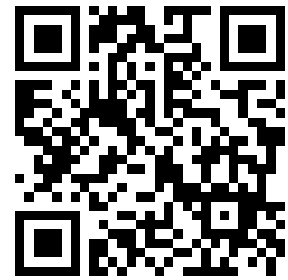

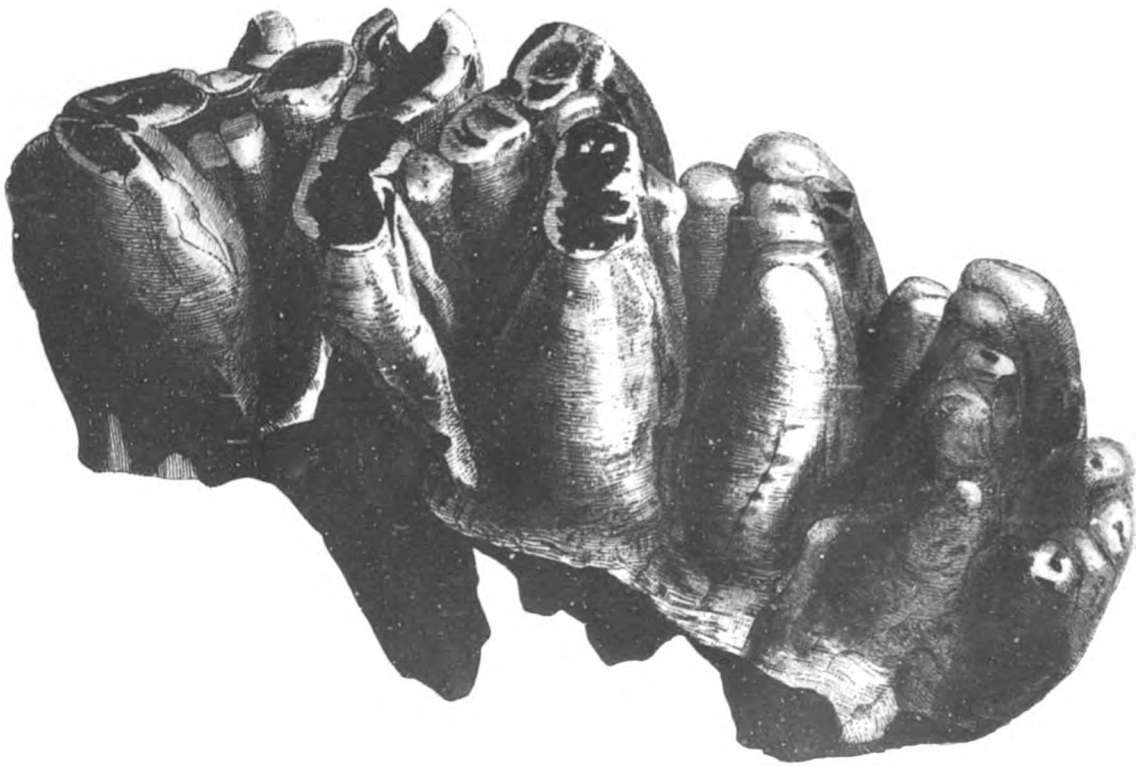

STRATA

IDENTIFIED BY

ORGANIZED FOSSILS,

CONTAINING

Prints on Colored Paper

OF THE MOST

CHARACTERISTIC SPECIMENS

IN EACH

STRATUM.

By WILLIAM SMITH,

MINERAL SURVEYOR,

AUTHOR OF "MAP OF THE STRATA OF ENGLAND AND WALES," AND "A TREATISE ON IRRIGATION."

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JUNE 1, 1816.

INTRODUCTION.

THE present age is distinguished by many of the most extraordinary discoveries that were ever unfolded to the human mind; and amongst them the discoveries in Chemistry stand pre-eminent. The most extensively useful part of this science has, however, been long before the Public, and contributed greatly to the improvement of various branches of manufacture; but the benefits of Chemistry have not yet been extended to the soil.

Agriculture in this, as in most other instances, is the last to profit by any thing new. That easy analysis of the soil, which seemed to promise great advantages to the Farmer, by telling him correctly the component parts of the materials he has to work upon, has not been spread through the country, or even yet become an object of attention with many of the best informed Farmers, by whom the advantages of this science must be carried into effect; and while the theory is in the possession of one class of men, and the practice in another, who have little or no connexion, it is greatly to be feared, that the culture of land may long remain without its expected benefits from Chemistry.

In a similar way, also, the benefits resulting from the science of Botany, have been equally limited, and likely to remain so, until those who grow the grasses shall take the trouble to distinguish one from another, or until those who know them scientifically shall condescend to become the cultivators.

Nature furnishes the clue to each of these sciences, and to the most extensive application of their benefits.

She has also given the Farmer other more easy helps, to much of the useful knowledge he requires.

The method of knowing the Substrata from each other by their various substances imbedded, will consequently shew the difference in their soils.—All this is attainable by rules the most correct, and easily learnt, and also the simplest and most extensive that can well be devised; for by the help of organized Fossils alone, a science is established with characters on which all must agree, as to the extent of the Strata in which they are imbedded, those characters are universal; and a knowledge of them opens the most extensive sources of information, without the necessity of deep reading, or the previous acquirement of difficult arts.

The organized Fossils (which might be called the antiquities of Nature,) and their localities also, may be understood by all, even the most illiterate: for they are so fixed in the earth as not to be mistaken or misplaced; and may be as readily referred to in any part of the course of the Stratum which contains them, as in the cabinets of the curious; and, consequently, they furnish the best of all clues to a knowledge of the Soil and Substrata.

The practicability of thus distinguishing so great a variety of materials in the earth, as successively terminate at the surface being admitted; and their courses delineated in a large map of the Strata just published; I may now confidently proceed with a general account of those organized Fossils, which I found imbedded in each Stratum, and which first enabled me more particularly to distinguish one Stratum from another.

Fossil Shells had long been known amongst the curious, collected with care, and preserved in their cabinets, along with other rarities of nature, without any apparent use. That to which I have applied them is new, and my attention was first drawn to them, by a previous discovery of regularity in the direction and dip of the various Strata in the hills around Bath; for it was the nice distinction which those similar rocks required, which led me to the discovery of organic remains peculiar to each Stratum. Their perfect state of preservation, and most tender structure, raised a doubt respecting their diluvian origin, and a close attention to the Gravel Fossils, clearly proved *two distinct operations of water.*

The Fossils of the former deposit being all finely preserved, while those of the latter, (which are chiefly superficial,) are all greatly rounded by attrition. Those of the first class are never found but in their respective sites in the Strata;—those of the latter, by their promiscuous mixture, superficial situation, and other circumstances, most strongly confirm the previous deposit, and complete induration of the Strata which contain the former. Conceiving, therefore, the Gravel Fossils to be the most indubitable effects of a great body of water passing over the surface of the earth, with violence sufficient to tear up fragments of the Strata, round them by attrition, and drive them many miles from their regular beds to the promiscuous situations which they now occupy. These have been called *alluvial Fossils*, and the Gravel which contains them being thus clearly distinguished from the regular Strata beneath, much of the mystery in which Fossil Shells, and other materials of the earth were involved, seemed to be removed by this distinction.

Thus far it may be necessary to apprise the reader of the meaning here attached to the word alluvial.

The organized Fossils which come under that head, being as various as the Strata from whence they have been dislodged, an account of them will most properly be given in the last number.

Under the same head, also, will be given, further particulars of the Frontispiece, or annexed Engraving of a singular Fossil Tooth, of some extinct monstrous unknown animal, which is opalized;---found in Norfolk.

STRATA

WITH ORGANIZED FOSSILS.

THE eastern and south-eastern half of England, as far inland as a curved line from Exeter to Teesmouth, abounds with organized Fossils, regularly imbedded in the Strata. The vast expanse of red Marl and its Sandstone, has none of them, but they are very abundant in the Limestones which accompany it.

These, however, occupy but a small portion of the island, compared to the great extent of Strata before-mentioned, and when it is considered that in the remainder of the Strata, Red and Dunstone, Killas and Granite, organized Fossils are not found, or very rare; they seem chiefly confined to the district before described, and to the Coalmeasures, the former nearly all animal, and the latter chiefly vegetable. The Muscles and Ammonites found in Ironstone of the Coalmeasures, and the bituminized wood of blue clays, in the other district, being trifling exceptions to general rules so extensive.

The eastern side of the island is, therefore, best for the commencement of regular observations on the organized Fossils which are illustrative of its Geology. It is also necessary that the series of British Strata, for the simplification of science, should be considered in classes. The part above the Chalk is one, and the principal divisions of which it is susceptible, are reducible to two---a great Sand and a great Clay, with a general parting of Crag; but each of these is subject to considerable variations.

The Sand lies next the Chalk, and the clay over that forms insular hills.

The great Sand is in many places interspersed with Clay, or Brickearth, and the Clay as frequently with Sand and Loam. Pebbles are common to both, but to what depth beneath the surface may be difficult to determine.

The chief partition Strata have not always the same appearance. The Crag being, in some parts of its course, composed of shells and sand, in some places of shells and clay, and in others of shells and coral, united in a soft stoney rock, which about Orford is used in building. In other places the shells are filled with, and imbedded in a hard blue grey Sandstone, and in some parts of their course they appear to be deficient, or found only thinly interspersed with a blue grey concreted loam, or indurated Brickearth. The alluvial Pebbles, Clay, and Sand spread over great breadths of the plains formed by the surface of these thin partition Strata, much increases the difficulty of tracing their outcrops.

The greatest breadth of the Clay is in Essex, and the vicinity of London, as described in my delineation of the Strata by the dun or dark blue colour, and the localities of the most remarkable sites of its organized Fossils, are noted in a list which accompanies the explanation of the plate.

The other great division of Sand and Brickearth, is represented on the map by yellowish brown, and the sites of its peculiar Fossils under the head of Crag, similarly described---but the partition Strata which produce these shells, vary so much in hardness, colour, consistence, and uses, as to render a local description of one part, almost unintelligible to those who are acquainted with it in another. For on a cursory view of these shelly Strata in their course through

the three north-eastern counties, from the banks of the Thames, some miles below London, it is singular that a considerable distinction in the site or accompaniments of the shells should be peculiar to each of the counties.

The shells in Essex are lodged in a strong blue Clay which makes a tenacious soil.

All through Suffolk in a light or blowing Sand, which, in many parts of the course of Crag, is some of the worst land in the county.

Through Norfolk the shells lie much nearer to, or in contact with the top of the Chalk, and under a loamy soil, on or near some of the best land in Fleg and the Vale of Aylesham.

In the present state of our knowledge of these Strata, and the shells they contain, any attempt at a minute division of them, seems, therefore, more likely to perplex, than instruct the reader.

The strong features only of the country, will therefore, first be noticed. The order of nature which is shown by my discoveries, suggests the outline of the work, and the different Strata serving like chapters for the principal divisions, the subject will be so treated; taking each of their outcrops in succession, from East to West The figures of organized Fossils in each Stratum are printed on coloured paper, to correspond with the most general colour of the matter in which they are imbedded, and also with that by which their courses are represented on the Map; where otherwise, as in the Chalk, it will be particularly noticed under each head.

It may be necessary to remark, that the Strata over Chalk, occupy much of the eastern, south, and south-eastern coast of England, and seem to be only parts of much larger districts of corresponding Strata on the Continent.

In England this class is separated into three portions, by vacancies on the heights of Hampshire, and in the sea by the Wash. The mouth of the Humber makes also a lesser division—but for these, the class might be said to extend from Dorsetshire to Yorkshire, for Pool Harbour is in one extremity, and Bridlington Bay in the other.

The northern-most of the three principal portions, North and South of the Humber, is small, long, and narrow, lying low, and as yet little noticed for organized Fossils, except large bones washed out of the crumbly cliffs of Holderness, which correspond with those washed out of similar cliffs on the coast of East Norfolk, Suffolk, Essex, East Kent, and South Hants.

The middle and principal portion extends north-eastward from the Hampshire Hills to the coast of Norfolk; it flanks the Chalk through Surrey and Kent, on the south side of the Thames; the Buckinghamshire and Hertfordshire Chalk Hills on the north side. It embraces the whole Estuary of the Thames; spreads over nearly all Essex, three-fourths of Suffolk, and all the eastern half of Norfolk, except the Vales about Norwich and Aylesham.

The southern portion, chiefly in Hampshire and Dorsetshire, narrows both ways from its widest part about the new Forest, to its western extremity, near Dorchester, and its eastern, near Brighton. Its widest part is from Newport in the Isle of Wight, to the similar elevations of Chalk and down lands, between Salisbury and Winchester. Each of these districts is abundantly stored with organized Fossils. Large teeth and bones, greatly resembling those on the Continent, have been most frequently collected from the shores of the middle portion, and and large vertebræ further inland, at Whitlingham, Leiston old Abbey, Diss, Hoxney, and Hawkedon.

LONDON CLAY.

SOIL.—*Colour*, Orange brown, Y. R. B. 2, of Sowerby's Chromatic Scale, varying when wet.
Consistence, Tenacious; free from Stone; dries clotty; cracks in drying; surface frequently covered with alluvial Pebbles.
SUBSOIL and Ditches, Retentive.
EXCAVATIONS, Hold Water.
STRATUM, Dry, of a dun colour. Darker when wet.
WATER, Rarely any; the little which it produces of a bad quality.

THIS thick Stratum, from its being the site of the Metropolis, and most abundant in its environs, has been called the London Clay. Its course north-eastward to the sea is described in the Map, by the same colour as the plate annexed.

The greatest length, from S. W. to N. E. is in a line passing from Richmond, through London to Harwich.

The greatest breadths, from Norwood Hill to Enfield Chase, and from Langdon Hills to the extremity of Epping Forest. It thence occupies the heights in the hundreds of Essex, and east of Chelmsford and Colchester; extends through the Sokens to the sea side at Walton Nase, and Harwich.

The soil is of a mellow brown or umber colour, and the subsoil generally the same, although the Stratum deeper (as lately shown by the tunnels under London,) is of the colour by which I have endeavoured to represent it.

The exact boundaries of soft Strata are generally difficult to define, but particularly so in this district, where they alternate with no hard materials in the form of Rock.

Outcrops also of such loose Strata, are too confused for the Geologist to avail himself of the distinctive advantages to be derived from their peculiar imbedded Fossils, as throughout the district over Chalk, they are found only in deep excavations.

The shelly part of the London Clay bears but a small proportion to the thickness of the mass. The shells, therefore, should rather be considered as Indices to the site of that particular part, than to a knowledge of the whole. They lie near the bottom of the Stratum, and in some instances are difficult to be distinguished from those of the Crag, which accompanies the sand.

ORGANIZED FOSSILS.

FIG.		
1	Vivipara fluviorum - -	Well at Brixton Causeway. Hordwell Cliff.
2	Tellina, &c. - -	Sheppey. Happisburgh.
3	Arca Linn. Pectunculus *Lam.* -	Bognor.
4	Chama - - -	Hordwell Cliff.

FIG.		
5	Voluta spinosa - -	Barton.
6	Voluta - - - -	Bognor.
7	Cerithium - - -	Woolwich. Bracklesham Bay.
8	Large Shark's tooth - -	Sheppey. Highgate.
9	Small do. - -	Highgate.
10	Pectunculus decussatus - -	Highgate.
11	Ammonites communis - -	Happisburgh.
12	Calyptrea, *Lam.* - -	Barton Cliff.
13	Crab - - -	Highgate. Sheppey.

SITES OF LONDON CLAY. *FOSSILS.*

Bognor
Selsea Bill
Stubbington
Ryde, Isle of Wight
Muddiford
Barton and Hordwell Cliffs
Alum Bay
Emsworth
Pagham
Newhaven Castle
Harwich
Sheppey.
Bexley Heath.
Woolwich.
Highgate.
Brentford.
Richmond.

LONDON CLAY.—*Sowerby's Mineral Conchology.*

Fusus Longævus, Tab. 63. Barton and Hordwell Cliffs. Muddiford.
Vivipara lenta, Tab. 31. Fig. 3. Barton and Hordwell Cliffs.
Nautilus Imperialis, Tab. 1. Highgate. Brentford. Minster Cliff, Isle of Sheppey.
Modiola elegans, Tab. 9. Bognor. Highgate. Richmond.
Venericardia planicosta, Tab. 50. Bracklesham Bay.
Teredo antenautæ. Sheppey.
Highgate.
Regent's Canal.
Croydon Canal.

Sowerby's Mineralogy.—Tab. 14. Pag. 33.
Argilla Marga, containing shells. Streatham, in Surry.

The Fossil shells of the Southern portion of this Clay, were first regularly described by Brander.

Those of the district round London, many years since excited much curiosity, from the great quantity turned up in digging the foundation of a house in Hanging Wood, near Woolwich.

They have, also, been found in sinking various wells around the Metropolis, but the recent excavations for a tunnel through Highgate Hill, brought them most into notice.

FIG.		
5	Voluta spinosa - -	Barton.
6	Voluta - - - -	Bognor.
7	Cerithium - - -	Woolwich. Bracklesham Bay.
8	Large Shark's tooth - -	Sheppey. Highgate.
9	Small do. - -	Highgate.
10	Pectunculus decussatus - -	Highgate.
11	Ammonites communis - -	Happisburgh.
12	Calyptrea, *Lam.* - -	Barton Cliff.
13	Crab - - -	Highgate. Sheppey.

SITES OF LONDON CLAY. *FOSSILS.*

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Selsea Bill
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CRAG.

CRAG is a local term for shells mixed with sand, overlaying the Chalk, in the counties of Norfolk and Suffolk.

It is best known and most in use for agricultural purposes in the latter county.

It extends from Tattingstone Park south of Ipswich, through the East Sands or Flock district, to Henham Park west of Southwold.

Re-appears South and North of the Yare, below Norwich, at Bramerton and Thorpe, and has been found at Marsham in the vale of Aylesham, in its course to the sea side west of Cromer.

Crag is but a small proportion in thickness of the sandy Strata overlaying chalk.

ORGANIZED FOSSILS.

FIG.		
1	Murex contrarius - -	Thorpe Common, Harwich. Alderton, Suffolk. Holywell near Ipswich. Tattingstone Park.
2	M. striatus - -	Bramerton, Holywell, Alderton, Aldborough.
3	Turbo littoreus - -	Bramerton. Trimingsby. Thorpe Common. Leiston old Abbey, between Norwich & Yarmouth.
4	Turbo *Linn.* Turritella *Lam.* -	Thorpe Common.
5	Patella Fissura *Linn.* Emarginula *Lam.*	Bramerton. Harwich. Holywell.
6	Balanus tesselatus - -	Bramerton.
7	Arca *Linn.* Pectunculus *Lam.* -	Tattingstone Park. Thorpe Common.
8	Cardium *Linn.* - -	Bramerton. Happisburgh (or Hasbro'). Tattingstone. Trimingsby.
9	Mya lata - - -	Bramerton. Trimingsby.
10 11 12 13 14	Vertebræ	Thorpe Common.
15	Palate - - -	Tattingstone Park.
16	Tooth - - -	Stoke Hill.
17 18 19	Teeth - - -	Reading. Ipswich.
20	Quadruped's Bone - -	Tattingstone Park.
21	Stalactite - -	Burgh Castle.

CRAG. *Sowerby's Min. Conch.*

Scalaria similis, *Tab.* 16. Bramerton. Holywell. Also at Newhaven Castle.

Murex corneus, *Tab.* 35. Aldborough. Holywell. Walton Nase.

Several Fossil shells of this and the Stratum preceding, greatly resemble some which are recent. In the Clay they are generally white, but some in the Crag, as Turbo littoreus, often retain their natural colour.

Oysters, of various sorts, found plentifully in the Strata over Chalk, seem to define the course of Crag at the following places:—Headley, Reading, Woolwich, Blackheath, and in stone at Stifford, in a valley one mile south of Hertford, at Beckingham and Damerham, and in stone at New Cross, and Addington Hills, near Croydon.

Crabs and Lobsters are more numerous in these than in any of the inferior Strata.

Horns of very large animals are also found in low places, where these Strata approach the Marshes, which are considered to be alluvial.

Ivory has been collected from the sandy Crag; teeth, vertebræ, and other bones are numerous in it, some of these, and the shells being rounded and mixed with fragments of numerous imperfect shells, lead to an opinion that this part of the Crag may be alluvial. It is, however, traced through the same course of country, and if not connected with the stoney Crag, is so very contiguous thereto, as not to be separated in a general account.

The stoney calcareous Crag is in more regular layers than the sandy. In some places it appears to be covered with Brickearth. Shells are found perfect in this sort, which are probably only fragments in the other, aud some perfect in that, are only casts in this, as the murex striatus of Sowerby.

UPPER CHALK.

SOIL.---*Colour*, generally brown, but by the sides of hills of various mellow tints, from that to brownish white.

Consistence, loose, crumbly, thickly interspersed with Flints, absorbent.

SUBSOIL, and Ditches, white, dry.

EXCAVATIONS ditto ditto.

STRATUM, dry to a great depth.

WATER, remarkably bright and clear, in chalk roads and rivulets white in hasty rains.

The chalk Stratum is generally known by the feature which it gives to our Island, in the white cliffs of Britain, and long ranges of interior hills.

For want of colour in the Stratum, it is defined in my map by a green line.

Its course through the Island from the English Channel to the German Ocean, is from S. W. to N. E. from a point on the western extremity of Dorsetshire, to Flambro'head in Yorkshire, with a considerable curve to the eastward. It has two singular branches from Hampshire, one through Sussex, and the other through Surry and Kent, which approach the sea in their respective cliffs at Beachyhead and Dover. These are the chains of hills which it forms; its greatest plains are in Wiltshire and Hampshire.

Insular parts occur in the Isle of Thanet, and the Isle of Wight, and on the western extremities of the Stratum in Dorsetshire.

The Flints which constantly accompany the upper part of this Stratum in abundance, furnish materials for its identification, far superior to those of the laxer Strata above it.

Our fields and highways are frequently strewed with Zoophites, Echini, and other fine Fossils of this Stratum, turned up by the plough, or brought in Gravel for repairing the roads.

The upper part of the Chalk is particularly distinguished by numerous Zoophites, and other marine remains, so that in some parts there are but few of those innumerable knotty and irregular Flints, but owe their form to a nucleus of some such organization.

ORGANIZED FOSSILS.

FIG.		
1	Alcyonium Flint, others in Chalk	Wighton. Wilts.
2	Ditto - - -	Wighton.
3	Serpula - - -	Norwich.
4	Valves of Lepas, *Linn.* -	Norwich.
5	Hollow Valve of Ostrea -	Norwich.
6	Flatter Valve of Ditto -	Norwich.
7	Ditto attached to a Belemnite -	Norwich.
8	Pecten - - -	Norwich.
9	Terebratula subundata, (long variety)	Norwich.
10	Echinus - - -	N. of Norwich. Croydon. Taverham, Wilts.
11	Palate of a Fish - -	Warminster.

12 Part of Echinus - - N. of Norwich.
13 Echinus Spine - - N. of Norwich.
14 Shark's Tooth with 2 ridges - N. of Norwich.
15 Shark's Tooth serrated - N. of Norwich.
16 Vertebræ - - - N. of Norwich.

Ovate Echini and Zoophites, without enumerating localities, may be found any where on the surface of Upper Chalk.

PLATE 2 London Clay

Plate of figures too dark to reproduce.

PLATE "2" (Second 2) Craig

Plate of figures too dark to reproduce.

N°1. Flint Alcyonite.
2. Flint Alcyonite.
3. Serpula.
4. Fragments of a Lepus. Linn.
5. Hollow valve of a Shell allied to Ostrea.
6 Flatter valve of D°.

N°7. D° attached to a Belemnite.
8. Pecten.
9. Terebratula rubundata Min. Con. t. 22. f. 7.
10. Echinus. Linn.
11. Fishes palate.
12. Part of an Echinus.

N° 13. Muricated Echinus spine.
14. Sharks tooth with two sharp ridges.
15. Sharks tooth serrated.
16. Vertebræ

LOWER or HARD CHALK,

Frequently called GREY CHALK.

SOIL.—*Colour*, Light brown, frequently grey, with small fragments of stoney Chalk, and in some places almost white.

In several places Chalk is exposed by cutting away the turf, in the form of a horse.*

On the White or Malm Land, at the foot of the hills, of a dirty grey, called *White Land*.

Consistence, Crumbly, with a mixture of whitish grey Flints:—Lower on the sides of steep hills, chiefly small rubble stoney Chalk, thinly interspersed with some browner fragments of soil—all very dry—at the foot of the hills mouldering when dry; smeary when wet.

SUBSOIL.—*Colour*, White, greyish white, or blue grey, small rubbly Chalk—pulverizable Malm, dry.

EXCAVATIONS, HOLLOW-WAYS, } Grey or bluish white, dry.

STRATUM, White, bluish white, or light grey; soft stone, which moulders with frost.

WATER, Bright, transparent.

THE bottom part of the Chalk, now under consideration, defines the boundary of that thick Stratum, which, though here divided into upper and under, has no distinct separation. It is the escarpment of this lower part of the Stratum, which forms in the west and midland counties the abrupt edge of the Chalk hills. Its course is the same as that of upper Chalk, before described. The chain of hills which extend in a north-easterly direction, from Dorsetshire to the fens, though they gradually diminish in height north-eastward, may be viewed distinctly from the similar and parallel escarpment of the Oolite rocks, as well from the heights near Sherborne, Bath, and Cheltenham, and the whole range of Cotswold hills; as also from the similar eminences in Oxfordshire and Northamptonshire.

The more northern part of this chalky range is likewise conspicuous from the Lincolnshire ridge of Oolite.

In Yorkshire, the escarpment of Chalk seems to form the western limits of the great vale of York. In the vicinity of New Malton, its dry surface, as at Swaffham in Norfolk, and on the Downs of Wiltshire, is equally famed for coursing and the sports of the field.

* The original white horse, which gives name to the hill and rich vale adjoining, 5 miles from Wantage, is thought to have been cut in honour of Alfred the Great, who was born in the neighbourhood: a white horse being the arms of Saxony.

Two others have since been cut in the turf near Calne and Westbury, and one lately near Marlborough.

The short turf on the Chalk hills, the site of ancient British sports, the seats of Druidism and ancient Kings, will ever continue to be favourite places of amusement: Gentlemen of *the Turf* having found this to be the best for ascertaining the comparative speed of British horses; the races of Newmarket, Epsom, Salisbury, Brighton, and several other places being on this Stratum. These open hills are also the sites of many large fairs and rustic sports. The Chalk hills have the purest air, and the clearest water flows in abundance from almost every part of their base.

This under part of the Stratum is much less chalky than the upper, it being scarcely any where soft enough for writing. It is in some places sufficiently indurated for building, in many burnt to lime, and in some parts used on the roads combined with flints, or, for want of better materials, alone; as at Market-Weighton, Marlborough, and the vicinity of Warminster.

Sharp ridges terminating in prominencies, are formed of this under part of the Chalk Stratum, as that between Dorchester and Weymouth, which extends through the Isle of Purbeck, to the remarkable promontory at its east end, which recommences in a still more remarkable one called the Needles, and extends in a ridge through the Isle of Wight. The promontory of Beachyhead is formed by the termination of a ridge of Chalk, called the South Downs; and that between Folkstone and Dover, of the ridge of Chalk which extends from thence through Kent and Surrey, to the Hogsback.

The chain of hills formed by the escarpment of this part of the Stratum, toward the south, and of the south Downs toward the north, are called, by the inhabitants of the interior weald district, the north and south Chalk hills. These, and other parts of the Chalk, from the abrupt ascent occasioned by it on every road south-west and north of London, are well known to travellers; as Beachy-head, Flamborough-head, and the north Foreland and cliffs of Dover, are known to mariners.

A singular variety, at least in the appearance, of this under part of the Chalk, occurs in Lincolnshire, which, from a tinge of red oxyde of iron, is there called red caulk. The same, very highly tinged with red, reappears on the opposite side of the Wash, under the cliff exposed to the sea, at the north-western point of Norfolk. Various beds towards the bottom of the Chalk sandy, and fine grained, seem to indicate the change to the coarser Strata of Sand which lie beneath. Considerable protrusions of the lower part of the Stratum of Chalk, Hurlock, Malm, and Firestone, greatly inferior in altitude to the general range of high downland, occur in several parts of the interior course of the Strata. Dunstable stands on the plain of one of these protrusions.

Other such projections, shown on the map by a second shade of green, about Watlington, spread westward to Tetsworth, which is on the extremity of the white or malm land.

South-west of the Thames, and similarly spread far west of the general line of Chalk hills, this kind of white land may be traced parallel to the river, half way from Wallingford to Abingdon.

The vale of Pewsey, and other vales which deeply indent the line of Chalk outcrop in Wiltshire, have some of the same kind of land. Some white land also spreads wide from the general range of Chalk, north-eastward of Dunstable, in different places thence to Cambridge.

ORGANIZED FOSSILS.

FIG.		
1	Inoceramus Cuvieri - -	Knook Castle and Barrow, Heytesbury. Hunstanton Cliff.
2	Inoceramus - - -	Wilts (Warminster).
3	Cast of a Trochus - -	Mazen Hill.
4	Ammonites - - -	Mazen Hill. Norton Bevant.
5	Cirrus depressus. - - -	Warminster.
6	Terebratula - - -	Heytesbury.
7	Terebratula - - -	Heytesbury. Warminster. Mazen Hill.
8	Terebratula subundata - -	Heytesbury. Mazen Hill. Warminster.
9	Shark's teeth - - -	Warminster.

CLASS of STRATA beneath the CHALK.

The preceding description having ended with the Chalk hills, which form the boldest feature of all the eastern and southern parts of England, it may here be necessary to make some observations on the class of Strata beneath.

Soils and Sub-strata as different as the appearance in the two surfaces, commence at the termination of Chalk: this difference is most striking in the northern and western parts. The most unobserving can scarcely pass without notice, in either of these, or a north-east direction out of London, this remarkable change in the country, which occurs on their descent from the Chalk hills.

In most parts a vale of considerable breadth appears to the extent of vision, parallel to the hills, which gives generally a correct notion of the country, as none of the Strata comprised within the class, which must necessarily be considered together, rise to great altitudes, or at least but rarely without some sort of intermediate valley. There are, however, some instances where the Sand (which is the next Stratum beneath the Chalk) rises to a greater height than the contiguous Chalk hills. Leith hill, and the hills about Longleat, Stourton, and Fonthill, are remarkable instances. These little hills show by their immediate connexion with the Chalk, that the greater sandy heights in the interior of Sussex and Kent, and those of Black Down and North York Moors, are formed of the same Strata. The materials of these vast spaces, and of those more inland; the vales of Blackmore, Wardour, Warminster, Pewsey, Whitehorse, and Aylesbury, and a similar vale extending through Bedfordshire to Cambridge, (with the Strata which compose the margin of those vales) form the class to be considered together, and which in many instances will be sub-divided with difficulty.

The districts enumerated consist of a great variety of Strata, which in the map are all represented by three colours—two blues, with a dark brown and its shades, representing the Oak-tree Clay, Purbeck and Portland stone, and the Carstone. The green sand being considered to occupy the white space on the map parallel to the termination of the Chalk, which is represented by green. The following is a more particular division of those districts of Strata:—

Three Sands, two Rocks, and two Clays.—Green or Chlorite Sand is the first, which contains Burstone, Fuller's earth, and Firestone. Indurated Brick earth succeeds, which is rather sandy and micacious. Sand and Rock, which produces the Portland and Swindon stone.—The other lower divisions come not within the present number.

Chlorite which gives the green tint, from which the name of Green sand has been taken, is repeated in the stony or concreted beds of land herein enumerated, and from these repetitions, the different courses of it, in different parts of the district, are liable to be mistaken or confounded.

The Oak-tree Clay also may be mistaken or confounded with the Brick earth, which in several parts produces good oak. It appears, however, on further investigation, that the Clay beneath the Portland stone, was the one generally so called by Mr. Davis in his Wiltshire report; and which in this, and the succeeding parts of the work, will be called by that name.

The green sand Stratum properly so called, which produces the extraordinary good land, is very limited in breadth, and is quickly succeeded by other sands, producing soil of an opposite quality.

GREEN or CHLORITE SAND.

Soil.—*Colour*, dark grey, dries whiter—another part so dark when wet and fresh plowed, as to be called *black land*, but dries much whiter.

Consistence, Dry, a fine mellow loam—where wet rather sticky.

Subsoil, Sandy, cohesive, absorbent.

Excavations, } Sides stand perpendicular, cohesive sand, dry; blue grey or greyish green,
Hollow-ways, } occasioned by small blackish specks of Chlorite—small Mica in some beds.

Stratum, Sand and incompact Sand stone, with layers of more concrete lumps or nodules, from some of which Burs or scythe stones are made.

Water, very bright, copious, and of a high temperature, where that of the Chalk and Sand flows all from this Stratum. In the west much used in irrigation.

No road stone along the course of this Stratum, and its white land boundary, but partakes either of Chalk, Malm, Greensand, or soft Freestone, or Sand concreted by a ferruginous cement; many of the roads (as in Sussex) are consequently bad.

Much of the first breadth of Sand from the Chalk hills in Sussex and Kent, is now, or till lately, was uninclosed heath.

ORGANIZED FOSSILS.

FIG.		
1	Alcyonite (funnel form) -	Pewsey. Warminster. Devizes. Dinton Park.
2	Alcyonite (doliform) - -	Pewsey. Warminster.
3	Venus angulata - -	Blackdown.
4	Murex *Linn.* - -	Blackdown.
5	Turritella *Lam.* - -	Blackdown.
6	Pectunculus *Lam.* - -	Blackdown.
7	Cardium	In a mass from Blackdown.
8	Rostellaria *Lam.*	
9	Trigonia alæformis	
10	Cucullæa *Lam.*	

FIG.		
1	Vermicularia (chambered) -	Horningsham, Wilts.
2	Solarium *Lam.* - -	Rundaway.
3	Pecten (echinated) - -	Chute Farm. Rundaway.
4	Terebratula pectinata - -	Chute Farm. Warminster.
5	Terebratula lyra - -	Chute Farm.
6	Terebratula - - -	Warminster. Chute Farm.
7	Chama haliotoidea - -	Dilton. Black Dog hill, Teffon. Evershot. Stourton. Alfred's Tower. Blackdown.
8	Pecten quadricostata - -	Chute Farm. Warminster. Blackdown.
9	Pecten - - -	Chute Farm.
10	Ostrea (Gryphea *Lam.*) -	Stourton. Dinton Park. Tinhead.
11	Echinus with a singular anal appendage - - -	Chute Farm. Warminster.
12	Echinites *Leske* - -	Warminster. Chute Farm.
13	E. lapis cancri - -	Chute Farm, &c.
14	Spatangus *Leske* - -	Warminster. Chute. Rundaway.
15	Cyclolites *Lam.* - -	Chute. Puddle hill, near Dunstable.
16	Madreporite - -	Chute Farm.
17	Alcyonite - - -	Chute Farm.

MICACEOUS BRICK EARTH.

Soil.—*Colour*, blackish brown.

Consistence, kneadable, tenacious or sticky when wet, mouldering when dry.

Subsoil, yellower than the soil, retentive, good brick earth, some of it works freely into tiles and coarse pottery.

Excavations, retain water, browner or bluer, digs hard, falls in large lumps of a conchoidal fracture.

Stratum, indurated micaceous clay, yellowish brown to dun blue; cuts smooth; returns earthy smell.

The surface of this stratum is frequently so obscured by the loose incumbent stratum of Sand, that in some parts its outcrop may be passed without notice, and its course traced with difficulty.

It often constitutes the base of some of the highest western promontories of chalk; seldom quits the chalk hills far enough to occasion any great breadths of clay land: is often covered with small woods, chiefly of oak, in tolerable state of luxuriance. As this clay keeps up the water of the chalk and green sand, and occasions the first springs at the foot of those hills; the course of it may thus be traced: also, by rushes and other indications of a clay surface, especially in a district so generally abounding in sand.

ORGANIZED FOSSILS.

FIG.		
1	Ammonites - - - - -	Near Godstone. Steppingley Park. Prisley Farm, Bedfordshire.
2	Hamites - - - - - -	N. West part of Norfolk.
3	Echinus *Linn.* Spatangus *Leske* -	Near Devizes.
4 5	Belemnites	North of Riegate, near Godstone. Norfolk (N. W. part). Steppingley Park. Prisley Farm.

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PORTLAND STONE.

SOIL.—*Colour*, Brown.

Consistence, absorbent, sandy loam; much intermixed with stones, which vary in quantity, size, and hardness, as the different beds of rock occupy the surface, commonly called Stonebrash.

SUBSOIL, Orange brown, all stone, or sand and stone alternating, absorbent.

EXCAVATIONS, all dry; in sand and stone; some made down to the water.

STRATUM, masses of stone in thick beds or layers; bluish white, brownish white, and some hard blue or blue grey.

Disintegration, Few persons who have not made observations on this subject can be aware, how a rock nearer and nearer to the surface, gradually divides into building stone, wall stone, rubble stone, and soil. This should be particularly attended to in tracing the terminations or outcrops of rocky Strata.

WATER.—Copious springs flow from the bottom of the rock.

The Swindon stone, unlike many other great rocks, forms not of itself, any elevated or distinct ranges of hills, except at particular places, and then only, too frequently in conjunction with the lower Strata, by which those of the stone are hidden or much obscured. The rock is also subject to great change in appearance and quality, yet the Portland stone can be easily identified at particular places, along the course of the Stratum which produces it, to as great an extent as some of the other Strata with which it alternates. Portland Isle is one extremity, and Hambledon hills, in Yorkshire, the other. The rock, however, it is evident from various causes, cannot, in a connected line of outcrop, ever be traced from one of these points to the other, which is a space of 300 miles, but the Strata above and below, which seem to inclose the rock, if not the identical beds of stone, may be recognized for a considerable part of the distance. It is best known in Portland, Purbeck, Wiltshire, the vale of Aylesbury, and in Kent and the vale of Pickering. Hambledon hills also produce the Portland variety. The stony land on the western border of Dorsetshire, appears to be the same. It has long been worked for building, equal in quality to that of the noted island, in the vale of Wardour. Sand is much blended with it at Swindon.

This rock, though long worked to a great extent in several places, in others would be discovered with difficulty. Its site is in many parts near the foot of the Chalk hills, and in others so widely distant from them as to leave the intermediate course doubtful with a skilful Geologist.

It contains some very thin beds of chert or flint, and some thick beds of Freestone, as soft as Chalk.

Large flinty nodules are sometimes enclosed in the Freestone, the beds of which vary much in different quarries. The organized fossils vary less. They are therefore in this instance, remarkably useful in identifying the Strata.

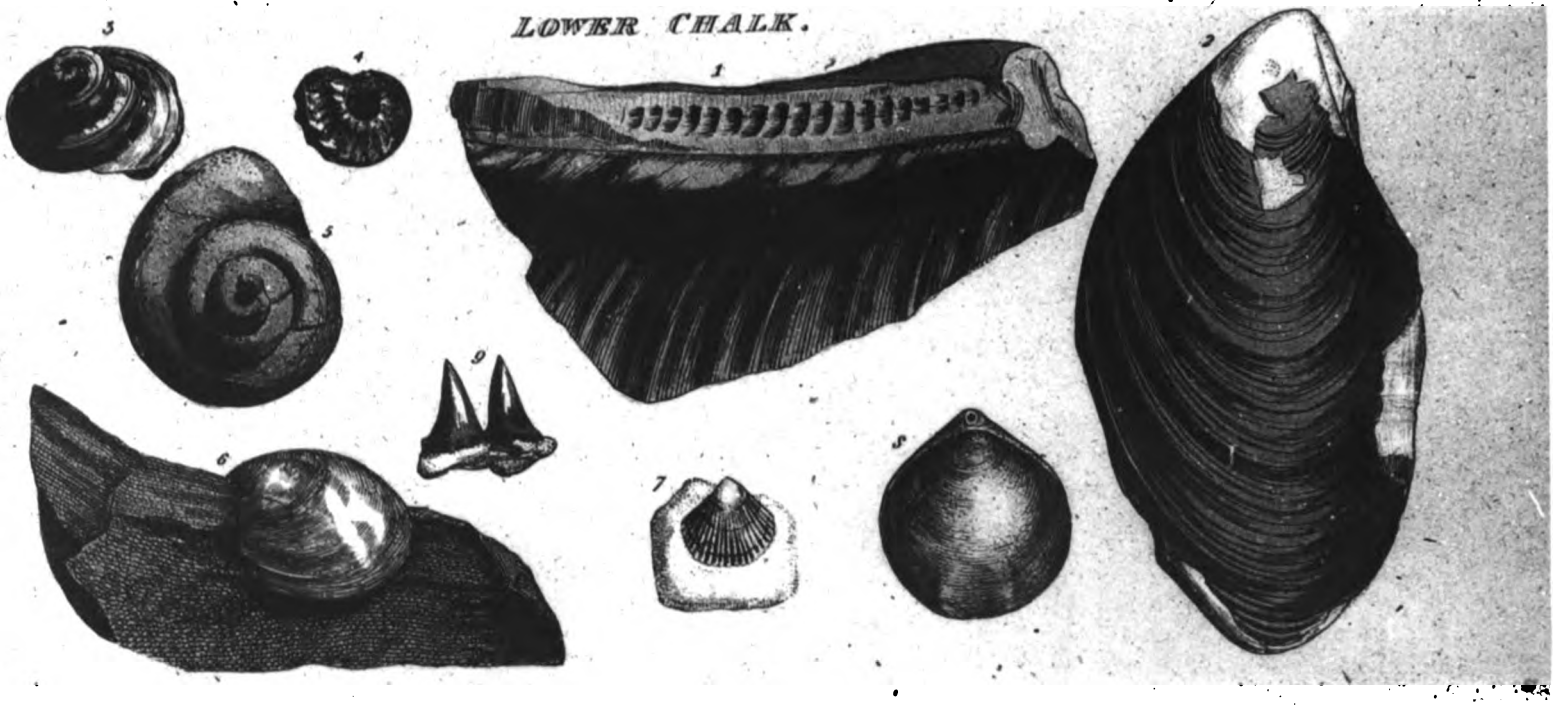
In passing over the Strata from east to west, and noticing their successive terminations, it may be remarked, that this Stratum, in a large portion of the island, is the first beneath the Chalk which produces quarry stone hard enough to be used on the roads. In the space between the course of this Stratum and the green sand, a very hard material is sometimes found, consisting of thin beds of coarse flint or chert, which, in layers about three inches thick, is used in building at Haslemere, Warminster, and Chard.

No flint below this Stratum. The organized fossil shells preserved in chert, are the finest in the kingdom.

ORGANIZED FOSSILS.

FIG.					
1	Cast of Natica *Lam.* - -	Swindon.			
2	Turritella inside cast - - -	Swindon.	Portland.		
3	Cast of Venus *Linn.* - - -	Swindon.			
4	Trigonia - - - - -	Swindon.	Chicksgrove.	Fonthill.	Teffont.
5	Venus, inside cast - - -	Swindon.	Chicksgrove.		
6	Pecten - - - - -	Swindon.	Portland.	Chicksgrove.	Thame.
7.	Fossil Wood - - - -	Woburn.	Fonthill.		

LOWER CHALK.



1. *Inoceramus Cuvieri.* Mantell Annals V. 4 p. 400.
2. *Inoceramus.*
3. *Cast of the inside of a Trochus.*
4. *Ammonites.*
5. *Cirrus depressus.* Sowerby. MS.
6. *Terebratula.*
7. *Terebratula.*
8. *Terebratula subundata.* M.C. t. 23 f. 7.
9. *Sharks teeth.*

Green Sand. 2 plates.

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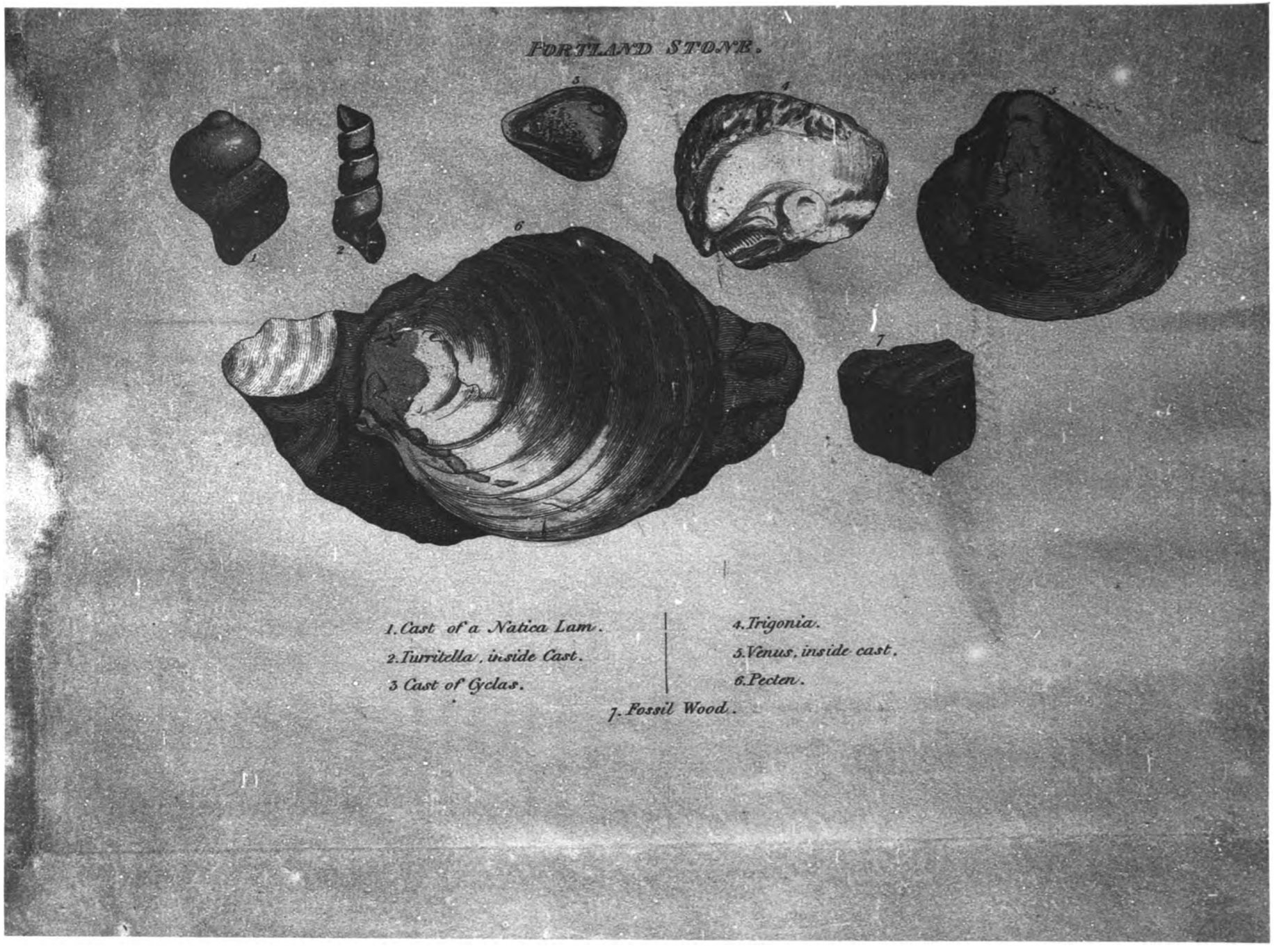


OAK TREE CLAY.

SOIL.—*Colour*, Brown, yellowish, bluish.
Consistence, Tenacious, unabsorbent Clay ; cracks in dry summers.
SUBSOIL.—Scarcely anywise different from the thick mass of the Stratum.
Colour, Sometimes yellowish tenacious Clay, varying to blue and yellow mixed, and deeper to the regular blue of the Stratum.
EXCAVATIONS, and Ditches, hold Water.
STRATUM, Hard blue Clay, interlaminated with stony nodules of indurated Marl, and layers of Fossil shells ; some blacker, laminated, splits like Clay slate ; some bitumenized wood.
WATER, In every pit and ditch, and through the winter in the foot-marks of every heavy animal. In summer short of water, and that in the wells generally of a bad quality.

SOIL, very different from that of the Stratum, is in this district common to a Subsoil of Gravel, which abounds with calcareous matter. This will be described at the end of the work, as such Fossils vary not according to their sites, but according to the nature of the Strata, from whence the fragments of the compound appear to have been torn, and rounded in water.

This is the second Stratum of the Clay vales, or those within the lowland class, at the foot of the Chalk hills. In some parts of the course of this Stratum it would appear to be properly the first thick blue Clay Stratum, descending in the series of British Strata ; the Clays above the Chalk being generally brown or dun coloured, or rarely exposed so blue as those below the Chalk, which form the two great interior Clay and Marl vale districts : that nearer the Chalk is more of a Brick-earth. As deep as the plough goes, the Clays in Essex are generally brown, but here the plough frequently exposes the native blue colour of the Stratum. Where the subsoil partakes thus much of the nature of the Stratum, this kind of land is little cultivated. Amongst these Clays a subsoil of a lightish brown yellow is exposed by the plough.

Widely-extended parts of this Stratum, and also insular and widely-detached hills of it rise upon a base of sand and stone, to considerable altitudes between the vales of White-Horse and Isis, and also between the vales of Aylesbury and Ottmoor. Badbury and Faringdon Hills, Bagley Wood and Shotover, on opposite sides of the Thames, below Oxford, and Brill Hill, are some of the most remarkable.

The surface composed of this Clay is of great breadth between Swindon and Wotton Basset. Thence eastward it connects with the vale of White-Horse, where it extends wide and long, and lies so flat as to give name to Standford in the Plain ; and in the space before mentioned, the names of Morton and Even-Swindon, are evidently taken from low, level, and watery parts on the surface of this Stratum.

It appears to be this Clay which forms the deepest part of the Strata, exposed by the vast rising in the under-Strata between the fork of the Chalk hills, in Kent and Sussex.

It is here, as in other parts, thickly covered with Oak; and here also, as in other parts of its course through the interior, it seems to be distinguished by considerable plains, which in this district are most remarkable on each side of the Forest Ridge, between the sands of that hill and those nearer the Chalk hills, and constitutes what may be called the deepest parts of the Wealds of Kent and Sussex.

Organized Fossils contained in the Septaria of a thick Stratum of Clay, incumbent on rock, are frequently the same as in the top of the rock itself; therefore, figures of these need not be repeated. The Melania of the Oak-tree Clay is the same species as M. Heddingtonensis, which, is common to the top of the Coral Rag rock.

Cockscomb Oysters are also common both to that rock, and to the Septaria above; in fact those large Clay-balls found plentifully in the deep cutting of the north Wilts Canal seemed to partake both of the inhabitants of the rock above, and of that below the Clay; the Trigonia of the Clay-balls being the same species as those large ones which compose the chief part of some beds of stone, about four feet thick, near the bottom of the Swindon rock.

It may at first appear that the identification of Strata, by the organized Fossils they contain, would in such cases be somewhat doubtful; but in the course of the work I shall make further remarks on such apparent repetitions, which will rather show the great utility of them, to well-sinkers and others, concerned in deep excavations in these thick Strata of Clay, abounding with alternations of stony matter and organized Fossils.

The flat Oyster, fig. 6, in a layer, is so common in the ditches of this land, as to be called *Clay Shells*.

None other of the organized Fossils are found but in deep excavations.

ORGANIZED FOSSILS.

FIG.		
1	Melania Heddingtonensis - -	North Wilts Canal.
2	Turbo - - - - -	North Wilts Canal.
3	Trochus - - - - -	North Wilts Canal.
4	Ampullaria - - - -	North Wilts Canal.
5	Chama - - - - -	Bagley Wood Pit. North Wilts Canal. Well near Swindon, Wilts and Berks Canal.
6	Ostrea delta - - - -	Canal at Seend. Well near Swindon, Wilts and Berks Canal. North Wilts Canal. Bagley Wood Pit. Near Shrivenham. Even Swindon. Wotton Basset.
7	Ammonites - - - -	North Wilts Canal. Well near Swindon, Wilts and Berks Canal.
8	Venus - - - - -	North Wilts Canal.
6	Terebratula - - - -	Bagley Wood Pit. Well near Swindon, Wilts and Berks Canal. North Wilts Canal.

CORAL RAG and PISOLITE.

Soil.—*Colour*, Dark brown.

Consistence, Loose when dry; rather tenacious or kneadable when wet; thickly strewed with small stones, roundish or irregularly shaped, which in roads wear white.

Subsoil.—Moist Clay and a rough irregular Limestone.

Excavations, Shallow, on outcrop of the rock; stone whitish; where mixed with Clay, hold water; where sandy, dry.

Stratum, Lightish blue in deep pits; where the Stratum is entire, beneath its incumbent Clay hard and solid, except the cavities occasioned by stems of Madrepores.

The Pisolite part of the rock beneath has a dryer, stony, and less adhesive soil, of the sort usually called Stonebrash. The stone in some of its beds is white, and composed of unequal sized ova. Loose ova may be seen at the sides of banks and other bare places.

Water, flows in abundance from this rock, and the Sand and Sandstone, which is the bottom of the Stratum.

My Geological Table of organized Fossils shows that this rock and the Sands have been represented on my map by the same colour; but now, by the better arrangement of my fossils in the British Museum, and my subsequent observations, these Strata are more distinctly divided.

The Coral Rag consists chiefly of lumps of coralline Limestone, which in the quarry are very rough, irregular, and dirty; but where roads cross the outcrop, or where this stone is used as a road material, it wears to a smooth surface, which is whiter and harder than any other stone in the vicinity.

The Pisolite Freestone beneath is softer. In some parts it being an Oolite of fine grain, is used in building, and in specimens without organized Fossils, is scarcely to be distinguished from Portland Stone.

Coral Rag and Pisolite, with the Sand and Sandstone beneath, make a surface of dry land, which, within a generally moist surface of Clay land, is very desirable for tillage, and is commonly thus appropriated.

Among the stones turned up by the plough, most of its organized Fossils may be found, but the quarries generally produce sharper and better specimens.

The greatest breadth of surface formed by the outcrop of this Stratum is in Wiltshire, Berkshire, and Oxfordshire: its course north-eastward becomes obscure, or is covered with alluvial matter before it reaches Buckinghamshire.

From Steeple Ashton, Wiltshire, the south-western course is indistinct, or the stone is deeply covered in the high hills of Sand, and forms part of their altitude; as in this direction it re-appears in the low part of Longleat park; and beyond the high Sand hills of Stourton, the

outcrop of this rock again occupies a considerable surface of ploughed land, extending Penselwood through the vale of Blackmoor to Stourminster Newton.

The greatest surface of this stony land is about Calne, by Bremhill, Lyneham ... ham, to Wotton Basset; thence by Lydiard, Blunsdon, Stanton, Stratton ... hampton, to Highworth; Coleshill, Shrivenham, &c. to Faringdon, and thence ... road to Oxford, and spreading eastward, almost to Abingdon, where it is covere...

Over the Thames it again expands from Sandford, westward by Cowley Common, and all the elevated plain between the foot of Shotover Hill and ... St. John's, &c. contracting in the width of its course northward, till it becomes ... great breadth of clay land.

The sand which lies beneath this rock is scarcely known in some plac... ng a great breadth of surface, and in others is highly tinged with the re... gives it a very different appearance.

Between the limestone rocks, containing the Fossils herein describe... lami- lies a floor of stone, which preserves the escarpment of the ston... clay vale district might be said to be divided into two ranges of vale... Horse and Aylesbury being to the east, and the vales of Bedford, ... the clays. north Wilts to the west of this ridge.

ORGANIZED FOSSILS

FIG.

1 Madrepora - - - Stanton near Hi... Pit. Bann... and Berks ... Bayford.

2 Madrepora - - - Steeple As...

3 Madrepora - - - Steeple As... ton ... Wilt... Woo...

FIG.

1 Turbo - - - I...

Ampullaria - - -

... riata - -

... rista galli -

...as -

latter spe... ...tic distin...

...and sands before ...eminences, and in ...tioned and the Port- ...nce of such partitions ...halk before-mentioned, ...above them very difficult. they ought all to be found, ...rvations on these and other of

...he confines of the stony district, ..., which are called knolls or knowls. ...xford, and Lew-hill, near Bampton, ...ry and Chippenham, and further west- ...e of Blackmoor.

...ay, through the interior of England, may ...enumerated, and likewise of the lowest land ... to inundation; but they also rise like other soft

...Stratum of Clunch Clay, from its N. E. course, ...shire, between Olney and Bedford, and is protruded ...e river Ouse, between these two places. The extreme ..., seems to form the summit of drainage, through the ...ne Ouse, and so continues to form the boundary between ..., into the fens below Peterborough, and continues north- ...and parallel to the low land.

CLUNCH CLAY and SHALE.

Soil.—*Colour*, Brown, darker and bluer wet.

Consistence, unabsorbent, adhesive, and tenacious clay; dries in hard lumps; cracks in dry summers.

Subsoil.—Much the same as the Stratum, in some places yellowish; deeper, gradually changing to blue.

Excavations and Ditches, hold Water.

Stratum, hard clay rising in lumps, called Clunch; deeper in the Stratum, blacker and laminated, called Shale.

Water, The remarks on water in the Oak-tree Clay are applicable to this Stratum.

The best water in the clay vale district lies in gravel, or in the rocks beneath the clays.

Clunch Clay forms the base of the hills which are surmounted by the rocks and sands before described, appearing chiefly, if not wholly on the escarpment side of those eminences, and in the lower grounds of the several wide vales adjoining. Where the last mentioned and the Portland rock, and their accompanying sands also, become deficient, the absence of such partitions in these clays, which altogether form the broad district parallel to the chalk before-mentioned, renders the distinction between the thick clays and the Brickearth above them very difficult. And which of them keeps possession of the low surface, wherein they ought all to be found, must ultimately be determined by further and more accurate observations on these and other of their respective distinguishing characters.

The Stratum of the Clunch Clay, and the other clay on the confines of the stony district, terminate in some parts of their course in rounded low hills, which are called knolls or knowls.

A small hill by the Worcester road, two miles out of Oxford, and Lew-hill, near Bampton, are some of these. Other such occur between Malmsbury and Chippenham, and further westward along the courses of these Strata, through the vale of Blackmoor.

The general course of these very thick Strata of clay, through the interior of England, may be known as the site of the broadest vales before enumerated, and likewise of the lowest land in the island, and of that most frequently subject to inundation; but they also rise like other soft Strata, into hills of moderate elevation.

The outcrop or basset edge of the thick Stratum of Clunch Clay, from its N. E. course, through Buckinghamshire, enters Bedfordshire, between Olney and Bedford, and is protruded on the heights, into the great bend of the river Ouse, between these two places. The extreme continuation of the Clunch northward, seems to form the summit of drainage, through the remainder of Bedfordshire, north of the Ouse, and so continues to form the boundary between Northampton and Huntingdonshires, into the fens below Peterborough, and continues northward through Lincolnshire, under and parallel to the low land.

Proceeding south-westward, from the well defined part in North Wilts, its course, in or near the same high ground as the Stratum before described, narrows much, but like that stone spreads again in the broad vale of Blackmoor, following the outcrop of the Coral Rag and Pisolite Rock, past the River Stour; further westward, where the stony land is deficient, the course of the Clunch Clay is less distinct, and here, as in the north, is not likely to be identified, or clearly distinguished from the other Clays above it, but by the organized Fossils in wells and other excavations.

But for these, and the numerous experiments for coal, the nature and contents of these clayey Strata deep in the earth could not have been known

By some of the perforations in Wiltshire, &c. it appears that the lower part of this thick Stratum is considerably laminated, and rises in large flat pieces, which when dried are slightly inflammable.

Thus as the best and most delicate fossils of this Stratum will not bear exposure, they can be found only by persons employed in excavations, or those who overlook such works; hence it would be fruitless to search for any but in those places; and there being little inducement to make deep excavations in these strata, and no canals or other public works in hand, specimens of these fossils cannot be multiplied for collections, or will be obtained with difficulty.

The lower part of this thick clay, like that of the one preceding, contains septaria stored with organized fossils, greatly resembling those of the stony Stratum beneath.

Ammonites Calloviensis in mass are inclosed in these septaria, remarkably sharp and fine, with a whitish exterior, but are liable to decomposition from the oxydation of the Sulphuret of Iron they contain.

The beautiful specimens many years since dug up from my good friend Mr. T. Crook's estate, in a large septarium lying in clay, are omitted in this Stratum, the same species being figured as characteristic of the rock beneath.

In this as in several other instances where the bottom of the clay contains the same fossils as the rock which it covers, it is difficult to determine to which Stratum they belong.

ORGANIZED FOSSILS.

FIG.		
1	Belemnites - - - - -	Dudgrove Farm.
2, 3	Gryphæa dilatata - -	Derry Hill. Meggot's Mill, Coleshill. Tytherton Lucas. Dudgrove Farm.
4	Ammonites - - -	Tytherton Lucas. Thames and Severn Canal.
5, 6	Serpula - - - -	Wilts and Berks Canal, near Chippenham.

The upper part of this thick Stratum contains large incurved oysters or Gryphæa, so much resembling others I have collected from remote parts, of a clay which now appears to be Oak-tree clay, as to be distinguished with difficulty; but this is only one of the many instances of the general resemblances of organized Fossils, where the Strata are similar.

KELLOWAYS STONE.

SOIL.—*Colour*, yellowish brown.

Consistence, over the stone dry sandy loam, above and below approaching to clay; kneadable clay loam intermediate.

SUBSOIL, yellower than the soil, sandy with rubbly stone; where wet, and the stone deficient, kneadable, or very sticky and tenacious.

EXCAVATIONS, rare, shallow, hold water; in some places a clay covering to the stone, abounding with Selenite.

HOLLOW-WAYS, in roads across the course of this Stratum but little sunk beneath the surface of the adjoining lands, seem to indicate its site.

STRATUM, brown rubbly stone, with sandy exterior; irregular lumps, bluer and harder within, composed chiefly of organized Fossils; used only on the roads.

In most parts the surface and soil of this stratum differs but little from that of the clay courses on each side, and that little distinction is still further partially obscured by the soil of the calcareous alluvium which is common to the clay vale district.

This extraordinary stone, which neither from its thickness or consistence can properly be called a rock, should be considered like the two preceding rocks and sands, only as one of the divisions in the great clay district before described; there being beneath this stone another stratum of clay, which is the boundary of the great stony district called the Stonebrash Hills.

The course of the Kelloways Stone is known only by the few excavations in it, chiefly for road materials, which in a country abounding so much with clay are very scarce. It no where forms any characteristic surface, or rarely a hill or other feature which is distinguishable to any but those who know where to look for the Stratum.

Several small commons in North Wilts, rather sandy and springy, seem to be of the soil formed by the outcrop of this Stratum, whose course is but partially defined.

Good bricks are made of earth dug near the course of this stone and its sand.

Selenite is very abundant in the clay above it: bituminous wood, and a brown aluminous earth below it. There is great reason to believe, that the mineral waters of the lower part of the clay vale series are from this stone, or some contiguous part of the clay above or below it.

Rarely as this stone appears by outcrop, the recent excavation for coal at Bruham proved it to be perfect in the deep, and there to contain the lobate Oyster, or Gryphus, (*b* in the British Museum,) and the other organized Fossils by which it is most distinctly characterised.

The excavations of the Kennet and Avon, and Wilts and Berks Canals, exposed new outcrops of this stone, which I afterwards found on the Thames and Severn Canal, near South Cerney.

From the great obscurity in the course of the Kelloways Stone, the organized Fossils of the Stratum can only be found in excavations, and in the stone used on the roads. Some of the larger Ammonites polished, exhibit the same beautiful arrangement of colours as the septa of the large Septaria, which in Dorsetshire are cut and polished for slabs and chimney-pieces.

ORGANIZED FOSSILS.

FIG.		
1	Rostellaria - - -	Kelloways. Wilts and Berks Canal, near Chippenham.
2	Ammonites sublævis - -	Christian Malford. Ladydown Farm. Kelloways.
3	Ammonites Calloviensis - -	Wilts and Berks Canal, near Chippenham. Kelloways.
4	Ammonites - - -	Dauntsey House. Kelloways. Wilts and Berks Canal, near Chippenham. Kennet and Avon Canal, near Trowbridge.
5	Gryphæa incurva - - -	Kelloways. Wilts and Berks Canal, near Chippenham. Ladydown. Bruham Pit.
6	Terebratula ornithocephala -	Kelloways. Dauntsey House. Thames and Severn Canal. Wilts and Berks Canal, near Chippenham.

From these and other organized Fossils, it is impossible to mistake the Kelloways Stone; and but for the course of this Stratum, the limits of the clays above and below it would be ill defined.

OAK-TREE CLAY.

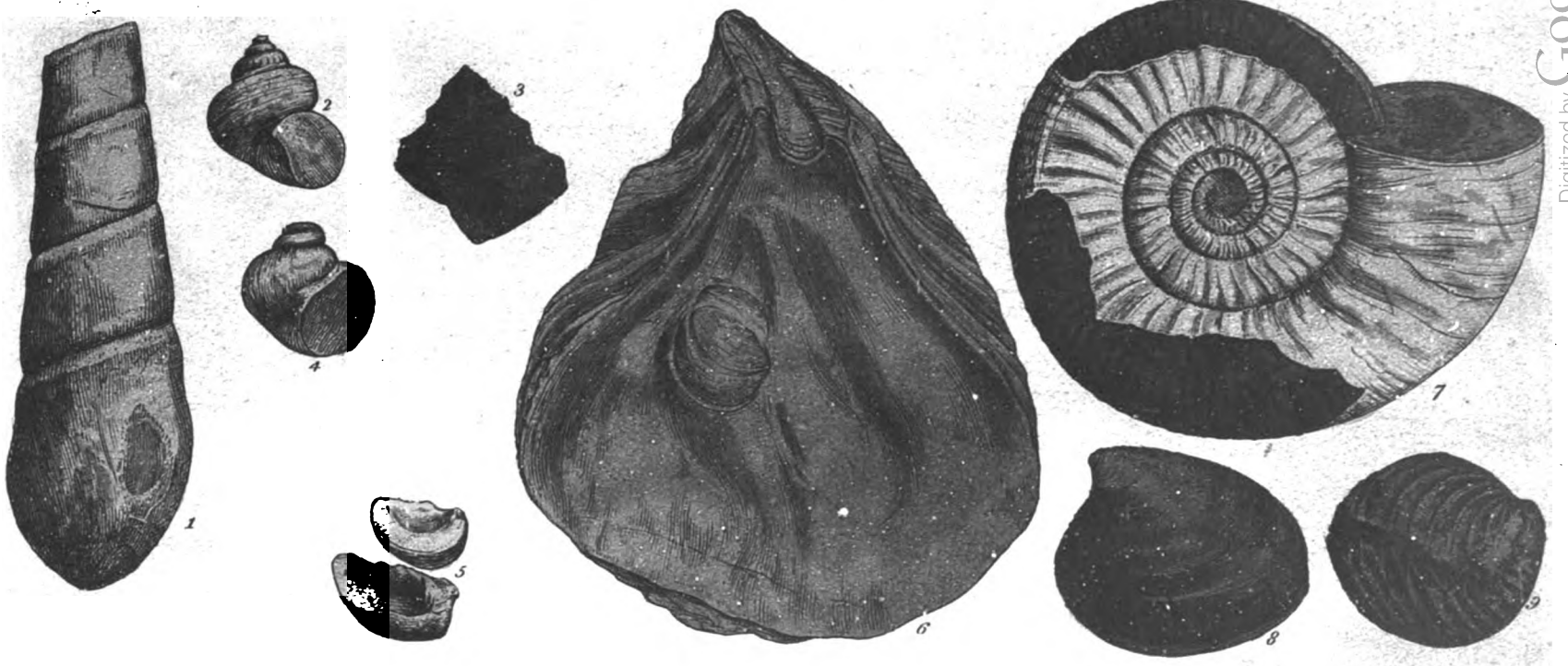


Fig: 1 Melania Heddingtonensis Min. Con: t. 39.

2 Turbo ?

3 Trochus

4 Ampullaria

Fig: 5 Chama

6 Ostrea delta Min. Con. t. 140.

7 Ammonites

8 Venus

Fig: 9 Terebratula

CORAL-RAG & PISOLITE.

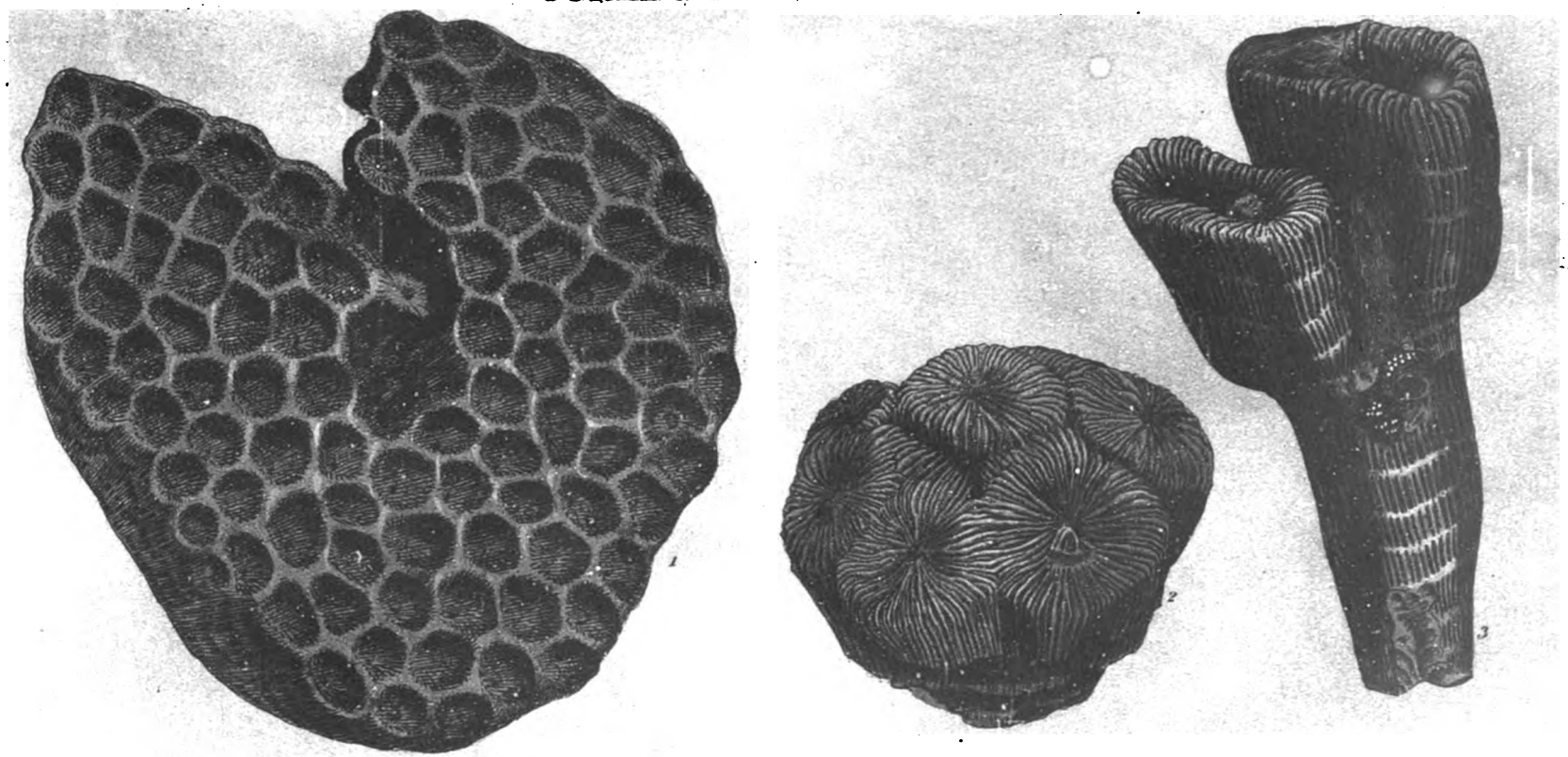


Fig. 1. Madrepora.

2. Ditto

3. D.°

CORAL RAG & PISOLITE.

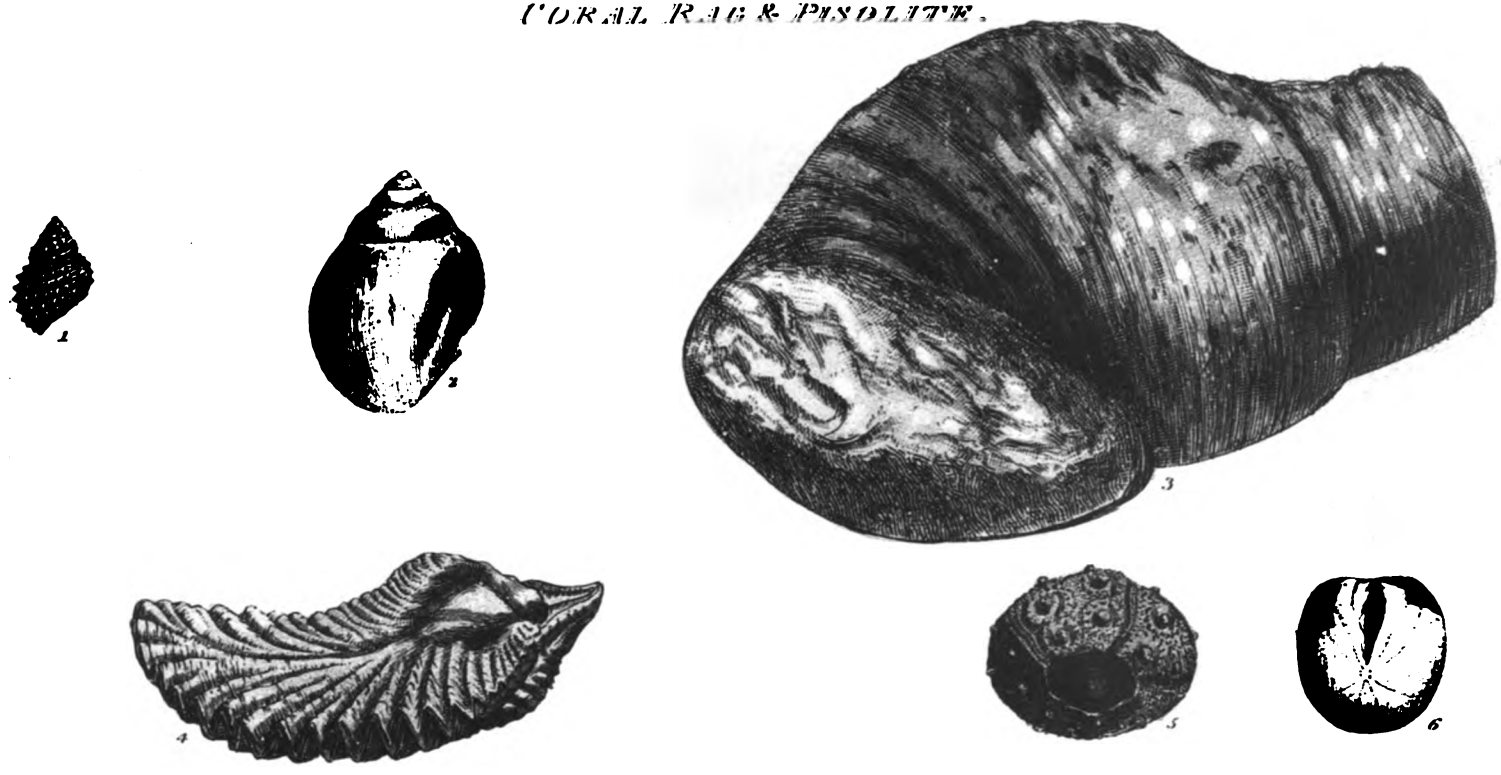


Fig: 1. Turbo

2. Ampullaria

3. Melania striata Min Con tab 47.

Fig 4 Ostrea crista-galli

5 Cidaris

6 Clypeus

Fig. 1 Large Belemnite

2 Gryphæa dilatata Min. Con. tab. 142. lower valve.

Fig. 3 Gryphæa dilatata upper valve.

4 Ammonites armatus? Min. Con. 495.

5 Serpula

6 Serpula

KELLOWAYS STONE.

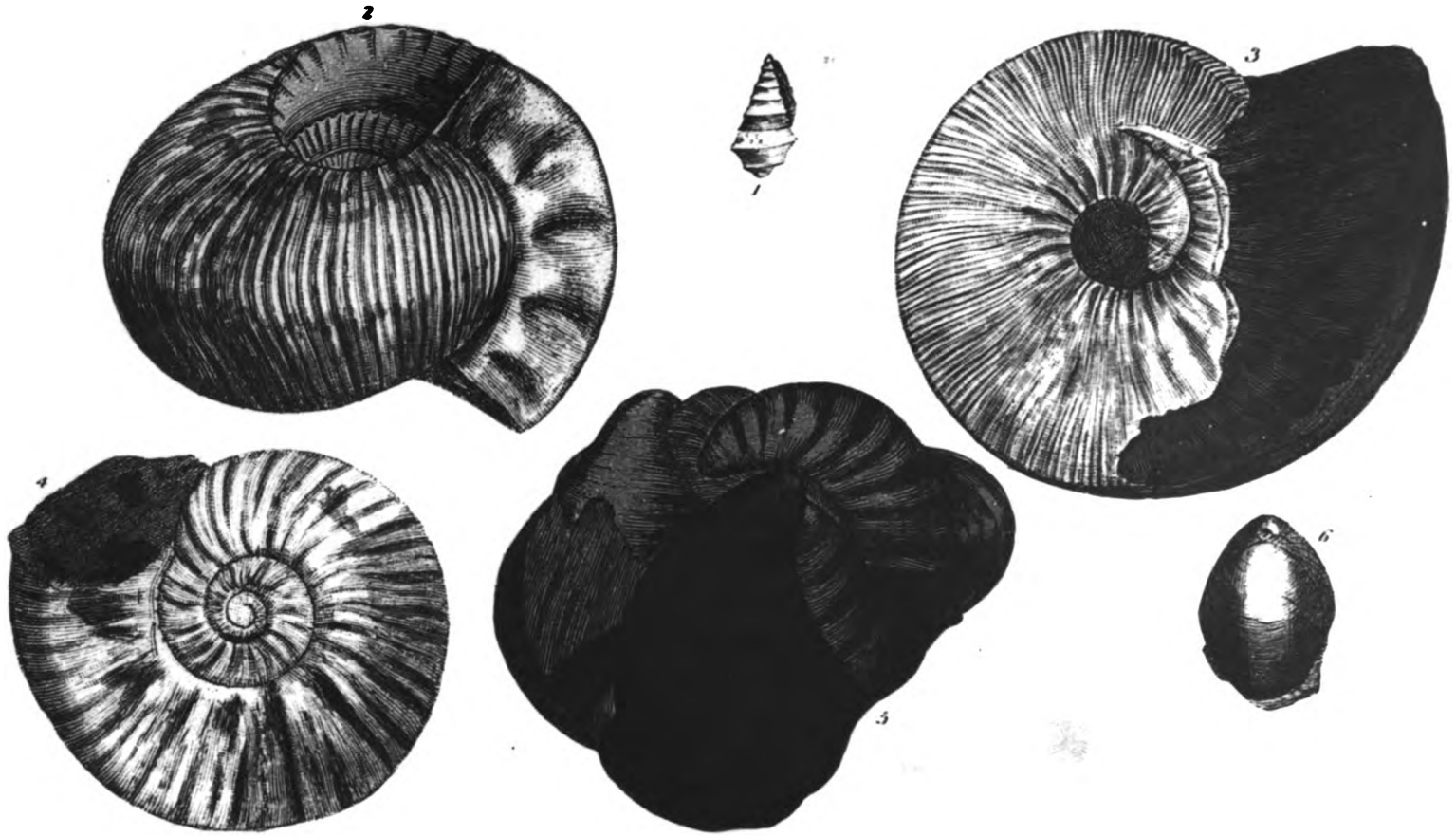


Fig 1 Rostellaria

2 Ammonites sublævis Min. Con. t. 54.

3 A. Callovicnsis Min. Con. t. 104.

Fig 4 Ammonites

5 Gryphæa incurva Min. Con. t. 112.

6 Terebratula ornithocephala Min. Con. t. 104.

CORNBRASH.

Soil.—*Colour*, reddish brown, more remarkable on the outcrop of the upper, than of the lower part of the rock.

Consistence, rather tenacious when wet; but like other Stonebrash soils on the rubbly subsoil of a Limestone rock, it is kept loose enough for cultivation by the small rubble stones thickly strewed on the surface of its ploughed fields, but which disappear when laid down to pasture. In some fields these are mostly organized fossils.

Subsoil, Rubble or roadstones, rather flat, and so little intermixed with soil or earth, as to be used on the roads as they are shovelled up from the quarries.

Stratum, the same. The bluer, thicker, and larger stones in deep quarries are rarely more than six inches thick in the beds: outsides brown and earthy, darker and harder within. The rock generally grey or blue under its incumbent stratum of clay.

Water, in the winter too commonly fills every crevice in the stratum of rock, the subsoil and soil; dry in the summer.

Excavations, hold water in winter,—not deep,—made for the use of the roads, to the extent of some acres, and if well levelled, resoiled, and drained, taking out the stone in some instances, rather improves than injures the land.

In a distinct arrangement of British Geology into assemblages of Strata, which collectively form distinguishing features of the Earth's surface, and each class described by an appropriate name, the Stratum under consideration must form the boundary of one of those important divisions. It is the decided limit of the *Clay Vale District*, and the commencement of the stony surface, which gradually rises to the Stonebrash Hills. It rarely ascends to the highest of those hills, but occurs more generally on the confines of the low ground formed by the incumbent Stratum of clay. As the hills of this stratum are not high, so its vallies are not deep: in some parts they are merely slight undulations of surface, which correspond to similar undulations in the Stratum, and crossing its general course, produce many small springs and rivulets, frequently dry in the summer.

Like some other Limestones, the Cornbrash forms small insular knolls, or caps of hills, on the sloping side of the great series of Stonebrash Hills, of which it forms a part. Such detached parts occur near Charterhouse Hinton, south of Bath. That of Addington, Woodford, and Wold Farm, north of the river Nen, in Northamptonshire, appears to be so.

It is remarkable for regularly sloping planes on its surface, as near Witney, Campsfield near Woodstock, and near Bicester in Oxfordshire, and also near Peterborough. It is chiefly in arable, superior in quality to much of the similar soils of the Stonebrash Hills, and when otherwise appropriated to pasture, produces grass of a good quality.

The Cornbrash, though altogether but a thin rock, has not its organized fossils equally diffused, or promiscuously distributed. The upper beds of stone which compose the rock,

contain fossils materially different from those in the under. The clusters of small oyster-shells, and the stems of the pentacrinus, lie near together, and not many other fossils occur toward the bottom of the rock. Both these sorts are found about the clay which lies beneath the stone; and in a detached piece of the Cornbrash Stratum, (not ten acres,) near Pipe-house, south of Bath, the encrini are found above the springs, in the brownish clay turned up by the plough.

ORGANIZED FOSSILS.

FIG.	
1	Natica? — Road, Sleaford. Wick Farm.
2	Ammonites discus — Closworth. Road. S. W. of Wincanton. Chillington.
3	Modiola — Closworth. Wick Farm. Holt.
4	Trigonia costata — North side of Wincanton. Wick Farm.
5	Venus *Linn.* — Trowle. Sheldon. S. W. of Wincanton. Norton.
6	Cardium — Road. Elmcross. Wick Farm. Sleaford. Woodford. Near Peterborough. Near Stilton.
7	Unio? — North Cheriton. Road. Draycote. Maisey Hampton. Sleaford. S. W. of Tellisford. Sattyford. S. W. of Wincanton.
8	Avicula echinata — Closworth. North Cheriton. Lullington. Trowle. Sheldon. Draycot. Norton. Stony Stratford. S. W. of Tellisford. North side of Wincanton. S. W. of Wincanton.
9	Terebratula digona (*var.* gibbosa, rotunda) — Closworth. Redlynch. Trowle. Wick Farm. Sheldon. Latton. Woodford.

FOREST MARBLE.

SOIL.—*Colour,* dull dark brown.

Consistence, tenacious, sticky, or adhesive, and difficult to plough when wet; when dry loose or dusty; thinly strewed with flat stones.

SUBSOIL, gray; broad flat stones, with clay or tenacious earth between: in some parts a whitish blue indurated marl between.

STRATUM, gray coarse grained stone, some of which on closer inspection appears to be composed of dark coloured shells, interspersed with whiter grains of ova. Bivalve shells most common to the thick beds; univalve to the thin. Decomposed pyritical wood often gives a partial redness; and some of the joints have a reddish tinge.

Some of the most solid beds in different parts of its course are raised and polished ... marble. Much of the stone is brown on the outside, and gray or blue within.

EXCAVATIONS, not very deep; sometimes dry, but more commonly in low ground hold w... particularly in winter.

This rock is distinctly separated from the preceding by a course of clay, below ... and sandstone, alternating with some of these shelly beds, renders the top ... distinct. The bottom of it rests upon clay, which is the covering of the up... which occasionally contains thin gray lamina of stone, like some of the ... composed of ova, and small turbinated shells compact enough to rec... of the rock which rise large and sound enough for slabs and marble ... rally in clay, or in pits which hold water. Where the separating c... rock sinks into the more capacious joints of the Oolite rock ... swallow-holes, which are very numerous in the course of this St... and other parts of the Cotswold Hills, to the forest of Whi... ton. adjacent quarries it has received the name of Forest Marble.

In some dry quarries the stone is so soft and porous, so ... Farley Castle. interspersed with ova, as to be scarcely distinguished by ... of the upper Oolit... hich is equally stored with smal... but lit... y bet... e two rocks

T... ... night th... lered ... ome hi... f the ... thro... and ... aina... flag...

fossils which are visible in every bed of stone, are rarely or ever obtained but from quarries, and other excavations: a few are occasionally found in the clay between the stone. Bones, teeth, and wood, firmly imbedded in the stone, are some of its most characteristic identifications. This is the third rock downwards, in the British series, which contains any ova. These little globular interpersions seem to indicate its contiguity and relationship to the greater and more perfect rocks of Oolite beneath. Through a great extent of country it is generally used on the roads.

Amongst the fossils of this Stratum, teeth and bones are the most remarkable. The teeth found in the stone quarries about Pickwick and Atford, are by the quarrymen called "bird's eyes," to which they bear some resemblance. They are all of a dark chocolate colour, which, with their high polish, and being set in the light coloured stone, renders them very conspicuous. Pickwick and Atford quarries used to be most noted for them; but since it has been generally understood that the same Stratum may uniformly be expected to produce the same organized fossils throughout its course, other quarries of the same stone have been searched, and found to contain them.

ORGANIZED FOSSILS.

FIG.		
1	Patella rugosa	Hinton. Minching Hampton Common.
2	Ancilla	Farley Castle.
3	Rostellaria ?	Poulton. Farley Castle.
4	Ostrea	Wincanton. Road Coal experiment.
5	Pecten	Siddington. Foss Cross.
6	Pecten	Farley Castle.
7	Oval Bufonite	Stunsfield. Pickwick.
8	Round Bufonite	Stunsfield. Pickwick. Didmarton.
9	Fish Palate	Pickwick.
10	Cap-formed Palate	Pickwick.
11	Shark's Teeth	Stunsfield. Pickwick. Farley Castle.

CLAY over the UPPER OOLITE.

As the bottom part only of this Clay contains organized fossils, and most of these being Zoophites, attached to the rock by their roots, and apparently extended up into the Clay by their growth, they need not be considered as the products of a separate Stratum, but rather as the appendages to the top of the upper Oolite rock, which is thus covered with Clay. The organized fossils being all filled with stone, further confirms their relationship to the rock. Lying in Clay they are all loose, and easily collected and cleaned. The stony matter contained in the shells, which are entire, has few or no marks of ova; nor is there much of this general characteristic of the rock in the first four or five feet beneath the Clay. Many of these fossils can only be found in excavations which expose the top of the rock. Corals, tubipora, fig. 4, and fragments of millepora, fig. 5, may be collected from some of the ploughed fields south of Bath, which are on the plane of the upper Oolite rock. The tenacious and adhesive nature of this soil readily distinguishes it from that of the Stratum beneath, and accurately defines the boundary of the stony land.

UPPER OOLITE, or Calcareous Freestone.

Soil.—*Colour*, yellowish brown.

Consistence, loose, crumbly, stony, with a large proportion of small stony fragments; over the Freestone some loose ova; over other parts of the rock some large flat stones, commonly called Stonebrash.

State of moisture, absorbent; where sufficiently free from small stones may be kneaded.

Subsoil, small stone with a little soil, and fragments of the rubble stone which lies over the rock.

Excavations, always dry.

Stratum, masses of rock in beds, divided by large open vertical joints.

Colour. The Freestone part yellowish white; other beds, some gray, and some almost blue in the middle. Freestone, calcareous, soft, oviform; cuts easily with a toothed saw or any edge tool; used in the repair of Westminster Abbey; alternates in the rock with other harder calcareous beds, but little interspersed with ova.

Disintegration. See remark on the Portland rock, page 15, applicable to this.

Water, hard, transparent: springs copious and numerous, in roads, ditches, and brooks; white from hasty rains.

This is the thickest of the calcareous rocks which form the great pile of Strata called the Stonebrash Hills. Where it occurs it forms the greatest breadth of their dry surface, and occasions many deep excavations for water. In these perforations, and in numerous deep quarries for the fine soft Freestone, which is imbedded between very thick beds of different sorts of stone, the nature and properties of the whole rock are ascertained. This most valuable part of it varies much even in quarries of the same neighbourhood, south of Bath. The other sorts of stone are rarely used but in rough walls around the fields, and in the stone

buildings common to its surface. The length of this Stratum, from unconformableness or other causes, is more deficient than either of the other rocks on the Stonebrash Hills. This might be adduced as one of the many instances of the necessity of attending to the course and full extent of every Stratum, before any geologist can decide upon the number contained in the British series; and hence also it must be evident, that those who have taken only partial views of the subject must be perpetually liable to error. Until the clay was removed from its top by the recent excavation of canals, &c. this rock was thought to contain but few fossils, and thus to be sufficiently distinguished from the under Oolite, which is most abundantly stored with them; and considering these fossils as appendages to the top of the Stratum, the remark still applies as to the rock itself. That extraordinary fossil zoophite, the pear encrinus, was first discovered most perfect with its root attached to the top of the rock, in a field belonging to my truly good friend, the Rev. Benjamin Richardson, at Berfield, near Bradford; and thence for some time afterwards was called the Berfield fossil. Several species of zoophites, with five or six species of inequivalved Bivalves and Echini, are the most numerous identifications. Between the beds of stone deeper in the rock, oysters and a few inside casts of equivalved bivalves occur: very small univalves, similar to those in Forest Marble, are numerously blended with ova and minute corals, in some of the upper beds, which are very indifferent Freestone.

On account of the scarcity of fossils in the rock, and the rare exposure of those on its top, and the great variation it is subject to, this seems the most difficult to trace to its extremities of any of the rocks which compose the Stonebrash Hills.

ORGANIZED FOSSILS of the Clay over the Upper Oolite.

FIG.		
1	Pear Encrinite	Bradford. Berfield.
2	Vertebræ ditto	Farley Castle. Hinton.
3	Stems ditto	Winsley. Pickwick.
4	Tubipora	Broadfield Farm. Farley Castle.
5	Millepora	Broadfield Farm. Farley Castle. Hinton. Pickwick. Westwood.
6	Chama crassa	Stoford.
7	Plagiostoma	Bradford.
8	Avicula costata	Bradford. Hinton. Winsley.
9	Terebratula digona: the long variety	Farley Castle. Stoford. Bradford. Winsley. Pickwick.
10	Terebratula reticulata	Farley Castle. Bradford. Stoford. Hinton. Winsley. Pickwick.

ORGANIZED FOSSILS of the Upper Oolite Rock.

FIG.		
1	Tubipora	Broadfield Farm. Combe Down. Westwood.
2	Tubipora	Combe Down.
3	Madrepora turbinata	Farley Castle. Broadfield Farm.
4	Madrepora porpites	Broadfield Farm.
5	Madrepora flexuosa	Castle Combe.

FULLER'S EARTH ROCK.

Soil.—*Colour*. This soil is rather distinguished by its being of a lighter brown than that of the rocks above and below; but in side-lying ground it is generally mixed with the rubblestone of the rock above. When less mixed is very tenacious, slippery, and retentive of moisture. The fragments of its included rock, blended with the soil, are chiefly organized fossils.

Subsoil.—*Colour*, lightish blue, yellowish white, &c. varying much in the more clayey parts to dark blue.

Consistence, soft rubblestone, mixed with indurated marl, clay, and fuller's earth.

Stratum, soft, whitish, yellowish, or light brown rock, and courses of rubblestone, generally too irregular and too slightly indurated for any use. The mass consists of this alternating with indurated marl, blue clay, and fuller's earth. The hardest bed of this stone is blue in the middle.

Excavations, some hold water; others not.

The Fuller's Earth Rock, which in many places is so soft and imperfectly lapidified as scarcely to deserve the name of stone, with the indurated marl and clay in which it is inclosed, occupies the midway slope of many of the steep hills around Bath. Its course is more distinctly definable around the sides of those steep hills than upon the more level parts of the Stonebrash district. Its clayey soil is in some degree distinguishable by less cultivation than upon the dryer soils of the Oolite rocks, above and below it, which are more genial to the growth of corn. Woods and timber trees are also common to it, on the slopes of the hills of which it so often forms a part. Little round insular hills in the vicinity of Bath, as Duncomb, Kelweston Round hill, and Monmouth's hill, seen from Pulteney-street, Bath, are also characteristic.

This Stratum of stone, with its accompaniments, may be traced from the high ground, six miles N. E. of Bath to Northleach, through the forest of Whichwood to Ditchley, in Oxfordshire, and through Northamptonshire to the ploughed fields on the north side of Stamford, and thence through the district of Kesteven, in Lincolnshire. It may be easily identified westward to a chasm in the hill south of Sherborn, in Dorsetshire. Every where it produces a very poor soil, distinguishable by its crops, whether in grass or tillage, unless greatly assisted by art.

The colour and nature of the subsoil materially assists the identification, which some of its numerous organized fossils readily confirm. They may be collected from the ploughed lands without the trouble of breaking them out of the stone, and consequently require but little cleaning. In this, as in some other respects, its organized fossils resemble those in the Cornbrash rock.

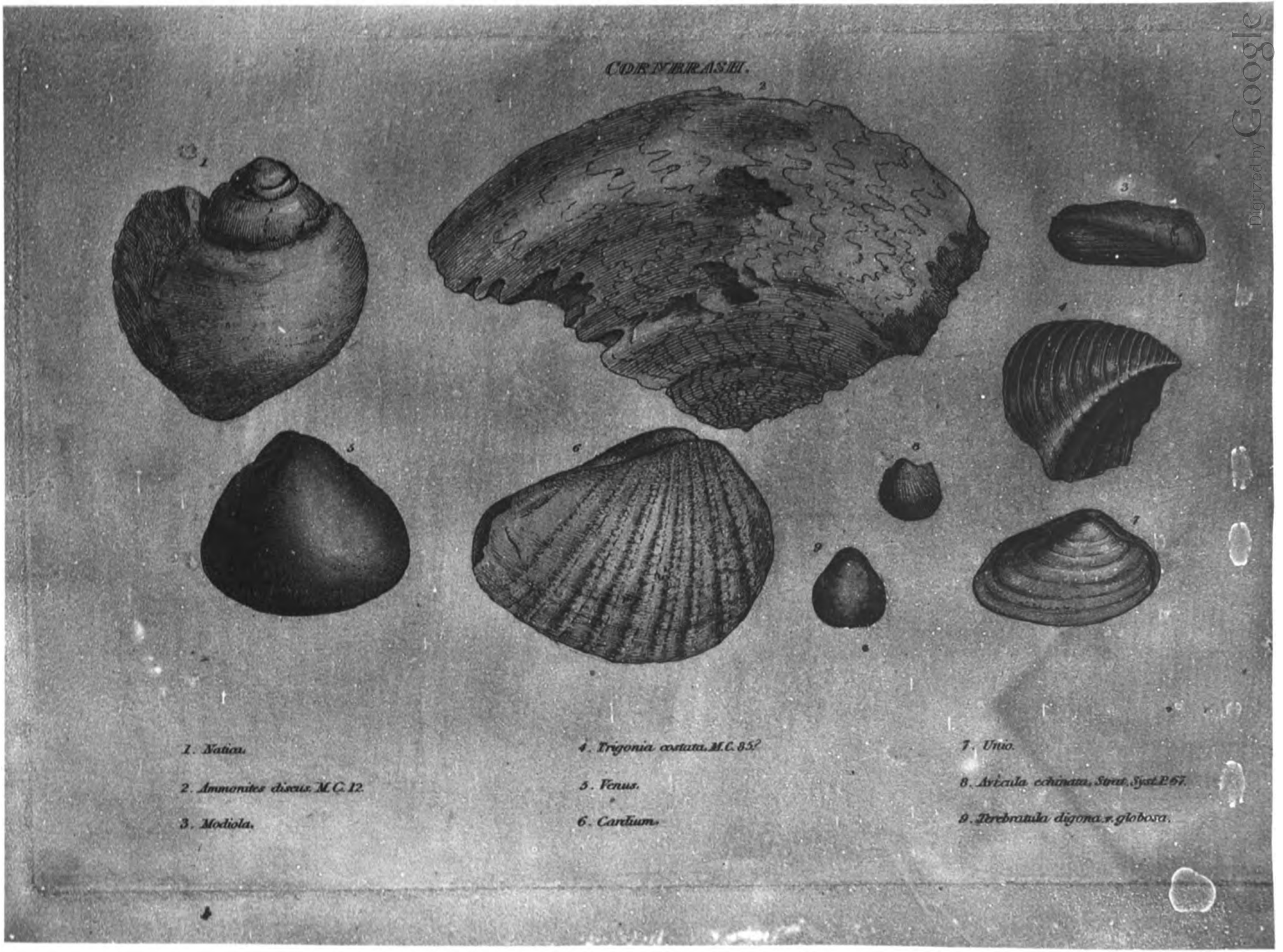
A small species of oyster, thin, smooth, and flat, is so abundant and so strongly contrasted by its dark colour with the whitish subsoil, turned up by the plough, or exposed in wheelruts, as to be highly characteristic of the outcrop of this Stratum.

Some parts of the course of the Fuller's Earth, and inferior Fuller's Earth and its rock, distinguishable chiefly by their organized fossils, long remained doubtful, as the boundaries of

these and other subdivisions of the rocky Strata which compose the Cotswold Hills, and great breadths of stony land adjoining, are not there so well defined as in the more abrupt slopes of the hills around Bath. The indistinctness of these intermediate Strata renders it difficult in many parts to ascertain the division of the two Oolites, and the great similarity of colour in all these Strata contributes to the obscurity. The organized fossils are, therefore, in some cases essential to the decision. The inferior Fuller's Earth, and the indurated clay which accompanies it has none of the long turbinated shells, but is distinguished by a peculiar nautilus, and some very thick Ammonites; yet Ammonites agreeing with the more general form are not common. Most of the fossils are casts, at least such are most numerous; all the large bivalves are so, except the great rough oyster, and Ostrea diluviana, *Linn.* (Marshii, *Min. Conch.*) These, like most of the species of oysters in other Strata, have their shells preserved. All the smaller fossils in these Strata, as the little hooked oyster, and all the terebratulæ, which are very numerous, have their shells entire.

ORGANIZED FOSSILS.

FIG.		
1	Nautilus	Lansdown.
2	Ammonites modiolaris	Dundry. Rowley Bottom.
3	Modiola anatina	Avoncliff.
4	Cardita	Grip Wood. Hardington.
5	Cardium	Charlton Horethorn. Near Gagenwell. Near Redlynch.
6	Tellina	Avoncliff. Hardington.
7	Ostrea acuminata	Orchardleigh. Avoncliff. Below Combe Down. Caisson. North of Stamford.
8	Ostrea Marshii	Monkton Combe. Cotswold Hills.
9	Terebratula media	Near Bath. Charlton Horethorn. Orchardleigh.



1. Natica.

2. Ammonites discus. M.C. 12.

3. Modiola.

4. Trigonia costata. M.C. 85?

5. Venus.

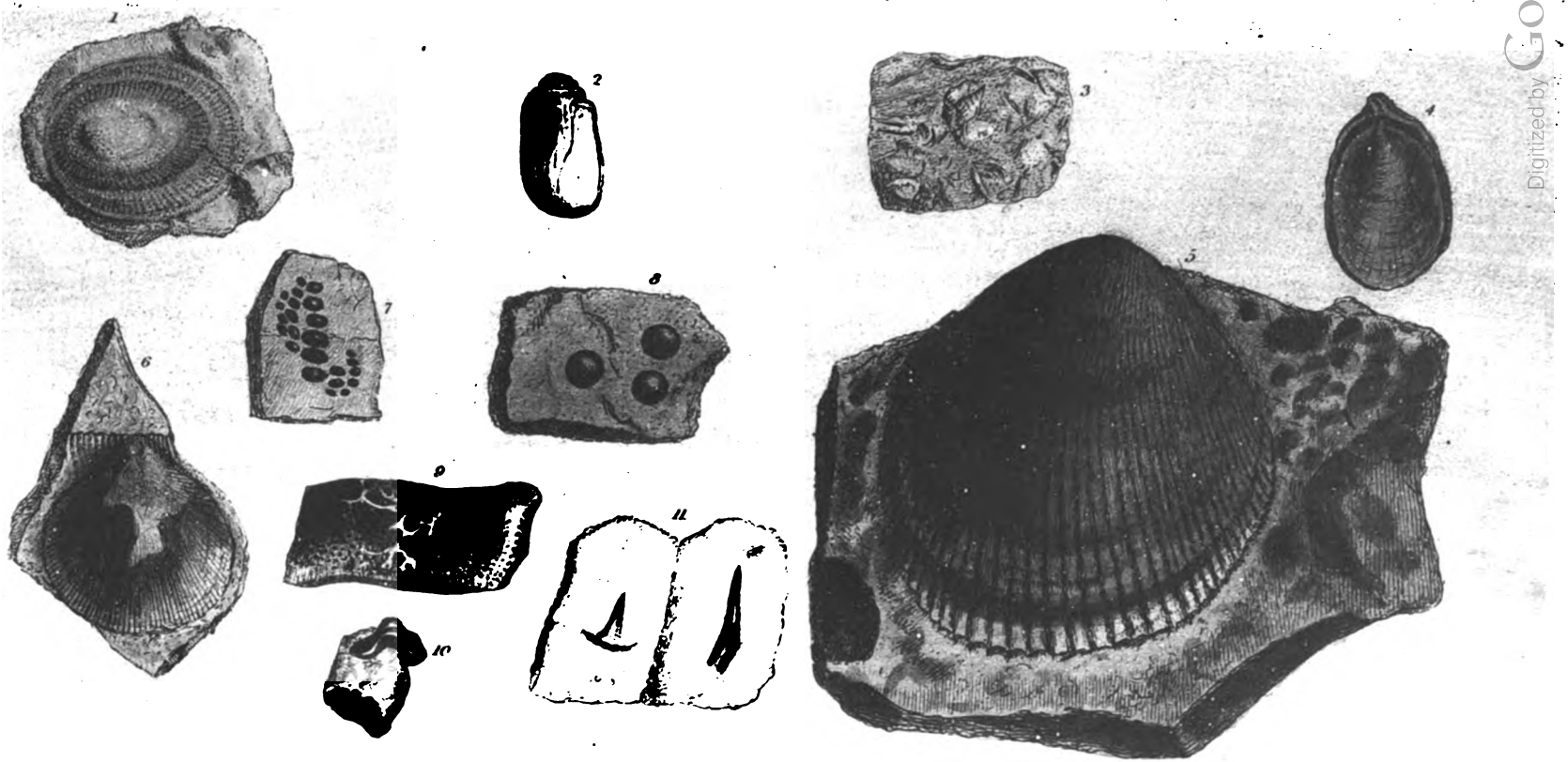
6. Cardium.

7. Unio.

8. Avicula echinata. Sowt. Syst. P. 67.

9. Terebratula digona. v. globosa.

FOREST MARBLE.



1. *Patella rugosa. M.C.*

2. *Ancilla.*

3. *Rostellaria imperfect Specimens. Strat. Syst. P. 72.*

4. *Ostrea.*

5. *Pecten.*

6. *Pecten.*

7. *Oval Buitonitæ. or Teeth.*

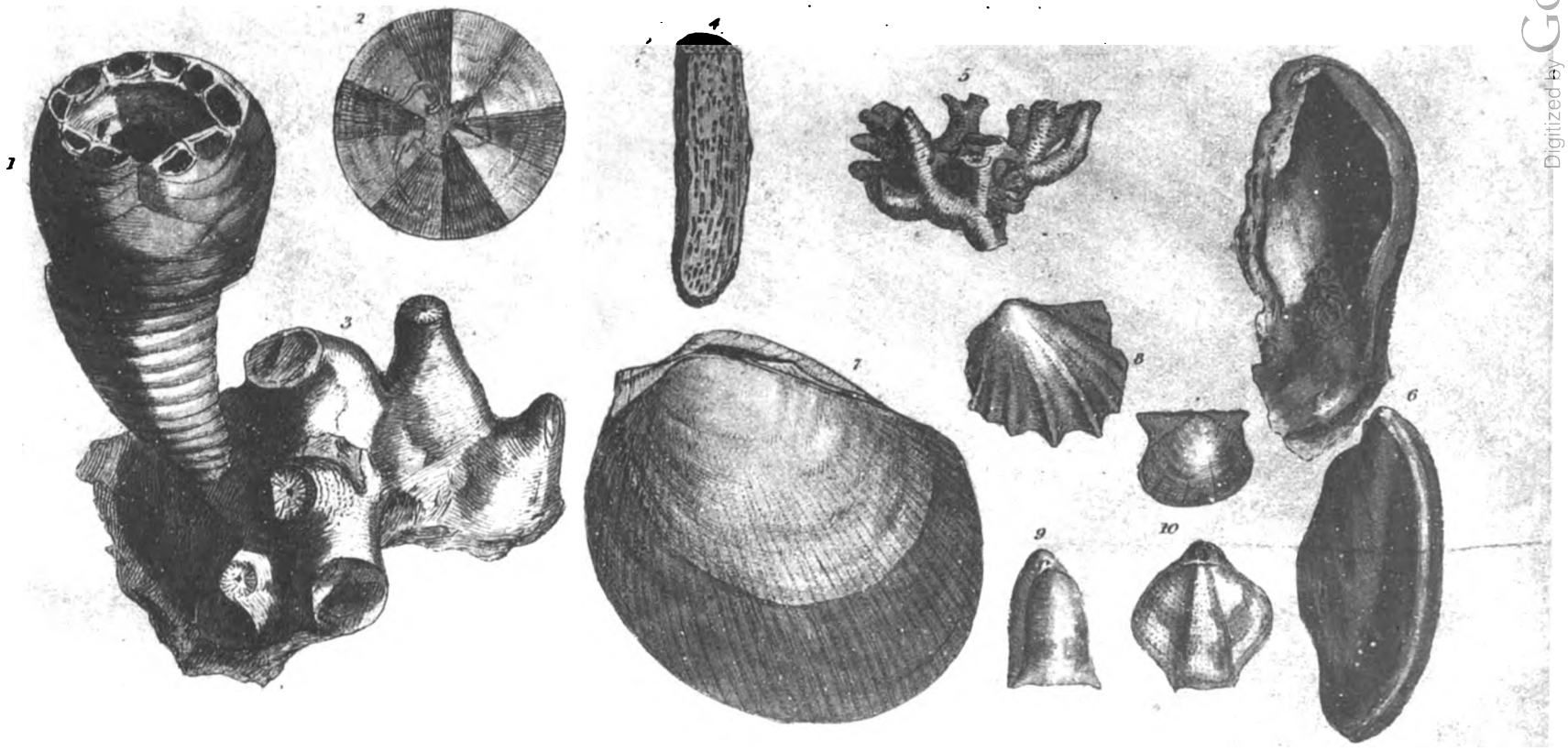
8. *Round Buitonitæ.*

9. *Palate of a Fish.*

M. D.

11. *Teeth of Fishes.*

CLAY OVER THE UPPER OOLITE.



1.2.3. Pear Encrinus. 2. The Clavicle.

3. The Root and Stems.

4. Tubipora.

5. Millepora.

6. Chama crassa. Strat. Syst. P. 80.

7. Plagiostoma.

8. Aricula costata. Strat. Syst. P. 81.

9. Terebratula digona. M.C. 96.

10. Terebratula reticulata. Strat. Syst. P. 83.

Fullers Earth Rock. Plate.

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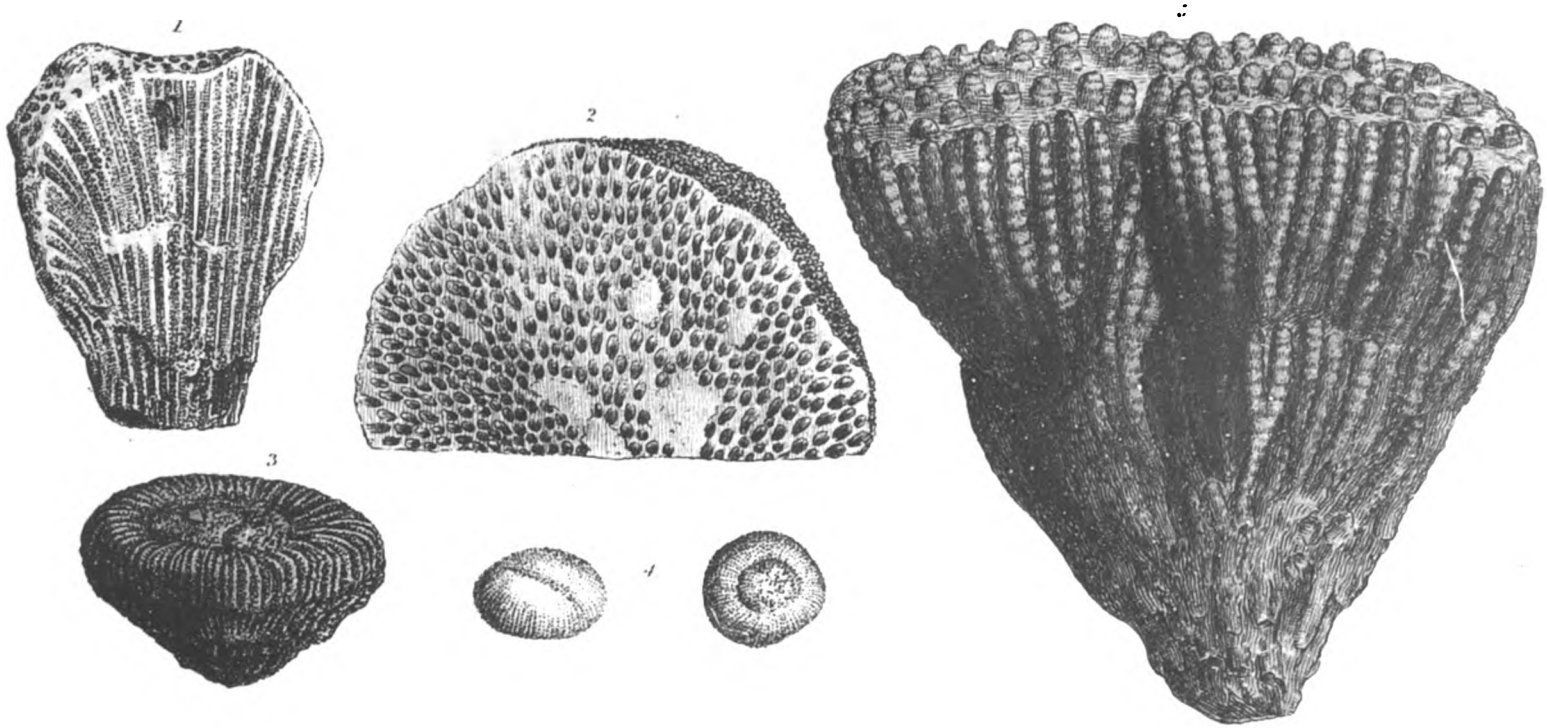

1. *Tubipora. Strut. Syst. P. 85.*

2. *Tubipora.*

3. *Madrepora turbinata. Linn. Strut. Syst. P. 84.*

4. *Madrepora porpites.*

5. *Madrepora flexuosa. Linn.*

Dear Sir,

I could wish You would furnish me with an account of the various purposes to which Salt is applied, or would be, in case the Duty were taken off — particularly how far it may be used as a Substitute or Basis for the Mineral Alkali — in short what reasons You can afford me for the Repeal of the Duty. I shall be at home at breakfast every morn next Week after Monday, & shall be happy to see You at abo. 10 o'clo.

I am Sir Yr obed. St.

Park St. 13 March 1817

W Smith