4.

MEMOIRS

OF THE

GEOLOGICAL SURVEY

OF

GREAT BRITAIN

AND OF THE

MUSEUM OF PRACTICAL GEOLOGY.

THE GEOLOGY

OF THE

COUNTRY BETWEEN FOLKESTONE AND RYE,

INCLUDING

THE WHOLE OF ROMNEY MARSH.

(SHEET 4.)

BY

FREDERIC DREW, F.G.S.

LISTS OF FOSSILS BY ROBERT ETHERIDGE, F.R.S.E., F.G.S.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY.

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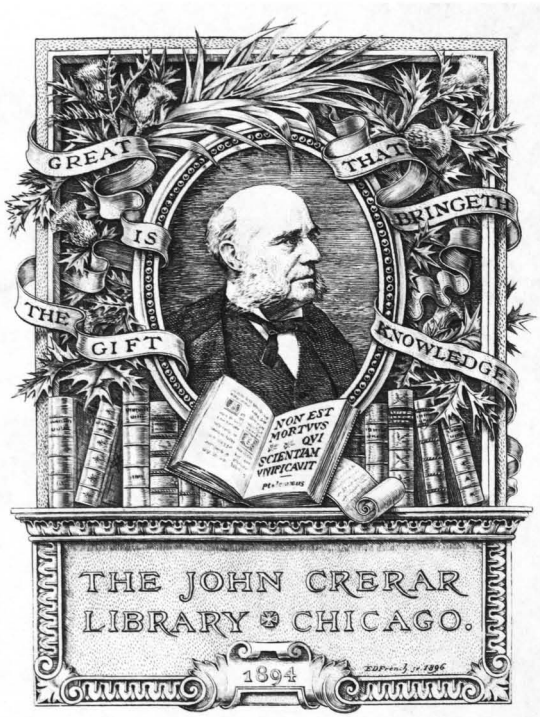
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THE GEOLOGY

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THE COUNTRY BETWEEN FOLKESTONE AND RYE,

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THE WHOLE OF ROMNEY MARSH.

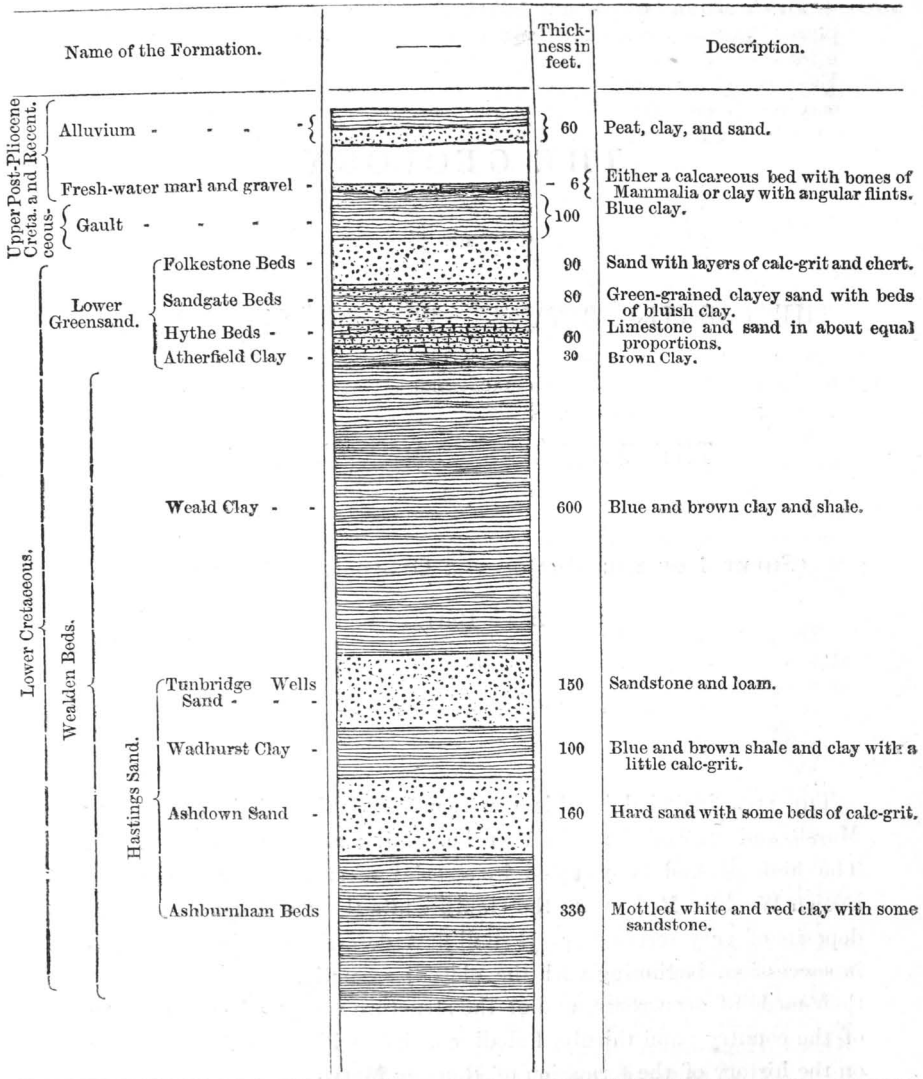
(Sheet 4 of the Map of the Geological Survey of Great Britain.)

The area included in this map consists of the whole of Romney Marsh, and part of the hills that bound it a mile or two in width. The high ground is occupied by a series of strata, from the lowest known Wealden Beds up to the Gault, while the marsh-land lies upon deposits of very recent date. I shall first describe all the formations in succession, beginning with the oldest; secondly, give an account of their mode of occurrence, and of the structure and physical geography of the country; and thirdly, I shall conclude with some facts bearing on the history of the formation of Romney Marsh.

I.—Lithological Account of the Formations.

The following woodcut, Fig. 1, is intended to show, in the order of their superposition, the beds that come to the surface in this Sheet. The names, thicknesses, and lithological characters of the several subdivisions are given in parallel columns by the side.

Fig. 1.



The whole of the 1,300 or 1,400 feet of strata classed under the name Wealden, with but slight exceptions, have been deposited in fresh water, as the fossils found in them, though not generally numerous, clearly prove. As is well known, the marine formations of the Lower Greensand and Gault, and all the Wealden divisions below are conformable to one another, as far as can be seen in sections, or from mapping the outcrops of the formations. The gravel and alluvium rest on any of the older deposits indiscriminately.

Wealden Beds.

Ashburnham Beds.

These strata, which undoubtedly underlie the Alluvium in many places, probably come to the surface at one spot only in this sheet, viz. a little north of the Land Gate at Rye, between it and the railway. Even here, however, the beds are not actually seen, but their presence may be inferred from the following account of a boring made close by, for which I have to thank Mr. Elliott, the engineer of Romney Marsh.

Boring at Bachelor's Brewery, Rye.

		ft.	in.	ft.	in.
Alluvium.	Clay. - - - - - - -	3	0 or 4	0	
	Peat, with logs of wood in it. - - -	6	0 or 8	0	
Ashburnham Beds.	White and red mottled clay, with several layers of sandstone, one (at a depth of about 150 feet) 23 feet in thickness, and a few thin layers of hard rock. - - - -	330	0		

No supply of water was obtained. This section resembles closely that of the Ashburnham Beds exposed in the cliffs below Fairlight, about six miles to the south-west.

As the bottom of the Ashburnham Beds is not reached in any section in England, a continuation of this boring would furnish most interesting results. It would not only give us the total thickness of these beds, but would also show by what formation the Wealden Beds are underlaid, whether by the Purbeck strata, or, as has been supposed by Mr. Godwin-Austen, by rocks of Palæozoic age.

Ashdown Sand.

These beds, which attain a thickness of about 160 feet, consist almost entirely of sand; the topmost beds are generally a hard sand or "rock-sand."* In some places, however, in the upper part of the formation one finds lenticular masses of a fine hard grey calcareous grit, which forms a serviceable roadstone.

The following are the chief sections of the Ashdown Sand:

The cliff that bounds, on the south and east, the hill on which Rye is built consists of sand containing masses of calcareous grit.

A similar section is presented by the cliff at Scots Float Sluice.

A sandpit a little N.W. of Playden Church shows the top of the Ashdown Sand to be a moderately coarse white rock-sand.

The road leading eastward down Boons Hill gives a section of white and buff rock-sand coming from underneath the Wadhurst Clay, with masses of calcareous grit a little below the junction.

By Thorndale Farm a pit shows the same beds with an eight-inch layer of grit exactly at the junction. At Stone Cliff a little west of Knock House seven feet of rock-sand are exposed, and beneath this three feet of calc-grit, which is dug for roadstone.

At Reading Street, near where the old barracks stood, there is a layer of very hard coarse calcareous grit.

Wadhurst Clay.

The Wadhurst Clay series consists of dark brown or blue shale or clay, probably about 100 feet thick, with a little sand and calcareous grit in it. The lowest beds, which are always clay, are seen capping the Ashdown Sand at the steps at the south-west point of Rye, at Boons

* I have used the word "Rock-sand" as a convenient term to denote a hard massively bedded sand, sufficiently compact to form natural rocks, but not close enough to constitute a sandstone fit for building purposes.

Hill, Thorndale Farm, and one or two places near Stone. There is a bed of sand in this division about 30 feet from the bottom. It is seen in the low cliff opposite East Guildford Church just north of the fault, and consists of 11 feet of loamy sand with a little ferruginous matter. From thence towards Iden it crops out, and coming in contact with the Ashdown Sand the position of the faulted boundary is rendered obscure. Again, a sandy bed underlying clay is seen about a mile west of the village of Stone, and a sandy stratum, apparently the same, crops out on the brow of the hill above Reading Street.

Tunbridge Wells Sand.

In this sheet we do not get sufficient data for determining the thickness of this subdivision of the Hastings Sand; but judging from what is known of it further west it is probably at least 150 feet thick. The lowest beds in this area are loose sand, and loam, and the top bed (as with the Ashdown Sand) is hard rock-sand, not close enough to constitute sandstone. This rock-bed is well seen at a place marked Cherry Garden on the map; and in another sandpit by the road a little to the south-east it consists of white sand curiously false-bedded. The same rock is also seen in many places about Kennardington and Warehorn, and often contains thin layers of loam and clay.

Weald Clay.

The Tunbridge Wells Sand is succeeded by the Weald Clay, the thickness of which, though not proved in this sheet, is probably not less than 600 feet, which it attains in other parts of Kent. The lowest beds are either sandy shale or loamy clay, and the rest of the formation consists entirely of shale and stiff clay, with the exception of two thin beds, one of sand and the other of limestone. The sand (a bed not many feet thick) is seen in a wood three quarters of a mile west of Woodchurch Beacon, at Orleston, near Horton Green, at Bilsington, and again at Hurst, where there are two sections beside the marsh of moderately coarse rock-sand, eight feet of it being seen.

It is at this place (probably above the sand) that the bed of freshwater limestone mentioned by Dr. Fitton,* and known as Bethersden marble, occurs. This bed consists almost entirely of Paludinæ. It seems, however, that towards the close of the Wealden epoch seawater got access to this area, for bands of *Ostrea distorta* associated with *Cyrena* have been found by Mr. Mackeson about 30 feet below the top of the Weald Clay behind the School of Musketry at Hythe. As in other areas there is here a distinct boundary between the Weald Clay and the Atherfield Clay that rests on it, for I am told that whenever a section is exposed, either by an unusually low tide, or by some artificial opening, the exact junction of the marine and freshwater formations can be made out. "Associated with the *Ostrea distorta* and *Cyrenæ* "are other fossils characteristic of the Wealden age, viz., *Cypris* "*valdensis*, *C. tuberculata*, *C. spinigera*, *C. granulosa*, *Paludina* "*fluviorum*, and spines of fishes; and a little west of the town, 100 "yards above the turnpike old road, good characteristic specimens of "the argillaceous ironstone nodules crowded with the small *Ento-* "*mostraca* above mentioned may be obtained."†

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* Transactions of the Geological Society of London, 2d series, vol. iv. p. 161.

† From the Note-book of Mr. Etheridge.

Lower Greensand.

This formation is composed of four subdivisions lithologically very distinct. These, in descending order, are as follows:

Folkestone Beds.
Sandgate Beds.
Hythe Beds (Kentish Rag).
Atherfield Clay.

The three first subdivisions were made out and described by the late Dr. Fitton in his paper "On the Strata below the Chalk," read in the year 1827; and their outcrops in this neighbourhood are given in a very accurate map in the same memoir. The same author first adopted the name Atherfield Beds in describing the strata at Atherfield in the Isle of Wight; the other subdivisions, not having been named by Dr. Fitton, have been called in this memoir after the places where they are most distinctly seen.

A.—Atherfield Clay.

The Atherfield Clay is seldom seen, as the beds of Kentish Rag that rest on it, in the long inland cliff from Aldington Knowl to Hythe, have slipped down and covered it up. I believe that it is brown, differing somewhat in character from the Weald Clay. It is about 30 feet thick, and at the lowest tide is exposed on the shore near Shorncliffe battery.

B.—Hythe Beds, or Kentish Rag.

The Hythe Beds are interstratifications in about equal proportions of limestone and sand. The former is close in texture, has a grayish blue colour and contains fine grains of quartz; the latter is for the most part drab-coloured, impure, rather clayey, and somewhat calcareous; the stone goes by the name of "rag," while the intermediate sandy beds are called "hassock." The beds which reach a thickness of about two feet are chiefly used for building, thinner ones are burnt for lime, and considerable quantities of the rag are used as roadstone. The following sections give an idea of the way in which the stony beds occur:

In the cliff between Hythe and West Hythe, an old quarry shows three courses of stone, two feet thick, nine thinner ones, and hassock, making up a total thickness of 18 ft.

At the quarries above Hythe, 14 courses of stone from one to two feet thick, with layers of hassock from six inches to three feet thick, make together 40 feet of strata.

In the lower part of this subdivision the beds are apt in quarryman's phrase to be more "hassocky," and the sand sometimes contains spheroidal concretions of stone, as is the case below Lympne, and there are also some beds of softer stone, full of dark green grains. The uppermost strata are usually irregularly bedded, more brown than blue in colour, and they are often rich in fossils, well seen, for instance in a small quarry at Pedling, and in another a little west of the Sluice House.

The total thickness of the Hythe Beds or Kentish Rag is about 60 feet. From the Kentish Rag a large assemblage of fossils has been obtained in the quarries immediately above the town of Hythe and those at Lympne W. of Hythe. The following lists have been prepared by Mr. Etheridge from observations and notes made upon the spot, and also through the liberality and assistance of Mr. Mackeson, who placed the whole of his collection at the disposal of the Geological Survey. The fossils from Lympne were originally in the collection of Mr. Hills of

Court et Street, but are now arranged in the Museum of Practical Geology in Jermyn Street.

LIST of FOSSILS from the LOWER GREENSAND of HYTHE.*

PLANTÆ.

Wood perforated by *Pholas*.
Chondrites fastigiatus, Sternb.
Cone.

ANIMALIA.

PROTOZOA.

Sponges (weathering rusty having white interstitial markings).
Siphonia pyriformis and var. Goldf.
S. clavata, Mss.

ANNULOSA.

ECHINODERMATA.

Cardiaster Benstedi, Forbes.
Diadema Mackesoni, Forbes.
Hemipneustes Fittoni, Forbes.
Pentacrinus Fittoni, Aust.
Salenia personata, Forbes. = *S. petalifera*, Defr.
S. punctata, Desor.

ANNELIDA.

Serpula variabilis, Sow.
S. antiquata, Sow.
Vermilia ampullacea, Sow.

CIRRIPEDIA.

Pollicipes.

MOLLUSCA.

BRACHIOPODA.

Rhynchonella Gibbsiana, Sow.
R. depressa.
Terebratula sulcata.
T. sella, Sow.
T. (*Waldheimia*) *celtica*, Rœmer.
T. prælonga, Sow.
T. oblonga, Sow.

LAMELLIBRANCHIATA.

Avicula pectinata, Sow.
Exogyra sinuata, Sow.
E. lævigata, Sow. = *E. conica*, Sow.
Gryphæa Ardennensis.
Gervillia anceps, Desh.
G. alæformis, Sow.
Hinnites Leymeriei, Desh.
Inoceramus Neocomiensis, D'Orb.
Lima parallela, Sow. = *elongata*.
Ostrea frons, Park. = *carinata*, Sow.
Pecten aptensis, D'Orb.
P. orbicularis, Sow.
P. obliquus, Sow. = *elongatus*, Lam.
P. circularis? Goldf.
P. quinquecostatus, Sow.
P. Rothomagensis, D'Orb.
(*Perna alæformis*) = *Gervillia alæformis*, Sow.
Pinna Robinaldina, D'Orb.
P. tetragona, Sow.
Plicatula placunea, Lam.
P. inflata, Sow.
Sphæra (*Corbis*) *corrugata*, Sow.
Astarte obovata, Sow.
A. substriata, Leym.
A. transversa, D'Orb.
Crassatella Robinaldina, D'Orb.
Lucina.
Myacites plicata, Sow.
Pholadomya gigantea, Sow.
Trigonia alæformis, Park.
T. nodosa, Sow.
T. spinosa, Park.
T. dædalea, Park.
T. caudata, Ag.
T. carinata, Ag.
T. ornata, D'Orb.
Thetis minor, Sow. = *Sowerbyi*, D'Orb.
Arca exaltata, Nils.
A. sp.
A. (*glabra*) = *cornueliana*, D'Orb.
A. electra.
Cyprina angulata, Flem.
Cardium sphæroideum, Forbes.
Fistulana.
Modiola lineata, Sow.
Pholas cornuelianus, D'Orb.

GASTEROPODA.

Natica.
Pleurotomaria gigantea, Sow.
P. perspectiva, Mant.
P. striata.
Periploma Robinaldina, D'Orb.
Rostellaria.
Solarium.
Vermetus polygonalis, Sow.

CEPHALOPODA.

Ammonites Hambrovii, Forbes.
A. Nutfieldensis, Sow.
A. Martini, D'Orb.
A. Deshayesii, Leym.
A. recticostatus, D'Orb.
A. monile, Sow.
Belemnitella.
Crioceras Bowerbankii, Sow.
Ancyloceras (*Scaphites*) *Hillsii*, Sow
Hamites.
Nautilus elegans, Sow.
N. inæqualis, Sow.
N. undulatus, Sow.
N. radiatus, Sow.
N. plicatus, Fitton.

* In The Geologist, vol. v. p. 338, Mr. Bensted mentions the fact of the tooth of *Ptychodon continuus* (Owen) having been found by Mr. Mackeson in the Kentish Rag of Hythe.

List of Fossils from the Lower Greensand of Lympne.

ANNULOSA.

ECHINODERMATA.

Cidaris ?
Catopygus carinatus, Goldf.
Discoidea subuculus, Leske.
Echinus arenosus, Sow.
Salenia.

ANNELIDA.

Serpula.

MOLLUSCA.

BRACHIOPODA.

Rhynchonella elegans, Sow.
R. sp.
Terebratula prælonga, Sow.
T. sella, Sow.

LAMELLIBRANCHIATA.

Anomia lævigata, Sow.
Exogyra sinuata, Sow.
Gervillia anceps, Desh.
Inoceramus Neocomiensis, D'Orb.
Lima expansa, Forbes.
Ostrea frons, Park.
O. flabella, D'Orb.
Pecten Rothomagensis, D'Orb.
P. quinquecostatus, Sow.
Plicatula placunea, Lam.
Pinna crassa, Sow.
P. sp.
Astarte obovata, Sow.
A. substriata, Leym.
A. transversa, D'Orb. = *Neocomiensis.*
Arca, sp.
Cardium Austeni, Forbes.
Cyprina angulata, Flem.
C. sp.
Modiola alæformis, Sow.
M. sp.
Myacites (Panopæa) rotundata, Sow.
Pholadomya gigantea, Sow.
Sphæra corrugata, Sow.
Trigonia spectabilis, Sow.
T. alæformis, Park.
T. caudata, Ag.
T. carinata, Ag.
T. spinosa, Park.
Venus.

GASTEROPODA.

Pleurotomaria gigantea, Sow.
Vermetus.

C.—Sandgate Beds.

The general character of the Sandgate Beds is dark clayey sand and clay, the dark colour being chiefly due to the presence of numerous green particles of glauconite (a hydrous silicate of iron and alumina).

The colour of the whole approaches to blue or green according to the predominance of clay or sand. These characters are perhaps best seen in the bank by the side of the Military road leading up to Shorncliffe Camp, and below the undercliff, east of Sandgate, where beds of bluish clay a foot or two thick alternate with equal beds of clayey sand.

The generally clayey nature of the strata is proved by a line of springs marking their junction with the sands above.

At the base of the Sandgate Beds a ferruginous layer six inches thick sometimes occurs. It may be seen in a quarry at Horne Street and on the shore near the turnpike between Sandgate and Folkestone.

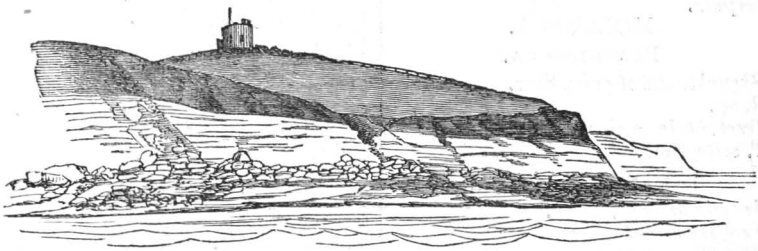
Here and there concretions of a soft green-grained calcareous stone are found, examples of which occur at Pedling and in the bed of a brook in Sandling Park; and spherical concretions of brown ironstone containing many fossils (like those that occur at Shanklin in the Isle of Wight) have been found above the village of Sandgate. As in many other clays, crystals of selenite are not uncommon. The thickness of the Sandgate Beds is about 80 feet.

D.—Folkestone Beds.

Resting immediately on the Sandgate Beds are about 90 feet of light brown or buff sand with layers and concretions of two sorts of stone. The more abundant, sometimes called Folkestone stone, is a hard rather coarse calcareous grit of a bluish or grey colour and crystalline in structure. It occurs in irregular beds about two feet thick. The other is a tough nearly white chert, with a sandy structure still discernible, in layers three or four inches thick, usually following the oblique bedding.

By the turnpike on the lower road between Folkestone and Sandgate the Folkestone Beds are seen resting on the Sandgate Beds, and somewhat above the junction the two kinds of stone are associated in the sand. At the cliff east of Folkestone (seen in the accompanying sketch, fig. 2), large masses of the Folkestone stone have fallen and cover the shore, presenting irregular surfaces, and often containing pebbles of quartz, jasper, &c.

Fig. 2.—Copt Point, Folkestone. Gault resting on Lower Greensand.



Towards the upper part of the sand the stone occurs only in isolated lenticular masses, as in the cliff beneath Folkestone church. Still higher up there are small light-coloured nodules of phosphate of lime, either in a layer about two feet from the top, or scattered through the topmost two or three feet.

Gault.

At the bottom of the Gault is a bed of dark grey phosphatic nodules very rich in fossils, and about six inches or a foot thick. It is seen resting immediately on the topmost beds of the Lower Greensand at the outlier by Folkestone church and all along the East Cliff, and "it also "occurs at Stone Farm, Saltwood, where it is about 18 inches thick, "and somewhat ferruginous."*

The following fossils have been collected by Mr. Etheridge and Mr. Mackeson from this coprolite or phosphatic bed at Stone Farm, Saltwood, East Cliff, and Copt Point.†

Wood bored by *Teredo* or *Pholas*.
Cone, fruit of *Conifer*.
Cliona on *Ostrea* and *Exogyra*.

MOLLUSCA.

Lamellibranchiata.

Ostrea.
Exogyra conica.
Inoceramus sulcatus.
I. concentricus.
Myacites.
Cyprina.
Unicardium.
Trigonia.
Pholas in wood.

Gasteropoda.

Solarium.
Rostellaria.

Cephalopoda.

Ammonites splendens.
A. varians.
A. lautus.
A. mammillaris.
A. interruptus.

With the exception of this bed of nodules the Gault consists entirely of stiff dark-blue clay, generally about 100 feet thick, but in this

* From the Note-book of Mr. Etheridge.
† These fossils occur chiefly in the form of casts.

Sheet the higher beds have been denuded off. The following list of Gault fossils has been compiled by Mr. Etheridge from the specimens collected by the Geological Survey at East Cliff and Copt Point.

CŒLENTERATA.

Actinozoa.

Cyclocyathus Fittoni, M. Edw.
Trochosmilia sulcata, M. Edw.

ANNULOSA.

Echinodermata.

Hemiaster (*Brissus*) *minimus*, Ag.
Cidaris Gaultina, Forbes.
Diadema tumida, Forbes.
Hemiaster asterias, Forbes.
H. Bailyi, Forbes.
Pentacrinus Fittoni, Aust.

Annelida.

Serpula.

Cirripedia.

Pollicipes rigidus, Sow.
P. unguis, Sow.
P. lævis, Sow.

Crustacea.

Adelia Bechei, Deslong.
Astacus.
Etyus Martini, Mant.
Hoploparia, sp.
Homolopsis Edwardsii.
Palæocorystes Stokesii, Mant.
P. Broderipii, Mant.
Plagiolophus Wetherellii, Bell.

MOLLUSCA.

Brachiopoda.

Rhynchonella sulcata, Park.
Kingœna lima, Defr.
Terebratula biplicata, Sow.

Lamellibranchiata.

Anomia.
Exogyra.
Gervillia solenoides. Defrance.
Inoceramus concentricus, Park.
I. sulcatus, Park.
Lima parallela, Sow.
Pinna.
Plicatula pectinoides, Sow.
Pecten quinquecostatus, Sow.
P. Dutemplii, D'Orb. = *interstriatus*, Leym.
Cucullæa (*Arca*) *costellata*, Sow.
C. Hugardiana, D'Orb.
Corbula striatula, Sow.
Cardita tenuicosta, Sow.
Cucullæa, sp.
Cytherœa.
Gastrochæna pyriformis, Mant.
Lucina.
Mytilus, sp.
Myacites plicata, Sow.
Nucula pectinata, Sow.
N. bivirgata, Sow.
N. ovata, Mant.
Pholas constricta, Phil.
P. sp.
Pectunculus.
Solecurtus.
Trigonia Fittoni, Desh.
Tellina.
Venus tenera, Sow.

Gasteropoda.

Avellana incrassata, Sow.?
Actæon affinis, Sow.
Cerithium, several species.
Dentalium affinis.
D. decussatum, Sow.
D. striatum, Sow.
Fusus.
Natica canaliculata, Geinitz = *Gaultina*, Sow.
N. Gaultina, D'Orb.
Pyrula Smithii, Sow.
Pleurotomaria gurgites, D'Orb.
P. Gibbsii, Sow.
Rostellaria carinata, Mant.
R. buccinoides, Sow.
R. marginata, Sow.
R. elongata, Sow.
Scalaria Dupiniana, D'Orb.
S. sp.
Solarium ornatum, Sow.
S. conoideum, Sow.
S. allied to *dentatum*, D'Orb.
S. „ *asterianum*, D'Orb.

Cephalopoda.

Ammonites Goodhallii, Sow.
A. cristatus, De Luc.
A. rostratus, Sow.
A. lautus, Sow.
A. mammillaris, Schloth.
A. denarius, Sow.
A. Jeanotti, D'Orb.
A. varicosus? Sow.
A. Bouchardianus, D'Orb.
A. tuberculatus, Sow.
A. inflatus? Sow.
A. circularis? Sow.
A. interruptus, D'Orb.
A. auritus, Sow.
A. splendens, Sow.
A. minutus.
A. varians, Sow.

A. symmetricus, Sow.
Ancyloceras spinigerum, Sow.
Belemnites attenuatus, Sow.
B. minimus, List.
Crioceras.
Hamites.
H. intermedius, Sow.
H. tuberculatus, Sow.
H. attenuatus, Sow.
H. maximus (var. of *rotundus*), Sow.
H. compressus, Sow.
Helicoceras rotundus, Sow.
Nautilus inæqualis, Sow.
N. sp.
Ptychoceras emericianus, D'Orb.
Rhyncholites.
Turrilites asterianus, D'Orb.
T. elegans, D'Orb.
T. Bergeri, Brong.
T. tuberculatus, Bosc.

Having thus given a brief description of the secondary strata comprised in this area, I shall now show their relation to the physical geography of the country.

II.—Form and Structure of the Country.

Those parts of the country coloured on the map as Alluvium and stippled to denote Shingle, are hardly at all above the level of the sea at high water. The edge of this plain marks the position of the former coast-line, for in very recent times, and perhaps within the historical period, the whole of the flat was covered by the sea. The hill on which the town of Rye is built is now entirely surrounded by Alluvium, and must therefore once have been an island. Its highest point, where the church stands, is about 80 feet above the sea,* and it is bounded on the south-west, south, and east by a cliff of rock-sand. Near the north-east point of the island the topmost beds of the Ashdown Sand are seen dipping northwards at a high angle, while at Bachelor's Brewery, a little further north, the Ashburnham Beds are close to the surface; this proves a fault between those points, with a downthrow on the south of not less than 160 feet, by which the uppermost beds of the Ashdown Sand have been thrown against the Ashburnham Beds. Further north about Playden and Iden there is a plateau 180 feet high, ending in a cliff that overlooks the Marsh, here and there cut into by valleys. At Playden Mills the cliff is nearly 150 feet high; it then becomes less distinct till at Scots Float Sluice (*Scots Flat* on the map) there is a low rocky cliff which rises towards Boons Bridge, and changes to a steep bank covered with underwood. Beyond that point the ground slopes gently to the marsh. The high cliff at Playden Mills exhibits the whole thickness of the Ashdown Sand, for there is Wadhurst Clay just at the top, and a spring coming out at the foot no doubt marks the beginning of the Ashburnham Beds. On the north side of the fault at the edge of the marsh there is a section of sand with some clay beneath it, but I believe this to be a sandy bed in the Wadhurst Clay, faulted against the Ashdown Sand, and as the bed is about 30 feet from the bottom of the Wadhurst Clay the throw of the fault will be nearly 200 feet. These two beds of sand being brought together by a fault renders the position of the dislocation inland very doubtful. From the fault to Boons Bridge there is a very gradual northerly rise of the beds and from thence to Thorndale Farm they are nearly horizontal. At the Isle of Oxney, the eastern half of which is mapped in this sheet, the Ashdown Sand makes the southern slope rising about 100 feet above the marsh; it is capped by Wadhurst Clay, the beds being flat, or dipping a little northwards. From Cliff Farm to Knock House there

* The heights in this Memoir are reckoned from the mean level of the sea.

is a steep bank which was once a sea cliff, 130 feet or more high ; it consists entirely of Ashdown Sand, but at Knock House there is clay from top to bottom of the hill, which, as the beds are horizontal, must therefore be faulted against the sand. Two miles to the north-west the Ashdown Sand again rises with a gentle southerly dip. The hill called Ebony consists entirely of Wadhurst Clay. At Reading Street the top of the sand is only about 10 feet above the Alluvium, but from thence to the N.W. the beds gradually rise to a much higher level, and at the edge of the sheet there is a bold feature made by the outcrop of a considerable thickness of sand. East of all these points there is a possible fault concealed by the Alluvium, expressed by the broken line ; this fault is proved at the edge of the sheet by the sand that comes from beneath the Weald Clay being brought against Ashdown Sand, which is seen in the road leading to Tenterden beyond the boundary of the present map. North of Appledore the junction of the Tunbridge Wells Sand with the Weald Clay occurs not many feet above the marsh, the beds dipping slightly to the north. The last that is seen of the Hastings Sand on the east is at Ham Street. North of the sand the Weald Clay country rises into undulating woody ground, as far as a line from Woodchurch Beacon to Orleston and Aldington Knowl.

At Aldington Knowl the Lower Greensand comes on, and from near this spot to Hythe overlooks the Marsh. A cliff of Kentish Rag, about 40 feet in height, makes a distinct feature, and below comes an irregular slope formed of the Atherfield and Weald Clays. Near Aldington Knowl the top of the cliff is a little more than 300 feet above the sea, at Lympne a little more than 350, at W. Hythe about as much, while from there eastwards it gradually gets lower, and as the beds dip slightly N.N.E. the junction of Kentish Rag and the underlying clay occurs just at the back of the town of Hythe. All along the foot of the cliff the outcrop of the clay is hidden by masses of stone that have fallen from above, so that where clay has been mapped the surface soil is by no means always clayey, but the springs coming out at a high level are sufficient to show the true junction, which is also indicated by a sudden change in the slope of the hill, the ground becoming much less steep as soon as the clay is reached.

The northerly dip soon brings on the higher beds of the Lower Greensand, while the two picturesque valleys, one on each side of Hythe, have been scooped down to the Atherfield and Weald Clays. Beyond Hythe the topmost sands or Folkestone Beds form an elevated plateau as far as the town of Folkestone, gradually getting lower as you go eastward. It is cut through by two valleys, one on the west of Shorncliffe Camp that reaches down to the Kentish Rag, and one on the east exposing only the clayey Sandgate Beds.

Between Sandgate and Folkestone there is a cliff from 100 to 150 feet high, and between it and the sea a small undercliff made by the slipping of the higher beds on the clayey strata beneath. This undercliff lessens in height eastwards, and ends altogether at Folkestone, where the Sandgate Beds disappear beneath the beach. The old part of Folkestone is built in a valley, which makes a break in the cliff, and at the further side the Gault comes on, shown in the woodcut, p. 10. The beds here fall eastwards at the rate of half or three-quarters of a degree, and the bottom of the Gault comes to the level of the shore just at the edge of the sheet, or perhaps a little way round the Point.

It is on the summit of the cliffs in this neighbourhood that superficial deposits of gravel, marl, and brick-earth occur. They are well described in the Quarterly Journal of the Geological Society, vol. vii., by

Mr. Mackie, whose account is condensed in what follows. The first section given by Mr. Mackie is that exposed on the face of the West Cliff near the Battery behind the Pavilion Hotel. The beds, in descending order, are as follows :

" Brick-earth.
Calcareous marl with snail-shells.
Flint gravel, and ferruginous grit with a few Gault nodules. } Bone Bed.
Contains bones of Mammalia."
Resting on Lower Greensand.

In digging the foundation of a house not far from the above section, a similar succession of strata was met with, viz. :

" Black earth, containing bones of *Canis lupus* and *Sus scrofa*, fragments of ancient pottery and iron arms (?) - - 6 feet.
Calcareous sandy marl.
Lower portion of the same with flint and ferruginous sandstone boulders and pebbles, both angular and round. } Marked with wavy lines of stratification, and containing bones of Mammalia } Bone Bed. 1—5 ft.
Lower Greensand *in situ*."

The following is a list of the Organic Remains from the " bone bed " :

" Bones and Horns.
Elephas primigenius.
Hippopotamus major.
Bos primigenius.
B. urus.
B. longifrons.
Megaceros Hibernicus.
Equus.
Hyæna spelæa.
Shells.
Helix nemoralis.
H. concinna."*

From these remains it is evident that the deposit is not marine, but probably of lacustrine or fluviatile origin. It is true that the calcareous marl abounds in Foraminifera, but these have evidently been derived from the Chalk.

Mr. Mackie also mentions the occurrence at London Street of brick-earth containing the following shells :

Helix concinna.
Pupa.
Succinæa oblonga.

The section at London Street can still be seen, and about half a mile to the west or north-west of Folkestone there is another deep section of brick-earth which probably belongs to the same period.

Along the East Cliff there is a thin clayey deposit, containing angular and " pitted " flints. They were probably washed down from the hills above by atmospheric agencies, and the deposit is perhaps partly of about the same age as the gravel described by Mr. Mackie and partly later.

III.—Romney Marsh.

In giving an account of Romney Marsh it will be necessary to go somewhat beyond the bounds of the present sheet, and beyond Romney Marsh proper,† following the arms or inlets of it up the course of the

* *Helix plebeia*, Drap.

† The name of Romney Marsh should perhaps properly be restricted to that part of the level which is on the north of the Rce Wall, along which the road goes from Appledore to Romney, the rest bearing the different names of Walland, Dunge, and Guildford Marshes ; but in common language the whole is called Romney Marsh. Certain other parts are called the Dowls on the north-east of Appledore, Shirley Moor which lies between Ebony and Woodchurch, Wittersham Level along the banks of the Rother, Pett Level south of Winchelsea, &c.

river Rother to Small Hithe and Bodiam, along the smaller streams that flow by Winchelsea, and to the most south-westerly point of the Marsh at Cliff End near Fairlight. These places are contained in Sheet 5 of the Ordnance Map.

It will be seen that the whole area is either coloured on the map as Alluvium or Blown Sand, or is marked as Shingle Beach. The whole of the Alluvium is below the level of high water at spring tides, but the access of the sea is prevented by tracts of shingle bordering the Marsh, which are partly piled above the level of high water, and by artificial walls which have been erected where no natural barrier of shingle exists. The patches of Blown Sand consist of irregular hillocks, generally less than 20 feet high.

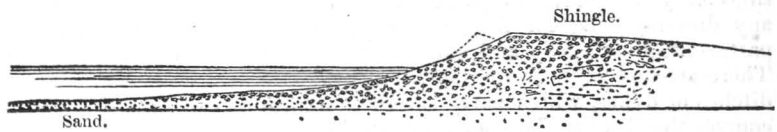
The soil of the Alluvium is generally clayey at top, but it is sometimes peaty (or moory, as it is called), and now and then sandy. The clay soil is not so stiff nor so cold as many clays, it is not difficult to till, and yields heavy crops of corn year after year without requiring any dressing. By far the greater part of the Marsh, however, is in pasture, feeding sheep and cattle in a large proportion to the acreage. There are no hedges in the Marsh, but the land is divided by means of ditches or dykes, which carry off the water into certain chief water-courses that lead to the shore, and drain into the sea at places called "Guts." The chief of these are Jews Gut, Dunge Marsh Gut, and Globsden Gut. At each gut there is a sluice which allows egress to the fresh water at low tide, and prevents the access of the sea when it rises. By these means the flat is kept dry and free from floods, with the exception of one part called Appledore Dowls which lies on the north of the road from Appledore to Snargate. This is the lowest part of the Marsh, and the water that falls on it is pumped up by steam into the Military Canal, but in spite of this the land is always flooded in wet seasons.

I will now proceed to describe the soils that are met with beneath the surface. The peat seems to occur mostly at the Dowls, and from there towards Ivychurch and Hope, but there is some in Dunge Marsh and Walland Marsh, and it often occurs in the marshes at the side of the Rother and its tributaries far inland. By the side of the railway on the north of Appledore station there are some pits, generally full of water, but where, after a long continuance of dry weather, peat and clay may be seen, with trunks of trees or moor-logs. The wood, which is oak, is black, and has a charred look outside, but it cuts smoothly with a knife, and would take a polish, being pretty hard and tough. The stumps of several trees seen here look as if they had grown on the spot. In other places I hear Alders and Hazel have been found in the peat, and nuts occur very frequently. When peat is at the surface there is generally clay below, at a depth of five or six feet perhaps. Clay also sometimes occurs overlying the peat. Along the shore for some distance about Leeds Gut, and opposite Holme Stone, as well as further east, there is seen below the shingle at about mean water level some hard peaty mud or clay, which is now being wasted by the sea. This fact has some bearing on a question that will be discussed further on. Sometimes in clearing the dykes the workmen come upon a layer of beach pebbles, not of any great width, a bar of shingle in fact. The lighter soil (sand being near the surface) occurs in patches about Broomhill and Guildford, and in many other parts, even for a long way up the valley of the Rother at Newenden, &c. Whatever the soil may be near the surface, it is almost invariably the case that at a depth of 10 or 20 feet there is loose sand, often containing

recent marine shells, especially cockles. The bottom of this is seldom reached in any well-sinking, and its thickness is not known. Mr. Elliott tells me he bored 70 feet in the Marsh, of which the last 50 were in sand.

The beach or shingle occupies so great an area, extending over thousands of acres, and occurring for miles inland as well as along the shore, that it deserves particular attention, and as there are some things to be noted in it that throw light on the order and time of the accumulation of these recent deposits, it will be well first to describe the way in which shingle is now moved and re-arranged by the waves on the present shore, and then the past changes will be better understood. The form of a shingle beach exposed at low water is generally somewhat like that drawn in the diagram (fig. 3). The summit is a

Fig. 3.—Diagram-section of a Shingle Beach.



few feet above the level of high water at spring tides, while the foot of the shingle is usually a few feet above low water mark, so the vertical height on this shore is somewhere about 18 feet. Now when the waves break, supposing their direction to be at right angles to the coast line, they run up the slope, and carry pebbles with them, and on returning they partly draw them back ; but the force of the breaking wave being greater than that of the return current (undertow) the beach is gradually " fulled," that is pebbles are heaped up in front of the breaker, generally forming a small ridge. This is shown by the dotted line in the diagram. As the tide rises or falls the level at which the action takes place changes, so that the result varies very much in different states of the weather, and according to the force of the waves at different times of the tide, and thus it often happens that what is done in one tide is undone during another.

The waves striking directly against the shore do not, however, produce so great an effect as those which come obliquely, for these wash the pebbles up diagonally, and on breaking still run along the shore, carrying the pebbles with them, thus both piling up the shingle and producing a general lateral movement of the stones from windward to leeward.

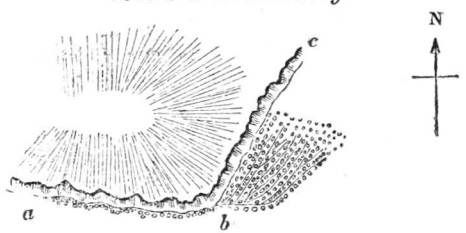
If the wind changes so as to make the waves strike obliquely to the shore the other way, the shingle will of course travel in the opposite direction ; but in the course of time it will have travelled in a direction determined by the prevalent winds. The average result is that, under favourable circumstances, a rounded shingle bank is formed, rising as high as the highest breaking waves can reach during gales in spring tides, the greatest slope of the shingle being generally seaward near the crest of the bank.

On this coast the south-west wind is by far the most prevalent, and the waves consequently strike on the shore in such a way as to give the shingle a movement from west to east, for the effect of the S.W. winds greatly overbalances any motion in an opposite direction brought about by easterly or south-easterly winds. It follows, therefore, that the shingle about Romney Marsh was derived from rocks that occur to the westward, being formed of flints that come directly or indirectly

from the chalk of Sussex, and other areas further west. If the shingle as it travels along meets with an obstruction, such as a jetty, pier, or one of those "groynes,"* so frequent on parts of this coast, it is stopped, and accumulates on the weather side, protecting the land from the wasting action of the sea. A change of wind will, however, occasionally sweep away for a time nearly all the shingle that had accumulated. In front of Sandgate, and from there to near Folkestone, some of these groynes can be seen.

Another cause of accumulation of a breadth of shingle is the following:—If *a*, *b*, *c*, (fig. 4) be a promontory, and *a*, *b*, the shingle

Fig. 4.—Diagram to illustrate the Formation of a Shingle Beach round a Promontory.



travelling eastward, when the pebbles reach the point *b* they will generally keep to the shore, and turning round go some way along the face *b c*; but here they are more or less sheltered from the action of the waves, and in spite of the occasional action of non-prevalent winds, the result would be a great supply of shingle at the point *b*, piled up in a succession of "fulls" or ridges, as shown in the figure. The same effect would be produced if the necessary form of the coast were brought about by artificial means, and one or two illustrations of this occur in the present district, to be explained further on.† It is to the above-described process, continued through a long course of time, that the wide tracts of shingle at the edge of the Marsh owe their formation. On the west they begin at Cliff End, three miles south-west of the old pier head, south of Rye. All along these three miles of coast there is a high straight bank of shingle running N.E., and forming the present beach, which is only overflowed when a high tide happens to be accompanied by a heavy sea. Within it is a strip of shingle about 200 yards broad, some feet lower than the present beach. The old lines of shore are plainly visible, trending away from the present one at an angle of about 45° in a northerly direction. They are expressed by the lines on the map.‡ Further inland lies the marsh-land at a still lower level. South and south-east of Rye the shingle is irregularly mingled with the Alluvium, but even when covered with turf, as it is in some places, the ridges can be traced out, and have been added by myself to the Ordnance Map as well as the one-inch scale would allow. In reality, however, they are far more numerous than I have drawn them, being not more than 20 or 30 yards apart.§ Further east, around where

* A "groyne" is a low wooden barrier or small jetty built out as far as low water mark, for the purpose of preventing the waste of the coast.

† For further information about the movements of shingle beaches, see Palmer "On the Motions of Shingle Beaches," Phil. Trans. vol. cxxv. p. 567; and Redman "On the Changes of the South Coast of England," Proc. Inst. Civil Engineers, vol. xi.

‡ Sheet 5, Geological Survey of Great Britain.

§ These remarks apply to all the old shingle within this sheet, which was entirely mapped by myself.

Midrips is marked, the shingle is very flat, and the ridges can hardly be traced. The country is there about six feet lower than the outermost "full" that runs nearly at right angles to them. Holme Stone is almost bare shingle, with here and there a few stunted holly bushes, trimmed by the wind to a regular slope on the south-west, while on the shingle generally deep-rooted bushes of blackthorn appear from one shoot, spreading out flat and low, and often not rising six inches above the ground. At Holme Stone the beach is arranged in very straight and regular ridges, continuing for a length of two miles and more inland; they are, however, seldom more, and sometimes less, than a foot above the troughs, and are about 40 yards apart. They are at a lower level than the present beach. In some places the lines are made more distinct by thin grass growing on the smaller shingle which here forms the top of the ridges, and not on the larger stones which are found in the troughs. In other places the ridges can only be distinguished by differences of colour, due to certain lichens which grow chiefly on the larger stones, and thus produce a tint which contrasts plainly with the brownish hue of the smaller pebbles. Lydd Ripe, on the south of the town, is shingle, overgrown with grass, and the ridges are very distinct; and north of the town the shingle, though covered by blown sand, may still in places be traced beneath it by the ridged form of the ground, the lines of which follow the same general direction as those on the south of the town, being nearly parallel to the roads.

Dunge Beach is the widest spread of shingle in this area, being three miles long and from one to three miles wide, in some parts absolutely bare of vegetation for hundreds of acres, and in others sparingly dotted with furze bushes and broom. Roads there are none, only a few tracks, and it is altogether a most desolate-looking place. Those who have to cross the shingle usually put on a pair of "baxters" or small flat pieces of wood with a leathern loop for the foot. They are used with a peculiar sliding gait, and make the walking much more easy. The "shingle-fulls" here run in various directions, and they vary also in height; those about Wigmore Pit are seven feet lower than the modern one which runs straight along shore, and may be taken as a standard, as it is nearly of the same height all along. A little east of the words *Abnor Pit* the "fulls" gradually get higher as you go south, and about Dunge Marsh Gut and the Lighthouse the inner "fulls" are only a foot or so lower than the outermost, while all those for a mile inland from the shore between Dunge Ness and Great Stone are at a high level. There is not much to remark about the shingle near Romney, it is so much covered either by the buildings of the town, or by blown sand. Along the shore by Dymchurch the shingle no longer accumulates now that the groynes have been removed, and a stone wall built in their stead. Near Hythe there is another tract of shingle, three or four miles long and half a mile wide; the ridges curve in various directions, they are about 30 yards apart, and are two feet or so above the troughs. From the Sluice House to Folkestone there is only a narrow beach of one ridge, but at the latter place there is some accumulation of it which will be spoken of later.

Having now described Romney Marsh as it is, it remains to relate in chronological order whatever facts of its history are known or can be inferred. I shall not attempt, except in a few cases (in which antiquaries are agreed), to quote historical evidence of the changes that have taken place, but shall confine myself to the geology of the question.

There is abundant evidence that the sea extended at a very late geological period over the whole of what is now the Marsh, and ran in-

land for many miles; and there are historical proofs that a harbour existed at the foot of Lympne Hill. It is also known that ships used to sail along the river past Appledore further up the country.* Besides this, every here and there in the marshes, even as high as Newenden, sand is met with different from any that occurs in the country drained by the river Rother, and evidently sea-sand. Lastly, there is the fact that the whole of this marsh-land, as far up the Rother as Bodiam, would be overflowed by the tide at high water if it were not for artificial embankments. This district then which now makes a promontory was once a bay with creeks and long inlets.

It will be remembered that underneath the clay and peat of the marsh loose sand has been found, in one place even to a depth of 70 feet. No one has yet determined how much deeper the sand may be, but this depth of 70 feet corresponds with that of the nine-fathom line on the Admiralty Charts, in which the soundings are reckoned from low water. Now it is likely that all the space, say as far as the centre of the Marsh, is occupied by 70 feet or more of these recent deposits, for if any ridge of secondary rocks lay close underneath it would probably be prolonged out to sea, deflecting the nine-fathom line; but as this line has a nearly straight course from outside Rye Bay to Dunge Ness, and from thence north-east towards Folkestone, it may be inferred that the projection of the land at Dunge Ness is due to the accumulation of sea-sand, shingle, and alluvium. Romney Marsh seems, therefore, to have been formed as follows:

The first stage was probably a shallowing and filling up of the bay by the accumulation of silt to such an extent seaward as to make a sand-bank or series of sand-banks exposed at low water. The origin of this accumulation is not quite clear, but it was probably caused by the meeting of the two tidal waves in this part of the channel, or else by a local tidal eddy produced by the form of the coast line. When in this way the bay had shallowed considerably the fine clayey and loamy sediment of the Rother and the other streams that flow into the marsh began to be deposited on the sand, instead of being carried further out to sea, as had previously been the case. Plants then began to grow upon the newly formed surface, which probably extended much further seaward than it does at present, and may have been actually upheaved by oscillation of level, forming a plain well raised above the level of the sea. Forest trees flourished on this surface for the moor-logs in the peat have all the appearance of having grown on the spot. If this be so it follows that since that time there has been a depression of the land, because the peat that occurs at Appledore, and along the shore between Rye and Dunge Ness, and also that often found in sinking wells, is at too low a level for the plants to have grown at these places while the sea had access there.

The amount of this depression cannot be determined for want of sufficient evidence. In later times it looks as if the long arms of the Marsh were made by the gradual sinking of the land and the letting in of the waters to the valleys, thus gradually filling them up with Alluvium; for they do not appear to have been at all denuded out or widened by the sea. The ground is cliffy only where the edges of the land face the Marsh.

It would be interesting to know what was the extent of this old land surface, but as yet this cannot be made out accurately; it is certain, however, that the land extended further towards the south-west than it

* In the beginning of the 16th century a licence was given for the burial of shipwrecked men at Small Hithe, south of Tenterden (Sheet 5).

does at present, the peaty mud along the shore is a proof of this, and one is tempted to think that it was continuous with the sunken forest that is seen on the fore-shore on the other side of Hastings. There is no reason to believe that any of the depression of land took place in the historical period, *i.e.* from the time of the Romans downwards, for no human remains nor works of art have been found deep in the Alluvium, and all the changes recorded in history can be accounted for by the ordinary action of the elements at the surface. It is likely therefore that the deposition of Alluvium had raised the ground above the level of low water, either before the Romans left the country (as is most probable), or at all events not long after. For in the time when Kent was a kingdom, grants of pasture and woodland in the Marsh were made by the kings to different monasteries, and are recorded in the Saxon Charters. The Rev. Mr. Jenkins, rector of Lyminge, has favoured me with notices of some of these: one of the earliest is a deed* of King Wihtraed's, dated A.D. 697 and 700, granting to the monastery of Lyminge pasture for 300 sheep on the south of the river Limen, which was the early name for the Rother, at that time flowing out near Hythe. Again, in a grant of Æthelbert, dated 740, mention is made of Bishopswick on the Marsh and of Lydd Ripe.

I have said that the Rother, then called the Limen, used to flow out at Hythe; Lympne was once a Roman station, called Portus Lemanis, and had a harbour kept open by the waters of the Limen. There are yet remains of the fortress in the ruined walls, of Roman masonry, of Stutfall Castle. Mr. Jenkins also tells me of a charter† by which King Egbert granted, A.D. 833, to the monastery of Lyminge a piece of land at Sandtun that was bounded on the south by the river Limen; Mr. Mackeson of Hythe recognized this place "Sandtun," as the same that is now called the Sandton, namely that patch of Blown Sand between West Hythe and Butters (or Botolph's) Bridge. This charter then gives the position of the river at that date and also proves (or at all events makes it very probable) that this Blown Sand existed as early as the ninth century.

It is likely that some of the most westerly of the shingle-fulls in that neighbourhood were formed at the time the river flowed out there, as they trend inland in such a direction as to make one think they then bounded the haven on the south, and from the sharpness with which they end on the coast it may be inferred that they once extended further out to sea and have since been partially denuded.

The Rother afterwards shifted its channel and flowed into the sea at Romney. At what time this alteration took place is not known, but it is likely that it was before the Norman Conquest. It was followed by a silting up of the old haven, which no longer had the waters of the river to scour it out. A further result was the accumulation of shingle, which at last, about 300 years ago, altogether closed the inlet. The lines on the map show the various positions of the shore at different times, and they can be very well seen, in a sort of bird's-eye view, from the hills behind the two Hythes. Granting then that the Rother began to flow to Romney about the tenth or eleventh century, we must try and trace its channel more exactly. In those days it flowed from Newenden round the north side of the Isle of Oxney, by Small Hithe and Reading Street, past Ebony (probably on the north) to Appledore, and from Appledore to Romney the course was along what is now the

* Kemble's Saxon Charters, tome i. p. 54, number xlvii.

† No. ccxxxiv. in Kemble's collection (tome i. p. 308).

road joining those two places, which runs on a wide bank on a higher level than the marsh; this is called the Ree Wall. Here there was formerly a channel banked up on each side, and judging from the size of the Ree Wall, it seems probable that the river gradually raised its bed by depositing sediment, the banks being heightened in proportion, till at last even the river bottom came to be as high as the land on each side. Part, however, of the elevation of the centre may have been caused by a levelling of the banks when the old channel was filled up to form the roadway. Where this Ree Wall bounds Appledore Dowls there is a good instance of what occurs in many places on the Marsh, namely, a difference of level between two parts, the lower one ending against an abrupt slope or bank that bounds the higher. On the south the fields are about at the same level as the road, while on the north there is a fall of many feet to the low ground of the Dowls; and the reason of this is that when the land is once enclosed, and kept from the influence of the sea, it gets no further sediment deposited on it, but keeps at the same level, while that outside is always receiving fresh accessions of mud, &c., which raise its level, sometimes even in a long course of time to nearly the top of the wall that was made to keep out the sea from the first tract. Therefore the older the enclosure is the lower the land; that about Rye, the most recent of all, having been enclosed in 1833, is at a high level, only three feet below high water mark of spring tides. The higher parts are mostly to seaward; those near the former shore, having been enclosed first, form the lowest part of the Marsh. When the Rother flowed down by the Ree Wall, Old Romney was the port, and afterwards New Romney was built on a spit or island of shingle. Towards determining the date of this there is the fact that New Romney church has a very fine tower of Norman architecture. The banks of the old channel can be traced (where there is a dotted line on the map) to the beginning of the town, and where they end there are some heaps or earthworks that are said to have been the forts that defended the entrance. The trend of the shingle from Globsden Gut to Romney, and the corresponding curve on the other side of the river mouth from Lydd northwards, render it likely that these banks were formed when the waters of the Rother flowed out there and kept a clear channel between the two towns. Following then the "shingle-fulls" from Jacks Court, we find that the ridges continuous with them are either those joining Lydd and Dunge Marsh Court, and leading to the south-east, and then curving round to the south-west, or if not, that which goes from Lydd to Abnor Pit, or else an intermediate one. All that great mass of shingle, therefore, forming Dunge Beach, which lies to the east of the first-mentioned line, was, as can be seen by the direction of the ridges, formed later, and must have been brought round the Point, and collected since the Rother first came to Romney.

Here it may be well to inquire as to the form of Dunge Ness at different periods. The shingle having come from the west and lapped round, so as to make the north and south "fulls," it is plain that the most westerly of these is the oldest. If, then, we suppose each "full" in succession on the east and south-east to be removed, the remainder will give us the form of the Point at different periods. Taking away, then, all that is marked Dunge Beach, the line of beach from Lydd to Dunge Marsh Court, and from there round to the shore between Abnor Pit and the Gut, will, as before stated, represent the Point about the tenth or eleventh century. The "fulls" that stretch from Lydd Ripe towards Wigmore Pit were formed earlier, and as these do not curve

round to the west, but, after running straight for a mile or two, abut against the present beach, they must have formerly extended further seaward and have had their ends washed away. The dotted line south of Abnor Pit, which curves round to the west, is an attempt to show what was the form of the Point when the most easterly of these "fulls" was the last that had been made ;* and the line leading out from Holme Stone represents what may have been the position and form of the Point when all east of that was sea. The same kind of argument holds good for the line still further west. Lydd Ripe having been, as we know, in existence in the eighth century, the most easterly of the dotted lines may represent the Point at that period, or even earlier. The relation of the present beach to these old "fulls" shows that there has been great destruction of the old shingle beaches from the weather side of the Point, and that a great part of the beach on the east is the spoil of earlier "fulls" on the west ; that, indeed, the pebbles have shifted on from west to east in stages, at one time collecting and remaining probably for centuries, and afterwards being again invaded by the waves and carried further on. There is a circumstance already mentioned not very easily accounted for, viz. that the shingle at Holme Stone and other parts is at a lower level than the present beach. It may be that the land has been slightly depressed since its formation, but I think it more likely that the reason of it is connected with the varying level of the tides, and that perhaps the spring tide did not rise so high here at that time ; or possibly each "full" did not remain for so long a time as the outermost one, and therefore had less chance of the combination of heavy sea and high tide which is so effectual in piling up the beach. The subject, however, still requires accurate working out.

We have now to trace the changes of Dunge Ness through the later periods. No accurate maps are known before the time of Queen Elizabeth, during whose reign a chart was made of the Marsh and the Ness, and from that and other authorities Mr. Redman has deduced several very important facts, which are given in a paper read before the Institute of Civil Engineers.† It appears from his researches that in Queen Elizabeth's time the distance of the Point from Lydd Church was just three miles, whereas in 1844, when the Admiralty Chart was made, it was three miles and seven-eighths. Reckoning from 1617, when an accurate map was published (by Cole), "the average annual "increase during two centuries has at least amounted to nearly six "yards."† The Ordnance Survey of this district is said to have been made in 1794, and the map was published in 1816. When I surveyed the district in 1860, and inserted all the "fulls" or shingle ridges on the previously featureless Ordnance Map, I found that in 66 years‡ the point had grown about 360 yards, always supposing, which is doubtful, that an Ordnance Map so old can be depended on as giving precisely the true form of the old coast. In like manner, at Christmas 1860, I found that on the north of the Point the shingle had increased since the Admiralty Survey ; and for the guidance of future observers I may remark that the point itself was then 420 yards from the Light-

* The part of the Alluvium marked *The Brooks* bears also the name of "Old Haven." If it was ever a harbour, it must have been so at a very early period, when perhaps the "fulls" at Wigmore Pit were the most easterly, and the sea flowed round them on the north and back towards where the coast-guard station now is, making an almost land-locked harbour.

† Proceedings of the Institute of Civil Engineers, vol. xi. (1852.)

‡ Or perhaps less if this part was resurveyed before the date of publication.

house in a direction 8° north of east, while the nearest point of the shore to the Light was 185 yards from it in a direction S. 20° E.

I will now return to the river Rother, and add a few more facts regarding its former channels. The Rother continued to flow out at Romney, keeping that port open, until the middle of the 13th century, when some destructive storms breaking down the walls, probably accumulated sand-banks at its mouth, and forced the river to seek a new channel. It then changed its course at Appledore, and fell into the sea at Rye. From that time New Romney decayed as a port, and it was not long before the harbour was disused; at the present day Romney Hoy, as this inlet is called, is nearly filled up with sand and mud, being only covered by the sea at high water about the period of spring tide. In the same century the old town of Winchelsea was destroyed by the waves, having been built on the sands or shingle not far from the present mouth of Rye Harbour, but its exact position is unknown, and it may have been somewhere out at sea beyond the present coast line. Cole's map of 1617 shows the Rother flowing in what he calls "Appledowre Channel," from the village of that name, to Knock House, and from there to Rye. Its course corresponds with *High Knock Channel* engraved on the Ordnance Map.

Winchelsea Castle (or Camber Castle as it is usually called) was built by Henry VIII. to defend the harbour, which at that time must have opened to the sea, in such a manner that the bar of shingle in front of the castle was then the shore. It would seem that shingle afterwards formed in "fulls" to the east and gradually drove the river mouth in that direction. In 1617 the shore on the east side of the harbour (which is all that is depicted on Cole's map) ran from East Guildford towards Broomhill of the map (formerly a town, but destroyed by the sea in 1287), and returned by Camber to a point near where the word *Harbour* is marked on the Ordnance Map. This shows us that the shingle on the north-west of the Lighthouses did not exist in 1617, nor probably did that which extends from the church at the harbour towards "Pier Head"; and it is quite certain that the long spit south-east of this had not been formed at that time.

About the middle of the 17th century a new cut was made for the Rother from a mile or two east of Newenden through Wittersham Level on the south of the Isle of Oxney to near East Guildford, and the river is still kept to this channel. In the last century a cut was made, beginning at Rye and passing near Winchelsea, that brought the waters of some small streams, and for a short time those of the Rother also, to a point three miles south of Rye at the very edge of this map. This channel, which is called Rye New Harbour, did not remain in use many years, and on its abandonment the old channel, which forms the present harbour, was readopted; the last mile of the former channel is now turned into grazing land.

The building of the Pier Head at the New Harbour has had a curious effect on the movement of the shingle, illustrating what was said in p. 17. The shingle collected on the west side of the piers till the bight was filled up and then passed the pier heads, making a long narrow spit with the "fulls" going diagonally across it, and leaving a nook or inlet of water between the spit and the older line of shingle. At the time the Ordnance Map was made (published 1816) this spit had only got a little more than half a mile to leeward of the pier; in 1840 it had nearly reached the present harbour, making the innermost of two claw-shaped banks marked on the map, and in 1858 the outer one had been formed, reaching past the new pier of the harbour and

threatening seriously to impede the navigation.* The nook or inlet mentioned above has at the same time been gradually filling with sand and mud, and a good many acres of it have been banked in.

It only remains to speak of a few more very recent changes and of those that are now going on along the shore.

The martello towers along the coast were built about 1808 ; at Rye Harbour there were two, Nos. 28 and 29 ; No. 29 was washed down about the year 1822, and a good deal of the shingle to the south-west of where it stood has also been swept away by the sea. No. 28 was with difficulty preserved, but now, from the formation of the new point of shingle, it is well protected and never exposed to a heavy sea.

On the other side of the harbour, the hillocks or dunes of Blown Sand have a good deal increased during the last 70 or 80 years. A ridge has been formed in front of the public-house (near the *b* of *Harbour* on the map), and at one time the sand was being blown over the rich land about Camber, but now it is held together by the growth of the *bent-grass* which was sown there for the purpose. At the present time the sand-hills are increasing somewhat on the seaward side. From Camber to Dunge Ness the land is losing a little ; some of the coastguard houses have been washed down, and so have two batteries (west of Dunge Marsh Gut) which were standing at the time of the Ordnance Survey.

At the part of the shore to the south-east of the Lighthouse the waste and supply are perhaps equally balanced, while at the Ness and north of it as far as Great Stone Point the land is increasing. The shingle must pass from that Point to Little Stone across a bar of sand which exists in front of the Hoy. I hear from coastguard men that beach pebbles are sometimes seen on it. The trending inwards of the "fulls" at Little Stone (somewhat hidden by the Blown Sand) is probably due to easterly and north-easterly winds, which drive the beach round to a position from which the waves, raised by the southerly winds, cannot remove it. It seems likely that in time the Hoy will entirely silt up, and the two Points will meet. Towards Globsden Gut the shore has receded a little lately, and the martello tower there (No. 26) is almost standing out in the sea. The coast about Dymchurch is not gaining at all, and of course the wall, which is kept in good repair, prevents any loss. The shingle, I am told, travels along it with great velocity when the waves are high. The beach in front of Hythe is gradually losing, as the waste is not compensated by a supply of shingle from the south-west, that which comes round Dunge Ness being for the most part deposited on the shore before reaching Romney. At Folkestone all that flat land on which the Gasworks, the Pavilion Hotel, &c. &c. are built consists of shingle, collected by the building out of the west pier of the harbour. When the shingle had reached the extremity of the pier and the beginning of a short work at the south-east point called the Horn, it washed round and made a bank outside the east pier, and began to fill up the harbour so much that except at spring tides vessels drawing nine or ten feet could not enter.† In this state the harbour was bought by the South-eastern Railway Company in 1843, and they adopted the plan of continuing the Horn, and carried it out so far and at such a height that all the shingle

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* For the details of this, both here and on the map, I am indebted to the survey made for the Rye Harbour Commissioners.

† Official Report to the Engineer-in-chief of the South-eastern Railway Company, by Alexander Swan.

is intercepted, and has formed a piece of land still growing, which has been of great value, the Harbour Station and the Custom House being built on it. When once the harbour was cleared of the shingle and mud that had accumulated it remained free, or at all events whatever finds its way in is scoured out by the return tide and the rush of the pent streams. Another consequence of these works is that the shore at the East Cliff has had all its beach washed away to the east, and gets no further supply, so the cliff is there being denuded, though it is now in part protected by masses of the hard stone that occurs in the Lower Greensand, which have recently fallen and make a kind of natural breakwater.

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