21. *The* Bagshot Beds *of the* London Basin. By Horace W. Monckton, Esq., F.G.S. (Read April 25, 1883.)

The opening of several new railways during the last few years has greatly increased the opportunities for studying the geology of the Bagshot district. The railway-cuttings, however, are rapidly becoming overgrown or obscured by fallen materials, and I think that a description of some of the sections may interest the Society. In compiling these notes I have been greatly assisted by Mr. Herries; and the lists of fossils are from our joint collection.

The Lower Bagshot beds, 100 to 150 feet thick, consist of yellow and white siliceous and micaceous sand, without green grains, with beds of greyish sandy clay, often laminated, and with more or less distinct vegetable impressions. On the western borders of Bagshot Heath the base of these beds is marked by

(*a*) Coarse, often ferruginous sand, occasionally laminated with nearly white clay and sometimes with pieces of wood.
(*b*) Irregular and extensive masses of rolled flint pebbles.
(*c*) Dark-coloured stiff clay, named Ramsdell clay by the Geological Survey.

The Upper and middle Bagshot Sands of Prof. Prestwich, consist of a series of the very persistent and well-marked beds shown in the following table:—

Upper Bagshot of Geological Survey.	Upper Bagshot of Prestwich. 226 feet or more.	A. Yellow siliceous sands with great numbers of casts of shells, often well preserved.	Shells of Lower Barton species.
		B. Yellow siliceous sands with a few green grains and casts of shells, few and ill preserved. Beds A and B are 226 feet or more thick.	
Bracklesham beds of Geological Survey.	Middle Bagshot of Prestwich. 40 to 60 ft.	C. Pebble bed, more or less regular and of variable thickness, in a greenish or ferruginous sand. 10 to 18 inches.	
		D. Yellow and greenish sands with ferruginous layers and light-coloured foliated clays. 10 to 20 feet.	
		E. Very fine green sand, with subordinate dark clay and lignite. Fossils abundant. Average about 20 feet.	Shells of Bracklesham species.
		F. Laminated clays, often black or liver-coloured, with beds of impure green sand, lignite, and plant-remains. 15 to 20 feet.	

The railway-cuttings at Goldsworthy Hill, at Ascot, and at Wellington College afford good type sections in the lower part of these beds, and show that the above subdivisions, though varying in thickness, are very persistent. The Goldsworthy-Hill section was described by Prof. Prestwich in 1847 (Quart. Journ. Geol. Soc. vol. iii. p. 382).

The subdivision C in the above table is there represented by a "coarse greenish sand with a few flint pebbles" two feet thick; the subdivision D by Prestwich's bed 2, foliated clays eleven feet; E by his beds 3, 4, 5, eighteen feet; and F by his beds 6 and 7, fifteen feet thick.

A very similar section was opened a few years ago on the branch of the South-Western Railway between Ascot and Bagshot, 7½ miles north-west of Goldsworthy Hill. Starting from Ascot station, the line passes over Lower Bagshot Sand for about three quarters of a mile; the middle Bagshot clays then come in, and are well shown in a brick-field close to the railway. This brick-field was described in the Memoirs of the Geological Survey (vol. iv. p. 332); but subsequent excavation has greatly improved the section.

The overlying fossiliferous beds are exhibited in an adjoining cutting on the railway, which was measured by Mr. William Herries and myself in 1879 (Geol. Mag. iii. p. 171); it is now much overgrown.

Section on the South-Western Railway, near Ascot.

		ft.	in.
B*	1. Fine light-yellow sand.		
	2. Yellow sand with layers of darker-coloured iron-sand	2	6
C	3. Pebble-bed, with rolled flint pebbles in iron-sand matrix often greenish	0	10
D	4. Yellow sand with layers of iron-sand, passing into a finely foliated sandy clay, with patches of yellow and greenish sand ...about	10	0
	5. Layer of flint pebbles	0	2
E	6. Yellow and liver-coloured foliated sandy clay	3	0
	7. Green sand with a little dark clay, casts of shells abundant in a layer of yellowish sand	8 or 9	0

Fusus longævus, Lam.; *Fusus*, ? sp.; *Voluta*, ? sp., like *V. cithara*, Lam.; *Pleurotoma*, ? sp.; *Natica* sp.; *Turritella sulcifera*, Lam.; *Phorus agglutinans*, Lam.; *Ostrea flabellulum*, Lam.; *Pecten corneus*, Lam.; *Cardita carinata*, ? Sow.; *C. planicosta*, Lam.; *Cardium porulosum*, Brand.; *Protocardium semistriatum*, Desh.; *Cytherea nitidula*, Lam.; *C. suberycinoides*, Desh.; *Corbula gallica*, Lam.; *C. striata*, Desh.; *Gastrochæna corallium*, Sow.; *Serpula*, sp.; and wood.

F 8. Clays and clayey green sand, shown in a brick-field near the railway, where the beds exposed are:—

Liver-coloured and yellow clay laminated with white and green sand.
A wedge-shaped bed of green sand.
Nearly black foliated clay with iron pyrites, vegetable impressions, and wood, 18 to 20 ft.

Fine white Lower Bagshot Sand.

At Hagthorn Hill, ¾ mile to the north-west of the above brick-field, there is a pebble-bed 2 feet 6 inches thick, apparently in nearly the same relative position as that numbered 3 in the railway-

* The letters in this and the following table refer to the table, p. 348.

cutting section. The mass of stones is here such as to be worth quarrying.

An almost precisely similar succession is shown in the series of shallow cuttings on the South-Eastern Railway, near Wellington College Station, which are shown in the annexed cut (p. 351). The following are the details:—

Section on the South-Eastern Railway, near Wellington College.

Gravel.

B. Light yellow sand, with small patches of green sand, casts of shells, numerous but very imperfect, including species of *Fusus*, *Natica*, *Phorus*, *Turritella*, *Voluta*, wood, &c. ..... 50 ft. or more.

C. A greenish sand, with two irregular lines of flint pebbles, and a few pebbles of old rock ..... 1 ft. 6 in.

D. Yellowish sand, iron-sand concretions, and layers, a few casts of *Turritella*, and wood..... Thickness varies, 2 to 4 ft.

Yellowish, reddish, or greenish sand, with numerous thin laminæ of light-coloured clay ..... About 15 ft.

[This bed was until recently worked for bricks at Wellington College.]

Dark-coloured laminated clay, with an irregular line of flint pebbles. 3 to 4 ft.

E. Green sand..... Thickness not shown.

F. Dark laminated clay, with a little impure greensand. (This bed is shown in a pit at Upwick or Wick Hill near Finchampstead.)

Lower Bagshot Sands, yellow clayey sand, with beds of stiff laminated clay, which are worked for brick-making at California near Finchampstead, and are there wrongly marked "Middle Bagshot" on the Geological Map.

The above examples establish, I think, with sufficient certainty, the succession of the strata in this district; and the well-sections at Wellington College and the Albert Asylum, Bagshot (Mem. Geol. Surv. iv. pp. 425, 537), are very similar. In all a pebble-bed appears at the top of the clayey beds, and affords good evidence of a break in the series at this point.

With the exception of the Albert-Asylum well, there is no section through the whole of the upper sandy beds lettered A and B in the table of strata; and it is therefore not easy to ascertain their greatest thickness. That well gives 226 feet above the pebbles; and I doubt whether this is exceeded in other places.

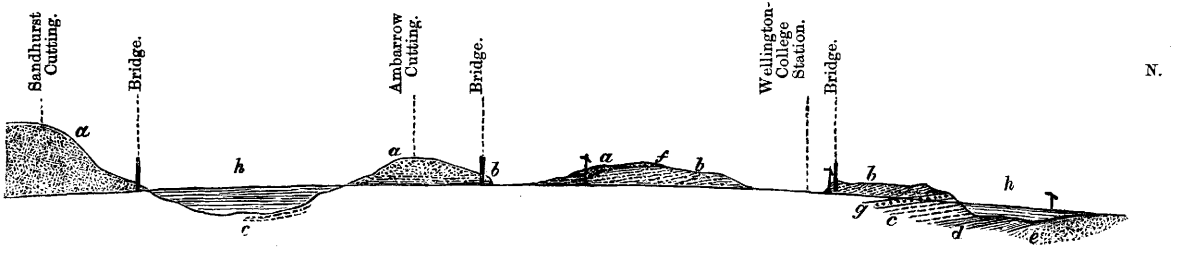
In the lower beds of these upper sands numerous green grains occur, either in patches or disseminated through the sand, and casts of shells are to be found in several pits and cuttings. I may mention Sandhurst cutting on the South-Western Railway, near Wellington College, Cæsar's Camp, Easthampstead, a road-cutting about a mile from the Royal Military College, on the Windsor Ride, and the cutting through the spur of the Fox Hills (S.W. R.), from which Prof. Prestwich obtained several fossils.

There are two very fine sections in the higher beds—the first at Crawley Hill, near Camberley, and the second at Tunnel Hill, on Pirbright Common.

The Crawley-Hill cutting, on the South-Western Railway, near Camberley Station, is unfortunately overgrown; but casts of shells were formerly very abundant there, though for the most part ill-

Section on South-Eastern Railway at Wellington College.

(Horizontal scale 4 inches to 1 mile. Vertical scale 150 feet to 1 in ch.)



Middle Bagshot.

a. Upper Bagshot Sands (of Prestwich).
b. Light-coloured sands and laminated clays.
c. Green sand with subordinate dark clays.
d. Clays, mostly dark-coloured.
e. Lower Bagshot Sands

f. The pebble-bed which marks the base of the Upper Bagshot.
g. Irregular line of pebbles in dark clay at the top of the green sand.
h. Embankments.

In the above cut the dip of the beds to the north of Wellington-College Station is too high; they are, in fact, nearly horizontal, and are brought into the cutting by the fall of the line, which is here 1 in 154.

Pebbles like those in the pebble-beds cover the surface of the ground for some distance north of the station. I have omitted the gravels and surface-earth.

preserved. They are apparently of nearly the same species as those at Pirbright.

At Tunnel Hill, on the Woking-Aldershot branch of the South-Western Railway, the casts are well preserved, and impressions of the exterior of the shells are often to be found.

The section is as follows:—

1. Darkish yellow sand, passing into ochre sand, with casts of shells. 20 ft. 6 in.
2. A line of bright yellow sand..... 8 in.
3. White sand, with numerous casts, passing into white sand, with patches of yellow sand, irregular iron-sand layers and concretions, numerous casts and impressions of shells, and a few flint pebbles..... 27 ft.
4. Variously tinted sands, with very few casts of shells ..... 39 ft. exposed.

Fossils from the Upper-Bagshot Sand, Tunnel-Hill Cutting, Pirbright, Surrey.

vc Rostellaria rimosa, *Sow.*
c Terebellum fusiforme, *Lam.*
Cancellaria (2 species).
Ancillaria canalifera, *Lam.*
Voluta, sp. (rare here, but very common at Crawley Hill).
Volvaria acutiuscula, *Sow.*
c Natica ambulacrum, *Sow.*
—— sp., perhaps N. conoidea, *Sow.*
c —— labellata?, *Lam.*
c —— patula, *Lam.*
Sigaretus canaliculatus, *Sow.*
Cerithium sp.?
vc Turritella imbricataria, *Lam.*
Turritella, or Niso, sp.?
c Littorina sulcata, *Pilk.*
Solarium bistriatum?, *Sow.*
—— plicatum?, *Lam.*
Phorus (2 species).
Dentalium striatum, *Sow.*
—— (small, smooth species).
Actæon sp.
Bulla attenuata, *Sow.*
—— sp.
vc Ostrea flabellulum, *Lam.*
vc Pecten reconditus, *Sol.*
Avicula media, *Sow.*?
Pectunculus sp.
Nucula similis, *Sow.*
vc Cardita sulcata, *Sol.* (variety with tuberculate ribs).
c Crassatella sulcata?, *Sol.*
vc Lucina mitis, *Sow.*
c —— divaricata, *Linn.* (Rigaultiana, *Desh.*).
Diplodonta sp.?
Cardium porulosum, *Brand.*
c Protocardium parile, *Desh.*
—— turgidum?, *Sol.*
Cytherea, apparently 4 species.
vc Tellina scalaroides, *Lam.*
Corbula gallica?, *Lam.*
c Corbula ficus?, *Brand.*
c —— pisum, *Sow.*
—— striata?, *Lam.*
Clavagella coronata, *Desh.*
Serpula extensa, *Brand.*
—— ? sp.
Serpulorbis Marshii.
Two or more species of corals.
Wood.

Correlation of the Bagshot Beds with the Hampshire Series.

A glance at the table of strata (p. 348) will show that there are two beds in which the occurrence of well-preserved fossils gives an opportunity for comparison between the Bagshot and Hampshire series. The first of these is the green-sand bed, E; and the second the higher beds of the Upper Bagshot Sands, marked A in the table. Now, there can, I think, be little doubt that the green sand, E, must be correlated with some part of the Middle Bracklesham of the Hampshire basin; and its great resemblance to the bed numbered

11 in Prestwich's Whitecliff-Bay section leads me to the conclusion that it should be placed in that portion of the Bracklesham termed Group C by the Rev. Osmond Fisher (Quart. Journ. Geol. Soc. vol. xviii. p. 65).

The Bagshot bed resembles Prestwich's bed 11 at Whitecliff Bay in colour and texture, in the abundance of *Cardita planicosta* and large *Turritellæ*, and in the occurrence of *Nummulites lævigatus*.

Passing now to the upper fossil-bed at Bagshot, marked A, and best seen at Pirbright, I venture to submit that the shells clearly prove it to be of Barton age.

The occurrence of such shells as *Volvaria acutiuscula*, *Littorina sulcata*, *Dentalium striatum*, *Lucina divaricata* (or *Rigaultiana*), *Tellina scalaroides*, and *Clavagella coronata*, all of which are well-marked types and not easily mistaken, taken together with the absence of *Cardita planicosta*, *Pecten corneus*, &c., which are so abundant in the underlying green sand, is, I think, quite sufficient to prove that we are here in Barton beds. On the other hand, if we compare the list of shells from Pirbright Common with that from Long Mead End, Hordwell, published by Mr. Tawney (Proc. Cambr. Phil. Soc. iv. p. 150), we can, I think, feel no doubt that the Long-Mead-End Upper Bagshot Sand, with *Cerithium pleurotomoides*, cannot be correlated with the Upper Bagshot Sand of Bagshot Heath. The upper beds of the Bagshot Sand of Bagshot Heath must therefore be correlated with the Barton beds of Hampshire and the Isle of Wight.

It might be objected to this correlation that it does not account for the absence of the Upper-Bracklesham beds in the London basin; but I think that, in the first place, the distance between the two basins is enough to account for almost any amount of thinning-out or change in the nature of the strata; and in the second place, the clear evidence of a break in the London-basin series, which is furnished by the remarkable pebble-bed marked C in the table of strata, is sufficient to account for the absence of the Upper Bracklesham in that basin.

The only question remaining to be considered is the point at which the division between the Barton and Bracklesham should be placed in the Bagshot area. On the whole, it appears to me to be most convenient to place it at the pebble-bed marked C in the table of strata (this was suggested by the Rev. A. Irving [Proc. Geol. Assoc. iv. pp. 334, 335], and is in accordance with Prof. Prestwich's Goldsworthy section [Q. J. G. S. iii. p. 382]), giving the Barton beds a thickness of 226 feet at least, and the Bracklesham an average thickness of about 45 or 50 feet.

In the Geological Survey Map some of the overlying sands are included in the Bracklesham, on the ground that they contain green grains. This, however, does not appear to me altogether satisfactory, a few green grains being no proof that a bed is not of Barton age; and I think it better to take the pebbles as a division than the very uncertain line proposed by the Survey.

Discussion.

Prof. Prestwich said it was forty years since the opening of a railway-cutting had first given us some idea of the position of these sands. The paper was a very careful record of observations. The fossils were so imperfect that comparison with the representatives of this series in Hampshire was very difficult. He himself had found but few. He thought that the so-called Upper Bagshots of that region were on the whole more probably synchronous with the Bracklesham. The occurrence of a little green sand was not of much importance, except that it sometimes was associated with occurrence of fossils. He asked how many species Mr. Monckton had found.

Mr. J. S. Gardner said that he thought Mr. Monckton had made a sufficiently large collection to show that the beds were really equivalents of the Barton Beds. As for the lower beds, they were probably freshwater, but might perhaps rather belong to the lower part of the Middle Bagshot than to the Lower Bagshot.

Prof. Judd thought that the author had brought valuable evidence as to the age of the "Upper Bagshots" of the London basin, showing that they might be correlated with some parts of the Barton series. It was important to have shown that these beds did not agree with the Hordwell Beds or Headon-Hill Sands. There was, indeed, no reason for correlating the two series in the Hampshire and Bagshot areas. For himself he thought it was unsafe to attempt to draw exact parallels between beds sixty miles apart, so far as the minor members were concerned.

Prof. Prestwich mentioned that he had found near Cooper's Hill traces of casts of marine shells in Lower Bagshot.

Mr. Monckton acknowledged the favourable way in which his paper had been received. He had obtained from the Upper Bagshot 28 species, and from the green-sand bed 18 species. It was easier to enumerate than to name the species.