CORRELATION AND FACIES OF THE UPPER AND MIDDLE OOLITES
IN ENGLAND AND NORTH-WEST FRANCE.

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The Jurassic, probably better than any other System, emphasizes the fact of a gradual transition of one series into another by means of passage beds, represented locally by unconformities,* and in spite of numerous local facies, the general sequence may be readily followed.

The beds dealt with in this paper comprise a well-marked group of clays, sandstones and limestones, the "Tripartite Series" of Phillips,† commencing with the Cornbrash at the base and terminating with the Purbeck Beds at the top.

These beds have been very fully dealt with, not only in the Memoirs of the Geological Survey, but also in numerous individual papers by Messrs. Blake, Hudleston and, more recently, Morley Davies.‡

In spite, however, of the attention that these beds have most deservedly received, there appears to be no readily accessible paper in which their general correlation can be found§. At Prof. Kendall's suggestion, therefore, I am venturing to attempt to supply this want.

Perhaps the most remarkable feature of the whole series is the inclusion at various horizons of arenaceous and calcareous facies in what is as a general rule an argillaceous series of beds. As has been pointed out by Blake, Hudleston and others, these beds are to be regarded as purely accidental, and the fauna is in every case transitional, the apparent sharp palæontological breaks being due to environment rather than to an actual change in a fauna by the extinction of a previous one. We thus find, as we should expect, repetitions of fauna, which render exact correlation extremely difficult. More especially is

* A recent school of geologists would probably prefer the term "non-sequences," since the unconformity is only recognizable by the absence of beds, not by a marked change in dip.

† *Geology of Oxford*, p. 392.

‡ See Bibliography at the end.

§ A correlation of the English and Weymouth sequence is given by Pellat, *Proc. Geol. Assoc.*, Vol. IV., p. 20.

YORKSHIRE

CAMBRIDGE

AYLESBURY

OXFORD

WIMBORNE

BOULONNAIS

Speeton Clay.
Kimmeridge Clay.
Upper Calcareous Grits.
Corallian Limestones.
Hambleton Oolite & Middle Calc. Grits.
Lower Calcareous Grits.
Pseudo-Kellaways.
Kellaways Beds.
Cornbrash.

Corall Rag.
Amphill Clay.
Elsworth Rock.
Oxford Clay.

Purbeck Beds.
Upper Portland Beds.
Lower Portland Beds.
Kimmeridge Clay.
Coral Rag & Limestones.
Lower Calcareous Grits.
Oxford Clay.
Kellaways Beds?
Cornbrash.

Purbeck Beds.
Portland Stone.
Lower Portland (Hartwell Clay).
Kimmeridge Clay with Pteroceren & Virgulien.
Astartien (Supracorallian part).
Upper Corallian Argovien.
Lower Corallian Argovien.
Oxford Clay.
Kellaways Beds.
Cornbrash.

Sandsfoot Grits.
Trigonia Beds & Osmington Oolite.
Benciff Grits.
Nothe Grits.
Oxford Clay.
Kellaways Beds.
Cornbrash.

DIAGRAM TO ILLUSTRATE THE RELATIONS OF THE VARIOUS FACIES OF UPPER & MIDDLE OOLITES IN DIFFERENT DISTRICTS.

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PURBECK FACIES.
SPEETON CLAY FACIES.
UPPER PORTLAND FACIES.
LOWER PORTLAND FACIES.

HARTWELL CLAY FACIES.
KIMMERIDGE CLAY FACIES.
PTEROCEREN FACIES.
ASTARTIEN FACIES.
SUPRACORALLIAN FACIES.

The more deeply shaded part of the Kimmeridge Clay marks the Virgula Beds.

UPPER CORALLIAN FACIES.
AMPHILL CLAY FACIES.
MIDDLE CALC. GRIT & HAMLETON OOLITE.
LOWER CALCAREOUS GRIT FACIES.
PSEUDO-KELLAWAYS = LOWER CALC. GRIT.

PSEUDO-KELLAWAYS = OXFORD CLAY.
OXFORD CLAY.
KELLAWAYS BEDS.
CORNBRASH.

This section is intended to shew the relations of the different facies only, and is, therefore, purely diagrammatic.

In order to bring out these features clearly no attempt has been made to shew the thickness of the different beds; and the relative distances between the districts, nor is it possible to put in the various unconformities, due, for the most part, to overlaps.

Prof. Kendall remarks that towards South Yorkshire the Corallian dies out by a series of unconformities as Acklam Brow is approached; and he has pointed out that when last seen the Kimmeridge clay rests directly on a greatly attenuated Lower Calcareous Grit.

ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES 273

this noticeable in the Supra-Corallian beds in the Weymouth districts where the alternation of Corallian and Kimeridgean faunas is well marked. Before the beds were examined by Dr. Hans Salfeld* in reference to Ammonite zones, the Abbotsbury Iron Ore, for instance, was always considered as the highest bed of the Corallian ; it is now seen, however, that this bed occurs high up in the Kimeridge Clay, and that the Corallian facies of its fauna is due to local conditions.

In this country the term "Corallian" is of such stratigraphical importance that its abolition would be most undesirable, yet when dealing with an area of Continental magnitude its abolition has much to recommend it. Similarly, as Dr. Strahan remarks,† the terms "Oxfordian," "Kimeridgian" and "Portlandian," associated as they are with definite districts, convey to us a very definite meaning, but they have been adopted in quite a distinct sense on the Continent. For this reason the terms "Upper" and "Middle Oolites," though inappropriate to argillaceous deposits, would be far more desirable.

The zones generally recognised in this country may be seen in Plate XXVIII. and are for the most part generally recognizable over the country ; the zones, suggested by Dr. Salfeld,‡ which are based entirely on Ammonites, are of considerable palæontological interest, but the unfamiliarity to British geologists of a number of the zonal indices and the adoption of a number of new genera and species render it very difficult to correlate his zones with those more generally known. A zonal table based on other groups—as has been done by the late Dr. Vaughan in the Avonian—placed at the side would have considerably increased the value of Dr. Salfeld's paper.

Shortly before his death, Blake commenced a monograph on the Fauna of the Cornbrash,§ with a view to shewing that it was more intimately linked with the beds above than with the beds below ; unfortunately, owing to his untimely death, the part dealing with the Pelecypods, on which most of his conclusions were based, was never published.

* *Quart. Journ. Geol. Soc.*, Vol. LXIX., p. 423 *et seq.*

† *Quart. Journ. Geol. Soc.*, Vol. LXIX., p. 432.

‡ *Ibid.*, p. 423 *et seq.* See also fig. 2.

§ Palæontol. Soc. Monograph, *Fauna of the Cornbrash.*

274 ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES

From my own field observations, extending over several years, at numerous points along the outcrop from Weymouth to Peterborough, I cannot help feeling that his views are fully upheld on purely stratigraphical considerations, and that the Cornbrash represents a period of great transgression, more often than not resting unconformably on the beds below. The classification is thus more readily brought into line with that of Continental geologists, who group the Cornbrash with the Kellaways under the general term of Callovien.

Starting therefore with the Cornbrash as a datum line, it is the object of this paper to point out the sequence in various districts and their correlation, paying special attention to passage beds.

In the neighbourhood of Weymouth there occurs in a comparatively small area a most complete sequence from the base of the Cornbrash into the Cretaceous. Here, also, the sequence is rendered very complete by the inclusion of numerous passage beds, so that this becomes a most suitable sequence with which to compare the beds in other areas.

On the shores of "The Fleet," near Langton Herring, the Cornbrash rests on beds usually classed as Forest Marble, but which may, to a large extent at all events, include the Middle Fullonian—true Great Oolite being apparently absent.

Succeeding the Cornbrash is a small thickness of sandy clay, the Kellaways Beds, which are best exposed at low water at Furzey Cliff (the "Ham Cliff" of old writers), just east of Weymouth. These form a complete transition from the Cornbrash into the purely argillaceous Oxford Clay above.

Between the Oxford Clay and the Calcareous Grits there occurs a series of passage beds with an admixture of Corallian and Oxfordian forms. These passage beds, consisting of the Nothe Grits, with the Nothe Clay above, are best seen just west of Nothe Point, the promontory constituting the western side of Weymouth Harbour; they also occur at the base of Bencliff, east of Furzey Cliff, but are here almost entirely hidden by the talus from the overlying Calcareous Grits, the Bencliff Grits. Ignoring the faulting, which is as a rule only slight, the south-easterly dip continually brings in newer beds, so that between Furzey Cliff and White Nab an almost complete sequence of Middle and Upper Oolites may be studied.

ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES 275

Above the Bencliff Grits, and passing up from them, occurs the Upper Corallian, consisting of the Osmington Oolite and *Trigonia* Beds. Further inland a true Coral Rag facies—i.e., a facies replete with numerous corals such as *Isastræa*, *Thamnastræa* and *Thecosmilia* occurs, but this facies does not appear to exist in the coastal sections, except in the Supra Corallian of Ringstead Bay as stated below.

Succeeding the *Trigonia* Beds there occurs a series of remarkable passage beds from the Corallian into the Kimeridge Clay, consisting of sandstones and sandy limestones alternating with clays, the hard beds having a Corallian fauna, whilst the intervening clays are full of specimens of *Ostrea deltoidea*, a typical Lower Kimeridge form. These passage beds are best seen in the cliff section near Sandsfoot Castle, west of Weymouth, but the uppermost two beds only occur in Ringstead Bay, east of Weymouth, and the highest Corallian facies, the Abbotsbury Iron Ore in the neighbourhood of Abbotsbury is well up in the Kimeridge Clay as mentioned above. The struggle for existence of the two facies (Corallian and Kimeridgian) is so remarkable that it seems desirable to record the complete sequence here. It is to be noticed that although *Ostrea deltoidea* occurs in the arenaceous beds, it is almost the only fossil in the clays, especially in the base where the lowest specimens are attached to the sandstones. To this series Hudleston has aptly given the name of Supra-Corallian, which includes the Kimeridge Grit of Damon.

SECTION OF SUPRA-CORALLIAN IN THE WEYMOUTH DISTRICT
(EXCLUDING THE ABBOTSBURY IRON ORE).

Supra-Corallian.	Upper Coral Rag.	6.—Gritty Limestone (Kimeridge Grit of Damon), with <i>Thamnastræa</i> , <i>Thecosmilia</i> , <i>Stylina</i> , <i>Exogyra nana</i> , <i>Ctenostreon proboscideum</i> , <i>Cidaris florigemma</i> , etc.
		5.—Blue Clay with <i>Ostrea deltoidea</i> .
	Sands- foot Grit.	4.—Ferruginous sands with <i>Ostrea deltoidea</i> and <i>Ctenostreon proboscideum</i> .
		3.—Blue Clay with <i>Ostrea deltoidea</i> .
Sands- foot Clay.		2.—Ferruginous sandstone with <i>Ostrea deltoidea</i> , <i>Pecten vagans</i> , <i>Pecten episcopalis</i> .
		1.—Blue Clay with <i>Ostrea deltoidea</i> and <i>Astarte</i> sp.
Corallian		<i>Trigonia</i> Beds.

276 ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES

The Kimeridge Clay, which succeeds, calls for no special note. The village of Kimeridge, from which it takes its name, being in the immediate neighbourhood, the sections are the type sections. The general succession will be most readily seen by reference to Plate XXIX., which shows the correlation between the Weymouth and Boulonnais districts.

At the top of the Kimeridge Clay, and insensibly passing up from it, come the Portland Sands, capped by Portland Stone, forming the Lower and Upper Portlandian of the district. The separation, though purely lithological and probably not occurring at a constant horizon, is valuable for mapping purposes. Above come the Purbeck Beds, a series of land, freshwater and estuarine beds, which seem to link the Jurassic with the Cretaceous. All these last beds are best studied in the Isle of Portland, with the exception of the Portland Sands, which are more accessible at Ringstead Bay.

Turning now to the Oxford district—with which is included not only the immediate vicinity of Oxford, but also some of the more easterly outcrops—we find many marked differences. The thicknesses of the beds have all enormously decreased.

Starting with the Cornbrash, we find that a lower horizon has come in, marked by an abundance of *Terebratula intermedia*. Of the Kellaways Beds there appears to be no definite representation, unless certain somewhat sandy beds at the base of the Oxford Clay in part represent them. The junction of the Calcareous Grits with the Oxford Clay is nowhere accessible, but the information afforded by well-borings, etc., gives no suggestion of alterations of clay and sandstones representing the Nothe Grits and Nothe Clays of the Weymouth district.

The Corallian in the neighbourhood of Oxford is usually divided into an Upper, or Coral Rag, and a Lower or Calcareous Grits. This classification, though useful for mapping purposes, is unfortunate since the base of the Upper Corallian is thus often included in the Calcareous Grits. The junction between the Upper and Lower Corallian is represented by a band characterized by a mixture of Lower and Upper Corallian forms, and containing numerous pebbles, chiefly of chert, quartz and jaspideous cherts. Passing eastwards from the neighbourhood of Oxford the Corallian, with a total thickness of about 100 feet,

UPPER AND MIDDLE OOLITES OF WEYMOUTH AND THE BOULONNAIS.

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WERMOUTH DISTRICT.

Zones usually recognised in England.

Zones according to H. Safield. *

Stratigraphical Details

Purbeck		Purbeck Beds.		Purbeck Beds		Purbeck	
Upper Portland	Perisphinctes	Cyrena rugosa.	Perisphinctes giganteus.	Portlandian	Portland Beds.	Purbeck	Purbeck
	giganteus.	Trigonia gibbosa.	Perisphinctes pseudogigas.				
		Perisphinctes bobbinensis.	Perisphinctes gored.				
		Trigonia incava.	Perisphinctes eastcottensis.				
Lower Portland	Perisphinctes	Perisphinctes pectinatus.	Perisphinctes pectinatus.	Kimmeridge Clay	Kimmeridge Clay.	Kimmeridge Clay	Kimmeridge Clay
	biplex.	Discina	Virgates mitchellensis.				
		Latissima.	Gravosa lyris.				
		Eoagra	Gravosa gravissima.				
Lower Kimmeridge Clay	Cardioceras	Aulocostephanus pseudumbilicatus.	Aulocostephanus yor.	Kimmeridge Clay	Kimmeridge Clay.	Kimmeridge Clay	Kimmeridge Clay
	alternans.	virgula.	Rosalia multibilis.				
		Ostrea	Rosalia cydonice.				
		deltoides.	Pictoria bijeli.				
Lower Corallian	Perisphinctes	Cidaris	Ringteadia pseudocardatus.	Lower Corallian	Lower Corallian.	Lower Corallian	Lower Corallian
	plicatilis.	Florigemma.	Perisphinctes decipiens.				
		Eoagra rugosa.	Perisphinctes vorax.				
		Aspidoceras parvum.	Perisphinctes mortali.				
Lower Oxfordian	Cardioceras	Cardioceras	Cardioceras	Lower Oxfordian	Lower Oxfordian.	Lower Oxfordian	Lower Oxfordian
	cordatum.	Bolonnensis abbreviatus.	Bolonnensis abbreviatus.				
		Quintaceras lamberi.	Quintaceras lamberi.				
		Cosmoceras ornatum.	Cosmoceras ornatum.				
Lower Callovian	Macrocephalus	Macrocephalus	Macrocephalus	Lower Callovian	Lower Callovian.	Lower Callovian	Lower Callovian
	calloviense.	Macrocephalus calloviense.	Macrocephalus calloviense.				
		Macrocephalus macrocephalus.	Macrocephalus macrocephalus.				
		Macrocephalus macrocephalus.	Macrocephalus macrocephalus.				

* For restrictions of specific names see G.S.G. vol. 41, figs 143-144.

ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES 277

undergoes remarkable changes. In the region round Studley and Arngrove we find a local facies of Lower Corallian in the form of a "chert" largely composed of the spicules of a sponge (*Rhaxella*) which is also common in the Lower Calcareous Grits of Yorkshire. This facies has been named the *Rhaxella* Chert or Arngrove Stone by Dr. A. Morley Davies,* and appears to occur at the base of the Calcareous Grits in this region only.†

The Upper Corallian is for the most part represented by "Coral Rag," usually resting on sandy beds with a pebble bed below, but on tracing it to the east of Oxford, we find rapid changes. At Stowood, Headington and Shotover, and to the west of this line, typical coral reef material exists, but to the east it is not seen in any of the quarries. Near Woodperry, Stanton St. John and Wheatley, the rock consists of detrital calcareous material with few perfect fossils; at Lye Hill a few beds of clay appear, and east of this the calcareous facies rapidly gives place to an argillaceous facies, the Amphill Clay.

The only exposure at present showing the junction of the Kimeridge Clay with the underlying Corallian occurs on Shotover; here, in contrast to the Weymouth district, there is a sharp break between the two, the clay resting on an eroded water-worn surface of the limestone, all the Supra-Corallian of Weymouth being absent.

The junction of the Kimeridge with the Portland is usually hidden by slips, but wherever the uppermost beds are exposed, the Kimeridge Clay becomes somewhat arenaceous, showing a transition into the Portland sands above. This is especially the case in the Culham brickyard, where the *mammilatus* beds of the Gault rest directly on the Kimeridge Clay; these uppermost beds of the Kimeridge Clay may, however, be of Hartwell Clay age.

In this district, the Portland series is largely arenaceous, but locally the upper beds are sufficiently cemented with calcareous material to form a "roach," the *Trigonia* "roach" bed of Portland, for instance, being readily recognizable at Wheatley.

Locally there occurs a well marked pebble bed of lydites and phosphatized bones separating the Upper Portland from the Lower

* *Quart. Journ. Geol. Soc.*, Vol. LXIII., 1907, pp. 37, 38.

† The Lower Calcareous Grits of Filey Brig also contain an abundance of spicules of *Rhaxella*.

278 ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES

Portland.* Blake remarks that this does not occur at a constant horizon, but H. B. Woodward† considers that the evidence of Blake's lists of fossils does not uphold this conclusion, and considers that such a marked lithological break extending over a large area is most likely to occur at a constant horizon. The beds of this age have been described in some detail by Dr. A. Morley Davies, who also appears to agree with Woodward.‡

On tracing this series eastwards it is found that the Lower Portland becomes more argillaceous, finally passing into the Hartwell Clay in the neighbourhood of Aylesbury, while to the south-west it is represented by the Swindon Clay. This, the Hartwell and Swindon Clay, appears to include some of the upper beds of the Kimeridge Clay as well as the Lower Portland, and constitutes a facies of its own. A similar condition is found in the Boulonnais.

In the neighbourhood of Wheatley and Brill sandy and marly beds have been described by Fitton§ as being of Purbeck age, and this identification has been verified by Morley Davies. The Purbeck on Shotover, however, does not appear to have been rediscovered.

In the neighbourhood of Upware, near Cambridge, the occurrence of Upper Corallian in the form of a true Coral Rag is remarkable, occurring as it does as an apparently isolated patch. Below comes the Amphill Clay with Elsworth Rock at the base, resting on Oxford Clay.

In Lincolnshire we find the Kimeridge Clay well developed at Market Rasen, while the Portland and Purbeck may in part be represented by the Spilsby Sandstone, which is considered to be equivalent to the *Belemnites lateralis* Beds of Speeton.**

Of the Yorkshire or North Country district, the valuable memoir by Fox Strangways†† renders certain facts quite clear. First, the

* Dr. Salfeld places the Lydite pebble bed of Swindon in the middle of the Lower Portland, as recognized in England, zone of *P. eastlecotensis*. *Quart. Journ. Geol. Soc.*, Vol. LXIX., p. 424.

† Geol. Survey Memoir, *Jurassic Rocks of Britain*, Vol. V.

‡ *Proc. Geol. Assoc.*, Vol. XVI., p. 25.

§ *Observation on Strata between the Chalk and the Oxford Oolites*.

|| *Proc. Geol. Assoc.*, Vol. XVI., p. 38 *et seq.*

** Lamplugh, *Quart. Journ. Geol. Soc.*, Vol. XLV., pp. 575-615.

†† Geol. Survey Memoir, *Jurassic Rocks of Great Britain*, Vol. I.

ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES 279

Cornbrash passes into the Kellaways, and often its exact junction cannot be defined ; thus further showing the affinity of the Cornbrash to the Middle rather than to the Lower Oolites. Secondly, the Kellaways often becomes locally of great importance, sometimes entirely replacing the Oxford Clay. Of this fact more will be said later. Thirdly, we find a bed of Oolite, the Hambleton Oolite, capped by calcareous grits separating the Lower Calcareous Grits from the Upper Corallian. Fourthly, Supra-Corallian beds occur, represented by the Upper Calcareous Grits. Fifthly, no Portland or higher Jurassic beds are definitely recognizable, except possibly at Speeton.

Taking these beds *seriatim*, we begin with the Cornbrash, which, in Yorkshire, probably represents only the uppermost beds of the southern counties.* That it is homologous to the south country Cornbrash is fairly clear, but it was probably deposited in an area cut off from the main mass by some land barrier. Petrologically and palæontologically the two types differ considerably, and a geologist from the South of England might well be excused in not at first sight recognizing the Yorkshire beds as Cornbrash. The succeeding beds, the Kellaways into which the Cornbrash merges, are of very special interest. The lower beds—for instance, those exposed round South Cave—are evidently true Kellaways, characterized by the abundance of specimens of *Keplerites calloviense*, but the greater part of the Kellaways to the North of the Vale of Pickering—*i.e.*, round Roulston Scar—appear to be of a different age. Not only does it represent an arenaceous facies of the Oxford Clay, but it may in part locally represent Lower Corallian, and even the base of the Upper Corallian, since among other fossils Fox-Strangways mentions *Perisphinctes plicatilis*, the zone-fossil of the Upper Corallian.

The diagram (p. 280) indicates the general relationship of these interesting beds.†

To this replacement of Oxford Clay by Kellaways Beds is due the success of an artesian borehole sunk at Oswaldkirk, near Gilling, on the suggestion of Prof. Kendall. Here the thickness of Oxford Clay

* Buckman, S. S., *Proc. Yorks. Geol. Soc.*, Vol. XVII., p. 191.

† Reference should also be made to *Jurassic Rocks of Britain*, Part I., Plate 5.

	WILTSHIRE	YORKSHIRE
UPPER CORALLIAN	Perisphinctes plicatilis	Perisphinctes plicatilis
LOWER CORALLIAN	Aspidoceras perarmatum	Aspidoceras perarmatum
OXFORD CLAY	Cardioceras cordatum.	OXFORD CLAY
	Belonnites abbreviatus	
	Cosmoceras ornatum	FACIES
KELLAWAYS BEDS	Quenstedtoceras lamberti	PSEUDO-KELLAWAYS
	Cosmoceras jason	FACIES
CORNBRAH	Keplerites calloviense	Keplerites calloviense
	Macrocephalites macrocephalus	Macrocephalites macrocephalus

GENERAL CORRELATION OF THE NORTH AND SOUTH COUNTRY MIDDLE OOLITES.

ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES 281

between the Corallian and the Kellaways is greater than anywhere else recorded in Yorkshire. This, however, is partly due to the high dip towards the fault near to which the borehole lies.

We thus see that in Yorkshire we have two distinct types under one name. The Lower or true Kellaways is comparable with that of the South, and, together with the Cornbrash, is approximately equivalent to the Callovien of Continental geologists. The Upper, to which the term "Pseudo-Kellaways" may be given, is of more recent date and is only an arenaceous and ferruginous facies of Oxford Clay and sometimes of even higher beds.

The Corallian calls for little special notice, the inclusion of an additional bed of calcareous grit and oolite (the Middle Calcareous Grits and Hambleton Oolite) above the Lower Calcareous Grits, appears to be peculiar to Yorkshire, whilst the Corallian Oolite may be represented in the South by minor bands of marl and thin oolitic lime-stones.

Of the Kimeridge Clay little is known. Forming as it does the floor of the Vale of Pickering, which is bounded to the north and south by fault scarps, it is almost entirely concealed by beds of glacial origin.

In the neighbourhood of Speeton there occurs a remarkable series of argillaceous beds, the Speeton Clay, showing a complete transition from the Jurassic into the Gault. The interest specially centres in the zone of *Belemnites lateralis*, below which lies undoubted Kimeridge Clay and above which is undoubted Neocomian. This zone contains a mixed fauna, some of the forms being certainly Neocomian, while others are claimed as being of Portland and Purbeck age. By some, these latter are claimed to be derived, but Lamplugh and Pavlow* appear to consider them to belong strictly to the beds in which they are found. Whichever view is adopted, there appears to be no doubt that beds of Portlandian age were deposited either in this district or very near to it; personally I should be inclined to consider them as an extreme form of passage beds.

In Scotland, the only comparatively complete sequence is to be found on the east coast, in Sutherlandshire. The most noteworthy points are the apparent absence of Upper Corallian and the admixture of Upper and Lower Kimeridge forms together with cycads, etc.

* *Quart. Journ. Geol. Soc.*, Vol. XLV., pp. 590 & 609 *et seq.*

282 ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES

On crossing the Channel to Boulogne, a very complete series of rocks from the Cornbrash into the Wealden may be examined in the coastal sections. Here the facies is for the most part argillaceous, except in the Corallian facies which is purely local. The limestones appear to be always argillaceous. Sandstones occur intercalated with the argillaceous deposits, and are for the most part neither constant over any large area nor restricted to definite horizons, as is the case with the Calcareous Grits and Portland Sands of this country.

The most noticeable stratigraphical break in the series occurs about the centre of the Portlandien Inferieur with the *Trigonia pellati* Conglomerate, which is certainly below the uppermost beds of our English Kimeridge Clay.*

The lower beds of the Astartien, with possibly the upper part of the Argovien, may be roughly paralleled with the British Supra-Corallian, to which series they bear certain affinities. The conditions, however, under which they were deposited were apparently more Kimeridgean.

The limestones composed almost entirely of *Exogyra virgula* form the most noticeable feature in the whole series. It is significant that this fossil flashes into prominence (in the zones of *Ammonites orthoceras* and *A. calentanum*) and then suddenly dies out, as in this country. The *Pterocera oceani* fauna appears to be unrepresented in Britain.

The true Portland Series include a Hartwell Clay facies, and an Upper Portland facies somewhat resembling that in the Oxford District capped by similar Purbeck Beds.

The resemblance between the two districts is further accentuated by the capping of ferruginous sands of Wealden age of a similar type to the Shotover Iron Sands. The complete sequence will be found by reference to Plate XXIX.

SUMMARY.

The whole of the Middle and Upper Oolites form one natural group normally without any sharp break between the various members.

* *T. pellati* is often recorded from the Portland of this country ; if this is identical with French species we have a further case of the same fossil occurring at different horizons in different areas.

ODLING : CORRELATION OF THE UPPER AND MIDDLE OOLITES. 283

Where such a break occurs, the higher beds rest either on a pebble bed or on an eroded surface of the underlying bed. The purely local faunas such as that of the Astartien, Pterocerien and Hartwell Clay are due entirely to local conditions, and are no more than the fossil equivalents of the local faunas that may be found to-day on the sea-floor.

When free-swimming animals, such as Ammonites, are taken as zonal indices instead of the more sedentary types such as oysters and echinoderms, it is seen that the general stratigraphical terms such as Coral Rag, Calcareous Grit, Kellaways Beds, etc., are of no more than local value, and that the occurrence of a similar lithological and palæontological group in two districts need not by any means mean contemporaneity in deposition, but is due to purely local conditions.

At the same time, correlation by Ammonites must not be carried to an extreme. The absence of a particular Ammonite need not necessarily mean the non-deposition or contemporaneous erosion of beds of this particular age, but merely that this form was not so rapidly distributed. The fact that absolute repetition of Ammonites does not appear to occur, whereas their more sedentary associates frequently are repeated at different horizons, is suggestive and tends to place more faith in their value for purposes of correlation.

When considering the Jurassic Series over large areas the fact of there being in reality only two great breaks in the Series—the Bathonian Transgression and the Callovien Transgression—is forced upon one, and the desirability of a regrouping of the series without reference to such terms as Portlandian, Kimeridgean, etc., names that can only be associated with local areas, becomes obvious.

Should this be adopted, we should then have the following general groups :—

UPPER JURASSIC	{ All below the Wealden down to and including the Cornbrash.
MIDDLE JURASSIC	{ All below the Cornbrash down to and including the zone of <i>Parkinsonia parkinsoni</i> .
LOWER JURASSIC	{ All below the zone of <i>Parkinsonia parkinsoni</i> down to and including the Rhætic.