

## THE NEW DOCK EXCAVATION AT SOUTHAMPTON.

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An excavation for a new dock in the Southampton Water, at the junction of the rivers Itchen and Test, has been in progress during the past two years. The object in view is to form an open dock sufficiently deep to allow vessels of the greatest draught to enter or leave the basin at all states of the tide, and to accomplish this it has been necessary to make an unusually deep excavation.

Between the natural river channels there was, previously to the construction of the old docks about fifty years ago, a spit of mud extending for more than half-a-mile from the beach, covered at high tide by from 12 to 17 feet of water, but uncovered at low tide; and the old docks were constructed near the shore line of this spit, the entrance to the basins being from the river Itchen. The new excavation is being made to the southward, where the basin will have an area of eighteen acres, the dock entrance to be near the natural junction of the river channels. To accomplish this work it has been necessary to remove the alluvial deposits which here lie on the Bracklesham beds, and over a great part of the area to remove the latter to a depth varying from a few feet near the junction of the river channels to thirty feet near the old dock boundary. The alluvial beds met with comprised estuarine mud, peat and shell-marl, clay, and gravel, and the Bracklesham, various sands and clays, chiefly green tinted.

The sea wall for inclosing the area was made of chalk brought from Micheldever. A bed of flint gravel was found in the excavation which has been used in making the concrete portion of the dock wall. The earlier work of the excavation consisted in moving the beds which lay upon the gravel, and in digging the trench along the sides for the deep foundations of the wall. On the Itchen side of the area, the thickness of the peat was so great that it was found necessary to go some feet deeper than usual at other part of the boundary line, in order to obtain a firm foundation for the

wall. Subsequently the mud was removed from the whole area; then the peat and next the excavation of the gravel sheet was completed; lastly that of the Bracklesham beds, and the remainder of the peat lying on the Itchen side of the excavation is going on at the present time (March, 1889).

Large collections of fossils have been made, including mammalian and plant remains from the peat, estuarine and freshwater shells from the mud and marl, and the characteristic shells from the Bracklesham beds.

The following table of thicknesses has been made from notes of the trial borings supplied by the courtesy of the Engineer, through Mr. P. Hedger. The numbers at the head refer to the plan (Plate I, Fig. 1) and indicate the position of the borings. The thicknesses are in feet.

	1	2	3	4	5	6	7	8	9	10	11	12	13
From Datum level	17	17	15	16	15½	14	12½	15	12½	12	13	13	20
Mud	16	15	16	14	12	15	5	10	6	17	17	17	12
Greensand	..	..	3	..	..	..	..	..	..	..	..	..	..
Peat	10	13	..	..	..	..	..	..	..	..	14	14	11
Gravel	3	3	2	5	10	8	5	3	4	..	2	4	3
Clayey gravel	..	..	..	..	..	..	..	..	..	..	..	..	..
Dark sand	..	..	8½	..	..	..	..	..	..	2	..	..	..
Greensand	..	..	..	..	..	8	..	..	..	..	..	..	..
Clay	..	..	8	..	..	..	..	..	..	..	..	..	..
Green clay	..	..	..	14	10	..	15	8	8	..	..	..	..
Dark clay	7	5	..	3	5½	8	15	17	22½	22	7	5	7
Totals	53	53	52½	52	53	53	52½	53	53	53	53	53	53

The second table has been prepared from a section drawn from four borings made along the Dock Extension wall, on the east side of the new dock, at the time that Extension was constructed, the figures as before in feet.

	South boring	400-ft. N.	500-ft. N.	500-ft. N.
From Datum line to surface	..	11	18½	17½
Mud	..	..	10	10
Dark Sandy Clay	..	..	6	..
Peat	..	..	12	10
White Malm.	..	..	..	13
White Clayey Sand	..	5½	..	..
Chalky Peat	..	..	6	..
Sandy Clay	..	..	6	..
Marly Clay	..	..	..	10
Sandy Gravel	..	..	5	..
Gravel	..	..	7	7
Bracklesham beds	..	..	2½	3

## BRACKLESHAM BEDS.

The beds of this series stretch beneath Southampton, but are generally obscured by pleistocene and recent deposits. The dip is a slight southerly one, and the outcrop of the lowest of them is observed at St. Denys and other places to the north, brown clay overlying the Lower Bagshot sand, one or two thin pebble beds occurring at the junction. Further south, beds of greensand occur, as in the abandoned cutting at Hill Lane. It does not appear that many records have been made of the occurrence of fossils. Mr. Prestwich catalogues a series from Freemantle, including *Nummulites lævigatus* (Q.J.G.S., 1847), and also mentions the occurrence of shells and teeth in the old docks. Later, the Rev. O. Fisher (Q.J.G.S., 1862) records *N. lævigatus* from the same locality; a few also of the shells described in the Monograph of the Eocene Mollusca (Pal. Soc.) and localized at Southampton, are from the Bracklesham Beds.

The following is a description of the Bracklesham beds which have been exposed in the new dock excavation:—

(a) Dark clay, generally green-tinted, and more or less sandy, extending over the northern half of the excavation, apparently unfossiliferous.

(b) Similar greensandy clay, containing abundance of fossils, especially *Sanguinolaria*, occupying most of the remainder of the dock area.

This bed and the successive ones were well exposed in the deepest drainage trenches. A rather bright green sandy clay with a small proportion of black grains (glauconitic), small nodules of ironstone, thin patches of lignite, and occasional pebbles; fossils abounding in a high state of preservation, many of them having a reddish tinge. *Sanguinolaria Hollowaysii* occurs in pairs in the position in which it lived, with *Voluta spinosa*, *Pseudoliva ovalis*, *Cardita planicosta*, *Crassatella Sowerbyi*, *Solen obliquus*, *Natica mutabilis*, *Voluta Selseiensis*, *Mesalia multisulcata*, a small *Pectunculus*, and many of the small species which occur in the sand above. The fossils are scattered rather thinly throughout, not forming beds.

Towards the south side and highest part of the greensand appears *Cytherea striatula*, and the matrix presently loses its sandy character.

(c) A bed of clay in which this species occurs in myriads with *Bifrontia Laudunensis* (?), and a small *Pisania*. A few small shelly concretions occurred in this bed, some of which showed the shells on the surface finely preserved.

(d) Above this clay lies a bed of small oysters (*O. tenera*) in a more sandy matrix, and on this a local patch of slightly clayey sand, of light puce grey tint, weathering a yellowish brown, with a considerable proportion of fine black grains, and abundance of small shells, *Cytherea striatula*, *Mesalia fasciata*, *Crassatella Sowerbyi* (immature), *Corbula cuspidata*, *C. longirostris*, *Cardita elegans*, *Tellina* (?), *Pisania*, *Arca modioliformis*, *Arca lævigata*, *Lutetia Parisiensis*, *Bifrontia Laudunensis*, *Tellina plagia*, *Pectunculus pulvinatus*, *Turbinolia*. The shells are of light brownish grey tint, and rather fragile and decorticated, many specimens are rolled, and others drilled by boring mollusca. About 60 species, chiefly small, some of them rare, have been obtained from the sand by sifting it under water. No nummulites have been found.

From the above facts and in absence of others the accompanying section (Plate I, Fig. 2) has been made, which is rather suggestive of what is probably the case than the representation of a certainty.

On comparing the section with those at Bracklesham, &c. (Fisher, Q.J.G.S., 1862), it will be seen that similar beds are there exposed. First we find a thin pebble bed, overlying sand, and underlying clay, followed by beds of green sand. At the open sections abundance of *Cardita planicosta* occur at a certain level, but this bed does not appear to have been traced in Southampton. The main bed of *N. lævigatus* is probably that found in the old docks and underlying the *Sanguinolaria* bed. At Whitecliff, immediately above the *N. lævigatus* bed, abundance of *Sanguinolaria Hollowaysii* are found, and the fauna of bed ix. (f) closely corresponds with that of bed b in the new dock. At Stubbington, the lower bed (the Hill Head) seems to correspond closely in respect of its fauna; several species that they contain in

common are rare, but seem to abound on this horizon, *e.g.*: *Ostrea zonulata*, *Arca modioliformis*, *Crassatella Sowerbyii*, *Bifrontia Laudensis*, *Voluta muricina*, *V. mutata*, *Pseudoliva ovalis*; *Cerithium cornucopiæ* (a fragment). At Bracklesham a bed of *Cytherea striatula* (Little Bed) occurs in a position inferior to the Brook bed, but above the *N. lævigatus*. It seems clear therefore that the succession of beds under Southampton is closely similar to that at the open sections, those in the dock now being made belonging most probably to the lower part of group B (of Mr. Fisher's Bracklesham beds). As Mr. Codrington has found an eroded surface above the *N. lævigatus* bed at Whitecliff, it may be suggested that Mr. Fisher's group B should be extended to the level, above which *N. lævigatus* does not occur.

It was not possible to obtain the thicknesses of the individual beds of the Bracklesham series. The vertical thickness shown by the borings varies from 5-ft. near the dock gate under the peat (Pl. I, Fig. 1—2, 12) to about 30-ft. on the north side (Pl. I, Fig. 1—7, 8, 9). The deepest points reached were 12-ft. and 15-ft. below the dock floor under the north wall. Here dark green clay, burning red, and very stiff brownish grey clay, burning white, variegated with green and blue streaks, were found, with lignitic matter.

The fine dotted lines on the plan (Pl. I, Fig. 1) indicate approximately the position of the outcrop of the successive beds of the Bracklesham series, running nearly east and west, or a little to the south of east. This corresponds with the strike of the beds in the neighbourhood, which is south of east several degrees.

Remarkably fine sand pipes were found in the Bracklesham beds. They have an internal diameter of one inch, contain lignitic matter, and probably are the result of concretion around roots of plants which grew in the peat, and penetrated the underlying beds.

Lignitic matter contemporary with the Bracklesham deposit also occurred abundantly, some of it in a pyritized and woody condition.

The mineral Vivianite occurred in the Bracklesham beds\* in the form of thin veins mixed with and colouring the matrix of a bright blue tint.

\* Also at the junction of the tufa and mud and in the Bracklesham bed at the Netley shoal.

A sample consisting of glauconite sandy clay, with small portions of Vivianite disseminated throughout the mass was analysed by Mr. Walter Crocker, in the laboratory of the Hartley Institution, with the following results:—

Soluble matter	.. ..	12.04 per cent.
Insoluble matter	.. ..	87.96 per cent.
		100.

The soluble matter consisted of:—

Vivianite, Fe <sub>3</sub> P <sub>2</sub> O <sub>8</sub>	.. ..	46.47 per cent.
Other matter, not analysed..		53.53 per cent.
		100.

Analysis of Vivianite:—

$$\left. \begin{array}{l} 3 \text{ Fe O} = 28.04 \\ \text{P}_2 \text{ O}_8 = 18.43 \end{array} \right\} 46.47$$

The following catalogue of the fauna of the Bracklesham beds is necessarily imperfect owing to the incomplete state of the monographs on the Eocene Mollusca. The shells have been compared with the Edwards collection in the British Museum (Nat. Hist.), and the aid of Mr. R. B. Newton of that museum was given in determining them. The list has been prepared from collections in the Hartley Museum, and in the possession of Mr. J. T. Kemp, M.A., and Mr. Elwes. The Mollusca are classified according to the order of description in the Palæontographical Society's monographs, so far as the latter are completed; the remainder follow the order of Woodward's Mollusca and Supplement.

*b, c, d*, refer to the beds in the Bracklesham series; *va*, very abundant; *a*, abundant; *f*, frequent; *r*, rare; *vr*, very rare.

#### FAUNA OF THE BRACKLESHAM BEDS.

			<i>b</i>	<i>c</i>	<i>d</i>
Anomia tenuistriata..	..	Desh.	r	—	—
Ostrea tenera	.. ..	Sby.	—	—	va
O. zonulata ..	.. ..	S. Wood	f	—	—
O. flabellula ..	.. ..	Lmk.	r	—	—
Arca aviculina	.. ..	Desh.	f	—	f
A. planicosta ..	.. ..	Desh.	—	—	f
A. modioliformis	.. ..	Desh.	—	—	va
A. lævigata ..	.. ..	Caillat.	—	—	va
Pectunculus pulvinatus	..	Lmk.	a	a	a

			<i>b</i>	<i>c</i>	<i>d</i>
<i>P. incertus</i> ? .. ..	Edw. M.S.		a	—	—
<i>Nucula Dixoni</i> .. ..	Edw.		r	—	—
<i>N. praelonga</i> .. ..	Edw. M.S.		—	—	vr
<i>Trigonocœlia deltoidea</i> .. ..	Lmk.				
<i>Cardita planicosta</i> .. ..	Lmk.		a	—	—
<i>C. elegans</i> .. ..	Lmk.		va	va	va
<i>Lutetia Parisiensis</i> .. ..	Desh.		—	—	va
<i>Crassatella Sowerbyii</i> .. ..	Edw.		a	a	va
<i>C. Bronnii</i> .. ..	Mérian		vr	—	—
<i>Chama Selseiensis</i> .. ..	Edw. M.S.		f	—	—
<i>Cardium Edwardsii</i> .. ..	Desh.		r	—	—
<i>C. alternatum</i> .. ..	Sby.		r	—	r
<i>Strigilla serrata</i> .. ..	Sby.		—	—	r
<i>Cytherea striatula</i> .. ..	Desh.		r	va	va
<i>C. obliqua</i> .. ..	Desh.		r	—	r
<i>C. suberycinoides</i> .. ..	Desh.		—	—	r
<i>Tellina plagioides</i> .. ..	Edw. M.S.		—	—	a
<i>T. concinna</i> .. ..	Edw.		f	—	—
<i>T. like lunulata</i> .. ..	Desh.		—	—	va
<i>Syndosmya</i> ? .. ..			vr	—	—
<i>Sanguinolaria Hollowaysii</i> .. ..	Sby.		va	f	f
<i>Solen obliquus</i> .. ..	Sby.		f	—	—
<i>Corbula cuspidata</i> .. ..	Sby.		a	va	va
<i>C. striata</i> .. ..	Desh.		—	—	r
<i>C. longivostris</i> .. ..	Desh.		—	—	va
<i>Teredo</i> .. ..			vr	—	vr
<i>Marginella bifido-plicata</i> .. ..	Chsw.		—	—	a
<i>Mitra labratula</i> .. ..	Lmk.		r	—	—
<i>Voluta Selseiensis</i> .. ..	Edw.		a	—	—
<i>V. spinosa</i> .. ..	Linn.		va	—	r
<i>V. muricina</i> .. ..	Lmk.		r	—	—
<i>V. mutata</i> .. ..	Desh.		vr	—	—
<i>Pleurotoma dentata</i> .. ..	Lmk.		f	—	—
<i>P. denticula</i> .. ..	Bast.		f	—	f
<i>P. several small species</i> .. ..			f	—	a
<i>Ancillaria canalifera</i> .. ..	Lmk.		r	r	—
<i>A. subulata</i> .. ..	Sby.		vr	—	—
<i>Pseudoliva ovalis</i> .. ..	Sby.		a	—	—
<i>Clavella longæva</i> .. ..	Sol.		r	—	—
<i>Cantharus polygonus</i> .. ..	Lmk.		vr	—	—
<i>Strepsidura turgida</i> .. ..	Sol.		r	—	—
<i>Leiosstoma pyrum</i> .. ..	Sol.		r	—	—
<i>Fusus unicarinatus</i> .. ..	Desh.		vr	—	—
<i>Trophon undosum</i> .. ..	Sby.		—	—	r
<i>Pisania, like lavata</i> .. ..			—	a	va
<i>Typhis pungens</i> .. ..	Sol.		vr	—	—
<i>Murex minax</i> .. ..	Sol.		a	—	—
<i>M. asper</i> .. ..	Sol.		vr	—	a
<i>Rimella canalis</i> ? .. ..	Lmk.		f	—	—
<i>R. rimos</i> .. ..	Sol.		f	—	f
<i>Natica labellata</i> .. ..	Lmk.		r	—	r
<i>N. obovata</i> .. ..	Sby.		—	—	r
<i>N. mutabilis</i> .. ..	Sol.		a	—	—
<i>N. Studeri</i> .. ..	Bronn		r	—	—
<i>Sigaretus canaliculatus</i> .. ..	Sby.		—	—	vr
<i>Turbonilla</i> .. ..			—	—	f
<i>Odostomia</i> .. ..			—	—	f
<i>Cerithium</i> .. ..	Desh.		r	—	—

		<i>b</i>	<i>c</i>	<i>d</i>
<i>C. cornucopiæ</i> .. ..	Sby.	—	—	—
<i>C. mutabile</i> .. ..	Lmk.	v r	—	—
<i>C. several small species, one-</i>	—	—	—	v a
<i>Turritella sulcifera</i> .. ..	Desh.	a	—	—
<i>T. edita</i> .. ..	Sol.	—	a	a
<i>T. bicincta</i> .. ..	Wood	f	—	—
<i>Mesalia multisulcata</i> .. ..	Lmk.	a	—	—
<i>M. fasciata</i> .. ..	Desh.	—	r	v a
<i>Scalaria punctulata</i> , var.				
<i>simplex</i> .. ..	Edw.	v r	—	—
<i>Solarium canaliculatum</i> .. ..	Lmk.	f	—	f
<i>S. trochiforme</i> .. ..	Desh.	—	—	—
<i>Nerita tricarinata</i> .. ..	Lmk.	—	—	r
<i>Rissoa cochlearella</i> .. ..	Lmk.	r	—	r
<i>Rissoa?</i> .. ..	—	—	—	r
<i>Bifrontia Laudunensis</i> .. ..	Desh.	—	a	v a
<i>Trochita aperta</i> .. ..	Lmk.	—	—	r
<i>Dentalium striatum</i> .. ..	Sol.	—	—	f
<i>Bulla Lamarckii</i> .. ..	Desh.	—	—	v r
<i>B. (Volvula) biplicata?</i> .. ..	—	—	—	v r
<i>Otoliths</i> .. ..	—	v r	v r	—
<i>Lamna</i> .. ..	—	—	—	—
<i>Myliobatis</i> .. ..	—	—	—	—
<i>Fish vertebræ</i> .. ..	—	—	—	—
<i>Turbinolia</i> .. ..	—	—	—	a

## REMARKS ON SOME OF THE SPECIES.

*Ostrea zonulata* S. Wood was found at Hill Head, Stubbington; it is closely related to *O. velata* of the Headon series. It is found sparingly in bed *b*.

*Arca modioliformis* Desh. occurs at the same locality, but is very rare, the Edwards collection containing but three specimens. In bed *d* it occurred abundantly.

A small Tellinoid bivalve occurs abundantly, which we have been unable as yet to refer to any known species. The nearest approach to it seems to be *T. lunulata* Desh. The species found at the Dock occurs at Hordle and Headon Hill, in the Middle Headon beds.

A small *Fusus* also has not been identified. It is apparently a *Pisania* or *Cantharus*.

The *Cerithium cornucopiæ* included in the list is based on a fragment obtained from a workman.

*Mesalia fasciata*. The small angulate form is referred temporarily to this species.

*Trigonocælia deltoidea*, one specimen found by Mr. Kemp. This is considerably below its usual horizon, the Headon and Upper Barton beds.

A beautiful specimen of *Solarium trochiforme* was also found by this gentleman.

*Gravel.*—After the denudation of the Eocene beds an uneven surface must have been left, on which a deposit of gravel was laid. This surface in places reached the floor of the basin of the dock, but generally was above it. About half-way across the dock the surface of the Bracklesham bed rose rapidly several feet, as though it had been left as a low riverside bank or slope. This was most apparent close to the west wall. A dotted line represents approximately the position of this slope (see Figs. 1, 3).

At the south side of the excavation there was evidence of erosion in the shape of certain Bracklesham fossils, such as *Cardita*, *Pectunculus*, *Turritella*, etc., included within the matrices of the drift period, with fragments of gravel within, and with coarse flint sand cemented to their surface by iron oxide.

Below and above the gravel there were irregular patches of glauconitic sand, some of it showing false bedding. The black grains were larger than those found in any bed of the Bracklesham series exposed. Much of the surface of the Bracklesham was re-deposited, in places containing scattered gravel.

The gravel lay chiefly as a sheet or terrace on the east side of the peat (*infra*). By the slope above described it was to some extent divided into two terraces. The lower of these was the thicker, 10 feet of gravel being found at No. 5, while to the north it did not exceed four feet (8, 9, 10). The surface showed a gentle inclination to the south, so that at the N.W. corner it rose much higher than against the south wall. At the slope it dipped rapidly for a few yards.

The gravel consisted of subangular flint in a coarse sandy matrix, brown and ferruginous. In places a considerable admixture of black flint pebbles derived from the Eocene beds were included, and a few blocks of greywether sand-

stone. The colour of a portion of the matrix of the gravel was a rather bright green, especially immediately below the peat, and in some places the gravel was dark coloured.

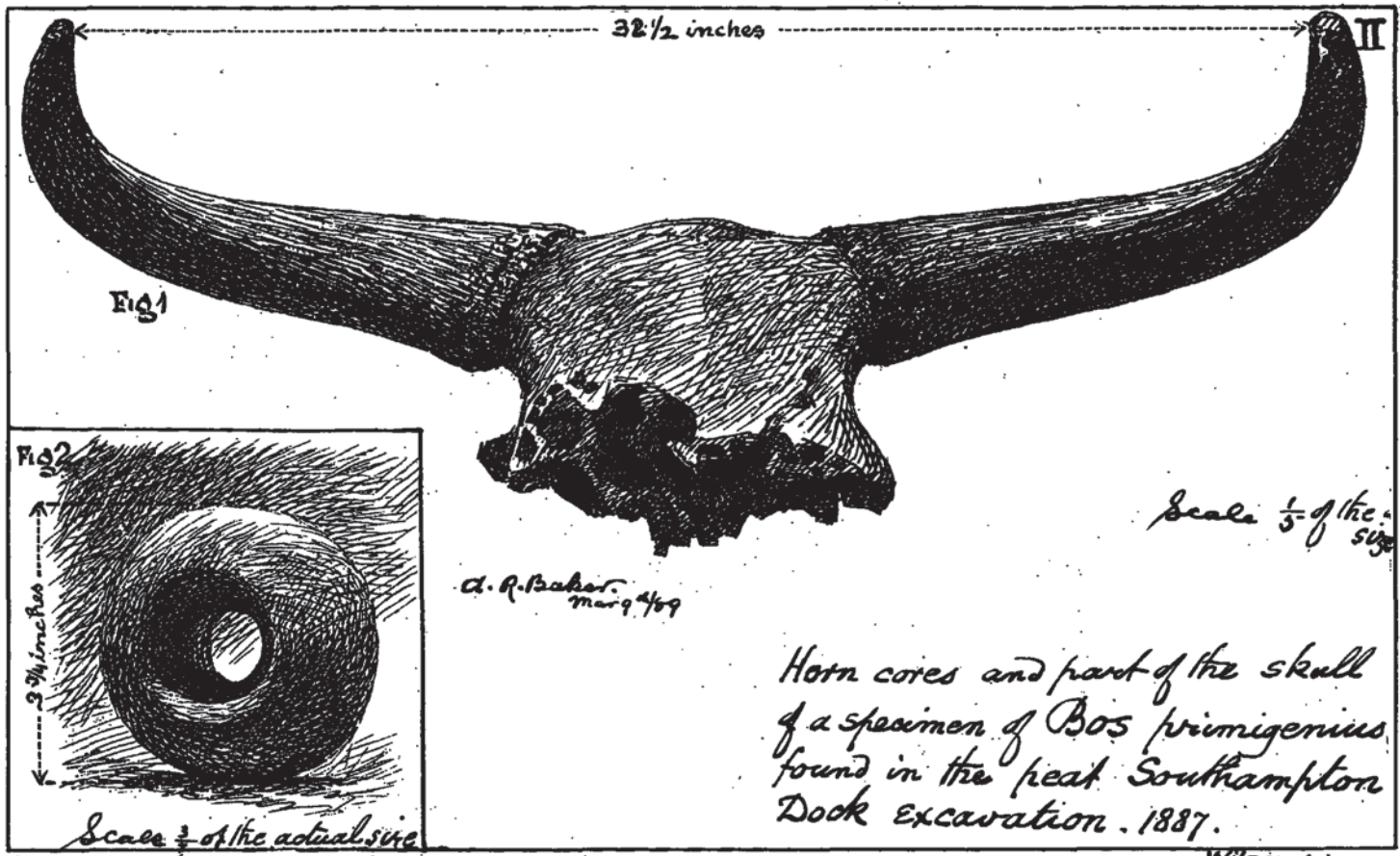
A few chalk flint fossils were found in the gravel. No mammalian remains or palæolithic implements have been noticed, although both have occurred near the town on higher gravel terraces, and teeth of the mammoth have been obtained from the equivalent bed of gravel on the opposite side of the River Itchen.

A portion of the gravel was overlaid by an alluvial clay, without any intervening peat; four to six feet of it is also recorded on the dock extension section, overlying the peat.

#### PEAT AND SHELL MARL.

The gravel on the west side of the basin having been laid, the channel of the Itchen, at a slightly later period, occupied the east side of the area, the river further eroding the Bracklesham beds to a slight extent, so that on that side they do not reach the level of the dock floor. The gravel was left to the west of this with a sloping edge (see Fig. 4), and against this the peat and shell marl, the marsh beds of the river, accumulated, until the channel east of the gravel was filled, and the gravel itself overlapped to a considerable extent, though on the north western side the mud lay on it without peat intervening. The thick peat lay on the Bracklesham beds in places, but 2-ft. to 4-ft. of gravel occurred beneath it along the east wall, Fig. 1 (1, 2, 11, 12, 13,) and along the dock extension 5-ft. to 8-ft, evidence perhaps of another terrace nearer the present river channel.

When the excavation had proceeded to a nearly uniform depth of from twelve to fifteen feet over the area, the line of the deep peat on the Itchen side of the works and east of the gravel terrace presented a very marked feature, the dark colour of the peat extending in a line, running about north east by north from the southern embankment, presenting a marked contrast to the clean washed surface of the terrace of flint gravel on the Test side of the works (see plan). This line of deep peat which extends into the estuary in a direction towards the junction of the river channels, appears to mark



Horn cores and part of the skull  
 of a specimen of *Bos primigenius*  
 found in the peat Southampton  
 Dock excavation. 1887.

the old river line of the Itchen, which apparently had a deeper channel than the Test, a feature it exhibits at the present day.

The peat contained within it a great quantity of land and freshwater shell marl, or tufa as it is sometimes called, which occurred partly in layers between the beds of peat, and partly in large pockets, from a few inches to four or five feet in thickness; these masses in some instances had a section of twenty yards from side to side, and from two to six feet in depth. This tufa consisted of loose calcareous matter, of small calcareous concretions around shells and vegetable matter, and a great abundance of the shells of land and freshwater mollusca, a complete list of which will be found in the paper by Mr. J. T. Kemp, M.A., published in the present number of the proceedings. The shells occur in various conditions; the greater part of them are white from loss of animal matter, while others are encased in calcareous concretions; a few have a residue of the epidermis (*Clausilia*, *Pisidium*, etc.), and some are stained of an indigo blue tint.

The peat contained much oak, some large trunks *in situ*, lying as they fell, with roots passing down into loam beneath. The largest trees observed were chiefly towards the Itchen side of the excavation. At the south-east part of the excavation such roots of trees were found in peat six feet thick, roots two feet in length passing into the loam. There were also abundant remains of the beech and hazel, and some remains of the birch and pine, mostly in a pulpy condition. The hazel nuts and fir cones were however well preserved. Other plants found in the peat, but much decomposed, were the bulrush (*Scirpus lacustris*), the common sedge (*Carex*), the bog myrtle (*Myrica, gale*), heaths, and the bracken fern (*Pteris aquilina*).

In excavating the deep trench for the dock wall on the north side, a fine specimen of the horn cores and part of the skull of *Bos primigenius* (Plan II, Fig. 1) was found, about twenty feet below the surface of the mud. This specimen, which has been placed in the museum of the Hartley Institution, was described in a communication to the Geological Magazine, by Mr. Shore, in November, 1887. Another single horn core of the same species, an inch and a half

longer than the specimen described, was also found. A large number of bones, apparently of *Bos primigenius*, including mandibles, or lower jaw bones, parts of frontal bones, many vertebræ, femurs, tibia, ossa innominata, canon bones, scapulae, rib bones, &c., have also been found and are preserved in the same museum. The other mammal remains found in this peat comprise the upper part of a skull, a considerable number of the horns of the red deer (*Cervus Elaphus*), and some mandibles and other bones of the same animal. The previous excavation for the Dock Extension wall, made some years ago, brought to light several bones of a small variety of horse, which may be similar to the indigenous New Forest pony of the present day. We also obtained from the peat the tusk of a boar and some bones of the hare, and a horn of reindeer has been found. Some of these mammal remains Mr. Shore saw removed from their positions, and on one occasion he was fortunate enough to be on the spot when what remained of an entire specimen of *Bos* was removed, the bones lying all together in the peat.

We hear every winter in Hampshire of the loss of the New Forest ponies and cattle in the deep forest bogs during wet periods, and such losses appear to explain the occurrence of animal remains in such old growths as that brought to light in the Southampton Dock excavation.

We have also found some remains of Neolithic man during the progress of this excavation. These consist partly of dark coloured flint flakes imbedded in the peat. In one instance a number of such flint chips were found all within a few feet of each other, as if a Neolithic flint worker had here fashioned his flint implement, which he was careful to take away. The position in which these flakes were found was on a site now occupied by the south-west part of the dock wall, and at a considerable distance from the old shore line. A very fine specimen of a round hammer stone (Plate II, Fig. 2), was also found near the bottom of the peat, twenty feet below the surface of the mud. This hammer stone, when brought to Mr. Shore, had adhering to it some of the peaty tufaceous material, in a pocket of which it was found. It is  $\frac{3}{4}$ -inch in diameter, with a beautifully worked circular hole,  $1\frac{1}{4}$ -ins. in diameter at the sides, and  $\frac{2}{3}$ ths of an inch diameter in the

middle. It weighs 1-lb. 9-ozs., and is made of fine grey, wether sandstone. This round hammer stone is larger than that found at Stifford, and engraved in Dr. J. Evans's work on Ancient Stone Implements. A very fine bone needle polished by use was also found in the peat.

The age of deposition of the gravel terrace and the associated peat and tufa was probably much the same as that of the great flat plains of the Itchen and Test around Bishopstoke and Romsey, which there appear at the surface, as the depression under the water of the estuary and its mud deposits, to which the drift beds of these rivers are gradually being subjected, has not reached these localities. Off Netley gravel and peat occur in similar position under the estuarine mud which has slowly encroached from the Solent.

The best examples of tufa sheets are still further up the river valleys, ten to twenty miles above Southampton, between the chalk hills, as at Twyford and Mottisfont.

#### THE ESTUARINE MUD.

The latest deposit, the first encountered in the work of excavation, was the mud of the tidal estuary, which has laid upon the river valley deposits a bed of blue clay as yet unconsolidated, containing shells which have not yet lost their animal matter. The thickness of the mud varied from five feet at the north-west corner (Fig. I, 7, 8, 9) to 17 feet at the east and south (Fig. I, 1, 2, 3, 10, 11, 12). Dock dredgings from the old basins having been emptied hereabouts, the mud is thicker in places than the original deposit. This stage commenced by a re-arrangement of some of the gravel to form a beach, including littoral shells. The mud contained masses of a small oyster in ill preserved condition, a relic of the former extensive oyster fisheries.

The fauna of the mud is similar to that of the numerous mud harbours on the south coast of Hants, mollusca, polyzoon, and foraminifer. There is evidence in it of the influence of more open water than that of the highest reaches of these estuaries; certain of the shells abound in slightly deeper waters, such as *Pecten varius*, *Nucula nucleus*, and *Cardium exiguum*.

Part of an amphora of Roman type was found in the mud.

## FAUNA OF MUD.

## LAMELLIBRANCHIA.

<i>Ostrea edulis</i> ,	<i>Linn.</i>
<i>Pecten varius</i> ,	<i>Linn.</i>
<i>Mytilus edulis</i> ,	<i>Linn.</i>
<i>Modiolaria discors</i> ,	<i>Linn.</i>
<i>Nucula nucleus</i> ,	<i>Linn.</i>
<i>Cardium edule</i> ,	<i>Linn.</i>
<i>C. exiguum</i> ,	<i>Gmel.</i>
<i>Loripes leucoma</i> ,	<i>Turton.</i>
<i>Lucina borealis</i> ,	<i>Linn.</i>
<i>Tapes decussata</i> ,	<i>Linn.</i>
<i>T. aurea</i> ,	<i>Gmel.</i>
<i>Tellina Balthica</i> ,	<i>Linn.</i>
<i>Scrobicularia piperata</i> ,	<i>Gmel.</i>
<i>Abra alba</i> ,	<i>W. Wood.</i>
<i>Mactra subtruncata</i> ,	<i>Dá Costa.</i>

## GASTEROPODA.

<i>Murex erinaceus</i> ,	<i>Linn.</i>
<i>Buccinum undatum</i> ,	<i>Linn.</i>
and var. <i>accuminatum</i> ,	<i>Brod.</i>

## GASTEROPODA.

<i>Nassa reticulata</i> , 2 vars.,	<i>Linn.</i>
<i>Purpura lapillus</i> ,	<i>Linn.</i>
<i>Odostomia unidentata</i> ,	<i>Mont.</i>
<i>Chemnitzia</i>	
<i>Rissoa membranacea</i> ,	<i>J. Adams.</i>
<i>R. striata</i> ,	<i>Mont.</i>
<i>R. albella</i> ,	<i>Lovén.</i>
<i>Littorina littorea</i> ,	<i>Linn.</i>
<i>L. rudis</i> ,	<i>Maton. var.</i>
<i>L. littoralis</i> ,	<i>Linn.</i>
<i>Lacuna puteolus</i> ,	<i>Turton.</i>
<i>L. divaricata</i> ,	<i>Fabr.</i>
<i>Phasianella pullus</i> ,	<i>Linn.</i>
<i>Trochus cinerarius</i> ,	<i>Linn.</i>
<i>T. magus</i> ,	<i>Linn.</i>
<i>Neritina fluviatilis</i> ,	<i>Linn.</i>
<i>Haminea hydatis</i> ,	<i>Linn.</i>
<i>Utriculus obtusus</i> ,	<i>Mont.</i>
<i>Polyzoa</i> , 1 species.	
<i>Foraminifera</i> , 1 species.	

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