"News from the Interior": what can we tell from plant microfossils preserved on historical archaeological sites in colonial Parramatta?

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Parramatta's relative freedom from high-rise developments has allowed the archaeological footprint of its early colonial past to survive below many of the late nineteenth and earlier twentieth buildings lining the principal thoroughfares such as George, Charles, Church, Marsden, O'Connell, Phillip and Smith Streets. Since 1990, 11 historical archaeological sites including the important Parramatta colonial hospital site have been analysed for fossil pollen, spores and other plant microfossils (>160 samples). Archaeological contexts range from late eighteenth-century soils and postholes on sites occupied by convicts, to nineteenth-century cesspits, drains, wells and waterholes on sites occupied by emancipated (freed) convicts and free settlers. Not all contexts preserve in situ *organic remains but plant microfossils unearthed to date archive the clearing of native sclerophyll vegetation from the river terrace on which Parramatta has been built; some of the edible plants grown, stored and eaten by convicts and free settlers; grazing; the use of the Parramatta River and its floodplain as a source of domestic water and sediment to level building sites; the local extinction of at least one native aquatic herb; and the progressive spread of exotic weeds due to dumping of domestic waste around public and residential sites. One palynomorph, which has proved useful in identifying contexts associated with human sewage in Parramatta and Sydney, is formerly described and illustrated* (Cloacasporites sp.).

INTRODUCTION

Parramatta is Australia's third settlement after Sydney and Norfolk Island. For this reason, Parramatta's archaeology and built heritage is identified as being of national significance and having exceptional potential in researching the earliest phases of the British settlement of Australia in general, and the Cumberland Plain west of Sydney in particular.

Unlike Sydney's CBD, Parramatta has undergone limited urban expansion during the mid to late twentieth century due to flooding problems associated with a tributary of the Parramatta River, Darling Mills Creek. This restricted the excavation of underground carparks because of likely flooding. As a result most of the eighteenth and nineteenth-century sites have survived buried beneath later nineteenth and early twentieth-

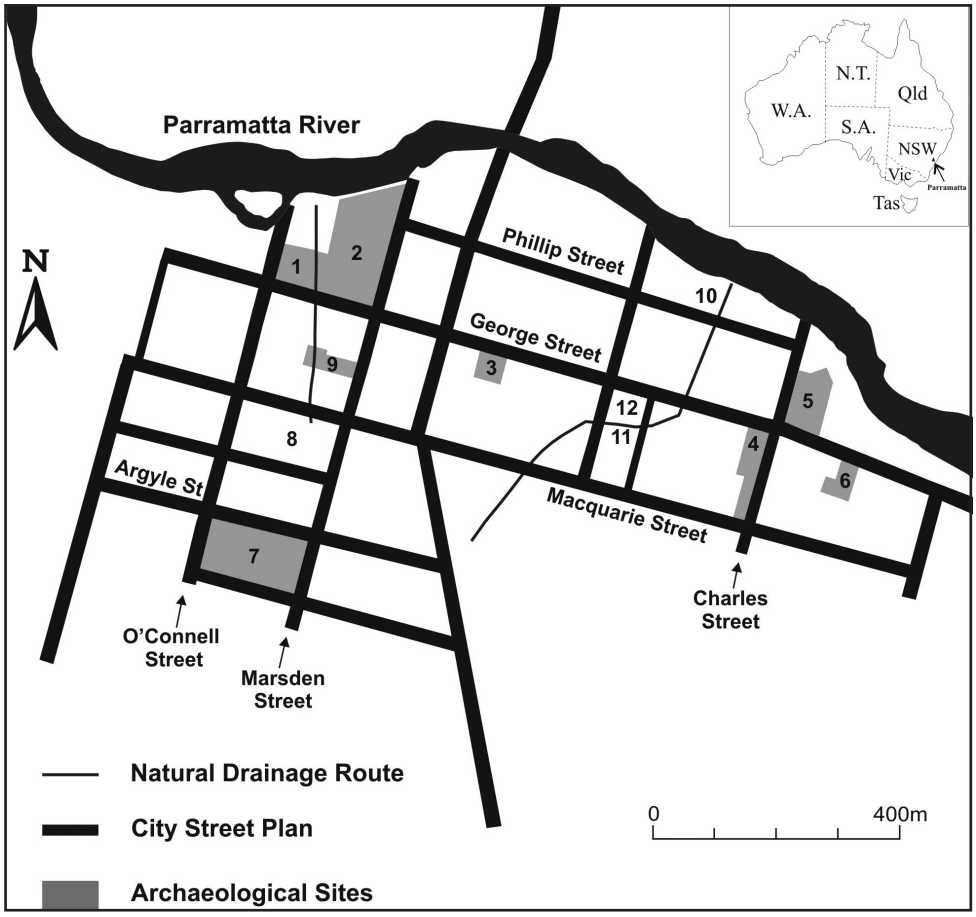

Figure 1: Location of archaeological sites mentioned in the text.
1: Parramatta Children's Court, 2 George Street.
2: Parramatta Justice Precinct, Convict Hopsital Site, cnr George and Marsden Streets.
3: Officeworks site 41-43 George Street.
4: 95-101 George Street.
5: 180-180A George Street.
6: 109-113 George Street.
7: Westfield Shoppingtown, Aird Street.
8: 24 Hunter Street.
9: 150 Marsden Street.
10: Metropolitan Water, Sewerage & Drainage Board site, 72 Phillip Street.
11: 16-18 Smith Street.
12: Babes in the Woods site, former Prospect County Council, 20 Smith Street.

century buildings. During the later nineteenth century while Sydney grew exponentially, Parramatta was isolated by 'long miles of bushland' from Sydney and newspaper reports as late as the 1840s concerning the settlement appeared under the caption "News from the Interior" (Jervis 1961:31). An important type of archaeological site are wattle-and-daub huts built between 1790 and c.1810s, whose archaeological 'footprints' survive under much younger buildings lining major thoroughfares such as George, Charles, Church, Marsden, O'Connell, Phillip and Smith Streets (Fig. 1). Other significant sites include the sequence of convict hospitals occupying what is now (2009) the Parramatta Justice Precinct at the corner of Marsden and George Streets, and James Ruse Reserve. The former is the longest continuously operating health services site in Australia (Casey & Lowe 2005, 2006a, c); the latter site is nearby to Experiment Farm, the first successful farm in Australia, and was later cultivated as a Chinese market garden and a twentieth-century dairy. At the other end of the social scale, some of the taller trees planted in the 'picturesque' English landscape around the vice-regal residence built in 1799 on Rose Hill may have contributed pollen to sites downslope along George Street.

Fossil pollen and spores (miospores) preserved in buried soils and other organic-rich deposits on these archaeological sites are a natural archive of exotic plantings (deliberate or otherwise) in Parramatta from the late eighteenth to late nineteenth century; a period which encompasses the clearing of the native vegetation, planting of the first crops, establishment of orchards and domestic gardens, and the transition of Parramatta from a convict/military society centred on subsistence agriculture to an emancipist/free settler society centred around limited commercial business enterprises, grazing of cattle on small holdings and the provision of services to the surrounding rural areas (Fernando Brambila sketch, April 1793). Many of the ~160 samples analysed so far are imprecisely dated, in particular buried soils unless they are part of a discrete archaeological context such as rubbish pits and wells. For this reason, as well as for practical difficulties in comparing very large amounts of pollen data from highly diverse archaeological contexts, it is premature to group the samples into age classes, but this would be a desirable outcome in further research. Accordingly, the approach adopted in this paper is to present the conclusions drawn from the fossil pollen data for each site and, where possible, use patterns in these data to test previous reconstructions of the vegetation at the time of British settlement of Parramatta in 1789 and infer general trends regarding the evolving townscape during the nineteenth century. Plant genera and/or species names are included in parentheses after the common name when first mentioned in the text. One palynomorph that has proved useful in identifying contexts associated with human sewage in Parramatta and Sydney, is described and informally named (*Cloacasporites* sp.) in Appendix 1.

Comparable microfossil data for historical archaeological sites analysed in Sydney up to 1998 have been published by Macphail (1999a). Details for the Parramatta sites can be found in the various archaeological assessment and excavation reports. Pollen relative abundance data are given in Appendices 2A to 2K, available online at www.caseyandlowe.com.au. Because of mostly low yields, these data are expressed in two ways: samples which yielded significant numbers of fossil pollen and spores (>100 counts), the fossil data are expressed as a percentage of the total identifiable pollen and spore count excluding algae, fungal spores and reworked taxa; values less than 1 per cent are shown as '+'. For samples yielding less than 100 fossil pollen and spores, the data are given in parentheses as raw counts.

NATURAL SETTING

Triassic bedrock (Ashfield Shale) outcrops on the northern river bank above the weir and ferruginized clays of possible Tertiary age occur close to the river near the Rosehill Racecourse. Elsewhere depths to bedrock are about 4–15 m and the town is built across a flight of Late Quaternary alluvial terraces some 5–10 m above the Parramatta River. Remnants of the Holocene floodplain, i.e. river terraces formed after postglacial sea levels stabilized about the present-day position about 6000 years ago,

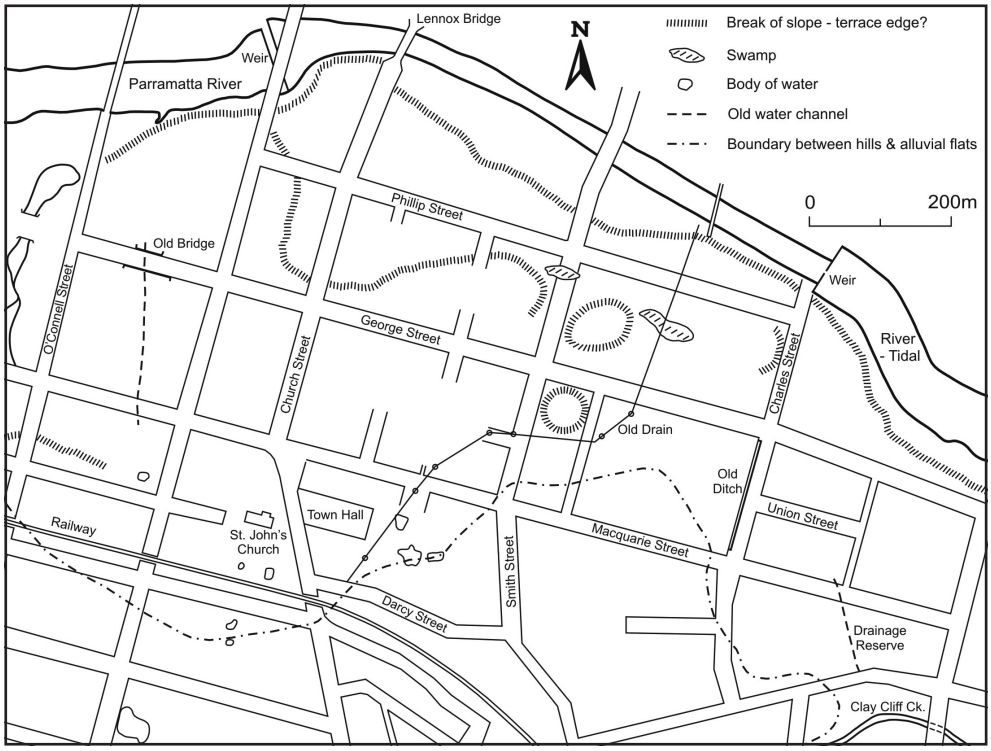

Figure 2: Reconstructed topography of Parramatta ca. 1789. Lawrie 1982, published with permission.

Figure 3: Eucalypt regrowth along the Parramatta River below the hospital in the 1880s. Published with permission of the Soceity of Australian Genealogists, SAG 5/5686.

occur up to 2 m elevation on both sides of the river. Archival and borelog evidence (Lawrie 1982, 2006) indicate that the pre-historic topography of the lower terraces was highly irregular, due to the prevalence of levee bank remnants (reduced to mounds) and back-swamp hollows. Some of the latter held permanent freshwater and were used as a domestic water supply after British settlement (Fig. 2). River terraces over 5 m above river level are more likely to have formed during or before the Last Interglacial period some 120,000 years ago. Here, any remnant fluvial landforms are highly subdued (see Mitchell 2003) and the terraces are mostly covered with reworked sand sheets. Soils are predominantly brownish-grey to yellow brown fine quartz sands or gradational red earths and A1, A2 and B1 horizons can be bioturbated by cicada larvae or worms, with infilled burrows reaching to an average depth of about 35 cm and occasionally to 50–60 cm depth below ground level (Mitchell 2003; Lawrie 2006).

The urgent need to ensure a reliable food supply for the colony meant that the vegetation growing on the site of Parramatta at the time of British settlement was only cursorily documented. Benson and Howell (1990) have used remnant stands to propose that these terraces were covered by woodlands dominated by eucalypt spp., in particular grey box (*Eucalyptus moluccana*) and forest red gum (*Eucalyptus tereticormis*), with an open grassy understorey. Mangroves (*Avicennia marina*) may have colonised the river margins up to the tidal limit, approximately below Charles Street, while the common reed (*Phragmites australis*), paperbarks (*Melaleuca linariifolia*) and rough-barked native apple (*Angophora floribunda*) are predicted to have occupied wetter and drier areas on the lower river terraces respectively. As late as 1798, a 'stately grove' of wattles (*Acacia*) was growing near the corner of Church and Macquarie Streets (Jervis 1961:25)

HISTORICAL BACKGROUND

Clearing of the alluvial terraces for the planting of the first successful crops in Australia began shortly after establishment of the military redoubt in November 1788. Preparation of the same terrain for the township began in July 1790 with the construction of High Street (modern George Street) linking the landing place on the Parramatta River to the vice-regal residence on Rose Hill about 1.6 km (1 mile) to the west. It is likely that most of the tall native trees and shrubs had been cleared within the town boundaries by the early or middle nineteenth century, although photographs show eucalypt regrowth lining the banks of the Parramatta River below the hospital in the 1880s (Fig. 3).

Built Heritage

In planning Parramatta, Governor Phillip intended that George Street be some 200 feet (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 about 24 feet (7.3 m) long and 12 feet (3.6 m) wide and capable of housing up to 10 persons (Jervis 1961). By November 1790, some 32 two-roomed huts 'built of wattles plaistered with clay, and thatched' had been completed as had two more substantial buildings: a store house and barracks close to the wharf. A large hut was erected to accommodate the governor on his visits to Parramatta (Collins 1789). Drawings of the period (McCormick 1987:17, 82) occasionally show cultivated land behind the huts although there may have been little fencing of land until c.1805 (Rosen 2003:53, fig. 4.5). Up to c.1820, the population of Parramatta reputedly exceeded that of Sydney Town. By 1828 the principal streets had been partially macadamised and by the late 1830s George Street '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' (1837 newspaper report cited in Jervis 1961:29).

The subsequent history of Parramatta, including the construction of buildings and other civic developments that have impacted on the individual sites, is recorded in the sequence of town maps and historical documents (e.g. Kass et al. 1996; Rosen 2003). This historical information along with detailed archaeological data and their interpretation allow the archaeological remains of buildings and associated external features (including some soils) on individual sites to be assigned to distinct occupation phases. For example, Casey subdivided the historic occupation of the Parramatta Children's Court site, corner of George and O'Connell

Streets, with its two separate properties into six occupation phases (Casey & Lowe 2006a:48–49). The earliest known town lease was issued in 1796 although as late as 1810, four-fifths of houses in Parramatta were estimated to be 'permissive occupancies' (Surveyor Meehan, cited in Jervis 1961:26). This situation continued into the 1820s when it was reported that out of 390 town allotments in Parramatta, not more than ten residents held their land by lease and only six persons held, or were entitled to, land grants (Surveyor General Oxley, cited in Jervis 1961:26). Accordingly a notice published in the *Sydney Gazette* 8 May 1823 offered inhabitants 'who can show no better claim to the portions they now occupy than mere sufferance [to] apply for formal [21 year] leases' and in 1844 all leaseholders were offered the opportunity to convert to a freehold title by paying 21-years quit rent or by erecting a house worth £1000 (Jervis 1961:27).

Agriculture

Cultivation at Parramatta (Rose Hill) began in January 1789, when a field planted by convict gangs occupied the area that was later to become the early town. Crops continued to be planted in the vicinity throughout the 1790s (early agricultural phase). 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. Tobacco, vines, figs, apples and (?) turnips were being grown by December 1791 (Tench 1793:212-213; Collins 1798:46). Although issued with rations of flour and salt meat, many of the convicts and soldiers were growing their own vegetables. A market for the sale of grain, fish, poultry and livestock was established in 1792. Tench (1793:214) 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 land 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 (Jervis 1960; Kass, Liston and McClymont 1996:125). Although broad-acre farming was relocated away from Parramatta over 200 years ago, waste ground in Parramatta continues to support a diverse flora of exotic shrubs and herbs derived from early colonial agriculture. Examples are privet (*Ligustrum*), which was used for hedges, and opportunist weeds including dandelions (*Taraxacum officinale*), plantain (*Plantago lanceolata*/*coronata*), starwort (*Stellaria*) and thistles (*Bidens*).

Horticulture

Visitors to Rose Hill provided reliable eye-witness accounts of edible plants being grown in Parramatta before 1820 but only casual mention is made of the associated ornamental plantings. The latter may have included agapanthus (*Agapanthus*), hibiscus (*Hibiscus*), oleander (*Oleander*), rose (*Rosa*), rue (*Ruta*), lupin (*Lupinus*), wallflower (*Cheiranthus*), larkspur (*Consolida*) and hollyhock (*Alcea*) and deciduous trees such as elm (*Ulmus*) and oak (*Quercus*) (Bligh 1980:16). Trench (1793, ch. 17) records grape (*Vitis*), melon (*Cucurbita*), cucumber (*Cucumis*), pumpkin (*Cucurbita*). Fruit trees including apple (*Malus*), banana (*Musa*), fig (*Ficus*) and, orange and lemon (*Citrus*) were growing in the vice-regal garden at the foot of Rose Hill in 1791 (Bligh 1980:11–12). In 1793, the same gardens included pomegranate (*Punicia*) and 'nearly all the vegetables [Apiaceae, Brassicaceae, Fabaceae, Lamiaceae] known in Europe for culinary purposes', with the different beds edged with 'strawberries (*Fragaria*), two types of geraniums (*Pelargonium*) and stock (*Matthiola*)'. By 1820, horticultural plantings included currant (*Ribes*), gooseberry (*Ribes*), peach (*Prunus*), raspberry (*Rubus*) and pear (*Pyrus*) (Bligh 1980:14, 34). At this time, the steep semi-circular hill (the Crescent) at the back of the vice-regal residence was 'covered with woods, on top of which is an alley of lemon trees…Along the hedge surrounding the garden masses of yellow downy Mimosa (*Acacia*) flowers are growing, with the kitchen garden located at the bottom of the hill' (von Bellingshausen 1820, cited in Bligh 1980:34). Fossil pollen confirm that other exotic species growing in the vicinity of George Street included palms (Arecaceae), kauri (*Agathis*) and Northern Hemisphere pines (*Pinus*) although the times of planting do not appear to have been recorded (M.K. Macphail pers. obs).

POLLEN ANALYSIS

Fossil pollen evidence can be difficult to interpret. Reasons include (a) the marked differences in the amount of pollen or spores produced by different plants and the distance these miospores are dispersed into the surrounding landscape; (b) difficulties in identifying most pollen and spore morphotypes to species level except under unusually favourable circumstances and (c) difficulties in determining whether some of the parent plants were trees, shrubs and/or herbs. Accordingly, fossil and spore pollen assemblages (microfloras) are a partial record of past floras (with some indication of their relative abundance) while plant community structure has to be deduced by analogy, e.g. when a fossil flora appears to match the composition of an extant community. Using miospores to reconstruct past environments involves additional assumptions (see Birks & Birks 1980) and, in many instances, conclusions are based on only a fraction of the available fossil evidence, e.g. the presence of one or two 'indicator' species whose ecology is well known.

Fortunately, colonial-period deposits in Parramatta usually are a special case in that, firstly, the depositional contexts are usually clearly defined by the excavation data, secondly the major native vegetation types are likely to have been floristically simple (see Benson & Howell 1990) and finally colonial plantings included 'indicator' species that produce morphologically distinctive pollen or spores (Macphail 1999a). If the time of introduction has been recorded, then exotic pollen also are a means of independently dating the deposit. The relative abundance of charcoal particles, whether from land-clearing or domestic fires, provides independent evidence of past fire 'activity' at or surrounding a site. High concentrations of large fungal spores are proxy evidence for rotting timber or putrescent matter.

Caution is needed when interpreting microfloras dominated by casuarina and eucalypt pollen for three reasons. Firstly, pollen produced by tree species in dry sclerophyll forest are identical to grains produced by shrub species growing in heath, on cliffs and in swamps. Secondly, all casuarina species produce pollen in astronomical numbers and these are dispersed by wind over long distances from the parent plant. Finally, even though eucalypts are insect-pollinated, their pollen also are dispersed in large numbers over long distance by wind. Accordingly, these two pollen types can be abundant in the fossil record because the parent plants were growing on the site, or appear to be abundant because the local flora consisted of trees, shrubs and/or herbs that produce/disperse relatively few pollen, or because the site was devoid of vegetation as was the case for many inner city archaeological contexts.

Otherwise, the main factors that complicate the application of palynology to historical contexts in Parramatta are the highly pervious texture of the sandy topsoils and the extent to which the soil profiles have been turbated by burrowing insects such as cicadas and worms (Mitchell 2003; Macphail 2005a, b; Lawrie 2006). In consequence, modern miospores can be carried down into older horizons by rainwater or insects and subjected to repeated wetting and drying cycles, resulting in the oxidative destruction of less resistant palynomorphs. Water seeping from drains has much the same impact on organic microfossils in the surrounding soil.

For these reasons, the best-preserved and diverse fossil microfloras mostly come from permanently water-logged contexts such as ponds, wells and cesspits (cf. Crook and Murray 2004). Nevertheless, topsoil and other sediments that have been protected from groundwater leaching provide useful information on European activity. Two examples were found at the site on corner of George and O'Connell Streets, where pollen preserved in a natural soil backfilled (c.1840) into a storage cellar provided evidence of vegetables and fruits either stored in the cellar or grown nearby (Macphail 2004c); and the site at 16–18 Smith Street, where mud enclosed within an *Anadara* shell showed that sediment used to level the site in the late colonial period had been dredged from the upper Parramatta River (Macphail 1999b).

The majority of shrubs, herbs and ferns are under-represented by their pollen or spores. For this reason, even low to trace occurrences of citrus and pea (*Pisum*) pollen are reliable evidence that these plants were growing, stored or eaten on a site. Trace values of cereal pollen (Poaceae pollen >60 μm diameter) may be derived from stock feed, stored grain, 'broad acre' crops, and/or escaped (naturalised) plants. Similarly, crucifer (Brassicaceae) pollen could represent vegetable species such as cabbage (*Brassica oleracea*) or turnip (*Brassica rapa*) if found in high relative abundances in tilled soil or cesspits, or come from native or exotic 'weed' species if found on waste ground or paddocks. Other examples of possible exotic species are daisies (Asteraceae) that produce 'high-spine' pollen grains, and samphires (Chenopodiaceae-Amaranthaceae). Many unidentified tricolpate and tricolporate pollen types potentially represent exotic plants.

Spores of hornworts and liverworts (*Cingulatisporites*, *Rudolphisporis*) are special cases in that their fossil spores are uncommon on historical archaeological sites except in soils that have been cleared using fire or in analogous damp situations such as creek banks, around ponds, and under the drip-lines of buildings. Swamp selaginella (*Selaginella uliginosa*) spores are a reliable indicator of organic-rich soils, especially if immature specimens are present.

SITES

Since 1990, more than 160 samples from 11 historical archaeological sites have been processed for fossil pollen, spores and other plant remains. Not all of these provide useful information on Parramatta's colonial past, either because the miospores were destroyed or are likely to be modern contaminants (Macphail 2007). For the same reason, none of the undisturbed natural soils analysed so far preserved microfossil evidence of the prehistoric vegetation although this can be inferred from pollen preserved in early agriculture phase soils.

George Street sites

Six historical archaeological sites included frontages on present-day George Street (former High Street): nos 180–180A, 109–113 and 95–101 at the eastern end, no. 41–53 in the middle, and no. 2, the Parramatta Children's Court site and the adjacent convict hospital site, at the western end near Government House and the Domain. Inferred maximum ages are based on the archaeological context or on the presence or absence of exotic pollen types, in particular pine, cereal, and 'agricultural' weeds such as dandelions and plantain. The minimum age is more difficult to infer using fossil pollen data because of the longevity (and probable ongoing replanting) of trees such as pines and casuarinas and also because short-lived exotics such as dandelions have become widely naturalised since 1790.

180–180A George

This site, is located at the northeast corner of George and Charles Street at about the tidal limit on the Parramatta River and where salt water changed into fresh water. By 1790 six convict hut allotments were established (lots 13, 14, 18, 69, 70, 72; Casey & Lowe 2002; Macphail 2004a). The land to the south and east was still used for cropping and as a military exercise ground in 1804. By c.1830 William Byrnes, a successful entrepreneur, had built a substantial house and commercial warehouse on lot 72. A brewery may have been built on lot 72 as early as 1822. The remains of a ruined cottage survived 'adjacent to an orchard' on lots 69 or 70 (Casey & Lowe 2002:24) but by 1895 the only buildings on the estate were the Byrnes' family residence and associated outbuildings since the Byrnes had acquired nearly all the lots within the study area. They also had a pump which transferred water up from the river and two water reservoirs. In the early twentieth century, lot 69 and the northern half of the combined properties adjacent to the river were leased to a series of Chinese market gardeners who also sold their goods from a small house on lot 69 on George Street. The soil report indicated the presence of human faecal matter in soils associated with the market garden (Casey & Lowe 2004, in prep; Lawrie 2005).

Twenty-four samples of grey to red-brown silty sands, from six of the seven allotments, were submitted for analysis (Table 1). All preserved low amounts of strongly humified, finely disseminated organic matter, including charcoal, fungal spores and algal cysts. Yields of fossil pollen and spores were much lower, with concentrations ranging from 0.01 to 1.8 x 10^3 grains per gram of sediment. None of these soil samples could be reliably dated using, for example, the relative abundance of pine and dandelion pollen, because of the high sand content of the soils and low organic content. Nevertheless, the data show that the relative abundance of pine varies markedly between samples on the same allotment and between allotments. For example, pine pollen is relatively more common in soil samples from lots 14 and 70 than elsewhere on the study site (Appendix 2A), and it is probable that these samples are younger than samples lacking pine pollen.

On present indications, the pre-clearance vegetation was dominated by eucalypts and possibly native apple, which produces very similar but larger pollen grains. Other shrubs or small trees included wattle, e.g. lot 72, and, less certain, casuarina. Because of its frequent use, for example shingles and firewood, any locally growing casuarinas are likely to have been cut down in the first decade of British settlement. The same may be true for eucalypts and wattles since general orders were issues against cutting down or removing timber and wattle bark in the Domain in 1810 and again in 1815 (Jervis 1960:48). Samphires pollen are considered to represent agricultural weeds such as fat-hen (*Chenopodium album*) rather than salt-marsh communities growing on saline mud-flats downriver of the tidal limit on the Parramatta River.

Table 1: Samples, 180-180A George Street

Lot	Context No.	Inferred age	Sample lithology	Pollen concentration
13	1804	pre-settlement	red-brown silty sand	0.01 x 103 grains gm^{-1}
	1893	post-settlement	red-brown silty sand	0.1 x 103 grains gm^{-1}
14	1601	early 19th century	grey-brown silty sand	2.2 x 103 grains gm^{-1}
	1603	early 19th century	grey-brown silty sand	0.4 x 103 grains gm^{-1}
	1768	19th - 20th. century	light red silty sand	0.4 x 103 grains gm^{-1}
	1655	early 19th century	light grey silty sand	0.3 x 103 grains gm^{-1}
	1360	[Holocene channel?]	light yellow sandy clay	0.4 x 103 grains gm^{-1}
	1783	early 19th century	grey-brown silty sand	0.3 x 103 grains gm^{-1}
18	2018	pre-settlement?	grey-brown silty sand	0.1 x 103 grains gm^{-1}
	2002	pre-settlement?	red-brown silty sand	0.01 x 103 grains gm^{-1}
69	2425	late 18th century	grey-brown silty sand	0.3 x 103 grains gm^{-1}
	2430	early 19th century	red-brown silty sand	0.3 x 103 grains gm^{-1}
	2407	19th century	red-brown silty sand	0.02 x 103 grains gm^{-1}
	2484	early-mid 19th century	grey silty sand	1.3 x 103 grains gm^{-1}
	2528	post-settlement	light brown silty sand	0.7 x 103 grains gm^{-1}
	2466	post-settlement	yellow silty sand	0.4 x 103 grains gm^{-1}
70	3187	early 19th century	grey-brown silty sand	1.7 x 103 grains gm^{-1}
	2202	early-mid 19th century	light grey silty sand	1.8 x 103 grains gm^{-1}
	2260	post-settlement?	light yellow silty sand	0.06 x 103 grains gm^{-1}
	2205	post-settlement?	light yellow silty sand	0.02 x 103 grains gm^{-1}
	2333	19th-20th century	light yellow silty sand	0.08 x 103 grains gm^{-1}
72	2791	late 18th century?	red-brown silty sand	0.15 x 103 grains gm^{-1}
	2666T	post-settlement	red-brown silty sand	0.02 x 103 grains gm^{-1}
	2669	post-settlement	light brown silty sand	0.02 x 103 grains gm^{-1}

The persistent to abundant presence of dandelion pollen and hornwort and liverwort spores indicates a high level of disturbance although the relative abundance of hornwort is much lower than under the drip-line of convict huts elsewhere along George Street (Macphail 1997). In some instances, land clearance or tillage may be responsible, e.g. lot 14. More often there is no obvious connection between the fossil pollen data and the documented agricultural activity, e.g. lot 18.

Fossil pollen data indicate that lots 13, 18, and 72 were largely devoid of vegetation other than grasses and opportunist 'weeds' throughout much of the nineteenth and twentieth centuries. Edible plants grown, threshed or stored on the site during the nineteen century included cereals on portions of lots 14 and 70, citrus on lot 14 and, less certain, apples and strawberries on lot 69. Ornamental plantings may have included two tree-ferns (*Cyathea*, *Dicksonia*), that in their natural environment are restricted to wet gullies and the margins of rainforest on the escarpment of the Blue Mountains west of Parramatta, awollas kauri, oak, elm, and members of the malva (Malvaceae) and geranium (Geraniaceae) families. It is possible these were growing in the Byrnes' garden. A pond and the burial of a pony and two calves suggests the grassy area at the rear of the property was used to accommodate family pets during the mid to late nineteenth century, prior to the establishment of the market garden (Casey & Lowe in prep.).

Unweathered Triassic shale appears to have been mixed through some remnant soils and in pit fills in some of the lots while other soil samples preserved pollen or spores of obligate aquatic herbs such as *Azolla* (context 1601), *Lemna* (context 2425) and two quillworts *Isoetes drummondii* and *I. muelleri* (contexts 2202, 2425, 2791). The most likely explanation is that the former profiles incorporated shale while the latter were irrigated using water carried or pumped up from the river (Casey & Lowe 2004:32). Quillworts do not now occur in the Sydney region and it is difficult to avoid concluding that the plant became locally extinct due to European activities (Macphail and Casey 2005).

109–113 George Street

In contrast to no. 180–180A, there were no 1790s convict-built structures on this section of a large four acre allotment at 109–113 George Street, just across the road. Whether the site had been cleared and planted for crops during the eighteenth century is uncertain since an early lease described the property as being in a swampy area (Casey & Lowe 2003, 2006b:24; Macphail 2005c). From 1803, a store near the site was being run by one of the early missionaries who fled Tahiti for New South Wales, the Rev. Rowland Hassall. The earliest recorded building on the site is a timber structure built by c.1804. Hassall, who initially was the government storekeeper, was appointed Superintendent of Government Stock in 1814 and around this time probably constructed a stone house with 13 rooms and a cellar, replacing the earlier house. Outbuildings included a detached kitchen, barn, stables, dairy and stores. By 1820 the house was surrounded by a 'garden, orchard, yard, buildings, and paddocks' (Hassall 1902:19). Plantings around the house included a large mulberry tree (*Morus rubra*), English oaks (*Quercus robur*) and hedge of lemon trees (*Citrus limon*). Subsequent horticultural developments are sketchy but the school playground of Harrisford built across the road from the house was 'bounded by fruit gardens' in the 1830s (Hassall 1902:16). A c.1880 photograph shows

the house in poor repair and it is reasonable to presume that the gardens and surrounding land also were derelict. The property was subdivided and the allotments put up for auction in 1882. The c.1814 stone house and outbuildings were sold off as building material, leaving the site vacant until single-storey houses was built in the early twentieth century (Casey & Lowe 2006b:24–25, 33, 36, 38–39).

Fifteen soil samples from two areas were submitted for analysis (Table 2). Despite the high sand and very low organic content, all yielded low to moderate amounts of strongly humified and well-preserved plant debris plus charcoal and highly variable numbers of fungal spores and fruiting bodies (0 to >700 x 10^3 spores per gram). Yields of fossil pollen and spores were generally lower than fungal spores, with concentration values ranging up to a maximum value of 4.0 x 10^3 grains per gram of sediment. These values are at the extreme lower end of the range of concentrations found in colonial period soils in Sydney (M.K. Macphail unpubl. data). Preservation was equally variable, with most assemblages including strongly biodegraded as well as perfectly preserved specimens. This phenomenon, which is typical of bioturbated soil profiles, usually indicates minor stratigraphic leakage has occurred.

A minimum of 50 morphotypes could be identified to a plant family, genus or species (Appendix 2B). Ten of these definitely represent exotic species, e.g. pine and citrus, and another eight taxa are likely to have been produced by exotic 'weeds' rather than their native relatives (see Macphail 1999a). Examples are samphire and crucifer pollen. The numbers of local native trees, shrubs, herbs and cryptogams represented by fossil miospores are unusually low relative to nineteenth-century historical sites in Sydney (Macphail1999a). With the exception of horn and liverworts, all commonly occurring types represent plants that produce/disperse pollen or spores in very large numbers, usually by wind. Examples are casuarina, eucalypts, native grasses (Poaceae pollen <50 μm diameter), crucifers and samphires. The eucalypt and native grass counts usually include immature pollen aggregates to whole anthers - evidence that the parent plants once grew on the site. Wetland taxa were not well-represented despite the proximity of the site to the Parramatta River and supposedly swampy ground

As at 180–180A, the pre-clearance vegetation growing on 109–113 George Street appears to have been dominated by eucalypts and possibly native apple. There is no pollen evidence that swamp or river oaks were growing on the site or lower river terrace below George Street. The persistent to abundant presence of dandelion and, less certain, crucifer pollen and hornwort and other liverwort spores indicate a high level of disturbance. Since the site was vacant land during the 1790s, the most likely explanation is that clearing of eucalypts by convict labour between 1789–1790 and subsequent tillage of the exposed mineral soils led to the rapid expansion of these 'opportunist' herbs (ash bed effect). One sample, from a fill layer in a pit whose backfilling is dated to after 1850, includes two grains of a cereal species and probable citrus pollen and may preserve evidence of agricultural activity during the 1790s clearance phase (Area B, context 5000) since the pit cuts into a number of earlier pits. The general area was planted c.1789 for crops but there is no archaeological evidence that the site or adjacent parts of the four acre property were used as an orchard before c.1804 and it is possible the citrus pollen came from discarded flowers (Casey & Lowe 2006b:26, 99). Trace numbers of quillwort spores in a natural soil in Area A (context 5050) suggest water was being carted up from the lower floodplain of the Parramatta River or a nearby creek line.

Many soil samples preserved 'mixed age' microfloras that are difficult to assign to any of the occupation phases recognised by Casey & Lowe (2003, 2006b) but overall the data demonstrate that the diversity of ornamental trees/shrubs and introduced weeds increases during the nineteenth century. Some shrubs may have been garden plants that had become naturalised due to domestic and commercial grazing. Examples are Oleaceae (privet?) and a tribe of daisies (Asteraceae: Mutisieae) that is mostly restricted to South America. Otherwise, most of the exotic species are shrubs that were widely planted by Europeans during the late eighteenth and early nineteenth century, e.g. pines, alder, a member of the pepper-tree family (Anacardiaceae), citrus, rose and possibly hibiscus. Exceptions are pollen of a family (Gyrostemonaceae) that is most abundant on the western slopes of NSW (context

Table 2: Samples, 109-113 George Street

AREA	Context	Archaeological Context	Lithology
A	4803	sediment infilling 19th? century pit	mottled orange-brown sand
	4886	post-pipe fill	red-brown sand, shell, brick
	5044	sediment between pavers in cellar	dark grey-brown fine sand
	5050	'natural' soil in context 4914	medium brown fine sand
	5050	sediment from middle of flue	medium brown fine sand
	5050	soil near stone wall context 4915	yellow-brown fine sand
	5051	'natural' soil	red-brown fine sand
	5051	'natural' soil profile near well	red-brown fine sand
	5064	remnant 'natural 'soil profile	dark brown fine sand
	5066	remnant 'natural' soil in dairy	red-brown fine sand
B	4819	basal fill layer in 19th? century pit (4820)	medium brown clayey sand
	4844	basal fill layer in 19th? century pit	grey-brown fine sand (wet)
	5000	fill layer in 19th? century pit	yellow-brown fine sand
	5017	fill layer in 19th? century pit	grey-brown fine sand
	5058	sediment in wall context 5058	medium orange fine sand

5051) and sandalwood (*Santalum*) pollen (context 4819). Sandalwood may have been a gift from visiting missionaries, who frequently stayed with Rev. Rowland Hassall on their way to and from the South Pacific. A similar explanation may apply to 'South American' Mutisieae (Casey & Lowe 2006b:25). The dating of context 4819 (c.1830) would indicate the plants were growing in Mrs Hassall's garden about 10 years after her husband's death in 1820. The 1828 census recorded that Martha Ranpsy (sic), who was 60 years old and arrived in NSW in 1819 as a convict with a seven-year sentence, was Elizabeth Hassall's gardener. Context 4819 probably was a compost pit and the presence of so many ornamental plants may indicate that the pollen comes from flowers picked for household decoration and eventually thrown into the compost pit when dead (Casey & Lowe 2006b:81). Pollen from 'large' English oaks, recorded growing on the site during the 1830s, were not found in this compost pit fill indicating that the backfilling may pre-date planting of the oaks.

Soil used to infill other pits backfilled during the mid-nineteenth century preserved two miospores that are uncommon on historical archaeological sites in Parramatta. These are a distinctive, possibly exotic, trilete spore (context 4803, 4819) and the native drumsticks *Isopogon* (context 4819). The presence of *Isopogon* pollen raises again (Macphail 1999a) the question whether native shrubs were being planted as garden ornamentals during the early 1800s or whether the fossil pollen comes from native flowers picked for household decoration. Two other samples were wholly dominated by fungal spores; *Biporipsilonites* sp. in context 5066 (remnant top soil in a dairy) and *Mediaverrusporonites* and *Inapterisporites* spp. in context 4844 (basal fill layer in a pit). The most likely explanation is that these spores came from fungi growing on spilled or discarded nutrient-rich domestic substances such as milk, whey or cooking fat.

95–101 George Street

Colonial-period remains on this site include drainage channels and postholes associated with convict gardens, an infilled well, a waterhole and a burnt tree (Macphail 2005b; Thorp 2005a, b: wk 8). The dates of the associated deposits range from the 1790s to c.1840. Sediment infilling a drain from an abattoir built on the site about 1870 provides a 'snap-shot' of the later colonial period. Eleven soil samples were submitted for pollen (Table 3). Most came from apparently securely-dated archaeological contexts, including a possible vineyard (context 1784).

The majority of samples yielded low to moderate numbers of fossil pollen and spores in a matrix of strongly humified organic matter. Fungal spores were sporadically abundant except for context 634 (natural topsoil) while the maximum age limit of about 1790 is consistent with the presence of pine, cereals and naturalized weeds such as dandelions and plantain. A minimum of 55 pollen and spores could be identified to a plant family or higher taxonomic level such as a genus or species (Appendix 2C). Ten of these fossil taxa definitely represent exotic species, e.g. pine and citrus, and another 11 taxa are likely to have been produced by exotic 'weeds' rather than their native relatives.

As with the previously discussed sites, the pre-clearance tree vegetation appears to have been dominated by eucalypts and possibly a species of the native apple. The persistent to abundant presence of dandelion and samphire pollen and liverwort spores indicates a high level of disturbance on the site during and since the late eighteenth century. None of the earliest (1790s) samples appear to have accumulated under the roof drip-line of buildings (cf. Macphail 1997) and the most likely explanation is that clearing and subsequent tillage led to the rapid expansion of 'agricultural' weeds and hornworts on the newly exposed mineral soils.

Two samples preserve pollen evidence for early horticultural activity. These are sediments infilling a hoe mark (context 791) and the waterhole (context 1037). The early surface underlying the built occupation was covered with hoe marks (Thorp 2005b: wk 8). The pollen in one hoe mark demonstrates that citrus were planted on the site between 1790 and 1800, sediment from the waterhole demonstrates that citrus and vegetables, garden pea and possibly cabbage or turnips, were growing in the vicinity of the pond c.1830. Because of poor pollen preservation, it is uncertain whether plants grown in the putative vineyard (context 1784) include grape. As for other contexts, any connection with convict agriculture is equivocal. For example, trace numbers of cereal pollen preserved in the 1790s drainage channels (contexts 726, 739, 1632) could be due to storage of grain on the site or reflect spilled stock feed or government planting in this area c.1789.

Trace numbers of cryptogam spores (*Azolla*, *Isoetes*), and bulrush and duckweed pollen in contexts 361, 634 and 791 are circumstantial evidence that domestic water was being obtained from the waterhole or, before the 1830s, from the lower floodplain of the Parramatta River. The late eighteenth-century 'storage' pit (context 921) appears to have been lined with wood

Table 3: Samples, 95-101 George Street

Context No.	Archaeological context	Sample lithology
361	sediment infilling a drainage channel from an 1870s abattoir	medium grey silty fine sand
634	natural (pre-1790s) sandy top soil	light yellow-brown fine sand
726	sediment infilling a 1790s drainage channel	yellow-brown clayey sand
739	sediment infilling a drainage channel near a 1790s garden	medium grey sandy clay
791	sediment infilling a hoe mark in a garden, c.1790–1800	grey-brown clayey sand
921	sediment infilling a possible storage pit, c.1790–1800	mottled ±black organic silt
1037	sediment infilling a 1830s waterhole	mottled yellow-brown clay
1611	upper fill layer in a 1810–1840s well	dark grey sandy clay
1632	sediment infilling a 1790s drainage channel	light yellow brown fine sand
1784	post-hole fill in a possible vineyard, c.1790–1840s	yellow-brown silty fine sand
2074	soil between brick paving around a hotel c.1810–1840	grey-brown silty fine sand

but otherwise its function is unclear (a water cistern?). The diversity of exotic weeds and shrubs appears to increase after about 1800, consistent with progressive degradation of the site. The channel associated with the 1870s abattoir (context 361) appears to have drained a stockyard attached to the abattoir.

Officeworks Site, 41–43 George Street

Five samples of post-packing material from convict hut post holes dating to between 1790 and c.1820, and one sample from the A2 horizon of a buried soil dated to between c.1830–1840, were submitted for analysis (Table 4). Fossil evidence such as dandelion pollen indicate all samples post-date British settlement: the absence of pine implies the samples are older than mid-nineteenth century (Macphail 1997).

Pollen recovered from the post-packing samples were poorly preserved, presumably due to alternate wetting and drying of the soil around the posts. The associated matrix of strongly humified plant debris, fungal spores/mycelia and minor charcoal almost certainly is derived from rotting timber. Two different age classes of pollen appear to be present (Appendix 2D). These are: an 'older' component comprising eucalypt and native grass pollen, suggested to represent the pre-clearance vegetation, and a 'younger' component, suggested to represent opportunist herbs colonising disturbed ground around the hut. The most prominent and probably earliest established 'weed' species were hornworts and other liverworts, both of which are prolific colonisers of damp mineral and/or ash-enriched soil, including cast-up B Horizon clays. Subsequent colonisers included ferns, dandelions and dock (*Rumex*). The key factor is likely to have been rainwater dripping from the roof, and it is possible that the higher diversity of opportunist herbs in contexts D522, E710 and E694 means these post holes were dug later than postholes contexts D540 or E725. There is no pollen evidence for cereals or any other edible plants, and the convict huts may have been surrounded by little more than trampled bare ground.

Parramatta Children's Court Site, 2 George Street, Parramatta

The Parramatta Children's Court site at the corner of George and O'Connell Streets is separated from the river by low-lying, unused grounds associated with the convict hospital site (Casey & Lowe 2004, 2006a; Macphail 2004c). The site was part of two 1790 convict huts on two early nineteenth-century town leases (lots 102 and 103); lot 102 subsequently became subdivided into two properties. The convict hut sites have been conserved *in situ* within the new development.

Casey (2006a) divided the archaeological remains and associated deposits into eight occupation phases. Those encompassing the colonial period are:

Phase 3: 1790–1810s

During this phase, the area was cleared and wattle-and-daub convict huts constructed on the site. Lot 102 was leased to a French prisoner-of-war, Anthony Landrin in 1809, who was probably responsible for planting the fruit trees illustrated in an early watercolour showing the view along George Street c.1805 (Fig. 4). Lot 103 was leased to a 'public baker', John Blakefield, in 1809 and, although it is possible he operated a bakery from the convict hut on its western boundary, no evidence of this was found in those parts of this lot subject to excavation (Casey & Lowe 2006a:18, 21, 31, 48–49).

Phases 4–5: c.1810–1880

These two phases include 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 his land was subdivided in 1836 into eastern (lot 102E) and western (lot 102W) sections, separated by a wooden fence. A house was erected along the street frontage of lot 102W sometime between 1831 and 1844 and a brewery built along the western boundary of the same allotment c.1838. During the 1830s, lot 103 was owned by Charles Blakefield who appears to have leased it to Patrick Hayes in the 1830s and 40s. Hayes was operating the brewery on lot 102 (Casey & Lowe 2006a:21–33; 46–82). It is possible that vacant ground around the buildings provided rough grazing for horses, the major form of transport at this period, and possibly cows.

Phases 6–7: 1880s–1900

These phases saw the additional construction, occupation and demolition of buildings on the three allotments between the 1840s and 1900. Buildings erected during this phase included tram sheds, linked by tramlines into George Street, at the rear of the same allotment in the 1880s. At about the same time, a relatively substantial brick house was erected on the adjoining property close to the eastern boundary of lot 102E. It is improbable that vacant land at the rear of any of these premises was soft-landscaped, e.g. by gardens or exotic trees, since the creek crossing the property adjoining lot 102E was described as an 'open and offensive sewer' in 1881 (Plan of the Reserve for the Hospital, Town of Parramatta, 1881).

Eleven soil samples from the three lots, 102E, 102W, 103, were submitted for analysis (Table 5). One, from a 1950s topsoil sealed under a bitumen car park (3503), provided a control sample against which the early colonial period microfloras could be compared. The samples are related to occupation phases recognised by Casey (2006a) using a combination of archaeological and palynological evidence. All samples yielded abundant, strongly humified and mostly finely disseminated plant debris, numerous fungal spores and

Table 4: Samples, 41-43 George Street

Context No.	Sample	Context	Inferred age	Lithology
D540	post-packing	convict hut	1790–c.1820	red-brown mottled sandy silt; charcoal smears
D522	post-packing	convict hut	1790–c.1820	red-brown mottled sandy silt; charcoal smears
E710	post-packing	convict hut	1790–c.1820	yellow-brown mottled clay-silt; charcoal
E725	post-packing	convict hut	1790–c.1820	red-brown mottled sandy silt; charcoal smears
D694	post-packing	convict hut	1790–c.1820	red-brown mottled sandy silt; charcoal smears
W291	buried soil	A2 horizon	c.1830s–1840s	dark grey loam; red clay aggregates, charcoal

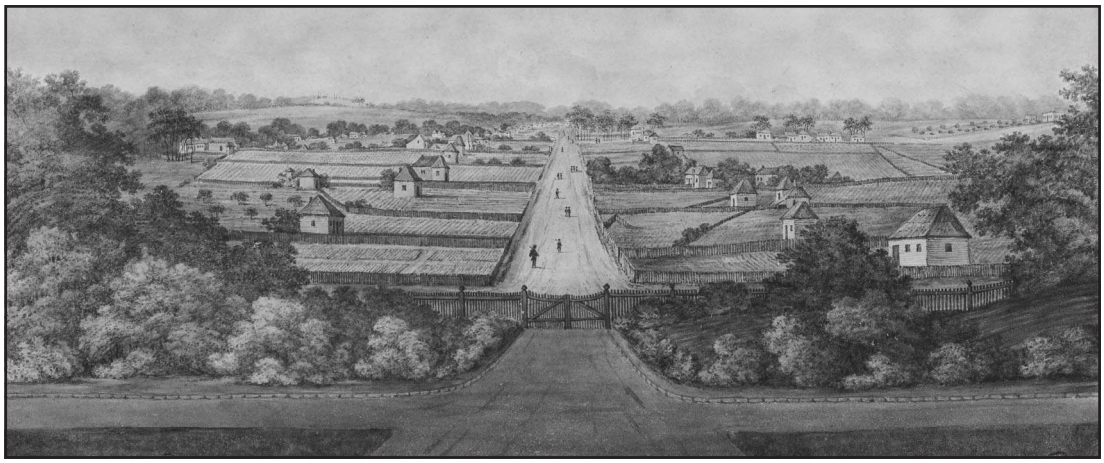

Figure 4: George Street, Parramatta, from the gates of Government House, George William Evans, c.1804–1805, watercolour on paper, Caroline Simpson Collection, Historic Houses Trust of NSW.

trace numbers of algal cysts. Yields of fossil pollen, fern spores and fungal spores were more variable (Table 6), possibly due to local variations in soil moisture and organic content. The relatively high concentration of fungal spores in context 4104 supports archaeological interpretation of the circular feature as a well. Fungal spore values in contexts 3960 and 3920 are much lower and consistent with drier conditions. Accordingly, this brick structure is more likely to have been a storage cellar and not a water cistern, cesspit or rubbish pit (Casey & Lowe 2006a:60–66, 80–82).

With the exception of samples from the storage cellar (contexts 3960, 3920), all microfloras are dominated by Myrtaceae (mostly eucalypts) and native grasses (Appendix 2E). Anthers and large pollen aggregates show that trees overhung or once grew on the site. Diversities are low relative to other sites along George Street, e.g. 50 taxa *versus* 80 taxa recorded at 180–180A George Street. A disproportionate number of these species (40%) from this site are derived from exotic 'weed' species or introduced native species such as the rough tree-fern (*Cyathea*).

Samples from the storage cellar (contexts 3960, 3920) provide one of the most detailed fossil records of plant foods grown and/or stored by the early residents of Parramatta. Those plants identified so far are: cereals (wheat?), garden pea, and members of the cabbage/turnip and umbellifer families, prunus and apple. Context 3920, the natural soil from the floor of the cellar, preserved a possible fragment of cotton pollen (*Gossypium*). The low relative abundance of dandelion pollen is against the infill (context 3960) being soil imported from an orchard or garden while the absence of *Cloacasporites* (Appendix 1) is against the structure being a cesspit.

One microflora from the storage cellar (context 3960) included a distinctive Asteraceae pollen type with vestigial echini (fossil species *Tubulifloridites pleistocenicus*). The record is potentially significant since local populations of the two known native sources may have been confined to areas on (*Calomeria amaranthoides*) or west (*Cassinia arcuata*) of the Blue Mountains before British settlement. The pollen may represent an exotic weed species such as *Artemisia* but, if not, the record is circumstantial evidence for the transhumance of stock from areas west of Parramatta in the early 1800s.

Parramatta Justice Precinct, Convict Hospital site, George & Marsden Streets

The convict hospital site, now subsumed within the Parramatta Justice Precinct on the corner of Marsden and George Streets, is one of the most important sites excavated so far in Parramatta (Casey & Lowe 2005a, 2005b, 2005c, 2006c; Lawrie 2006; Macphail 2006c). Firstly, the site is the longest continuously operating health services site in Australia. Secondly, the archaeological remains exemplify the colonial administration's changing attitudes to the convicts whose labour and health underpinned the early economic development of the Parramatta district.

Three phases of hospitals buildings are definitely known to have occupied the site since 1792 (Table 7). The first convict or 'tent' hospital was established c.1789, and was probably outside of the boundary of the site but its location

Table 5: Samples, Parramatta Children's' Court site

PHASE	LOT	ACN	Context	Sediment	Comment
7-8	102E	3503	1950s topsoil	grey-brown sandy loam	soil sealed under bitumen car park
6-7?	102W	4065	buried topsoil	grey-brown silty fine sand	relationship unknown
6-7?	102W	4065	buried topsoil	grey-brown silty fine sand	relationship unknown
6-7?	102W	4065	buried topsoil	yellow brown silty fine sand	relationship unknown
5	103	4104	infill of circular feature	grey sandy loam , charcoal	feature interpreted as a well
3-4	102W	3960	infill in large pit	grey silty sand	feature interpreted as cellar or store
3?	102W	3920	natural sand below pit	yellow brown silty fine sand	predates cellar or store
1-2	102W	3920	natural sand	orange-brown silty fine sand	predates convict huts, 170s–1810
1-2	102W	3409	natural sand	orange-brown silty fine sand	predates convict huts, 170s–1810
1-2	102W	3409	natural sand	yellow-brown silty fine sand	predates convict huts, 170s–1810
1-2	103	3920	natural sand	orange-brown silty fine sand	predates convict huts, 170s–1810

Table 6: Concentration data (10^3 palynomorphs $gram^{-1}$), Parramatta Children's Court site

Inferred Phase	Lot	Context No	Concentration	
			spore-pollen	fungal spores
7-8	102E	3503	1.1 x 10^3 g^{-1}	0.7 x 10^3 g^{-1}
6-7?	102W	4065	2.2 x 10^3 g^{-1}	2.9 x 10^3 g^{-1}
	102W	4065	1.8 x 10^3 g^{-1}	3.0 x 10^3 g^{-1}
	102W	4065	1.4 x 10^3 g^{-1}	1.6 x 10^3 g^{-1}
5	103	4104	3.6 x 10^3 g^{-1}	8.8 x 110^3 g^{-1}
3-4	102W	3960	3.9 x 10^3 g^{-1}	1.3 x 10^3 g^{-1}
3?	102W	3920	1.5 x 10^3 g^{-1}	0.9 x 10^3 g^{-1}
1-2	102W	3920	0.8 x 10^3 g^{-1}	0.8 x 10^3 g^{-1}
	102W	3409	0.4 x 10^3 g^{-1}	0.05 x 10^3 g^{-1}
	102W	3409	1.3 x 10^3 g^{-1}	1.2 x 10^3 g^{-1}
	103	3920	1.0 x 10^3 g^{-1}	0.3 x 10^3 g^{-1}

is not certain. Known hospitals within the site are: the second convict hospital (1792–1818), the third convict hospital (1818–1840s), the Parramatta District Hospital (1848–1890s), which used the same buildings except for the 1870s kitchen/laundry, and the Sulman Power Hospital or the fourth hospital (1890s–1999). Surrounding buildings include Brislington built on lot 98 c.1820 by emancipist convict John Hodges on George Street. Subsequently, Brislington was occupied by a family of local doctors, the Browns, from the 1870s up to 1940s when the building was formally resumed by the hospital to accommodate medical staff. Footprints of convict huts were found on this allotment and also on lot 99, currently occupied by the Australian Red Cross Blood Bank, as well as along the Marsden Street frontage (Casey & Lowe 2005b, c, 2006c).

Forty-seven samples, from the site of the surgeon's residence and garden (Hosp. 1 area), the grounds of convict hospitals 2 and 3 (Hosp. 2 area), Brislington (lot 98) and the Blood Bank property (lot 99) both on George Street, were submitted for analysis (Table 8). The samples are grouped according to the excavation areas (Hosp. 1 etc.), which relate to specific historical properties, and then by archaeological context number. Each sample has been referred to an occupation phase based on a combination of archaeological and palynological evidence. Topsoil and subsoil samples were difficult to date since these may have been exposed to the pollen rain for considerable periods of time and/or been contaminated with recent pollen and spores infiltrating into the soil profile in rainwater or via burrowing insects. Soil profiles at three sites have been analysed by Lawrie (2006).

All samples preserved strongly humified to well-preserved plant debris, charcoal, fungal spores and fruiting bodies although numbers and state of preservation were highly variable. The yield of fossil pollen and spores was equally variable, with the topsoil and subsoil samples yielding the lowest, and sediment infilling drains and cesspits the highest, numbers. Concentration values were between <0.1 to 8 x 10^3 grains per gram of sediment but many samples failed to yield the minimum number (100–250) required to make statistically robust estimates of relative abundance (Appendix 2F). Approximately 50 pollen and spores could be identified to a plant family or higher taxonomic level such as a genus or species and ten types represent definite exotic species.

Table 7: Phasing, colonial hospital site

Phase 1	Natural Landscape (before ~20 ka BP)
Phase 2	Aboriginal Occupation (20 ka to 1788)
Phase 3:	Beginnings of European Settlement, Agriculture, Convict Town to Free Settlement (1789–1817)
Phase 3.1:	Early Clearing and Agriculture (1789–1792)
	First Hospital? (1789–1792)
Phase 3.2	Second Hospital (1792–1818)
	Marsden Street convict hut (1792–1817)
Phase 4	Third Convict Hospital (1818–1843)
Phase 5	Upgrading & the District Hospital (1844–1878)
Phase 6	Rebuilding (1879–1902)
Phase 7	Construction of the Sulman Power Hospital (1890s–1902), the Fourth Hospital and demolition of the Third Hospital
Phase 8	Later twentieth century constructions (1902–1999)

Hosp. 1, Surgeons Residence and Grounds

One topsoil sample (context 5354/S100) was wholly dominated by small/immature eucalypt pollen grains (including whole anthers) and fungal spores in a matrix of strongly humified and apparently carbonised plant detritus. This microflora, which includes significant numbers of grass pollen and hornwort spores, closely resembles early agriculture phase microfloras on other early colonial sites in Parramatta. However, cereal pollen are absent and it seems unlikely that crops *per se* were being grown on the hospital land during this phase despite historical evidence that the whole area was cleared for crops prior to laying out the town in July 1790 (Casey 2008). Another topsoil sample from the Hosp. 1 area (context 5354/S102) and sediment infilling a brick drain (context 5419) are suggested to date to the District Hospital phases (c.1848–1890s). If correct, the combined pollen evidence points to a marked increase in the diversity of the 'weed' flora due to damp conditions created within and beside the drain. There is no pollen evidence for soft landscaping and the Hosp. 1 area seems to have been used as a 'dump' for putrescent waste and ash from domestic wood and coal fires. More generally, the data hint at crowded conditions and possibly poor hygiene during the middle to late nineteenth century.

Hosp. 2, site of the main hospital buildings from 1792 to 1999

The 28 samples from the Hosp. 2 area appear to correlate with the pre-European occupation (contexts 5637, 6231) and the early agriculture phase (contexts 5544, 5636, 5643), second hospital phase (context 6336), to the District Hospital phase (1844–1879), e.g. contexts 5572, 5579, 5583, 5269, 5640 and 6213. To some extent, the inferred ages and environmental reconstructions involve circular reasoning and the data are difficult to compare because of the diverse contexts but generally they have been found to fit with the archaeological phasing of these deposits. Nevertheless, it is significant that similar microfloras are preserved in disparate archaeological contexts (Casey & Lowe 2009).

Pollen dominance of the inferred early agriculture phase samples provides additional evidence that the pre-clearance

Table 8: Samples, colonial hospital site

Area	ACN	Inferred phase	Archaeological context	Sediment
Hosp. 1	5354	Early Agriculture	topsoil, south of surgeon's residence	silt
	5354	3rd Hospital	topsoil from west section	silt
	5354	3rd/District Hosp.	topsoil from beside drain context 5377	sandy clay
	5419	District Hospital	fill, east end of brick drain context 5377	sandy clay
	5419	District Hospital	fill, west end of brick drain context 5377	silty loam
Hosp. 2	5525	Early Agriculture?	topsoil./underfloor deposit Sq. M2, spit 1	silty loam
	5544	Early Agriculture	topsoil under east verandah, Sq. H1, spit 1	silty loam
	5572	3rd/District Hosp.	fill in cesspit	loam
	5579	3rd Hospital	fill in privy	mortar/wood
	5583	3rd Hospital	fill of flushing channel in privy	sand
	5629	3rd/District Hosp.	fill between pavers in laundry/dead room	silty sand
	5636	3rd/District Hosp.	topsoil below context 5635, north of hospital	sandy loam
	5636	3rd/District Hosp.	topsoil near south verandah	silty loam
	5636	3rd Hospital	topsoil within area of 3rd Hospital	silty loam
	5636	Early Agriculture	topsoil Grid Sq. H7 near 2nd. (1792) Hospital	silty loam
	5636	Early Agriculture?	topsoil (A1/A2) west of well context 6347	silty loam
	5637	Pre-1788	subsoil within Test Trench TT24/T10	silty loam
	5637	Early Agriculture	subsoil north of 3rd Hospital	silty loam
	5640	3rd/District Hosp.	garden bedding fill north of hospital	silty loam
	5643	Early Agriculture	hoe marks in subsoil south of convict hut	silty loam
	5682	District Hospital	garden bed west of hospital	clay loam
	6212	District Hospital	fill, south end of stone drain	silty loam
	6213	District Hosp.	fill in north end of drain	clay
	6215	2nd Hospital	backfill of wall trench in hospital	clayey sand
	6216	Early/2nd Hosp.	original foundation trench 2nd Hospital	silty clay
	6221	2nd Hospital	mortar from footings of 2nd Hospital	silty loam
	6231	Pre-1788	fill in feature cut by 2nd Hospital	silty loam
	6336	Early 3rd Hospital	fill below context 6331, within context 6330,	silty clay
	6339	Early 2nd Hospital?	charcoal-rich deposit Grid Sq. F5	charcoal loam
	6340	Early 3rd Hospital	base fill, eastern half of feature context 6330	sandy loam
	6348	2nd. Hospital	fill near base of drain context 6324	silty clay
	6425	3rd Hospital	drain fill context 6428, near cesspool,	sandy loam
	6469	3rd Hospital?	fill of drain context 6462	sandy loam
Brislington (Lot 98)	5712	Hodge's occupation	topsoil, Strip 1 (east)	silt
	5712	Hodge's occupation	topsoil, Strip 5 (west)	silt
	5712	Hodge's occupation	topsoil, Strip 6 (east)	silty loam
	5712	Hodge's occupation	topsoil, Strip 7 (west)	silty loam
	6548	Pre-1788?	mixed A1/A2 topsoil	silty loam
	6623	Brown Family occupation	fill (garden feature?)	sandy clay
	6604	Brown Family occupation	fill in trench 6603 (garden feature?)	silty loam
Blood Bank (Lot 99)	5935	Indeterminate	fill from centre of trench	clay loam
	5937	3rd Hospital	fill from top of trench	silty loam
	6033	3rd Hospital?	fill in cesspit (spit 4)	silt loam
	6034	3rd/District Hosp?	subsoil from northeast corner of lot	silty loam
	6035	Indeterminate	subsoil from west end of lot	sandy loam
	6045	3rd/District Hosp.	topsoil from south end of lot	silty loam
	6050	3rd/District Hosp.	fill at west end of trench	silty loam

vegetation was *Eucalyptus* open forest or woodland with a predominantly grassy understorey. It is unclear from the pollen data whether other woody taxa such as wattles and casuarina were present in the understorey or growing along the river banks. Some eucalypts may have survived on the site into the second hospital phase (context 6348). Otherwise, clearing of the native vegetation (see contexts 5544, 5643, 6336) resulted in a massive expansion of hornworts (ash bed effect) and naturalisation of exotic weeds, especially dandelions. One sample, from hoe marks in a tilled soil to the south of a convict hut on Marden Street (context 5643), includes moderate numbers of a tricolporate pollen type that is tentatively identified as a member of the pea flower family (Fabaceae).

Few or no fossil pollen and spores are preserved in samples from the second hospital, e.g. context 6215, and by this time, soils within the fenced enclosure may have been eroded down to the A1/A2 horizons. A similar (trampled/bare dirt) environment seems to have prevailed during the convict and District Hospital phases although the diversity of weeds growing within the enclosure continued to increase, presumably due to the ongoing disposal of domestic waste. Pines and possibly a tree-fern (*Cyathea*) may have been widely planted in the vicinity but the only fossil pollen evidence for soft landscaping in the Hosp. 2 area comes from sediment infilling drains, including those used to flush the hospital privies. Examples are members of the pepper-tree and rose families.

The same (privy) contexts provide a detailed record of plant foods being eaten by the occupants of the convict and District Hospitals. Primary sources of carbohydrates were cereals and one or more members of the cabbage/turnip and pea-flower families. Fruit appear to have been less commonly eaten, e.g. citrus, pear and passion fruit (*Passiflora*). Mint (*Mentha*) may have been used as an herbal medicine or in cooking.

Brislington, Lot 98

Topsoil and soil samples from a garden provide little or no evidence of the planted shrubs that are shown in early sketches and photographs of the house when Brislington was occupied by the Brown Family (Casey & Lowe 2006c:52). The only moderately diverse microflora (context 5712) that may predate 1843 (Hodges phase or earlier) indicates a sparse ground cover dominated by weeds.

Blood Bank, Lot 99

One cesspit sample (context 6033), sealed by c.1870, preserved an unusually detailed pollen record of vegetables and fruit eaten by the nineteenth-century inhabitants of the house on this property, which was located immediately outside the hospital grounds. The former include cereals, cabbage/turnip family, citrus, mint, pea, pear and prunus species. Ornamental plantings included members of the broom (Caesalpinaceae), daisy, olive, pepper-tree, rose and umbellifer families.

'Weeds' include dandelions, plantain, samphires, starwort, thistles, and wire-weed (*Polygonum aviculare*) and climbers such as the European honeysuckle (*Lonicera*). Diversities are 'high' relative to the 'privy' microfloras in the Hosp. 2 area and may have socio-economic or chronological implications. Conversely, pollen and spores preserved in topsoil and subsoil samples on the Blood Bank site contribute to the general impression of neglect and/or decay but otherwise are uninformative regarding conditions on lot 99 during the nineteenth century.

Soil analysis

Soil profile descriptions (Lawrie 2006) indicate that only the uppermost 20–25 cm had been modified by human activity and that this layer, and to a lesser extent underlying undisturbed soil horizons, have become more alkaline and enriched with calcium. This is suggested to be due to the frequent disposal of soapy laundry and washing water from the hospital, a conclusion supported by pollen evidence for the dumping of waste on hospital's grounds (Lawrie 2006).

Other Archaeological Sites

Parramatta slowly developed from the layout of six streets and laneways left by Governor Phillip in 1792, through a phase of unplanned expansion to the planned town under Governor Macquarie's administration between 1810–1821. Under his administration the town expanded considerably. By 1815, Aird, Campbell, Argyle, Hunter, O'Connell, and Phillip Streets had been planned or constructed to provide for the growing township (Jervis 1960:37). The expanding town was built upon areas previously used for grazing cattle or growing crops.

Westfield Shoppingtown Site, Aird Street

Aird Street is one of several streets laid out in 1810 on the south side of the town (Higginbotham 1992; Macphail 1993). The first houses fronting this streets are likely to have been built between 1810 and 1823, when most of the allotments became formally leased (Higginbotham 1992). Archaeological remains include pits and postholes associated with the 1810–1820s houses built on lots 14, 16 and 20, and sandstone and masonry footings of more substantial houses built between 1844 to 1858 on lots 16, 18 and 19 (Higginbotham 1992). The first houses on lot 15 were two semi-detached cottages built between 1858 and 1895. All nineteenth-century dwellings were demolished and replaced during the twentieth century.

Seventeen samples from the lots 14 to 20 were submitted for analysis (Table 9). Most of these are associated with built structures and are assigned to three broad phases, based on a combination of archaeological and palynological evidence. These are: a commencement phase (1810–1836), an early occupation phase (1836–1858), and a late occupation phase (1858–1890s). From the palynological perspective, the most informative samples come from the fenced pond on lot 14. The impetus for the initial excavation of this pond, which first appears on an 1846 map (E. Higginbotham pers. comm.), may have been gross pollution of river water by drainage from the riverside slaughter-houses, the colonial hospital, and the male asylum (Jervis 1961:164). The pond appears to have been used as a dump for domestic waste such as broken bottles, crockery and discarded footwear during the later part of its existence.

Pollen from two samples from the commencement phase (post-packing) in lot 20 (contexts 868, 998) and the early occupation (pond infill) preserved statistically reliable numbers of fossil pollen and spores (Appendix 2G). Pollen dominance of the post-packing samples indicates the pre-clearance vegetation was *Eucalyptus* open forest or woodland with a predominantly grassy understorey. Otherwise, native trees and shrubs are uncommon but include ti-tree (*Leptospermum*), native hops and wattles. High relative abundances of hornwort spores may reflect water dripping from the eaves or plants colonising damp mineral soils following clearing of the native vegetation from the site prior to construction of the houses. Casuarina pollen are unusually common (26%) in a sample of

soil used to pack the posts of 1810–1823 structures (context 1079). This is difficult to explain since the pollen type is uncommon in most early colonial deposits in Parramatta. If the grains are *in situ*, a possible explanation is that casuarinas had been planted on this site to provide shade or as a source of roofing shingles by the 1830s.

Fossil pollen preserved in the clay infill confirms the pond was surrounded by a grassy sward in which citrus species (lemon trees?) had been planted. Initially, water quality was sufficiently good to support the water-fern, duck-weed and a marsh-flower (*Villarsia*), and it is possible that the pond was used as a source of domestic water. This is unlikely to have been the case by the late 1850s given the high relative abundances of green alga *Botryococcus*. Possible reasons for this pollution are the replacement or extension of the early colonial house built on lot 14 between 1844–1858 or because an alternative supply of clean water became available.

Apart from citrus and, less certain, trace occurrences of cereal pollen, there is little evidence for horticultural plantings on the site. The only (equivocal) evidence of ornamental shrubs are trace numbers of pollen of native drum-sticks, clematis (*Clematis*) and members of the rose and polygala (Polygalaceae) families in samples from lots 14 and 20. Conversely, a comparison of relative abundance data from the commencement and late phase samples demonstrates the expansion of 'agricultural weed' tax such as dandelions, plantain and samphires onto vacant ground during the middle to late colonial period. Human sewage may have been used as fertiliser since soil samples from the garden on lot 14 (1088) and post-packing on lot 20 (868, 887, 998) included trace to frequent numbers of the human sewage indicator (*Cloacasporites*).

24 Hunter Street

One sample of a sandy loam (context A–021) overlying hoe marks in a buried soil was submitted for pollen analysis (Macphail 2006a). Few details were provided regarding the history or archaeology of the site and the only independent age control is a half-penny dated 1806 in a post-pipe fill in the underlying soil. This may indicate the tilled surface predates 1820 (M. Kelly pers. comm. 2006).

The sample yielded low to moderate amounts of strongly humified and well-preserved plant debris plus charcoal and large numbers of fungal spores (3 x 10^3 spores per gram). The yield of fossil pollen and spores was similar (5 x 10^3 grains per gram of sediment). The microflora includes four taxa that definitely represent exotic species, e.g. pine, citrus and a member of the olive family. Another pollen type represents a native species that does not naturally occur in the local flora, the silky oak (*Grevillea robusta*), and six taxa are likely to have been produced by exotic 'weeds' rather than native analogues. Whether any of these grains are *in situ* is uncertain since the specimens are perfectly preserved. The identity of the plants being grown on the tilled soil surface is not recorded by pollen.

150 Marsden Street

The extension of Marsden Street to the south of George Street was laid out by Governor Macquarie in May 1811. This road provided access to a dam built across the Parramatta River in 1818, which remained the town's main water supply up to the 1840s (Jervis 1960:157). The northern end of Marsden Street formed the eastern boundary of the Parramatta convict hospital grounds by 1792. The footprints of early colonial huts fronting onto Marsden Street survive on this and adjacent sites and it is probable that areas to the south were also occupied. Evidence of initial clearing of the site is preserved in the form of the partially burnt stump of a massive tree, presumed to be a *Eucalyptus* sp. (Macphail 2007).

The history of 150 Marsden Street follows a similar pattern to sites along George, Macquarie and Phillip Streets except that it is unlikely to have become a residential allotment until after 1811. Subsequent developments included the

Table 9: Samples, Aird Street

Lot	Context No.	Occupation Phase	Context	Sediment
14	-40 cm AHD	Late	surface of sediments infilling pre-1846 fenced pond	clay
	-80 cm AHD	Early?	base of sediments infilling pre-1846 fenced pond	clay
	1086	Early?	sediment between bricks in fireplace built about 1836	red sand
	1088	late Early?	buried soil in bordered garden adjoining 1836+ house	organic loam
	1087	Late?	soil infilling brick-lined drain, W side of 1836+ house	organic loam
15	1079	Late?	soil from vacant allotment	organic loam
16	1123	Commencement	soil used as post-packing, 1810–1823 hut	silty loam
	1308	Commencement	soil used as post-packing, 1810–1823 hut	silty loam
18-19	1308	Commencement	soil used as post-packing 1810–1823 hut	silty loam
	428	Early	soil used as packing under foundations 1840s house	silty loam
	472	Early	soil used as packing under foundations 1840s house	silty loam
20	882	Commencement	topsoil outside 1810–1823 hut	silty loam
	643	Commencement	soil used to pack hearth stones in 1810–1823 hut	silty loam
	868	Commencement	soil used as post-packing, 1810–1823 hut	silty loam
	873	Commencement	soil used as post-packing, 1810–1823 hut	silty loam
	887	Commencement	soil used as post-packing, 1810–1823 hut	silty loam
	998	Commencement	soil used as post-packing, 1810–1823 hut	silty loam

construction of two dwellings by Thomas Shaw, one a two-roomed weatherboard cottage and, the other a smaller one-room slab hut set well behind the main house, built between 1811 and 1823 (Thorp 2007). Archaeological evidence shows that the initial site preparation included the removal of all topsoil and its replacement by a thick clay layer (to help damp-proof the site?). A 4 m deep, brick-lined well dug at the back of the main house overflowed into a sandstone box drain that connected with earlier drains. The western side of the allotment appears to have been used as a garden and Wendy Thorp (pers. comm. 2007) suggests that an arrangement of post holes represents 'individual plantings of trees [associated with] staked plants, possibly climbers such as beans, peas or tomatoes'. By c.1850, the site had been sold, for the fourth time, and all existing buildings demolished. The allotment appears to have remained vacant land up to at least 1859. By 1877, a new 3 to 4-room house had been built by the new owners, Jordan and Mary Ann Sparkes, along the footprint of the pre-1850s main house, with the remainder of the site being a 'featureless yard surfaced with a variety of material' (Thorp 2007). The property was re-sold in 1897 and the 'Sparkes' house demolished. By 1905, the allotment was turned into a small commercial (market?) garden although a cottage at the back of the site was retained as a residence for the new owners, Thomas and Sarah Michael. This involved levelling the site with imported sand, clean shale fill and topsoil as well as the construction of rubble (French) drains around the periphery of the new gardens (Thorp 2007).

Seven samples from this site were submitted for pollen analysis (Table 10). All samples preserved sparse to abundant and strongly humified to well-preserved plant debris, sub-round to angular charcoal and fungal spores although numbers were highly variable. The yield of fossil pollen and spores (miospores) was equally variable and, except for contexts 388 and 605, counts are below the minimum number required to make statistically robust estimates of relative abundance (Appendix 2H). However, preservation was unusually good for buried soil contexts. Where possible, the microfloras have been assigned to occupation phase(s) recognised by Thorp: pre-settlement phase (pre-1789), site clearance phase (1790s–1811), Shaw phase (c.1811–1825), the Marsh-Marsden phase (1825–c.1850), Sparke's phase (c.1850–1897s) and commercial garden phase (1897–1913).

Approximately 60 pollen and spores could be identified to a plant family or higher taxonomic level such as a genus or species. Eleven of these fossil taxa definitely represent exotic species, e.g. pine, oak and citrus, and another 11 taxa are likely to have been produced by exotic 'weeds' rather than native analogues. Examples of the latter group are pollen produced by the daisy (Asteraceae high-spine types), crucifer and samphire families. Most of the unidentified tricolpate and tricolporate pollen types are presumed to represent exotic plants. Rare taxa included native shrubs that may or may not have occurred naturally in this area of Parramatta during the nineteenth century, e.g. banksia (*Banksia integrifolia*-type), native hops and drum-sticks. Several samples preserved low numbers of a large, two-cell fungal spore (*Dicellaesporites* sp.) that on some sites appears to be associated with nutrient-rich domestic waste, e.g. contexts 555 and 605. Otherwise the samples were dominated by casuarina, eucalypt and grass pollen and hornwort spores.

Sediment infilling a box drain built c.1811 but in use up to the 1860s (context 388) preserved significant numbers of citrus pollen and indicates the drain was channelling water from an orchard or a grassy sward in which citrus had been planted as ornamental shrubs. The infill of the drain is suggested to date to 1849–1897 when Jordan and Mary Ann Sparkes occupied the site. Similarly, sediment infilling a drain constructed in the 1840s (context 605) preserved pollen of four deciduous European trees including: alder, elm, lime and oak. The infill is suggested to date to the late nineteenth century, because the plant microfossils and sediment significantly post-date the construction of the drain. The same is likely to be true for all other plant microfossils and sediment samples in drain samples on the site. None of the other drain samples preserved useful pollen and spore assemblages and unfortunately clays washed into a very early 'reservoir' on the southern boundary of the site, which may have preserved a detailed record of the 1790s clearance phase and any crops planted in the vicinity of Marsden Street, were not sampled (W. Thorp pers. comm. 2007).

Metropolitan Water, Sewage & Drainage Board Site, 72 Phillip Street

Phillip Street was formally laid out in 1810 between George Street and the Parramatta River. The site, which has been used throughout the twentieth century by the Metropolitan Water, Sewage & Drainage Board as their Parramatta depot, includes a portion of the escarpment separating the lower and higher river terraces (Fig. 2). A brick barrel drain, which drains swampy areas to the south, was built across the site in the 1820s. The site may have been occupied or leased as early as 1804 but its earlier history is uncertain (Carney and Atkinson 2003). In 1823, the site was part of a formally leased allotment but there is no evidence that any dwelling was built before about 1834. This weatherboard building appears to have been a temporary structure since an 1895 plan shows the allotment as vacant. The land was used for grazing into the 1870s. A brick building constructed in 1884 on the adjacent allotment was being used as a cordial factory in the 1890s and its occupants probably used 72 Phillip Street in association with their business (Carney and Atkinson 2003).

Two samples from the truncated remains of the 'escarpment' were submitted for pollen analysis (Table 11). Yields were low

Table 10: Samples, 150 Marsden Street

Context No.	Date	Archaeological context	Lithology
362	pre-1850	excavated drainage channel	medium grey-brown silty sand
388	c. 1811-1860	fill of box drain	medium grey-brown sandy clay (plastic)
392	c. 1811?	fill at base of box drain	medium grey-brown sand, occasional pebbles
417	c. 1820-1840?	fill in second box drain	mottled grey blocky clay with fine gravel inclusions
555	c. 1840?	fill in brick box drain	dark grey sandy loam, fine charcoal & clay inclusions
605	c. 1840+?	fill in timber box drain	dark grey sandy loam with sandstock brick fragments
623	pre-1850	fill in timber box drain	medium grey-brown silty sand

(Appendix 2I) except for fungal spores and the cysts? of an unidentified soil microorganism (Macphail 2004b). Despite their reported stratigraphic position, artefacts and high relative abundances of exotic pollen types including pine, dandelions and samphires (Appendix 2I), indicate both samples date from the middle to possibly late nineteenth century. Sedge, pondweed, and bulrush pollen indicate that context 103 incorporates material (sediment and/or water) obtained from freshwater depressions on the lower river terraces, while Triassic pollen and spores hint that unweathered Ashfield Shale may have been used as landfill on the site or the site has been inundated by flood water at some time. Otherwise the pollen data are consistent with the site being used for grazing.

Table 11: Samples, 72 Phillip Street

Context No.	Lithology	Concentration
PSP 03-102	mid grey-brown silty sand, sandstock brick fragments	1 x 10^3 grains gm^{-1}
PSP 03-103	mid grey-brown silty sand, roots, seed, glass, clay pellets	6 x 10^3 grains gm^{-1}

16–18 Smith Street

Unlike the adjacent Prospect County Council site early colonial remains at 16–18 Smith Street had been destroyed by building activity during the middle to late nineteenth century (Macphail 1990, 1999a). The oldest surviving structure was a stone-capped 'convict' brick drain that carries storm water from the centre of Parramatta (Civic Place) across the site before turning northwards to flow into the Parramatta River (Fig. 2). Small circular access ports show that the drain was utilised as a sewer sometime during the nineteenth century. Other architectural remains on the site appear to post-date the 1860s. These include a subterranean vault built of finely dressed sandstone blocks, the sandstone foundations of 1870s terraces houses (which partly extend across the stone roof of the vault), and the brick and/or concrete foundations of later houses and factories. Sometime during the nineteenth century a 10 cm thick red clay was spread across the site. Fragments of nineteenth-century terracotta tiles used to border pathways were found in the twentieth-century rubble.

Two sections were sampled for palynological analysis (Macphail 1999b), sediments within and adjacent to the 'convict' drain and two sands separated by a red clay overlying Pleistocene alluvium at the northeast corner of the site. The articulated shell of an estuarine bivalve (*Anadara*) was preserved at the top of this red clay. Nine samples were submitted for analysis (Table 12). All yielded low to abundant amounts of humified plant detritus (wood?) and fungal spores with varying amounts of micro-charcoal but few fossil pollen and spores. Exceptions were silt enclosed within the *Anadara* shell and silty sands at the base of the lower sand unit (Appendix 2J).

The 'shell' microflora (context 039) included at least four genera of estuarine/marine algae (dinoflagellates), trace numbers of mangrove (*Avicennia maritima*) pollen, abundant casuarina pollen (41%) and fern spores (35%). These demonstrate the clay stratum incorporates material dredged from the upper Parramatta River, presumably to provide an impervious barrier against water leaking from the 1830s drain into the foundations of late nineteenth-century buildings on the site. Low numbers of cereal pollen are the only evidence of horticultural activity and could easily represent plants established from spilled stock feed. Casuarina pollen are common in the silty sand (context 006) but otherwise the eucalypt-dominated microflora resembles those recovered from early clearance phase deposits. Miospores in contexts 038, 039 and 006 are modern.

James Ruse Reserve

James Ruse Reserve, bounded by Parkes and Harris Streets and Clay Cliffs Creek, differs from previously discussed sites in three respects. The site is located on the northern, Clay Cliff Creek, boundary of Experiment Farm, established by James Ruse in 1791. The site became part of a large Chinese market garden between 1893–1911. A 1 m soil monolith was submitted for pollen analysis, allowing the (gradational) profile to be sampled at closely spaced intervals.

Crops grown on Experiment Farm included maize, bearded wheat, and (unspecified) vegetables in a 'small kitchen garden' (Jervis 1961:13). How Ruse used the land now within the Reserve is unknown but in 1793 the farm was sold to Surgeon John Harris who owned land on its western boundary. The combined estate was subdivided by the Harris family in 1876 and leased out as small farms although the area encompassed by the Reserve remained uncultivated until 1893 when it was leased to Chinese market gardeners. These gardens were maintained using water from Clay Cliff Creek and possibly manured with human waste. Apart from a 'Chinese humpy' and a well, there was no evidence of any built structures on the site. In 1917, the subdivision encompassing the study area was sold and the site used as a dairy. Clay Cliff Creek was realigned in the 1930s and enclosed within a concrete conduit by 1951. In 1958 the area was purchased by the Parramatta City Council and proclaimed a reserve (Macphail 2005a; Stuart 2004).

Sixteen samples, taken at 5–10 cm intervals down the monolith, were analysed for fossil spores and pollen (Table 13). European domestic waste such as ceramic sherds occurs throughout the top 40 cm of the profile. All samples preserved low to significant amounts of strongly humified and mostly finely disseminated organic matter, including charcoal, fungal spores and fungal fruiting bodies. Marked changes in pollen yields and dominance indicated four distinct units were present (Appendix 2K); only trace numbers of miospores occurred below 45 cm depth.

<u>Unit 1: 0–5 cm</u>

This interval is distinguished by very high concentrations of charcoal particles (up to 3000 x 10^3 particles per gram) and high relative abundances of pine, grass and an unidentified Fabaceae pollen type, presumed to come from plants growing in the local turf. Ornamental plants growing in the vicinity include pines, privet or another member of the olive family, camphor laurel (*Cinnamomum*) and two exotic species of lily (Liliaceae). Spores of swamp selaginella and a fern (*Pteris*) that is usually found in wet gullies and the margins of rainforest may have been carried-in in water used to irrigate the reserve. This unit represents topsoil that has accumulated since the area was declared a public reserve in 1958.

<u>Unit II: 10–25 cm</u>

This interval is distinguished by 'high' relative abundances of pine pollen and variable numbers of tree-fern spores and lower

Table 12: Samples, 16-18 Smith Street

Context No	Depth AHD	Context	Sediment	Inclusions
1830s drain				
-		sediment infilling drain	silts, sands and gravel	-
032		clay packing around drain	mud in red-brown clay matrix	-
Stratified sand and clay sequence				
038	-0.30 m	top of upper sand	light grey brown silty fine sand	charcoal
038	-0.44 m	base of upper sand	dark brown silty sand	bottle glass sherds
039	-0.45 m	unconformity surface	silt infilling articulated *Anadara* shell	-
039	-0.50 m	red clay	massive red clay, cutan structures	-
006	-0.60 m	top of lower sand	dark brown silty sand	clay pelletoids (ash?)
006	-0.70 m	base of lower sand	olive-green silty sand	charcoal

numbers of daisy, dandelion, samphire and Caryophyllaceae pollen. Cereal pollen occur in some samples, e.g. at 20 cm depth but pollen of other edible species were not recorded. It is uncertain whether or not the unit represents the period when the site was part of the market garden. If this is the case, then tillage has led to oxidative destruction of such pollen. Alternatively, the edible plants were harvested before setting flowers. The virtual absence of casuarina and eucalypt pollen is difficult to explain.

Unit III: 30–45 cm

This interval is distinguished by major changes in pollen dominance between closely spaced samples. For example the microflora recovered from 30 cm depth is wholly dominated by a distinctive monosulcate pollen type typical of those produced by exotic palms (Arecaceae) or lilies. The grains often occur in clumps associated with what appears to be the remains of floral tissue. Other microfossils include a eucalypt anther and trace numbers of pollen produced by a member of the olive family. In contrast, the microflora at 35 cm depth is dominated by prunus and includes trace numbers of passionfruit (*Passiflora edulis*), hazel (*Corylus*) and dock pollen. The microflora at 40 cm depth is dominated by Solanaceae-type pollen, which do not match pollen produced by the two most widely grown vegetable species in this family, potatoes (*Solanum tuberosum*) and tomatoes (*Lycopersicon esculentum*). The microflora at 45 cm depth is dominated by clover (*Trifolium*). The rapid shift in pollen dominance implies that either the microfloras represent a stacked succession of very thin (~5 cm thick) alluvial strata or (the preferred explanation) burrowing insects have carried modern pollen down into an otherwise barren soil horizon.

Unit IV: 50–100 cm

The interval is distinguished by low to moderate amounts of charcoal but only trace numbers of pollen and spores. It appears to be alluvium in which the pollen and spores content has been destroyed by natural weathering processes.

CONCLUSIONS

In a parallel review of palynological evidence from Sydney, Macphail (1999a) noted that few unambiguous conclusions could be drawn from fossil pollen and spores preserved in colonial archaeological sites. Reasons included the low taxonomic resolution of both common and rare taxa, their biased representation and preservation, and the mixing of different age assemblages. Most of the general caveats regarding colonial Sydney also apply to Parramatta, not least because the archaeological contexts are similar. For example, tillage appears to have destroyed whatever pollen may have been shed by cultivated plants. The soil overlying the tilled horizon at 24 Hunter Street is one example. On other sites, deposits representing one or more occupation phases may have been removed by erosion, e.g. James Ruse Reserve. Nevertheless, the close geographic proximity and similar occupational histories of the Parramatta sites have allowed particular aspects of colonial culture to be preserved in unrelated archaeological contexts. For example, the composition of the pre-1788 vegetation can be deduced from pollen preserved in younger historic contexts. Similarly, evidence of soft-landscaping is archived by miospores preserved in ponds, cesspits and drains as well as garden soils. The same data indicate which contexts are most likely to preserve diverse plant microfossil assemblages and therefore provide a guide for future sampling.

Table 13: Samples, James Ruse Reserve

Depth (cm)	Lithology	Comment
0	fibrous peaty loam	modern turf
5	friable dark grey-brown silty loam	modern top soil
10	friable dark grey-brown silty loam	tilled zone?
15	friable dark red-brown silt loam	tilled zone?
20	friable dark red-brown silt loam	tilled zone?
25	medium red-brown loam	tilled zone?
30	red brown sandy loam	tilled zone?
35	red brown sandy loam	tilled zone?
40	orange-brown sandy clay loam	tilled zone?
45	orange-brown sandy clay loam	tilled zone?
50	yellow-brown silty loam	alluvium?
60	yellow-brown silty loam	alluvium?
70	yellow-brown silty loam with clay pelletoids	alluvium?
80	yellow-brown silty loam	alluvium?
90	dark yellow-brown silty loam (iron-pan)	alluvium?
100	dark yellow-brown silty loam (iron-pan)	alluvium?

Patterns and Processes

On present indications, 11 cultural landscapes and aspects of cultural activities can be inferred using microfossil evidence preserved in late eighteenth and nineteenth-century archaeological contexts (Table 14). Not all can be recognised at every site, nor are the pollen data more than partial records of a particular landscape or activity. As for colonial Sydney (Macphail 1999a) the generalisations are presented as working hypotheses to be tested in future historical archaeological research.

Pre-1788 Environment

None of the 'natural' or buried/undisturbed topsoils, which on the archaeological evidence pre-date British settlement of Parramatta, were found to preserve fossil pollen and spores. Nonetheless, the near ubiquitous presence of common to abundant, small/immature eucalypt (*Eucalyptus*) and grass (Poaceae) pollen in 'clearance phase' deposits strongly support Benson and Howell's (1990:68) hypothesis that the higher river terraces supported open sclerophyll forest with a predominantly grassy ground cover. It is not possible to determine from the pollen data whether the dominant trees were *Eucalyptus*, *Angophora* or a mix of both genera although the small size of the pollen grains is more typical of *Eucalyptus*. However, it may be possible to identify individual species via fossil wood and charcoal preserved on, for example, the colonial hospital site or at 150 Marsden Street. Both the documentary and fossil pollen evidence suggest that the understorey included wattles but the hypothesised occurrence of other woody genera such as paperbarks (*Melaleuca*) cannot be confirmed or rejected. The data are equivocal whether other woody taxa, in particular casuarina, banksia, native drum-sticks and native hops species were growing along the upper (non-tidal) reaches of the Parramatta River before 1788. For example, relative abundances of casuarina pollen preserved in some 1790s–1820s post hole packing samples at 41–53 George Street and also at Aird Street are higher than would be expected if the pollen type was transported by wind from distant stands. Aquatic herbs growing in depressions on the lower river terraces included at least one genus (*Isoetes*) which in now extinct in the Sydney flora.

Clearance phase

Late eighteenth-century sediments found on seven sites preserved a distinctive palynoflora dominated by small/immature eucalypt pollen, hornwort spores and micro-charcoal. Similar assemblages are recorded in younger contexts, e.g. where wood-ash from domestic fireplaces has been dumped on the colonial hospital site but the combined data strongly imply clearing of the native vegetation resulted in a massive expansion of hornworts (ash-bed effect) over the exposed damp mineral soil surface. This evidence accords with the historical use of burnt vegetation as the only source of fertiliser during initial agricultural activities in Parramatta (Rose Hill). This in turn resulted in the widespread naturalisation of exotic weeds, especially dandelions.

Early agriculture/horticulture, pre-1830s

Trace numbers of cereal and/or citrus (*Citrus*) pollen occur in several 'clearance phase' palynofloras and probably represented early plantings along the terrace traversed by George Street. Examples occur in sediment infilling a 1790–1810 drainage channel and hoe-mark at 95–101 George Street (contexts 791, 1632) and 150 Marsden Street (contexts 392, 417). Less commonly recorded cultigens are bean (*Phaseolus*), pea (*Pisum*) and unidentified members of the legume (Fabaceae), malva (Malvaceae), melon (Cucurbitaceae) rose (Rosaceae) and umbellifer (Apiaceae) families. No reliable pollen evidence for viticulture has been found, including on the site of a probable vineyard at 95–101 George Street.

At present the most detailed pollen evidence for *in situ* early horticulture comes from soil profiles on the former Prospect County Council (Babes in the Woods) car park site on George Street (Macphail 1999a). Here abundant Brassicaceae pollen imply that cabbage or other botanically-related vegetables such as turnips were being grown on damp ground adjacent to 1790s convict huts. Similar relative abundances of Brassicaceae pollen occur in colonial cesspits. Otherwise, the most detailed pollen records of edible plants being grown by the early colonial residents comes from soil infilling and below the early nineteenth-century cellar excavated at the Parramatta Children's Court site.

Late agriculture/horticulture, post-1830s

Not surprisingly, the pollen data indicate that essentially the same mix of vegetables and fruit trees continued to be grown in Parramatta during the mid to late nineteenth century. In several instances, e.g. at 180–180A George Street, high relative abundances of pine (*Pinus*) and casuarina pollen are the main criterion used to distinguish these 'late' and 'early' horticultural assemblages. Again the most detailed evidence comes from the non-garden contexts, in particular sediments infilling a 1840s waterhole at Aird Street, and drains at 95–101 George Street and 150 Marsden Street. Passionfruit and prunus pollen, inferred to have been carried into the soil profile by burrowing insects, may represent plants being grown in the Chinese market garden between 1897–1913 on the site of James Ruse Reserve.

Colonial diet

Pollen in archaeological contexts such as cellars, drains, post packing and ponds or water holes are reliable evidence for the cultivation of edible plants but the only direct evidence that such plants were in fact being eaten comes from cesspits. For example, the palynoflora recovered from the cesspit on the Blood Bank site is the most diverse example of edible plants recorded so far on any historical archaeological site in the Sydney region. The most commonly found pollen types are members of the crucifer family and cereals, with low to trace numbers of legumes, including bean and pea, fruit including citrus, prunus, fig, and probably apple, pear and strawberry, and herbs including mint.

Soft landscaping

Cesspits and drains usually preserve pollen of exotic shrubs and trees that are likely to be planted for ornamental purposes as well as for their utilitarian value. The best represented genera in the latter category are pine (*Pinus*), which almost certainly will have been used as windbreaks and for shade since its relative abundance increases during the early-mid nineteenth century, privet (*Ligustrum*) used to make 'quick-set' hedges, and prunus. Less commonly recorded trees and shrubs include hoop-pine (*Araucaria*), kauri (*Agathis*), cypress (Cupressaceae-Taxodiaceae), alder (*Alnus*), birch (*Betula*), broom (Caesalpinaceae), elm (*Ulmus*), lime (*Tilia*), oak (*Quercus*), pepper-tree (Anacardiaceae), rose (*Rosa*), silky oak (*Grevillea robusta*) and hibiscus (*Hibiscus*). Ornamental herbs are less easily distinguished because their pollen are similar to

Table 14: Shading indicates where fossil pollen was found at a range of sites relating to different phases or activities in Parramatta as a whole.

CULTURAL ASPECT	ARCHAEOLOGICAL SITES												
	George St						Aird St	Hunter St	Marsden	Phillip St	Smith St		J. Ruse
	180-180A	109-113	95-101	41-53	PCC	Hospitals	-	24	150	72	20	16-18	-
prehistoric pre-1789													
clearance 1790-1800												?	
early agriculture/ horticulture pre-1830		?									?		
late agriculture/ horticulture post 1830		?											
colonial diet											?		
soft-landscaping							?						
damp conditions							?						
water supply										?			
waste disposal													
degraded environments													
Permo-Triassic taxa													

those produced by weed or native species, e.g: members of the daisy (Asteraceae), carnation (Caryophyllaceae), geranium (Geraniaceae), lily (Liliaceae), polygala (Polygalaceae) and verbena (Verbenaceae) families.

Apart from casuarina, whose relative pollen abundance increases during the early to late nineteenth century, it is unclear whether native shrubs were being grown as ornamental shrubs or if bush flowers were being picked for household decoration. Two possible examples are native drum-sticks and wattle. Many samples included trace to low numbers of *Cyathea* and *Dicksonia antarctica* spores and these tree-ferns are likely to have planted in early colonial gardens. Both spores are known to be transported long distances by water and it is possible some specimens were deposited during flood events.

Damp conditions

The ubiquitous presence of drains on most of the archaeological sites is compelling evidence for damp conditions and the management of stormwater was a major consideration for increasing the comfort of the residents of Parramatta. For example, the sequence of drains excavated at 150 Marsden Street approximately covers a 100 year period, from the 1790s to the late nineteenth century. Not surprisingly, pollen and spores of ferns and mesophytic confirm conditions within or adjacent to drains were damp but it is uncertain whether similar conditions extended across the site as a whole. Evidence that this was the case for some sites is provided by the use of clay-rich sediments dredged from the Parramatta River as an 'aquitard' at 16–18 Smith Street. Indicators of locally damp conditions include the spores of fern allies such as slender club-moss (*Lycopodium laterale*), swamp selaginella and ferns that occur naturally in damp gullies and on the margins of wet forest types, e.g. the rainbow fern (*Calochlaena*), and pollen of buttercups (Ranunculaceae), wire-rushes (Restionaceae) and sedges (Cyperaceae). Many of the same taxa occur in deposits infilling damp pits and below brick paving, e.g. at 109–113 George Street.

Water supply

Despite damp conditions, obtaining water for drinking and domestic purposes was a major pre-occupation in colonial Parramatta, especially since water obtained from wells tended to be brackish (Jervis 1961:157). For example barrels, some of which might have been used for storing water rather than foodstuffs, have been uncovered on the Prospect County Council car park site (Macphail 1999a) and the same appears to have been the case at 95–101 George Street (context 921). In the former instance, fossil pollen recovered from the barrel infill included water milfoil (*Myriophyllum*); at the latter site, damp conditions are indicated by frequent hornwort spores. On most sites, however, pollen evidence for the domestic use of water comprises trace amounts of the spores or pollen of obligate aquatic herbs that are unlikely to have been growing naturally on the higher river terraces. Examples are quillwort (*Isoetes*), duck-weed (*Lemna*), pondweed (*Potamogeton*), bulrush (*Typha*) and marsh flower (*Villarsia*), all of which are likely to have grown in depressions on the lower river terrace (Fig. 2). Wells and small ponds occur on several sites, e.g. 95–101 George Street but the associated sediments often are soils used to infill abandoned structures. To date, the clearest

example of a waterhole that may have supplied domestic drinking water during the early to mid nineteenth century occurs at Aird Street. Significantly, the relative abundance of a green alga that is typically associated with brackish or polluted conditions (*Botryococcus*) increases at a time when other sources of domestic water may have become available.

Waste disposal

As in colonial Sydney, disposal of domestic rubbish other than sewage seems to have been *ad hoc*. For example, the 1840s waterhole at Aird Street included shoes, glass and china in the infill. The palynological signature of this activity is similar to that of 'clearance phase', viz. microcharcoal-rich sediments that preserved high relative abundances of fungal and hornwort spores, small/immature eucalypt pollen, and pollen of opportunist weeds such as dandelions. One major difference is that the relative abundance of casuarina, pine and samphire (Chenopodiaceae) pollen is often much higher in the more recent deposits, e.g. at the Babes in the Woods (former Prospect County Council) car park site (Macphail 1999a). All samphires are halophytes and high relative abundances are compelling evidence that by the mid-late nineteenth century saline soils were present on many sites. In rare instances, the sediment is wholly dominated by the one fungal spore, indicating the waste being disposed was nutrient-rich, e.g. fats or milk. Examples occur at 150 Marsden Street (contexts 555, 605), 109–113 George Street (contexts 4844, 5066) and on the colonial hospital site (contexts 5354, 5682).

Degraded environments

In general terms, the palynology of colonial sediments as varied as soils, post-packing, ponds, wells, drains and cesspits is the record of an increasingly degraded 'natural' environment. This may be reflected in the increase in the diversity of herbaceous weeds, especially dandelions, plantain (*Plantago lanceolata*-type), docks (*Rumex*), samphires and starwort (*Stellaria*), or naturalized exotic vines such as honey-suckle (*Lonicera*). Conversely the absence of these and other commonly-occurring pollen types indicates the site in question was virtually devoid of vegetation. One example is 95–101 George Street, where in contrast to 1790s to early 1800s deposits, the upper fill layer in a well in use up to c.1840 (context 1611) is dominated by samphire and dandelion pollen. Soils on the colonial hospital site (contexts 5354, 5419, 5712, 6545, 6623 and 6604) indicate the hospital grounds comprised little more than damp trampled earth upon which putrescent waste and ash were being dumped.

Permo-Triassic palynomorphs

Triassic gymnosperm pollen and, rarely, Late Permian spores are preserved on over half of the sites. The latter may be derived from coal, e.g. the specimen of *Dulhuntyispora* recovered from sediments infilling a drain on the colonial hospital site (context 5419). Otherwise the source is most likely to be Triassic Ashfield Shale although debate continues regarding the implications of Permo-Triassic taxa in soils, post-packing and deposits infilling drains, wells and trenches. What is certain is that the parent rock can not have been exposed to prolonged weathering since the palynomorphs are over 200 million years old. Suggestions include the palynomorphs were deposited during flood events, river alluvium was used to build up gardens, and/or brick-pit waste was used to level sites. Flooding would appear to be the most likely explanation for lower-lying sites. Examples are the Babes in the Woods site, where Triassic gymnosperm pollen occur in significant numbers in the upper horizon of a buried soil profile (Macphail 1999a), and 180–180A George Street, where up to 21 per cent Triassic gymnosperm pollen and spores occur in silty sands on lot 14 (contexts 1601, 1603), which abuts directly onto the Parramatta River. Conversely imported alluvium may explain significant (4%) numbers of Triassic pollen in an early twentieth-century orchard or market garden on a second lot on the same site (lot 69, context 2484), and also trace numbers in sediment infilling a hoe mark at 95–101 George Street. Excavated shale is a possible explanation for Permo-Triassic palynomorphs recovered from sediments infilling an 1810–1840s well and a channel associated with an 1870s abattoir at 95–101 George Street.

FUTURE RESEARCH

Australian historical archaeology has developed to the point where general socio-economic 'models' based on documentary evidence can be tested by analysis of the material artefacts. One example is the Conservatorium Site, Sydney, NSW where analysis of government house inventories provided an interpretative framework to explore items recovered from the main rubbish dump, in use from the 1840s into the early twentieth century (Casey 2005). Another is the Viewbank Site, Heidelberg, Victoria, where faunal remains interpreted as table and kitchen refuse should allow 'the impact of [socio-economic change] on the pastoral character of a rural property' to be explored and 'the extent landholders were able to insulate themselves against fluctuating conditions in the nineteenth and early twentieth century' to be assessed (Howell-Meurs 2000).

Like material culture, plant microfossils are a 'footprint' of past human activity at Parramatta although the present role of palynology in historical archaeology is to flesh-out particular aspects of the documentary and archaeological evidence. Nevertheless, palynology also has the ability to uncover aspects of the past that are unlikely to be documented in the written or archaeological record. An example is the apparent massive expansion of hornworts and dandelions following clearing of the native vegetation on sites before these were planted with cereal crops, vegetables and/or fruit trees. In other instances it is possible to use the palynological evidence to resolve how particular structures were used or how particular environmental problems were resolved. Prime examples are the early storage cellar on the Children's Court Site, where pollen confirms the structure was used to store grains, fruit and vegetables, and 16–18 Smith Street, where clay spread across the site to reduce the impact of flooding was found to incorporate material dredged from the Parramatta River.

As with artefacts, good preservation of fossil miospores is often a matter of chance but the microfossil evidence from Parramatta confirms that cesspits, wells and ponds need to be sampled in greater detail if these are not to remain an undervalued resource in Australian historical archaeo-botany (see also Crook & Murray 2004). For example, detailed pollen analysis of an infilled mid-colonial-period waterhole at Richmond (Macphail 1996) suggests that close sampling of sediments infilling the waterhole at Aird Street could have revealed changing attitudes to the disposal of household putrescent waste. Similarly, cesspits, wells and associated drains are a natural archive of long-term changes in living standards, including diet, of the residents, especially where the infill is the result of a gradual accumulation of human and associated waste. On the other hand, deposits resulting from the rapid deposition of household waste following clearing or

abandonment of a site are a snapshot of conditions at specific times in the history of that site.

In these, and probably most archaeological contexts, the chronostratigraphic resolution able to be provided by fossil pollen and spores is directly related to sample densities. Accordingly, one challenge to historical archaeologists is to replace 'spot' or 'bulk' sampling of soil profiles by techniques able to recover continuous monoliths (cores) that can be sub-sampled in appropriately fine detail in the laboratory and which potentially provide a reference framework against which spot samples from built archaeological contexts can be compared. On most development sites, some long cores will be drilled for geotechnical purposes and these can provide additional material for pollen analysis at no cost to the archaeologists, as long as the developers are alerted before the cores are discarded.

Samples from the surface of buried soils have proved to be useful on specific sites, in particular the convict hospital site where the fossil evidence, or lack thereof, points to the hospital buildings being surrounded by disturbed (trampled?) and bare earth. Some areas were used for the disposal of domestic waste such as ash from domestic fireplaces, putrescent matter and grey water. To what extent these conditions echo hospital management practices is unclear but the data are consistent with damp, neglect, crowded and possibly insanitary conditions. Otherwise, soil samples from Parramatta have proven to be a 'mixed bag' although the combined data have contributed to the same impression of an increasingly degraded townscape, due as much to the attitudes as to the actions of its citizenry?

The low taxonomic resolution of many commonly occurring pollen grains and spores, the mobility of pollen and spores in sandy soils, and, with rare exceptions, the destruction of cultigen pollen by tillage, are likely to remain a perennial problem in archaeo-palynology. An equally important consideration is that the sedimentary infill in archaeological contexts may be significantly younger than the date of construction, and in many instances, the miospores will represent the time when the context was abandoned (gardens), buried (soils) or ceased to be maintained (drains). Nevertheless, any context that incorporates fine-grained, preferably water-logged, sediments that are able to be closely sampled will allow fossil pollen and spores or siliceous microfossils such as phytoliths (Bowdery 2007) to test models of colonial Parramatta's evolving cultural landscape based on material evidence.

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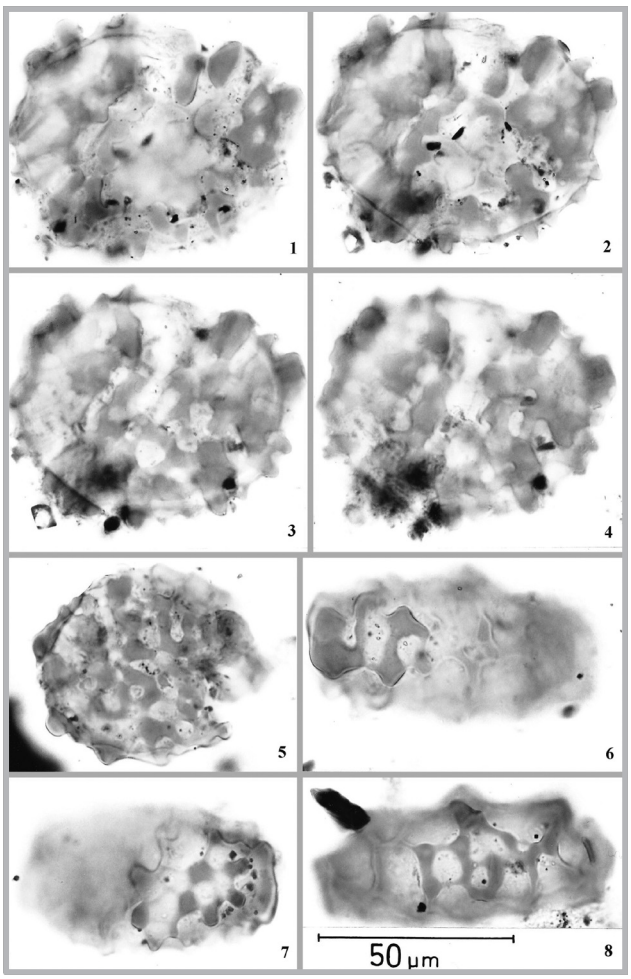

Plate 1: Type (Figs 1–4) and representative specimens of Cloacasporites sp. gen. nov. (x 788 magnification
Figs 1–4: Context 3400 Spit 4 (cesspit): House 38/40, 50–72 Union Street, Pyrmont.
Figs 5–6, 8: Context G–2875 (upper fill layer in well): Quadrant Development Site, Mountain Street & Broadway, Sydney.
Fig. 7: Context 390 (cesspit in use from the 1830s): KENS Site, Kent & Sussex Streets, Sydney

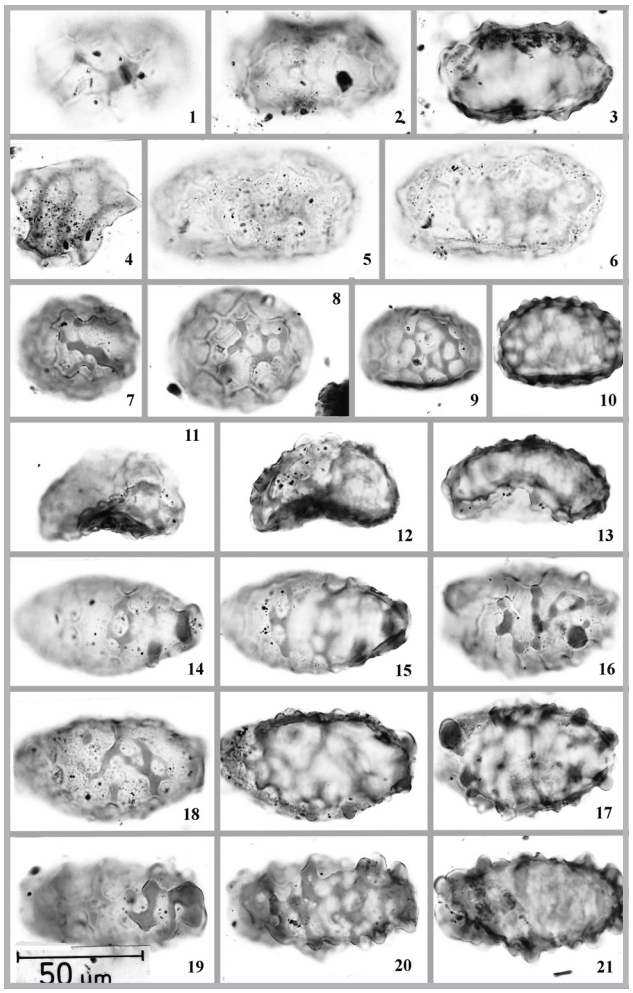

Plate 2: Morphological variation in Cloacasporites sp. gen. nov. (x 600 magnification)

Fig. 1: Irregular ellipsoidal specimen, context 33236 (cesspit): Room4, House 36 400 Spit 4, 50–72 Union Street, Pyrmont.
Figs 2–3: Irregular ellipsoidal specimen, context 3400 Spit 4 (cesspit): House 38/40, 50–72 Union Street, Pyrmont.
Fig. 4: Fragmented specimen, context 5583 (fill in flushing channel): Colonial Hospital Site, Parramatta
Figs 5–6: Large ellipsoidal specimens, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Convict Hospital Site, Parramatta.
Fig. 7: Subspherical specimen, context F–1186 (cesspit): 66 Howard Street, Quadrant development Site, Mountain Street & Broadway, Sydney.
Fig. 8: Subspherical specimen, context F–1013 (cesspit): 66 Howard Street, Quadrant development Site, Mountain Street & Broadway, Sydney.
Figs 9–10: Plano-convex specimen, context F–1013 (cesspit): 60 Howard Street, Quadrant development Site, Mountain Street & Broadway, Sydney.
Figs 11–12: Concavo-convex specimen, context F–1013 (cesspit): 60 Howard Street, Quadrant development Site, Mountain Street & Broadway, Sydney.
Fig. 13: Concavo-convex specimen, context 390 (cesspit in use from the 1830s): KENS Site, Kent & Sussex Streets, Sydney.
Fig. 14–18: Ellipsoidal specimen with pseudo-apertures at apices, context F–1013 (cesspit): 60 Howard Street, Quadrant development Site, Mountain Street & Broadway, Sydney.
Figs 19–21: Irregular ellipsoidal specimen with pseudo-apertures at apices, context G–2875 (upper fill layer in well): Quadrant Development Site, Mountain Street & Broadway, Sydney.

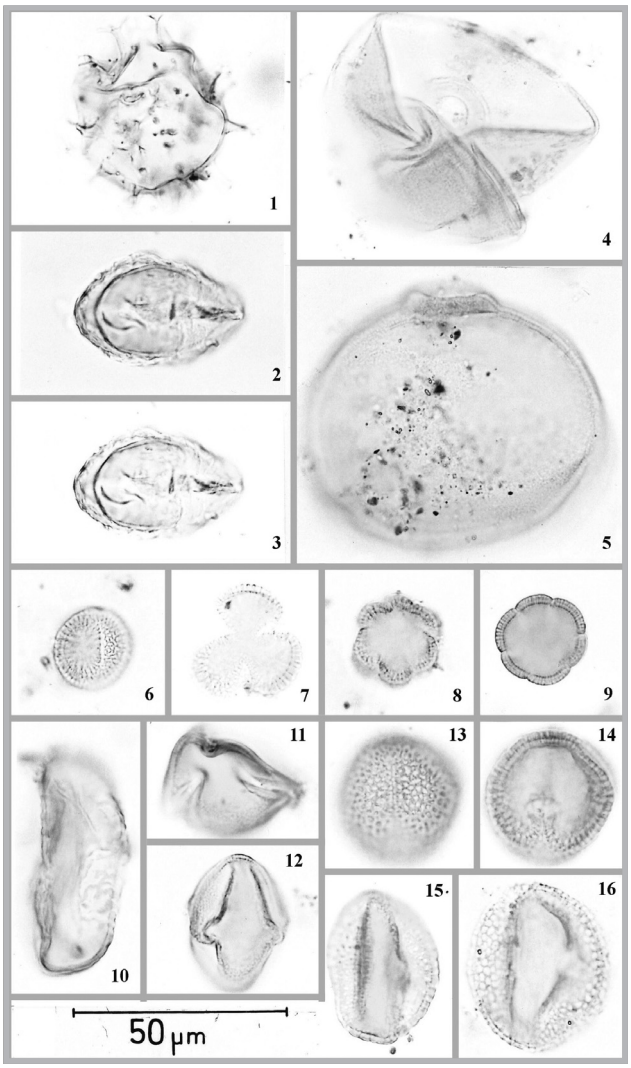

Plate 3: Algal cysts, spores and pollen recovered from archaeological sites in Parramatta

Fig. 1: Marine dinoflagellate (Spiniferites sp.), from mud enclosed within an Anadara shell, 16–18 Smith Street, Parramatta.
Figs 2–3: Quillwort (Isoetes drummondii) spore, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Colonial Hospitals Site, Parramatta.
Figs 4–5: Cereal (Poaceae) pollen, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Colonial Hospitals Site, Parramatta.
Figs 6–7: Crucifer (Brassicaceae) pollen, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Colonial Hospitals Site, Parramatta.
Figs 8–9: Mint (Mentha-type) pollen, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Colonial Hospitals Site, Parramatta.
Fig 10: Pea (Pisum sativum) pollen, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Colonial Hospitals Site, Parramatta.
Figs 11–12: Prunus (Prunus-type) pollen, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Colonial Hospitals Site, Parramatta.
Figs 13–15: Citrus (Citrus) pollen, context 6033 Spit 4 (cesspit): Blood Bank (Lot 99) Colonial Hospitals Site, Parramatta.

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APPENDIX 1

TAXONOMY

Incertae sedis

Genus: *Cloacasporites* n. gen.

Type species: *Cloacasporites sydneyensis* n. sp.

Derivation of name

From the Latin noun *Cloaca* 'a sewer', referring to the cesspit association.

Diagnosis

Inaperturate laterally biconvex monad characterized subsphaerical to ellipsoidal shape and flange-like rugulate sculptural elements which may coalesce to enclose subcircular to subangular lumina.

Comment

No comparable fossil palynomorph is known to have been described in the Cenozoic literature. To date the morphotype has only been recorded on historical archaeological sites in the Sydney region, in contexts associated with human sewage. The Type specimens have been lodged in the Palaeontological Type (CPC) Collection at *Geoscience Australia*, Canberra.

Cloacasporites sydneyensis n. sp.

Plate 1: Figs 1–8 & Plate 2: Figs. 1–21

Holotype

Geoscience Australia CPC 39787. Context 3400, spit 4 (cesspit): House 38/40, 50–72 Union Street, Pyrmont Slide 1 *England Finder* E31/4 (slide label on RHS of stage).

Type locality

Historical archaeological site, House 38/40, 50–72 Union Street, Sydney.

Derivation of name

From Sydney, the capital city of New South Wales, where the palynomorph was first recorded.

Description

Monad, quasi-isopolar, subspherical to ellipsoidal; aperture if any obscured; laterally biconvex to concavo-convex, amb elliptical to subcircular; wall not stratified c. 0.8–4 µm thick; reticulate-rugulate, sculptural elements varying in width and thickness, *ca*. 1–8 µm thick, weakly aligned longitudinally, coalescing to enclose subcircular to subangular lumina up to 16 µm in maximum diameter, or breaking down into irregular rugulae and verrucae; 52 (71) 84 µm x 30 (44) 56 µm (20 specimens measured).

Paratypes

1. *Geoscience Australia* CPC 39788. Context G–2875 (upper fill layer in well): Quadrant Development Site, Mountain, Street & Broadway, Sydney. *England Finder* co-ordinates G58/3 and U63/0 (slide label on RHS of stage); another co-ordinated specimens on the same strew mount occurs at P37/1.
2. *Geoscience Australia* CPC 39789. Context 390 (cesspit in use from the 1830s): KENS Site, Kent & Sussex Streets, Sydney. *England Finder* co-ordinates T35/1 (slide label on RHS of stage). Another co-ordinated specimen occurs at T43/0 on the same strew mount.

Affinity

Unknown; presumed to be the egg case of an unidentified parasite.

Known distribution

Parramatta: Colonial Hospital Site, Parramatta Justice Precinct, Lot 99 (Blood Bank) Context 6033 Spit 4 (cesspit), Hosp. 2 Area Context 5583 (flushing channel of privy).

Sydney: Family Court Site, Goulburn Street (cesspit?), KENS Site, Kent & Sussex Sts. Contexts 390 (cesspit), 454 (cesspit?), (cesspit), 1611 (drain), surface of twentieth-century yard; Quadrant Development Site, Broadway, Contexts F–1013 (cesspit 60 Howard St.), F–1186 (cesspit 66 Howard St.), G–2875 (well infill); Transgrid Site, Haymarket, -78 cm AHD in clay pit; 64 Union St, context 3236 (drain infill).

DISCUSSION

All specimens recovered so far come from contexts such as cesspits and associated drains used for disposal of human sewage or contexts that are likely to have been contaminated with raw sewage. The latter include samples from a twentieth-century yard on the KENS Site in Sydney (spilled 'night soil'?) and a well in the yard of a demolished terrace house on the Quadrant Development Site, Broadway which appears to have been flooded by sewage backing up along Blackwattle Creek during storm and high-tide surges (J. Czastka pers. comm.).

The distinctive but morphologically variable palynomorph lacks an obvious aperture and is highly unlikely to be of plant origin. Specimens shown to medical colleagues could not be linked to any known human gut parasite (D. Woodward pers. comm.) and it is possible the host was one of the many animals eaten by humans during the Colonial period. The hypothesis is an attractive one since it also explains why *Cloacasporites* is found in most but not all of the cesspits analysed in Sydney. For the same reason, *Cloacasporites* is less likely to be recovered from the upper fill layers (usually yard-waste) in abandoned cesspits. If correct, then *Cloacasporites* may be useful as a proxy for butcher's meat in contexts where the other microfossil evidence of diet is centred on plant foods (Plate 3: Figs 4–16).