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FOSSILIFEROUS DEPOSITS AT LAKE TANDOU, NEW SOUTH WALES, AUSTRALIA

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Abstract

Fossil specimens (mainly marsupial) from Lake Tandou, lower Darling River region, N.S.W., now in the S. Australian and W.A. Museum collections, are listed. Some extinct taxa are included. They probably represent the remains of Aboriginal meals during two or more climatic episodes in late Quaternary time, mixed by deflation of a sandy matrix in which they were originally buried, by burrowing animals and by intrusive human burials. Similarly mixed stone artefacts and human skeletal remains are noted.

Introduction

Lake Tandou is one of a series of lakes, normally dry, associated with the Anabranch W. of the lower reaches of the Darling River. It is about 40 km SW. of the township of Menindee, and about 150 km N. of Wentworth, N.S.W.

The presence of fossil mammals at Lake Tandou has been known locally for many years, and was brought to the attention of the S. and W.A. Museums in 1966. P. F. Lawson (S.A. Museum) with H. Marchant and A. Warwick (who made the initial reports) visited Lake Tandou early in May 1967 for reconnaissance, and D. Merrilees (W.A. Museum) and P. F. Lawson (with the assistance of A. Warwick for part of the time) spent 11 days there also in May 1967. A short note on this visit was published by Merrilees (1968, p. 9).

Lake Tandou contains water only intermittently, and its appearance in 1967 was that of a flat grassy plain (Pl. 19, fig. 2) abruptly bounded on the E. by a sandy ridge forming, in plan, a continuous smooth curve with a N. to S. diameter of about 16 km. The W. boundary of the lake floor is less sharply defined, and is indented, so that the floor is nowhere more than about 10 km wide E. to W. The 1967 collecting party confined its attention to the E. shore of the lake.

The 1967 collection was divided between the S. and W.A. Museums. Catalogue numbers such as P 13587 and A 57340 refer to specimens in the S.A. Museum. Catalogue numbers such as 68.9.97 refer to fossil vertebrates, 68.1419 to fossil invertebrates and A 16576 to archaeological specimens in the W.A. Museum. Label data distinguish specimens from the N. (Leonora Downs Station), central (Boothingie Station) and S. (Bindara Station) sections of the area sampled.

Other collections have been made from Lake Tandou. One such is under study in the American Museum of Natural History (R. H. Tedford, pers. comm.) and another, stressing human skeletal material, in the Australian National University (H. Allen, pers. comm.). This report deals only with the S.A. and W.A. Museums collection of 1967.

Nature and Age of Deposit

The sandy ridge on E. side of L. Tandou appeared to consist of a central core of weakly lithified, pale grey to buff, fine sand overlain by and sharply demarcated from barely coherent, bright red, fine sand. Plate 19, fig. 1 shows the contact between these two deposits, and undisturbed residuals left by deflation. Between the residuals is a pale mobile fine sand, generally rippled (Pl. 19, fig. 2). The residuals may be smaller with vertical walls, or much larger than that shown in Pl. 19, fig. 1.

Tedford (1967) describes similar deposits at Lake Menindee, about 40 km NE. of Lake Tandou. Tedford suggests that the ridge bordering the N. and E. shores of Lake Menindee is a lunette (Hills 1940), that the central pale core and the overlying red sand, despite their difference in field appearance, are essentially continuous, but that the red colour of the constituent sand grains in the lower part is masked by a white carbonate cement. Tedford suggests that deposition of this cement is part of a process of soil development. Mobile sand overlying the profile is ascribed to deflation and it is recognized that several episodes may be represented by this uppermost sand.

The ridge bordering Lake Tandou presumably also is a lunette, but parts of it appear to be more complex, so that differentiation of red non-calcareous from pale calcareous sand seems to have been a recurrent process.

Bowler, Jones, Allen and Thorne (1970) describe Lake Mungo, one of a series of lakes, each bordered on the east by a lunette, and all associated with a distributary of a major river, reminiscent of Lake Tandou and Lake Menindee. At Lake Mungo three 'soil-sedimentary' units are described, the sequence capped by mobile sand. Bowler (1970) describes two 'major stratigraphic units' in the lunette bordering Lake Nitchie, S. of Lake Tandou. More detailed stratigraphic studies may reinforce the superficial similarities of the Tandou, Menindee, Nitchie and Mungo lake sites, and reveal recurrent soil formation both at Lake Menindee and Lake Tandou.

Nearly all the fossils recovered from Lake Tandou in 1967 were found lying on eroded surfaces in the middle of the lunette. A few (e.g. 68.9.99) were found *in situ* in lithified grey to buff sand and one or two (e.g. P 13980) in red sand. Most of the specimens had a partial coating of matrix of the order of 1 mm thick. Often this matrix preserved the original articulation of one bone with its contiguous bones in a limb or vertebral column e.g. P 13531. The cement was calcareous. Thus it appeared that nearly all the specimens from the lunette had been embedded in fine sand before lithification, and that many of them had been buried in an articulated condition.

Despite search along the flanks of the lunette, including many water cut channels in the lakeward flank, very little fossil or artefactual material was recovered. Some search was made also on the vegetated seif dunes E. of the lunette, but very little material was found (71.9.44 is an example). However, artefacts (including one made from a large australite) have been found in Redbank Creek, the outlet from Lake Tandou (H. Marchant, pers. comm.).

By contrast, it was rare to walk more than a few metres over eroded lunette surfaces without seeing some scrap of bone or other fossil material, but there appeared to be local concentrations. One such local concentration of mussel shells is shown in Pl. 19, fig. 2. Within each local concentration, the material was usually very heterogeneous, with bettong and wombat bones generally predominant, together with bones of macropodine and other marsupials, reptiles, murids (not in abundance), and fish, egg-shell fragments, shells of fresh water mussels, gastroliths of crustaceans, artefacts (including balls of baked clay), coprolites (e.g. P 14090, 71.9.50) and fragments of human skull and teeth. Charred bettong, fish and other bone fragments not readily identifiable were found occasionally, e.g. P 14092-3, 67.7.3, 71.9.39.

Charring of some bone specimens, the presence of balls of baked clay (probably the linings of cooking pits, cf. Mitchell 1949), the heterogeneity of most of the local concentrations, with remains of aquatic and terrestrial animals ranging from very small to very large size, and direct evidence of human presence in the area suggest that man was the major agent accumulating the animal remains at Lake Tandou.

An occurrence of bone and other remains on bare eroded sand surfaces at Bremer Bay, W. Australia, is described by Butler and Merrilees (1971) but here the major accumulating agent appears to have been owls (possibly only one owl) because the bones were small, predominantly of murids, generally unbroken, and aquatic animals were very sparsely represented although a river and the sea lay within a few hundred metres. None of the bones was charred, and no artefacts or human skeletal remains were found.

Both at Bremer Bay and Lake Tandou the main mode of accumulation appears to have been supplemented. At Bremer Bay, natural deaths on the site, bone débris left by scavenging animals such as foxes or ravens, and bony fragments from the disintegration of carnivores' faeces, appear to have been added. At Lake Tandou, all three agencies appear to have operated, and other factors also appear to have complicated the accumulation.

Deflation seems to have reduced the original level of the lunette up to 20 m at Lake Tandou but by less than 1 m at Bremer Bay. Thus a square metre at Lake Tandou would have received the fossil content of a much larger volume of matrix than at Bremer Bay, and the fossils on the Lake Tandou surface might represent more than one depositional episode. Burrowing by wombats, bettongs and perhaps other animals, and intrusive burials by man, may well have mixed further the fossils from different stratigraphic units at Lake Tandou.

Thus the fossils (listed below) collected at Lake Tandou in 1967 probably represent in the main refuse from Aboriginal meals, mixed with contributions from natural deaths and scavengers, and all further mixed by burrowing and human burials, and by differential deflation. Apart from the remains of rabbits, cats, sheep and such exotic fauna, the geological age of the fossils remains unknown, but by analogy with Lake Menindee (Tedford 1967) and Lake Mungo (Bowler et al. 1970) falls late in the Quaternary.

Because the material collected in 1967 may include remains deposited at different times and under different climatic conditions, neither taxonomic nor climatic inferences from it are made. However, with detailed stratigraphic study of the lunette, and study of the matrix encrusting many of the specimens, decisions on their provenance and age might be feasible in many cases, so permitting such inferences. Bone from exotic animals such as cat often has a different appearance from that of extinct animals, and a few specimens of such modern bone (71.9.68-70) have been kept for reference.

Fauna

The following indigenous taxa have been recognized:

EUTHERIANS

Hydromys sp.—P 13659, 68.11.92-93
Leporillus conditor—P 13570-77, 68.11.94, 68.11.95x, 68.11.96, 68.11.98-101
Other pseudomyines—P 13587-91, P 13593-95, 68.11.113-116
Rattus lutreolus—P 13567, P 13584, 68.11.95y, 68.11.102, 68.11.104
Rattus sp. (*lutreolus*?)—P 13568, P 13578-80, P 13582-83, P 13585-86, P 13592, 68.11.97, 68.11.103, 68.11.105-109, 68.11.112
Rattus sp. (not *lutreolus*)—P 13581, 68.11.95, 68.11.110-111

MARSUPIALS

Dasyurus (*geoffroii* or *viverrinus*)—P 13258-30, 68.9.81
Dasycercus cristicauda—P 13538-42, 68.9.91-96
Sarcophilus harrisii—P 13532-36, P 13910, 68.9.84-85
Sarcophilus laniarius—P 13537, 68.9.86
Thylacinus (probably *cynocephalus*)—71.9.5
Macrotis lagotis—P 13531, 68.9.82-83
Isoodon (*obesulus*?)—P 13527, 68.9.80
Trichosurus (*vulpecula*?)—P 13526, 68.9.86a-88a
Lasiorhinus krefftii—P 13445-13525, P 1309-10, 67.11.1, 68.6.130-279, 71.9.72, 71.9.86-88
Large wombat (*Phascolonus gigas*?)—P 13977-78, 71.9.32
Bettongia penicillata—P 13980, 71.9.36
Bettongia lesueur—P 13907, P 13981-14013, P 14015-23, P 14025-59, P 14061-67, P 14069-73, P 14075-80, P 14082-89, 68.10.2-19, 68.10.22-25, 68.10.34, 68.11.133-161, 68.11.171, 68.11.182, 68.11.184, 68.11.189-190, 68.11.196-201, 68.11.203-210, 71.9.34-35, 71.9.37-39
Onychogalea lunata—P 13556, 68.9.106-110
Onychogalea fraenata—P 13555, P 13559-61, 68.9.112-116
Onychogalea (*lunata* or *fraenata* or both)—P 13553-55, P 13557-58, P 13562-65, 68.9.111, 68.9.117-121
Lagorchestes (*hirsutus* or *leporides* or both)—P 13543-52, 68.9.97-105, 71.9.49
Large wallaby (*Macropus agilis* or *Wallabia bicolor*)—P 13566, 71.9.30

Protemnodon A (*anak*?)—(P 13972?), 71.9.31
Protemnodon B (*brehus*?)—P 13911, P 13971, P 14109, 71.9.18-19
Megaleia rufa—P 13974
Macropus A (*fuliginosus*?)—71.9.25
Macropus B (*birdselli*?)—P 13973, 71.9.23
Macropus C (*titan*?)— P 13909a
Macropus D (*ferragus*?)—P 13970, 71.9.24
Procoptodon goliah—P 13908, P 13912a and b, P 13975-76 (71.9.6-16? 71.9.21?)
Diprotodon optatum—(P 13979?), 68.9.90

MONOTREMES

Tachyglossus aculeatus—P 14094-5, 71.9.71

LOWER VERTEBRATES

Birds—P 14096-7, 71.9.73-75
Lizards—P 14098-9, 71.9.80-81
Snake—P 14100, 71.9.76-79
Fish—P 14101-5, 71.9.82-85

INVERTEBRATES

Freshwater mussels—68.1412-15
Crustacean—P 14106-8, 71.1429-32
(Insect pupal case?)—71.1434

By far the most abundant remains were those of bettongs (at least 90 individuals) and wombats (at least 30 individuals). *Bettongia lesueur* contributed the overwhelming majority of the bettong remains, and the specimens listed above are those with the diagnostic premolar teeth. In addition many specimens showing only molar teeth, and some post-cranial remains, probably are attributable to *B. lesueur*. Remains of only two individuals of *B. penicillata* were found, but one of these specimens (P 13980) was among the most complete of any of the associated skeletal remains collected, obviously representing a carcase which had escaped dismemberment. In most other cases in which associated portions of skeletons were found, it appeared that the carcase concerned had been partially dismembered before burial.

Protemnodon specimen 71.9.18 comprises a rostrum, most of the mandible, most of the pelvis and the shaft of a tibia found in such close proximity as to be reasonably interpretable as parts of the same individual. Like the specimen described by Tedford (1967 p. 104) the pelvic portion of 71.9.18 is 'badly checked and broken' and only the central part of the right innominate bone could be pieced together to form a useful comparative specimen.

However, unlike Tedford's specimen, this includes a complete acetabulum, showing that the acetabulum in *Protemnodon* is slightly more elongated than that of *Macropus fuliginosus*. In 71.9.18 the ratio of greatest diameter of acetabulum to 'least diameter' (measured at right angles to the greatest diameter and crossing the acetabular fossa) is 1·28 as compared with 1·25 for this ratio in a large modern *Macropus fuliginosus* (W.A. Museum M 3328). In *Macropus eugenii* specimen M 6860 this ratio is 1·43.

The tibia of 71.9.18 is badly cracked and lacks both proximal and distal epiphyses. Nevertheless it shows that *Protemnodon* like modern *Macropus eugenii* had a relatively shorter tibia than modern *Macropus fuliginosus*. In the specimens mentioned in the previous paragraph, the ratios of length of the last three lower molars to greatest diameter of acetabulum are comparable (0·89 for *Protemnodon*, 0·90 for *M. eugenii*, 0·86 for *M. fuliginosus*) suggesting that head and body proportions were similar, but the ratios of length of tibia to greatest diameter of acetabulum (120 for *M. fuliginosus*, 95 for *M. eugenii* and an estimated 100 for *Protemnodon*) show that *M. fuliginosus* had relatively longer legs than the other two species.

A second species of *Protemnodon* appears to be represented at Lake Tandou, some 12% smaller than 71.9.18 in tooth dimensions. There has been no recent review of the species of *Protemnodon*, and the Lake Tandou specimens are referred only provisionally to *P. brehus* (the larger species) and *P. anak*.

All the small wombat specimens collected in 1967 are listed above under *Lasiorhinus krefftii* because there is no reason to suspect that any other wombat species of comparable size was present, but many of these specimens are fragmentary and strictly speaking not identifiable to species.

Mr H. E. Wilkinson has kindly supplied the following comments on the more complete specimens from the 1967 collection and other material currently under study by him:

'*Lasiorhinus* specimens collected from Lake Tandou are very similar to those from other localities in the Murray-Darling Basin, including Lake Menindee, and Lake Victoria, and it is clear that they are part of a wide Late Pleistocene to Early Recent distribution, which extended from S.E. Queensland through inland N.S.W. into N. Victoria. The species involved is *Lasiorhinus krefftii* Owen 1872, of which *Lasiorhinus gillespiei* De Vis 1900 is a junior synonym. The species is known to have been living in parts of the N.S.W. Riverina Plains at the time of European settlement, as well as on the Moonie River in Queensland, type locality for *gillespiei*. The type locality for *L. krefftii* is Wellington Caves, and a study of casts of Owen's types and *Lasiorhinus* specimens from the caves, has convinced me that Owen was mistaken in recording *latifrons* from there, and that he confused some of the *krefftii* and *mitchelli* mandibles.

'The confusion is understandable, as *krefftii* has some features which are normally thought of as being *Vombatus* characters, the one which led Owen astray being the presence on many *krefftii* mandibles of a very, to moderately, deep masseteric fossa. In addition, many have a well-developed groove on the upper premolar, and the nasals have a length greater than their combined width. The antero-buccal inflection characteristic of *latifrons* molars is poorly developed in this species, and is confined to M2 and M3 if present. The differences shown by dentition and cranial morphology are amply supported by studies of the post-cranial skeleton, and these also reveal affinities with *Vombatus*. A full description of this species is being prepared, based principally on the material collected at Lake Menindee by the University of California.'

Artefacts and Human Skeletal Remains

Stone artefacts lay scattered in abundance on bare eroded surfaces in the Lake Tandou lunette, and like the faunal remains, probably consisted of a mixture of items let down by deflation from higher parts of the deposit, and items left lying on occupied surfaces and revealed by erosion.

Surface collections of stone implements were made largely from Lake Tandou, but also from Lake Menindee, to which a brief visit was made. The collection was returned to Adelaide, sorted, and divided between the S. and W.A. Museums by the late H. M. Cooper. The S.A. material was registered under A 57339 and A 57340, and the W.A. material under A 17066-88 and A 17094-98. The S.A. Museum share has been examined by G. L. Pretty and the W.A. Museum share by C. E. Dortch, and their comments follow. In each case, material from both Lake Tandou and Lake Menindee is treated as a single sample.

S.A. Museum Collection

This consists largely of scrapers made from cores and flakes with both steep and shallow retouch. The general form of the edge can be divided into discoidal (probably for wood working—planing and shaping of wood), grossly dentated (probably for gouging and graving), or having a relatively straight edge (probably for use as knives when even and saws when dentated). Horse-hoofs (Bowler et al. pp. 49, 51) are represented by a single, small, broken specimen. Hammerstones and points are also represented. Finally, there is a small group of campsite débris—burnt mud hearthstones and freshwater molluscs. The stone from which the implements are made is mostly silcrete, with some chert and milky quartz.

The general characteristics of the assemblage conform to the description given by Tindale (1955) for Lake Menindee. The same range of industries as Tindale describes would seem to be present. The industry discovered at Lake Mungo (Bowler et al. 1970) would appear to be an early phase of this same industrial succession and certain items of this present assemblage parallel those described for Mungo. Radiocarbon dates for both localities would seem to support this correlation (Bowler et al. 1970, p. 57).—G. L. Pretty (pers. comm.).

W.A. Museum Collection

This consists of flake scrapers of varying proportions (flat, thick, and core-like) and edge contours (nosed, notched, irregular and rounded). There are also some crude adzes and a typical horse-hoof core. Other implements include unifacially retouched points of the pirri type, a backed blade, several millstones and hammerstones, and a number of retouched flakes. There are no geometric microliths, and the single backed blade is atypical (C. E. Dortch, pers. comm.).

Skeletal material consisted mainly of small fragments of skull and isolated teeth (e.g. W.A. Museum A 16573-76), suggesting that the site had been used extensively as a burial ground, and that deflation had released, and allowed to become scattered the component bones of buried human bodies. In one case in which some detail could be observed, it appeared that the body had been buried in a kneeling position.

Despite the apparent profusion of animal remains at Lake Tandou, they do not imply very long occupation by or very large groups of human beings. As a first approximation, one might accept 1 bettong as equivalent to 1 meal for a human being, and the 1967 collection listed above as representing about 300 'bettong-equivalents' or meals. This represents only about two months' occupation (if continuous) by a family group of five persons assuming they also ate much plant material. Not all the fossil specimens seen were collected, and probably not all represented remains of human meals, so it is not feasible to decide whether shorter occupation by a larger group of persons fits the evidence better than the rough estimate above.

Relatively little material was found in situ at any level in the Lake Tandou lunette, but among it was mussel shell at the lowest stratigraphic level observed. Presumably this shell was transported from the lake nearby in the same way as shell found at higher stratigraphic levels. Thus it appears that man was present during the whole of the time of accumulation of that portion of the lunette stratigraphically observable in 1967, i.e. nearly all of it.

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Explanation of Plate 19

Fig. 1—Contact between upper red weakly lithified and lower pale buff more lithified sands at Lake Tandou, N.S.W., indicated by figure. The two sands are probably the A and B horizons of a single soil profile. The grassed surface may represent an intermediate phase in the degradation of the lunette.

Fig. 2—Concentration of freshwater mussel shells on wind-rippled surface of mobile sand, Lake Tandou. Scale from hammer. Dry bed of lake in background.