ORDINARY MEETING, MARCH 1ST, 1878.

Professor MORRIS, F.G.S., President, in the Chair.

The following Donations were announced :—

"Quarterly Journal of the Geological Society of London," Vol. xxxiv., Pt. 1, No. 133; from that Society.

"Abstracts of the Proceedings of the Geological Society of London," Nos. 346 and 348; from that Society.

"Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire," N.S., Pt. iv., 1877; from that Society.

"Journal of the Society of Arts," Nos. 1316-9; from that Society.

"Thirlmere Defence Association—Manchester and Thirlmere Water Scheme;" from B. B. Woodward, Esq.

The following were elected Members of the Association :—

C. N. Octavius Curtis, Esq.; Joseph Gundry, Esq.; Thomas McKenny Hughes, Esq., M.A., F.S.A., F.G.S., Woodwardian Professor of Geology, University of Cambridge; D. L. Lawson, Esq., M.A.

The following Papers were read :—

1. ON THE NEW TOWN WELL AT SHEERNESS.

By WILLIAM H. SHRUBSOLE, Esq.

(*Abstract.*)

A well of a greater depth than any other in the Isle of Sheppey having been recently sunk to obtain a larger water supply for Sheerness, the author brought before the Association the geological facts recorded, during the progress of the work, by himself and his friend Mr. Boughey.

After breaking the surface, and getting through three feet of made ground, dark blue to black mud was met with down to 47 feet, passing at 30 feet a layer of peat, just below which were roots of grasses and aquatic plants. At 47 feet, a band of flints, bedded in pale-brown, almost yellow loam, rested on the London Clay at 48 feet. Light-brown at first, and then streaked

with blue, at 67 feet the clay was of a pale blue tint, changing to a warm-brown on exposure. It continued of uniform close fine texture and appearance down to 157 feet. Some of the septarian nodules found on the way had a quantity of water in the internal crevices, although the clay around them was quite dry, as indeed was the case right through. At 157 feet the clay, still of the same colour, began to come up in very large blocks, and the fossils found were flattened as if by pressure.

To connect the two wells, a heading was begun at 200 feet. Here a sub-angular fragment of white-coated flint, and a well-rolled chalk pebble were met with. At this depth *Nodosaria costata* was found. After careful washing, by means of an elaborate process, which was described in detail, a cart load of clay was thoroughly examined by the author. This clay was selected from all that was excavated from a shaft 7 feet in diameter by 335 feet deep. From the heading at 200 feet down to 280 feet, the washings yielded 60 species of Foraminifera, particulars of which are appended.

At 220 feet the clay came up much more shaly and brittle, broken up in conchoidal wedges. Two feet further down, evidence of disturbance was met with for the first time. The clay was polished and striated on every surface, wherever broken. All the lines of bedding were thus polished. In some of the joints it was broken up into very small cubical splinters, all of which presented the same appearance.

At 230 feet from surface, the clay had changed to a grey slate colour, and was deficient in the feeling of greasiness that had characterised it previously. Here was found a seed corresponding to Bowerbank's *Leguminosites*. On splitting open the clod containing this seed, the outer integument burst open and peeled off before it had been one minute exposed to atmospheric influences. It may be noted that apart from exogenous wood in various conditions, and another seed found by Mr. Boughey, no other representative of the vegetable kingdom was met with. The almost entire absence of fruits, and the complete absence of those of endogenous trees in such a large excavation as this, where other fossil remains were found in considerable number and variety, demands further consideration.*

* Close by, the Sheppey cliffs exhibit, for a length of six miles, a section of the upper 150 feet of the London Clay. There, on the beach, with other

A marly character was observed at 240 feet, and the clay became gradually harder and darker in colour down to 280 feet. Here perfect specimens of Foraminifera were lost sight of, but chalky patches and seams, sometimes nearly an inch thick, attested their former plentiful existence. Occasionally the outline of a specimen was sufficiently preserved to admit of identification. This continued down to 335 feet, when a greenish tint and a little intermingled sand betokened nearness to the bottom of the clay. It should be mentioned that at and below 293 feet the clay was studded with very minute discs of iron pyrites, each having a boss in the centre, and the edge slightly turned up all round. They were uniformly perfect, as much so as if cast in one mould. At this stage the workmen returned to the unfinished heading, at 200 feet. The difference in the clay was strikingly apparent. The changes downward had been gently graduated; here clay of lighter tint suddenly recurred, softer, moister, and much greasier than that left at 335 feet. Forams were found again throughout this heading; most abundantly about half-way through.

After completing the communication between the two wells, the workmen commenced boring from the bottom of the shaft. The clay became more sandy till the bottom was reached at 338 feet. Here a hard crust of greenish sand was encountered, and the chisel had to be brought into use, proving clearly that the Lon-

things are found, to the extent of several hundreds weekly, fruits of many genera, *Nipadites* being much more plentiful than any other fossil, either of vegetable or animal origin. As Prof. Prestwich tells us there is evidence to prove that the condition of animal life was similar at the end to that which existed at the commencement of the London Clay period, it might also be expected that indications of equal uniformity in the vegetable kingdom would be found. The entire absence of *Nipadites* and other endogenous fruits was rather surprising, and led to the enquiry if any had been found where sections of the lower part of the London Clay have been exposed.

Between Herne Bay and Oldhaven Gap, where the cliffs present a large section of the lowest part of the London Clay, cones, named by Bowerbank *Pterophiloides*, which in Sheppey are extremely rare, have been at times found in large numbers; the author is not aware that endogenous fruits have been met with there or elsewhere at the same horizon. The question arises whether or not this evidence that conifers flourished at the beginning, and palms at or near the close of the London Clay period, indicates climatic variations of considerable range?

Although Sir Charles Lyell states that it is in the uppermost 50 feet of the Sheppey cliffs that the fruits are chiefly found, the author is unable, after nearly 30 years acquaintance with these cliffs, to find any reason why 50 feet should have been assigned as the limit. Having found them *in situ* at the base oftener than higher up, he submits that the 50 should be enlarged to 150 feet, which may be taken as the average height of the cliffs.

don Clay had been left behind. The green colour of the clay near the junction is due to chloritic grains.

Of the mineral substances found in the clay, the most abundant were the well-known septarian nodules, which on being burnt and ground produce Roman-cement. Some, as has been elsewhere noticed, contained water, which flowed out on the crust being cracked. There were also concretions that the workmen called "clay-stones." These generally had a very hard core, and a nucleus of organic origin could often be made out. A problem to be solved in connection with these is the hardening of the clay upon and around them in concentric layers. There were also a few angular fragments of flints, and two or three pebbles, also one or two pebbles of chalk. Neither iron pyrites nor selenite was so plentiful as was expected. The Molluscan and other organic remains are not pyritized to the same extent as those from the higher level, and many are not impregnated with iron at all. Indeed, the cliff specimens are no longer shells, but pseudo-morphs in pyrites. The shells from the well, on the contrary, are comparatively unaltered. Another point of difference is that where the shell has decayed since being exposed, a cast in clay—not pyrites—is presented. These facts show that pyrites was by no means abundant at the well sunk.

Almost without an exception, the shark's teeth, that are most abundant in the cliffs, have the fangs perfect, while the few teeth met with in the London Clay of the well were in every case without fangs, and the crown of the tooth was hollow.

The Lower London Tertiaries were marked by continual alternations of sandy loam, and loamy sand of various tints. There were few fossils. In the Woolwich and Reading Beds were *Cyprina planata* and teeth of *Lamna*, and these were all. The variations observable in the sections of the Dockyard and Garrison wells are very peculiar, and seem to point to great irregularities in bedding.

Keeping to the new Town Well, at 500 feet, two feet of the usual green-coated flints, bedded in clay, were met with, and at 502 feet Chalk was reached for the first time in Sheppey. At 750 feet a fissure was reached which promises to yield a most abundant supply of water. The boring was afterwards continued to 805 feet, but the last 30 feet was in a kind of Chalk-marl where there was little prospect of finding more water. This marly chalk was very tenacious, and on being washed yielded

a considerable proportion of sand. When the pumps are at rest the water now stands in the two connected wells at 85 feet from surface. The water level in the 1862 well at first was 37 feet. It fell by slow degrees to 100 feet, till the influx from the new well raised it to 85 feet.

In the determination of the fossils the Author had the valuable help of Messrs. Etheridge and E. T. Newton, of the Geological Survey; Mr. J. Siddall, of the Chester Natural Science Society; and the Rev. J. F. Blake, M.A.

LIST OF FOSSILS FOUND IN THE LONDON CLAY.

PISCES.

- Teeth of *Lamna elegans*.
- Scales, ear-bones, and vertebrae of fish.

CEPHALOPODA.

Nautilus.

GASTEROPODA.

- † *Buccinum labiatum*.
- * *Dentalium acuticosta*.
- Fusus bifasciatus*.
- „ *sp.*
- Natica*.
- Phorus extensus*.
- Turritella*.
- Voluta Wetherelli*.

LAMELLIBRANCHIATA.

- * *Arca* sp. allied to *A. impolita*,
- Avicula papyracea*.
- Corbula*.
- * *Cryptodon angulatum*.
- „ *Goodhallii*.
- Leda amygdaloides*.
- * „ *prisca*.
- Nucula Bowerbankii*.
- † „ *striata*.
- † *Ostrea edulina* (young).
- * *Pecten duplicatus*.
- † *Plicatula* (fragment.)
- Syndosmya splendens*.
- † *Tellina* sp. Probably an undescribed species.
- Teredo antenautæ*.

BRACHIOPODA.

- * *Lingula tenuis*.
- Terebratulina striatula*.

POLYZOA.

- † *Flustra* sp. allied to *F. pertusa*.
- † *Idmonea* sp. allied to *fenestrata*.
- † *Lepralia*, new ? similar to *puncturata* or to *maceocheila* (Reuss).

CRUSTACEA.

- Archæocarabus Bowerbankii*
- * *Bairdia subdeltoidea* ?
- * *Cythereis Bowerbankiana*.
- * *Cytherella compressa*.
- * *Cythere scrobiculostrata*.
- * *Cytheridea perforata*.
- Hoploparia Bellii*.

ANNELIDA.

- * *Ditrupa plana*.
- * „ *sp.*
- * *Serpula*.
- † *Spirorbis* sp.

ECHINODERMATA.

- Astropecten*.
- * *Cainocrinus tintinnabulum*.
- Arms and pinnulæ of crinoids.
- Marginal plates of *Goniaster Stokesii*.
- Pentacrinus sub-basaltiformis*.
- Fragments and plates.

ACTINOZOA.

- Graphularia Wetherellii*.

PLANTÆ.

- Leguminosites* (one specimen);

FORAMINIFERA.

† <i>Cornuspira involvens</i> ; exceedingly rare.	* <i>Cristellaria Italica</i> ; abundant.
† <i>Triloculina trigonula</i> ; rare.	* „ <i>rotulata</i> ; abundant.
† <i>Quinqueloculina seminulum</i> ; rare.	* „ <i>crepidula</i> ; very rare.
† „ <i>Ferussacii</i> ; rare.	† <i>Uvigerina pygmaea</i> ; very common.
† „ <i>secans</i> ; rare.	† <i>Bulimina pyrula</i> ; frequent.
† „ <i>bicornis</i> ; very rare.	† „ <i>pupoides</i> ; frequent.
† „ <i>agglutinans</i> ; very rare.	† „ <i>variabilis</i> ; rare.
† <i>Spiroloculina excavata</i> ; exceedingly rare.	† <i>Virgulina squamosa</i> ; exceedingly rare.
† <i>Spiroloculina planulata</i> ; rare.	† <i>Textularia variabilis</i> ; rare.
* <i>Trochammina inserta</i> ; rare.	† „ <i>saggitula</i> ; frequent.
† <i>Lagena marginata</i> ; frequent.	† „ <i>difformis</i> ; frequent.
† „ <i>sulcata</i> ; rare.	* „ <i>agglutinans</i> ; common.
† „ <i>globosa</i> ; rare.	† <i>Bigenerina nodosaria</i> ; abundant.
† „ <i>melo</i> ; very rare.	† <i>Verneuilina Muensteri</i> ; frequent.
† „ <i>striata</i> ; very rare.	† <i>Gaudryina muensteri</i> ; frequent.
† „ <i>lævis</i> ; very rare.	† <i>Orbulina universa</i> ; rare.
† „ <i>aspera</i> ; very rare.	* <i>Globigerina bulloides</i> ; frequent.
† <i>Glandulina glans</i> ; exceedingly rare.	† <i>Nonionina umbilicata</i> ; frequent.
† <i>Nodosaria radícula</i> ; frequent.	† „ <i>communis</i> ; exceedingly rare.
† „ <i>adolphina</i> ; common.	† <i>Discorbina rosacea</i> ; common.
* „ <i>raphanus</i> ; abundant.	† „ <i>globularis</i> ; rare.
† „ <i>longisecta</i> ; frequent.	* <i>Planorbulina Ungeriana</i> ; common.
* „ <i>ovicula</i> ; frequent.	* „ <i>ammonoides</i> ; common.
* „ <i>pyrula</i> ; frequent.	* „ <i>Haidengerii</i> ; common.
† „ <i>scalaris</i> ; exceedingly rare.	* <i>Truncatulina lobatula</i> ; frequent.
† „ <i>hispida</i> ; exceedingly rare.	† <i>Rotalia Soldanii</i> ; frequent.
* <i>Dentalina pauperata</i> ; common.	† „ <i>Beccarii</i> ; frequent.
† „ <i>obliqua</i> ; frequent.	† <i>Cymbalopora Poyei</i> ; exceedingly rare.
† <i>Vaginulina legumen</i> ; rare.	† <i>Polystomella striata punctata</i> ; exceedingly rare.
* <i>Marginulina Wetherelli</i> ; very abundant	
† „ <i>glabra</i> ; very rare.	

* New to Sheppey 30

† „ „ London Clay 54

Sheppey species previously known ... 25

Total of species found... .. 109

Pisces	... 2	Gasteropoda	... 8
Cephalopoda	... 1	Lamellibranchiata	... 15

Brachiopoda	... 2	Echinodermata	... 5
Polyzoa	... 3	Actinozoa	... 1
Crustacea	... 7	Foraminifera	... 60
Annelida	... 4	Plantæ	... 1

OF THE FORAMINIFERA.

9 species were exceedingly rare.	7 species common.
8 „ very rare.	1 „ very common.
13 „ rare.	1 „ very abundant.
17 „ frequent.	4 „ abundant.

Nodosaria costata was the first species seen. *Trochammina incerta* was very rare at first, but lower down many solitary individuals were found, after perfect specimens of other species had been lost sight of. *Marginulina Wetherelli* was by far the most abundant.

Copy of Report on New Well, 1876-77-78, supplied to Sheerness Board of Health, by Mr. T. Tilley :—

FEET.	DESCRIPTION OF STRATA.							FEET.
3 0	Made ground	...	...	...	...	...	...	3 0
12 8	Blue soft mud	...	...	...	...	...	...	9 8
15 8	Black soft mud, with vein of sand on top	...	...	...	...	...	...	3 0
44 0	Blue soft mud	...	...	...	...	...	...	28 4
46 0	Black peaty mud and water	...	...	...	...	...	...	2 0
47 0	Light yellow clay and flints	...	...	...	...	...	...	1 0
70 0	Dull red clay	...	...	...	...	...	...	23 0
273 0	Blue London Clay, with <i>Septaria</i>	...	...	...	...	...	...	203 0
338 0	Dark-blue London Clay, with pyrites and wood	...	...	...	...	...	...	65 0
346 0	Green sandy rock with very little water	...	...	...	...	...	...	8 0
354 0	Grey sandy rock, with fossils and little water	...	...	...	...	...	...	8 0
359 0	Dark sandy crusty rock, with pebbles	...	...	...	...	...	...	5 0
362 0	Dark clay, with lignite on top	...	...	...	...	...	...	3 0
364 0	Reddish sand, with a little water	...	...	...	...	...	...	2 0
369 0	Hard red sand-rock, with veins of pyrites and a little water	...	...	...	...	...	...	5 0
370 0	Very light sand-rock, with a little water	...	...	...	...	...	...	1 0
372 0	Dry sandy loam	...	...	...	...	...	...	2 0
383 0	Greenish sand, pebbles and pyrites	...	...	...	...	...	...	11 0
385 0	Very hard, tough, dark-green clay	...	...	...	...	...	...	2 0
395 0	Grey sand, with pyrites and beds of sand-rock. Good spring of water which rose to height of 160 feet from surface while pumping was going on...	...	...	...	...	...	...	10 0

FEET.							FEET.
400	0	Green sandy loam	...	...	...	...	5 0
412	0	„ with shelly rock, pebbles and some					
		water	...	...	...	...	12 0
425	0	Grey loamy sand, rotten shells and fish teeth	...				13 0
440	0	Loamy sand and rotten shells	...	...	...	...	15 0
443	0	„ and pyrites, and vein of sand with water					3 0
448	0	„ and rotten shells	...	...	...	...	5 0
470	0	Sandy clay and sand stones	...	...	...	...	22 0
471	6	Dark-green sandy clay	...	...	...	...	1 6
502	0	Brown sandy clay, the last two feet being flints					
		bedded in clay	...	...	...	...	30 6
503	0	Flints and Chalk	...	...	...	...	1 0
553	0	Chalk rubble, with dirty vein or pot-hole	...	...	...	...	50 0
670	0	White solid Chalk with flints; a little water at 670 feet					117 0
715	0	„ „ no water	...	...	...	...	45 0
728	0	„ „ „ „	...	...	...	...	13 0
738	0	Yellow gritty Chalk, with flints. At 738 feet water					
		rose over the bore pipe to 100 feet from surface,					
		and flowed for two hours while the pumps were					
		going	...	...	...	...	10 0
750	0	Chalk with flints, and fissures with good supply of					
		water	...	...	...	...	12 0
770	0	White Chalk with flints	...	...	...	...	20 0
773	0	Small fissure in Chalk, with flints and a little water...					3 0
805	0	Hard, dull, sticky Chalk, apparently leading to Grey					
		Chalk, from which no water is to be expected	...				32 0
							<hr/>
							805 0

2. ON SOME RECENT DISCOVERIES AMONG THE SPONGIDÆ— LIVING AND FOSSIL.

By W. J. SOLLAS, Esq., B.A., F.G.S.

(*Paper Deferred.*)