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NOTE ON THE OCCURRENCE OF THE SAND-ROCK CONTAINING BONES OF EXTINCT SPECIES OF MARSUPIALS (EMU, KANGAROO, WOMBAT, ETC.,) ON KING ISLAND, BASS STRAIT, TASMANIA.

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During a recent visit to King Island I was, through the kindness of Mr. J. M. Bowling, fortunate in being able to make a cursory examination of the deposits in which the bones of extinct species of Marsupials occur, and to obtain a small collection of the fossils which are now deposited in the Australian Museum, Sydney.

It has not previously been observed that the wind-blown sand forming the recent dunes is not the original matrix of the fossils. Hence this note!

The literature dealing with the geology of the island, the occurrence of the deposits and the description of their bone contents is as yet of a very limited character. The earliest reference to the fossil bones is a short note, recording their discovery by Mr. Bowling, published in an early number of the King Island "Record,"[1] subsequently followed by a paper[2] in which Professor Baldwin Spencer and Mr. J. A. Kershaw describe a collection of these bones and a paper[3] by Mr. F. Debenham on the general geology of the island.

Allusion is made, in a paper[4] by Mr. F. Noetling, to the occurrence of remains of *Nototherium*, obtained by Mr.

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[1] The Record, King Island, i., 2, 6th Dec., 1905.

[2] Spencer and Kershaw—Mem. Nat. Mus. Melbourne, 3, 1910.

Debenham—Journ. Roy. Soc. New South Wales, xliv., 1910, p, 560.

Noetling—Proc. Roy. Soc. Tas., 1911, p. 124.

Stephenson of Yambacoona, while draining a swamp on his property in the northern portion of the island. The specimens, consisting of portions of the lower jaw are now in the Victoria Museum, Launceston, and are the first and only specimens yet obtained from the island. These remains, however, occurred in an inland lake deposit and not in marine coastal accumulations such as the ossiferous sand-rock of the southern end of the island, with which this note deals. They are probably geologically earlier, as, so far, there have been no evidences of contemporaneity with the extinct species of Marsupials above referred to.

The deposits from which the bones were collected and from which the specimens were obtained which were described by Professor Spencer are situated near the extreme southern point of the island, on the most southerly of Mr. J. M. Bowling's farms, to the south-east of Surprise Bay. The sand-dunes in this locality attain a considerable elevation. They are the most extensive on the southern half of the island, and with the ossiferous sand-rock occurring among them, cover its most southerly promontory, the geological formation of which consists of metamorphosed sedimentary rocks, chiefly phyllites, schists, quartzites, etc. similar to those exposed in other parts of the island. Outcrops of these are not infrequent protruding from among the sand deposits and they usually prevail along the immediate foreshore, around the southern end of the island.

The bones are usually found in the loose wind-blown sand now forming the recent sand-dunes, but this is not their original matrix, which is generally a fairly hard sand-rock, of a reddish-brown colour, coarse in texture and frequently exposed through the sand-dunes. There is no apparent lamination in the deposit, yet on the eastern aspect of the peninsula, it outcrops through the sand in numerous bold, parallel ridges, exhibiting suspicions of false bedding, which form quite a feature in the sand-dune landscape.

These ridges of sand-rock appear to have a decided southerly dip which, however, may perhaps be due to blown sand weathering. This, in other regions, is very often the case, and is chiefly due to the occurrence of a persistent prevailing

wind. In exposed areas, where the winds are variable and non-persistent, such degradation of similar strata produces most irregular outcrops unless the deposit has been distinctly bedded originally, in which case the stratification becomes emphasised rather than obliterated. Among the higher exposures of the sand-rock there are fairly extensive outcrops of light coloured calcareous and siliceous rocks containing numerous concretions, some of which are of considerable thickness individually and usually irregularly vermiform in character. Some are hollow, but the majority are solid. So far as my cursory examination went they showed no plant structure although often a radiating structure is present which is probably aragonite. By their size and the frequency of their occurrence it is possible they may represent roots or stems of plants and trees. On the other hand, there are, the world over, calcareous deposits in which segregation, due to chemical agencies has produced the most curiously contorted concretions which have had no connection whatever with an organic origin. At the same time, I may mention the fact that in climates which are not so very different from that of the southern part of Australia, I have known occurrences such as the following:—On the west coast of Madagascar, and on the opposite east coast of Africa, where the rocks consist chiefly of Cretaceous calcareous strata, the recent deposits now forming, principally among the mangrove swamps, are calcareous. There, one occasionally sees, especially in an estuary which has become more or less silted up, and is in process of geological regeneration, that the deposited matter is a calcareously cemented mud exhibiting hollows which originally were occupied by the roots and in some cases the lower ends of the stems of the mangrove. In the King Island concretions there are no signs of vegetable structure and to all intents and purposes they might be fulgurites, or worm burrows, filled with calcareous material.

Other calcareous deposits containing similar concretions occur in different parts of the island near the coast; one such outcrop is about a mile to the north of the township of Currie. These deposits, on the southern peninsula, abut against each other in such a way that they would seem to be contemporaneous with the red sand-rock. Besides the concretions the southern calcareous deposits contain isolated specimens of the

bones of extinct species of Marsupials. Mr. Bowling informed me he had obtained a number of specimens from them. There are no pebbles or boulders in either the calcareous or the red sand-rock except in the immediate vicinity of the metamorphic rock outcrops. These deposits are now exposed quite near the highest parts of the sand-dunes and of the peninsula. In some cases the highest outcrops consist of the metamorphic slates, quartzites, etc., and the bone-bearing deposits are present at least over one hundred and fifty feet above sea level.

The fossils occur sparingly in the calcareous and siliceous deposits but are quite common in the hard sand-rock. In the former they have to be chiselled out, while in the latter a pointed implement of some kind is necessary to release them from the matrix and careful manipulation is needed if a useful specimen is to be obtained. On the outcrops of the sand-rock, fossil bones are extremely plentiful and are distributed promiscuously through them, the long bones and jaw bones often protruding from the exposed surfaces at all angles and sometimes resting intimately upon each other in couples and bunches. There are no instances of the occurrence of whole skeletons or even portions of the same skeleton being found together. In the sand-rock itself and frequently in the loose sand, even at the highest exposures specimens of more than one species of bivalve are of frequent occurrence, together with numerous stout opercula of Gasteropoda, and much comminuted shell material is disseminated through the deposits. Those portions of the bones exposed to the atmosphere on the outcrops of the sand-rock are usually eroded by the action of wind blown sand and for the same reason, all the bones which are present in the recent loose sand make equally bad specimens.

There is little doubt in my mind that these deposits, with the exception of the blown sand, have been formed under marine shallow water conditions. The occurrence of the bones on every exposure justifies such a conclusion. They are scattered indiscriminately through the matrix showing no arrangement in layers and it seems certain that the animals whose remains are here embedded did not die in the position in which their bones are fossilised. There had been little or no erosion of the bones prior to their deposition and even the teeth in the lower jaws of the various genera are mostly intact

and in position, except after exposure in the blown sand. It is more than probable that these detached skeletal remains have been conveyed to their present position in the sand-rock, not by running water but by a gradual assimilation, into an estuarine or coastal sandy deposit, of the already disjointed skeletons, probably from the immediate foreshore where they had been accumulated after death. Other facts which lend support to the conclusion that these deposits were formed under marine coastal conditions are the presence of several species of mollusca, with opercula of Gasteropoda, fragments of shells, and much comminuted shell material.

This seems to me the most feasible explanation which would account for the wide distribution of the individual bones of the various genera of animals occurring in the sand-rock. If they had been fossilised in the place where the animals died there would, of a certainty, have been present local accumulations of bones which had belonged to one individual skeleton or a portion of one. In all the bones that have been picked up there is, so far as observation has gone, no trace of any individual specimen exhibiting marks of having been gnawed by carnivora, although the bones of a much larger "native cat" than the present species appear indiscriminately mixed with them. This would tend to show that the bones were not exposed for any length of time before their deposition in the sand-rock.

The majority of the specimens which have been loosened from the original matrix and are now found detached among the sand of the recent dunes occur in close relation to the bones of the same genera of the present day, together with those of the sheep and horse, so that in collecting, a certain amount of discrimination is necessary. They have, almost in every case, been liberated from the original matrix by the triturating effect of the wind-blown sand on the exposures of the hardened sand-rock, thus freeing the bones and leaving them isolated in the recent sands. This action has continued further on the loose exposed bones, resulting in the destruction of the external boney surface and the laying bare of the spongy interior. Especially is this the case with the ends and articular surfaces of the long bones, although not confined to them.

Similar cases of erosion by wind-blown sand are not uncommon where it has acted upon the later geological formations. Its action on granites and other plutonic and intrusive rocks is well known. One particularly good example of this occurs along the south east coast of Africa, on the littoral of Zululand, where high cliffs of Tertiary strata are being gradually worn away by blown sand weathering, leaving detrital heaps, at the bottom of the cliffs, of fossils, lignitic wood and fragments of foraminiferal limestones, which are present in thin beds in the sections above. These cliffs present a curious aspect, showing the thin protruding limestones, the much excavated sandy beds, while the clayey deposits are cut into the most wonderfully fantastic shapes but often present more or less flat and fairly extensive exposures forming a remarkable and sometimes grotesque feature in the coastal scenery, just as these outcrops of sand-rock form a distinctive feature in the landscape of the sand-dunes, on the south coast of King Island.

The sand-dunes themselves have not been formed in the ordinary way, by the heaping up of wind-blown beach sand but chiefly consist of sand particles resulting from the trituration of the sand-rock, from the period of the elevation of the island after the last subsidence, to the present day, no doubt assisted to a small extent by the drifting sea-shore sands. Although in the majority of cases the chief origin of dune sand, except perhaps on a desert coast line, is undoubtedly blown shore sand, in some cases where there have been uplifts of the coast line, the rocks of which consist of late geological formations, such as Pleistocene, Tertiary, or even Cretaceous strata, the accretion to the amount of sand, and its chief source after these beds had become dry land has been from the wind-blown sand degradation of such exposed soft deposits. Just as in this case on King Island, the present-day sands of the southern coast dunes are undoubtedly to a small extent composed of blown beach sands, but the major portion consists of the triturated sand grains eroded by the wind from the hardened fossiliferous sand-rock.

The fact that similar bone deposits are known to occur at points on both coasts of the island would lend support to the conclusion that during the deposition of the sand-rock, containing the isolated specimens of fossil bones, the whole island

was at a much lower level and was necessarily not so large as at present, pointing to a period of submergence. It is even possible that it underwent a sudden sinking, up to a certain level, the result of which may account for the killing off of large numbers of the animals whose bones have been subsequently found as fossils in the sand-rock. This period of submergence may not have been of any great duration, as there are no evidences of raised beaches or other data suggestive of a lengthened period of submergence. But it seems to me that in suggesting a possible explanation for the presence of this deposit, with its enclosed osseous remains, some such occurrence as the above must have taken place. From other sources we have evidences of great physical disturbances in recent geological times over the area now known as Bass Strait, and it seems quite probable that this suggested disturbance on King Island occurred as a part of these physical changes in the geography of this region.

The whole subject of the physical geology of the islands in Bass Strait, which form partially submerged connecting links between the continent of Australia and the island of Tasmania, is one of exceeding interest but as yet one which has hardly been touched upon by geologists and zoologists. There is no doubt that when this subject has been worked up, not only will there be some remarkable facts discovered, both zoological and palaeontological, but also facts of importance which may have far reaching applications in Australasian physical geology, relating to the geological movements of this most interesting portion of Australasia, which have taken place within geologically recent times. Even now some curious facts in distribution are known; for instance, the large islands, called the Hunters, to the south of King Island and lying off the north coast of Tasmania, although only separated from each other by a strait, not three miles wide, until lately showed a curious zoological anomaly. The geological formation of the two islands differs, the western consisting of granite and the eastern of metamorphic sedimentary rocks. The strait now undoubtedly occupies a line of fault, which within recent geological times caused the separation of the two islands. It has been reported that within living memory the western island was overrun by wallaby while the eastern was absolutely

free from these marsupials, until recently when they were introduced from the western island. Reports are also frequent of animals having been occasionally met with, which were entirely different from the ordinary marsupials to which the layman has been accustomed. Although such reports are not always to be relied upon in their entirety, it has been my experience, in different parts of the world, that where a layman without any special scientific knowledge or even a native (as in the case of the *Okapi* of central Africa) has noted some peculiarities in animals he has either killed or seen, which seemed to him to distinguish them from others he has been acquainted with, it is always judicious to bear the fact in mind and endeavour if possible to prove or disprove it as occasion offers. At any rate this subject must inevitably be dealt with as it is one of the most interesting in the physical geology of the Australian continent.

In their Memoir "A Collection of Sub-fossil Bird and Marsupial Remains from King Island, Bass Strait," Prof. W. B. Spencer and Mr. J. A. Kershaw, the Director and Curator respectively of the National Museum, Melbourne, described the remains of an Emu *(Dromœus minor)* first found on Kangaroo Island, or Ile Decrès, discovered by Admiral Baudin's expedition in the ships Géographe, Naturaliste and Casuarina, in 1802, of small size, and "possessing when young a greyish plumage that became quite black when the bird reached maturity"; to the osseous remains of a bird (believed to be identical) found on King Island, the above authors applied the name of *Dromœus minor*. The Phascolomine or Wombat remains found on King Island enabled Messrs. Spencer and Kershaw, supplemented by bones from other islands in the Strait, and historical data, to show that the name *Phascolomys ursinus*, Shaw, must be restricted to the "Wombat of the Bass Strait Islands." Amongst the other osseous remains obtained and described, were those of two "Native Cats" *(Dasyurus)*, a larger and a smaller species; to the larger of these the name *Dasyurus bowlingi* was applied. In addition to these fossils portions of six other existing Marsupials were obtained.

BIRD AND MARSUPIAL BONES FROM THE SAND-ROCK DEPOSITS OF KING ISLAND, BASS STRAIT.

Presented by MR. WM. ANDERSON, February, 1914.

4	l. tibio-tarsi ...	Dromæus minor, *Spencer*.
8	r. „ „	„ „
1	pt. sternum ...	„ „
3	fibulæ	„ „
9	r. femora	„ „
8	l. „	„ „
5	r. tarso-metatarsi ...	„ „
6	l. „ „ ...	„ „
7	vertebræ	„ „
5	pt. pelves	„ „
2	skulls	Macropus ruficollis, *Desmarest*.
1	l. ramus mand. ...	„ „
1	incisor tooth ...	„ sp.
1	pt. mandible ...	„ „
1	skull (calvarium) ...	„ „
2	costae	„ „
1	skull	(Opossum ?)
2	„	Phascolomys ursinus, *Shaw*.
3	mandibles	„ sp.
2	l. ramus mand. ...	„ „
2	r. „ „ ...	„ „
1	skull	Dasyurus bowlingi, *Spencer*.
1	r. ramus mand. ...	„ ? maculatus, *Kerr*.
1	l. „ „ ...	„ sp.
2	(bird ribs)	

Addendum.—To the brief "Literature" previously given, must be added a paper by Mr. F. Chapman, "Notes on a Collection of Tertiary Limestones and their Fossil Contents, from King Island (Mem. Nat. Mus. Melbn., No. 4, 1912, p. 39, pls. vi. and vii.)