

Section 8.5: Pollen Report – Mike Macphail

**POLLEN ANALYSIS OF SOIL SAMPLES,
PARRAMATTA CHILDREN'S COURT DEVELOPMENT SITE,
CORNER OF GEORGE & O'CONNELL STREETS, PARRAMATTA**

by

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1.0 INTRODUCTION

The proposed Children's Court on George St., Parramatta, is the latest development along what is one of the most historic urban thoroughfares in Australia. For example, unlike its namesake street in the Sydney CBD, the remains of wattle-and-daub convict huts still survive under buildings constructed in the later nineteenth and twentieth centuries. Two of these huts are predicted to occur within the study area and will be conserved for the future below the proposed Courthouse complex. Of equal significance is that, by the 1820s, the huts were occupied by emancipated convicts or free settlers and the site potentially preserves a record of the transition from a convict/military society centred around subsistence agriculture to an emancipist/free settler society centred around rural commodities.

- 1.1 This report.** The report analyses fossil pollen and spores preserved in buried soils under a late twentieth century car park used by the Attorney General's Department on the corner of George and O'Connell Streets (Fig. 1). The site, which is separated from the Parramatta River by the grounds of the Parramatta Hospital, encompasses an early 1800s town lease. This allotment was subdivided into two, subsequently three, town leases (Lots 102E, 102W, 103) by 1822 (Fig. 2a).
- 1.2 Previous studies.** Archaeological sites for which pollen analytical data are available, are located at the corner of Smith and George Sts., at 41-54 George St. and 16-18 Smith St. (Macphail 1999a 1999b) and the corner of George and Charles Sts. (Macphail 2004).
- 1.3 Samples.** Eleven soil samples from the three Colonial period allotments were submitted for pollen analysis by Dr. Mary Casey, Casey & Lowe Pty Ltd. (see Table 1). Copies of the Archaeological Assessment and Excavation Permit Application (Casey & Lowe 2004), the illustrated weekly excavation reports (Casey 2004) and the Trench Report (Miskella 2004) were provided by Dr. Casey. These allowed unusually precise formulation of archaeological questions likely to be resolved by pollen analytical techniques.
- 1.4 Aims.** The primary aim of the study was to determine whether fossil pollen and spores are preserved in the soils and, if so, whether these provide:
- Evidence for the landscape occupied by the Darug Aboriginal people prior to the arrival of British colonists at Parramatta in 1788 (ACNs 3920, 3409).
 - Independent evidence of early Colonial agriculture. Of particular interest are plantings made by the earliest known occupant of the site, Andrew Landrin, brought out to NSW to grow vines for wine-making. A watercolour dated to *c.* 1805 appears to show fruit trees (but no vines) growing behind the hut occupied by Landrin in 1809.
 - Independent evidence for the function of two features interpreted (Miskella 2004) as a well (ACN 4101) and a store or cellar (ACN 3957).
 - Evidence for the age(s) of three buried topsoils that were not associated with any built archaeological remains on Lot 102W (ACN 4065).

Fossil pollen and spores preserved in a sample of *c.* 1950s topsoil (ACN 3503) sealed under the bitumen-paved car park provides benchmark data against which the earlier Colonial period samples can be compared (control sample).

TABLE 1: SAMPLE DATA

SAMPLE	PHASE	LOT	AREA	ACN	1 Archaeological Context	Sediment	Comment
SS-1	7-8	102E	D	3503	current top soil	dark grey-brown sandy loam	soil sealed under bitumen car park (control sample)
SS-48	6-7?	102W	D	4065	buried topsoil	medium grey-brown silty fine sand	Relationship to built heritage unknown
SS-50	6-7?	102W	D	4065	buried topsoil	dark grey-brown silty fine sand	relationship to built heritage unknown
SS-54	6-7?	102W	D	4065	buried topsoil	medium yellow brown silty fine sand	relationship to built heritage unknown
SS-17	5	103	F	4104	top infill in circular feature	dark grey sandy loam , charcoal	feature interpreted as a well
SS-29	3-4	102W	D	3960	lower infill in large rectangular pit	medium grey silty sand	feature interpreted as cellar or store
SS-58	3?	102W	D	3920	natural sand at base of above feature	medium yellow brown silty fine sand	predates construction of cellar or store
SS-36	1-2	102W	D	3920	natural sand	orange-brown silty fine sand	predates construction of convict huts, 170s-1810
SS-05	1-2	102W	C	3409	natural sand	orange-brown silty fine sand	predates construction of convict huts, 170s-1810
SS-09	1-2	102W	C	3409	natural sand	yellow-brown silty fine sand	predates construction of convict huts, 170s-1810
SS-42	1-2	103	F	3920	natural sand	orange-brown silty fine sand	predates construction of convict huts, 170s-1810

2.0 SUMMARY

- All samples preserved low but adequate numbers of fossil pollen and spores. However their value as evidence for past vegetation is reduced by bioturbation of the 'natural' soils, e.g. by burrowing cicada larvae.
- Despite this constraint, the fossil data add to a growing body of evidence from Parramatta archaeological sites, that prior to European settlement, the higher river terraces (including the one traversed by George St.) supported open eucalypt woodland with a grassy understorey. Shrub-communities may have been confined to the riverbanks and appear to have included significant stands of wattles (*Acacia*). There is no evidence that river oaks (*Casuarina cunninghamiana*) or other casuarinas were prominent in the vicinity of the site.
- Clearing of trees by convicts resulted in the rapid spread of herbs associated with European agriculture: The site occupied by Lots 102 and 103 and probably other areas along George St. that were stripped of the native vegetation cover in the early 1790s but not built upon, remained weed-infested wasteland throughout much of the nineteenth and twentieth centuries.
- Three samples of a buried topsoil from Lot 102W [ACN 4065] are likely to have ceased development sometime between the late 1850s and mid twentieth century.
- Material used to infill a structure [ACN 4100] identified as a well appears to post-date the demolition of the brewery.
- Two samples associated with a feature identified using archaeological evidence as a cellar or store [ACN 3957] preserved trace to large numbers of pollen types produced by fruit trees (*Prunus* spp. and other Rosaceae including? apple), cereals, legumes (*Pisum*) and vegetables belonging to the cabbage/turnip family (Brassicaceae). These records are direct evidence that the structure was used to store unprocessed plant foods and seed during the early Colonial period.
- Pollen of type produced by native species confined to the central-southwest slopes and central tablelands indicates this cellar/store post-dates crossing of the Blue Mountains in 1813.
- The combined plant microfossil evidence point to a self-reliant society during the early Colonial period.

3.0 BACKGROUND

3.1 Geomorphology: Early Colonial Parramatta was built on a flight of Late Quaternary river terraces near to the tidal (and initially navigable) limit of the Parramatta River. Remnants of the Holocene floodplain - i.e. river terraces formed after postglacial sea levels stabilised about the present day position about 6000 years ago level - occur up to 2 m elevation on both sides of the river (Mitchell 2003). Higher terraces above 5-6 m above sea level, including the one upon which the study site is located, are more likely to have formed during the Last Interglacial period some 120,000 years ago. Weathered Triassic bedrock (Ashfield Shale) outcrops across the river near the 'dam' (Fig. 1).

Archival and borelog evidence indicate that the pre-settlement topography of the lowest (Holocene) terraces was highly irregular due to the prevalence of levee bank remnants (reduced to mounds) and back-swamp hollows (Lawrie, 1982). Some of the latter held permanent freshwater and were used as a water supply. Early plans show one of the creeks draining the upper terraces crossed the property (Section 19) adjoining the study site (see Fig. 2.5 in Casey & Lowe 2004).

3.2 Soils: Natural soils on the site are likely to be brownish-grey to yellow brown or red fine quartzose sands, covered by reworked alluvium (cf Mitchell 2003). Small circular features recorded by Miskella (2004) in the buried soils are likely to be the infilled burrows of cicada larvae and raise the possibility that the upper soil horizons have been extensively bioturbated since European settlement.

By analogy with modern floodplains, even small changes in topography and soil moisture availability (including salinity levels) will have had a major influence on the distribution of native plant communities.

3.3 Pre-Settlement vegetation: Benson & Howell (1990) propose that at the time of European settlement, the higher river terraces at Parramatta were covered by woodlands of grey box (*Eucalyptus moluccana*) and forest red Gum (*Eucalyptus tereticormis*) with an open grassy understorey. In 1798, a "stately grove" of wattles (*Acacia*) was growing near the present day corner of Church and Macquarie Sts. immediately to the east of the study site (Jarvis 1961:25). Large irregular pits found on one allotment on the study site (Lot 102W) are suggested to be holes left by the removal of trees (Miskella 2004:3)

Mangroves (*Avicennia marina*) are likely to have colonised the river margins up to the tidal limit (approximately below O'Connell St.) whilst the common reed (*Phragmites australis*), paperbarks (*Melaleuca linariifolia*) and rough-barked native apples (*Angophora floribunda*) occupied wetter and drier areas on the river terraces respectively. The sub-saline quality of the groundwater in wells (Jarvis 1961:157) indicates that samphires (Chenopodiaceae-Amaranthaceae) will have colonised areas subject to ephemeral flooding, e.g. clay pans on the higher terraces, as well as forming saltmarsh communities along the river.

4. EARLY COLONIAL HISTORY

4.1 George St. Clearing of the alluvial terraces began in 1789 and levelling of the same terrain was initiated in June 1790 with the construction of George St. (the first planned road in Australia) from the landing place on the Parramatta River 2 km west to the vice regal residence on Rose Hill.

In planning Parramatta, Governor Phillip intended that George St. be some 200 ft. (61 m) wide and lined by huts placed some 100 ft. (30 m) apart to reduce the risk of fire. Each hut was to be ca. 25 ft. long and capable of holding up to 10 persons (Jarvis 1961). By November 1790, some thirty-two 'wattle and daub' two roomed huts had been erected, as had two more substantial buildings - a storehouse and barracks close to the wharf. The first town lease was

issued to John Macarthur in 1796. Up to c. 1820, the population of Parramatta reputedly exceeded that of Sydney Town. By 1828 the principal streets had been macadamised and by the late 1830s George St. *could boast some very handsome dwellings and a few splendid inns* [whilst elsewhere] *the town was extending on every side with surprising activity; new and reputable dwelling houses were springing up in all directions and the value of town allotments was daily increasing* (newspaper report of 1837, quoted in Jervis 1961).

- 4.2 Agriculture.** Clearing and cultivation of the land at Parramatta were carried out by convict gangs between 1789-1791. For example Tench (5 December 1791) noted of a 200 acres area of cleared ground that 'six weeks ago...[it]...was a forest. It has been cleared and the wood nearly burnt off the ground by 500 men' (Tench 1793). The first crops included wheat, barley, oats and maize, planted on ground broken up by hoe and fertilised by the ashes of burnt native vegetation.

In 1789, a wheat field occupied part of the projected route of George St., whilst by late 1790 maize was being grown in the "marines' garden surrounding the barracks. Tobacco, vines, figs, apples and? turnips were being grown by December 1791 (Tench 1793). Although issued with flour and salt meat, many of the convicts were growing their own vegetables. A market for the sale of grain, fish, poultry and livestock was established in 1792. Tench (*ibid*) noted (with some surprise) that *although the cattle look in good condition...neither corn nor fodder is given to them* [and their] *enclosures furnish hardly a blade of grass*.

The first Agricultural Society in Australia was founded at Parramatta in July 1822 and in the following year a piece of ground on the north side of the river was made available as an experimental garden in which trials of new varieties of horticultural and ornamental plants could be made.

- 4.3 Horticulture:** Visitors to Rose Hill provide a reliable account of the introduction of edible plants in Parramatta before ~1820 (Bligh 1980) although only casual mention is made of the associated ornamental plantings. These may have included agapanthus (*Agapanthus*), hibiscus (*Hibiscus*), oleanders (*Oleander*), roses (*Rosa*), rue (*Ruta*), lupins (*Lupinus*), wallflowers (*Cheiranthus*), larkspurs (*Consolida*) and hollyhocks (*Alcea*) and deciduous trees including elms (*Ulmus*) and oaks (*Quercus*) (*ibid*: 16). Trench (1793) records that in 1791, vines such as grapes (*Vitis*), melons (*Cucurbita*), cucumbers (*Cucumis*), and pumpkins (*Cucurbita*), and fruit trees including apples (*Malus*), bananas (*Musa*), oranges and lemons (*Citrus*), and figs (*Ficus*) were growing in the vice-regal garden at the foot of Rose Hill (Bligh 1980: 11-12).

By 1793, these gardens included pomegranates (*Punica*) and "nearly all the vegetables known in Europe for culinary purposes" (Apiaceae, Brassicaceae, Fabaceae, Lamiaceae) with the different beds edged with "strawberries (*Fragaria*), two types of geraniums (*Pelargonium*) and stock (*Matthiola*): By 1820 currants (*Ribes*), gooseberries (*Ribes*), peaches (*Prunus*) and raspberries (*Rubus*) are singled out for special mention; "masses of yellow downy Mimosa (*Acacia*) flowers" grew along the hedge surrounding the garden; and the steep semi-circular hill at the back of the vice regal residence was "covered with woods on top of which is an alley of lemon trees...recently planted" (von Bellingshausen 1820 cited in Bligh 1980: 34).

Fossil pollen and spores (Macphail 1999a, 199b, 2004, this study) confirm that other ornamental species in the vicinity of George St. included the rough tree-fern (*Cyathea*), members of the Northern Hemisphere pine (Pinaceae) and elm (Ulmaceae) families although when these were first planted is unknown. The subsequent history of Parramatta, including agricultural and other civic developments that impacted on George St., is outlined in Jervis (1961).

5.0 SITE HISTORY

Documents covering the complex occupation and changes of ownership of Lots 102 and 103 have been reviewed by T. Kass (see Casey & Lowe 2004). Plans dating from 1822 to 1895 provide independent evidence for the position of the nineteenth century building on the site (Figs. 2a, 2b). Miskella (2004) has assigned the archaeological remains of these buildings and associated external features and soils into 7 European occupation phases (Phases 3-10) preceded by two earlier phases that encompass Aboriginal occupation of the upper Parramatta River during the Holocene (Phase 2) and its deep time (Pleistocene) past (Phase 1).

Phases 1-2. This interval covers the (a) Late Pleistocene (>10 kyr BP) when the river terrace traversed by George St. was constructed by fluvial processes ('natural sands'); (b) the Early-Middle Holocene (6-10 kyr BP) when Aborigines are likely to have established permanent camp sites in the area and when rising sea levels marine brought saltwater up to Parramatta; and (c) the Late Holocene, when fire is likely to have shaped the wooded landscape encountered by Europeans in 1788.

Phase 3. This interval covers the construction, occupation, and in some instances, demolition of wattle-and-daub convict huts between *c.* 1790-1810s.

It is reasonable to presume that all native trees and shrubs on the site had been cleared by 1792 since one convict hut was occupying the centre of Lot 102. This allotment is known to have been leased to a French prisoner-of-war (Anthony Landrin) in 1809 and Landrin may have been responsible for planting the fruit trees illustrated in a watercolour showing the view along George St. *c.* 1805 (see Fig. 2.3 in Casey & Lowe 2004). Lot 103 was leased to a 'public baker' (John Blakefield) in 1809 and it is possible he operated a bakery from a building (convict hut?) located on its western boundary.

The remains of both dwellings lie within the conservation area (Fig. 2a) and little information exists regarding the use made of vacant land surrounding the convict huts and subsequent buildings within the curtilage of Lots 102 and 103.

Phases 4-5. This interval (*c.* 1805-1840s) covers the occupation, upgrading and/or replacement of the convict era dwellings by more substantial buildings occupied by leaseholders (including emancipated convicts).

By 1824, Lot 102 was occupied by a Government Clerk (Samuel Larkin) who was appointed the Government Storekeeper in Parramatta in 1813. By 1824, improvements to Lot 102 include 'well-stocked fruit trees'. Larkin died in 1835 and in 1836, Lot 102 was split into eastern and western sections separated by a wooden fence.

A building ('1830s house') was erected along the street frontage of Lot 102W sometime between 1831 and 1844, and a brewery built *c.* 1838 along the western boundary of the same allotment. During the 1830s Lot 103 was owned and? occupied by the gaoler at Parramatta Gaol. It is possible that vacant ground around the buildings will have provided rough grazing for horses (the major form of transport at this period) and possibly cows.

Phase 6. This interval covers the construction, occupation and demolition of buildings on the three allotments between the 1840s and 1900.

The demolitions included the brewery in the late 1850s. Buildings erected during Phase 6 include three small houses along the street frontage of Lot 103 (by 1865), and tram sheds linked by lines onto George St. on the rear of the same allotment in the 1880s (Fig. 2b). At about the same time, a relatively substantial brick house was erected on the adjoining property (Section 19) close to the eastern boundary of Lot 102W.

It is improbable that vacant land at the rear of any of these premises was soft-landscaped, e.g. by gardens or trees, since the creek crossing the property adjoining Lot 102W (Section 19) had become an 'open and offensive sewer' by 1881 (see Fig. 2.9 in Casey & Lowe 2004).

Phases 7-9. Phase 7 covers residential occupations and demolitions between c. 1900 and 1930s when Lots 102 and 103 were recombined under the ownership of Sydney Ferries. Phases 8-9 covers the construction, occupation and demolition of the Maternity Hospital across Lots 102 and 103 in the late 1950s-1980s and the use of the vacant (waste) area as a car park attached to Attorney General's office.

Trees lining the footpaths of George and O'Connell Sts. are likely to have been planted since the 1950s. Photographs indicate these include eucalypts, paperbarks (*Melaleuca*) and possibly lilly-pilly (*Acmena*). Over the past decade, numerous exotic shrubs and herbs have invaded the site. These almost certainly includes privet (*Ligustrum*) as well as thistles (*Bidens*) and other widespread opportunist weeds such as plantain (*Plantago lanceolata/coronata*) and starwort (*Stellaria*).

6.0 AGE CONTROL

The eleven samples have been assigned to Miskella's (2004) phases based on a combination of archaeological and palynostratigraphic evidence (Table 2)

PHASE	SAMPLE	LOT	AREA	CAN	Context
7-8	SS-01	102E	D	3503	'current' top soil
6-7?	SS-48	102W	D	4065	buried topsoil
	SS-50	102W	D	4065	buried topsoil
	SS-54	102W	D	4065	buried topsoil
5	SS-17	103	F	4104	top infill in 'well'
3-4	SS-29	102W	D	3960	lower infill in 'cellar/store'
3?	SS-58	102W	D	3920	sand at base of 'cellar/store'
1-2	SS-36	102W	D	3920	natural sand
	SS-05	102W	C	3409	natural sand
	SS-09	102W	C	3409	natural sand
	SS-42	103	F	3920	natural sand

On the data available, the samples span the period from before European settlement (Phases 1-2) up to the construction of the bitumen car park in the 1960s (Phase 8).

7.0 POLLEN ANALYSIS

7.1 Processing: Because of the low organic content, approximately 20 grams of soil were digested - about ten times the usual amount. Otherwise each sample was processed using chemical, heavy liquid and sieving standard palynological techniques developed by the author and colleagues to concentrate acid-resistant plant microfossils from soils (see Macphail 1999a). Addition of a known number of exotic *Lycopodium* spores allowed the concentration of fossil pollen, spores and other plant microfossils to be expressed as 10^3 grains per gram of moist sediment.

7.2 Yield, preservation and contamination. Despite the high sand content, all samples yielded abundant but strongly humified and mostly finely disseminated plant debris, associated with numerous fungal spores and trace numbers of algal cysts. Yields of fossil pollen, fern spores and fungal spores were more variable, and at the lower end of values found in Colonial period soils (Table 3).

TABLE 3: Concentration data (10^3 palynomorphs per gram)

PHASE	SAMPLE	LOT	AREA	ACN	CONCENTRATION		PLAN
					spore-pollen	fungal spores	
7-8	SS-01	102E	D	3503	$1.1 \times 10^3 \text{ g}^{-1}$	$0.7 \times 10^3 \text{ g}^{-1}$	4.2
6-7?	SS-48	102W	D	4065	$2.2 \times 10^3 \text{ g}^{-1}$	$2.9 \times 10^3 \text{ g}^{-1}$	3.1
	SS-50	102W	D	4065	$1.8 \times 10^3 \text{ g}^{-1}$	$3.0 \times 10^3 \text{ g}^{-1}$	3.1
	SS-54	102W	D	4065	$1.4 \times 10^3 \text{ g}^{-1}$	$1.6 \times 10^3 \text{ g}^{-1}$	3.1
5	SS-17	103	F	4104	$3.6 \times 10^3 \text{ g}^{-1}$	$8.8 \times 10^3 \text{ g}^{-1}$	well, 4.1
3-4	SS-29	102W	D	3960	$3.9 \times 10^3 \text{ g}^{-1}$	$1.3 \times 10^3 \text{ g}^{-1}$	storage pit 3.1
3?	SS-58	102W	D	3920	$1.5 \times 10^3 \text{ g}^{-1}$	$0.9 \times 10^3 \text{ g}^{-1}$	storage pit 3.1
1-2	SS-36	102W	D	3920	$0.8 \times 10^3 \text{ g}^{-1}$	$0.8 \times 10^3 \text{ g}^{-1}$	3.1
	SS-05	102W	C	3409	$0.35 \times 10^3 \text{ g}^{-1}$	$0.05 \times 10^3 \text{ g}^{-1}$	4.2
	SS-09	102W	C	3409	$1.3 \times 10^3 \text{ g}^{-1}$	$1.2 \times 10^3 \text{ g}^{-1}$	4.2
	SS-42	103	F	3920	$1.0 \times 10^3 \text{ g}^{-1}$	$0.3 \times 10^3 \text{ g}^{-1}$	3.1

A reasonable assumption, supported by concentration data for the natural sand samples assigned to Phases 1-2 (SS-05, SS-09, SS-36, SS-42), is that the concentration of fungal spores is reliable proxy evidence of soil moisture and organic content.

Using this criterion, the most damp/organic-rich sediments come from ACN 4104 (SS-17) and support the interpretation of ACN 4101 as an infilled well.

Fungal spore concentration in sediments in and below an underground structure interpreted as a cellar or store (SS-29, SS-58), are relatively low and close to those values found in most topsoils and natural sands on the site. The conclusion - that these contexts (ACN 3960, 3920) were relatively dry - is consistent with the structure (ACN 3957) being used as a storage area and strongly against it being an unusually large cess-pit or cistern.

Preservation was adequate to fair, with all assemblages including strongly biodegraded and/or crumpled as well as perfectly preserved specimens.

This phenomenon, which is typical of bioturbated soil profiles, usually indicates that some stratigraphic leakage has occurred. Confirmation of this is provided by trace numbers of (often corroded) exotic pollen types including Pinaceae and dandelion (Liguliflorae) in many samples assigned to Phase 1-2.

7.3 Fossil pollen data. With the exception of SS-36 (pollen count <200 grains), the fossil pollen data, calculated as a percentage of the total identifiable pollen and spore count excluding algae and fungal spores, are statistically robust (Table 3). Values less than 1% are shown as '+'. Selected culturally significant plant microfossils are illustrated in Appendix 1.

The relative abundance of *Eucalyptus* pollen is difficult to estimate with precision since most samples yielded aggregates of immature Myrtaceae pollen. These range in size from four grains up to whole anthers and many could not be identified with certainty to either of the two locally occurring genera: *Eucalyptus* and (SS-1) *Melaleuca* (paperbarks).

7.4 Dominance and diversity: Diversities were low (~50 taxa) relative to the George & Charles Sts. site (~80 taxa), and markedly lower than numbers found in many Colonial period deposits within the Sydney CBD (Macphail 1999a, unpubl. data).

At least 20 pollen and spore types represent definite exotic species, or native species such as the rough tree-fern (*Cyathea*) that are unlikely to have been part of the riverside vegetation before the 1790s. It is probable that most of unidentified reticulate tricolpate and tricolporate pollen grains also represent exotic plants although none of these match modern grape (*Vitis vinifera*) pollen (see Figs 46, 49-54 on Plate 4, Appendix 1).

The diversity of native taxa, especially ferns and fern allies, is unusually low and only casuarina (*Allocasuarina/Casuarina*), eucalypts and another? Myrtaceae (Myrtaceae), grasses (Poaceae), wattles (*Acacia* spp.) and two liverworts (*Cingulatisporites*, *Rudolphisporis*) are consistently recorded.

With the exception of samples from the cellar/store (SS-29, SS-58), all microfloras are dominated by plants which produce/disperse pollen in very large numbers (well-represented taxa): Myrtaceae (mostly *Eucalyptus*) and native grasses (Poaceae): Fossilised anthers and large pollen aggregates show the parent plants overhung or grew on the site. The virtual absence of Pinaceae is surprising given pines are intrinsically strong producers/dispersers of pollen and *Pinus* is sporadically frequent (7%) on the George & Charles Sts. site (Macphail 2004).

Other sporadically common pollen taxa are crucifers (Brassicaceae), cereals (Poaceae: Cerealia), dandelions (Liguliflorae) and samphires (Chenopodiaceae). Apart from samphires, these taxa are under-represented in that their pollen is not dispersed far into the surrounding environment. Accordingly, even low relative abundance values are reliable evidence that the source was present on or very close to the site. High relative abundances of samphires on the study site are more likely to indicate disturbed, dry or salt-influenced soils than come from saltmarsh developed on mudflats lining the Parramatta River.

Liverwort spores (*Cingulatisporites*, *Rudolphisporis*) are special cases in that their fossil spores are uncommon except after fires (clearance phase) or in damp mineral soils accumulating under the drip-lines of eaves (see Macphail 1999a).

8.0 SAMPLES

8.1 Phase 7-8: This phase is represented by topsoil preserved under the bitumen car park (SS-1).

ACN 3503 [SS-1]

Lithology: dark grey-brown silty sand
 Inclusions: none observed in the sample provided
 Inferred age: 1950s-1960s
 Yield: low
 Preservation: variable
 Common taxa: Myrtaceae, Poaceae
 Frequent taxa: *Allocasuarina/Casuarina*, Liguliflorae, *Trifolium*, *Cingulatisporites*
 Edible spp: (trace numbers of cereal pollen)

Comment: The microflora is assumed to come from the undisturbed A₁ horizon of a soil that ceased development sometime was in the 1950s-1960s. The significant representation of clover (*Trifolium*), dandelion and liverworts, suggests the area was weed-invaded lawn prior to laying the bitumen seal.

Since there is no pollen evidence for woody species in the vicinity other than Myrtaceae (*Eucalyptus?*) and wattles (*Acacia*), the general area must have been subject to some form of maintenance (by maternity hospital ground staff?) to prevent the spread of opportunist shrubs. The microflora includes a rarely found specimen of Gyrostemonaceae pollen. This family includes xerophytic species confined to semi-arid regions west of the Blue Mountains but a more probable source would be planted specimens of the rainforest tree *Codonocarpus*.

8.2 Phases 6-7? Three samples of buried top soil recovered from the rear of Lot 102W (Area D) could date anywhere from the early nineteenth to late twentieth century but are assumed to post-date demolition of the brewery in the late 1850s because of the virtual absence of cereal pollen. The reasoning is that use of horses by the brewery would be reflected in significant numbers in samples accumulating before c. 1860s.

ACN 4065 [SS-48]

Lithology: medium grey-brown silty fine sand
 Inclusions: none observed in the sample provided
 Inferred age: < 1860
 Yield: low
 Preservation: variable
 Common taxa: Myrtaceae, Poaceae
 Frequent taxa: Chenopodiaceae, Liguliflorae
 Edible spp: none recorded

Comment: This low diversity microflora closely resembles the control sample (SS-1) except that grasses and samphire pollen are relatively common, and clover and liverworts are absent. The sample is suggested to represent a disturbed open ground behind the '1830s' house.

One unusual record is *Didictriletes ericanus*, a species that defines Stage 5 of the Permian in NSW. Its presence indicates Permian coals or Hawkesbury sandstone were brought onto the site since the local 'basement rock' (Ashfield Shale) is younger (Triassic).

ACN 4065 [SS-50]

Lithology: dark grey-brown silty fine sand
 Inclusions: none observed in the sample provided
 Inferred age: < 1860
 Yield: low
 Preservation: variable
 Common taxa: Myrtaceae, Poaceae
 Frequent taxa: Brassicaceae, Chenopodiaceae, Liguliflorae
 Edible spp: Brassicaceae?

Comment: The microflora closely resembles that recovered from SS-48 except that crucifers (Brassicaceae) are frequent (2%) and the sample preserves trace numbers of fern and fern ally spores. It is uncertain whether Brassicaceae pollen was derived from edible plants such as cabbage or turnip, or merely from one or more of the many weed species.

Shrubs and cryptogams include the two species whose presence on the study site is difficult to explain: (a) *Micrantheum ericoides* which is a low shrub found in heath and open forest on sandy soils from the coast to the mountains; and (b) slender clubmoss (*Lycopodium laterale*) which is found in bogs, swamps and similar damp areas within coastal heath. Other cryptogams could have grown on damp, shaded foundations in the vicinity.

ACN 4065 [SS-54]

Lithology: medium yellow-brown silty fine sand
 Inclusions: none observed in the sample provided
 Inferred age: < 1860
 Yield: low
 Preservation: variable
 Common taxa: Myrtaceae, Poaceae, Liguliflorae
 Frequent taxa: *Allocasuarina/Casuarina*, Chenopodiaceae, *Cingulatisporites*
 Edible spp: (trace numbers of cereal and Brassicaceae pollen)

Comment: Although fungal concentrations are similar to other topsoils, liverwort spores (3%) indicate the site was subject to minor run-off or used for the disposal of domestic water. Unusual records include rice-flowers (*Pimelea*) and a reticulate pentacolpate grain (source unknown).

- 8.3 Phase 5.** One sample, from the surface sediments infilling a circular feature identified as a well (ACN 4100), is assigned to Phase 5 based on its probable association with the brewery. Casuarina pollen are relatively frequent in this and older (Phase 3-4) samples, suggesting that a few river oaks (*Casuarina cunninghamiana*) may have survived (or been replanted) in the general area.

ACN 4104 [SS-17]

Lithology:	dark grey sandy loam
Inclusions:	charcoal
Inferred age:	1850s
Yield:	low
Preservation:	variable
Common taxa:	<i>Allocasuarina/Casuarina</i> , Myrtaceae, Poaceae, Liguliflorae
Frequent taxa:	Brassicaceae, Cyperaceae, <i>Cingulatisporites</i> , <i>Rudolphisporis</i> , monolete and trilete ferns
Edible spp:	(trace numbers of cereal and Brassicaceae pollen)

Comment: High values of dandelion, associated with sedge (Cyperaceae) pollen (2%), monolete and trilete ferns (4%), liverwort spores (3%), and charcoal imply the infill (ACN 4104) came from a (damp) domestic ash heap.

- 8.4 Phases 3-4.** This interval is represented by one sample (SS-29) recovered from one of the lower layers of sediment used to infill the rectangular 'cellar/store' feature. Since the structure (ACN 3957) is lined with brick, it is likely to post-date occupation of the site by convicts.

ACN 3960 [SS-29]

Lithology:	medium grey sandy loam
Inclusions:	none observed in the sample provided
Inferred age:	1810s-1830s
Yield:	low
Preservation:	variable
Common taxa:	Brassicaceae, Myrtaceae, Poaceae
Frequent taxa:	<i>Allocasuarina/Casuarina</i> , cereals, <i>Prunus</i> , trilete ferns
Edible spp:	Apiaceae, Brassicaceae, cereals, <i>Malus?</i> , <i>Pisum</i> , <i>Prunus</i> ,

Comment: Pollen of edible species are found in a variety of contexts on historical archaeological sites, the most common of which are cesspits. However, cesspit microfloras almost always include a palynomorph (cf *Ischyosporites*: see Macphail 1999a) which is absent in Sample SS-29.

This negative evidence, combined with the concentration data (see above), strongly implies that the edible pollen types come from foodstuffs stored in the underground structure [cereals, vegetables (peas and members of the cabbage/turnip and umbellifer families), and fruit ('prunus' and a type resembling apple or pear)]. An alternative explanation - that the sediment used to infill the structure came from a vegetable garden/orchard - is discounted because of the very low representation of dandelions (see above). It is tempting to link the prunus and? apple pollen with trees planted by Anthony Landrin or Samuel Larkin.

The microflora includes a distinctive Asteraceae pollen type with vestigial echini (fossil species *Tubulifloridites pleistocenicus*). The record is potentially significant since the two known native sources (*Cassinia arcuata*, *Calomeria amaranthoides*) were confined to the central-southwest slopes and central tablelands, respectively, prior to European settlement. It is always possible that the pollen came from an exotic source, e.g. *Artemisia*. If not, then the occurrence of *Tubulifloridites pleistocenicus* is evidence for the transhumance of stock from western NSW (i.e. the infill post-dates crossing of the Blue Mountains in 1813).¹

¹ MTC note – we consider that the storage cellar was backfilled around the 1830s.

ACN 3920 [SS-58]

Lithology:	medium yellow-brown silty fine sand
Inclusions:	none observed in the sample provided
Inferred age:	1790s-1830s
Yield:	low
Preservation:	variable
Common taxa:	Brassicaceae, Myrtaceae, Poaceae
Frequent taxa:	<i>Allocasuarina/Casuarina</i> , cereals, Fabaceae, Liguliflorae
Edible spp:	Brassicaceae, cereals, <i>Prunus</i> ,

Comment: The microflora is a depauperate version of that recovered from the lower fill layer (SS-29). In this instance, the pollen of edible plants appears to have infiltrated into a Pleistocene? sand underlying the structure and provides additional support for its use as a storeroom. Relative abundances of Brassicaceae pollen as high as 30% are extremely rare and imply that vegetable taxa stored in the structure included cabbage, turnip and/or rape (canola). The Chenopodiaceae count (2%) may also represent an edible species in this context, e.g. *Chenopodium album* (fat hen).

- 8.5 Phases 1-2.** These phases are represented by four samples of 'natural sand' (SS-05, SS-09, SS-36, SS-42). How much of the plant microfossil content in these sands is contemporary with the inorganic matrix is debatable since low to trace numbers of definite exotic pollen types are present; pollen dominance is similar to the control sample (SS-1) and other buried top soils on the site.

ACN 3920 [SS-36]

Lithology:	orange-brown silty fine sand
Inclusions:	none observed in the sample provided
Inferred age:	pre-1790s
Yield:	low
Preservation:	variable
Common taxa:	Myrtaceae, Poaceae
Frequent taxa:	<i>Allocasuarina/Casuarina</i>
Edible spp:	none recorded

Comment: This (very low diversity) microflora includes trace numbers of pine and dandelion, plus a small fragment of a Malvaceae pollen resembling *Gossypium* (cotton). The identification is provisional since the Malvaceae is a large family which includes numerous 'weed' species, e.g. *Malva* and *Malvastrum*, as well as ornamental plants. As far as is known, none of the three native species in the Sydney flora (*Hibiscus*, *Howitta*, *Abutilon*) produce pollen with the spines (echini) of the same size and shape found in the fossil specimen.

ACN 3409 [SS-05]

Lithology:	orange-brown silty fine sand
Inclusions:	none observed in the sample provided
Inferred age:	pre-1790s
Yield:	low
Preservation:	variable
Common taxa:	Myrtaceae, Poaceae
Frequent taxa:	<i>Allocasuarina/Casuarina</i> , Chenopodiaceae
Edible spp:	none recorded

Comment: The diversity is lower than that found in SS-36, and the exotic element includes Pinaceae and *Centaureium* (a not uncommon exotic weed in present-day lawns and gardens).

ACN 3409 [SS-09]

Lithology: orange-brown silty fine sand
 Inclusions: none observed in the sample provided
 Inferred age: pre-1790s
 Yield: low
 Preservation: variable
 Common taxa: Myrtaceae, Poaceae
 Frequent taxa: Cyperaceae, Pinaceae
 Edible spp: none recorded

Comment: This sample is the only one in the study that (just) failed to yield statistically significant numbers of pollen and spores. The exotic/non-local component includes the highest relative abundance of pine (1%) found in the study as well as trace numbers of dandelion and plantain pollen and a tree-fern spore.

ACN 3920 [SS-42]

Lithology: orange-brown silty fine sand
 Inclusions: none observed in the sample provided
 Inferred age: pre-1790s
 Yield: low
 Preservation: variable
 Common taxa: Myrtaceae, Poaceae
 Frequent taxa: none
 Edible spp: none recorded

Comment: The microflora most closely resembles that recovered from the control sample (SS-1). For example, numbers of native shrubs represented by trace amounts of pollen are higher than in other samples in the study. This may be due to location since both samples come from Lot 103, located relatively close to the riverbank. The presence of *Acacia* spp. is consistent with documentary evidence that wattles were part of the pre-1790s flora on the river terrace traversed by George St.

TABLE 4 (cont.)

OCCUPATION PHASE	7	5?-7			5	3-4	3?	1-2				
SOIL SAMPLE NUMBER	1	48	50	54	17	29	58	36	5	9	42	
LOT NUMBER AND PORTION	102E	102W	102W	102W	103	102W	102W	102W	102W	102W	103	
AREA NUMBER	A	D	D	D	F	D	D	D	C	C	F	
ARCHAEOLOGICAL CONTEXT NUMBER (ACN)	3503	4065	4065	4065	4104	3960	3920	3920	3409	3409	3920	
NATIVE TREES & SHRUBS												
<i>Acacia</i> (granulate)	wattle	+					+				+	
<i>Acacia</i> (non-granulate)	wattle	+		+		+		+		+	+	
<i>Allocasuarina/Casuarina</i>	river oak	2%	+	+	2%	7%	3%	1%	3%	1%	+	
<i>Amperea xiphoclada</i>	broom-spurge	+										
<i>Dodonaea ericifolia</i>	native hops				+						+	
<i>Micrantheum ericoides</i>	-			+								
<i>Monotoca</i>	broom-heath	+			+	+		+			+	
Myrtaceae	eucalypt &? paper-bark	63%	53%	59%	53%	33%	52%	37%	60%	49%	67%	
<i>Pimelea</i>	rice-flowers				+							
Proteaceae cf <i>Persoonia</i>	geebung			+							+	
NATIVE HERBS												
Asteraceae (low spine types)	daisy	+		+		+	1%	+	+	+	+	
Cyperaceae	sedge					2%	1%			+	1%	
<i>Gonocarpus</i>	raspwort		+									
Liliaceae	lily family					+	+					
Poaceae	native grasses	22%	40%	26%	25%	26%	18%	26%	33%	41%	25%	
unidentified reticulate tricolporate	-		+						+	+	+	
NATIVE FERNS, FERN ALLIES & LIVERWORTS												
<i>Calochlaena</i>	rainbow fern	+	+			+	+		+	+	+	
<i>Cingulatisporites bifurcatus</i>	liverwort	2%		+	2%	3%	+	+	+		+	
Gleicheniaceae	coral-fern						+					
<i>Lycopodium laterale</i>	slender clubmoss			+								
<i>Microsorium</i>	kangaroo fern											
monoete types (small)	includes fishbone fern			+	+	2%	+					
<i>Rudolphisporis rudolphi</i>	liverwort			+	1%	+	+				+	
trilete types	ground ferns	+				2%	1%	+	+			
Permian spp.			+									
POLLEN SUM		301	271	301	273	332	311	300	276	143	308	269

9.0 DISCUSSION

Because of bioturbation, much of the fossil pollen data are reliable evidence only for the types and relative abundance of plants growing on or near to the site, not when the parent plants were alive. Nevertheless the results add to a growing body of evidence that the dominant vegetation growing on the higher river terraces was eucalypt open woodland in which grasses, not shrubs, formed the groundcover: there is no evidence that river oaks or other casuarinas were prominent in the dryland vegetation.

Any extensive areas of shrubland are likely to have been confined to the banks of the Parramatta River, and these may have included significant stands of wattles. However this can only be confirmed by a comparison of plant microfossils preserved in residual fine-textured sediments in channels and depressions on the higher and lower river terraces. Agricultural 'weeds' rapidly invaded all cleared areas during the first decade, if not the low diversity of woody taxa other than Myrtaceae in almost all samples suggests areas at the rear of Lots 102 and 103 remained waste/open ground throughout much of the nineteenth and twentieth centuries.

Samples associated with the cellar/store (ACN 3957) are an exception to the above generalisations in (almost) every respect. Not only do the microfloras from the lower infill (SS-29) and underlying 'natural sand' (SS-58) strongly support the inferred function of the structure, and provide independent evidence of plant species underpinning the early Colonial food economy, they also under score the self-reliance of the early Colonialists. To elaborate:

At present vegetables are harvested before producing viable flowers, and some of these and many fruit species do not produce viable (or any) seeds. An example is the seedless grape. This cannot have been the case in the early Colonial period since vegetables picked before flowering, and processed grains and fruits, would not have left a palynological 'signature' in the sediments. A not unreasonable conclusion is that the structure was used to store unmilled cereals, legumes, fruit and other plant foods produced in a given year and also home-grown seed for replanting crops and gardens in the following year. This in turn may indicate an unavoidable? need for self-reliance that is at odds with the documented 'charitable' role of the Government stores in supplying the settlers' needs.

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APPENDIX 1

Photomicrographs of selected fossil pollen spores and related plant microfossils

All photomicrographs taken at x788 magnification (longer 50 μm scale bar) unless otherwise stated. The shorter 50 μm scale bar applies to photomicrographs taken at x600 magnification

PLATE 1

Figures 1-4 Plant cuticle and pollen aggregates

- Fig. 1 Leaf cuticle showing well-preserved stomata (eye-like cells). The oval object at the lower right hand side is a fungal spore. SS-17. x300.
- Fig. 2 Anther of immature Myrtaceae pollen (*Eucalyptus?*). SS-48. x600.
- Fig. 3 High magnification view of a fragmented anther showing individual pollen tetrads (*Eucalyptus*). SS-58
- Fig. 4 Aggregate of native grass pollen (Poaceae). Note the small size of individual grains relative to cereal pollen (compare Figs 30-32 on Plate 3). SS-1.

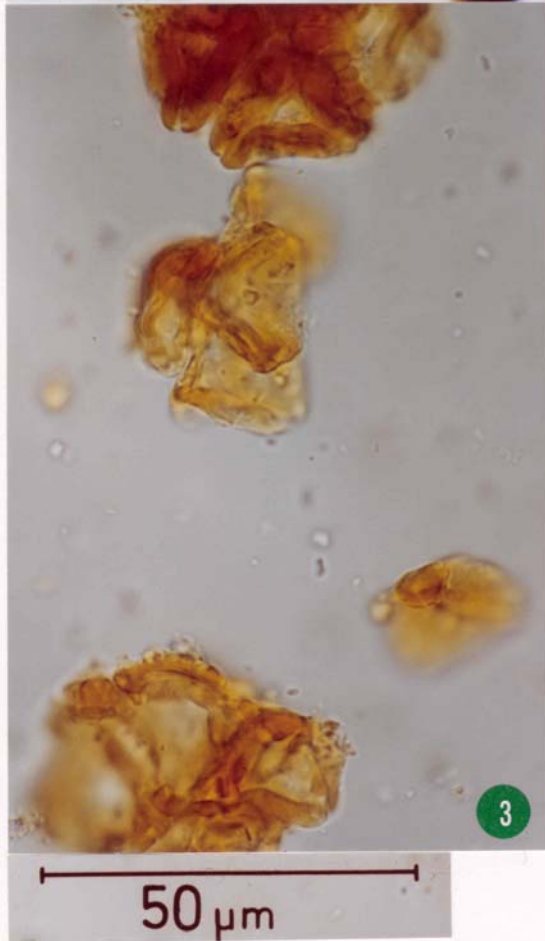
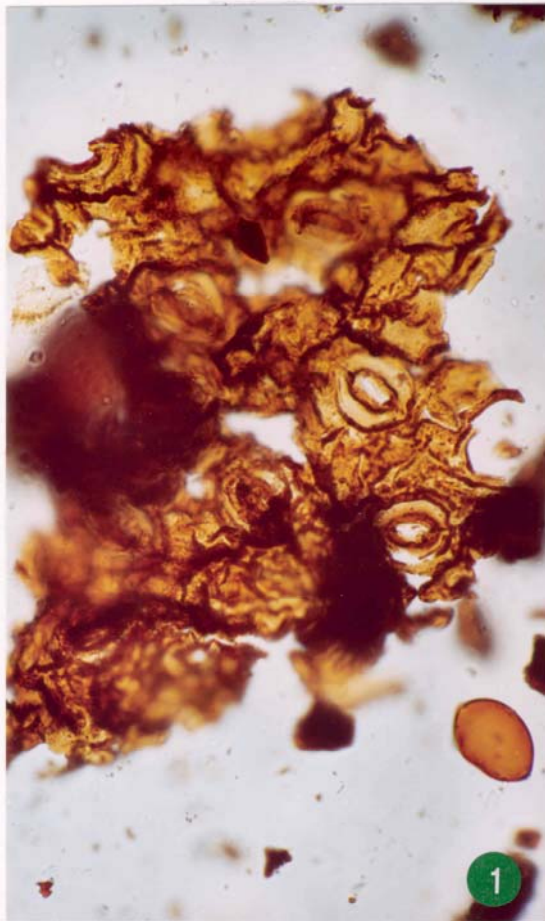


PLATE 2

Fig. 5 Reworked Permian spore

Fig. 5 *Didecitriletes ericanus* (from Permian Sage 5 coal or shale). SS-48.

Figs. 6-12 Ornamental trees and shrubs

Fig. 6 Corroded pine pollen (Pinaceae). SS-17

Fig. 7 Sphaeroidal periporate pollen with clavate-rugulate ornamentation (Alangiaceae?). SS-1.

Fig. 8 Rough tree-fern spore (*Cyathea*). SS17

Fig. 9 Elm family pollen (Ulmaceae). SS-48

Fig. 10 Oblate pentacolpate medium reticulate pollen grain (unidentified exotic plant). SS-54

Fig. 11 Gyrostemonaceae pollen (*Codonocarpus?*). SS-1.

Fig. 12 Gyrostemonaceae pollen (*Codonocarpus?*). SS-42

Figs. 13-16 Agricultural weeds and other exotic species indicative of disturbed habitats.

Fig. 13 Dandelion pollen (Liguliflorae). SS-17.

Fig. 14 Plantain pollen (*Plantago lanceolata/coronopus*). SS-48

Fig. 15 Micranthem pollen (*Micranthem ericoides*). SS-50.

Fig. 16 *Tubulifloridites pleistocenicus* pollen. SS-29.

Figs. 17-21 Edible and useful plants

Fig. 17 Umbellifer pollen (Apiaceae). SS-29

Fig. 18 Medium-reticulate crucifer pollen (Brassicaceae) in polar view. SS-29.

Fig. 19 Medium-reticulate Crucifer pollen (Brassicaceae) in equatorial view. SS-29.

Fig. 20 Fine-reticulate crucifer pollen (Brassicaceae) in equatorial view. SS-17.

Fig. 21 Coarse-reticulate crucifer pollen (Brassicaceae) in equatorial view. SS-29.

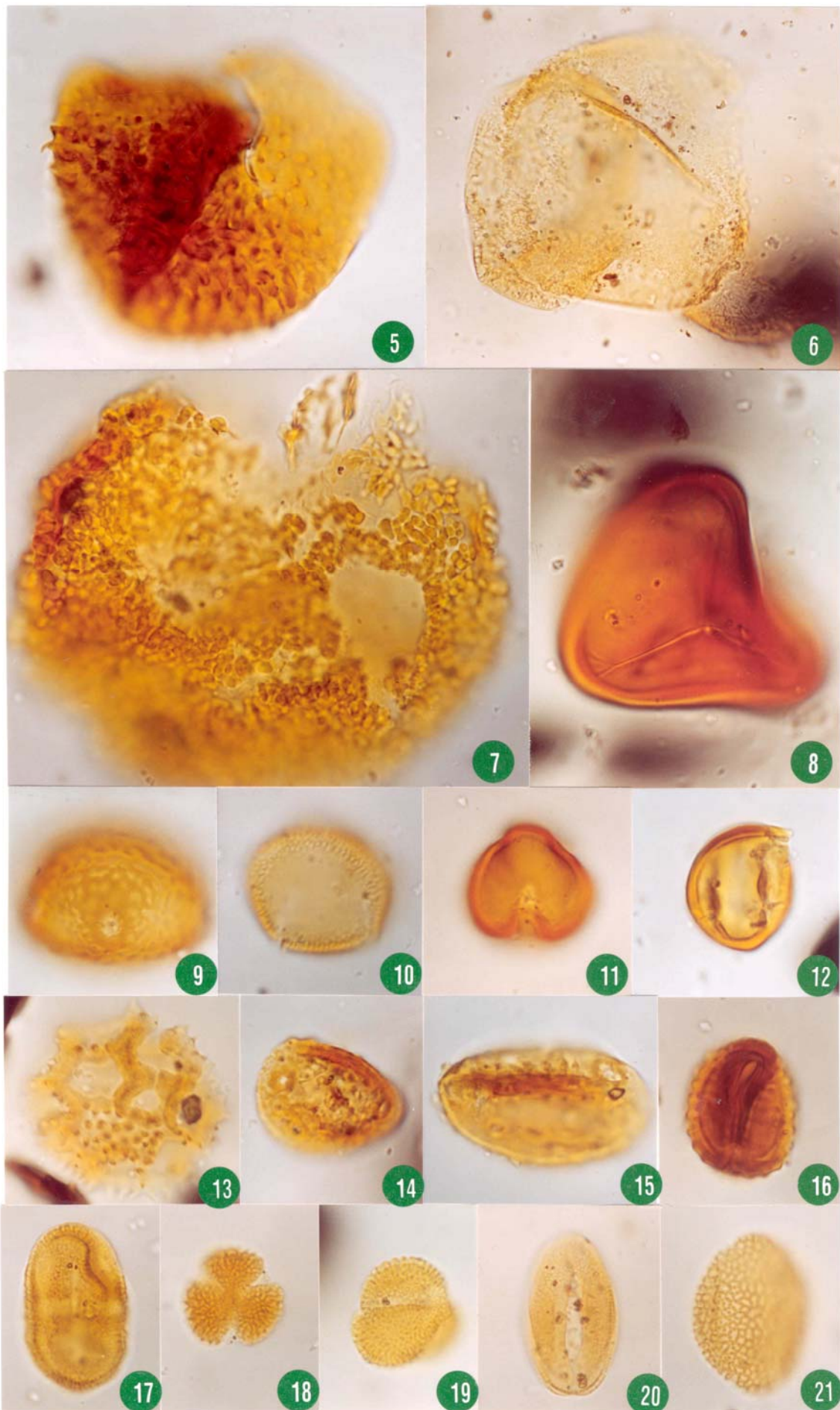


PLATE 3

Figs. 22-32 Edible and useful plants (cont.)

- Fig. 22 Modern prunus pollen (*Prunus amygdalo-persica*).
- Fig. 23 Fossil prunus pollen (*Prunus* sp.). SS-29.
- Fig. 24 Fossil prunus pollen (*Prunus* sp.). SS-58.
- Fig. 25 Modern apple pollen (*Malus pumila*).
- Fig. 26 Modern pear pollen (*Pyrus communis*).
- Fig. 27 Fossil pollen cf apple (*Malus*-type). SS-29.
- Fig. 28 Fossil pollen cf apple (*Malus*-type). SS-29.
- Fig. 29 Fossil pea pollen (*Pisum sativum*). SS-29.
- Fig. 30 Fossil cereal pollen (Poaceae: *Cerelia*). SS-58.
- Fig. 31 Fossil cereal pollen (Poaceae: *Cerelia*). SS-29.
- Fig. 32 Fossil cereal pollen (Poaceae: *Cerelia*). SS-29.
- Fig. 33 Portion of a cotton pollen grain (*Gossypium* sp.) showing the diagnostic ornamentation - spines (echini) rising from a cushion-like swelling of the outer pollen wall layer (sexine).
- Fig. 34 Fragment of the fossil Malvaceae pollen grain (cf *Gossypium*). The spine is more acute (sharper) but otherwise very similar to those on modern *Gossypium* pollen. SS-36.

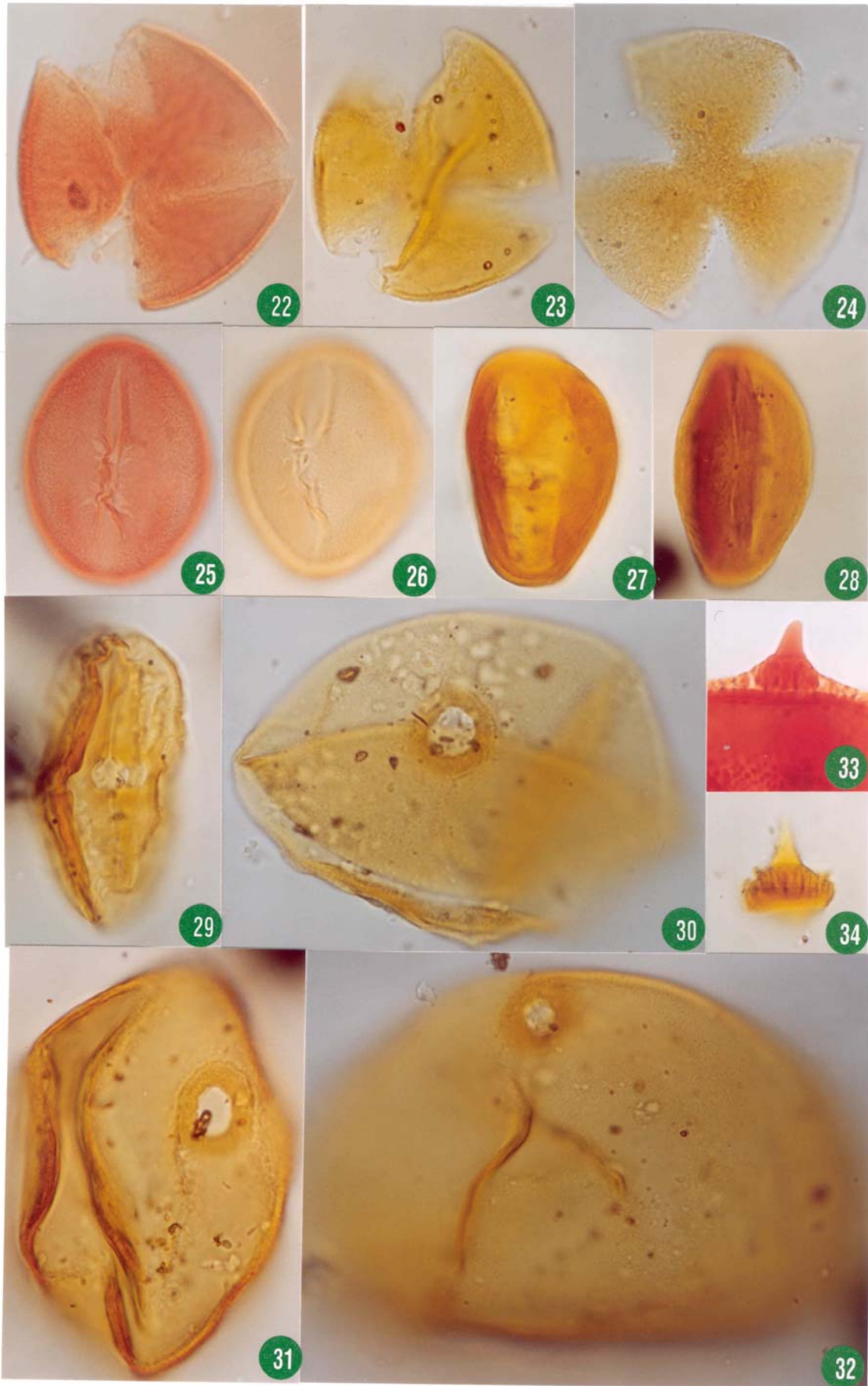


PLATE 4

Figs. 35-42 Native plants

- Fig. 35 Liverwort spore (*Rudolphisporis rudolphi*). SS-09.
- Fig. 36 Liverwort spore (*Cingulatisporites bifurcatus*). SS-54.
- Fig. 37 Non-granulate wattle pollen (*Acacia*). SS-36.
- Fig. 38 Granulate wattle pollen (*Acacia*). SS-01.
- Fig. 39 Fan-flower pollen? (Goodeniaceae cf *Scaevola*). SS-36.
- Fig. 40 Fan-flower pollen? (Goodeniaceae cf *Scaevola*). SS-09.
- Fig. 41 Rice-flower pollen (*Pimelea*). SS-54.
- Fig. 42 Native hops pollen (*Dodonaea ericifolia*). SS-42.

Figs. 43-52 Unidentified pollen types

- Fig. 43 Prolate tricolporoidate-reticulate pollen (cf Brassicaceae). SS-29.
- Fig. 44 Oblate tricolporoidate-reticulate pollen (cf *Trifolium*). SS-48.
- Fig. 45 Prolate tricolporate-scabrate pollen (Fabaceae?). SS-17.
- Fig. 46 Prolate tricolporate-microreticulate pollen. SS-36.
- Figs. 47-48 Prolate tricolporate-psilate/microapiculate pollen. SS-09.
- Fig. 49-50 Prolate tricolporate open medium-reticulate pollen. SS-36.
- Fig. 51 Prolate tricolporate dense medium-reticulate pollen. SS-09
- Fig. 52 Prolate tricolporate dense medium-reticulate pollen. SS-48
- Figs. 53-54 Modern grape pollen (*Vitis vinifera*).

