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A SHORT POLLEN DIAGRAM FROM CROWN LAGOON IN THE MIDLANDS OF TASMANIA

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(with one table and three text-figures)

ABSTRACT

SIGLEO, W.R. and COLHOUN, E.A., 1981 (30 ix): A short pollen diagram from Crown Lagoon in the Midlands of Tasmania. *Pap. Proc. R. Soc. Tasm.*, 115, 181-188 (with three figures). https://doi.org/10.26749/rstpp.115.181 ISSN 0080-4703. Department of the Interior, Geological Survey, Reston, Virginia, U.S.A. and University of Tasmania, Hobart, Tasmania, Australia.

Pollen analysis of a 2 m core from the floor of Crown Lagoon in the Midlands of Tasmania indicates that the vegetation varied from grassy woodland through grassland to grassy woodland and grassy open-forest during late Pleistocene and Holocene times. It is suggested that these variations represent changes of climate from moister to colder and drier conditions during the later part of the Last Glacial Stage (25 000-10 000 BP) with a return to moister conditions in the Holocene. The core is undated.

INTRODUCTION

During a recent investigation of the stratigraphy of the aeolian sediments that compose a lunette and the clays that floor the adjacent dry lake at Crown Lagoon near Lemont (lat. 42°17'S; long. 147°38'E) in the Midlands of Tasmania (fig. 1) a short core was taken for pollen analysis. The core from the *Upper Unit* of lacustrine clays (Sigleo 1979; Sigleo and Colhoun 1981) was obtained by the Tasmanian Department of Mines whose drilling and seismic work showed that the following stratigraphy occurred beneath the core site located at the obtuse angle on the section line A-B (fig. 2):

0-0.45 m	Very dark grading downwards to dark greyish-brown organic-rich silty clay with a distinct thin horizon of clayey fine quartz sand at 0.45 m.
0.45-2.05 m	Olive-coloured silty clay with 5-10 per cent of very fine quartz sand.
2.05-15 m	Greenish grey to greenish black deeply weathered basalt.
15+ m	Unweathered Tertiary basalt.

This brief paper records the pollen obtained from the core and makes an interpretation of the vegetation and palaeoclimatic history of the area after some general considerations on the present environment and dating of the sediments.

The floor of Crown Lagoon occurs at 375 m on a plateau surface of between 370 and 450 m above sea-level on the eastern boundary of the Midland Graben (350-500 m) with the Eastern Highlands (600-800 m) of Tasmania. The area has cool winters (5°C) and warm summers (15°C), and is sub-humid. Precipitation increases slightly eastwards from 400-500 mm in the rain-shadowed Midlands to 600-700 mm on the Eastern Highlands. West of the Midlands the steep Jurassic dolerite escarpment of the southern part of the Western Tiers rises to 900-1100 m and forms the eastern margin of the Central Plateau which, though cooler, is also a relatively dry region with precipitation values of approximately 700 mm.

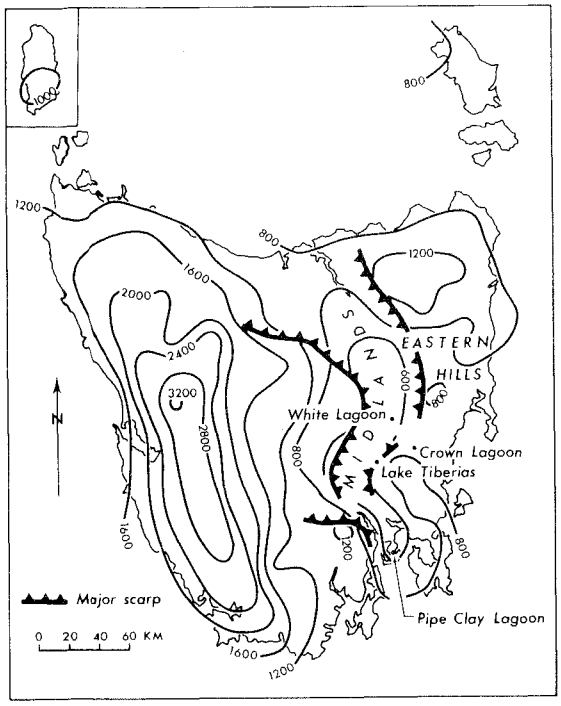

FIG. 1 - Topography and precipitation (mm) in Tasmania.

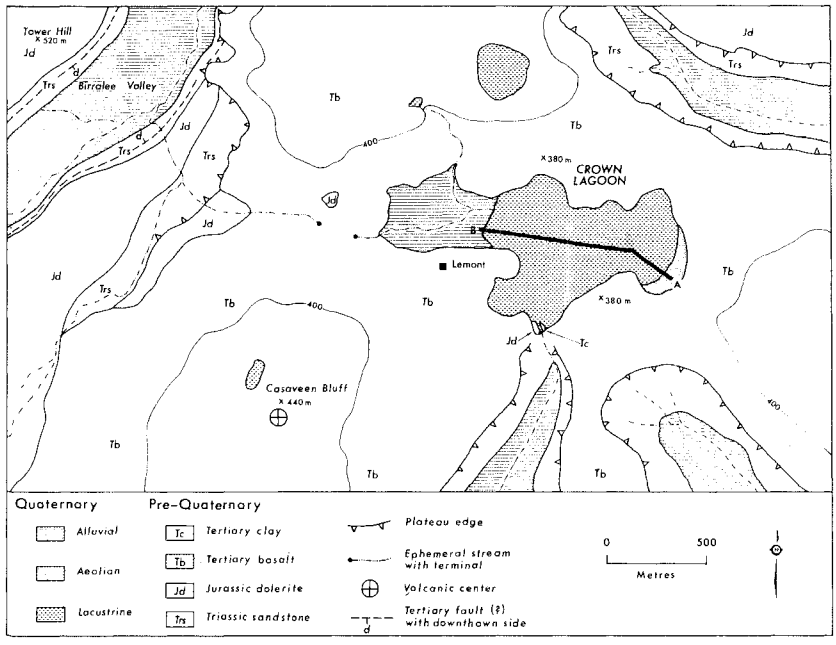

FIG. 2 - Crown Lagoon

There is a broad correlation between the vegetation and climate of these three north-south trending zones which were, prior to the advent of agriculture and lumbering, predominantly occupied by grassy open-forests and woodlands on the Central Plateau, tall open-forests on the scarp of the Western Tiers, grassy woodlands in the Midlands and open-forests with shrub understoreys on adjacent parts of the Eastern Highlands (Specht 1970). On the dolerite escarpment *Eucalyptus delegatensis* is the dominant tree and broadleaf shrubs form an understorey. On the plateau a sequence related to drainage occurs which varies from *E. rodwayi* in poorly-drained depressions through *E. pauciflora* and *E. dalrympleana* with a grass ground layer on gentle slopes to *E. delegatensis* with sclerophyll shrubs on the steepest slopes. The grassy woodlands of the Midlands were dominated by *E. ovata* and *E. pauciflora* with a ground layer of tussock grasses on lower, less well-drained sites, and by *E. viminalis* and *E. amygdalina* on higher, drier ridge sites. *E. delegatensis*, *E. viminalis* and *E. amygdalina* are the most important species of the open-forests on the adjacent part of the Eastern Highlands (Kirkpatrick 1981).

Insufficient organic material was obtained from the core at Crown Lagoon to provide ^{14}C assays to date the lake clays and the vegetation changes as inferred from the pollen content. Although undated it is suggested that the lithological boundary at 0.45 m approximately divides the Pleistocene and Holocene deposits.

POLLEN ANALYSIS

Pollen samples were taken at 0.1 m intervals and were processed using HF digestion and acetolysis (Mehringer 1967) as required for sediments likely to have low pollen concentrations. The pollen taxa were identified and counted at 600x using reference materials supplied by the Botany Department of the University of Tasmania and standard keys. The method of counting employed the double fixed sum procedure (Adam 1967). The first sum of 200 grains included all pollen taxa. To obtain the second sum the values for aquatic taxa were subtracted from the first sum and an additional sum of 200 grains was counted for all non aquatic types. Spores of pteridophytes were excluded. The results are shown separately on the relative pollen diagram of figure 3 as infilled and open curves respectively for individual taxa. The nomenclature follows Curtis and Morris (1975) and Curtis (1963, 1967).

Modern Pollen

For the purposes of interpretation of the relationship between the pollen and vegetation two modern surface samples were taken from within and adjacent to a small undrained marsh 600 m northeast of the lagoon. Each surface sample integrates 36 sub-samples that were collected from a 50 m^2 area at 10 m grid intervals.

Examination of Table 1 suggests that in the grassy woodlands, *Eucalyptus* pollen is overrepresented by a factor of approximately 2 while grass is underrepresented by a factor of 0.6. Pollen of Compositae is grossly overrepresented but the absence of Compositae from the sampled area is not typical for the whole area where both native and introduced Compositae are widespread. Cyperaceae pollen is underrepresented by a factor of 0.5. *Phyllocladus asplenifolius* (1%) is the only long distance indigenous component presently reaching the site and this pollen is windborne a minimum distance of 40 km from the Central Plateau to the west.

In the marsh habitat, which probably most closely resembles the conditions at Crown Lagoon prior to its artificial draining at the end of last century, *Myriophyllum* pollen is underrepresented by a factor of 0.65 while the herbs *Pratia* and *Villarsia* are not represented by pollen. Pollen of Cyperaceae exceeds the presence of *Eleocharis* by a factor of 3.8 and is probably mainly of local habitat origin. In addition, pollen of Myrtaceae, Gramineae and Compositae is recorded in substantial quantities in the marsh assemblage and clearly represents the main components of the local dryland vegetation. As in the grassy woodland, the Myrtaceae pollen (≈ *Eucalyptus*) exceeds the percentage *Eucalyptus* cover by a factor of between 1.3 and 3 to 1, and while the Gramineae pollen overrepresents the local marsh grass it underrepresents the regional grass cover by a factor of 0.25 to 0.35.

Pollen Diagram from Crown Lagoon, Tasmania

TABLE 1

MODERN PLANT SPECIES AND POLLEN ASSEMBLAGES FROM SAMPLE SITES ADJACENT TO CROWN LAGOON

Species	Relative Cover, %		First Sum Pollen, %	Second Sum Pollen, %
	Grassy *Eucalyptus* Woodland			
Eucaluptus ovata	<5		20.0	
Eucalyptus pauciflora	<5			
Banksia marginata	rare		0.5	
Coprosma quadrifida	rare		-	
Poa spp.	45		46.5	
Danthonia spp.	20			
Themeda australis	10			
Convolvulus sp.	5		-	
CYPERACEAE	3		1.5	
Rumex acetosella†	rare		-	
Plantago major†	2		-	
Oxalis corniculata	<1		-	
Acaena echinata	<1		-	
Geranium sp.	rare		-	
Anagallis arvensis†	rare		-	
Pollen taxa only:				
Acacia			0.5	
Bursaria spinosa			0.5	
Casuarina			0.5	
Dodonaea			0.5	
Pinus†			0.5	
Phyllocladus asplenifolius			1.0	
CUPRESSACEAE?†			0.5	
COMPOSITAE			23.0	
Unknowns			4.5	
	Marsh			
Myriophyllum	40		26.0	excl.
Pratia spp.	5		-	-
Villarsia exaltata	30		-	excl.
Eleocharis sp.	5	CYPERACEAE	19.0	excl.
Hydrocotyle sp.	<5		2.0	3.0
GRAMINEAE	<5		18.5	26.0
Triglochin procera	<5		2.0	excl.
Utricularia sp.	<3		-	excl.
Lepidosperma sp.	<1	CYPERACEAE	-	excl.
Juncus sp.	<1		-	excl.
Pollen taxa only:				
Myrtaceae			13.0	30.0
Casuarina			-	1.0
CUPRESSACEAE?†			0.5	1.0
Goodenia			0.5	0.5
COMPOSITAE†(partly)			16.0	34.5
CHENOPODIACEAE/AMARANTHACEAE			-	1.0
Unknowns			2.0	2.5

† introduced species

Compositae pollen again grossly overrepresent their importance in the vegetation of the area. However, the ratios of *Eucalyptus*/Gramineae plus Compositae in the soil surface and in the marsh samples are 0.29 and 0.5 respectively which can be used as guideline values for the modern grassy woodlands even though the Gramineae and Compositae values may be somewhat high as a result of species introduction and agriculture in the area.

Fossil Pollen

Pollen of arboreal taxa rarely exceeds ten per cent in the first sum and twenty per cent in the second sum. The tree pollen consist of a local component of *Eucalyptus* and *Casuarina* and a windborne component of *P. aspleniifolius*, *Phaerosphaera hookeriana*, *Nothofagus cunninghamii* and *Podocarpus lawrencii* most of which has been transported from the western part of the Central Plateau and western Tasmania. Most of the pollen (89-90%) of both sums is derived from local herbs, shrubs and aquatic plants with Gramineae, Compositae, Chenopodiaceae and *Myriophyllum* types being predominant.

Ratios of *Eucalyptus* to Gramineae plus Compositae and of *Eucalyptus* to the wind-pollinated tree taxa have been calculated from the second sum data and graphed as a means of judging the relative importance of trees to herbaceous plants in the local vegetation, and the input of extraneous tree pollen components to the site. Although some of the *Casuarina* may be local its covariance with *P. aspleniifolius* and *P. hookeriana* suggests a more distant source for most of the input.

No pollen was recorded in the sediments below 0.75 m depth. At least the surface 0.1 m (possibly 0.2) of the core have been destroyed either by oxidation of organic matter consequent upon draining and ploughing of the lagoon floor or by mechanical compaction and removal of surface material.

The pollen diagram is divided into three zones on the basis of broad changes in the relative pollen frequencies.

Zone 1 (0.85-1.7+ m) is characterised by relatively high values for *Eucalyptus* (6-16.5%) and windborne pollen of the tree taxa *Casuarina* (3-12%), and *P. aspleniifolius* (3-23%), the shrub *P. hookeriana* (0-6.5%), and by relatively low values of Gramineae (5.5-29%) (second sum). *Myriophyllum* is very abundant (76.5-92.5%).

Zone 2 (0.3-0.8 m) is characterised by low values of *Eucalyptus* (2-6.5%) and wind transported pollen of *Casuarina* (0-2.5%), *P. aspleniifolius* (0-10%) and *P. hookeriana* (0-4%), and by a strong rise in pollen of Granineae (28-52.5%) and Chenopodiaceae (11.5-31%). *Myriophyllum* is greatly reduced (2.5-17.5%).

Zone 3 (0-0.3 m) is characterised by a sharp increase in *Eucalyptus* (16-17%) with some accompanying increase in consistence of presence of *Casuarina* (1-1.5%) and *P. aspleniifolius* (3.5%), and by a marked decrease in pollen of Gramineae 23%. Pollen of *Myriophyllum* (14%) and Cyperaceae (11-18%) increases during this zone.

The high values of *Myriophyllum* in Zone 1 indicate that a shallow lake surrounded at least in part by abundant rooted aquatic plants was present during this period. The relatively high values of wind-pollinated tree taxa suggest that much of the tree pollen was transported into the area which probably had a grassy woodland to open-forest vegetation not markedly dissimilar from the present vegetation, but perhaps with fewer eucalypts as suggested by the ratio to wind-pollinated AP. It is difficult to assess the composition of the herb flora except to indicate that grass was probably more important than the curves of Compositae and Chenopodiaceae would suggest, as the modern samples point to grass being underrepresented and Compositae being grossly overrepresented.

The association of a gross reduction in *Myriophyllum* with very strong increases in Gramineae, Compositae and Chenopodiaceae low in Zone 2, where pollen of distant trees and local *Eucalyptus* was markedly reduced, points strongly to the development of a

Pollen Diagram from Crown Lagoon, Tasmania

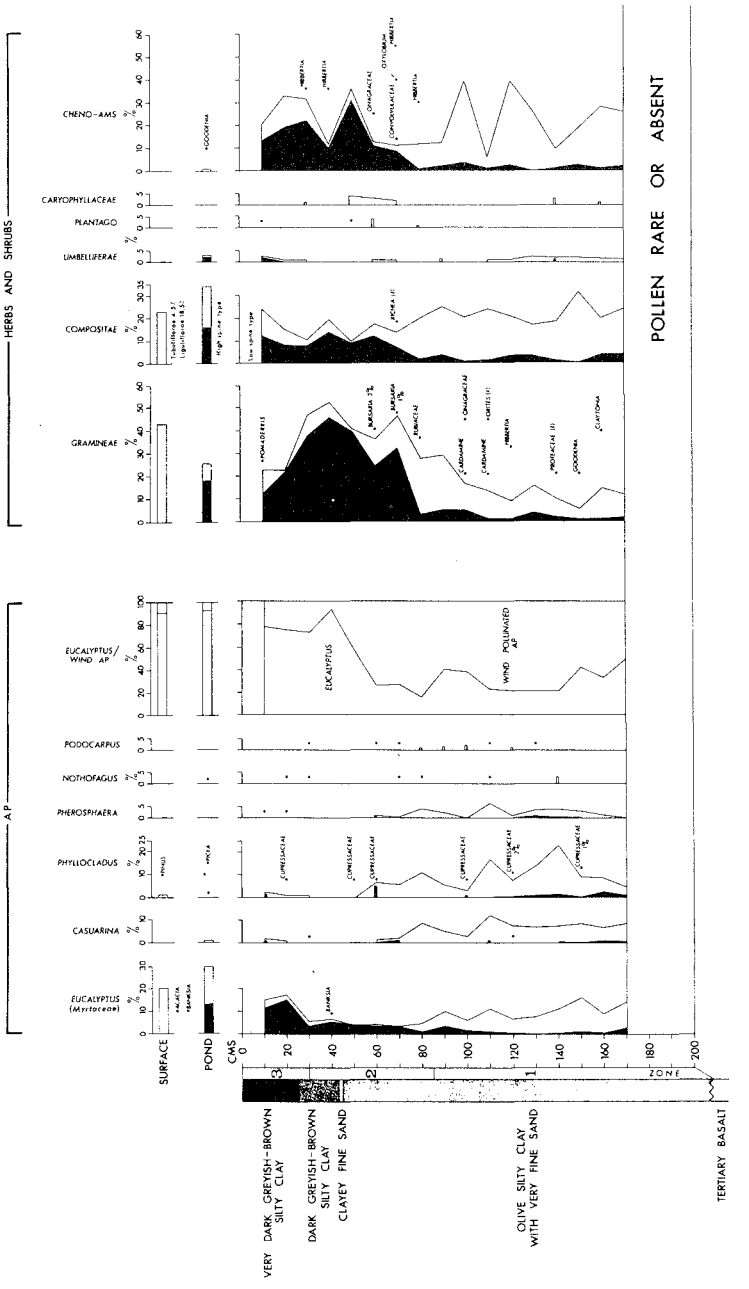

FIG. 3A - Part of pollen diagram.

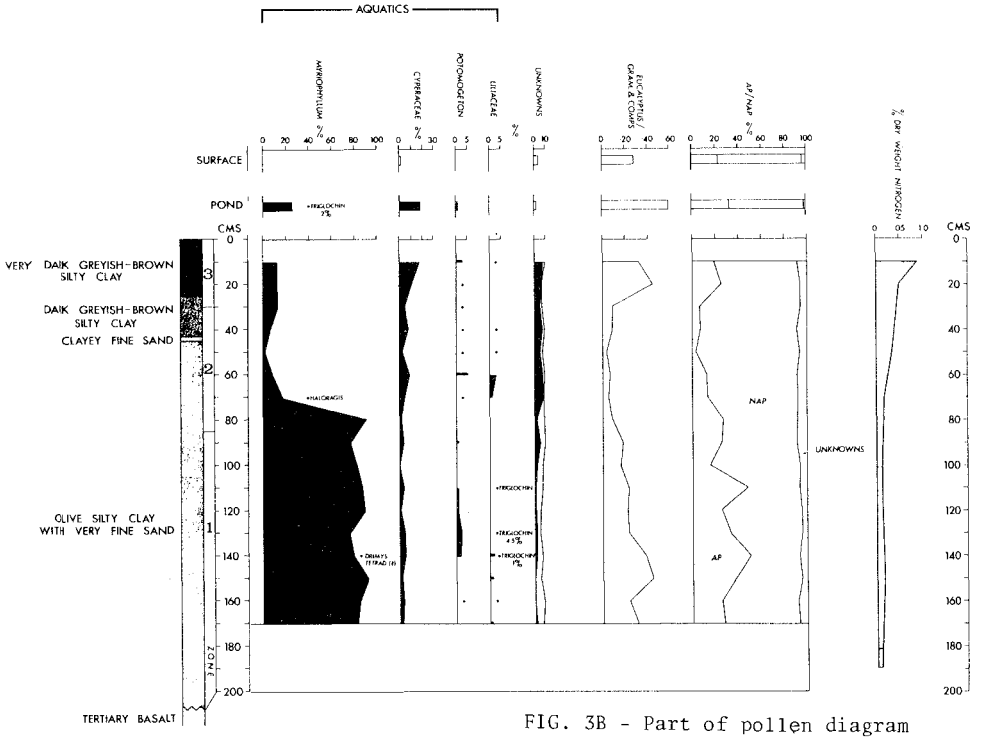

FIG. 3B - Part of pollen diagram

predominantly grassland environment with few trees present. During this period the lagoon probably dried out seasonally sufficiently often not to favour the maintenance of significant quantities of aquatic plants. This suggests that the climate associated with the vegetation of Zone 2 was markedly drier, at least during the summer season than that associated with the vegetation of Zone 1 in which eucalypts and aquatics were more abundant.

During Zone 3 the marked increase in Cyperaceae and nitrogen levels may partly be related to infilling of the lake by organic materials. However, there is both a significant increase in *Eucalyptus* pollen almost to its modern level and a marked decrease of Gramineae also almost to its modern level of deposition in a pond environment. This suggests that Zone 3 represents part of the Holocene vegetation of the area which was grassy woodland and grassy open-forest in a subhumid environment not dissimilar from the present one. It should be noted that the sharp rise in *Eucalyptus* at the base of Zone 3 does not coincide with the main lithological boundary at 0.45 m, taken to be the approximate Pleistocene-Holocene boundary but occurs at the next lithological boundary at 0.25 m. As it has not been possible to obtain ^{14}C assays on either boundary it is difficult to ascertain the time difference that may be involved between the slight increase in organic content of the sediments and the rise in *Eucalyptus*, or its significance. However, a gradual return to more wooded conditions is implied by the steep decrease in the curve for Gramineae between 0.4 and 0.3 m and by the marked increase in *Eucalyptus* above 0.25 m.

From a consideration of the terrestrial and aquatic pollen taxa recorded it may be concluded that during the Late Pleistocene and Holocene at Crown Lagoon the vegetation varied from a grassy woodland through grassland (perhaps steppe) to grassy woodland or grassy open forest with more *Eucalyptus* being present during the Holocene than at any time previously. The vegetation suggests that the climate would have varied from being slightly drier and presumably cooler than at present with permanent water in the lagoon indicating a lack of extreme seasonal differences, through a phase of increased dryness probably

related to reduced temperatures but with marked seasonal differences that caused regular drying out of the lagoon, to approximately the present subhumid climate.

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