colour. It has been formed by bottom currents, and has every appearance of a sand that was at one time filled with shells which have been dissolved away by acidulated water. It is, in fact, what is known as a "rotten sand."

At page 14 of the report it is stated that spines of *Echinus* and *Spatangus* were obtained in No. 6 bore at a depth of 21 to 24 feet, in hard-bound sand. This may have been the same bed as the above.

The top bed is *sandy* Boulder-clay and stones, of the great thickness of 43 feet, and I take it to be a ground moraine¹ of the second glaciation.²

I have now only to add that when the glacial deposits (drift formation) receive a closer examination than has hitherto been given to them, many more proofs of their marine origin will, I think, be forthcoming. The most accessible exposures are the scours of drift along the stream courses, and I seldom return from a day's examination of them without finding additional proofs of the *whole drift formation* having been deposited in the sea.

X.—NOTES ON THE GLOBIGERINA LIMESTONES OF THE MALTESE ISLANDS.

By JOHN H. COOKE, F.G.S.

THE *Globigerina* Limestones of the Maltese Islands consist of a series of beds of varying character, the upper portions of which belong to the Lower Langhian, while the lower are referred to the Upper Aquitanian. The formation extends throughout both islands, but in the north-western and western portions it is masked by overlying beds of clays, greensands, and limestones, of Tortonian and of Helvetian age.

The Maltese Langhian may be divided, lithologically, into two well-marked sub-series—the upper, which includes the "Marls and Clays," and extends from the base of the Greensands to the top of the *Globigerina* Limestones; and the lower portion, which includes the beds A to F of the "*Globigerina*" series. Palæontologically both divisions agree closely, and contain such characteristic Langhian forms as *Aturia aturii* and *Pecten denudatus*. The palæontological analogies of the two groups are shown in the synoptical table of fossils at the end of this paper. The total thickness of the formation ranges from 150 feet to 250 feet.

Regarded vertically the following tabular summary gives the serial order and the thicknesses of the subdivisions.

¹ From what I have since seen in Ayrshire I have been obliged to abandon the idea that the Boulder-clays are *ground moraines* pure and simple. I think there is ample proof that they are *marine deposits*. In places where they have been *dragged* a bit by the last glacier-ice they become ground moraines.

² It is not here argued, of course, that during the period between the two Boulder-clays the country was entirely free from ice.

THE GLOBIGERINA LIMESTONES.				
Sub-division.	Lithology.	Thickness	Series.	Equivalents in Vienna Basin.
A	A ferruginous, argillaceous freestone.	15 to 30 ft.	Langhian.	↑ Homer Schichten
B	First seam of phosphatic nodules.	1 foot.		
C	A fine-grained, bluish freestone.	30 to 50 ft.		
D	Second seam of phosphatic nodules, with smaller seams above and below locally developed.	1 to 2 ft.		
E	Fine-grained limestone, with several bands of phosphatic nodules locally developed.	35 to 50 ft.	Aquitanian.	↓ Solszka-Schichten
F	A massive, compact limestone, with chert nodules.	30 to 50 ft.		
G	Third nodule seam.	1 to 2 ft.		
H	A variously textured limestone, with phosphatic nodules sparsely distributed.	50 to 80 ft.		
I	Fourth seam of phosphatic nodules.	2 to 4 ft.		

Bed A.—The “Marls and Clays” that overlie this formation graduate downwards into a close-textured, fine-grained freestone, the upper portion of which contains from 25 to 30 per cent. of alumina, but towards the lower part this percentage decreases until the ratio of alumina to calcium carbonate is as 1 to 9. The bed is variously coloured, the upper layers being generally of a bluish-grey, and the lower part of a light-yellow or yellowish-ashen colour. Iron pyrites abound, and it is to the decomposition of these that the tinctorial variations are due. Organic remains are plentiful, but as a rule they are so pseudomorphed with either peroxide or phosphate of iron, as to be barely recognizable. The carbonate of lime, of which the shells were originally composed, has been wholly or partially replaced by carbonate of iron, and this, by subsequent oxidation, has been converted into a hydrous peroxide. The pyritized condition of the fossils is a feature of this bed. The most prevalent and characteristic forms are *Aturia aturii*, *Pecten Kokeni*, *Pecten denudatus*, *Chenopus pes-pellicani*, *Dolichotoma cataphracta*, *Nuculana fragilis*, and *Marginella Deshayesi*. Many forms of the Gorgonidæ,¹ e.g. *Isis Peloritana*, *I. Melitensis*, and *I. compressa*; the claws and carapaces of *Cancer macrocephalus*; and the tests of pteropods, chiefly *Vaginella* and *Hyalæ*, invested in thin metallic-iron coverings, are also numerous.

The *Scalariæ*,² which make their first appearance in division F, and are continued in the successive beds up to the “Marls and Clays,” are here represented by the minute form *S. Melitensis*, Fuchs.

¹ For the determination of the Gorgonidæ I am indebted to Professor Angelli, Università di Roma.

² Mr. G. F. Harris, F.G.S., kindly determined the *Scalariæ*

Of the Echinodermata, *Echinocyamus Studeri*, *Echinolampas Manzoni*, *Hemiaster vadosus*, *Sarsella anteroalto*, and *Schizaster Parkinsoni*, are found here and in the underlying divisions B, C, and D.

At this horizon lignite is of common occurrence. Mr. N. Tagliaferro described a piece, in the pages of the *Mediterranean Naturalist* for June, 1893, that measured 11 ins. $\times$ 4 ins. $\times$ 1 in., and which a microscopical examination showed to be the outer layer of a tree-trunk.

Division B: the first nodule seam.—A seam of phosphatic nodules forms the base of the limestones of division A. The cliff exposures along the southern shores of Malta show this seam to average about 9 inches in thickness, and the nodules are small and sparsely distributed. But in the hill escarpments of Emtarfa, Wardia, Boschetto, and Hemsia it averages 15 inches, and the nodules are large, numerous, and compactly cemented together in a phosphatic paste. Most of the nodules and the fossils found with them are of a jet-black colour, and they have a high, metallic lustre. In composition they vary from the nodules contained in the underlying seams, being composed for the most part of phosphate of iron. Of the fossil organisms the corals are a noteworthy feature. The following species occur in abundance: *Trochocyathus laterocristatus*, *T. pyramidatus*, *Flabellum avicula*, and *F. intermedium*. All of these species have a considerable vertical range, being also found in the Tongrian of Dego, the Helvetian of Torino, of Belforte, and of Val Salice, the Tortonian of Tortona and of Stazzano, and in the Pliocene of Zinola. In the Maltese Islands they occur in the subdivisions A to I.

Division C.—This bed consists of a variously textured rock, having a reddish-yellow colour. The upper portion is coarse and susceptible to weather influences; but it merges imperceptibly into a fine-grained, compact limestone, massive and homogeneous, and with a total absence of the tendency to cleave which characterizes the coarser variety. Small concretionary masses of hæmatite and chert frequently occur, and when the rock is cut through they appear on the slabs as black or red blotches which are known locally as *suaba* or finger-marks. Thin layers of phosphatic nodules are locally developed at Fom-ir-Rieh, but they seldom extend far. The fauna of the bed is similar to that of B and D; but several fossils of note occur in it that are deserving of mention. A portion of a carapace of turtle, *Tryonx Melitensis*, Lyd., was obtained by Mr. G. Gollcher; a fragment of the symphyseal part of the slender mandible of *?Ichthyosaurus gaudensis*, Hulke, was exhumed at Marsa Forno; the greater portion of the jaws of *Tomistoma champsoides* and the remains of numerous crocodilians and whales have been obtained from this horizon by Adams and others.

The Brachiopoda are here well represented by *Terebratula caput-serpentis*, *T. minor*, and *T. Cortæ* var. *parumlobata*, De Greg.

Division D: the second nodule seam.—This bed consists of an aggregation of irregularly-shaped nodules, intermixed with enormous quantities of the phosphatized remains of molluscs, echinoderms,

crustaceans, corallines, fish, and cetaceans. It has an average thickness of about 18 inches, and it is very uniform in its general physical and chemical aspects. The interstitial cement contains about 2 per cent. of phosphoric anhydride, all of which is found in combination with iron, alumina, or lime. These nodules contain a much higher percentage of alumina and of iron than do the nodules of seam iv.

The following analysis shows the composition of the nodules of this seam:—

Carbonate of lime (CaCO_3)	...	...	...	...	...	...	40.24
Sulphate of lime (CaSO_4)	...	...	...	...	...	...	1.55
Phosphate of lime ($\text{Ca}_3 2\text{PO}_4$)	...	...	...	...	...	...	39.52
Phosphates of iron and alumina...	...	...	...	...	...	...	6.50
Residue...	...	...	...	...	...	...	12.00
							99.81

The interstitial cement is of a very soft nature and readily disintegrates. The nodules and fossils therefore drop out in considerable quantities along the bases of the valley escarpments, and, becoming incorporated with the soil, they render it highly fertile and productive. Many of the fossils are of a jet-black colour, due to the substitution of the pre-existing phosphate of lime for phosphate of iron by the decomposition of bicarbonate of iron.¹ *Pecten denudatus*, *P. Pandora*, and *P. varians* occur; *Scalaria retusa* is common; but *S. Ducei* is rare. Among the echinoderms *Brissopsis crescenticus*, *Schizaster Parkinsoni*, and *Brissus latus* are common. Pteropods and large-sized Foraminifera, chiefly *Cristellaria* and *Nodosaria*, are enormously prevalent, as well as the teeth of Telostean and other fish, and the rib-bones and vertebræ of Cetaceans.

Division E.—This bed is fully developed in nearly every portion of the two islands, and it is, therefore, the most conspicuous stratigraphical member of the series. In colour it varies from blue to a pale ashen-gray, and it has an average thickness of about 40 feet. It is traversed at different levels by two thin seams of phosphatic nodules; but though of frequent occurrence they are only locally developed. They commence and break off very abruptly. At Maddalena, near the northern extremity of the Great Fault, three of these seams are shown, the uppermost of which is very pockety and disappears in an easterly direction, while to the westward it thins out and breaks off abruptly. The remaining two may be traced for 50 yards to the east, when they, too, break off abruptly. Thin mounted sections of the rock show them to be made up almost entirely of the tests of minute foraminifera, among which *Globigerinæ* predominate. The corals and the *Scalariæ* now become very rare; and pelagic mollusca and other forms characteristic of deep waters take their place. *Terebratula sinuosa*, *Balantium*, and *Vaginella depressa* occur at this horizon. I obtained two specimens of *Aturia aturii* (British Museum Collection) from the middle of

¹ Bicarbonate of iron would be formed by the reaction of iron-oxide, and carbonic-oxide derived from decaying organic matter.

this bed; but below this, *Aturia* does not seem to occur, its place being taken by a large nautiliform cephalopod, many casts of which may be seen in the Valetta Museum.

Division F.—The rock of this division is a yellowish, soft-textured limestone, homogeneous and fine-grained, and composed for the most part of minute, thin-shelled tests of foraminifera. The formation extends throughout the islands, but it varies in thickness from 50 feet in the western parts of Gozo to 30 feet in eastern Malta. A characteristic feature of the bed is the quantity of siliceous concretions which occur in the lower parts of the formation. These concretions have already been described.¹ The upper portion of this bed is not prolific in fossils, but in the lower part, and especially in and around the pockets of phosphatic nodules, numbers are to be found in a good state of preservation. The mollusca are numerous represented: *Pecten denudatus*, *P. spinulosus*, *P. cristatus*, *Conus dubius*, *C. Russigert*, and casts of *Arca* are very common. Of the corals, the eight species that occur in the overlying beds are also found here.

The remains of cetaceans and sharks are common, and it was from this horizon that the teeth and vertebræ of *Phoca rugosidens*² were obtained. It is noteworthy that no *Scalariæ* have been found below this bed. *Cirsotrema retusa*, *C. Ducei*, and *C. pumiceum* were found above the third nodule seam, but they were rare. Another interesting fossil which seems to make its first appearance here is the pteropod *Cavolina Cookei*, Simonelli.³ Its vertical range is very limited, as it appears to be strictly confined to this horizon. The pockety phosphatic seams at Kala and Xenchia in Gozo yield it in comparative abundance. During the construction of the new dock at Burmola, numerous ribs, vertebræ, and teeth of reptiles having crocodilian affinities were discovered in this bed. A portion of a skull of *Tomistona champsoides* with teeth *in situ* and with two vertebræ imbedded by the side of it were obtained from the lower portion of the bed by the Dock engineer, and were presented by him to the Valetta University. Several large pieces of amber, of a dirty brown colour and semi-opaque, were found imbedded in the rock at the same place.

Division G: the third nodule seam.—This layer of phosphatic nodules forms a well-marked horizon in the strata of Malta and Gozo. The nodules are small, and they have a greenish lustre due to the presence of glauconite and phosphate of iron. In chemical composition they vary considerably, those portions of the seam being the richest in phosphoric acid which are the more compact and fossiliferous. The following analysis made by Mr. J. P. Walton, A.R.S.M., represents the average composition of the bed:—

¹ Cooke, J. H., "On the Flint and Chert of the Globigerina Limestones of the Maltese Islands": *Geol. Mag.*, Dec. III, Vol. X, 1893, p. 157.

² *Ibid.*, "On the occurrence of *Phoca rugosidens*, Owen, in Maltese Strata": *Geol. Mag.*, Dec. IV, Vol. II, May, 1895, p. 215.

³ Simonelli, V., "Sopra un nuovo pteropod del miocene di Malta": *Bol. del. R. Com. Geol. d'Italia*, June, 1894.

Carbonate of lime	...	...	...	...	51·70
Phosphate of lime	...	...	...	...	41·46
Peroxide of iron	...	...	...	...	1·82
Insoluble siliceous matter	...	...	...	...	3·55
Moisture, etc.	...	...	...	...	1·47
					<hr/> 100·00 <hr/>

This seam is specially interesting, as it seems to mark the line of demarcation between the Langhian and the Aquitanian series. It is not so fossiliferous as the other phosphate seams. *Pecten denudatus* and *Aturia aturii*, which are so characteristic of and prevalent in the overlying beds, are neither found here nor in any of the strata beneath. Teeth and bones of *Phoca rugosidens*, Owen, were obtained from this horizon in the neighbourhood of Marsa Forno, Gozo. *Pentacrinus Gastaldi*, *Scalpellum Melitensis*, *Trochocyathus latero-cristatus*, *T. pyramidatus*, *T. vericostatus*, several species of *Flabellum*, and *Stephanocyathus*,¹ are very abundant.

Division H.—This bed of limestone constitutes a considerable bulk of the series that represent the Maltese Aquitanian. It varies from 50 to 80 feet in thickness, and it crops out in every valley and cliff in the two islands. The general character of the bed is that of a yellowish-grey limestone. Sections of the rock under the microscope show it to be made up almost entirely of the calcareous skeletons of foraminifera, among which those of the Globigerinæ, Textulariæ, Uvigerinæ, and Orbulinæ are the most numerous. Minute grains of glauconite, granules of oxide of iron, and curiously-formed nodular masses of manganese having radiating arms of the same mineral, are also abundant.

Coccoliths and rhabdoliths are also present, and like those contained in the *Pietra Leccese* and in the Sicilian rocks (Ragusa) they are of forms similar to those that have been collected in the Adriatic in depths of from 500 to 700 fathoms and described by Schmidt.² This limestone is remarkable for the change in the fauna which manifests itself. *Scutella striatula*, *Thecidium Adamsi*, *Heterostegina Stricklandi*, *Cidaris Scillæ*, and *Echinolampas posterolatus*, occur sparingly; but they have not been found in any of the overlying beds. Towards the base of this bed, as well as in phosphate seam iv and in the transition bed at Ricasoli, they are very abundant. A considerable number of fish-remains have been obtained from this horizon in the quarries at Luca. During the governorship of Sir William Reid many of them were figured; but the illustrations were not sufficiently accurate to render them of much scientific value. These illustrations, as well as the original fossils, are now in the Valetta Museum, but the latter are in a very indifferent condition. Spratt³ has recorded the occurrence in this bed of a fossil turtle; and at St. Julians and Dingli the teeth and

¹ I am indebted to Professor Angelli, of Rome, for the determination of the corals.

² Capellini, G., "Della Pietra Leccese e di Alcuni suoi Fossili," Bologna.

³ Spratt, T., "On the Geology of Malta," Valetta, 1854.

vertebræ of *Stereodon Melitensis*, a fish having sauroid dentition, were found.¹ Leith Adams obtained ear-bones, caudal vertebræ, and a penultimate molar of *Halitherium*²; and in the Valetta Museum are several large vertebræ of *Zeuglodon* that, judging from the limestone matrix on them, were also obtained from this bed.

Division I: the fourth nodule seam.—The fourth or lowest seam of phosphatic nodules averages three feet in thickness, and ranges from two to four feet. The nodules are irregular in shape, and generally present an exceedingly wrinkled and coriaceous appearance. Nearly all of them contain one or more fossil organisms, around which the phosphate of lime has segregated; and in many cases they consist almost entirely of the shells of foraminifera. Phosphatized remains of molluscs, corals, and echinoderms, the teeth and vertebræ of sharks, bones of whales, and immense quantities of casts and pseudomorphed tests of pteropods, *Vaginella* and *Hyalea*, enter largely into the composition of the seam. Alluding to the origin of these nodules, Dr. John Murray³ points out that they are precisely similar to the phosphatic nodules that were dredged from modern sea-beds during the voyage of the "Challenger," and he is of opinion that these nodules, like their modern prototypes, were formed *in situ* at the bottom of the Oligocene sea. A sample of rock from this seam was sent to Professor J. F. Blake for analysis and report. The following was the result:—

Sulphate of lime ...	...	...	...	...	1·97
Carbonate of lime ...	...	...	...	...	51·12
Phosphate of lime ...	...	...	...	...	31·66
Alumina ...	...	...	...	...	10·55
Silica ...	...	...	...	...	3·83
Moisture ...	...	...	...	...	·87
					<hr/> 100·00 <hr/>

Conclusion.—The foregoing details afford evidences as to the nature of the bathymetric conditions that prevailed when these strata were deposited. These conditions have already been indicated by Dr. John Murray⁴ and Dr. J. W. Gregory,⁵ and I shall therefore now confine myself to a brief summary of the conclusions which the details in this paper seem to corroborate.

The *Globigerina Limestones* of the Maltese Islands are broadly divisible into three sections—

I. The lowest beds, comprising the subdivision *I* and the lower

¹ Cooke, J. H., "Notes on *Stereodon Melitensis*, Owen": GEOL. MAG., Dec. III, Vol. VIII, December, 1891, p. 546.

² Adams, A. L., "On the Discovery of the Remains of *Halitherium*": Q.J.G.S., vol. xxii, p. 595.

³ Murray, Dr. J., "The Maltese Islands, with special reference to their Geological Structure": Scot. Geog. Mag., vol. vi, p. 449.

⁴ *Vide ante.*

⁵ Gregory, J. W., "The Maltese Echinoidea, etc.": Trans. Roy. Soc. Edin., vol. xxxvi, p. 585.

portion of *H*, have a composition of from 70 to 90 per cent. of calcium carbonate, and are made up for the most part of shallow-water organisms. These limestones, together with the underlying transition bed and the upper portion of the Lower Coralline Limestone, were laid down on a sinking sea-floor and in about 300 fathoms of water.

II. The subdivisions *D*, *E*, *F*, *G*, and the upper portion of *H*, are composed of from 80 to 90 per cent. of calcium carbonate, the greater portion of which consists of *Globigerina* and other pelagic organisms. These were probably deposited in about 1000 fathoms.

III. The subdivisions *A*, *B*, and *C* contain from 50 to 70 per cent. of lime. These, together with the overlying "Marls," are considered by Dr. John Murray to have been laid down on a rising sea-floor and to have been within the influence of river waters and their detrital products. They were probably laid down in about 300 fathoms.

The following is a list of the fossils of the formation, about one-half of which are new to the palæontology of the Maltese Miocene, and many are new to science.

Palæontology.—The figures 1, 2, 3 placed after the names of the fossils indicate the occurrence of the fossils in the three sections referred to in the conclusion.

MAMMALIA :

<i>Carnivora</i> —	<i>Sirenia</i> ¹ —	<i>Cetacea</i> —
<i>Phoca rugosidens</i> , Owen,	? <i>Halicore</i> , 1, 3.	<i>Zeuglodon</i> , 3.
1, 2.	<i>Halitherium</i> , 1, 2, 3.	<i>Delphinus</i> , 1, 2, 3.
<i>P. Scillæ</i> , Capellini, 1.	? <i>Manatus</i> , 1, 2, 3.	<i>Cetacea</i> (gen. ?), 1, 2, 3.

REPTILIA—

? <i>Ichthyosaurus gaudensis</i> , Hulke, 3.	<i>Crocodylus gaudensis</i> , Hulke, 1, 3.
<i>Tomistoma champsoides</i> , Lyd., 1, 3.	<i>Tryonx Melitensis</i> , Lyd., 3.

PISCES—

<i>Stereodon Melitensis</i> , Owen, 1, 2.	<i>Sphærodus</i> , 3.
<i>Notidanus primigenius</i> , L. Ag., 1, 2, 3.	<i>Sphenodus</i> , 3.
<i>Platax Woodwardi</i> , L. Ag., 1.	<i>Hemipristis serra</i> , L. Ag., 1, 2, 3.
<i>Oxyrhina xiphodon</i> , L. Ag., 1, 2, 3.	<i>H. paucidens</i> , P. Gerv., 2, 3.
<i>O. hastilis</i> , L. Ag., 1, 2, 3.	<i>Lamnidae</i> , 1, 2, 3.
<i>Carcharodon megalodon</i> , L. Ag., 1, 2, 3.	<i>Diodon Scillæ</i> , L. Ag., 2.
<i>Carcharias</i> , 1, 2, 3.	<i>Ætobates</i> , 3.
<i>Holocentrum Melitense</i> , A. S. Woodw.	<i>Chrysophrys</i> , 1, 2, 3.
<i>Odontaspis Hopei</i> , L. Ag., 1, 2, 3.	<i>Scyliidae</i> , 1, 2, 3.

MOLLUSCA : (1) *Cephalopoda*—*Aturia aturii*, Basterot, 3. *Nautilus*, sp. ? 2, 3.

(2) *Pteropoda*—

<i>Vaginella depressa</i> , Daudin, 1, 2, 3.	<i>Hyalea taurinensis</i> , Sism., 1.
<i>Cavolina Cookei</i> , Simonelli, 2.	<i>H.</i> , sp., 1, 2, 3.

(3) *Gasteropoda*—

<i>Conus Melitensis</i> , De Greg., 2, 3.	<i>Conus Russigeri</i> , Haues, 1, 2, 3.
<i>C. Mercati</i> , Brocchi, 2, 3.	<i>C. betulinoides</i> , Lamarek, 1, 2, 3.
<i>C. dubius</i> , Gulia, 1, 3.	<i>C.</i> (casts indet.), 3.
<i>C. Melitoticulus</i> , De Greg., 3.	<i>Dolichotoma cataphracta</i> , Brocc., 3.
<i>C. Ruschi</i> , Michelotti, 1, 2, 3.	<i>D. ramosa</i> , Brocc., 3.

¹ Most probably all the Sirenian remains found in Malta are referable to the genus *Halitherium*.—EDIT. GEOL. MAG.

Cirsotrema Swanni, Adams, 3.
C. scaberrima, Mich., 2, 3.
C. Melitensis, Fuchs, 3.
C. Ducei, Wright, 1, 3.
C. crassicostratum, Deshayes, 2.
 — *var.*, 3.
C. retusa, 2, 3.
C. pumiceum, Brocc., 2.
C. taurovaricosum, Sacco, 2.
Cirsotrema (sp. indet.), 3.
Cyprea amygdalum, Brocc., 1.
C. labagina, Lam., 2, 3.
Turritella inequiculpta, Seg., 3.
T., sp., 2, 3.
Natica pratensis, Raqa., 2.
N. hortensis, Bayan, 1.

Oliva (casts), 1, 2, 3.
Trochus patulus, Brocc., 1.
T. (casts), 1, 2, 3.
Voluta ficularia, Lam., 2.
Cassidaria fasciata, Borson, 3.
C. echinophora, Lam., 3.
 — *var.*, 3.
Cassis Neumayri, Hörnes, 2.
Patella Melitensis, De Greg., 3.
Fissurella, sp., 3.
Erato laevis, Don, 3.
Actæon pinguis, d'Orb., 3.
Solarium simplex, Brong., 2, 3.
Chenopus pes-pelicanii, Phil., 3.
Acera (casts), 1, 2, 3.
Xenophora incertissima, De Greg., 3.

(4) *Lamellibranchiata*—

Pecten Melitensis, De Greg., 3.
P. Cookei, De Greg., 2, 3.
P. scabrellus (Lam.), Desh., 3.
 — *var. arcæopsis*, De Greg., 3.
 — *var. gibbosulus*, De Greg., 3.
 — *var. parti-imbricatus*, De Greg., 3.
 — *var. post-scabriusculus*, De Greg., 3.
P., sp. (?), De Greg., 3.
P. Haveri, Mich., *var. Koheni*, Fuchs, 3.
P. denudatus, Reuss, 2, 3.
P. Pandora, 3.
P. Reussi, Hörnes, 3.
P. varians, 3.
P. dubius, Wood, 3.
P. spinulosus, 2.

Pecten cristatus, 2.
P. Koheni, Fuchs, 3.
Ostrea cochleare, Poli, 3.
O. mutabilis, Desh., 3.
O. tenuiplicata, Seg., 2.
O. teriodentata, De Greg., 3.
O. perminuta, De Greg., 3.
Lucina sinuosa, Don, 3.
Cardita tornanacta, Bast., 3.
Pholas (casts), 1, 3.
Nuculana pellicidiformis, Hörnes, 3.
N. nitida, Brocc., 2.
N. fragilis, Chemn., 3.
Nucula Mayeri, Hörnes, 3.
Lima, sp., 2, 3.
Arca (casts), 1, 2, 3.
Isocardia (casts), 1, 2, 3.
Astarte (casts), 1, 3.

BRACHIOPODA—

Terebratula caput-serpentis, 1, 2.
T. Cortæ, Seguenza, 3.
 — *var. parumlobata*, De Greg., 3.

Terebratula minor, 1, 2.
T. sinuosa, 3.
Thecidium Adamsi, McDonald, 1.

BRYOZOA—*Idmonea*, 3.

CRUSTACEA: *Decapoda*—*Cancer macrocheilus*, Mantell, 3. *Cancer*, sp., 1, 3.

Cirripedia—

Scalpellum venustum, De Greg., 1.
S. Melitense, De Greg., 1, 2, 3.
S. magnum, Darw., *var. angustum*, De Greg., 1.
 — *var. equisignatum*, De Greg., 1.
 — *var. radiatum*, De Greg., 1.

Scalpellum magnum, Darw., *var. ornatum*, De Greg., 1.
S., sp., 1.
S., sp., 1.
Cirripede, nov. sp.

ECHINOIDEA—

Cidaris Scillæ, Wright, 1.
C. avenionensis, Desml., 3.
Echinus Hungaricus, Laube.
Echinocyamus Studeri, Sism., 2, 3.

Breynella Vassalli, Wright, 3.
Studeria Spratti, Wright, 3.
Echinolampas Manzoni, Greg., 2, 3.
E. posterolatus, Greg., 1.

Hemiasfer Cotteani, Wright, 3.	Brissopsis crescenticus, Wr., 3.
H. Scillæ, Wr., 1, 2, 3.	Spatangus pustulosus, Wr., 3.
H. vadosus, Greg., 1, 2, 3.	Euspatangus De Konincki, Wr., 3.
Pericosmus latus, Agassiz, 2.	Sarsella Duncan, Greg., 2, 3.
P. coranguinum, Greg., 3.	S. anterolata, Greg., 2, 3.
Schizaster Parkinsoni, DeFr., 1, 2, 3.	Pygorhynchus Spratti, Wr., 2.
S. Desori, Wr., 2, 3.	Scutella striatula, Greg., 1.
Metalia Melitensis, Greg., 2.	Brissus latus, 3.

CRINOIDEA—Pentacrinus Gastaldi, Mich., 1, 2.

ALCYONARIA: *Gorgonide*—

Isis Peloritana, Seg., 1, 3.	Isis Melitensis, Seg., 3.
I. compressa, Seg., 3.	— var. antiqua, Seg., 3.

ACTINOZOA—

<i>Ceratrochus typus</i> , Seg., 2, 3.	<i>Trochocyathus vericostatus</i> , Mich., 1, 3.
<i>Cœnocyathus</i> Adamsi, Duncan, 3.	T., sp., 3.
<i>Stephanocyathus</i> , sp., 1, 2, 3.	Flabellum extensum, Mich., 1, 2, 3.
<i>Caryophyllia</i> , 1, 3.	F. Melitensis, De Greg., 1.
<i>Trochocyathus latero-cristatus</i> , Edw.	F. avicula, Mich., 1, 2, 3.
& H., 1, 2, 3.	F. intermedium, Mich., 1, 3.
T. pyramidatus, Mich., 1, 3.	F. fecundum, Mich., 1, 3.

SPONGIDA—Cliona (perforating shells of Lamellibranchs).

FORAMINIFERA—In addition to the 54 species recorded by Dr. John Murray, I have collected—

<i>Nodosaria soluta</i> , Reuss, 2, 3.	<i>Crustellaria variabilis</i> , Reuss, 3.
N. consobrina, d'Orb., 3.	Marginulina Boehmi, Reuss, 1, 2.
<i>Textularia carinata</i> , d'Orb., 3.	Fronclularia interrupta, Karrer, 3.
<i>Crustellaria cassis</i> , F. & M., 3.	Miliolina agglutinans, d'Orb., 3.
C. radiata, Born., 2, 3.	Heterostegina Stricklandi, Adams, 1.

NOTICES OF MEMOIRS.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Sixty-sixth Annual Meeting, held at Liverpool, September 16–28, 1896.

I.—LIST OF PAPERS READ IN SECTION (C), GEOLOGY.

J. E. MARR, Esq., M.A., F.R.S., Sec. Geol. Soc., President.

President's Address (see October Number, p. 464).

Prof. W. Boyd-Dawkins.—On the Geology of the Isle of Man.

H. C. Beasley.—Observations on some Footprints from the Trias in the Neighbourhood of Liverpool.

G. H. Morton.—Recent Borings in the Red Marl near Liverpool (see p. 496).

G. H. Morton.—Erosion of the Sea-coast of Wirral (see p. 516).

T. Mellard Reade.—Oscillations in the Level of the Land as shown by the Buried River-Valleys and Later Deposits in the Neighbourhood of Liverpool (see p. 488).

A. Bell.—Tertiary Deposits in North Manxland.