CHAPTER XII.

HAMPSHIRE AND THE BAGSHOT DISTRICT.

By HORACE W. MONCKTON, F.L.S., F.G.S., AND H. J. OSBORNE WHITE, F.G.S.

THE COAST SECTIONS.

By H. W. MONCKTON.

THE Association has on three occasions visited the cliffs of Bournemouth and Barton, viz., at Easter, 1880, Easter, 1888, and Easter, 1894, and Mr. Starkie Gardner, who acted as director, or as one of the directors, on these occasions, explained that he did not wholly agree with the classification of strata adopted by the Geological Survey. His views of the relation of the Hampshire Eocene beds to those of the Isle of Wight are very clearly shown by the diagram, Fig. 47, which is reproduced from the *Quarterly Journal of the Geological Society* for 1879 (vol. xxxv, p. 212).

Bed 8 of the diagram, which represents the brightly-coloured sands and sandstone of Studland Bay and the pipe-clay beds of the Wareham-Corfe Castle district of Dorsetshire, is called "Lower Bagshot" by Mr. Gardner, but is termed "Bagshot Beds" on the Geological Survey Map. Bed 7 of Mr. Gardner's diagram, the "Bournemouth Freshwater Series," is also included in the "Bagshot Beds" by the Geological Survey. The cliffs between Poole Harbour and Bournemouth give a grand section in these beds, the details of which are shown in Fig. 48, also by Mr. Gardner, and borrowed from the *Quarterly Journal* (vol. xxxviii, 1882, p. 4). Whatever we are to call these strata there can be no doubt that they are of fluviatile origin, formed in the bed of a large river which flowed in a more or less easterly direction.

Mr. Gardner remarks on these cliffs:* "Their general appearance seaward is that of a confused mass of lenticular patches, now of sand, and now of light- or dark-coloured clay, suggesting forcibly a transverse or oblique section across an old river-valley. The sections up the chines do not present the same lens-shaped patches, but more continuous beds; and it may therefore be assumed that they are somewhat more in the direction of the former channels." The clays in many cases contain beautifully preserved leaves and other vegetable remains, and many good specimens were obtained on the excursions. We may add that a fossil feather was obtained by Mr. Gardner from one of the clay patches.

* *Quart. Journ. Geol. Soc.*, vol. xxxviii (1882), p. 5.

FIG. 47.—IDEAL VIEW OF THE ISLE OF WIGHT AND THE ADJACENT LAND.—*J. Starkie Gardner.*

The dotted lines connect the nearly horizontal beds of the mainland with the vertical beds of the island.

- 0. Oligocene.
- 1. Barton Beds.
- 2. Upper Bracklesham and High Cliff white-sand beds.

- 3. Upper Hengistbury Head Beds with ironstone.
- 4. Lower Hengistbury Head Beds with green grains.
- 5. Boscombe Sands.

- 6. Bournemouth Marine Series.
- 7. Bournemouth Freshwater Series.
- 8. Lower Bagshot.
- 9. London Clay.
- 10. Woolwich and Reading Beds.

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FIG. 48.—VIEW OF THE CLIFFS BETWEEN POOLE HARBOUR AND BOSCOMBE, SHOWING POSITION OF PLANT-BEDS, ETC.—
J. Starkie Gardner.

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Bed 6 of the diagram, Fig. 47, is the "Bournemouth Marine Series" of Mr. Gardner, and it is a part of the "Bracklesham Beds" of the Geological Survey Map. This Series was formed nearer the mouth of the river than the Freshwater Beds mentioned above, and we begin, as we go east, to find marine fossils soon after passing the pier at Bournemouth.

There are, nevertheless, still plenty of vegetable remains, and near Boscombe Chine portions of branches of trees, three to four feet long, are found in the cliff. The wood has been bored by *Teredo*. Mr. Gardner's reading of this part of the section is explained by Fig. 5, *Quart. Journ. Geol. Soc.*, vol. xxxv, page 225.

At Honeycomb Chine there is a layer full of *Nipadites*, and

FIG. 49.—HENGISTBURY HEAD, WESTERN SIDE.—*J. Starkie Gardner.*

- 3. Highcliff Sands.
- 2. Hengistbury Head Beds with ironstone.
- " " with green grains.
- 1. Boscombe Sands.

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many specimens were obtained by the members on the 1894 excursion.

Bed 5 of the Diagram is the "Boscombe Sands." They are included in the "Bracklesham Beds" of the Geological Survey. Between Boscombe and Southbourne-on-Sea the Boscombe Sands contain extensive shingle beds. The stones in the shingle are practically all pebbles and nearly all flint, and these Eocene pebble beds are thus easily distinguished from the Plateau Gravel which caps the cliff, since it contains a large proportion of subangular flints, and also pebbles of quartz.

The Eocene Beds are not seen between Southbourne-on-Sea and Hengistbury Head, the low cliff being formed of Valley Gravel.

Hengistbury Head furnishes a section in Beds 5, 4, 3, and 2 of the diagram, Fig. 47, all of which are included in the Bracklesham Beds of the Geological Survey Map. Mr. Gardner's reading of the section will be made quite clear by Fig. 49. On the shore at the western side of Hengistbury Head we find some

current-bedded sand with a few layers of pebbles, which are probably a continuation of the sands with shingle of the Boscombe Cliffs, Bed 5 of the Diagram, Fig. 47.

Beds 4 and 3 of Fig. 47 are the Hengistbury Head Beds of Mr. Gardner, and contain some layers of tabular iron concretions and compressed tree stems often of some size. The ironstone was once worked here.

At the top of the Hengistbury Head section we find some sands, which Mr. Gardner believes to be on the horizon of the sands which form Highcliff in Christchurch Bay (No. 2 of Fig. 47).

On the east of Hengistbury Head we cross the mouth of the combined Rivers Stour and Avon, and the rapid changes in the position of the banks of sand and shingle gave rise to discussion on all our excursions to this coast. In Mr. Herries's report of the 1888 excursion he remarks: "The remarkable change in the outlet of the Avon was pointed out. The natural mouth of this river is at Christchurch Harbour, just east of Hengistbury Head, but a bar of shingle having formed across it, the mouth was gradually driven farther and farther eastward, till the river flowing along the shore parallel with the cliff reached the sea under Highcliff House, about two miles off. Then in 1883, during a great storm, this barrier was broken through, and now once more it flows out at Christchurch Harbour. The old course under the cliff is marked by a series of lagoons inside the great shingle bar."*

We now come to the Barton Cliffs, celebrated amongst geologists from early days. The white sand of Highcliff is a prominent feature of the western end of the section. There are two pebble beds in the cliffs, one near the shore and the other near the top of the white sands. About 10 ft. above this latter there is an ironstone band, which is well marked, and can be seen from a distance. About a foot above the ironstone band *Nummulites elegans* occur in a dark-grey clay with grains of green sand. It is stated that on the 1888 excursion this Nummulite band was sought without success, but there is usually no difficulty in finding it if one works upwards from the pebble bed.

This Nummulite band is the best palæontological line of division between the Bracklesham and Barton series, though possibly, from a lithological point of view, it is best to take the pebble bed some 11 ft. lower down as the base of the Barton Series.†

The following section of the Barton Beds at Barton will, we think, be found useful by collectors:

* *Proc. Geol. Assoc.*, vol. xi, p. xix.

† See Gardner, Keeping and Monckton. *Quart. Journ. Geol. Soc.*, vol. xlv (1888), p. 586, and C. Reid, "Geology of Bournemouth," *Mem. Geol. Survey*, 1898, p. 8.

SECTION OF THE BARTON BEDS—BARTON CLIFF.

The Upper Barton Series.

Thickness, 90 ft. ; *Voluta solandri* ; *V. scabricula*, *V. scalaris*, *V. subambigua*, *V. humerosa*.

i. Long Mead End Beds.	White and tawny sands	ft.
ii. Becton Bunny Beds	(a) Clays with a brackish water fauna in the upper part. In the lower part <i>Oliva branderi</i> is common	20
	(b) Whitish sand without fossils	25
iii. <i>Chama</i> Beds	Clayey, dark coloured sand	26
		18

The Middle Barton Series :

Thickness, 53 ft. ; *Voluta luctatrix*, *V. ambigua*.

i. Shell bed, mainly comminuted shells ; when weathered forms hard slabs which lie about the shore. Dark clay, very fossiliferous, with two bands of septaria in the middle. The best fossil zone is a little above the lower Septarian band	20
ii. Clay, more or less sandy, with a band of septaria at the bottom	28
iii. The <i>Voluta suspensa</i> bed. Clay, with a band of septaria at the bottom	5

The Highcliff Beds or Lower Barton :

Thickness, 49 ft. ; *Voluta athleta*, *V. nodosa*. These beds are now almost hidden by the planting, etc., undertaken for the protection of the cliff. The upper part consists of a glauconitic clayey sand, "The Highcliff Sands," about 12 ft. in thickness. The lower part is more clayey. The base of the Barton Series is marked by a band of green sandy clay, full of *Nummulites elegans*, 8 ins. thick.

When the Association last visited these cliffs we found that though the Lower Barton was much hidden, the Middle Barton, or Barton Clay proper, was still open to the collector, and it is recorded that we had luncheon on the "best fossil zone."

The Middle Barton Clays include all the septaria bands that occur in the Barton Series, the lowest of these forming a good landmark for the inferior junction, and the shell bed an unmistakable line of demarcation for the superior limit. This bed sets when exposed to sea water into a hard stone, and is used for building purposes.

The *Chama* beds at the bottom of the Upper Barton are not fossiliferous unless capped by the clays of the overlying Becton Bunny Beds, but when they do contain fossils the *Chama* occurs in great abundance. The *Chama* is rare in the Lower Barton, absent in the Middle Barton, and this is the last appearance of the genus in England.

The Long Mead End Sands contain beautifully preserved, but very delicate, fossils, including *Cerithium pleurotomoides*. These beds have been described as "Upper Bagshot" and as

"Headon Hill Sands," and it has been a matter for discussion whether they should be placed with the Barton or with the Headon. It is, however, probably best to treat them as the top of the Barton Series.*

The Headon Beds are well seen in the cliff section, and a fair number of fossils were obtained on the 1894 excursion. The succession of the strata is as follows:

SECTION OF THE LOWER HEADON BEDS AT HORDWELL.

	ft.	in.
1. Marl, stained with gravel	3	0
2. Limnæan marl (dark layer with serpents' vertebrae, rodents' teeth, etc., 1 in. thick)	0	9
3. Greenish rusty marl, with broken turtle and mammal bones	1	8
4. Laminated sand, with grey partings of clay, darker towards the base, passing down into the <i>Unio</i> -beds, with <i>Unio</i> , <i>Paludina</i> , <i>Melania turritissima</i> , in nearly slate-coloured clay. At the bottom there is a layer of seeds	11	0
5. Bright, green marly clay, with crushed <i>Limnæa</i>	12	0
6. <i>Chara</i> -bed. Lignite and drab clays, with roots, rushes, etc., then lignite, with roots, rushes, and seeds at base	3	9
7. Greenish mottled clay and marl, various kinds, with a black band 4 in. thick near base; <i>Dreissena</i> , <i>Limnæa</i> , etc.	10	4
8. <i>Limnæa</i> -limestone	0	7
Black band	0	1
9. Mottled green marly clay, with masses of clay and iron-stone up to several tons in weight	4	0
10. Crocodile bed (a) Very fine pale grey sand, becoming darker at base and more clayey. Layers of <i>Potamomya plana</i> at top and bottom. Crocodile-bones with <i>Cerithium pyrgatum</i> one-third down	6	4
(b) Coprolite bed, with rolled bones and comminuted shells, a thin black layer at bottom	1	0
(c) Stiff marly clay, becoming clunchy	4	0
11. Leaf bed. Dark, sandy clay, slightly mottled with yellow, and with roots passing down into drab pipe clay, with black roots and partings	3	2
12. Mammalia bed. Bright green marl, with roots. <i>Paludina</i> drifted in pockets. An iron band 8 in. thick, below which there is mottled green marly clay	17	0
13. Impure, friable lignite and clay	2	2
14. Black clay with <i>Potamomya</i> , <i>Dreissena</i> , <i>Mytilus</i> and <i>Cerithium pyrgatum</i>	0	7
15. Black clay with roots and occasional broken <i>Potamomya</i>	0	10
16. Lignite, with fish scales, sand at base, $\frac{1}{2}$ in. thick, with <i>Cyrena</i>	0	3

* See Gardner, Keeping and Monckton, *Op. cit.*, pp. 593-594; and Tawney, *Proc. Cambr. Phil. Soc.*, vol. IV, pt. 3, p. 140.

SOUTH HAMPSHIRE INLAND SECTIONS.—TERTIARY BEDS.

By H. W. MONCKTON.

During the Easter Excursion of 1886 a visit was paid to the cuttings on the railway between Christchurch and Brockenhurst. The beds seen belong to the Barton and Headon series, with overlying gravels. The Barton Clay was very fossiliferous, and included a well-marked band of septaria. The Headon beds were seen to be very much contorted at one place.*

On April 23rd, 1886, a party of our members took a walk round part of the suburbs of Southampton under the guidance of Mr. Whitaker. We give a few extracts from his report:†

"The large pit in Bevois Valley was first visited, and attention drawn to the fine section of Lower Bagshot Sand capped by gravel and showing signs of the passage down into London Clay. Passing on to another pit close to St. Denys Station, the junction of the Bracklesham beds with the Lower Bagshot Sand was seen, the former series consisting of clayey loam, in the bottom part of which flint pebbles occur. Attention was drawn to the fact that in the neighbouring low ground of St. Denys excavations for sewers had proved the occurrence, beneath the gravel, of London Clay with highly-fossiliferous septaria.

"The formations below the Bracklesham beds . . . have been brought up by a rise of the beds, which is a continuation of the great saddle-back bringing up the Chalk of the Portsdown ridge many miles eastward.

"From St. Denys the course was through Portswood, when a brickyard, apparently in the loamy passage beds from the Lower Bagshot to the London Clay, was seen; and then the Church Farm sandpit, Highfield, a little higher up the same slope, was examined. Here the Lower Bagshot Sand was again seen capped by a gravelly and loamy deposit, the lower part of which clearly consisted of the broken-up, pebbly base of the Bracklesham beds, from which it would be inferred that the latter must come on directly above. This inference was shown to be justified by the sections at the neighbouring Highfield brickyard at a rather higher level, close to the eastern edge of Southampton Common, when the junction of the Bracklesham beds and the Lower Bagshot beds was again seen at a much higher level than at St. Denys."

On April 8th, 1887, Mr. Whitaker conducted a party of the Association to the Southampton Waterworks near Otterbourne, between Southampton and Winchester.‡ He remarked "that the excavation for the reservoir had shown a most interesting and unique section, the Bagshot Pebble-beds resting somewhat

* See *Proc. Geol. Assoc.*, vol. ix, p. 524, and *Quart. Journ. Geol. Soc.*, vol. xlv (1888), pp. 597-599.

† *Proc. Geol. Assoc.*, vol. ix, p. 522.

‡ *Proc. Geol. Assoc.*, vol. x, p. 133. See also C. Reid, "Geology of Southampton," *Mem. Geol. Survey*, 1902, p. 14.

irregularly on the sandy top London Clay in the absence of the Lower Bagshot Sand."

On April 9th the members examined sections on the railway then in course of construction between Netley and Fareham.

We quote Mr. Whitaker's account of a cutting between the Titchfield Valley and Fareham :*

"The cutting will be a long one, but its western part was almost all that was to be seen. This, however, was of considerable interest, for the more or less sandy London Clay contained many, though mostly very fragile, fossils; the discoloration of the upper part, from dark grey to brown, by peroxidation of the ferruginous colouring-matter, was plainly seen, and Londoners were probably much astonished at the occurrence of two continuous pebble-beds, each about a foot thick, in the midst of their own particular clay, no such occurrence having been noted in the London Basin.† These beds consisted of flint pebbles with fossils (chiefly oyster-shells) in a loamy matrix; they were about 2 ft. apart, and in one of them Mr. E. Westlake found a specimen of a large *Terebratula*, the first of its sort in the formation. This turned out to be *Terebratula bisinuata*, a species that has very rarely been found in Barton and Bracklesham beds, though plentiful sometimes in the Calcaire grossier of France. Since the excursion a great number of specimens have been found by Messrs. Westlake, W. Dale, J. W. Elwes, Shore, and Whitaker. They seem to occur in nests like miniature mussel-banks."

THE CHALK.

By H. J. OSBORNE WHITE.

In the Hampshire mainland this formation appears to have a maximum thickness of 1,000 to 1,100 ft., of which about 200 ft. may be assigned to the Lower division, 180 ft. to the Middle, and 700 ft. to the Upper; but these figures are merely rough estimates.

The Lower, or Cenomanian, Chalk comprises :

		ft.
2.	ZONE OF <i>Holaster subglobosus</i> .	100 ?
	Sub-zone of <i>Actinocamax plenus</i> . Grey laminated marl containing a thin bed of white or greyish chalk. <i>Act. plenus</i> , etc. (10 ft.).	
	Firm, massive, greyish-white chalk, with <i>Hol. subglobosus</i> , <i>Hol. trecentis</i> , <i>Cidaris bowerbanki</i> , etc.	100 ?
1.	ZONE OF <i>Ammonites</i> [<i>Schloenbachia</i>] <i>varians</i> .	100 ?
	Chalk Marl; grey marly chalk, with <i>Schloenbachia varians</i> , etc.	
	Chloritic Marl; glauconitic and phosphatic marl, with <i>Aucellina gryphaeoides</i> , etc. (1½ to 4 ft.).	100 ?

* *Proc. Geol. Assoc.*, vol. x, p. 138.

† Thin pebble-beds occur in the London Clay at Aldershot. See *post*, p. 289.

Beds belonging to this division are exposed in the neighbourhood of Alton, at the western end of the Weald area; also in the railway cuttings south of Burghclere, in the anticlinal inlier of Kingsclere, and in pits in the similar inlier of Winchester. The Burghclere section, which shows portions of both zones, and probably the Winchester sections (at Bar End and Chilcombe), which at present show little chalk below the *Act. plenus* marl, were visited by the Association in the Easter of 1888, but no details are given in the report of the excursion.*

The Middle Chalk (Turonian), which is exposed in the same parts of the country as the Lower Chalk, consists of:

		ft.
2.	ZONE OF <i>Terebratulina</i> .	{ White and greyish-white chalk, with seams of grey marl, and a few flints 100 ? <i>Terebratulina gracilis</i> , var. <i>lata</i> <i>Ino-</i> <i>ceramus brongniarti</i> , etc.
1.	ZONE OF <i>Rhynchonella cuvieri</i> .	{ Hard, white and greyish-white nodu- lar chalk; flints rare and small. 80 ? Melbourn Rock at base. <i>Inoceramus mytiloides</i> (= <i>I. labiatus</i>), <i>Rhyn. cuvieri</i> , etc.

The Melbourn Rock was seen at Burghclere in 1888, and in a pit to the south of Alton during the Selborne excursion in 1891;† while the *Terebratulina*-beds were inspected at Star Grove, near East Woodhay,‡ in 1902, and probably also in the large quarry in St. Giles's Hill, Winchester, in 1888.

The Upper Chalk (Senonian) occurs at the surface over the greater part of central and northern Hampshire, and has been quarried, for marling the land and other purposes, in many hundreds of pits, which are now, for the most part, disused and overgrown.

This division includes the following zones:

		ft.
6.	ZONE OF <i>Belemnitella mucronata</i> .	{ Soft white chalk, with few flints . . . 100 ? <i>Bel. mucronata</i> , <i>Magas pumilus</i> , etc.
5.	ZONE OF <i>Actinocamax quadratus</i> .	{ Soft, white chalk, with flints—many being small and sub-spherical . . . 200 ? <i>Act. quadratus</i> , <i>Ostrea lateralis</i> var. <i>striata</i> , <i>Offaster pillula</i> , <i>Echinocorys scutatus</i> (gib- bous form), etc.
4.	ZONE OF <i>Marsupites testudinarius</i> .	{ Soft, white chalk, with few flints. . . 100 ? Sub-zone or band of <i>Marsupites</i> . Sub-zone or band of <i>Uvulacrinus</i> . <i>Echinocorys scutatus</i> (pyramidal), etc.
3.	ZONE OF <i>Micraster cor-anguinum</i> .	{ White chalk, with many flints. . . 200 ? <i>Micraster cor-anguinum</i> , <i>Conulus albogalerus</i> , <i>Cidaris perornata</i> , etc.
2.	ZONE OF <i>Micraster cor-testudinarius</i> .	{ White chalk (nodular in part), with many flints . . . 50 ? <i>Micraster præcursor</i> , <i>Inoceramus lamarccki</i> , etc.

* *Proc. Geol. Assoc.*, vol. xi (1889), pp. xv, xvi.

† *Ibid.*, vol. xii (1891), p. 192.

‡ *Ibid.*, vol. xvii (1902), p. 394.

I. ZONE OF <i>Holaster planus</i> .	{	Greyish-white nodular chalk, with flints.	50?
		Sub-zone of <i>Heteroceras reussianum</i> (marked in places by Chalk Rock) at or near the base <i>Hol. planus</i> , <i>Microaster leskei</i> , <i>M. præcursor</i> , <i>Heteroceras reussianum</i> , <i>Scaphites geinitzi</i> , <i>Solariella gemmata</i> , etc.	

Railway cuttings, showing an almost complete sequence of the beds between the base of the *H. planus*-zone and the top of the zone of *Marsupites*, were examined, by an Association party, between Highclere and Whitchurch Stations, during the excursion of 1888, before mentioned. The occurrence there of the Chalk Rock, with the usual green nodules and "some fine gasteropods," and the pronounced dips to north and south, due to the Kingsclere anticline, are noticed in the report, by Mr. R. S. Herries.

During the Easter excursion of 1887, the Association examined a pit in the *Act. quadratus*-zone at or near Shawford, south of Winchester. It is recorded* that the chalk there exposed afforded "an abundant supply of *Holaster* [*Offaster*] *pillula*."

The *Bel. mucronata*-chalk is believed to be confined to the southern part of the county. No sections have been seen by the Association.

THE TERTIARY AND POST-TERTIARY BEDS OF NORTH HAMPSHIRE AND OF THE BAGSHOT DISTRICT.

By H. W. MONCKTON.

The succession of the strata above the Chalk in this part of the country is very well shown by the section through Alder-shot (Fig. 50) which Capt. Lyons has kindly allowed us to reproduce.† It will be seen that we have, upon the Chalk, a representative of the Woolwich and Reading Series, that we then get a thick bed of London Clay, and that above it the various beds, classed as Bagshot, complete the solid geology, and are only overlain by patches of Drift.

The Woolwich and Reading Beds.—I have not been able to find any representative of the estuarine beds forming the Woolwich phase of this formation in the area now under consideration. There is, however, a layer with *Cerithium* and *Cyrena* at the top of the Series in the brickfield, close to Guildford Station, to the south-east of the district, and *Cerithium*, together with various marine shells, have been found at Reading to the north-west, in that case near the bottom of the series.‡

* *Proc. Geol. Assoc.*, vol. x (1887), pp. 132, 133.

† *Quart. Journ. Geol. Soc.*, vol. xliii (1887), p. 431, Fig. 1.

‡ *Ante*, p. 226.

cutting, and the writer found in it a layer of *Cyprina scutellaria* with valves closed and united. There are usually fair sections in London Clay in the brickfields near Aldershot Station. The clay contains a few bands of pebbles, and the writer saw a section at Hang Wood, Nately Scures, where the surface was formed of a mass of pebbles six inches in depth, resting upon London Clay. Another, and probably similar, patch is marked on the Geological Map at Binfield's Farm, north-west of Basingstoke, and these pebbles were probably derived from the thin pebble-beds, which occur in the London Clay of this district.* Fossils are fairly common in the upper part of the London Clay at Wokingham and Bracknell, and they usually appear to have lived where we find them, and suggest a fairly deep water deposit, thus differing from the shore-like accumulations of shells in the Basement Bed of the London Clay, which is exposed in a brickfield near Nately Scures.

The Lower Bagshot Beds.—The London Clay becomes more or less sandy at the top, and passes up into a series of sands, with subordinate beds of clay, named the Bagshot Sands, by Warburton, in 1821.† The main mass of this formation extends from Hampshire into the adjoining parts of Berkshire and Surrey, and the whole area will be dealt with in this chapter.

The Lower Bagshot Beds have already been mentioned at page 229. Their character is very uniform, and there are many sections in the Bagshot district. Pebble-beds occur, but are not so common as in West Berkshire, and locally, beds of clay are found. One of these clay-beds, at Walton Common, has been described by W. H. Hudleston,‡ and a good deal of clay was found in the Lower Bagshot Beds in a well at D. Lines, Aldershot.§

Vegetable remains are occasionally found, and casts of marine shells occur in considerable abundance in a bed of sand some 3 ft. thick in a pit near Jackman's Nursery Garden, about a mile south-west of Woking Station.|| This is close to the top of the formation.

The Bracklesham Beds.—These are the "Middle Bagshot" and "Middle Bagshot Sands" of the sections Figs. 50, 51. They are essentially a clayey series, interposed between the sands of the Lower Bagshot Beds and those of the Upper Bagshot Beds. Beds of pebbles occasionally are found, and there is nearly always a good deal of, more or less, clayey green sand. The green sand indeed is so marked a feature that Prestwich in one place speaks of the series as the "green-sand division."

* See Well Section at Aldershot, H. G. Lyons, *Quart. Journ. Geol. Soc.*, vol. xliii (1887), p. 434.

† *Trans. Geol. Soc.*, 2nd Series, vol. i, pt. i, p. 48.

‡ *Quart. Journ. Geol. Soc.*, vol. xlii (1886), p. 147.

§ H. G. Lyons, *Quart. Journ. Geol. Soc.*, vol. xliii (1887), p. 434.

|| *Proc. Geol. Assoc.*, vol. xv, p. 187.

Fossils are not common, but sufficient have been found to prove that these beds belong to the marine Bracklesham Series. Teeth and bones of fishes are recorded by Prestwich from Goldsworth Hill, near Woking, and from Shapley Heath, near Winchfield.* At both localities there are deep cuttings on the

FIG. 51.—SECTION FROM FRIMLEY RIDGES TO WOKING STATION.
—Prestwich.

The following is abridged from *Quart. Journ. Geol. Soc.*, vol. iii (1847), p. 382.

	Feet.
a. Upper Bagshot Sands	150
b. Middle Bagshot Sands :	
1. Greenish sand, with a few pebbles	2
2. Sandy clays	11
3. Grey clay, with traces of lignite	1
4. Green sand, with fossils	16
5. Compact lignite	1
6. Sandy clay, the upper part with green sand tubes	6
7. Brown compact clay, with sand and traces of vegetable remains	8
c. Lower Bagshot Sands	130
d. London Clay	—
e. Interval of 3 miles.	
f. Dark grey clay in the Lower Bagshot Sands.	
† Interval of ¼ mile. In both these spaces the strata are continuous.	
..... Strata proved.	

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London and South-Western Railway, and a collection of fish-teeth, etc., was made from the Shapley Heath and Goldsworth cuttings on our excursions of July 21st, 1900, and September 21st, 1901.†

Still more recently Mr. Coomaraswamy has collected from a third locality in the same part of the series near Brookwood,

* *Quart. Journ. Geol. Soc.*, vol. iii (1847), p. 390.

† *Proc. Geol. Assoc.*, vol. xvi, p. 521, and vol. xvli, p. 265.

and has published a list of the fish-teeth from the Bagshot Sands (London Basin).*

Casts of shells have been recorded from the Bracklesham Beds of the Bagshot district, and in one case well-preserved shells were obtained. They were from a well at Yately-Green, described by Dr. A. Irving, who exhibited some specimens at the Geological Society.† Prestwich gives a list of shells from this series at Goldsworth and Shapley, and also from the heaths of Chobham Place and Winchfield,‡ and Mr. W. H. Herries published a list from the Ascot-Bagshot Railway.§

The Upper Bagshot Beds.—These are the “Upper Bagshot Sands” of Prestwich and, like the Lower Bagshot Beds, are practically a series of light-coloured sands. There is even less clay in the Upper than in the Lower Bagshot Beds; the thin layers of pipe-clay so common in the latter formation being absent, and there is no record of thicker clay-beds, though the sand is rather loamy in places. The Lower Bagshot Beds are as a rule current-bedded, but in the Upper Bagshot Beds current-bedding is very rare, and indeed the only sign of bedding at all usual is a banding of variously-tinted yellow and white sands. There is a well-marked and persistent pebble-bed at the bottom of the series.

The only fossils from the Upper Bagshot Beds known up to now are casts of marine shells, but they are sufficient to enable us to say with tolerable certainty that the Upper Bagshot Beds of the Bagshot district are on the horizon of the Lower Barton Beds of the Hampshire coast.||

The greatest known thickness of the Upper Bagshot Beds is 228½ ft. at the well at the Albert Asylum on Chobham Ridges, and as there are no overlying beds but Drift in the district the full original thickness cannot be known.

The Sarsen Stones.—Prestwich mentions the “well-known blocks of light-coloured or nearly white saccharine sandstone,” and remarks that they are “met with chiefly in the upper beds of these [Upper Bagshot] sands generally just below the gravel.”¶ These blocks are very common on the hills and plateaux of the district, and are more especially abundant on one of the highest of these plateaux, Chobham Ridges, but, though I have watched the sections for a good many years, I have never seen one of these blocks which had the appearance of being *in situ*; they all seemed to have been more or less water-

* *Proc. Geol. Assoc.*, vol. xviii, p. 83.

† *Quart. Journ. Geol. Soc.*, vol. xli (1885), p. 500.

‡ *Quart. Journ. Geol. Soc.*, vol. iii (1847), p. 390.

§ *Geol. Mag.*, dec. 2, vol. viii (1881), p. 171; and see also, *Quart. Journ. Geol. Soc.* vol. xxxix (1883), p. 349; and H. W. Monckton, “Short Papers,” Edin. 1893, p. 29.

|| See Gardner, Keeping, and Monckton, Upper Eocene (Barton and Upper Bagshot Formations), *Quart. Journ. Geol. Soc.*, vol. xlv (1889), p. 578.

¶ *Quart. Journ. Geol. Soc.*, vol. iii (1847), p. 384.

or weather-worn. Their position shows that they are newer than the highest Bagshot Beds still left in the district and older than the oldest Drift. I have suggested that in the Chobham Ridges case at all events they are relics of an old land-surface formed of Upper Bagshot Sand.*

The Drift.—There are in this district many, and in some cases, large sheets of gravel, both on the hills, or plateaux, and in the valleys. At one time it was generally supposed that the gravels of the higher plateaux were of marine or estuarine origin, whilst those of the valleys were formed after the retreat of the sea.† An examination of these deposits has, however, led me to believe that they are all river-gravels, or in any case of subaërial origin.‡

One interesting feature about many of the gravels is that they contain fragments and pebbles which have clearly been derived from the Hythe Beds of the Lower Greensand, but the rivers of the district do not now drain any part of the Hythe-Bed area, and, in short, it is pretty clear that a river, corresponding more or less to the Blackwater, drained at one time a great area now in the basin of the River Wey.§ These Hythe Bed fragments are very rare in the highest gravel of the district—that of Cæsar's Camp and Upper Hale, Aldershot; they are abundant in the sheet of gravel on Chobham Ridges, which is at a rather lower level, and even more abundant in the patches of gravel near Ascot at a level of a little above 300 ft. O.D. The Hythe-Bed fragments are found in the gravels of Hazeley Heath, Heckfield Heath, and Spencer-wood Common, but not in those of the hills farther to the west, showing that the gravel of those hills belongs to a different river with a drainage-area which did not include the Hythe Beds.

Some stones which Mr. Shrubsole believed to be Eolithic Implements were found in the gravel of Finchampstead Ridges at a level of a little over 300 ft. O.D.,|| and implements have been recorded from near Camberley.¶

* *Rep. Brit. Assoc.*, Southport, 1903, p. 669.

† See Col. Cooper King. *History of Berkshire*. Elliot Stock (1887), pp. 1-9.

‡ See H. W. Monckton. *Quart. Journ. Geol. Soc.*, vol. xlviii (1892), p. 29, and vol. liv (1898), p. 184.

§ See H. Bury. *Quart. Journ. Geol. Soc.*, vol. lxiv, p. 318.

|| *Report Wellington College Nat. Sci. Soc.*, for 1901, p. 58 and Plate.

¶ *Proc. Geol. Assoc.*, vol. vi, 329; *Record of Excursions*, p. 286.