ADELAIDE

PHILOSOPHICAL SOCIETY.

ANNUAL REPORT AND TRANSACTIONS

FOR THE YEAR ENDING 30TH SEPTEMBER, 1865.

OFFICERS FOR THE PAST YEAR:—

PRESIDENT:

His Excellency Sir Dominick Daly.

VICE-PRESIDENTS:

His Honor R. D. Hanson, Esq. | Charles Todd, Esq.

REPRESENTATIVE MEMBER OF THE BOARD OF GOVERNORS:

W. Wyatt, Esq., M.D.

TREASURER:

John Howard Clark, Esq.

HONORARY SECRETARY:

Mr. James Hosking.

ADELAIDE:

ANDREWS, THOMAS, AND CLARK, PRINTERS, REGISTER GENERAL PRINTING OFFICE, GRENFELL STREET.

1865.

ADELAIDE PHILOSOPHICAL SOCIETY.

PAPER READ MAY 2, 1865, BY THE REV. J. E. TENISON WOODS, F.G.S., F.L.S., &c.

SUBJECT—"THE TERTIARY ROCKS OF SOUTH AUSTRALIA."

No. 1.—Introduction.

It is now about 65 years since attention was first called to the Tertiary Rocks of the southern portion of the continent, and since that time very little has been done towards establishing the period to which they belong, or to fix their succession. It is known that we have in the various formations exposed on the banks of our rivers and sea beaches sections of extensive deposits; but whether they belong all to one vast province, representing one era in the world's former history, or whether they are divisible into all the various periods which the tertiary epoch includes in Europe, has never been satisfactorily explained. I propose to publish, with the assistance of the Philosophical Society, a series of papers on this subject, and I hope by placing the facts at our disposal in regular order to obtain something like a satisfactory conclusion. In order to do this, it will be necessary perhaps to give a slight sketch of what has been already done, and to notice recent investigation in tertiary formations near our continent, from which I think much valuable light may be thrown upon our investigations.

The first person to notice our Tertiary Rocks was Flinders, who, in sailing along the Great Australian Bight, saw the high cliffs of limestone which there form so remarkable an object on our shores. He imagined them to be portion of a coral reef, and described them as of a white calcareous base for two-thirds of their height, and then capped by a stratum of brown earth, in neither of which could stratification be observed, because of the great distance at which the observations were made. The lower part of the cliffs seemed to be corroded into caves and burrows, showing the stone to be of a very soft structure.

It is a matter of regret that we have no observations beyond those of Flinders of these very interesting rocks. That they are fossiliferous there can be no doubt, because Eyre was able to ascertain that fact in the course of his overland journey to King George's Sound; but no collections of the fossils have been made, and to this day we can only guess at their character.

The next person to call attention to our Tertiary Rocks was Sturt, who, in his journey down the Murray, passed by and examined the celebrated fossiliferous cliffs of that stream. He collected a number of specimens, and they are figured and described in the account of his first and second expedition (London: Boone, 1843.) With the peculiar views held by Sturt as to the origin of these beds we have just now nothing to do. The fossils he believed he had identified, were either of Middle Eocene or Miocene character, but it may be doubted whether a single one of his identifications is correct. Only two works appear to be referred to, and these seem to me to be Goldfuss's "Petrefacta Germaniæ, Iconibus Descriptionibusque Illustrata" (Dusseldorf, 1826-40); and G. P. Deshayes' "Description des Coquilles Fossiles des Environs de Paris" (Paris, 1824-37). Unaccustomed as Sturt was to the investigation of those finer shades of difference which divide species from species, it is not astonishing that he was misled by appearances; for it has been remarked by our most distinguished Australian palæontologist, Professor McCoy, that the distinctions between some of the fossils of our Miocene and those of Germany, and some of our Eocene and those of England, are of the faintest possible description. In some of his definitions he was also doubtless led astray by the imperfect character of the drawings he had to consult. As it is of consequence in the investigation upon which we are entering to point out in what respect Sturt has been in error, I shall here enumerate those species which are figured in his work, and which are wrongly determined.

In plate III, fig 1, *Eschara celleporacea* is *Cellepora Gambierensis*, Busk, not determined until many years after Sturt's publication. Fig 5. *Cellepora escharoides* is a new species which I have named *C. lunularia*, distinct from *C. nummularia*, as I shall show in a subsequent paper. Fig 6. *Retepora disticha* is a species of *Idmonea*, which is not figured sufficiently in detail to enable one to determine. Fig 7. *Retepora vibicata* is a new species *R. Gambierensis*, to be described subsequently. *Glauconome rhombifera* is *Salicornaria sinuosa*, Hassall. Fig 2. *Eschara piriformis* is as well as I can make out *Eschara Hamiltonensis*—a new species which I shall have occasion to describe. Fig 4. *Cellipora echinata* is *Pustulipora rugosa;* new species. Fig. 9. *Scutella* is, according to Dr. Duncan, identical with an urchin found in the Miocene beds of Malta. Fig. 10. *Spatangus Hoffmannii* is *Hemiplagus Forbesii* (Woods and Duncan). Sturt thought that the species was identical with one found in Westphalia, and named as above by Goldfuss. Its difference was seen by me, and I applied a name given previously to it, I believe, by some members of the Geological Survey. Desor, a French palæontologist, has made a subdivision of the *Spatangi* family, and our specimen was removed into the *Hemiplagi* division by Dr. Duncan, who, in "The Annals of Natural History for September, 1864," published a description of the fossil for the first time. The other urchin figured by Sturt is evidently a *Cidaris*. Indeterminable.

The names of five other species are given belonging either to the Middle Eocene of the Paris basin or the Lower Eocene of the London clay. They are *Corbula Gallica*, *Corbis lamellosa*, *Cytherea lævigata*, *C. obliqua*, and *Ostrea elongata;* but as none of them are figured it is impossible to say on what basis the identification rests. There is a *Corbis* in my collection which on the surface of the shell bears a good deal of resemblance to the species just named, but the hinge is very different. It came from the tertiary beds of Hamilton, which contain many specimens in common with those of the Murray. The only living specimens exist in the China seas, and might be found on the north coast of Australia. Fig. 12 is *Pecten Gambierensis*, named, however, by Sturt, *P. coarctatus*, and under this title it appears in my work. The other specimens of Sturt's plate are casts and cannot be determined, with the exception of a *Terebratula*, to be noticed subsequently.

In justice to the palæontological researches of Sturt, it should be said that in the case of the *Bryozoa*, he is not to blame for the difference between the names he gave his species and those which they have subsequently obtained. The whole of that portion of science has been recently in a shifting and unsatisfactory state, until Dr. Busk published his "Catalogue of the Polyzoa and the Monograph of the same Fossils in the Crag." As it is, we can say no more than that we are delivered from an enormous amount of most embarrassing synonyms.

From the time of Sturt we find no attempt made to describe our tertiary rocks until that of Jukes, who, in 1850, published a little book entitled "Physical Structure of Australia." It did not contain anything more than a notice of our rocks. The author seems to have visited some of the beds, but did not notice the character of the fossils any more than to state that they were tertiary.

Leichardt made some observations on the geology of Australia, but they were never published; and the few scattered notes of Strezelecki on the geology of South Australia (the south coast) contain only description of one fossil (*Terebratula compta*, Sowby), which should be a *Terebratella*.

In 1859 a notice was sent by Mr. Selwyn to the Geological Society on the classification of our tertiary rocks. Without any reference to fossils, or the evidence on which his summary rests, he merely gives the results of his observation, which are as follows:—The upper gold drift he classes as Post Pliocene, together with the raised beaches and estuary beds. The Newer Pliocene is the older gold drift, with the red marine rocks of Flemington. The Older Pliocene is the lowest of the gold drift, with the Upper Brighton marine beds and the lignite beds of the coast. The Miocene beds are those of Corio Bay, Cape Otway, Murray Basin, and Lower Brighton beds. All marine, he adds, with characteristic Miocene fossils. The Eocene beds are at Schnapper Point, Hamilton, blue clays, with selenite and characteristic Eocene fossils.

The Rev. W. B. Clarke, in a paper read before the Philosophical Society of New South Wales in November, 1861, gives the above division of the Tertiary as one in which he fully coincides; but in commenting on that portion which refers to the Miocene bed he gives an opinion which I think it better to quote. He says:—"Mr. Selwyn ranks the Murray Cliffs as Miocene also. Most of the English geologists have considered them Pliocene; but the late Professor Edward Forbes believed them to be much older; and Dr. Hochstetter thought them older still, judging from some fossils I gave him, and others which he saw in the Museum. As the genus *Spondylus* occurs among them, and that genus has twenty species which are cretaceous and only twenty tertiary, and as *Spondylus* is an Eocene genus in Europe, the Murray deposits may be partly older than Miocene. I must here mention a fact with which I have become acquainted—that within a few months wells have been opened on the Murray Flats, and that at a depth of 120 feet fish teeth, said to be *Carcharodon* and as large as those from Malta, have been found. Now, as *Carcharodon* is a cretaceous and Eocene as well as Pliocene genus, these deposits on the Murray may therefore be probably as old as has been just stated, especially as the shells occur in clay, and not, as in the Murray Cliffs, in yellow limestone." After this Mr. Clarke goes into the evidence for regarding the older gold drifts as Pliocene.

Professor McCoy, in his "Essay on the Ancient and Recent Natural History of Victoria" ("Prefatory Essays to the Victorian Exhibition Catalogue, Melbourne, 1861"), gives a chronology for our Tertiary Rocks, which differs very much from that of Mr. Clarke, and to some extent with that of Mr. Selwyn. He regards the Geelong beds as Lower Miocene, and the Schnapper Point beds as Upper Eocene. From the enumeration of the fossils, however, he would seem to include the Hamilton beds with Geelong, instead of with the Eocene of the east side of Port Phillip.

Last of all, my own work on "The Geology of South Australia" gives a much higher level to the Murray beds and those of Mount Gambier, making

them both Pliocene. Palæontological determinations are, however, carefully avoided, except in the case of the Bryozoa. The corrections in the fossils *Hemiptagus* and *Pecten* have been already alluded to; but it should be mentioned, also, that the figure of *Terebratula compta* belongs to another fossil, not *T. compta*, but probably a new species. The *Nautilus ziczac* appears to be a correct determination, and its presence in the beds at Mount Gambier, while it is also a common Upper Eocene form in the Isle of Wight, is somewhat enigmatical.

I have given above all that has been done, as far as I am aware, towards a description of the tertiary beds of South Australia, with the exception of a paper forwarded by me to the Royal Geological Society, which was embodied with my work, and need not be further alluded to here. My object now is to describe the different beds, as far as I am able, before going into detail as to their palæontological evidences.

The uppermost beds we meet with in South Australia are loose shifting calcareo-siliceous sands, entirely devoid of fossils, and sometimes highly ferruginous. I believe that they are extensively distributed throughout the whole continent; and, as they lie above all the other formations, I believe they are the most recent beds we have—marine beds, that is to say, and excepting the raised beaches and estuary beds. Under these lies a coarse granular calcareous sandstone, easily decomposed, and stretching out upon the coast into reefs of fantastic form. It is irregularly stratified, and lies in patches here and there, sometimes of considerable thickness—as, for instance, Portland Bay. It generally rests there upon an older trap rock.

Underneath this is an extremely brittle white limestone of such fine grain as to be almost like chalk. It contains abundance of fossils and layers of flint. The fossils are confined almost to *Pectenidæ*, *Echini*, and *Bryozoa*, and if any others are found they are only casts. The testa of the *Echini* are always altered into crystalline carbonate of lime, and are often broken. The casts are very white, and are formed of the finest marine mud. No fragments of the original shell can be discovered in them. Corals are never found, but sharks' teeth occasionally, and then not of recent species. The flints are full of fossils, but do not seem to be from fossil sponges. Some strata of the rock are very hard and cherty, and in these the *Pectenidæ* are more numerous; in other places the stone is soft and powdery, not even hardening upon exposure. The above formation is what I generally distinguish as the Mount Gambier limestone. It is capped at Portland Bay by a coarse shelly deposit, on which the fragments are all so much broken that species cannot be identified, excepting a few oyster-shells and some sharks' teeth, belonging to recent species. A small fragment of the same deposit is seen at Mount Gambier.

Of the Murray beds I can say no more than from the descriptions of others; but I have seen a good many fossils, and can state their differences. At the North-West Bend the shells also occur in casts, often in the form of Selenite. Sometimes a mass of *Turritellidæ* is found completely converted into selenite, and quite transparent. The formation seems to abound principally with the above fossil, as well as a large species of *Nautilus*, and a *Waldheimia* also of large size, and, though very different from the *Terebratula grandis*, of the English Pliocene, has still some points of resemblance. *Bryozoa* seem to be common, and corals occur occasionally The tops of the beds are often covered with loose oyster-shells

There can be no doubt that the Murray beds and those of Mount Gambier show remarkable points of difference, though the character of the stone and some of the fossils are similar. It has already been suggested by me that the difference is one of climate and geographical, and not more than we have a right to expect where the latitude of one place is nearly three degrees south of the other. Probably, however, there may be diversities greater than can be accounted for thus. If so, I should consider the Murray beds the more ancient of the two, for reasons which I shall give at length when treating of the chronological arrangement.

The fossil cliffs of the Murray disappear long before the mouth of the river is reached, though I believe there is no dip or any elevation. It would seem to me as if the cliffs are the remains of an extensive formation which covered equally a large superficial extent of the southern portion of the continent. We know that a very great area of our tertiary rocks have been denuded away; in fact, the loose character of the strata renders them so liable to decay that, as before remarked, we only meet with them under circumstances very favourable to their preservation. Yet the fossils do not disappear. In the Murray flats deposits of shells occur, but are generally only obtained by digging. They are decidedly on a lower horizon than the cliffs; and this fact, in a locality where there has been very little disturbance of level, is an important aid in the determination of the relative ages of the beds. The fossils found in the flats are very different from the Mount Gambier shells, but possess some forms in common with those of the cliffs and those of Geelong and Hamilton, to be mentioned subsequently. Altogether, I should consider them passage beds between the cliffs and the deposits, which I shall now refer to.

At Harrow, about 120 miles from the coast, there is a small deposit of shells in ironstone. It it on a little bank in a creek leading into the River Glenelg. The fossils are entirely confined to the surface, and are so broken and worn, so altered, in addition, by a copious infiltration of hydrated oxide of iron, that it is very difficult to make out the species. A long familiarity with the Miocene fossils of Victoria has enabled me to determine a great many of the forms, which I think belong to the Hamilton deposits now to be mentioned.

At the Muddy Creek, a small tributary of the Wannon River, about five miles south of Hamilton, there is a very extensive bed of fossiliferous clays lying under a bed of trap rock some 60 or 70 feet in thickness. The strata, no doubt, owe their preservation to the volcanic stone which covers them, which here, as indeed throughout the whole of the Wannon River, is developed in the form of Doleritic Lava. It is in consequence of an accidental fissure, down which the stream flows, that the beds are revealed; but there can be no doubt that they cover a much greater area of ground than the immediate neighbourhood of the creek, for their characteristic fossils have been brought up from the bottoms of wells sunk at a distance of eight or ten miles. The strata are sometimes loose and sandy, but generally compact and even, in places converted into a hard rock of carbonate of lime. They abound in fossils of every kind, showing an equal deep-sea bottom, on to which shells were swept from neighbouring islands. The aspect of the shells, according to Professor McCoy, denotes a warmer climate, and in fact some fossils are found amongst them which still exist, but only in a much warmer sea—such, for instance, as the large *Pectunculus laticostatus*, Lamk., which is only found now in New Zealand—not, however, in a much warmer sea—the *Flabellum Candianum*, Edw. and Haime, which is only found in the Chinese seas—a *Corbis*, *Crassatella*, and *Harpa*, all of which are now confined to the tropics. It should be mentioned, however, that a more uniform type of life is found throughout the whole of the Miocene deposits—that is to say, shells seem to have had a much wider geographical range than they are known to have now, so that the argument for a warmer temperature is not quite convincing. Again, a good many shells which are found as fossils in Europe in the Miocene strata are found still living in the Chinese or Oriental seas; so that it proves rather a migration and change of habit since the Miocene times rather than a great change of climate. Yet, in spite of all this, most geologists think that there still remains evidence of a difference of climate in the Miocene period, and the beds under consideration seem certainly to favour that idea.

It has also been pointed out that the deposit is very much like what would have accumulated round a chain of rocky islands, not only in the nature of the beds, but in the character of the fauna. Many of the species of fossils are scarcely distinguishable from forms now common in the Philippine Islands. This island character proves two things—first, that the Hamilton beds were deposited under very different circumstances from the Mount Gambier beds, which are deep-sea deposits. Were there no other facts to prove the distinctness of the two this would be sufficient, for both deposits preserve their peculiar characters, and can be traced to within six miles of each other. The second thing is, that the destruction of these islands must form one of the remarkable facts in the geological history of the Australian portion of the earth's surface.

Below these beds Professor McCoy places the Upper Eocene deposits of Schnapper Point; but I have not visited them, and cannot describe them. From the fossils in my possession I can see that they are blue clays, which preserve the most delicate markings on the shells; but of about two dozen specimens, I can only count about three which I have not found in the muddy creek beds; neither have I found any *Foraminifera* nor *Bryozoa*, though I believe the latter are to be obtained.

The difference between the Schnapper Point beds and those of Hamilton is that the former is a dark-blue clay with mica and no *Foraminifera*, and the latter a light-brown ferruginous clay, containing many particles of iron oxide, and teeming with *Foraminifera*, especially *Amphistigina vulgaris*, D'Orb., whose coin-like discs are found in every pinch of the dust. The Murray beds, again, have fewer *Foraminifera*, and the shells are more frequently casts. The Mount Gambier deposits have very few shells at all and no corals, but the beds are made up of broken *Bryozoa*.

I have already indicated the succession of these various formations as I regard them, but I must add that I do not give it as a matter which is decided. The only way to settle their position will be by the determination of their geological chronology, and this can only be done after lengthened investigation. The rule adopted towards all Tertiary Rocks is to ascertain the percentage of existing species in any given bed; and according as it is more or less than others, so it is newer or more ancient. I think we are almost sufficiently acquainted with our coast fauna to be able to enter into such an investigation, but the material wanted is a sufficiently wide examination of the fossils. Tried by such a standard, however, we are not without difficulties in the very first application of the rule. The Mount Gambier rocks do not possess a single shell or urchin which is known to exist upon our shores at present. Now, I have strong reasons for believing that the beds in question are very modern, geologically speaking; but this is certainly a fact which would militate against my view were there nothing else to support it. But, as I said, the shells, &c., are so few in number that we must depend upon the *Bryozoa* for any results we may hope to obtain. Only a very few years ago it would have been hopeless to look for any results from such a source; but now so much has been done in their classification that identifications are more easy with them than in the case of some of the mollusca. What these results are I hope to point out in the course of these papers.

The Hamilton beds being very rich in shells give us a good number which still exist, and many are found common to them and all the other beds; but this should not excite astonishment. Even the Eocene or most ancient tertiary formation contains about 10 per cent. of existing species, and as they can be traced into all the other formations upwards, of course such fossils must be common to all. I am not aware that it has as yet been decided what percentage of peculiar species constitutes a separate formation; but I think we shall find in Australia that each has a sufficient number of peculiar forms to justify a separation. The rule would seem to be that differences which cannot be accounted for by climate and geographical situation should be held to indicate a different kind of marine life, and an epoch in geology.

In accordance with these rules, I would propose the following subdivision of our Tertiary beds which contain fossils:—

Newer Pliocene.—Tertiary beds near Adelaide, Government House quarry, &c.

Older Pliocene.—Mount Gambier, Portland, &c.

Upper Miocene.—Murray Cliffs.

Lower Miocene.—Murray Flats; Victorian representatives—Geelong, Cape Otway.*

---

* In separating the Geelong and Cape Otway beds from those of Hamilton, I believe I am justified by the fossil remains, but in making the Schnapper Point beds Middle Eocene, I differ from Professor McCoy, who makes them Upper Eocene. My reason is this:—Mr. Selwyn makes the Hamilton beds and those of Schnapper Point of the same age, but though many fossils are common to both deposits, they are not contemporaneous. The Hamilton beds are, however, older than those of Geelong, and since Professor McCoy determines the latter to be Lower Miocene, the former must be Upper Eocene. But the Schnapper Point beds are, according to the learned Professor, a step below those of Geelong; therefore they are Middle Eocene—ar

Upper Eocene (not known in South Australia).—Hamilton, Victoria.

Middle Eocene (not known in South Australia).—Schnapper Point, Port Phillip.

I have only made this subdivision provisionally, and with considerable hesitation. I am but slightly acquainted with the Adelaide tertiaries, but I think they contain a large proportion of existing species; and this is a department where the members of the Institute can make useful investigation. Careful comparison of the fossils with good collections of our coast shells is all that is required, and this can be done without any attempt at classification. For my own part I only offer the above classification as a basis upon which to work. This paper is intended as an introduction to a series in which the Mount Gambier fossils will be carefully described. It is only by making ourselves familiar with the fossil forms that we can hope to arrive at any sound conclusion as to the identity or separation of different beds which are found at great distances from each other.

In my next paper I propose giving figures and descriptions of all the *Pectenidæ* of the Mount Gambier beds.

---

age which would tally with the remarkable resemblance shown between the fossils of the Point and those of Barton Cliff, Hampshire. The difference between the Professor's chronology and mine is in my not regarding the Geelong and Cape Otway beds as identical; and in justice to the other side of the question I must admit that the corals hitherto described are Miocene in character, and no characteristic Eocene form, such as *Turbinolia*, has yet been found at Hamilton, but this is also true of the Schnapper Point beds, of whose Eocene age there is no question.

Andrews, Thomas, & Fisher, Printers, Register and Observer Offices, Grenfell Street, Adelaide.