KEEPING.—"The Fossils and Palæontological Affinities of the Neocomian Deposits of Upware and Brickhill." Being the Sedgwick Prize Essay for the year 1879. Cambridge University Press.

For Jurassic Rocks consult various Papers by Professors SEELEY and BLAKE, and Mr. HUDLESTON. (See above, WHITAKER's List of Works.)

ORDINARY MEETING.

FRIDAY, JUNE 6TH, 1884.

HENRY HICKS, Esq., M.D., F.G.S., President, in the Chair.

The list of donations to the library since the last meeting was read, and the thanks of the Association were accorded to the donors.

The following were elected members of the Association :—

W. D. Carr ; Edwin Charles Harris, B.A. ; Alfred Jacobs ; Isaac Mosley ; V. Perrones Sells, jun. ; Rev. Francis Augustus Walker, D.D., F.L.S. ; A. H. Williams ; Edward Wilkinson ; William White.

The following papers were then read :—

'On some curious excavations in the Isle of Portland,' by T. V. Holmes, F.G.S.

'On the underground waters of England and Wales,' by Charles E. De Rance, F.G.S., Assoc. Inst.C.E.

Publication of the latter paper is deferred.

ON SOME CURIOUS EXCAVATIONS IN THE ISLE OF PORTLAND.

By T. V. HOLMES, F.G.S.

A short notice in the 'English Mechanic and World of Science' of the excursion of the Geologists' Association and Essex Field Club to the Deneholes of Hangman's Wood, last summer, attracted the attention of Mr. A. M. Wallis, a quarryman and fossil collector living in the Isle of Portland. He thereupon wrote to our secretary, Dr. Foulerton, describing and sending drawings of some remarkable beehive-shaped excavations recently laid bare during quarry extensions in Portland, which seemed to him somewhat akin to Deneholes. Having recently visited the Isle of Portland in order to see something of these holes, it occurred to me that a brief account of my excursion might be interesting to the Geologists' Association. There is no mention of excavations such as those to be described in Murray's 'Handbook to Dorset, Wiltshire and Somersetshire ;'

FIG. 1.

FIG. 2.

Sections of some peculiarly situated Pits, reduced from drawings by Mr. A. M. Wallis. Fig. 1—One pit above another. Fig. 2—Two pits close together with an opening between them. *a* soil. *b* rubble-stone. *c* clayey seam. *d* hard "slate." *e* is the rubble with which the space close to the outside was filled after the construction of the pit.

Damon's 'Guide to the Geology of the Isle of Portland,' or the last edition of Hutchins' 'History of Dorset.' And Mr. Wallis, who is a native of Portland, told me that he does not remember the discovery of any holes of this kind previous to the last two years, or thereabouts.

The Isle of Portland must be well known to many members of this Association both on account of the geological interest of the neighbourhood generally, and because it was the scene of an Easter excursion five years ago. At its northern end it rises at the Verne to a height of 495ft. above the sea, and thence slopes gradually down to about 30ft. at its southern extremity which is known as Portland Bill. The hillside at its northern end between the Verne and Portland Bay is made up of Kimmeridge Clay overlain by Portland Sand, Portland Stone capping the summit of the hill. A short distance south of the Verne the Portland Stone is, in its turn, overlain by the Purbeck beds, which form the surface of the greater part of the island. The amount of Portland Stone which is of thoroughly good quality for building purposes being limited, and the demand for it great, the quarries tend to creep southward from the small area in which Portland Stone forms the surface, and to occupy that covered by the Purbeck Beds. The excavations to be described have been laid bare from time to time during the process of removing the Purbecks from the surface in order to get at the more valuable Portland Stone beneath. Mr. Wallis informed me that they had all been found a little eastward of the road from Yeales to Easton, in the quarries owned by Mr. Weston and Messrs. Stewards and Co.

The surface rocks where these excavations are found consist of:—

					ft.	in.
Soil, about	...	...	...	...	2	0
Limestone Rubble	...	...	...	...	5	0
Clay	...	...	...	...	1	6
Hardstone (Slate)	...	...	...	...	4	0
"Bacon tier," thin alternating bands	...	...	...	...	5	0
Dirt Bed	...	...	...	...	1	0
					<hr/>	
					18	6

Portland Stone.

The holes themselves are all beehive-shaped (Mr. Wallis states), and walled by the rubble in which they have been excavated. They vary in size to some extent, the largest chambers being seven or eight feet in height and about nine feet in diameter at the bottom, the floor being eleven or twelve feet beneath the surface of the

ground. The smallest are only about four feet high and six feet in diameter, or thereabouts. On the occasion of my visit (March 26), the remains of three rather small ones were still visible, others that had been exposed to view in January having since been worked away. The entrance to these chambers is a narrow opening in the middle of the roof, just large enough to admit a man, and covered in by a piece of the hard flaggy stone locally called slate because formerly used in the Island for roofing houses. The floors of the chambers are all of this slate, while the flat stone covering the entrance at the top is placed just below the vegetable soil, which is from one to two feet thick at the surface. The remains of the chambers that I saw were from ten to fifteen yards apart, but Mr. Wallis informs me that two were discovered close together, side by side, with an opening in the wall between them. In another case one small chamber was found to be directly above another, the entrance to the lower being in the centre of the floor of the upper chamber. It struck Mr. Wallis, as an experienced quarryman, that the makers of these holes must have had very bad excavating tools, the floors of the chambers being very uneven.*

Bones are said to have been found in these holes, and a bronze coin; and in one of them there was a considerable amount of blackened corn mixed with black earth, the latter probably marking the total decomposition of a much larger quantity. I obtained some of this corn, the presence of which seems to me to give the true explanation of the purpose for which these pits were made: they are granaries dating probably from prehistoric times.† For it is well known that Diodorus Siculus,‡ writing in the first century, B.C., states that the inhabitants of Britain lived in mean dwellings made for the most part of reeds or wood, and that harvest with them meant the cutting off the ears of corn and storing them in pits underground, whence were fetched day by day those that had been longest in keeping to be dressed for food. Prof. Rhys adds:—“This appears to have been a way of preparing the cereal for food, which was well understood in the last century in the Western Islands of Scotland, where one proceeded so skilfully to prepare the corn with the aid of a flame that it might be dressed, winnowed, ground, and baked within an hour after reaping.”

* I learn that from twelve to fourteen beehive-shaped holes have been discovered up to the present date (June 6th, 1884).

† I learn from Mr. Wallis, in a letter dated May 29th, that three old millstones (querns) have been found close by the beehive-shaped pits.

‘Celtic Britain,’ by Prof. Rhys.

Subterranean granaries, varying in form and size according to circumstances, either abound now, or were formerly abundant, in almost every country in the world. In southern England some were discovered last year by Major-General Pitt-Rivers during his examination of the hill-fort on the Chalk called Winklebury, which is situated on the borders of Wiltshire and Dorset. The following description of some now used in southern India forms an almost accurate description of those of Portland :—" They are usually situated on somewhat high ground, and in gravelly soil or decomposed rock. Their construction is simple. A circular hole, about two feet in diameter is dug to three feet in depth, when a domed chamber of an oval shape is excavated, capable of containing from ten to twenty cartloads of grain. Neither masonry nor props are used. A little straw is laid on the floor and against the walls of the chamber to a third of their height, when the grain is filled in. A slab is placed over the pit at the bottom of the short shaft that enters it, and the shaft is then filled in with earth. Rági thus stored will keep for an indefinite number of years. It is safe from insects and rats, and is not easily accessible to thieves, as the pits are generally situated near the village—sometimes in the streets—and it takes some little time to dig to the grain. Moreover, it is highly dangerous to enter a rági pit till 12 hours or more after it has been opened. The carbonic acid gas generated therein is instantaneously fatal, and, though natives are well aware of this, accidents frequently happen." *

No one can visit the Isle of Portland without seeing that it is a natural fortress, which, when the whole country was divided into the territory of more or less isolated tribes or clans, must have formed the great stronghold of one of them—whether the Durotriges or some earlier race. This clan, however, probably held, in addition, a tract of the mainland, more suitable for corn-growing than the storm-swept Isle. The only spot in Portland at which a village or town is likely to have existed in or before Romano-British times is at Fortune's Well, where the largest collection of houses now exists, where the Verne heights form a shelter on the east, and where there is a good water supply from a spring at the junction of the Portland Sands with the underlying Kimmeridge Clay. Evidence of an ancient British fort was once visible on the

* 'Thirteen Years among the Wild Beasts of India.' By G. P. Sander-son, Officer in charge of the Government Elephant-Catching Establishment in Mysore. London, 1878.

Verne, while Romano-British cemeteries have been discovered at the Grove and at Southwell. The position of the granaries on the high ground south of Fortune's Well is such as to render them secure, both from enemies advancing across the isthmus from the north, and from any landing in boats on the low shore near Portland Bill.

As these Portland granaries have only been noticed during the quarry extensions of the last two years, it would appear that they are confined to a certain area, and, possibly, may soon be entirely cleared away. It must be gratifying to the Geologists' Association to think that, owing to the report of their Denehole excursion, these interesting excavations have not passed away unrecorded, as otherwise might possibly have been the case. A few words suggest themselves, in conclusion, on the amount of affinity between Deneholes and these Portland excavations. In spite of the immensely greater size and depth of the former, it appears to me that they both belong to the same group, that of ancient artificial excavations made for some domestic purpose, and not for the sake of the material removed. The evidence showing that Deneholes were evidently made for some domestic purpose or purposes, and not for the sake of the chalk brought out of them, having been omitted in the reports of the excursions of the Geologists' Association to Bexley and Grays, I will briefly state it here. I will take the case of those at Hangman's Wood. It has been suggested that they were made either for the supply of top-dressing to the soil, or to furnish chalk for the ancient export-trade of the Thames. Now, if for top-dressing, why are these pits densely concentrated in a small space where the chalk is from fifty to sixty feet below, though there is plenty of bare chalk within a mile; and why is there a separate shaft to each Denehole, and no communication between adjacent pits? Where marl pits for top-dressing exist, as in Norfolk and elsewhere, they are broad, irregular hollows, made where the marl is near the surface, and diffused so that no given spot is more than a certain distance from one. Moreover, supposing their broad distribution to be impracticable, ancient pits for top-dressing would necessarily have been made where modern pits now abound; in other words, where a given amount of labour obviously produced the greatest return—where the chalk is at the surface, not where it is covered by fifty or sixty feet of profitless material. Then, again, as regards the ancient chalk export-trade of the Thames. Every-

body knows that huge quarries exist close to the river, both at Gravesend and Rosherville, in Kent, and at Purfleet, in Essex. Hundreds of millions of tons of chalk have been removed from the cliffs at those places, and they must always have had the same advantages over the pits at Hangman's Wood (nearly two miles from the river) that they now have. In short, everything, both in the position and construction of the Hangman's-Wood pits, points to the conclusion that they were not made for the sake of the material excavated, but for some domestic purpose. And the same remarks apply more or less strongly to all the Deneholes I have ever seen. Of course it matters not whether the material removed was utilized or wasted, if the evidence shows the pits were not excavated for its sake.

Many Deneholes, however, do not contrast so markedly in size and plan with the Portland Pits as do those of Hangman's Wood. On the contrary, among the shallower and, probably, older Deneholes which have been excavated mainly or wholly in the chalk, the beehive shape is the common one. One of these older Deneholes is described by Mr. F. C. J. Spurrell as being 36ft. 6in. deep and 18ft. in diameter, while its contents showed that it dated back to pre-Roman times. These dimensions are, perhaps, not far from the average of the older Deneholes; but it must be remembered that chalk, from its combined softness and coherence, offered special advantages to primitive man wishing to make an excavation; for it could be worked even with such an implement as a deerhorn pick, which would hardly produce any perceptible effect on the harder rocks of the Isle of Portland.*

* June 6th, 1884. I wrote to Mr. Wallis in April, asking him to send me a telegram when any new beehive-shaped pits appeared. He promised to do so, but none have since been discovered. On the 28th May a pit discovered turned out to be an oblong burial pit, that had fallen in. Mr. Wallis remarks, in a letter of May 29th, that "these oblong pits are often found with human remains and black pottery in them." And finding that Mr. H. B. Woodward, of the Geological Survey, is at present stationed at Weymouth, I wrote, telling him what I had learned about the beehive-shaped pits, and asking him to send me the latest intelligence about them in time for the Geologists' Association meeting this evening. He tells me, however, in a letter dated June 4, that he has learned nothing new so far, though he hopes to do so before leaving the neighbourhood of Portland.

July 19th, 1884. In a letter dated June 15th Mr. Woodward says:—"I have seen all that is to be seen of the Portland Pits. Those you saw are for the most part effaced, and only their sites are indicated by pockets of rubble. I did see the half of one of the beehives in another (adjoining) pit. The portion was exposed at the top of a quarry, and by lying down I could discern that it was built of loose pieces of stone, forming a 'hive' four or