THE

QUARTERLY JOURNAL

OF THE

GEOLOGICAL SOCIETY OF LONDON.

EDITED BY

THE ASSISTANT-SECRETARY OF THE GEOLOGICAL SOCIETY.

Quod si cui mortalium cordi et curæ sit non tantum inventis hærere, atque iis uti, sed ad ulteriora penetrare; atque non disputando adversarium, sed opere naturam vincere; denique non belle et probabiliter opinari, sed certo et ostensive scire; tales, tanquam veri scientiarum filii, nobis (si videbitur) se adjungant. —*Novum Organum, Præfatio.*

VOLUME THE TWENTY-FIRST.

1865.

PART THE FIRST.
PROCEEDINGS OF THE GEOLOGICAL SOCIETY.

LONDON:

LONGMAN, GREEN, LONGMAN, ROBERTS, AND GREEN.

PARIS:—FRIED. KLINCKSIECK, 11 RUE DE LILLE; J. ROTHSCHILD, 14 RUE DE BUCI; LEIPZIG, T. O. WEIGEL.

SOLD ALSO AT THE APARTMENTS OF THE SOCIETY.

MDCCCLXV.

the Nile, where we may expect to detect the vestiges of his earliest abode. It is there where the necessaries of life are produced by nature in the greatest variety and profusion, and obtained with the smallest effort—there where climate exacts the least protection against the vicissitudes of the weather—and there where the lower animals which approach man nearest now exist, and where their fossil remains turn up in the greatest variety and abundance. The earliest date to which man has as yet been traced back in Europe is probably but as yesterday in comparison with the epoch at which he made his appearance in more favoured regions.

The large question which these reflections concern, is at the present time followed up with the keenest intelligence and with the closest scrutiny over a large portion of Europe. But in the tropical regions, which promise to be the most fertile of results, the ground has been barely broken. The observations of Russegger in the valley of the Nile would seem to have fallen into that oblivion which shrouded the shrewd observations of Frere on the Hoxne implements, until they were brought to light by the researches of Mr. John Evans. In India also the inquiry, begun so auspiciously nearly thirty years ago, appears to have stagnated in later days, and to require a fresh impulse. The important discoveries of Captains Speke and Grant will assuredly attract explorers, until the affluents which feed the lake out of which the White Nile flows are traced to their sources. It is incredible that that great river should run for fifteen or seventeen hundred miles, often through alluvial deposits, ancient and modern, without yielding traces of its former population. In the interest of the general investigation, I have therefore thought it might be useful to bring together the facts and speculations which are set forth in the preceding observations, as a guide to future inquiry.

April 5, 1865.

Henry Clark Barlow, M.D., Newington Butts, S.E.; Townshend Monckton Hall, Esq., Pilton Parsonage, near Barnstaple; John Lawson, Esq., C.E., 34 Parliament Street, S.W.; William Milnes, Esq., Blackheath, Kent, and Yeolm Bridge, South Devon; J. Samuel Perkes, Esq., C.E., Belvedere House, West Dulwich, S.; and Minos Claiborne Vincent, Esq., C.E., Frankfort, Ohio, U.S., were elected Fellows.

The following communications were read:—

1. *On some* Tertiary Deposits *in the* Colony *of* Victoria, Australia. By the Rev. Julian E. T. Woods, F.G.S., F.L.S., &c. *With a* Note *on the* Corals; by P. Martin Duncan, M.B., Sec. G.S.

(Abridged.)

Tertiary Deposits of Victoria.—Some time ago (in Nov. 1859)* I had occasion to lay before the Society an account of a Tertiary formation which extends along a great portion of the south coast of Australia. That formation is characterized, as I then observed, by

* See Quart. Journ. vol. xvi. p. 253.

the peculiar white appearance of the stone, and the immense quantity of Bryozoa and Foraminifera of which it is composed. The strata are, in fact, very much like chalk-deposits. They have the same appearance when exposed in sections, and contain sheets or layers of flint, with occasionally formations like the potstones of Norwich. I have already described the extent of these beds. They are found throughout the south-eastern portion of the colony of South Australia, and they thin out, I believe, about seventy miles due east of the boundary between that colony and Victoria. Of its extent west and north less can be said. Shelly limestones occupy the whole country in those directions for many hundred miles; but whether they are united with the limestones of Mount Gambier, or whether they belong to the formation I am about to describe, cannot as yet be decided. The object of this paper is to draw attention to another deposit, which is very widely spread in the colony of Victoria. At Hamilton, a town in that colony in about lat. 37° 45′ S., long. 142° E., there is a remarkable bed of fossils. It occurs at the junction of the Muddy and Violet Creeks, about four miles south-west of the town. Hamilton is the centre of a volcanic district which possesses several craters. Those who have read the explorations of Sir Thos. Mitchell will remember the place better in connexion with his description of the extinct volcanoes of Mounts Napier, Ecles, &c. In consequence of the extensive development of vesicular doleritic lava which flowed from them, it is only seldom that a view can be obtained of the underlying rocks. The banks of the creeks are best for the purpose, and, like all Australian streams, these have cut a deep channel for themselves. The town of Hamilton stands upon a plateau probably 300 feet above the sea-level, and rising from it by a series of terraces. The best and, as far as I am aware, the only place for viewing the beds to which I shall draw attention is at the junction just described, where, for the distance of nearly a mile, the following order is observed:—black soil 2 feet; doleritic lava 3 to 10 feet; yellow or brown clays to the bottom of the section, about 12 feet. The clay is very soft when first dug, but upon exposure it whitens and becomes hard. In the bottom of the creek one sees occasionally blocks of a very hard stone belonging to the same deposit, but much harder and more flinty from exposure than any part of the cliffs, requiring, in fact, smart blows of a hammer to break off a fragment. No beds could be richer in fossils than the whole of the clay. They bleach out upon the banks in the most conspicuous manner. They are easily extracted, but until they are dry are so brittle that the slighest touch destroys them. The shells have more the appearance of a shallow than a deep-sea deposit. The most prevalent fossils are more or less encrusted with *Bryozoa*, *Serpula*, &c., and though some of the shells are broken and worn, their general character is not such as one would expect in a strictly littoral deposit. Pectens, species of *Mitra*, *Cerithium*, *Nucula*, *Cucullæa*, and a *Corbula* are the prevailing fossils of the beds. The Bryozoa are numerous and extremely interesting, but of their character I shall speak more in detail at the close of this paper. Some of the specimens have

become glazed over with a ferruginous oxide so as to look like earthenware. The Foraminifera are large and numerous; indeed one species, *Amphistegina vulgaris*, D'Orb., is so common that the clay is principally composed of it. Its large lenticular form can be traced in almost every pinch of the débris, and what makes the individuals more conspicuous is that they have all received the ferruginous glaze which makes them look like little coins. From their numbers the strata may in truth be called an Amphisteginabed, similar to that in Vienna, and probably of the same age. Other Foraminifera occur, such as *Discorbina turbo*, *Pulvinulina pulchella*, *Planorbulina Haidingerii*, *Operculina complanata*, *Polymorphina lactea*, *Textularia sagittula*, *Miliola semiluna*, and *M. trigonula*. Prof. T. Rupert Jones has given me to understand that the above list is indicative of a recent Tertiary formation, some of the fossils being Miocene for Europe. Next in frequency to the *Amphistegina vulgaris* is the *Operculina complanata*, Bast., and though equal in size with the species found at Mount Gambier it is much more common in the latter locality. The most common of the fossil shells next to the *Pecten*, sp., is a species of *Pectunculus* (*P. laticostatus*, Lam.), large living specimens of which have been obtained by me from New Zealand*. The corals occuring fossil in these strata are numerous and peculiar. They will be found described at the end of this paper.

This fossiliferous section is, as I have observed, only traceable for about a mile along the rock, and I know of no other locality near Hamilton where it is so exposed again. But near Harrow, about sixty miles to the north-east, the deposit reappears, but in a way which renders it rather difficult to recognize. The river Glenelg runs close to the town and cuts a deep bed for itself through the coarse granite rocks of the tableland. The level country back from the banks is probably 600 feet above the level of the sea, and is much intersected by creeks which flow to form the main stream. The surface of the country is occasionally covered with what appears to be ancient lacustrine basins, because the limestone which fills these depressions has a few small fossils of existing species of *Planorbis*, *Physa*, *Paludina*, &c. Where the limestone is absent an ironstone deposit takes its place, and seems to be nothing more than a surface-gravel of rounded or glazed pebbles formed from a very ferruginous sandstone. On these pebbles one can sometimes trace the faintest outline of a shell, and sometimes a good cast of a fossil, but much too worn to enable one to distinguish even the genus to which it belongs. At a place called Reilly's Creek the following section is observed: first about six inches of the ferruginous gravel, then two feet of red loam, six inches of porcelain earth, and, lastly, about 20 or 30 feet of coarse granite with schorl, passing into mica-schist in places. The ferruginous gravel is the fossiliferous deposit, and nearly every pebble contains impressions or casts of shells—sometimes very well preserved. There are, however, none to be found except upon the surface; I have dug in many places but never

* See also Prof. M'Coy's Essay prefatory to the 'Catalogue of the Victorian Exhibition, 1861,' p. 169.

could find fossils except in the first few inches of loam. After a careful examination of all the specimens, I could not detect one which does not belong to the Hamilton beds. The species prevailing are the same, but the *Nucula* is the most common. The *Cyprœa eximia* appears to have been common too, and also some of the corals enumerated below, but in other respects the specimens are too broken to be pronouuced upon without long and careful examination. In fresh broken pebbles the *Amphistegina vulgaris* can be readily detected in the usual abundance. It is a curious fact that though the ferruginous gravel is distributed over many miles of the neighbouring country, this neighbourhood is the only one in which I have found fossils among its pebbles. The same kind of gravel has been noticed throughout a great portion of the continent of Australia, almost, in fact, wherever an explorer has penetrated. It would be interesting to ascertain whether it was all of the same geological age. As yet we can only speculate on the subject; but as the continent is generally at so uniform a level, even a guess may be founded on strong probability. It is certain that the formation is widely distributed. It has been found in Hobarton, Tasmania, at Geelong, at Hamilton, and at Harrow, making an extent of at least six degrees of latitude and five of longitude. Add to this the fact that the fossils have strong Philippine affinities, and thence we may infer that the whole continent of Australia was then submerged, leaving a clear sea to the equator. Under ordinary circumstances we might look for similar deposits in remote parts of Australia, and it is just possible that the ferruginous gravel which is so widely distributed may belong to the same geological age.

The Hamilton beds and the Mount Gambier limestones have been regarded as belonging to the same age, yet I have now little doubt that this opinion must be modified. In the first place the character of each deposit is very different. The Hamilton beds are clays full of large fossil shells, while at Mount Gambier the formation is hard and rocky, and even in its most friable state has at least the consistence of chalk. It has also flints which are never found in Hamilton or Geelong. Then, again, the fossil contents of the beds could not be more different. At Mount Gambier the limestone teems with Bryozoa, but rarely contains a perfect shell. If they do occur they are confined to three or four genera, such as *Terebratula* (which is the only common form), *Pecten*, *Spondylus*, and *Anomia*. *Echinidæ* are also common, particularly such genera as *Echinolampus* and *Spatangus*. The stone where such fossils do not occur is made up of a kind of limestone-paste, with Foraminifera and broken Bryozoa abounding. The Foraminifera are such as exist now at a depth of from 200 to 300 fathoms, and therefore the Bryozoa may have been derived from a distance. In fact the deposit seems like a series of layers of deep-sea mud tranquilly deposited in the bottom of the ocean or brought by slow degrees from a distance.

In scarcely one of these respects does the Hamilton deposit resemble the limestone. Bryozoa are common, but do not, as at Mount Gambier, make up the principal part of the deposit. *Echinidæ* are rare, and so are *Terebratulæ*, at least in comparison with the numbers

found at Mount Gambier. In the latter strata corals never occur, but at Hamilton they are almost as common as Bryozoa. The beds of the last-mentioned place instead of being a limestone-paste are loose soft clays, and do not appear to have been deposited in anything like a deep sea. Species are common to both deposits, but not by any means all of each. *Terebratula compta*, Sow., *Pecten coarctatus*, Goldf., are the commonest fossils at Mount Gambier, but I have not been able to find them at Hamilton. The species of *Echinidæ* are different and the Bryozoa have a separate character, but the latter feature will be spoken of by and by.

It has been objected to me that the differences between the beds are not greater than might be expected in localities at least 90 miles apart, supposing Hamilton to have been the shore of an island, and Mount Gambier deep sea at the time; but the following reasons are directly against such an explanation. The Mount Gambier limestone preserves its character for a distance of more than 100 miles in a northerly direction, and 60 miles in a north-easterly direction. Wherever it is found in that interval it can be easily recognized, not a fossil is altered, and in every respect it is still like a deep-sea deposit. On the other hand the distinctive features of the Hamilton beds can be identified at Geelong, which is 120 miles to the south-east, or at Harrow, which is 60 miles to the north-west. The strata are distinguishable not only by the fossils but by the character of the clays. I may add also that the two formations have been seen by me within 10 miles of each other, that is to say, near the Wannon River, and I think no one could possibly mistake one for the other.

It may be asked, then, if the formations are distinct, which is the more modern? I think the Mount Gambier limestone. It possesses a great many more recent Bryozoa, and Dr. Busk has already expressed his opinion that the fossil contents show considerable analogy with the Lower Crag of England. This may, however, be too modern a date for this formation, which I have always regarded as identical with the well-known Murray River beds. I have so many strong reasons for believing the two deposits to be continuous, that I fancy a better acquaintance with the fossil contents will show them to be more modern than the Hamilton beds. The Murray River beds may be passage-beds between the Mount Gambier and the Hamilton strata. Indeed I have some reason for thinking that there are two deposits at Murray River; at least very different sets of fossils are collected from the River near Lake Alexandrina, and from the more northerly portions, such as the overland corner, and both are different from what we find at Mount Gambier.

Bryozoa of the Hamilton Beds.—In pointing out as I have done the difference between the two deposits at Hamilton and Mount Gambier, I have reserved any remarks on the specific characters of the Bryozoa until now. In the first place it may be stated that in one respect the Bryozoa of both deposits resemble each other, and that is in the absence of those forms, such as *Catenicellidæ*, *Menipea*, *Dimetopia*, &c., which give to the recent genera of the Australian seas so peculiar a character. It certainly may be objected that the horny joints between each cell would render them more liable to

decomposition; but then the separated cells would be easily detected by the microscope amid the dust, as they are now in nearly every pinch of beach-sand from the beach which surrounds the Australian shore. It would appear from this that *Catenicellidæ* are peculiar to the recent period. Yet some recent forms are represented at Mount Gambier, as Mr. Busk has already pointed out. Among them are *Salicornaria sinuosa*, Hassall; *Crisia eburnea*, Johnst.; *Carbasea lata*, Busk; *Membranipora ctenostoma*, Busk; *M. cyclops*, Busk; *M. bidens*, Hag.; *Idmonea Milneana*, D'Orb.; *Retepora monilifera*, Macgil. Of these none exist at Hamilton except *Salicornaria sinuosa* and *Membranipora cyclops*. The former is a very common fossil at Mount Gambier. Scarcely a fragment of the stone can be found, or a cast of a fossil on which portions of its cylindrical branches cannot be traced. At Hamilton it is not very common and is somewhat distinct in character. It is larger than ordinary, and the reflected margin round the mouth is much more clearly defined. The *Membranipora cyclops* is very similar in character in both places, but more rare at Hamilton. With reference to the extinct species, the difference between the deposits may be thus described. At Mount Gambier, as Mr. Busk has remarked, the Bryozoa are distinguished by the peculiar and characteristic forms of the genus *Cellepora*. This genus is rare at Hamilton, and the beds are, on the contrary, distinguished by the variety and peculiarity of the genus *Eschara*. No less than eleven different forms have been found by me, only three of which can be referred to the Mount Gambier limestone. A peculiar form of *Cellepora* in the latter, which has been named by Mr. Busk *C. nummularia*, is perhaps found at Hamilton and Geelong, but so very much larger in size that I fancy the species must be distinct. *Melicerita angustiloba*, Busk, is found in both localities, but more commonly at Mount Gambier. Lunulites, which are pretty common at Hamilton, are rare in the limestones, and the species are different. Finally, all the different species of *Eschara* are of singular beauty in the forms of their cells, while those of Mount Gambier are comparatively destitute of ornament. On the whole, the aspect of the Bryozoa at the Mount is much the more modern of the two.

NOTE *on the* FOSSIL CORALS *from* MUDDY *and* VIOLET CREEKS, SOUTH AUSTRALIA. By P. MARTIN DUNCAN, M.B., Sec.G.S.

THE Corals forwarded by the author of the preceding paper have been described by me in the 'Annals of Natural History' (No. 81, Sept. 1864); they are solitary species and probably dwelt in deep water from 80–120 fathoms. There are no reef or atoll species amongst the collection, and the evidences of luxuriant coral growth are deficient.

List of the Species.

1. Caryophyllia viola, *nobis.* } Turbinolia viola, *Woods, M.S.* }
2. Flabellum Victoriæ, *nobis.*
3. Flabellum Gambierense, *nobis.*
4. Placotrochus elongatus, *nobis.*
5. Placotrochus deltoideus, *nobis.*
6. Balanophyllia Australiensis, *nobis.*
7. Trochoseris Woodsi, *nobis.*

The condition of the specimens is peculiar, most of them are glazed externally, are very fragile, and present no evidences of mineraliza-