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POSTPONED PAPER.

*On the INSECT BEDS of the PURBECK FORMATION in WILTSHIRE
and DORSETSHIRE.* By the Rev. P. B. BRODIE, M.A., F.G.S.

[Read June 15, 1853*.]

PROF. E. FORBES, in a valuable paper† in Jameson's Edinburgh Journal, was the first to divide the Purbeck Series in Dorsetshire into upper, middle, and lower, and to define the varied conditions under which the whole was accumulated. In this memoir he pointed out that this Series consisted of alternations of freshwater, marine, and brackish water deposits, differing as much in their lithological as in their zoological characters, giving us also a new and more enlarged view of the distribution of freshwater and marine life during this portion of the Oolitic period.

At the time when I first (now nearly thirteen years ago) laid before this Society an account of the occurrence of Insects and other new fossils in the Purbecks in the Vale of Wardour, I was induced to consider the Insect and Isopod limestones as belonging to the *lower* part of the *lower* Purbecks. Since then, however, the subdivisions of Professor Forbes, and the joint investigations of my friends the Rev. Messrs. Austen and Fisher, have led me to examine the few available sections in the Vale of Wardour again, and to pay a visit to Durlstone Bay, in order to institute a more careful comparison between these two distant portions of the formation,—the result of which I now proceed briefly to describe.

Vale of Wardour.

The upper Purbecks are entirely wanting in the Vale of Wardour‡, but the middle and lower are tolerably well developed; although these

* For the other Communications read at this Evening Meeting, see Quart. Journ. Geol. Soc. vol. ix. p. 317 *et seq.*

† Read at the Meeting of the British Association at Edinburgh, 1850.

‡ For a general Section of the Vale of Wardour, see 'History of the Fossil Insects in the Secondary Rocks of England,' pl. 11, and page 1 *et seq.* See also Trans. Geol. Soc. 2 ser. vol. iv. pt. 2. pl. 7 & pl. 10 *a.*

form a very reduced equivalent of the more enlarged and perfect system in Dorsetshire. It is extremely difficult to get good consecutive sections in Wiltshire, and allowance must be made for faults and denudation; but the following section, in descending order, taken at different points, makes the order of succession clear and definite. It was drawn up by my friend the Rev. O. Fisher, and with his permission I subjoin it here, as it tallies in most respects with a section which I had made in the same direction, and gives one or two beds which I did not detect.

Adjoining Quarries on the south side of the River Nadder, near Teffont Mill.

	MIDDLE PURBECKS.	ft. in.
1.	Brownish-yellow clay	
2.	Indurated sand, in layers	2 0
3.	Whitish sandstone.....	0 6
4.	Brown earth, with comminuted shells.....	1 0
5.	"Beef" (fibrous carbonate of lime).....	0 2
6.	Layer of oysters	0 6
7.	White earthy limestone, with many <i>Archæonisci</i> (<i>A. Brodiei</i>) and <i>Corbula</i>	0 6
8.	Hard blue limestone*, splitting into laminae.....	0 2
9.	Thinly laminated white marly limestone and clay ("biscuit"), containing <i>Archæoniscus</i> and Fucoids	0 6
10.	White sandstone	0 0½
11.	Reddish-brown coarse laminated sandstone, with <i>Ostrea</i> and <i>Cyrena</i> (The contrast of colour here is remarkable.)	0 5
12.	Thin-bedded, white, soft limestone	1 8
13.	Shale, with <i>Cypris fasciculata</i> , and Fish scales. This forms the bottom of the old quarry.	

Proceeding to a newer quarry on the east, the above section is repeated as far as No. 13; and is presumed to continue as follows:—

14.	Shale, with scales of Fish and <i>Cyclas major</i> ? on the under side.	
15.	Clay, with <i>Ostrea</i> and lenticular bands of chert, containing <i>Cyrena</i> or <i>Cyclas</i>	0 4
16.	Cinder, with large <i>Ostrea</i> ; marly at the top, sandy at the bottom, with <i>Cardium</i> and <i>Trigonia</i>	1 10
17.	Laminated sand and clay	0 7
18.	Very hard fine-grained sandy rock	1 0
19.	Ditto, not so fine	0 8
20.	Sandy rock, with casts of <i>Cyrena</i> or <i>Cyclas</i>	0 6
21.	Fine white limestone, like the Swanage "freestone"	1 0
22.	Ribbon clays and sands, with compressed shells	1 0
23.	Hard crystalline limestone, with comminuted shells, <i>Cypris</i> and <i>Cyclas</i>	1 6

Nos. 21 and 23 may be observed in two small quarries where there is a lime-kiln, towards Teffont; and then follow—

24.	Brown sand, full of crushed Bivalves and <i>Serpula</i>	0 9
25.	Blue and grey laminated clay with limestone nodules, and thin "beef" and crushed Bivalves	1 0

* On the rising ground opposite this quarry, and about parallel with Nos. 8 and 9, in a partial excavation, many years ago I observed thin slaty limestone, containing traces of Insects, *Archæoniscus*, and *Leptolepis Brodiei*.

This is the lowest of the *Middle* Purbecks; and the *Lower* are—

LOWER PURBECKS.

26. Hard gray marly limestone, having a conchoidal fracture; identical in appearance with the upper Insect beds of Ridgway. <i>Cypris Purbeckensis</i> ? common.....	ft.	in.
27. Dirt-bed	3	6
28. Laminated clay and soft and hard marls.....	0	3
29. Hard marl with conchoidal fracture	1	6
Bottom of quarry.	0	8

In my earlier examination of the Vale of Wardour, some of the quarries where the above appear were not worked, being only partial excavations for stone; and several others then open are now entirely closed. I had then never observed the "*Cinder*" anywhere *in situ*, which forms so good a line of demarcation in Dorsetshire, occurring towards the lower part of the Middle Purbecks. A violent storm had fortunately exposed it at the time of Mr. Fisher's visit, in a lane leading from Chicks-grove to Teffont, and hence the connexion of the Purbecks in Wiltshire was determined with greater accuracy. It therefore appears evident that the Isopod and Insect limestones (properly so called) overlie the "*Cinder*." At the eastern end of the Vale, where they first emerge from beneath the Green-sand, they seem to be much less expanded than they are towards Teffont, a little further to the west, and although *Archæoniscus* is tolerably abundant throughout, the Insects are scarcer, and not so well preserved. There is no doubt a certain general agreement in mineralogical character between the Purbecks in Wilts and Dorset; but in the former case, where the whole series is so much reduced in bulk, it is extremely difficult to make a very correct or close comparison. The forthcoming Memoirs of the Geological Survey will no doubt give an accurate account of them, while a closer investigation of the Mollusks and Cyprides and other fossils by Professor E. Forbes will form a complete and valuable history of the Purbeck formation in Great Britain.

Dorsetshire.

The Section at Durdlestone Bay, near Swanage, is now so well known that it is unnecessary to repeat it here. I shall, therefore, merely refer for details to Professor Forbes's paper above-mentioned, and to the Rev. J. H. Austen's 'Guide to the Geology of the Isle of Purbeck*,' in which a full account is given of the strata and their fossil contents†. The richest depositary of Insect remains at Durdlestone Bay, on the coast, is in the lower Purbecks, while in Wiltshire (with one exception) they are confined to the middle division. During a late visit to Swanage, I discovered a small wing in a band

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† Of course the important and earlier papers by Dr. Buckland, Mr. Webster, and Dr. Fitton, on the Dorsetshire Purbecks, published in the Geological Transactions, must not be forgotten, for nothing was previously known of the complicated coast sections in Durdlestone Bay and other places, nor of the interesting organic remains which their investigations brought to light.

of hard blue limestone, somewhere about No. 31 in Mr. Austen's list of strata*, towards the upper part of the middle series; and it is worthy of remark, that this layer, and the superior and inferior beds connected with it, especially those designated "Pecten Beds," bear a close lithological and zoological resemblance to the Isopod and Insect limestones and associated strata at Dallards in the Vale of Wardour, and their position accords pretty nearly with that of the latter. Mr. Fisher has favoured me with the following Section of the above in descending order, about 200 yards south of a small stream, not far from the Preventive Station :—

	ft.	in.
Two or three bands consisting of pinkish shelly limestone, with <i>Corbula</i> , <i>Ostrea</i> , and <i>Cyrena</i>	1	6
Clay	0	8
Hard shelly limestone, yellow on the outside, with <i>Ostrea</i> and <i>Bulla</i> ...	0	8
Clay, passing from dark blue at the top to yellow, with a little "beef" (fibrous carbonate of lime)	2	4
Thin band of hard shelly stone, <i>Cypris</i> , <i>Cardium</i> , &c.	0	2
Hard marly limestone, breaking into rhomboidal fragments, with Insect remains	0	3
Ditto, with lenticular masses of <i>Corbula</i> , and Insects.....	0	6
Brown and blue clay, with shells and shelly rubble	2	0
Marly shale	0	5
Hard calcareous cream-coloured and blue marl, splitting into rhomboidal fragments; lower part shaly, contains Insects.....	0	10
Coarser and shelly stone, with <i>Cypris</i>	0	4
Blue shaly clay	0	8
Coarse shelly stone.....	0	5
Coarse shelly stone and blue clay.		
Total.....	10	9

The strata containing Insects in these "Pecten beds" are somewhat slaty in their texture, varying in colour and hardness; the blue slaty limestone, which so closely resembles one of the Insect bands in Wiltshire, passes into a yellowish-white fine-grained stone, the prevailing colours being blue, white, and yellow; it has a very uneven fracture. Traces of minute plants occur throughout, consisting of broken carbonized stems and rounded bodies which look like seed-vessels. I requested my cousin Mr. W. R. Brodie, who resides at Swanage, and is a most zealous and indefatigable collector, to examine the above more closely, and he informs me that he has since found a number of wings and elytra; and he has been kind enough to give me a small but interesting collection, from which Mr. Westwood has made a selection for description and figuring.

The inferior Insect-beds†, which consist of two or three distinct

* Mr. Austen describes these as "blue and cream-coloured indurated marls;" they were probably deposited in brackish water.

† In order that the Section may be quite clear to the general reader, I subjoin, from Mr. Austen's 'Guide,' a copy of that portion of the Section which includes the richest Insect beds, beginning with the highest of the *lower* Purbecks :—

	ft.	in.
94. Marly limestone, with thin band of shells.....	1	0
95. Rubbly marlstone	2	0
96. Cream-coloured marly limestone	2	0

strata, occupy a rather central position in the lower Purbecks in Durdlestone Bay, and are well described in the Section in Austen's 'Guide' above referred to. There are two or three white earthy limestones, like chalk more or less indurated, in which relics of Insects are most abundant. The middle one of these is the richest, especially for groups of elytra and wings, but they are by no means confined to this portion of the formation, having been noticed (as before observed) in the "Pecten beds" above, and again lower down at No. 128 in Mr. Austen's List, near the second chert beds, where they are associated with *Archæoniscus*. Few or no other fossils, except small fragments of carbonized plants, occur in the white Insect-beds at the top of the lower Purbecks. In these I have only seen one small Fish, which was discovered by Mr. W. R. Brodie,

	ft.	in.
97. Soft shaly band	0	4
98. Cherty band	0	4
99. Marly limestone	1	3
100. Rubbly limestone.....	1	0
101. Marly limestone	0	8
102. Rubbly blue marly limestone.....	3	0
103. Rubbly white marly limestone	4	0
104. Marly limestone, with vegetable remains, wings, elytra, and bodies of <i>Insects</i> , abundant in patches	3	0
105. Slaty marl	1	6
106. White marly limestone, with a harder band in the centre, con- taining <i>Insect</i> and vegetable remains	4	0
107. Blue slaty marl	1	6
108. Hard marly limestone.....	1	6
109. Blue slaty marl	1	6
110. Laminated sandy marl, with traces of Vegetables, Fish-scales, <i>Serpula</i> , small <i>Cardium</i> , and a cherty band with <i>Melania</i> .		
111. Marl, with <i>Cyprides</i> and shells (<i>Leda</i>)	1	6
112. Slaty marls	4	0
113. Marly limestone, containing <i>Insects</i> and a branching Plant	2	0
114. Blue laminated shales and marl and gypsum	3	0
[The beds here are hidden by the fallen cliff.]		
115. Slaty marl.		
116. Cream-coloured marl, full of shells (<i>Cardium</i>), with vegetable and <i>Insect remains</i>	2	6
117. Cherty band, full of shells, chiefly univalves, and <i>Cyprides</i> . A small <i>Cardium</i> abundant	0	4
118. Slaty coloured marls	1	6
119. Indurated marls, <i>elytra of Insects</i> , <i>Cyprides</i> , and Univalves	3	0
120. Bluish marl.		
121. Indurated marl, with many Bivalves.		
122. (Cliff disturbed.)		
123. (Ditto, and contains blocks from several beds.)		
124. Cypris shales	3	0
125. Indurated marl and shales alternated; with vegetable remains and <i>Archæoniscus</i>	4	6
126. Band of white marl, vertically cracked		
127. Hard band, containing <i>Archæoniscus</i>	0	5
128. Blue and brown indurated marl, with a large species of <i>Archæo- niscus</i> , <i>Cyprides</i> , <i>Estheria</i> , and shells.		

The whole of the above were deposited in brackish water; and it is worthy of remark, that here we have the greatest number and variety of Insect remains.

and he liberally presented it to me. I forwarded this specimen to Sir Philip Egerton, who states, that it most nearly resembles the curious genus *Nothosomus*, but it is too imperfect to warrant any decided opinion upon the subject, as the tail and dorsal fin are deficient. He is inclined to think that it will ultimately prove to be a new genus.

The position of the strata containing Insects at Ridgway near Weymouth is not exactly the same as at Durdlestone Bay (Nos. 103 to 119, Mr. Austen's List), though it agrees pretty nearly with the latter. In the neighbourhood of Dorchester they are somewhat harder, but the prevailing colour is much the same, and no insect remains have as yet been observed there higher than the lower Purbecks.

Observations on the Organic Remains.

No *Archæoniscus* has yet been met with at Durdlestone Bay higher (I believe) than No. 58 in Mr. Austen's list of the strata, not far above the "Cinder" in the middle Purbecks, where the brackish-water series commences in a bed of shaly blue and brown marl, in which I found the claw of an *Astacus*. In all probability, that portion of the series from Nos. 55 to 70 (middle Purbecks), which immediately reposes on the "Cinder," most nearly corresponds with the Section at Teffont from Nos. 10 to 15. At Dallards there are grits and shaly stone associated with the Insect limestone, containing *Ostrea*, *Cyclas*, *Cypris*, and numerous scales, teeth, and coprolites of Fish and Saurians. The first appearance of *Archæoniscus* is in the basement-beds of the lower Purbecks; occurring in the Cap at Chicks-grove, in the Vale of Wardour, where I procured some of very large size, associated with *Ophiopsis breviceps*, Egerton (Survey Mem. Decade 6. pl. 6), and a few elytra. At Ridgway, near Weymouth, the same stratum, undistinguishable from the Cap in Wilts, contains numerous fragments of *Archæoniscus* and Fish; but the former has never yet been detected there entire. This crustacean appears to be limited to the "Cap;" here at least it has not been observed higher up in the Section. It occurs again, abundantly and in clusters, towards the lower division of the middle Purbecks, accompanied by a few elytra, in Durdlestone Bay (Nos. 125 & 127, Mr. Austen's List), and again in No. 58 higher up; in both cases, in bands of blue shale and marl, more or less indurated, both of which were deposited in brackish water. The *Archæonisci* vary in size, but the prevailing species appears to be the *A. Brodiei* (M. Edwards), though it is probable that another species will ultimately be determined.

With respect to the general character of the Insect remains in the lower Purbecks in Dorsetshire, it appears, from Mr. Westwood's investigations*, that they agree closely with those which mark the

* Those who are aware of the imperfect and fragmentary state in which most of the Insect remains occur in various formations in this country will understand the difficulty of the task which Mr. Westwood has undertaken in elucidating their true characters, and will duly appreciate the result of his labours. The beauty and accuracy of the plates require no comment.—[Aug. 14, 1854.—P. B. B.]

middle Purbecks in Wiltshire, although the *Cyprides* and shells in the former are quite distinct from those in the latter. The Insects in the middle division especially bear a near resemblance to those in the Vale of Wardour, and consist chiefly of wings and elytra. These are from the "Pecten beds," Nos. 31 *et seq.* Many of them indeed are identical, some few agreeing with species in the lower beds, and some (apparently) with those of the Lias, and a few may be new. The elytra and wings are generally detached, rarely collected together in masses, lying in different portions of the stone, and not in particular layers. They are, however, remarkable for their beautiful state of preservation, the elytra usually retaining their elytrine or chitine, and the wings their most delicate nervures and colouring. In this they present a contrast to the insect relics in the inferior strata. They are occasionally mingled with *Corbula*, *Cyclas*, and *Cypris*. The wing-covers of beetles are tolerably abundant, but of small size. I have observed only one perfect Beetle, a few minute but peculiar larvæ, abdomens, and only one entire dipterous (probably) insect. The detached wings consist chiefly of *Gryllus*, *Acheta*, *Blatta*, and *Libellula*, most of which seem to be identical with specimens figured from the Vale of Wardour (see "Fossil Insects," plates 2, 3, 4, 5, 6). One very beautiful wing resembles the *Ephemera* of the Lias (*ibid.* pl. 10. fig. 14). In the lower beds (from Nos. 94 to 128 in Mr. Austen's Section, some of which he denominates "Insect beds," and which form the top of the lower Purbecks, see note, p. 478), elytra are very abundant, grouped together in clusters, especially in one particular stratum at Durdlestone Bay and at Ridgway near Dorchester. As many as sixty or seventy elytra and several wings and bodies have been counted on one small slab. The elytra generally retain their delicate sculptured markings, and sometimes the colour. They are mostly small, though a few larger specimens have been met with; some are of great size, much larger than any I ever procured in the Vale of Wardour, and rather more so than the largest elytra from the Stonesfield slate. A few attached elytra occur, but perfect beetles are extremely rare, only three or four having been noticed. At Ridgway a very peculiar pupa is rather characteristic, and a small beetle, allied to *Notonectis*, which is an aquatic species; and this possibly may account for its being found entire, while all the terrestrial ones are disjointed and imperfect. The grouping together in masses is one distinctive feature in the insect remains from the lower Purbecks in Dorsetshire; the wings too are usually broken, and portions of Insects are scattered about in all directions, and the whole appear to have been carried down a stream of some violence, and deposited at a considerable distance from their original habitats. At any rate they must have been exposed to some very destructive agency before they were imbedded in the mud of the waters in which they floated. In this respect they differ from those in the Vale of Wardour, and in the Lias generally. The smaller number of entire insects (scarcely any in fact) is to be noted.

At Ridgway the masses of elytra have one uniform direction; as

if indicating the course of the current. This is not so much the case at Durdlestone Bay. Some gigantic wings of *Neuroptera*, rarely perfect, are rather prevalent; there are also wings of *Gryllus* and other *Orthoptera*, associated with some *Blattæ*, *Homoptera*, and other families. A very large collection of Insects has been made from the Dorsetshire Purbecks* by the officers of the Geological Survey, and by Messrs. W. R. Brodie, Austen, Fisher, and Willcox. I am indebted to the kindness and generosity of Mr. Brodie for the greater part of the specimens in my cabinet, and I have to thank the last-named gentleman for the loan of his valuable collection of insect exuvie, which also were sent to Mr. Westwood for examination.

P.S.—I cannot conclude without referring to the interesting and important discovery of Mammalian and Reptilian remains near Swanage, by Mr. W. R. Brodie and Mr. Wilcox, which have been lately described by Professor Owen. These consist of two small lizards (*Nuthetes*, from No. 84 of Mr. Austen's Section, and *Macellodus*, from No. 93) and a small Mammal (*Spalacotherium*, also from No. 93†), most closely resembling the *Thylacotherium* of the Stonesfield slate. Professor Owen considers both the Mammal and the Reptiles to have been insectivorous; and although the presence of insects would have led to the inference, as I have elsewhere observed‡, that some insectivorous animals must have existed contemporaneously, it is extremely interesting to be able to prove the fact; and we are greatly indebted to the zeal and energy of the discoverers for bringing these remains to light.—[August 14, 1854.]

* Not long after Prof. Forbes's discovery of a few insect wings in the Hastings Sand in the Isle of Wight, Mr. W. R. Brodie sent me a fragment of a wing from the Hastings sand at Swanage Bay, north of the town. Since then, Messrs. W. and H. Binfield have detected numerous insect remains throughout the Wealden Series near Hastings. See Quart. Journ. Geol. Soc. for May 1854.—[Aug. 14, 1854.—P. B. B.]

† This bed occurs in the "Marly middle freshwater series" of Prof. E. Forbes, and is the basement-bed of the Middle Purbecks.

‡ Fossil Insects, p. 112.