

THE STRATIGRAPHICAL RELATIONS OF THE TERTIARY-FORMATIONS ABOUT ADELAIDE, WITH ESPECIAL REFERENCE TO THE CROYDON-BORE.

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Plate IV.

[Read October 9, 1890].

Not many weeks since a bore was commenced at Croydon, three and a-half miles from Adelaide; but at the present date operations have been suspended, when a depth of 800 feet was reached. Whether the boring will be resumed is not yet decided on; but it is earnestly hoped, in the interest of geologic science, and to the attainment of the fullest knowledge of the water-bearing capabilities of the formations underlying the Adelaide-plain, that the bore will be extended into the Archæan rocks, which is necessary to ensure a certain measure of finality as regards the scientific as well as the utilitarian aspect of the exploration.

The geological information hereby gained is supplementary to the foregoing communication on the Dry Creek-bore; and because of this it is deemed undesirable to postpone the publication of

the facts on the uncertain chance of the resumption of boring operations.

The main stratigraphical features, summarised from the boring account (kindly furnished by the Conservator for Water, and herewith appended), are introduced in the accompanying section, Plate IV., which represents in the fullest manner the stratigraphical relationships of the various formations of the Tertiary Period in South Australia; the eastern part of the section has already been published, *Trans. Roy. Soc., S. Aust.*, vol. V., pl. 1, p. 40, 1882, and is here added for the sake of completeness. The section shows that the Old Tertiaries (Eocene and Miocene), underlying the City of Adelaide, crown a steep escarpment of Archæan rocks, against which have been deposited in succession the marine beds of the Older Pliocene and the Mammaliferous Drift; whilst at Port Adelaide, recent marine deposits margined by sand-dunes, resting unconformably on the Mammaliferous Drift, mark a post-tertiary shore-line; and finally modern sand-dunes line the present shore.

The Section affords clear evidence of a time-interval between the Miocene and Older Pliocene; and induces me to remark that a closer study of "erosive surfaces" among our Tertiary beds will prove of high value in determining their relative ages and check the conclusions drawn from palæontological data alone. The remarkable diversity of sedimental conditions and concurrent faunal changes within the same geologic basin may lead us to incorrect conclusions if we do not admit that palæontology is based wholly on stratigraphy.

The superposition of the dissimilar Miocene-fauna on the Eocene is in most localities unaccompanied by any visible stratigraphical break; feebly so, however, at Muddy Creek, but in this case the palæontological conclusions led up to the recognition of an interruption in the succession of deposits. However, the stratigraphical break is most pronounced in the maritime tract in mid-southern Gippsland, where the Miocene-beds are laterally in juxtaposition with Eocene-strata, which rise to much greater altitudes—a relationship analogous with that of the Newer and Older Tertiaries at Adelaide as exhibited in the present Section.

Thus all the grander groups, Eocene, Miocene, Older Pliocene, and Pleistocene, are separable on stratigraphical data; and when these are obscured or not determinable, then our knowledge of the fauna of each, when sufficiently varied and well-developed, will enable us to identify geological horizons within the same geological basin or probably in contiguous ones.

## MAMMALIFEROUS DRIFT.

At several localities, within two and three miles of Croydon, the clayey loams and associated gravels that form the more superficial deposits of this horizon have yielded species of extinct Mammalia—of *Diprotodon*, *Palorchestes Azael*, *Phascalomys*, &c.

At about the position indicated on the Section, carbonaceous debris was obtained, some years ago, at a depth of 50 feet; on this bare fact, an appeal is made to speculators to invest capital in a search for coal at this place. The comparatively recent geological age of the Mammaliferous Drift had been early proved by me by the discovery of chalky limestone-pebbles, containing the Eocene-species, *Turritella Aldingæ*, in the loams forming the cliffy banks of the River Torrens near the present Weir, whilst later discoveries of mammalian debris in the same deposit have settled the relative position of this geological horizon. Having in view the age of the deposit, its limited vertical depth, and its restricted area on the east, as made certain by the data derived from the Croydon-bore, there seems to me very little hope of any useful purpose to be served by sinking in it in search of coal, unless it be to supply the exact position of boundary-lines between the successive formations, instead of the conjectural ones of my section.

The details of the nearly 400 feet of Mammaliferous Drift passed through in the Croydon-bore are appended. The base of the formation has been fixed at the first marine bed, though a higher position may have been selected on lithological considerations; seeing that the main mass of the Older Pliocene consists of sharp sands and those at 380 feet closely resemble an Æolian formation, it may be questionable if the beds from 350 to 395 feet should not be included in the Older Pliocene.

## OLDER PLIOCENE.

The Croydon-section supplies very detailed information as to the thickness and nature of the beds passed through; the official record I have in part revised, as the outcome of a careful examination of the material submitted to me. In these particulars, the Dry Creek-bore was deficient, though on the other hand the palæontological data furnished by the Croydon-bore are meagre, probably because of the very much less quantity of material available. Nevertheless the small collection of fossils, which has been gathered, proves that the Dry Creek shell-bed was reached in the Croydon-bore at about the same horizon, 340 feet below sea-level.

Some species additional to those obtained from the Dry Creek bore occur, but they do not affect the general palæontologica

conclusions previously arrived at. It seems needless to furnish a list of the species, as I hope at an early date to examine exhaustively and report upon the fauna as a whole.

Below the chief shell-deposit, from 395 to 450 feet, species of mollusca prove to be rare and in a fragmental condition. The few forms which seem largely to make up the more calcareous portions, included within the depths of 605 and 738 feet, afford no very trustworthy index to age, of these *Ditrypa Wormbetensis*, McCoy, which is the most abundant, has hitherto been known to me only from undoubted Eocene-beds, but as it is associated in the higher levels of the Croydon-bore with some determinable fragments of the characteristic mollusca of this formation, it must be conceded that this dentaloid annelid is a survival from Eocene times.

The great thickness of the Older Pliocene, 406 feet at the least, is unexpected, as I had conjectured that its base was near-approached in the Dry Creek-bore at a level corresponding with the superior beds only passed through in the Croydon-bore; but admitting the correctness of the assumption, then, the new facts simply indicate a great inequality of the floor on which the Older Pliocene deposits have accumulated.

SECTION OF THE STRATA PASSED THROUGH BY THE CROYDON BORE.

"MAMMALIFEROUS DRIFT."

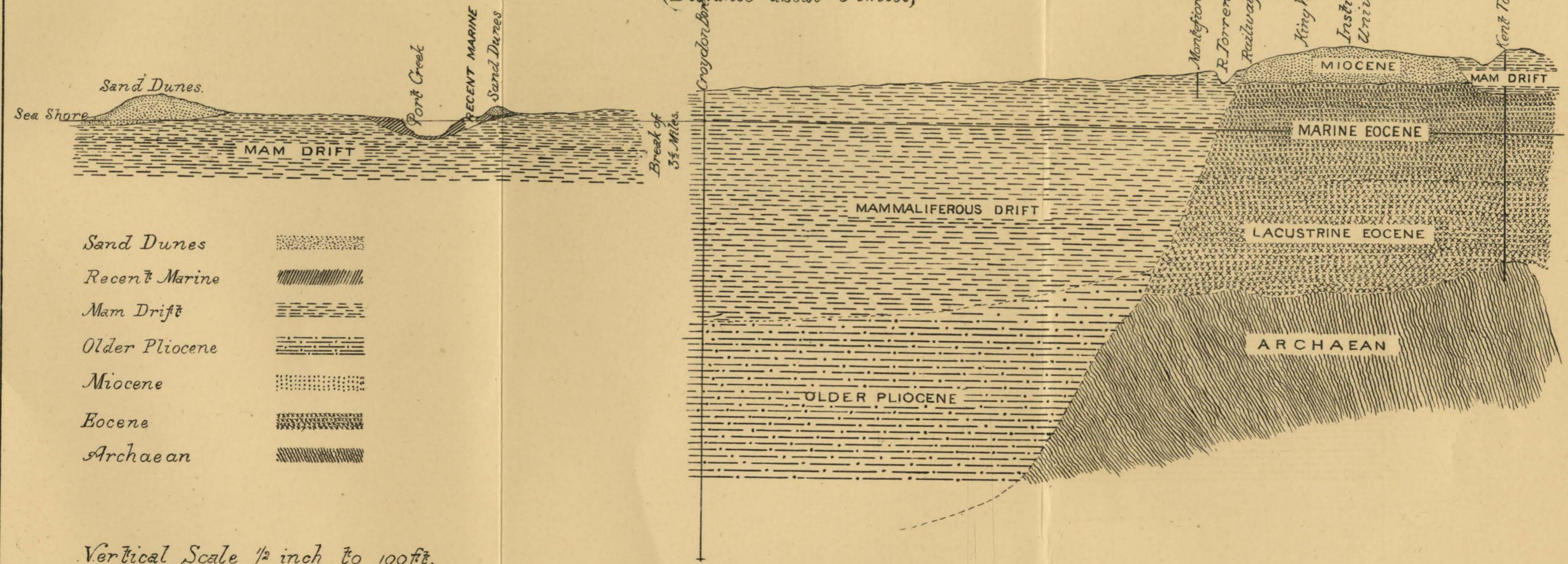
Depth in feet below surface (66ft. above sea-level).	Nature of strata.	Remarks.
to 10	Brown clayey loams.	
10 " 18.5	Brown clay.	
18.5 to 19	Brown sandy clay.	
19 " 45	Brown clay.	
45 " 57	Coarse quartzose sand and gravel.	
57 " 75	Clay and gravel.	
75 " 95	Brown clay.	
95 " 110	Clay with limestone-nodules.	
110 " 212	Brown clay.	
212 " 215	Grey clay.	
215 " 235	Clay and quartz gravel.	Water at 215ft. { rising to 30ft.
235 " 260	Yellow clay and sand.	Water at 245ft. { from surface
260 " 295	Brown clay.	
295 " 315	Brown clay and quartz-gravel.	
315 " 320	Brown clay.	
320 " 325	Brown sand.	
325 " 330	Brown clay.	
330 " 350	Light-brown sandy clay.	
350 " 378	Yellow sand.	
378 " 382	Yellow sand with calciferous lumps.	
382 " 385	Light-grey sharp sand.	
385 " 395	Greenish-grey and brown clay.	

## "OLDER PLIOCENE."

Depth in feet below surface (56ft. below sea-level).	Nature of strata.	Remarks.
395 " 415	Grey sharp sand, with small angular gravel and shell-chips	( <i>Ostrea Angasi</i> , <i>Pectunculus obliquus</i> , <i>P. convexus</i> , <i>Limopsis Belcheri</i> , <i>Crassatella oblonga</i> , <i>Mesalia Provisi</i> , <i>Cassis fimbriatus</i> ; <i>Orbitolites complanatus</i> .)
415 " 416	Hard blue calcareous sandstone, with shells.	
416 " 430	Grey sharp sand, with shell-chips.	<i>Pectunculus obliquus</i> . Small gastropods.
430 " 435	Greyish-brown sharp sand, with small shell-fragments.	( <i>Only small mollusca entire, some with colour; Lagunum; Orbitolites, abundant. Ostrea Angasi.</i> )
435 " 450	White, medium-grained, fairly well-rounded sand, mixed with sharp shell-debris.	
450 " 455	Black and grey, fine sand; shell-chips rare.	<i>Ostrea Angasi</i> .
455 " 470	Grey sharp sand, with small angular gravel and shell-chips.	( <i>Carditta Preissi</i> , <i>Cucullæa Corioensis</i> , <i>Limopsis Belcheri</i> , <i>Lucina quadrisulcata</i> , <i>Ostrea Angasi</i> , <i>Pellicaria Mesalia Provisi</i> ; <i>Cassis fimbriatus</i> , <i>Crassatella oblonga</i> , <i>Meleagrina crassicaudia</i> )
470 " 500	White sharp sand, with small sharp gravel and broken shells	
500 " 520	Greyish - brown sharp sand, with small shell-fragments.	Fragments of large <i>Celloporæ</i> abundant.
520 to 525	Shelly gravel, with white sand.	
525 " 550	Very fine grey sand; shelly chips very rare.	<i>Ostrea</i> , <i>Spondylus</i> , <i>polyzoa</i> ; <i>Ditrypa</i> (common).
550 " 570	Fine, grey, sharp sand, with some shell-debris.	
570 " 572	Fine grey sand-rock, with much comminuted shell-debris.	<i>Natica balteata</i> , <i>Corbula ephamilla</i> , <i>Ostrea Angasi</i> , <i>Ditrypa</i> , <i>Echinus</i> .
572 " 595	Very fine grey sand.	( <i>Ostrea</i> , <i>Cucullæa</i> , <i>Pecten anti-australis</i> , <i>P. spondyloides</i> , <i>Lucina quadrisulcata</i> , <i>Siliquaria</i> , <i>Turritella</i> , <i>Ditrypa</i> , <i>Echinus</i> , <i>Laganum</i> .)
595 " 605	Fine grey sand and sand rock and shelly fragments.	
605 " 655	Yellow gritty calcareous sand.	Water at 630ft., rising to 20ft. from surface.
655 " 720	Yellowish - grey calciferous sand and sand-rock.	Foraminifera; fragments of polyzoa, echinoids and <i>Ditrypa</i> .
720 " 795	Very tenacious blue clay, with foraminifera and small nests of iron-pyrites.	
795 " 800	Sandstone.	



Section from Adelaide to Holdfast Bay.  
 (Distance about 8 Miles)



- Sand Dunes
- Recent Marine
- Mam Drift
- Older Pliocene
- Miocene
- Eocene
- Archæan

Vertical Scale 1/2 inch to 100ft.  
 Horizontal Scale 2 inches to 1 mile