A MONOGRAPH

ON THE

CRETACEOUS ECHINODERMATA.

ON THE CRETACEOUS GROUP.

The Cretaceous group, as a whole, as developed in England, has been so fully described by Conybeare and Phillips,[1] and its subdivisions by other authors,[2] that it appears to be unnecessary to devote any great space to this branch of the subject, beyond an epitomized outline of the subdivisions of the Cretaceous rocks, with brief notes on the species of *Echinidæ* found therein, and the co-relation of these stages with their equivalent zones of life in the Cretaceous systems of the Continent of Europe; and as the Isle of Wight exhibits some of the best coast-sections of the Cretaceous rocks in the British

[1] The 'Outlines of the Geology of England and Wales' contains a most able account of this formation.

[2] The following, among many others, may be consulted for important information on the Cretaceous formation:—Dr. Fitton's various memoirs in the 'Geol. Transactions,' and 'Quarterly Journal of the Geol. Soc.;' Sir H. De La Beche, "On the Chalk and Greensand of Lyme Regis," 'Geol. Trans.,' vol. ii; Young and Bird and Professor John Phillips on the Geology of Yorkshire; Dr. Mantell's works on the Geology of Sussex; Samuel Woodward's 'Geology of Norfolk;' Dixon's 'Geology of Sussex.' The various memoirs in the 'Quarterly Journal of the Geol. Soc.' on the Cretaceous Rocks, by Professor E. Forbes, Messrs. Lonsdale, Rose, Austen, Cunnington, Morris, Weaver, Rose, Clarke, Bunbury, Bowerbank, R. C. Taylor, Ibbetson, Toulmin Smith, D. Sharpe. The Manuals of Geology, by Sir H. De La Beche, Sir Charles Lyell, and Professor Jukes; and the "Geology of the Isle of Wight," by Mr. H. W. Bristow, in the 'Memoirs of the Geological Survey.' The reader will likewise find most valuable information in Le Vicomte D'Archiac's 'Histoire des Progrès de la Géologie,' tom. iv and v, "Sur la Formation Crétacée;" the memoirs by M. E. Guéranger, in the 'Bull. Soc. Géol. de France;' M. Cornuel's "Section of the Environs of Vassy" ('Mém. Soc. Géol. de France,' t. iv); M. Leymerie's "Memoir on the Department of the Aube" ('Mém. Soc. Géol. de France,' t. iv and v); and in the different important works by the late M. Alcide d'Orbigny.

Islands, in their stratigraphical order of superposition, I shall take these as a type of the whole, supplying any deficiency in the series by examples afforded by other localities.

THE LOWER GREENSAND.

The Lower Greensand, occupies an extensive tract in the southern part of the Isle of Wight, where it attains a thickness of nearly 900 feet; this great formation has been so carefully examined and well described by the late Dr. Fitton,[1] in his stratigraphical account of the section from Atherfield to Rocken End, on the south-west coast of the island, that I must refer the reader for full information to that valuable memoir for further details. Having worked several times over all the beds of that remarkable and most instructive district, and in my excursions had the advantage of the local knowledge and assistance of Dr. Fitton's collector and guide,[2] I shall now merely attempt a generalized account of this section, for the purpose of pointing out the beds with which we are more immediately interested, in our description of the Echinidæ contained therein.

The entire series of the Lower Greensand beds, 809 feet in thickness, rise in succession from the shore and ascend into the cliffs between Atherfield Point and Rocken End, towards which they dip at an inclination of about 2°.

The following Subdivision of the Atherfield Section was proposed by Dr. Fitton, in ascending order.

	Feet.	Inches.
I. Perna Mulleti Bed	5	3
II. Atherfield Clay	60	0
III. The Cracker Rocks	85	0
IV. The Lower Gryphæa Group	32	0
V. Scaphites Group	50	4
VI. Lower Crioceras Group	16	3
VII. Walpen Clays and Sands	57	0
VIII. Upper Crioceras Group	46	2
IX. Walpen and Ladder Sands	42	0
X. Upper Gryphæa Group	16	0
XI. Cliff-End Sands	20	0
XII. Foliated Clay and Sand	25	0
XIII. Sands of Walpen and Black-Gang Undercliff	97	0
XIV. Ferruginous Sands of Black-Gang Chine	20	6
XV. Upper Clays and Sand-Rock	118	0
XVI. Various Sands and Clays	118	4
	808	10

[1] "A Stratigraphical Account of the Section from Atherfield to Rocken End, in the South-west Coast of the Isle of Wight," 'Jour. of the Geol. Soc.' vol. iii, p. 289, 1847.

[2] Mr. Charles Wheeler, fisherman, at Ventnor, is the person alluded to, he has a most correct knowledge of the range and position of all the beds, and of their fossil contents, and is a most trustworthy guide to the Atherfield Section.

I. *The Perna beds*, which here form the base of the Lower Greensand, rest upon Weald clay; the junction between the lacustrine series of the latter with the marine deposits of the former exhibit no trace of disturbance; a thin seam of bone-bed, composed of the teeth of fish of lacustrine species, attest a change of conditions similar to that observed in some junction-beds in other formations, as between the Upper Keuper and the Lias, and the Upper Silurian and Devonian series. This junction, which is only sometimes visible, occupies about eight inches of vertical thickness; on one occasion I succeeded in detaching a block of rock, about a foot thick, from the beds, the lower half of which contained the lacustrine shells of the Weald clay, whilst in the upper half *Perna Mulleti*, Desh., *Exogyra sinuata*, Sow., and other Lower Greensand shells, were found. The Perna beds rise from the base of the cliff, at a point a few yards to the east of the flag-staff of the coastguard-station; they consist of dark-blue sandy clay and greenish sand, forming in parts a very hard rock, and characterized by that remarkable shell *Perna Mulleti*, Desh., which is not found in any other bed in the section. Nearly one hundred species of marine shells are found in the Perna beds; among these *Nautilus Requinianus*, d'Orb., and *Exogyra sinuata*, Sow., appear for the first time, of very large size, and *Hemipneustes Fittonii*, Forb., among the Echinida, with the remains of fish belonging to the genera *Lamna*, *Odontaspis*, *Saurocephalus*, *Hybodus*, &c.

II. *The Atherfield Clay* is of a drab colour, passing into bluish-gray, and contains flat nodular masses. *Ammonites Deshayesii*, Leym., *Pinna Robinaldina*, d'Orb., and several other species of Conchifera, with the bones of a Turtle, and the remains of Echinidæ, are found in this bed.

III. *The Crackers*, so called from the noise produced by the waves dashing over the ledges formed by these rocks on the shore, are the most interesting fossiliferous group of the entire series, and consist of alternations of sandy clays and clays, and two layers of ferruginous sandy nodules. All the clays resemble Fullers' earth, and the sand between the nodular concretions in the lower bed is sometimes indurated into an imperfect stone. The lower part of this group is a brown clay and sand, called the Lower Lobster bed, from the number of *Astacus Vectensis*, Bell, found therein; the succeeding beds are sands, containing concretionary masses of sandstone full of beautiful fossil shells, *Ammonites Deshayesii*, Leym., *Pholadomya Martini*, Forb., *Myacites plicata*, Sow., *Corbula striatula*, Sow., and several other Conchifera. Many of the *Myadæ* are found in the upright position they assumed during life. The lower sandstone, from a foot to eighteen inches in thickness, is almost entirely made up of *Gervillia aviculoides*, Sow., *Trigonia Dædalæa*, Park., *Ammonites Deshayesii*, Leym., and other shells. The upper layer of sandstone contains coniferous wood and a *Teredo*, and the upper clays are fossiliferous throughout. In the concretionary nodules of the lower series of this group I have collected *Pseudodiadema Autissodorense*, Cott., *P Ibbetsoni*, Forb., and *Hemipneustes Fittoni*, Forb., with the

beautiful winged shells *Rostellaria glabra*, Forb., *R. retusa*, Sow., *Pterocera Fittoni*, Forb., and several species of Cerithia, as *Cerithium turriculatum*, Forb., *C. Neocomiense*, d'Orb., and *C. Phillipsi*, Leym.

IV. *The Lower Gryphæa* or *Exogyra Group* has for its base a thick bed of ferruginous sand, overlain by sand containing *Perna alæformis*, Sow., and *Terebratula sella*, Sow., in great abundance, in thin seams of sand. The zones with *Exogyra sinuata*, Sow., which here are very large, are found in the upper part of the group.

V. *The Scaphites Group* forms three beds; the lowest is composed of brown ferruginous sand, containing *Exogyra sinuata*, Sow., *Terebratula sella*, Sow., *Rhynchonella Gibbsiana*, Sow.; and of the Echinidæ I found *Cardiaster Benstedi*, Forb., and *Nucleolites Olfersii*, Ag.; the middle beds, about two feet in thickness, contain layers of nodules enclosing *Scaphites gigas*, Sow., and *Scaphites Hillsii*, Sow.; the upper consist of thick beds of greenish sand, containing, in the upper part, fine large specimens of *Exogyra sinuata*, Sow.

VI. *The Lower Crioceras Group* consists of ranges of large sandy nodules, enclosing *Crioceras Bowerbankii*, Sow.; the lowest range rises on the west of Whale Chine, and is succeeded by two other ranges, all three enclosed in sand about nine feet thick; the lowest, furnishing the best fossils, passes the bottom of Whale Chine, from whence I have obtained several large specimens.

VII. *The Walpen and Ladder Sands and Clay* extend from the east of Walpen to half way between Ladder and Whale Chines, where they are well seen; the lower half of this group contains *Ammonites Martini*, d'Orb., and a large *Gryphæa;* the upper half, which is clayey below and sandy above, contains *Dentalium*, *Myacites mandibula*, Sow., *Pinna Robinaldina*, d'Orb.

VIII. *The Upper Crioceras Group* consists of sandy nodules imbedded in sand, and contains *Crioceras Bowerbankii*, Sow., *Ammonites Martini*, d'Orb., *Gervillia solenoides*, Defr., *Terebratula sella*, Sow., and several other shells. This group is seen for some distance along the shore east of Walpen Chine, which is crossed by it, as are also Ladder and Whale Chines.

IX. *The Walpen and Ladder Sands* consist of greenish and gray sand, with a layer of large fossiliferous nodules at the base, containing *Serpulæ*, *Thetis*, *Gervillia*, *Cucullæa*, *Corbula*, and other shells, together with an Urchin belonging to the genus *Brissus*.

X. *The Second Gryphæa or Exogyra Group*.—The lower part of this group consists of

sand and clay containing small nodules enclosing a *Brissus*, *Ammonites Martini*, d'Orb., and detached valves of *Exogyra sinuata*; above are three or four ranges of *Exogyra sinuata*, Sow.; the parallel edges of these large shells, as seen in the cliff, indicate three or four continuous strata, with irregular clusters between them. The second or upper Gryphæa group appears at low water at Shanklin, where the several ranges of *Exogyræ* are seen rising beneath each other. Varieties of this shell appear to me to characterize different beds; for example, the specimens of *Exogyræ* from the Crackers and Lower Gryphæa group present marked differences when compared with shells of the same species from the Upper Gryphæa group. A similar observation has been made by M. Cornuel on the *Exogyræ* collected by him near Vassy, in France. This geologist assured Dr. Fitton "that he could at once assign each variety of form to a special place in the section of that vicinity." Small fragments of vegetable remains (*Lonchopteris Mantellii*, Brong.) occur not only in these beds, but nearly throughout the entire formation.

XI. *The Cliff-End Sands* consist of uniform sand about fourteen feet thick, with a subordinate bed of fossiliferous clay containing *Trigonia Dædalæa*, Park., in the lower part, and plant-like pyritiferous concretions in sand and clay in the upper part.

XII. *Foliated Clay and Sand.*—Consist of alternations of dark-blue clay and greenish, translucent, siliceous sand, containing nodules of pyrites and large irregular masses of coarse sandstone. These beds are well seen in Walpen and Black-Gang Chines, but no fossils have hitherto been found in them.

XIII. *Sands of Walpen and Black-Gang Undercliff.*—This group commences with a bed, about ten feet in thickness, of loose white sand, with thin laminæ of gray clay; this is succeeded by seventy feet of greenish and brownish sand overlain by seven feet of coarse ferruginous sand, with rounded grains of iron-ore in the lower half of the bed, and by twelve feet of alternating sand and clay, making a total of 100 feet. There are only very few fossils in this group—*Myacites plicata*, Sow., and *M. mandibulata*, Sow.

XIV. *The Ferruginous Bands of Black-Gang Chine* rise from the shore between Rocken End and Black-Gang Chine, and form the uppermost fossiliferous group of the Lower Greensand; they are composed of brown and yellow sand, with layers of ferruginous concretions, overlain by a bed of ferruginous sandstone, about five feet in thickness; the group is about twenty feet in all, and is the equivalent of the zone of Lower Greensand at Parham Park, and other places in Sussex, and near Sandgate in Kent. The sands in this group are fossiliferous throughout, and the species identical with those found in the Perna bed and Cracker rocks at the bottom of the section.

XV. *The Upper Clays and Sand Rock* consist of forty feet of dark clay with pyrites, separated by eighteen feet of white and green-coloured sand from a mass of clays and sands sixty feet thick. The bed 47 of this group is dug near Rocken End for the manufacture of glass; it contains no fossils.

XVI. *Various Sands and Clay* constitute the remainder of the section; they measure about 120 feet in thickness, and are overlain by the Gault.

The Lower Greensand represents the upper portion of the rocks known as the *Terrain Néocomien* of MM. Thurmann and d'Orbigny; *Terrain Jurassique supérieur* of M. Mathéron; *Couches adossées au Jura* of Von Buch; *Formation Waldienne et Néocomienne* of MM. Dufrénoy and Élie de Beaumont; *Calcaire à Spatangues, L'Argile ostréene*, of M. Cornuel; *Argiles tégulines et grès vert* and "*Terrain Néocomien*" (Wealden) of M. Leymerie. The French geologists consider the Wealden clay and Hastings sand as the inferior, and the Lower Greensand the superior, portion of their *Néocomien*, whilst English geologists describe the Wealden and Lower Greensand as distinct formations.

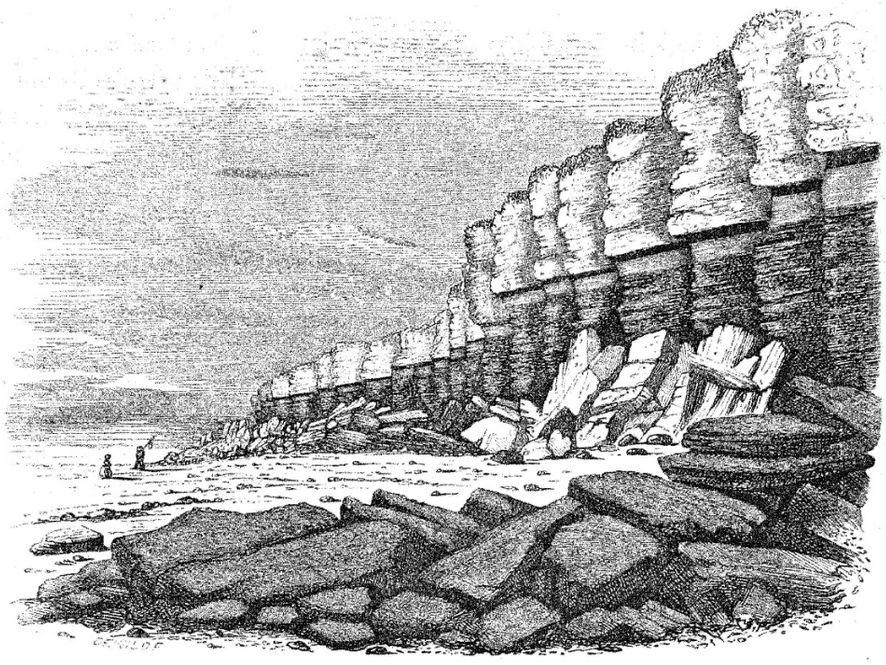
THE GAULT.

In several coast-sections the Gault is seen separating the Lower from the Upper Greensand; this bed of dark clay is called "the blue slipper," from the tendency of the overlying strata to form landslips by gliding over its surface. The charming scenery of the Undercliff has been in a great measure produced by the foundering of the Upper Greensand and Cretaceous rocks over the Gault clay; the rain-water having saturated these porous beds, bursts forth in springs, which wet the surface of the clay, and occasions slips of the superincumbent strata. A rich fertile soil is thus formed upon a broad terrace of stiff clay, exposed to the south, and sheltered from the north by a high mural escarpment of Upper Greensand. Under these favourable physical conditions vegetation springs up in great luxuriance, on a natural terrace high above the sea, producing a coast-scene unequalled in beauty in the British Isles.

The Gault is about 100 feet in thickness, and in the Isle of Wight contains few fossils, as *Inoceramus sulcatus*, Sow., and *I. concentricus*, Sow.; near Folkstone and Charmouth it has yielded many beautiful shells in high preservation. I shall figure some rare *Echinidæ* from this bed at Folkstone.

The Red Chalk is a remarkable stratum, supposed to be the equivalent of the Gault; it is limited both in thickness and extent, for if we take, says the Rev. T. Wiltshire, one hundred feet as its maximum and four feet as its minimum thickness, and 100 miles as its extreme length, we shall not be far from the truth. It is said to be peculiar to the English Chalk. It is well exposed at Speeton, near Filey, on the Yorkshire coast, and at Hunstanton Cliff, near Lynn, Norfolk; in both localities it is a red calcareous rock, deeply coloured by

the peroxide of iron, and containing minute siliceous grains, and small pebbles of chalcedony, quartz, flint, &c. This rock from Hunstanton yielded by analysis carbonate of lime, with a little alumina, 82·3; peroxide of iron, 6·4; silica, 11·3 = ; 100.



Hunstanton Cliff,[1] of which the annexed woodcut gives an idea, consists of five different beds—1st, the uppermost, or white chalk, is forty feet thick; 2nd, bright-red chalk, four feet; 3rd, yellow sandy bed, ten feet; 4th, a dark brown pebbly stratum, forty feet; and 5th, a dark-coloured bed, almost black, twenty feet.

These divisions at Hunstanton, the Rev. T. Wiltshire states, do not run into each other, but are quite distinct; the red chalk is as clearly separated from the white as though the one had been covered by a broad band of paint, and the same remark holds true of the others. When the sun shines upon the cliff, and lights up the bright white, bright red, the pale yellow, and the dark brown and black, and casts a shadow over the mass of gaily tinted materials at the base, a picture is produced not easy to be surpassed in beauty, and certainly not to be fully appreciated unless it is seen.

The Red Chalk is very fossiliferous, containing Ammonites, Belemnites, Brachiopoda, Echinidæ, and Corals.

In compliance with my request, my friend the Rev. T. Wiltshire, F.G.S. has kindly sent me the following note, embodying his latest observations on the Red Chalk at Speeton.[2]

"In answer to your inquiry respecting the natural section of the Red Chalk at the

[1] For ample details, see the Rev. Thos. Wiltshire, on the 'Red Chalk of England.'

[2] To this gentleman's kindness I am likewise indebted for the above woodcut, copied from a water-colour drawing in his collection.

most northern extremity of that bed in England, viz., in the neighbourhood of the little Yorkshire village of Speeton, I send you a few scanty notes. On my first visit to Speeton, some years since, I imagined, as I subsequently described in the second volume of the 'Geologist Magazine,' and in the 'Proceedings of the Geologists' Association' for 1859, that the Red Chalk in Yorkshire consists of a couple of bands of a highly coloured marl, of about thirty feet in thickness from top to bottom, and that its fossils are of such forms as to imply a close relationship with Gault species. This opinion I derived from seeing the section in a gulley to the east of the village; but subsequent investigations made upon the shore under the cliff, at a mile or more from the ravine, showed me that my former observations were slightly incorrect, and that the Red Chalk, in that part of Yorkshire at least, contains two more additional coloured bands, and that its total thickness from top to bottom is not less than 100 feet, and that its upper portion belongs to the Lower Chalk series.

"The highest bed of Red Chalk at Speeton may be seen rising from the beach at a very gentle inclination, at about a mile and a half to the south-east of the gulley. This bed, which is of varying thickness throughout its course, may be estimated as being on an average about five feet thick; it is of a pale pink colour, very hard, and presents a strongly marked appearance from the white chalk, above and below, with which it is in contact. The fossils found in it are *Rhynchonella Mantelliana*, *Gryphæa vesicularis*, *Discoidea cylindrica*, *Holaster subglobosus*, *Spines of Cidaris*, *Spines of Diadema* small vertebræ and teeth, together with a considerable number of *Terebratulinæ graciles*. Above this bed, in the white chalk, are found *Holaster subglobosus* and *Ammonites peramplus*. The pink band just mentioned is followed by a greenish-yellow chalk, about forty feet thick, almost destitute of organic remains, except fragments of *Inocerami*, and marked by numerous thin layers of marl, not unlike those met with in the Lower Chalk of Sussex. The next bed in descending order is one of a light pink colour, about three feet in thickness, likewise destitute of fossils, with the exception of fragments of *Inocerami*. This is followed by another stratum of greenish-yellow chalk, about nine feet thick, containing small *Gryphææ*, and *Terebratulæ semiglobosæ*, and *Peltastes*, but, like the two preceding beds, generally unfossiliferous. The greenish-yellow chalk is succeeded by five feet of white and red chalk, in thin bands, very deficient in organic remains, and this rests upon a pale-red band, about seven feet thick. In the upper part of this last seven feet of red material are many *Vermiculariæ umbonatæ*, and in its lower portion many small *Terebratulæ* and *Inocerami*. About ten feet of greenish-white chalk, somewhat hard, is the next bed, in which few fossils are to be noted except a Terebratula and a bone or two of a Star-fish. In all these strata enumerated there is a marked absence of Belemnites, but in the succeeding and last bed, one of a bright-red colour, and more than thirty feet thick, they become exceedingly abundant. This red band is the one from which most of the Red Chalk fossils from Speeton are derived; it is exceedingly fossiliferous. In its uppermost portion very large *Terebratulæ* may be obtained, and generally many of an ordinary size; at about twenty feet below its commencement, *Belemnites*, *Pentacrini*,

and spines of a Cidaris occur, which appear to be distinct from the Cidaris spines, ninety-four feet above, in the pink band. There are, moreover, no traces of *Holaster subglobosus* nor *Discoidea cylindrica* in this bright-red bed; and Ammonites cannot be seen, though so numerous in the Speeton Clay, upon which it rests. This red band gradually becomes nodular, and of a bluish cast, and gradually merges into the Speeton Clay.

"Inland the Yorkshire beds put on a somewhat different appearance, for on the escarpment of the Wolds, as at Great Givendale, the beds of Red Chalk abound in pebbles and in *Terebratulæ biplicatæ*, a feature that is absent at Speeton, though conspicuous at Hunstanton, in Norfolk.

"A careful inspection of the fossils derived from the Red Chalk series of Yorkshire and Norfolk shows that the two extremities of the bed are very distinct in character, and have not much in common, and that the southern stratum is a more littoral deposit than the northern."

My friend John Leckenby, Esq., F.G.S., of Scarborough, having studied critically the fossils of the Speeton Clay, has kindly supplied the following note on that formation, from which it appears that until now the true relations of this deposit have not been clearly understood.

"The Speeton Clay of Yorkshire, besides many minor subdivisions, presents two important and well-marked sections; well-marked lithologically, still more so by their fossils. The line of separation midway, or nearly so in the series, is also distinct and clear, with no passage-beds indicating a transition from one set of conditions to another. Its entire thickness cannot be less than 400 feet, but in consequence of the denudation of the inclined edges of its beds it nowhere presents a continuous section of more than 150 feet.

"The lower division is characterized in its upper beds by Ammonites and Gasteropods, which I at one time felt inclined to refer to the Oxfordian system, and many palæontologists yet contend that the thick coronated Ammonites which here abound belong to the Oxfordian group. Without, however, doing violence to our preconceptions of stratigraphical relations, we shall find that they approach much more nearly to Portlandian types, as figured by d'Orbigny; and *Am. Gravesianus* cannot be distinguished from a common, but unpublished form, in the Speeton Clay. In the lowest beds of this lower division are found *Am. triplicatus*, *Am. excavatus* (var. *alternatus*, Von Buch), with univalve and bivalve shells identical with species which I have obtained from the Kimmeridge Clay of Lincolnshire, in a railway-cutting near Brigg. The line of demarcation before referred to is characterized by a thickish band of pseudo-coprolites, and by many remains of Saurian animals; it would appear that here there has been a period of repose, during which the Saurian dwellers upon a shallow reef disported themselves, and that we have a well-marked division between the close of the Jurassic and the commencement of the Cretaceous period. A large and almost perfect example was lately procured and is now in the possession of Right Hon. Lord Londesborough, the lord of the manor of Speeton.

"The habit of referring the whole of the Speeton Clay of Yorkshire to the Cretaceous period, in deference to established authorities, has hitherto prevented a clear reading of

the evidence furnished by its fossils, and from the fact of so many of its Ammonites of the Oolitic type being found, not *in situ*, but in boulders, has led to the inference of the existence, at some remote period, in Filey Bay, of great beds of Oxford Clay similar in character to the Oxford Clay of the south of England.

"The Ammonites can, however, with much more propriety, be referred to Portlandian types, and the wasted beds which have furnished the boulders doubtless pertain to the same epoch.

"Above the line of Saurian remains alluded to, all the fossils belong to the Cretaceous type; and amongst the exact representations of a Neocomian fauna many others are found which in general features closely resemble them. Amongst the former, *Ammonites Deshayesii*, Leym., and *Vermicularia Sowerbii* may be mentioned, while *Crioceras Beanii*, Phil., cannot easily be distinguished, if at all, from *C. Cornuelianum*, d'Orb.

"If we seek for the equivalents of the Upper Greensand in the Speeton Clay, we must do so rather in the lower beds of Red Chalk which overlie that deposit than in the clay itself; and the frequent presence therein of *Inoceramus Coquandianus*, d'Orb., favours this view.

"The junction of the lowest beds of Speeton Clay with the Coralline Oolite cannot be traced along the coast, but may be seen at some distance inland, near the village of Grimston, one of the stations on the line of railway between Malton and Driffield."

The Gault is the equivalent of the *Étage Albien* of d'Orbigny, and the *Gault* of the Germans.

THE UPPER GREENSAND.

This formation forms an important feature in the physical geology of the Isle of Wight; in Compton and Sandown Bays it is seen in its relative position to the Lower Greensand below and the Chalk above, and in the Undercliff it forms a bold, mural, light-coloured escarpment, with rugged lines of cherty beds, producing a fine effect above the rich foliage which clothes the undercliff. According to H. W. Bristow,[1] Esq., F.G.S., the Upper Greensand under St. Catherine's Down is about 155 feet thick; the lower fifty-five feet consist of "bluish, sandy, micaceous beds, throwing out water at their junction with the Gault, and passing upwards into yellowish-gray sand, also micaceous, with sandstone and some chert, forty feet thick. Sandstone and chert imbedded in sand make up the greater part of the rest of the section, the middle portion of which is mostly blue chert based upon seven feet of sandstone, inclosing a bed of freestone four feet thick, whilst the uppermost fifteen or twenty feet consist of calcareous sandstone, forming a vertical face at the summit of the cliff."

In the island the remains of Echinidæ are not abundant in these beds; the Upper Greensand, near Warminster and Devizes (Wilts); Blackdown (Devon); and near Charmouth (Dorset), and Cambridge, are the best localities for the fossil Echinodermata of this formation.

[1] "Memoirs of the Geological Survey," the 'Geology of the Isle of Wight,' p. 24.