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HISTORY OF AUSTRALIAN TERTIARY GEOLOGY.

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[Read 11th July, 1876.]

The first person to call attention to the tertiary formations of Australia was Capt. Flinders, who, in his survey of the south coast in 1802, noticed the fossiliferous cliffs of the Australian Bight. He imagined them to have been derived from some vast coral reef. Tertiary geology as such was not then known. In 1829 Capt. Sturt traced down the Murray River, and in doing so came to a portion bounded on each side by high limestone cliffs, which were one mass of fossils, many of which converted into selenite. He identified some of those collected with European forms, and though in this he was mistaken, yet he was correct in designating the formation as tertiary. The subject then remained in abeyance, except from some cave remains sent home by Sir Thomas Mitchell, until 1859, when, encouraged by Sir Charles Lyell, who was in a great measure my instructor in geology, I prepared an account of the tertiary formation in South Australia, for the Geological Society, which was published by them. This was accompanied by a valuable notice of the Polyzoa and Foraminifera, by Professors Busk and Rupert Jones respectively. These investigations were followed by my work on the Geology of South Australia, in 1862, subsequent to which the regular reports of the Victorian Geological Survey have thrown a flood of light upon the whole subject. Professor McCoy has from time to time issued notices of some of the most interesting fossils and their affinities, while two parts of the "Decades" of the Museum have been dedicated to Palæontology, principally tertiary. Within the last ten years Professor Duncan, the illustrious President of the Geological Society, has steadily devoted himself to the elucidation of the Australian Tertiary Corals; while Professor Laube, in Vienna, has given equal attention to our fossil Echinodermata. The eminent palæontologist, Thomas Davidson, has taken our Brachiopoda in hand,—a work begun already by Robert Etheridge, jun., who has also, with Professor Duncan, added something to our knowledge of the Echinodermata.

It will be seen from this brief sketch that though the tertiary formations of Australia have occupied many minds, yet our progress, so far, has been somewhat slow. This is the more remarkable, as it has long been believed among scientific men that the development of Australian geology must reveal facts of the utmost importance to science generally. It has been remarked by some geologists that the present state of Australia is very similar to what Europe was immediately after the secondary or Mesozoic period. The position of Australia renders it less liable to an admixture of its species with those of other continents, and therefore its natural history is to a certain extent peculiar to itself. In the Flora the correspondence to the Mesozoic period is well marked. There

the *Araucarie*, so common in the secondary rocks, are represented; and these are only found in the Pacific Islands and Australia. There are the *Lamie* and *Arthrozamia* found only at the Cape of Good Hope and Australia, being closely allied to species found in secondary deposits.

With regard to the Mammalia, no indigenous animals have been found distinct from the Marsupialia except rodents, and one or two species about whose introduction doubts have been entertained. The rodents belong to an order which has many affinities with marsupials, and in one genus, *Phascalomys*, the characters are interchanged.

The following passage from Mantell's "Wonders of Geology" will show that the views of geologists on this subject were. Speaking of the Wealden strata, he says:—"Nor can we resist the conviction that not only did the same terrestrial area, however modified it must have been during the long succession of ages, supply the *débris* of an almost unchanged system of animal and vegetable life to the Jurassic seas at first, and subsequently to the Cretaceous ocean; but that, also, the fauna and flora of this ancient land of the secondary epoch had many important features which now characterise Australia. The Stonesfield marsupials and the Purbeck *Plagiulax* are allied to genera now restricted to Australia and Tasmania, and it is a most interesting fact, as Professor Phillips was first to remark, that the organic remains with which these relics are associated also correspond with existing forms of the Australian Continent and neighbouring seas; for it is in those distant latitudes that the waters are inhabited by *Cestracions*, *Trigonice* and *Teribratula*, and that the dry land is clothed with *Araucarie*, tree ferns, and cycadeous plants."

These facts, coupled with the circumstance that no true secondary rocks had been found in Australia, lent great force to the opinion that we had in Australia a continent which, having been dry land during the Mesozoic epoch and only a small portion of it since submerged, had preserved the fauna and flora of that time. But later investigations have shown that we possess on the continent nearly every leading representative of the secondary strata of Europe. In Western Australia, and in Southern Queensland, the lower and middle Mesozoic formations are largely represented; while in N.E. Australia and all around Carpentaria we have immense areas exclusively occupied with deposits which very closely represent the upper and lower Cretaceous with the Greensand of Europe.

The more advanced state of our knowledge places us now in a position to give a solution to many important questions which naturally arise. The first is whether the secondary forms show any remarkable divergence from the typical forms of that period. To this we may answer in the negative. In accordance with the general rule in geology that the lower we descend in time the wider the range of species and the closer the resemblances, we find a strong resemblance, and, perhaps, in some cases, an identity which enables us to say not only that the fossils are secondary, but, also, to what particular subdivision of the secondary rocks they belong. As a further illustration of the same rule, we find in our Palæozoic

(Devonian) rocks absolute specific identity with European forms, with rare exception.

This being the case, it becomes most interesting to ask, in the interests of the evolution theory, whether there are in our tertiary formations any signs of a persistence of the secondary types, so that their preservation, in the existing state of things, can be accounted for. To this, we must again answer "no." The secondary types in the tertiary rocks of Australia are few and rare. We have two *Trigonia*, both very different from the existing forms; but one very similar to our Oolitic species, and a *Pleurotomaria*, which is a Palæozoic type! Some of the Brachiopoda have faint secondary affinities, but the Echinodermata are certainly not Mesozoic in character. In all other respects our tertiary formations have very close affinities with the tertiary rocks of Europe, and, indeed, with the rest of the world; while there is the same singular and remarkable break between the secondary and tertiary periods that is found to prevail everywhere. Imperfect and incomplete as the geological record must necessarily be when it is interrogated as to evidence in favour of evolution from what it gives in Australia, it must say decisively "in Australia I have none to give."

In this I am not putting any interpretation on the evidence. I am merely stating the fact. Whether another interpretation against evolution could be given is a matter of individual opinion, and I withhold my own. My researches in Australian tertiary geology have now extended over twenty years, and during that time, as I have helped somewhat to create its literature, I may say, probably without arrogance, that I have as good an opportunity of becoming acquainted with its palæontology as any one. It may be, therefore, of some value to state that in all my examinations of our fossil and living fauna I have carefully sought for any reasonable evidence in favour of evolution or clue to its mode of operation, and have found none—none whatever. I must add that Australian geology, whether reluctantly or not, must admit that she can urge nothing in favour of that theory being true, the true explanation of nature as we find it.

But in the supposition that in our land fauna and flora we have a relic of secondary epoch, there is something not easy to reconcile with the evolution hypothesis. Types remaining stationary during such long periods of time appear, to my imperfect knowledge of evolution, inconsistent with the necessary postulates. Possibly I may misunderstand the question, but it must be of use to point out that the evidence of the submergence of Australia since the Mesozoic period is somewhat cogent. Not only are relics of the Cainozoic strata found at considerable distances from the sea, but the northern as well as the southern portions of the continent are covered at intervals with a deposit which some regard as marine and some as lacustrine, but all agree in referring to the most recent of our tertiary strata. It would be, therefore, a hasty conclusion to assert that any part of the continent has been preserved as dry land since the Mesozoic period, and the weight of evidence is against it.

COMPARATIVE TABLE SHOWING DISTRIBUTION OF AUSTRALIAN
MARINE TERTIARY SHELLS, ETC.

[illegible]

NAME OF SPECIES.	Tas- mania		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

GASTEROPODA—

continued.

Pleurotoma (?)

Ditto (?)																											
Ditto (?)																											
Ditto (?)																											
Ditto (?)																											
Ditto (?)																											
Ancillaria mucro- nata, Sow.	c																										
Voluta Hanna- fordii, M'Coy	x										y	y						c									
Ditto, ditto	x																										
Ditto anticingu- lata, 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	x																										
Ditto M'Coyi, Tenison-Woods	x																										
Ditto, ditto	x																										
Ditto, ditto	a																										
Ditto, ditto	a																										
Marginella Went- worthi, ditto	c																										
Ditto strombifor- mis, ditto	c																										
Ditto octopticata, ditto	x																										
Ditto, ditto	x																										
Cypraea (Aricia) gigas, M'Coy											y																
Ditto platypyga, ditto											x																
Ditto platyrhyncha, ditto	a									x																	
Ditto gastrophylax, ditto											y	b															
Ditto eximia	y																										
Ditto Archeri, Tenison-Woods	c																										
*Ditto (Trivia) europea, Mont- fort	x																										
Ditto arellanoides, M'Coy									y		a	a						c									
Ditto, ditto	x																										
Daphnella colum- belloides, Teni- son-Woods	x																										
Ditto tenuisculpta, ditto	a																										
Ditto gracillima, ditto	c																										
Mangelia gracili- rata, ditto	c																										

Doubtful

Britain

NAME OF SPECIES.	Tas- mania	Flinders Isld. Group.	Victoria.																		Aus.	Aus.	Existing.				
	Table Cape Ten miles south Cape Grim	Turritella Limestone Heathly 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.	Fvan'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

GASTEROPODA—
continued.

Natica Wintlei, Tenison-Woods	c																										
Ditto vixumbili- cata, ditto	x																										
Ditto polita, ditto	x																										
Ditto, ditto	x																										
Turbonilla, lyræ- costata, ditto	x																										
Ditto pagoda, ditto	x																										
Ditto, ditto																											
Ditto, ditto																											
Pyramidella Ro- berti, ditto																											
*Bittium																											
*Eulimella subu- lata, Donov.	x																										
Cerithium Flem- ingtonensis, M'Coy																											
Ditto	c																										
Ditto	c																										
Ditto	c																										
Cerithiopsis John- stoni, Tenison- Woods	x																										
Tectaria?	x																										
Turritella Tasman- ica, Tenison- Woods	c																										
Ditto Sturtii, ditto	c																										
Ditto Warburtoni, ditto	c																										
Ditto, ditto	c																										
Ditto, ditto	c																										
Ditto, ditto	c																										
Ditto, ditto	c																										
Ditto, ditto	c																										
Vermetus conohe- lix, ditto	x																										
Ditto, ditto	x																										
Ditto, ditto	x																										
Tenagodus occlu- sus, ditto	c																										
Rissoia varicifera, Tenison-Woods	c																										
Ditto	a																										
Ditto Tateana, ditto	c																										
Ditto Johnstoni, ditto	c																										
Ditto																											
Ditto																											
Ditto																											
Turbo Etheridgii, ditto	c																										
*Imperator (As- tralium) imperi- alis (?)	y																										
Trochus Josephi, Tenison-Woods	y																										

Bruni Isld.

Europe

New Zealand

NAME OF SPECIES.	Tas- mania	Flinnders Isld. Group.	Victoria.																	S. Aus.	W. Aus.	Special 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 (Mande)	Mth. Gellibrand Rv.	Fyan's Ford	Month 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.																											
Ostréa	c																										
Ditto	z																										
Ditto				c																							
*Lima Bassi, Tenison-Woods	c																										
= squamosa, Lamark																											
*Ditto subauriculata, Montf.	x																										
Plicatula (?)	x																										
Spondylus	y																										
Ditto	y																										
Cucullæa coriolicensis																											
M'Coy	c																										
Ditto cainozoica, Tenison-Woods	c																										
Arca	y																										
*Ditto, ditto	y																										
*Pectunculus latirostatus	c																										
Limopsis Belcheri, Broc.	z																										
Ditto aurita, ditto Nucula tumida, Tenison-Woods	c																										
Leda crebricostata ditto	c																										
Chama lamellifera, ditto	c																										
Venus Allporti, ditto	a																										
Ditto (Chione) propinqua, ditto	c																										
Ditto cainozoica, ditto	c																										
Ditto, ditto (?)	z																										
Ditto, ditto (?)	z																										
Cardita gracilicostata, Tenison-Woods	c																										
Ditto (?), ditto Cardium (?)	y																										
Ditto (?)	c																										
Crassatella oblonga Tenison-Woods	c																										
Ditto aphrodina, ditto	y																										
Tellina cainozoica, ditto	c																										
Solecurtus Le- grandi, ditto	z																										
Lyonsia Agnewi, ditto	c																										
Myodora (?)	y																										
Ditto (?)	c																										
Trigonia acuticostata, M'Coy																											
Ditto semiundulata, ditto	c																										
Ditto Howittii, ditto																											
Vulsella (?)	z																										

[illegible]