FURTHER NOTES ON THE TERTIARY MARINE BEDS OF TABLE CAPE.

By R. M. Johnston.

[*Read* 11*th July*, 1876.]

In a former paper upon the above subject, I confined my observations principally to the organisms themselves. Since that time I have visited Table Cape, and, assisted by Mr. T. R. Atkinson of this town, I have not only added to my collection a large number of new species, but have by careful investigation become possessed of important particulars which may be of some value in determining the relative position of this interesting deposit.

On approaching Wynyard from the sea, the eye is at first arrested by a bold basaltic headland, rising from the water at an angle of 45 degrees, to a height of about 500 feet. The bold outline and the characteristic level summit at once suggests the idea that the striking object before you must be the well-known Table Cape. On a nearer approach, two smaller rounded bluffs come into view, and are rendered conspicuous by the contrast which their white precipitous cliffs present, as compared with the wooded and sombre slopes of Table Cape proper. The two smaller bluffs are isolated from each other and from Table Cape by narrow valleys formed by erosion, while the larger valley or basin by which the river finds its course to the sea separates them from the little township of Wynyard. Notwithstanding the gaps between the bluffs, an ordinary observer can perceive at a glance that the stratified beds of the smaller ones were at one time continuous, and that the protecting cap of basalt at the same time spread in one continuous sheet over all the adjacent ridges. On closer examination it becomes evident that we have in these two solitary bluffs a small fragment of that raised sea bottom which, most probably, at a recent period connected Tasmania with the continent of Australia. At any rate it is most conclusive that we have in these stratified beds myriads of organisms which were during the tertiary period inhabitants of that vast shallow sea which then covered the greater part of Australia and Tasmania and separated the remaining portions into island groups.*

The bluff nearest to the township of Wynyard is about 160 feet high. The general strike is north and south, and the dip inclines about 5 degrees in a north-westerly direction ; and at this angle the beds disappear at sea level under the great basaltic promontory of Table Cape. As the series of beds

* See the Rev. J. E. Tenison-Woods' paper.

forming the deposit attains its greatest thickness in the bluff nearest to the township, and as the same relative characters are maintained at other places where the beds are exposed I have chosen this point as the most suitable for illustrative purposes. [The accompanying diagram will show the relative extent and position of the various beds.]

Conceive, therefore, a white, beetling sea-cliff, whose base is obscured by enormous blocks of sandstone which, by the ceaseless undermining action of the sea, have recently been dislodged from the various ledges high overhead.

Those restless sea waves by which they were originally formed are now at once engaged in their destruction, and in re-arranging out of the same materials a very similar set of sandstone beds in the quiet coves of the neighbourhood. Thus we have the work of destruction and construction carried on by the same agency, and although we may find in the new arrangement a certain parallelism with the older formation; yet there are differences at once striking and instructive. For example—while the particles of sand forming the original rock have only been subjected to a little more tear and wear, the included organisms are in every case wholly dissolved. It is true that the existing types of life which find a home and a grave in the new formation may have secreted in their tests the same elements which formerly entered into the composition of the tests of the organisms of the older formation, but the forms themselves are very different in appearance. Were the present sands consolidated and elevated into a series of cliffs corresponding to those which now exist along the shore, the most careful observation might fail to find any organism having its exact counterpart in the older formation. The characteristic shells—

Trigonia semi-undulata; Pectunculus laticostatus; Cucullea corioensis; C. cainozoica; Voluta anticingulata; V. weldi, etc., and the Polyzoa *Cellepora gambierensis; C. nummularia*; *C. hemispherica; C. spongiosa; Sâlicornaria sinuosa.*—Corals—*Plachotrochus deltoideus; P. elongatus, etc., etc.*, of the older formation, are not found in the new formation, whilst the characteristic shells of the latter—*Trigonia margaratacea; Waldheimia australis; Venus roborata; Phasianella australis; Nassa pauperata, Risella nana, etc., etc.*, are nowhere to be found in the beds of the former.

I shall now give a brief description of the various rock divisions of the section given in the diagram, and in following a downward order I shall offer such observations as may be necessary to impart to the members of this Society; some knowledge of the composit and relative extent of the various beds and their included organisms. My work in this particular is rendered comparatively easy by what is now being carried on by the Rev. J. E. Tenison-Woods, in classifying and describing the organisms themselves.

BASALTIC CAP *(a.)*

It is a singular feature connected with the older stratified rocks that, where exposed as cliffs, they are invariably capped with sheets of igneous rock. It would seem that where the soft stratified beds were unprotected by a capping of this sort they have been washed away entirely or eroded into valleys of which Fingal Valley may be taken as a type. This supposition would fully account for the vast districts of elevated table lands in Tasmania, everywhere terminating in precipitous bluffs. A corresponding feature on a smaller scale may be seen in connection with the stratified beds of tertiary age, of which the Table Cape beds form a striking example. It is probable that the deposit which forms the main subject of the paper would have been entirely wasted away long ere this time had it not been that during a late volcanic period it was covered with sheets of basalt and basaltic tuff. The bluff already mentioned is covered by a cap of basalt and basaltic tuff about 80 feet in thickness. This cap, though shown in diagram to be separate from corresponding caps in the neighbourhood must have, prior to the erosion of the valleys, formed with them one continuous sheet.

The basalt at the only place where a face is exposed is greatly decomposed, and at first sight it might be inferred that the basaltic capping might be the re-arranged *detritus* of a basalt older than the rock which it now reposes upon. This inference is however extremely improbable, inasmuch as there is not the slightest evidence to show that the cap has been the result of the re-distribution of older material. It may be remembered that in a former paper I described a similar cap of basalt, overlying the beds of lignite at Breadalbane.

As they presented a superficial resemblance I determined to subject them to analytical comparison, and for this purpose I sent specimens of the rocks in question to Professor Ulrich, of Melbourne, whose labours in connection with the rocks of Australia have obtained for him a wide-world reputation. After making sections of the rocks, and subjecting them to microscopic examination he thus writes with reference to the Table Cape basalt :—" The rock is somewhat similar to some of our recent basalts here, viz., it is essentially a feldspar basalt with very little augite ; lots of glass and magnetic titaniferous iron, and rendered porphyritic by abundant grains and crystals of olivine. It differs from the basalt of Breadalbane by that the latter contains abundance of augite in well developed crystals." "These mineral differences are however no criterion of age; for we have here genuine miocene basalts which can, mineralogically, not be distinguished from recent pliocene ones. If the feldspar were replaced by Nephelene or Leucite throughout a basalt sheet, we might perhaps be justified to declare the geological age, within certain limits, different from that of an adjoining feldspar basalt flow, but even in this instance great care is required, especially if conclusions are to be drawn as to the age of underlying rocks." Happily we have now a more reliable index to the age of the underlying rocks than may be obtained from the comparative analysis of the constituents of igneous rocks; it is, however, satisfactory that the learned professor's analysis tends to confirm the opinion which I formerly entertained, viz., that the protecting cap overlying the marine beds at Table Cape is *a recent basalt*, and very slightly differs from a similar flow which overspreads the lignites at Breadalbane.

In order to ascertain whether the intrusive rock, mentioned by Mr. Allport in connection with the Travertin at Geilston Bay, is of a similar character to the rocks at Breadalbane and Table Cape, Professor Ulrich has, in a letter to me, kindly volunteered to analyse any specimens from that quarter sent to him. For this purpose, Mr. Allport, on being applied to, at once procured and forwarded an interesting suite of specimens. It will be of great value to have an established relationship with the various basaltic rocks in Tasmania and Victoria. The rock known as the "older volcanic" in Victoria is very similar to the rock at Table Cape, and, like it, the "older volcanic" frequently caps the marine beds considered to belong to the miocene age.*

I regret that I could not find an accessible spot to ascertain whether the sandstone, upper bed, was altered at point of junction with the basalt or not. Perhaps some future observer may be more fortunate in this respect.

TURRITELLA GROUP (*b.*)

Following the descending order we come upon the group of beds which immediately underlie the basalt as already described. The group has been named by me in the diagram as the "Turritella Group," because the small shell, *T. warburtonii* (Tenison-Woods), so abounds through this particular formation as to give it a character which would be sufficiently distinctive when compared with the only other

* I have since been informed by Mr. Ulrich that the composition of the intrusive rock at Geilston Bay is similar to that at Breadalbane and Table Cape.

division of which the tertiary marine deposit at Table Cape is composed. The group is about 80 feet thick where fully exposed, and consists of a series of beds of white or gray calcareous sandstone, more or less firmly consolidated.

Although there are some of the beds in which scarcely any other organism can be seen but the Turritella already referred to; yet there are others in which organisms are extremely varied and abundant.

There are also bands frequently occurring throughout the group, some of them can be traced horizontally for about a mile perhaps, in which *Cellepora gambierensis* (Busk) seems to be particularly abundant.

So much does the latter organism appear to be abound in these bands, that I am of opinion that it is owing to the segregation of the carbonate of lime around this coral, that the great relative hardness cf these bands is due.

The other forms which give a character to these curious bands appear to be Echinodermata and Brachiopoda. Of six distinct species sent to the Rev. J. E. Tenison-Woods for diagnosis,the form resembling *Hemipatagus woodsii* (Etheridge) (so called after the learned gentleman just referred to) seems to be the most abundant. Among the seven species of Brachiopoda found, the most conspicuous is the fine shell, *Waldheimia gambierensis* (Tenison-Woods), also described from specimens supplied by the Rev. J. E. T. Woods, from Mount Gambier, South Australia. The most abundant, however, is a species of Terebratula, resembling a large *T. compta* (*Teribratella tenisoni*, Tenison-Woods).

In the less indurated sandstone beds, or between the bands already described, I have discovered 15 or 16 species of Polyzoa and Corals among which I have been able to recognise many of the Mount Gambier forms, described in "Observations on the Geology of South Australia" by the Rev. J. E. Tenison-Woods, viz., *Cellepora nummulina, C. spongiosa, Salicornaria sinuosa, Plachotrochus deltoides, P. elongatus? Flabellum victoriae? F. gambierense?* etc., etc.

As we approach the point of junction with the underlying division we come upon forms common to both divisions, and only distinguished by relative abundance, among which I may mention—*Typhis M'Coyi* (Tenison-Woods); *Voluta anticingulata* (M'Coy); *Ancillaria mucronata* (Sow); *Natica Wintlei* (Tenison-Woods); *Cucullea cainozoica* (Tenison-Woods); *C. Corioensis* (M'Coy); *Pectunculus laticostatus* (M'Coy) (Tenison-Woods); *Nucula tumida*, a small species of *Cardita*; a small species of *Myadora*; and two species of Pecten, one of them being an extremely minute species.

Altogether this group presents a facies so similar to that described by the Rev. J. E. Tenison-Woods, as belonging to the limestone beds of Mount Gambier, that the description of the latter would almost suffice for the Turritella Group of Table Cape, e.g., in page 75, *Geo. So. Austral.*, the following description of the Mount Gambier beds is given—"It is here seen that in addition to a distinct line of stratification, dividing the rock into layers about fourteen feet thick, there are regular zones where particular fossils are associated. Thus, at the first bed (fourteen feet) little is seen but *Bryozoa* and *Terebratulae;* in ten feet next, less of the moss corals, and mere Pectens; the next is almost exclusively composed of a Pecten common to this formation with imbricated striæ called *Pecten coarctatus,* and a cellopore coral subsequently to be described (*C. gambierensis*). This state of things is nearly continued to the bottom, where Echini and Reteporæ combine with the general mass." Had the learned author added that the small shell *Turritella warburtonii* was found in great abundance throughout the mass I should have supposed that he was giving an exact description of the Turritella Group at Table Cape.

THE CRASSATELLA BED.

We come next to the lowest division of the marine deposit. For itself as a rock it hardly deserves to be considered as separate from the Turritella Group, which rests immediately upon it, were it not for the fact that it appears to have been accumulated under different circumstances. The nature and relative abundance of the organisms contained in it also give a character which though most probably brought about by local circumstances is yet most peculiar and sufficiently distinctive. In making a distinction, therefore, between the Turritella Group (b.) and the Crassatella Bed (c.), it is not to be understood that the forms of the lower are nowhere to be found in the higher, and *vice versa.* All that is meant by the distinction is that the characteristic shells of the lower bed or division suddenly diminish in quantity as we enter the higher group and as we ascend even these gradually disappear.

We also observe that certain forms, especially Corallines and Terebratulæ, abundantly appear in the upper beds in bands, which were rarely seen or altogether absent from the lower.

The Crassatella bed is extremely variable in thickness, for in some places it attains a thickness of three and four feet, while at other places it is reduced to a mere band of 3 and 4 inches thick. Everywhere throughout, however, it preserves a uniform character.

I have named it in this paper the *Crassatella Bed,* because this organism belongs almost exclusively to it, and in some places it is so abundant that it forms distinct layers. The bed itself may be said to be composed of an irregular agglomeration of shells bound up in a matrix of ferruginous looking mud.

This substance is very fine and soft, and seems to have a wonderful preservative property, for many of the shells invested by it have not only the fine enamel preserved but in many cases the gelatinous epidermal membrane of a species of Pecten (possibly *P. coarctatus* ?), as perfect as though it still contained the living animal.

In this mud I have also found grit and rounded pebbles of a yellowish quartz very abundant. The fine yellow muddy substance is itself principally composed of the comminuted remains of various species of foraminiferæ. Perfect forms of the latter are, however, abundant, among which I have noticed various species of *Rotalia*, *Marginulina*, and *Textularia*. I intend, at some future time, to study these microscopic forms more carefully.

Although the exposed face of this shelly rock is extremely hard, yet when masses of the rock are detached they are found to be extremely friable, and with ordinary care the most delicate shells may be easily extracted. Unfortunately many of the latter are already so fractured in the rock that when separated from the matrix they fall to pieces. There are numerous small caves hollowed out of this rock by the waves of the sea at high tide—along the Sandstone Cave, and it is from the roof of some of these caves that some of the most interesting species of shells have been obtained. The greater number of species have also been obtained from this bed. As their number is so large I have prepared a complete list in a tabular form in another place.* It is only necessary to state here the names of those species, which from their extraordinary size and abundance, give a distinctive character to this small but interesting division, viz.—

*Typhis m'coyi (Woods).

Cyprea platypyga (M'Coy) Murex eyrei, Fusus roblini. *Spondylus.

Cyprea platyrhynca (M'Coy) *Cassidaria reticulospira, Pectunculus laticostatus (Lamarck).

Cyprea archeri (Woods), Cassis sufflatus (Tenison-Woods), Cucullea corioensis (M'Coy).

Voluta anticingulata (M'Coy), Lyonsia agnewi (Tenison-Woods).

*Trivia europea, Voluta hannafordia (M'Coy), Crassatella oblonga (Tenison-Woods).

* See Tabular List.

Voluta weldii (Tenison-Woods).
Ancillaria mucronata, Venus allporti (Tenison-Woods).
Venus cainozoica (Tenison-Woods).
*Trochita calyptræformis, Desh.
*Crepidula.
*Fissurella.
*Emarginula transenna (Tenison-Woods).
Turritella sturtii (Tenison-Woods), n.s.
Turritella warburtoni, ditto, n.s.
Columbella oxleyi, ditto, n.s.
Marginella wentworthii, ditto, n.s.
Delphinula tetragonostoma, ditto, n.s.
Zizyphinus blaxlandi, ditto, n.s.
Margarita kekwickii, ditto, n.s.
Tenagodus occlusus, ditto, n.s.
Pleurotoma johnstonii, ditto, n.s.
Astralium (Calcar) flindersii, ditto, n.s.
Astralium (Calcar) ornatissimum, ditto, n.s.
Lima squamosa, ditto, n.s.
Cardita gracilicostata, ditto, n.s.
Chione propinqua, ditto, n.s.
Nucula tumida, ditto, n.s.
Leda cerebrecostata, ditto, n.s.
Cucullea cainozoica, ditto, n.s.
Terebra additoides, ditto, n.s.

It is also important to notice the occurrence of fossil wood greatly decomposed in this deposit, and occasionally the teeth of two species of shark which had a world-wide distribution during the tertiary period, viz., *Lamna elegans*, *Charcharodon angustidens* (Ag.)†

Of the latter Professor McCoy writes :—" The present species, even as originally restricted by Agassiz, is one of the most abundant and characteristic miocene tertiary fossils of every part of Europe and America in which strata of this age exist, and I recognised it amongst the Australian beds to which I assigned miocene and oligocene with great astonishment, from this evidence of its world-wide distribution in the tertiary period."

CONGLOMERATE *(d.)*, AND SLATE *(e.)*

The rock forming the floor upon which the marine deposit at Table Cape has been thrown down is a highly indurated conglomerate. It presents a very irregular outline, and forms

* New species not yet described.
† Discovered by A. Willis, Esq., Wynyard.

all the numerous dangerous reefs between Table Cape and Emu Bay.

I am of opinion that this is the same conglomerate which crops out on the *Dial Range*, and which is assigned by Mr. Gould to Silurian age. It is composed of highly altered water-worn pebbles derived from various ancient rocks. Some of them are derived from a dark crystalline limestone, which appears to be non-fossiliferous.

One remarkable block, however, was, so far as I could learn, picked out of this conglomerate by Mr. James Smith, of Westwood, Forth. It is highly fossiliferous, the prevailing form, as shown in various sections, is undoubtedly a species of Brachiopod. I have not sufficiently studied this rock. I have observed, however, that it has been greatly subjected to denudation, and that it rests, so far as I could see, unconformably upon a more or less inclined slate rock.

GENERAL.

I have thus referred as briefly as possible to the vertical distribution of the organisms contained in the tertiary marine beds at Table Cape. It is of the utmost importance, prior to establishing any relations with similar isolated deposits elsewhere in Tasmania, Flinders Island, or the continent of Australia* that each isolated bed or series of beds should be fully investigated, especially as regards the extent and distribution of its organic contents.

While I do not deny that reasonable inference or conjecture, so long as it is recognised as provisional, is most useful in stimulating enquiry and helps to make interesting what would otherwise be a chaos of isolated observations, yet as the tendency to create minor subdivisions with reference to distant European beds, is in many instances too apparent, it may be the means of introducing much error into our classification.

Among recent geological authorities of eminence, perhaps, no one has drawn more particular attention to this source of error than the late respected Mr. Jukes.

In connection with chronological observation he thus writes (p. 409, manual). "In order to avoid error each great district of the earth, such as Europe or North America should be surveyed separately, without reference to anything out of the district, and that the order of superposition of its strata and their classification into groups or formations, should be settled independently on evidence to be found in the district only. When this has been done the two series may be compared, and the synchronism of different parts of each may be decided on."

If such care be necessary in the determination of the great

* See table.

classes themselves, it is surely more necessary to be careful in our classification of the isolated beds of a system into sub-divisions, when we take into consideration the horizontal distribution of organisms as affected by migration of colonies, physicial barriers and local influences.

As an example of classification which might ignore the effect of migration of species, it is interesting to notice that although the shell *Pectunculus laticostatus* (Lamarck)* so abundant in the lower shell bed at Table Cape, is not now found living near the shores of Australia or Tasmania, it still exists in abundance on the coast of the distant colony of New Zealand. It is possible that this shell had a wider distribution during the tertiary period; but if there be evidence to the contrary, it is probable that change of circumstances have caused the species to migrate from its original centre, and that the great distance of our coast from the shores of New Zealand, represent horizontally or in space, the long duration of time necessary for the slow migratory progress of such an organism.

Take again the following instance:—

In the Turritella† limestone of Flinders Island, there occurs three species of shells also common to Table Cape deposit; one of them being the shell so abundant at the latter place. *Cucullea cainozoica* (Tenison-Woods.) Had an observer only reported the discovery of these three forms, without reference to their abundance or associated organisms, it would be a reasonable enough inference, so far as evidence went, that they belonged to the same sub-division. But as I have fuller evidence which informs me that, with the exception of the organisms already referred to, the characteristic shells of Flinders Island, though there very numerous, had never been detected in the beds of Table Cape. This knowledge, taken in conjunction with the consideration that the latter beds have now been very fully investigated, is sufficient to postpone the final co-relation of these deposits until the other isolated formations, of a similar character, afford some additional clue to their exact position.

As an example of local distribution in the same bed at Table Cape, I noticed, especially that *Cylichna arachis* (Quoy) though very common at one particular point, could be found nowhere else in the same horizon or indeed anywhere else. This is another important consideration when comparisons

* At Table Cape this shell has invariably 29 radial ribs, not 39 as figured and described by Prof. McCoy in the Victorian Decades.

† A very different species to that which characterises the Turritella group at Table Cape.

are sought to be made with various isolated deposits widely separated.

Generally, horizontal extension of a particular species from its orignal centre may represent a period of time during which vast deposits may have accumulated, vertically, on the original habitat, where each succeeding layer, perhaps, shewed a gradual extinction of the older forms, and the introduction of a new class of organisms. Thus, for example, could we depress the present group of tertiary beds at Table Cape so that the marine beds now in process of formation rested conformably upon them; a vertical section would show such a complete change in the character of the various beds as to justify the local geologist in sub-dividing his section into separate groups with, locally speaking, well marked characters. At the same time could we follow the horizontal movement of organisms as they gradually disappeared from the original centre, we would yet find in a very far distant part of the earth's surface, that amid all the vicissitudes of migratory change, a few persistent forms of the lowest stratum of the original centre would still be found to be the true contemporaries of those new forms which gave a complete change of character to the upper beds.

It follows from considerations of this nature that the existence of a few specific forms common to two or more widely separated deposits, is, in itself, no guarantee that they belong to the same subdivision of a great class; or even to the great class division itself.

Such being the case we should accept with the greatest caution the subdivisions of the various widely separated tertiary marine deposits of Victoria into *Oligocene*, *Miocene*, and *Pliocene*, until we know more fully the extent and quality of the evidence which forms the basis of their classification.

It also follows that until we have worked up independently and fully each deposit of the tertiary period, and also compared them with a fully worked up list of existing forms in the same neighbourhood, any attempt at classification will be premature and misleading.

Being deeply impressed with the importance of such considerations I have most carefully gone into the investigation of our Table Cape marine deposit, and I have been rewarded in the discovery of the remains of at least 150 distinct specific organisms. When the great number of new species are described and classified by the Rev. J. E. Tenison-Woods, to whom science in Tasmania is already so deeply indebted, we shall then be in a better position to compare with similar deposits elsewhere and with the existing forms in our own neighbourhood. But it is not enough to have our own deposits worked up with care. It will be useless to make comparisons with the deposits of Victoria or New South Wales without the co-operation of the naturalists and geologists of Australia generally.

This might be most effectually brought about by appeals to the various learned societies in Australia and New Zealand to make exchanges with us and to send catalogues of their classified fossils, with descriptions of habitat and distribution.

For this object I have arranged the marine fossils at Table Cape into a tabular form, which not only shows at a glance the distribution, so far as known, throughout the Australian deposits, but also, by signs, is made to show the relative abundance of each particular organism. Were the various learned societies to aid in classifying their fossils in a similar way, we would then be able to dispel all doubts with regard to the present classification. Co-operation, therefore, is at the present time of the utmost necessity, and I trust that the members of the Royal Society of Tasmania will take the initiative in a work so desirable and of such importance.

Note.—In the table the following signs are used :—† Not yet described, or being examined for description by the Rev. J. E. Tenison-Woods. *a*, common ; *b*, abundant ; *c*, very abundant ; *x*, not uncommon ; *y*, rare ; *z*, very rare ; *l*, still living.

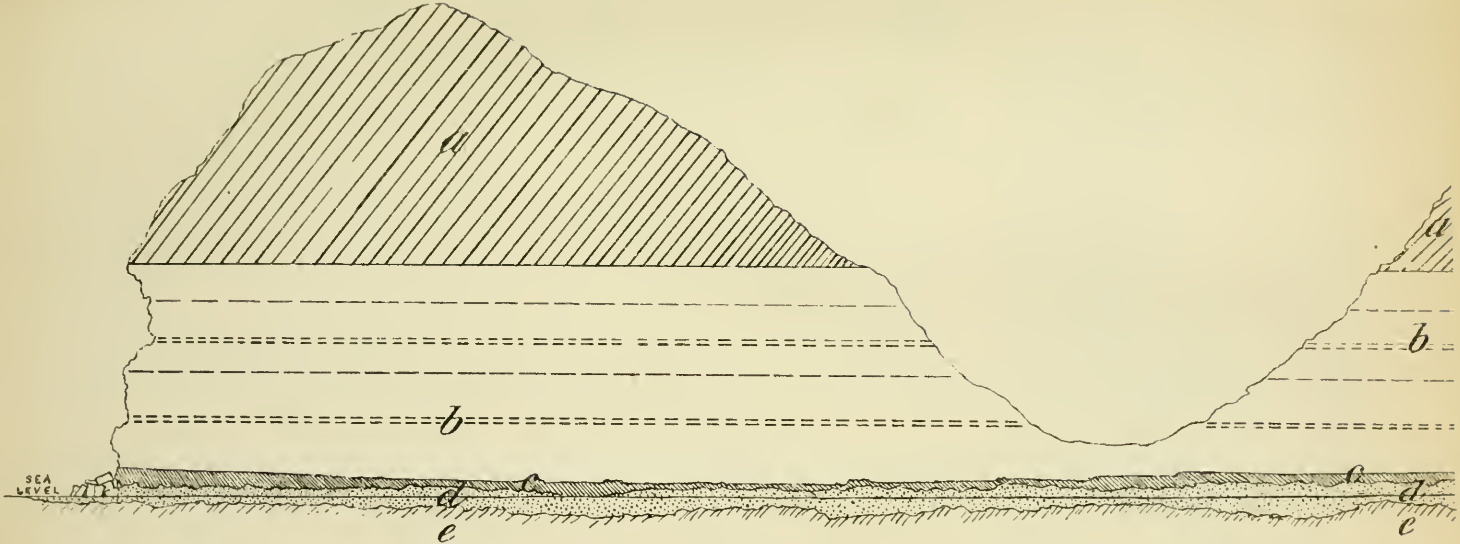
The following also occur in abundance at Table Cape:—

CORALS.

Heliastrea cainozoica (Tenison-Woods), Table Cape.
Balanophyllia australiensis (Duncan), Table Cape, and S.A.
Ditto nov sp., Table Cape.
Trochoseris Woodsi (Duncan), South Australia.
Conotrochus McCoyi (Duncan) Table Cape and South Australia.
Ditto nov. sp, Table Cape.
Sphenotrochus excisus (Duncan) Table Cape.
Antillia lens (Duncan), Table Cape.
Plachotrochus elongatus (Duncan), Table Cape and Mount Gambier.
Ditto deltoideus (Duncan) ditto.
Caryophyllia viola (Duncan), Table Cape.
Dendrophyllia Duncani (Tenison-Woods).Table Cape.
Flabellum Duncani (Tenison-Woods), Table Cape.
Ditto victoriæ, Table Cape and South Australia.
Ditto gambierensis, ditto.

POLYZOA.

Cellepora gambierensis (Busk)	Table Cape	and Mount Gambier.
Ditto spongiosa	,,	,,
Ditto nummularia	,,	,,
Ditto hemispherica	,,	,,
Pustutipora ramosa (Tenison-Woods)	,,	,,
Buskia typica	,,	,,
Retepora sp.	,,	,,



SECTION SHOWING POSITION OF TERTIARY MARINE BEDS AT SANDY COVE BLUFF, TABLE CAPE.

a. Cap of recent basaltic *tuff* and *wacke* ... ... 80 feet

b. Group of beds composed of calcareous sandstone, in which a small species of Turritelli (*T. Warburtonii*, Woods) abounds. Bands also frequently appear, containing abundant remains of corals, echinoderms, and brachiopods... 78 feet

c. Crassatella bed ... ... 80 feet

d. Metamorphosed conglomerate ... ... ——

e. Highly inclined micaceous slate ... ... ——

C MPARATIVE TABLE SHOWING DISTRIBUTION OF AUSTRALIAN MARINE TERTIARY SHELLS, ETC.

NAME OF SPECIES.	*Tasmania*		*Flinders Isld. Group.*				*Victoria.*															*S. Aus.*		*W. Aus.*		*Species Still Existing.*	
	Table Cape	Ten miles south Cape Grim.	Turritella Limestone Heathy Valley	Oyster Bed, River Arthur	Hummock Island	Cameron's Inlet	Flemington	Mornington	Corio Bay	Birds Rock Point, Geelong	Mordialloc	Mt. Eliza	Mt. Martha	Schnapper Point	Moorabool (Maude)	Mth. Gellibrand Rv.	Fyan's Ford	Mouth of Lakes, Gippsland	Muddy Creek, Hamilton	Jemmy's Point		Mount Gambier	Aldinga Beds			In Tasmania	Elsewhere.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
ASTEROPODA.																											
ex eyrei, enison-Woods	x																		c								
us Meredithæ, ditto	c																										
o Roblini, ditto	z																		c								
o Johnstonii, ditto	z																										
o Tateana, ditto	c																										
o, ditto	z																										
o, ditto	z																										
o, ditto				c																							
o transenna, ditto	z																										
on Abbotti, ditto	b																		c								
o minimum, ditto	c																										
cinum fragile, ditto	c																										
phon ditto, ditto	c																										
ainella lyræcostata, ditto	a																										
to cancellata, ditto	a																										
ila marginata, ditto	z																										
ssa ditto, ditto				c																							
ebra additoides ditto	c																										
to simplex, ditto	y																										
sis sufflatus, ditto	z																										
to ?	c																		c								
sidaria reticulospira, M'Coy	x																										
rnola bifasciata Tenison Woods	z																										
tæon scrobiculatus, ditto	c																										
umbella oxleyi, ditto	x																										
to cainozoica, ditto	x																										
urotoma Johnstonii, ditto	y																		c								
to paracantha, ditto	a													c					c								
tto sandleroides, ditto	z																										
tto pullulascens, ditto	x																										
tto ?	z														c												
tto ?	z														c												
tto ?															c												

NAME OF SPECIES.	*Tasmania*		*Flinders Isld. Group.*				*Victoria.*															*S. Aus.*		*W. Aus.*		*Species Sti Existing.*	
	Table Cape	Ten miles south Cape Grim	Turritella Limestone Heathy Valley	Oyster Bed, River Arthur	Hummock Island	Cameron's Inlet	Flemington	Mornington	Corio Bay	Birds Rock Point, Geelong	Mordialloc	Mt. Eliza	Mt. Martha	Schnapper Point	Moorabool (Maude)	Mth. Gellibrand Rv.	Fyan's Ford	Mouth of Lakes, Gippsland	Muddy Creek, Hamilton	Jemmy's Point		Mount Gambier	Aldinga Beds			In Tasmania	Elsewhe
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
GASTEROPODA—*continued.*																											
Pleurotoma (?)															*c*												
Ditto (?)	*z*																										
Ditto (?)	*z*																										
Ditto (?)	*z*																										
Ditto (?)	*z*																										
Ancillaria mucronata, Sow.	*c*																										Doubtfu
Voluta Hannafordii, M'Coy	*x*											*y*	*y*						*c*								
Ditto, ditto	*z*																										
Ditto anticingulata, ditto	*c*									*b*									*c*								
Ditto antiscalaris, ditto	*c*												*x*						*c*								
Ditto Weldii, Tenison-Woods	*c*																		*c*								
Ditto macroptera, M'Coy	*a*										*x*								*c*								
Ditto granatina, Swainson	*z*																										
Ditto M'Coyi, Tenison-Woods	*z*																										
Ditto, ditto	*z*																										
Ditto, ditto	*z*																										
Ditto, ditto	*a*																										
Ditto, ditto	*a*																										
Marginella Wentworthi, ditto	*c*																										
Ditto strombiformis, ditto	*c*																										
Ditto octopticata, ditto	*z*																										
Ditto, ditto	*z*																										
Cypræa (Aricia) gigas, M'Coy												*y*															
Ditto platypyga, ditto												*z*															
Ditto platyryncha, ditto	*a*									*x*																	
Ditto gastroplax, ditto												*y* *b*	*b*														
Ditto eximia	*y*																										
Ditto Archeri, Tenison-Woods	*c*																										
*Ditto (Trivia) europea, Montfort	*z*																										Britain
Ditto arellanoides, M'Coy									*y*			*a*	*a*						*c*								
Ditto, ditto	*z*																										
Daphnella columbelloides, Tenison-Woods	*z*																										
Ditto tenuisculpta, ditto	*a*																										
Ditto gracillima, ditto	*c*																										
Mangelia gracilirata, ditto	*c*																										

NAME OF SPECIES.	Tasmania		Flinders Isld. Group.				Victoria.															S. Aus.		W. Aus.		Species Still Existing.	
	Table Cape	Ten miles south Cape Grim	Turritella Limestone Heathy Valley	Oyster Bed, River Arthur	Hummock Island	Cameron's Inlet	Flemington	Mornington	Corio Bay	Birds Rock Point, Geelong	Mordialloc	Mt. Eliza	Mt. Martha	Schnapper Point	Moorabool (Maude)	Mth. Gellibrand Rv.	Fyan's Ford	Mouth of Lakes, Gippsland	Muddy Creek, Hamilton	Jemmy's Point		Mount Gambier	Aldinga Beds			In Tasmania	Elsewhere.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
STEROPODA—*continued.*																											
ica Wintlei, enison-Woods	c																		c								
o vixumbilita, ditto	z																										
o polita, ditto	c																									l	Bruni Isld.
o, ditto	x																										
bonilla, lyræostata, ditto	x																										
o pagoda, ditto	x																										
o, ditto	x																										
o, ditto				c																							
midella Rorti, ditto																											
tium				c																							
limella subuta, Donov.	z																										Europe
thium Flemgtonensis, 'Coy							c																				
o	c																										
o	c																										
o	c																										
thiopsis Johnonii, Tenisonoods	z																										
aria?	z																										
itella Tasmana, Tenisonoods	c																										
o Sturtii, ditto	c																										
o Warburtoni, tto	c																										
o, ditto	c																										
o, ditto	c																										
o, ditto	c																										
o, ditto			c																								
o, ditto			c																								
netus conohe-, ditto	x																										
o, ditto	x																										
o, ditto	x																										
igodus occlus, ditto	c																										
oa Stevensiana tto	c																										
oina varicifera, nison-Woods	c																										
o	a																										
oTateana, ditto	c																										
o Johnstoni, tto	c																										
o				c																							
o				c																							
o				c																							
o Etheridgii, tto	c																										
erator 'Asalium imperiis ?'	y																										NewZealand
hus Josephi, nison-Woods	y																										

NAME OF SPECIES.	*Tasmania*		*Flinders Isld Group.*				*Victoria.*															*S. Aus.*		*W. Aus.*		*Species Stil Existing.*	
	Table Cape	Ten miles south Cape Grim	Turritella Limestone Heathy Valley	Oyster Bed, River Arthur	Hummock Island	Cameron's Inlet	Flemington	Mornington	Corio Bay	Birds Rock Point, Geelong	Mordialloc	Mt. Eliza	Mt. Martha	Schnapper Point	Moorabool (Maude)	Mth. Gellibrand Rv.	Fyan's Ford	Mouth of Lakes, Gippsland	Muddy Creek, Hamilton	Jemmy's Point		Mount Gambier	Aldinga Beds			In Tasmania	Elsewher
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
GASTEROPODA—*continued.*																											
Thalotia alternata, Tenison-Woods	*y*																										
Gibbula crassigranosa, ditto	*b*																										
Ditto Clarkei, ditto	*x*																										
Ditto æquisulcata, ditto	*x*																										
Astralium (Calcar) Flindersii, ditto	*c*																		*c*								
Astralium (Calcar) ornatissimum, Tenison-Woods	*y*																		*c*								
Margarita Keckwickii, ditto	*c*																										
Zizyphinus blaxlandi, ditto	*y*																										
Delphinula tetragonostoma, ditto	*z*																										
Liotia tasmanica, ditto	*z*																										
Ditto discoidea, ditto	*z*																										
Ditto lamellosa, ditto	*z*																										
Solarium (Torinia) gibbuloides, ditto	*x*																										
Fissurella concatenata, ditto	*z*																										
Emarginula. transenna, ditto	*z*																										
Crepidula lævis, ditto	*z*																										
Trochita	*c*																										
Cylichna arachis (Quoy)	*c*																										Australi Tasmar
Humphreyia, ditto	*x*																										
Dentalium Kicksii Nyst.	*c*																		*c*								
Ditto lacteum (?) Deshayes	*a*																		*c*								Indian O.
BRACHIOPODA.																											
Terebratulina Davidsoni, A. Etheridge																						*b*					
Ditto, Tenison-Woods	*c*																										
Ditto, ditto	*z*																										
Waldhemia Garibaldiana, Davidson																											
Ditto Tayleri, ditto																						*b*					
Ditto gambierensis ditto	*b*																					*b*					
Ditto, ditto (?)	*x*																					*b*					
Ditto, ditto (?)	*z*																										
Ditto, ditto (?)	*z*																										
Terebratella compta, Sow.																											
Rhynconella lucida M'Coy	*c*																					*b*					

NAME OF SPECIES.	Tasmania: Table Cape	Tasmania: Ten miles south Cape Grim	Flinders Isld. Group: Turritella Limestone Heathy Valley	Flinders Isld. Group: Oyster Bed, River Arthur	Flinders Isld. Group: Hummock Island	Flinders Isld. Group: Cameron's Inlet	Victoria: Flemington	Victoria: Mornington	Victoria: Corio Bay	Victoria: Birds Rock Point, Geelong	Victoria: Mordialloc	Victoria: Mt. Eliza	Victoria: Mt. Martha	Victoria: Schnapper Point	Victoria: Moorabool (Maude)	Victoria: Mth. Gellibrand Rv.	Victoria: Fyan's Ford	Victoria: Mouth of Lakes, Gippsland	Victoria: Muddy Creek, Hamilton	Victoria: Jemmy's Point	Victoria	S. Aus.: Mount Gambier	S. Aus.: Aldinga Beds	W. Aus.	W. Aus.	Special Still Existing: In Tasmania	Special Still Existing: Elsewhere.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
ONCHIFERA.																											
ea	c																										
:o	z																										
.o				c																							
na Bassi, Teni- n-Woods	c																										
squamosa, amark																											
tto subauricu- ta, Montf.	x																										
atula (?)	x																										
ndylus	y																										
:o	y																										
ullea corioensis 'Coy	c																										
o cainozoica, enison-Woods	c																										
a	y																										
tto, ditto	y																									c	
ctunculus lati- status	c																		c								NewZealand
uopsis Belcheri, roc.	z																										Cape
:o aurita, ditto																											Deep seas
ula tumida, enison-Woods	c																										
a crebricostata tto	c																										
ma lamellifera, tto	c																										
us Allporti, tto	a																										
:o Chione) pro- nqua, ditto	c																										
:o cainozoica, tto	c																										
:o, ditto (?)	z																										
:o, ditto (?)	z																										
lita gracilicos- ta, Tenison- 'oods	c																										
:o ?, ditto	y																										
lium (?)	c																										
o ?)	c																										
ssatella oblonga enison-Woods	c																										
o aphrodina, tto	y																										
ina cainozoica, tto	c																										
curtus Le- andi, ditto	x																										
nsia Agnewi, tto	c																										
dora (?)	y																										
o ?)	c																										
onla acuticos- ta, M'Coy																											
o semiundu- ta, ditto	c																										
o Howittii, tto																											
sella (?)	z																										

NAME OF SPECIES.	*Tasmania*		*Flinders Isld. Group.*				*Victoria.*															*S. Aus.*		*W. Aus.*		*Species Still Existing.*	
	Table Cape	Ten miles south Cape Grim	Turritella Limestone Heathy Valley	Oyster Bed, River Arthur	Hummock Island	Cameron's Inlet	Flemington	Mornington	Corio Bay	Birds Rock Point, Geelong	Mordialloc	Mt. Eliza	Mt. Martha	Schnapper Point	Moorabool (Maude)	Mth. Gellibrand Rv.	Fyan's Ford	Mouth of Lakes, Gippsland	Muddy Creek, Hamilton.	Jemmy's Point		Mount Gambier	Aldinga Beds			In Tasmania	Elsewhere
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
CONCHIFERA—*continued.*																											
Balanus	*z*																										
Aturia zic-zac, var. australis, M'Coy																											
ECHINODERMS.																											
Micraster brevistella																						*c*					
Ditto ditto, var.	*a*																										
Hemipatagus Forbesi, Woods and Duncan																											
Ditto Woodsi, R. Etheridge																											
Ditto ditto, var. cordiform, &c.	*c*																										
Ditto (?)	*z*																										
Ditto (?)	*x*																										
Cidaris (?)	*x*																										
POLYZOA AND CORALS.																											
Cellipora gambierensis																											