or 50 foot. At the bottom of this Cliff, there is a *Stratum* of Clay about a foot thick, which is succeeded by another of Stone for a foot more; in this *Stratum* of Stone are imbedded divers Shells (though but thinly) as well of the *Turbinata* as *Bivalve* kind, and also pieces of Wood and Sticks, as you may observe by the Fragments thereof, which I have sent you. Over this are divers *Strata* of blueish Clay, of which you have also a Sample about the height of 20 foot or more; this Clay hath *Pyrites* or *Copperas* Stones sticking

sticking in it, but no Shells that I could observe. Above this are likewise divers *Strata*, which reach to within about two foot of the Surface, some of which are only of fine Sand, other small Stones and Gravel mixt with fragments of Shells, of which I likewise sent you a *Specimen*, and in others small Pebbles are mixt; and it is in some of these last mentioned *Strata*, that the *Fossil Shells* are imbedded, which lye promiscuously together, I mean the *Bivalve* or *Turbinate*; neither do the *Strata's* with the Shells observe any order in their lying, being sometimes higher and sometimes lower in the Cliff; and sometimes 2 or 3 one above another with other *Strata's* of Sand, Fragments and Gravel between. Above all these is a covering of common Sandy Earth, which is about 2 foot thick, in which, in some places are Veins of a Species of *Osteocolla*, tho more tender than *Osteocolla Officinatum*, which is brought from *Germany*: This I have adventured to call *Osteocolla Anglicana*, it doth incrust about small Strings like the Fibres of the Roots of Trees, it's of divers magnitudes, and sends forth Branches here and there, but is so tender, as not to be gotten out of the Earth in any large pieces. Whether like the *German* it appears above the Earth, I never could discover.

Before this Cliff, the Shoar, as far as the ebbing of the Sea would permit my observation, was rudely paved with Stones, divers of which are vein'd with that sort of Body, which by *Helmont* and other later Naturalists, is called *Ludus Paracelsi*: Of these Stones the Inhabitants have a tradition that they are form'd by the Clay, which tumbling down from the Cliff, and being washed by the flowing of the Sea, are in a short time converted into Stone; and the ingenious Mr *Silas Tayler* in his Manuscript *Collections of Harwich and Dovercourt*, (a Copy of which I have) thus writes concerning it. *The Washing of these Cliffs discovers a blueish Clay, which tumbling down upon the Shoar, altho washed by the Sea at High-water, within a short*

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time turns into Stone: There they may be seen, some that are new fallen as soft as the Clay in the Cliff, and others that have lain there longer crusted over and hard, but if opened or broke, the Clay still soft in the middle; others that have lain longest petrified to the very heart, and with these the Walls of the Town are for the most part built, and the Streets generally are pitch'd. How far this is matter of fact I will not determine, my stay at *Harwich* being always too short for me to make observations so critical as this *Phenomenon* doth deserve; and altho I must at the same time own that many of the Stones are washed out from the *Stratum* at the bottom of the Cliff, yet I have sometimes been inclined to Mr *Taylor's* opinion, because he lived long upon the Spot, being *Store-keeper* of the *Kings Building yard* for many years, and by his *Collections, &c.* seems to be a person of Probity and Learning: and also because divers of the said Stones have cracks or chops in them, as Clay and Earth will have by being expos'd to the Sun; and there is yet [*Anno 1702.*] lying upon that Shoar a Stone, in which a large pile (perhaps of Oak) such as was formerly made use of there to preserve the Cliff from the injuries of the Sea, doth evidently appear to be imbedded; which can owe its situation to no other Original, than by being prest into the superficies of the Clay while soft, and petrifying with it, which being square, takes off an objection which some might make had it been round, of its being lodged there in the general Deluge.

I am not insensible that this manner of Petrification is not only different from the common methods Nature useth in that operation, but also thwarts the opinions of divers Learned and Ingenious men, and it was strenuously oppos'd by the Reverend Mr *John Morton* of *Oxendon* in *Northamptonshire*; when we, together with Mr *John Luffkin*, an Apothecary of *Colchester*, were upon the place; the substance of which discourse he wrote down, and afterwards at my request sent me, together with his thoughts

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thoughts of *Petrifications*, which perhaps will not be unacceptable to you, and therefore I shall transcribe it from his Letter, dated *August 4th, 1699.* — At Harwich, under the Cliff, upon the Sea-shore, there is a Stratum of a Clayie-Stone, which is cover'd here and there with ragged Stones of a closer texture, which was formerly (I conjecture) another entire Stratum, but is broken thus by the Tearing of the Waves. The Clayie-Stone Stratum, Mr Dale and Mr Luffkin my Companions were of opinion had been formerly a softer substance, but was daily petrified by the Sea Water. Having argued a little about it, when turning to the Cliff, I found a Stratum there, of the very same sort of Clayie-Stone with that upon the Shore; yet the Sea water very seldom comes up hither, unless by Storms and at Spring tydes. I broke a little piece off, and shew'd it to you, and then you was convinc'd (I think) it was not hardned or petrified by the Sea water, but in its natural state. And I have often, I assure you, met with just such sort of Stone in many of our Stone-pits here, in Inland Countries. * It appears to me, that the Water should have rather softned than hardned the Stone upon the Shore, tho by washing away the looser Clayie matter and other Earthy stuff, that is sometimes left upon it at the ebb, it might seem to be a sort of Petrification, and occasion this mistake.

As to Petrifications: I've only observed these three sorts. 1st, A Stony Incrustation upon Sticks and any thing that lyes in the way, in the Petrifying Springs; the Earth in those Waters is usually intermixt with particles of Stone, that trickle down into it with the Water, and are there detain'd. Of this first sort you have doubtless many instances in Essex, and I think there is one at Harwich Cliff; tho this in my opinion is not so properly call'd a Petrification. 2dly, The second sort is that which is perform'd by the Permeation or Insinuation of the finer sorts of Stony Particles, as it is in the case of some of our Petrifying waters, (I believe) particularly that at Knaresborough sometimes; the Stony particles

however of the Knaresborough Spring are very fine. And many of the Fossil-shells have undergone the same fate. 2dly, The third, which indeed is a Petrification, properly so call'd, is often met with on the sides of Caves and Grotto's, as at Pooley-hole in the Peak, and in the Fissures, and Clefs of Mines and Quarries. Of this kind are the several sorts of Fluors, the Lap. Stillatitii, Stalagmitæ, &c. that we meet with in the Fissures, and Hiatus's of the Earth. These are continually growing (as they vulgarly say) that is, are receiving an additional increase of real and solid Stone, as is observ'd in many Caves in the Peak, &c. This I take to be perform'd in such a manner as the Incrustations are, viz. the particles of Stone are brought along with the Water as their Vehicle, and are deposited at length upon the sides of the Cave or Fissure, (this is matter of fact, that there is always a watry Stream, and usually Water a trickling down upon the sides of those Caves:) but here, the particles of stone are extremely minute and fine, and do thereby naturally concrete and join together very close; whereas in our Incrustations the particles of Stone being grosser, the Stone is rough, and coarse, and friable. And this I leave to your Judgment if it be not a more reasonable Hypothesis, than that of Dr Plot in pag. 33 of his History of Oxfordshire, viz. That the very body of the Water is turned into Stone as it drops down from the Rocks. I know not indeed of any other sorts of Petrification than these I have already mention'd. As to that Hypothesis of the Transmutation of a Stratum, e. g. of Chalk to Clay, of Coal to common Stone, or the like, I must confess I never met with any thing in Nature which would countenance it, that is, such a Transmutation in the Bowels of the Earth. Nor is there any thing that proves it, that ever I have met with in any Natural Observations. Only some will guess and fancy such a thing, but for making it out, I am sure I am no more able to do it, than to make the Philosophers Stone, whatever they are. Thus I have freely given you my thoughts of these things

A late Author is of opinion, that *this Bed of Stones was the Foundation of the Loamy Cliff, where the Cliff has been washed away or cut: And that they are the Production of a Vitrioline Juice in conjunction with the Loam;* as the common Copperas Stones are by the same Juice, in a Gravel, and that the latter were only to be found where the Cliff was gravelly, and not where the Loam is. How far these Stones are the effect of a Vitrioline Juice, I will not determine, but this I can affirm, that I have now by me some of the Pyrites or common Copperas Stones, which I did pick out of the Clayie Stratum of this Cliff, in which they may be frequently met with, as mention'd in its description. Nor do I remember at any time to have observed these Stones to be invested with either Gypsum or Trichitis, as the same Author affirms, but with the aforesaid Ludus Paracelsi, and some other sorts of Lap. Stalagmitæ frequently.

How those Shells or Marine Bodies came to be here posited, is a Subject, which hath employed the Heads and Pens of divers learned and ingenious men; and your self being engaged in the controversy, I shall not pretend to say any thing thereof, lest I should be thought like *Phormio* to treat of the Art of War before *Hannibal*, only crave leave to make some remarks on the positive assertion of the aforesaid Author, concerning the imbedding of these Fossil Shells in this Cliff, and the alteration of the Channel, viz. That this Bed of Shells, which covers the Cliff, was carried thither at the making of the Harbour or clearing of it. For the Harbour or Channel there is artificial and of no old date, the Current having been formerly on the other side of Languard Fort, which then stood in Essex. Against the first part of which, altho many reasons might be given to prove the contrary, I shall only trouble you with the following, and as our Author begs the Question, *How else could the Shells lye a top of this Cliff?* So I shall also ask him, why the same Strata of Sand, and Fragments of Shells, with the same Fossils imbedded, are to be found at

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Walton Nejs on the other side of the *Æstuarium*, which is 5 or 6 miles broad from *Harwich*, as likewise at *Bawdfey Cliff* in *Suffolk*, which is 8 or 9 miles distant, and in other Cliffs on that Shore, where I have met with them. A second Question may here be askt. How it comes to pass that none of those *Buccina Heterostropha*, (whereof such plenty of their *Exuvie* are in all the Cliffs hereabouts) are not now to be found in this Channel, nor the adjacent Seas? (where I have divers times been a fishing) for I cannot think the clearing this Harbour could have destroyed all that species of Shell-Fish, whereof there was then such plenty; and therefore some other Original must be allow'd them, than what this Author has assign'd. Nor can I allow the Harbour here to be *Artificial*; because so great a work as this is, *viz.* the making a Channel 2 miles wide, as it is in this place, would not have been without some Record thereof in History, and besides, the Earth, &c. which must arise by this work, must consequently have made a much greater Hill than the Cliff ever was; and another doubt will from hence arise, why the Workmen should bring all the Earth, &c. to this side the Channel, and not lay some thereof on the other, as it's plain they did not. The ground on which *Landguard Fort* stands, as far as *Walton Colnefs*, which is about 3 miles, is only a Sandy Level or Beach, which I believe hath in time subsided there, as may be observed at the mouths of other great Rivers. And as to the Argument which our Author brings of *Landguard Fort* being accounted to stand in *Essex*, to confirm his Hypothesis of the change of this Channel, it will be of no force with any one which doth but observe, that not only parts of Parishes, but likewise of Counties, are often divided from those Parishes and Counties to which they belong, and included in others, of which I could give you many instances, *e. g.* a part of *Kent* is on the *Essex* side the *Thames*; and in
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Oxfordshire the Parishes of *Skilton* doth belong to *Berkshire*, *Daylesford* to *Warwickshire*, *Compton* to *Gloucestershire*, and *Stratton Audley* to *Buckinghamshire*, altho all included in the other : And there is a Farm which doth belong to this Parish of *Braintree*, that is separated from it at least 2 miles, and many others might be given, but let these suffice. And to me a probable reason of this Forts being accounted in *Essex*, is, the Sands here subsiding, made at first, I suppose, an *Insula*, which being nearest to *Essex* was accounted of that County ; or 2dly, the Island so made belonging to none but the Crown, it was at the pleasure of the *Kings Officers* to call it of which County they pleased. Nor was it the *Gentleman in Cambden's* ignorance (whatever this Author saith) that made him mention these Stones for *Petrifications made by the Sea*, for *Mr Tayler* in his aforefaid *Collections* did not omit the tradition the Inhabitants of this Town have about the alteration of the Mouth of this Haven, which I will transcribe in his own words. *It's generally believed that Stoure did formerly in a straighter current (than now it doth) discharge it self into the Sea about Hoasley-bay, under the High-land of Walton-Colnefs and Felix-Stow in the County of Suffolk, betwixt whom and Landguard Fort are (as they are reputed) certain remains of the old Channel, which the neighbouring Inhabitants still call Fleets, retaining at this day the tradition of the course of the Water, and the entrance into this Haven to have heretofore been by and through them.*

And I am of opinion that this Tradition is matter of fact, having before hinted to you what mutations the Mouths of great Rivers daily undergo by the lodgment of Sands, &c. which may be assign'd as a better reason for this alteration than that of our Author, *i. e.* that it was Artificial ; and the yearly washing of the Cliff on the *Harmich* side, doth likewise add to its probability ; it being a constant observation, that where the Sea gaineth

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eth on one side it loseth on the other. And that this level was so made I am confirm'd by the modern removal of the Fort, more towards the point, more Sands, I conjecture, being added after the old Fort was built : This alteration is taken notice of by the aforesaid *Mr Tayler* in these words. *And altho several now living pretend to the remembrance of the building it ; [Landguard Fort] yet we find there was an ancienter Fort thereabouts, and called by the same name [Anno 1553.] which was not far distant from this modern one, a little North of it, where are yet to be seen two Faces and Flankers of a Bastion, the rest of it being eaten away by the Sea, but in its place bath left upon the Shoar a long row of Sand Banks.*

The Spring mentioned by the Ingenious *Mr Edmund Gibson* in his *English Edition* of *Cambden*, from the aforesaid Manuscript of *Mr Silas Tayler*, is a very small inconsiderable thing ; nor could I observe that it did petrifie or incrustate either pieces of Wood or Sticks, but I have a piece, which I broke off from a large Pile upon that Shoar, which was petrified so far as it was droven into the Earth, and the Sea Water came ; and do suspect there yet remains some others of the same. And of this sort I believe, is that large piece sent from hence, which *Mr Tayler* mentions to be reserved in the *Repository of the Royal Society*.

I have already taken notice, that the *Fossil Shells* are imbedded in a loose *Stratum* of Sand, Gravel, &c. which may serve to demonstrate that their *Matrix* is not a *Clay bed upon the top of the Cliff* ; as likewise for another Argument to evince that they could not be there scattered by *Crows, Gulls*, and other Sea Fowls, as well as that some of them are likewise bedded in Stone at the bottom of the Cliff ; and altho some few of them may be met with upon the top of the Cliff, yet it's only where the Earth has been broken by digging of *Ditches, &c.*

And

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And now I think it time to close this Letter, lest I should quite tire your patience with its length ; and shall only add a Catalogue of the Fossils by me found at this Cliff ; after I have subscribed my self,

Sir,

Your obliged humble Servant,

S. Dale.

1. Buccinum fossile heterostrophum rostratum lævem maximum Listeri referens.
2. Buccinum fossile rostratum maximum Listeri referens.
3. Buccinum fossile minus ventricosum mucrone obtuso.
4. Buccinum fossile tenue minus ponderosum, striatum & undatum
5. Buccinum fossile tenue confragosum.
6. Buccinum fossile strijs prominulis marginalibus insignitum.
7. Buccino-turben fossile reticulatum minus.
8. Buccino-turben fossile Sulcatum.
9. Buccino-turben fossile rostratum.
10. Buccino-turben maximum rostratum fossile Spiris intus Strijs elatis insignitis.
11. Cochlea fossilis maxima umbilicata quinque Spirarum.
12. Cochlea fossilis umbilicata mucrone obtuso.
13. Nerita parva fossilis.
14. Turbo fossilis Spiris duabus Strijs eminentibus insignitis.
15. Pecten minor fossilis unica aurita.
16. Auricularia maxima.
17. Pectunculus fossilis fere circinatus Strijs tenuibus, valvis per ginglymon connexis.

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18. Pectun-

18. Pectunculus fossilis crassius rostro acuto Striis majoribus.
 19. Pectunculus fossilis fascijs transversis undantibus notatis.
 20. Pectunculus vulgaris fossilis.
 21. Pectunculus fossilis Strijs majoribus & elatioribus.
 22. Pectunculus maximus fossilis Listerianum maximum referens.
 23. Pectunculites maximus Strijs latis.
 24. Concha parva fossilis fascijs transversis insignis.
 25. Concha longa fossilis fasciata.
 26. Conchites lævis maxima.
 27. Conchites parva fasciata.
 28. Trigonella minor sive vulgatio Anglica *Lithoph.*
Brit. 816.
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III. An Instrument, for seeing the Sun, Moon, or Stars, pass the Meridian of any Place. *Useful for setting Watches in all parts of the World with the greatest exactness, to correct Sun-Dyals; to assist in the discovery of the Longitudes of Places, &c. By the Reverend Mr William Derham, F. R. S.*

AMong all the ways contrived for finding the Meridian of any Place, the most commodious I could ever meet with, or think of for common Use, is an Instrument of Sir *Christopher Wren's*, or two of Mr *Gray's*, or one published in the Appendix of a little Book, called *The Artificial Clockmaker*.