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'...lost in the *Sirius*...'? – Consideration of the Provenance of the Hatchet Head Recovered from the *Sirius* Wreck Site, Norfolk Island

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ABSTRACT. A ground stone hatchet head was found in the excavation of the *Sirius* which was wrecked off Norfolk Island in 1790. This paper explores the problems of establishing its ultimate origins, its cultural context and its historical significance. Historical, formal and petrological studies suggest a source for the raw material in the cobble beds of the Nepean River, New South Wales, and the inclusion of the hatchet head in a collection of 'curiosities' of an officer on the *Sirius*.

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An intriguing find from the recent underwater excavation of the *Sirius* wreck off Sydney Bay, Norfolk Island, was a stone hatchet head (SI 479). Its distinct form, size and raw material caught the eye of a diver working amongst the flint pebble ballast of Area I of the site (Fig.1). Many queries came to mind on examining this simple artefact when the excavation's director, Graeme Henderson, sent it to us for comment. It would have intrigued Fred McCarthy with his lifelong interest in stone artefacts. Indeed, one of his early papers discussed artefacts from Norfolk Island and possible pre-colonial occupation by Polynesian voyagers (McCarthy, 1934). He also spent many years studying the culture of Aboriginal groups of the Sydney District, as well as trade and exchange in wider Australian contexts. These themes are all relevant to the puzzle of this artefact's provenance; so it is a fitting topic for a volume honouring his contributions to Aboriginal studies.

The questions raised by this hatchet head (Fig.2) relate to its ultimate provenance and cultural context. How did this stone artefact become part of the archaeology of a late 18th century ship wrecked on an island that was uninhabited when the British occupied it in 1788? What were its origins? How did it come to be on board *Sirius* in March 1790? Should we accept without question that it *was* on board *Sirius* at that time? Several major options may be considered:

1. Given the find spot, associated with flint pebble ballast from the wreck of an English naval vessel recently re-fitted and ballasted in the Thames, the artefact could be a British Neolithic axe head which had become incorporated in Thames flint gravels.

2. The artefact could be Australian, an Aboriginal hatchet head, acquired by one of the ship's officers for his collection of 'artificial curiosities' or, alternatively, the possession of an Aboriginal person from Sydney

travelling on the ship.

3. The artefact could have been part of an officer's collection, but acquired in South Africa, India or South-East Asia. Many ships travelling to and from Australia called at the great trading centres of Asia and the Dutch East Indies, while the Cape was a major source of grain and livestock for the settlement of Port Jackson. At the end of 1788 the *Sirius* voyaged there to acquire urgently needed supplies.

4. The artefact could have been added to *Sirius'* ballast unintentionally at Port Jackson when she was refitted in 1789. At that time the 90 tons of shingle ballast were presumably dumped on the nearest shore; some local 'pebbles' or isolated artefacts could have been included on reloading. Given that several guns were left off at Sydney (thus lightening the ship) there could well have been instructions to add local stone to the shingle ballast. Testing of this hypothesis must await assessment of the stone ballast on the site, most of which has not been raised.

5. The artefact could be Polynesian, lost off-shore from a Polynesian canoe, or an archaeological witness to an earlier wreck. Its incorporation in the wreckage of the *Sirius* on the high energy shoreline of Sydney Bay could be purely coincidental. Sydney Bay is a likely landing place for any voyager. Polynesian artefacts and the bones of Polynesian rats have been found nearby at Emily and Cemetery Bays in recent archaeological studies (McCarthy, 1934; Specht, 1984:6-12; Meredith, Specht & Rich, 1985). In the late 18th century stone adzes were uncovered in the agricultural activities of the first settlement (King, 1791, 1792, 1793; Specht, 1984:12). Similar finds have been made since then elsewhere on the island (McCarthy, 1934; Specht, 1984:13-31). They are not surprising, as Polynesian visits were clearly possible given prevailing conditions of winds and currents (Irwin, 1989).

To test these various hypotheses, we must look to

Fig.1. A diver working on the flint pebble ballast of the *Sirius* wreck site. Photograph: Patrick Baker. Print kindly provided by Graeme Henderson.

historical evidence relating to the Port Jackson settlement and to the *Sirius* herself, as well as the artefact's intrinsic and extrinsic attributes, particularly the petrology of its raw material.

Examination of a Non-Australian Origin

To consider first the question of an English derivation: could the artefact be of an English Neolithic origin, incorporated in the Thames' prehistoric stone gravels, and so ultimately in the ship's stone ballast? Certainly, it would not be the first British prehistoric stone implement to reach a distant location and confuse archaeologists. Its features, however, are not those of a British axe-head of hard-rock, such as artefacts from the Langdale quarry or from Cornwall. Furthermore, it is not made from quarried rock but from a water-worn cobble.

The *Sirius* carried iron, shingle and coal ballast. Her iron ballast was in the form of blocks, weighing about 152 kg, laid down in the main hold before the shingle was set in place (in this case flint pebbles) followed by the coal. This ballast was all newly-set in place after the ship's major refit in England in 1786-1787. So she was not carrying remnants of ballast acquired on previous voyages. Considerable quantities of iron ballast and of flint pebbles were discovered in the excavation of the wreck site, including a substantial mound of iron blocks in Area 12 and flint pebbles in Areas 1, 2 and 3 (Henderson & Stanbury, 1988: chapter 9 and fig.1). Had the artefact's features been consistent with a British origin, its discovery in an area where ballast was concentrated could be seen as supporting this interpretation. Other materials associated with the hatchet head and the ballast were lead shot, together with bronze and copper pieces from the exterior of the lower hull.

Arguments for an Indian, Asian or African provenance must be tested against opportunities for the ship's officers to acquire such items, as well as against the artefact's archaeological attributes, including raw material. In her last voyages the *Sirius* visited Rio and Cape Town. A copper two-maravedi coin, dated 1774 and bearing the head of Charles III of Spain, was found on the wreck site in 1988; it may have been acquired in Rio or Teneriffe. So the possibilities are narrowed unless one of her officers had with him collections made on previous voyages, or acquired from someone on another ship recently arrived in Port Jackson. Given that the *Sirius* was wrecked early in the settlement's history, such opportunities were very limited indeed. The features of the artefact do not suggest an Indian or Indonesian provenance. Though there might be some similar petrologies in the hinterlands of Goa, the lithologies of the regions behind the major ports of Bombay or Madras are quite dissimilar to the pelitic hornfels of the *Sirius* specimen. However, *Sirius* did visit the Cape. The voyage there at the end of 1788 to obtain supplies was her last before sailing for Norfolk Island. Intervening months were spent in Port Jackson undergoing a much-needed overhaul. Archaeological specimens of edge-ground pebbles might have been available in Cape Town, as such artefacts do occur in the Wilton-related industries of Southern Africa. However, they are rare in these assemblages compared with more fully polished axe-heads (Sampson, 1975: 337, 418, 425), so the chances of acquisition are diminished. That they occur in archaeological deposits of some antiquity, and then only rarely, makes them rather unlikely curios to be available to avid collectors in the Cape Town of 1787/1788. They were not part of indigenous material culture at the Cape in the 18th century.

Discussion so far assumes that the artefact belongs to

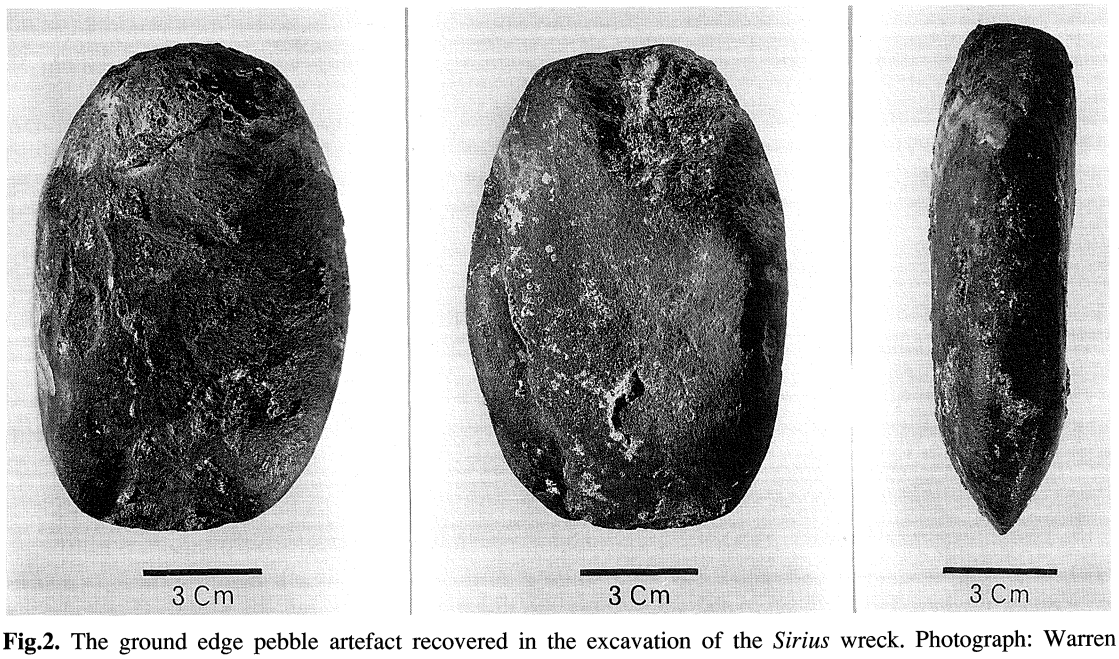

Fig.2. The ground edge pebble artefact recovered in the excavation of the *Sirius* wreck. Photograph: Warren Hudson.

the March, 1790 shipwreck, that it was on board *Sirius* when she struck the reef. This assumption could well be challenged raising possibilities of other non-Australian sources. The coastline of Norfolk Island around Sydney Bay is one of high energy. Movement of the *Sirius* between March, 1790 and February, 1792 is well documented, while there has been considerable dispersal of her timbers and contents since then (Fig.3). Items lost overboard in Sydney Bay before or after the wreck could well have become incorporated with material from the *Sirius*. However, the particular location of the *Sirius* wreck site is obviously dangerous and mariners normally would have avoided it. The landing place was some 250 metres westward.

Polynesian artefacts recovered from near Emily Bay and faunal remains in contexts dated about 900-1000 AD from Cemetery Bay, both not far from the *Sirius* wreck site, bear witness to earlier voyages. These have been investigated by Specht (1984) who also surveys the previous artefactual finds suggesting Polynesian visits in the past. The sinking of a canoe or casual losses could well have left a Polynesian adze on the sand or corals of the bay, later to become mixed with the material from the *Sirius* wreck. King, the settlement's commander, noted the presence of stone artefacts on the island. He was intrigued by their implication of earlier occupation, and reported them to Sir Joseph Banks (King, 1791, 1792, 1793; see also Collins, 1798:184). In 1792 he sent a 'stone axe' to Banks, its exact provenance uncertain but found by a 'reliable person'. Later arrivals could also have carried Polynesian stone artefacts to Sydney Bay; King brought some Maoris from New Zealand in 1792 to instruct the convicts in the arts of flax weaving. These male Polynesians were little-versed in such arts and were soon returned home. However, the attributes of the *Sirius* artefact differ substantially from those of Polynesian adzes known archaeologically or from 18th century collections (Shawcross, 1970; Shawcross & Terrell, 1966). The hypothesis of Polynesian origin and the artefact predating the *Sirius* wreck must be rejected.

Evidence for an Australian origin

Absence of positive evidence to sustain arguments for a non-Australian origin for the artefact leads us to examine those for an Australian provenance. We should then also ask how such a non-European artefact came to be on the *Sirius*. To whom did it belong? How had it been acquired? Historical, archaeological and petrological perspectives suggest some answers.

Assuming for the moment that the artefact is Australian (an Aboriginal hatchet head), let us explore the question of how it could come to be on *Sirius* when she struck the reef in Sydney Bay. The hatchet with its stone head was a vital part of an Aboriginal man's equipment for daily use, carried with his spears, spear-thrower and club. Does the presence of this piece of equipment then signal an Aboriginal presence on the *Sirius*? Certainly we have records of Aborigines visiting Norfolk Island, for example Bennelong and Bondel in 1791 (Collins, 1798:177).

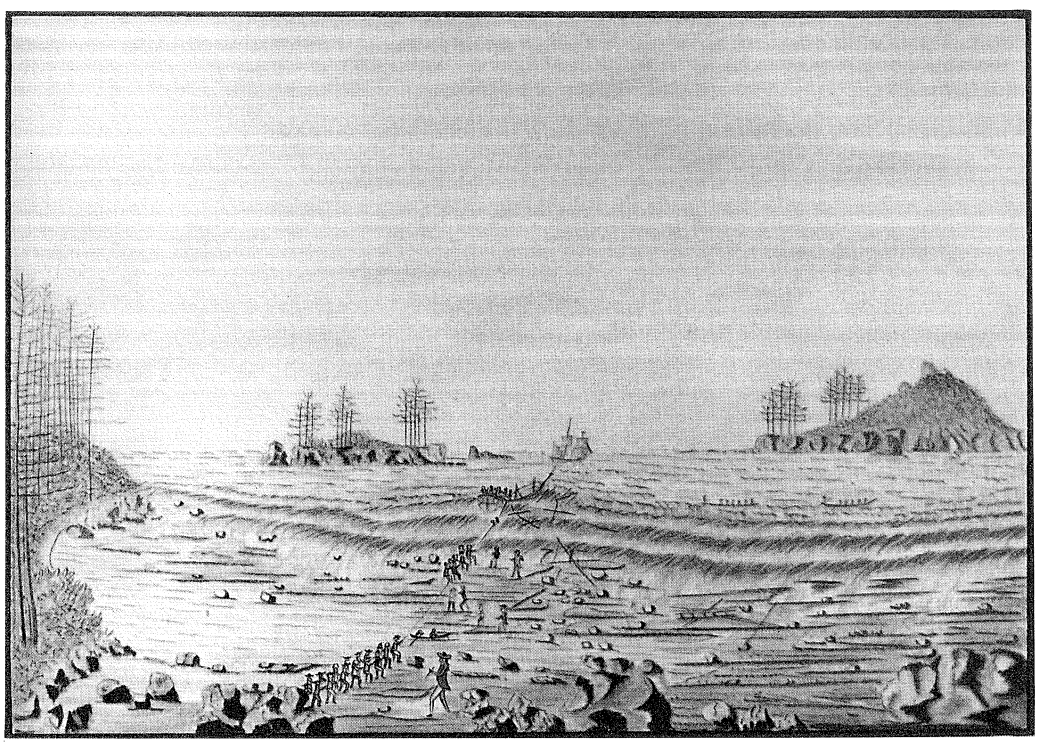

Fig.3. Salvaging equipment and stores from the wrecked *Sirius*, Norfolk Island, March 1790. This record by William Bradley, First Officer of the ship, shows the dispersal of items and the energy of wave action across the reef. William Bradley, Journal, March 1790. Reproduced by courtesy of the State Library of New South Wales.

Bennelong went again in April 1796, as did another, but un-named, 'New Hollander'. The island's Victualling Books (1792-1796) are our only record of these later visits.

The letters of Chapman, King's assistant, give us more details of Bennelong's visit (Chapman, 1791):

> ...one of the native has taken a fancy to go with us to Norfolk Island and yesterday morning brought all his spears and fish-gig, stone hatchet, bones for pointing his spears and his basket to be packed up for him. The governor is to give him two Nankeen dresses and white shirts and a trunk to keep [them] in which pleases him very much his name is Bennelong he is a very well behaved man he drank tea and supped with us last night at the governors.

So Aborigines did travel to Norfolk Island on English vessels, taking their equipment with them, including stone hatchets. But all recorded instances post-date the wreck of the *Sirius*. The *Sirius*' crew list does not record any Aborigines on board during the voyage to Norfolk Island.

In considering Aborigines and Norfolk Island, and the possibility of the artefact's deriving from later visits and only being fortuitously associated with the *Sirius* wreck, one must note two curious isolated finds from the island. These are two ground edge pebble artefacts (one is also hammer dressed) recovered from McCoy's property west of Slaughter Bay. On both form and raw material these could have an Aboriginal origin (see the discussion in Specht, 1984:18-29). Their dimensions are very close to those of the *Sirius* artefact (Specht, 1984:23). They are intriguing hints of an Aboriginal presence on the island in the period of early settlement from Sydney or of loss of some officer's collected 'curiosity'. Their form resembles that of the *Sirius* specimen, but their petrology is quite distinct.

Was the *Sirius* hatchet head then carried not as part of Aboriginal equipment, but in a collection of native tools and weapons made by one of her officers? The ships' officers and 'gentlemen' of the First Fleet were avid collectors of natural history specimens and 'artificial curiosities' (McBryde, 1989). When the artefact was located in the excavation it was not associated with the material from the stern cabins which would have housed the senior officers, those most likely to have such collections. This could be accounted for, however, by underwater movement of material across the site over time, while many personal items would have been displaced during the long period of salvage and scavenging before *Sirius* finally broke up (Fig.3). Of the First Fleet officers who have left us clear records of their collecting activities (Ralph Clark, Watkin Tench, Arthur Bowes Smyth, Newton Fowell, John White, Arthur Phillip himself), only Newton Fowell was on board the *Sirius* in March, 1790. He wrote to his father that in the wreck he lost documents and maps, as well as 'a very Valuable Selection of Birds which cost me a great deal of Trouble' (Fowell, 1790, *in* Irvine, 1988:131).

Other officers and crew members may well have held collections, including Aboriginal artefacts. As early as October, 1788 Phillip took strong measures to deter the stealing of Aboriginal weapons and tools to meet the demand from collectors among the crews of fleet transports and of passing vessels (Bladen, 1892:208; Phillip, 1789:139-140).

The loss of artefacts caused continuing resentment among the Aborigines of Port Jackson (Collins, 1798:13):

> ...the convicts were everywhere straggling about, collecting animals and gum to sell to the people of the transports, who at the same time were procuring spears, shields, swords, fishing-lines and other articles from the natives, to carry to Europe; the loss of which must have been attended with many inconveniences to the owners.

There were probably several such collections in the officers' quarters of the *Sirius*. The long stay in Port Jackson for repairs after the voyage to Cape Town increased opportunities for their acquisition. Testing against available historical evidence, we certainly cannot reject the hypothesis that our artefact was part of such a collection, acquired by an officer in some personal exchange with a Port Jackson Aborigine (Fig.4).

Thus, acceptable historical explanations exist for the presence on *Sirius* of an Australian hatchet head from the Sydney district. Can we take this further than historical probability? Are there additional clues in the features of the artefact itself? How do its attributes match up against those of other Australian examples? We shall look at its dimensional, formal and functional features

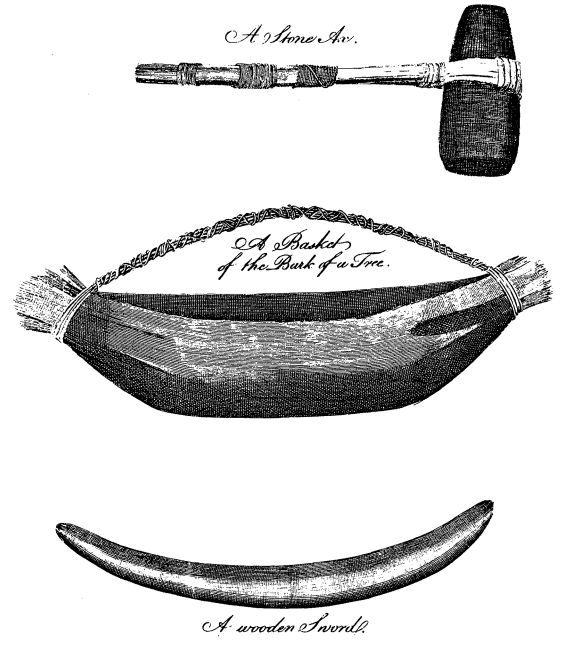

Fig.4. Illustration in The Voyage of Governor Phillip to Botany Bay, 1789 (plate opposite p.136) showing Aboriginal artefacts of the kind collected by officers of the First Fleet. The hatchet may well have been one of those given to Phillip by Aborigines met while exploring near Richmond Hill. It seems to be made on an unmodified pebble preform with features similar to those of the *Sirius* find. Reproduced by courtesy of the State Library of New South Wales.

as well as the petrology of its raw material, likely to be a diagnostic attribute.

Comparison with Relevant Collections

The hatchet head is made on a cobble preform given minimal modification (Fig.2). The removal of a few flakes from one surface has shaped the butt and the bevelled working edge is clearly ground; manufacturing striations are still visible. The grinding extends back from the cutting edge into the second quarter of the artefact's length. The edge is slightly curved in plan shape, has an edge angle of 78°and shows some edge damage (abrasion and tiny flake scars). Symmetrical in profile, it displays a slight skew in plan view which may indicate re-sharpening at some stage in its use-life. The butt is slightly curved. In section the artefact is an irregular flattened oval, the shape of the original cobble. Its dimensions are: length 11.4 cm, width 7.6 cm, and thickness 3.5 cm.

Pitting on one surface indicates hammer or anvil use, and there are traces of a resinous material, probably the medium used to retain the wooden haft. These have been analysed and reported on by David Kelly of the Western Australian Museum (Henderson & Stanbury, 1988:144). The raw material is a spotted pelitic hornfels; its specific characteristics are discussed in detail below.

Is this combination of attributes sufficient to identify the artefact as Australian? Could one further say there are characteristics of hatchet heads from the Sydney district? Is there a distinct aggregate of features specific to the Sydney District? The *Sirius* artefact is a very unelaborate piece; the modification of the natural cobble preform is functionally oriented, confined to creating the bevelled edge and shaping the butt. The needs of size, shape, weight and balance were met in the selection of the cobble itself. The artefact lacks features that could be interpreted as distinctive, that might be indicative of regional or local stylistic conventions. Its attributes could well be functionally determined, of a kind duplicated whenever and wherever that combination of particular edge shape and angle with body-size, weight and form is needed for a specific range of cutting or chopping tasks. Such edge ground pebbles, like the unifacially flaked pebble chopping tools, constitute a difficult category of artefact with which to play the games of provenance allocation, whether geographical or cultural. However, as with flaked pebbles, within the broad similarities there may be some minor discriminating features, so comparisons could be useful. They may indicate, of course, only that the *Sirius* artefact falls within a locally preferred range of features and not suggest any certain provenance.

To assist comparison, some general features of edge ground artefacts from locations in south-east Australia are presented here (Table 1, Appendix). The choice of pebble or cobble as convenient preform is prevalent in many coastal localities of eastern Australia, especially in northern New South Wales and eastern Victoria, so the comparative collections are chosen from these areas as well as the Sydney Basin.

For interest, Table 2 (Appendix) shows dimensional data for two inland assemblages (one from Victoria and one from New South Wales) in which ground edged artefacts made of quarried stone dominate, most of them shaped by bifacial flaking of a core or thick flake preform. These artefacts are consistently smaller than the coastal pebble ones.

Comparing the features of one specimen with those of an assemblage calls for caution, the more so when the artefacts concerned are poorly differentiated and share many attributes. However, there are characteristics of the collections of ground-edge artefacts which seem to distinguish those of the Sydney Basin from collections of north-eastern New South Wales. The latter are larger, are more extensively shaped by flaking before the edge is ground, while the grinding extends over more of the blade's length than is usual in our sample of hatchet heads made on pebble preforms from the Sydney Basin. Certainly the *Sirius* artefact falls easily within the range of attributes commonly represented among collections studied from Emu Plains/Richmond and the Sydney district. One could not claim, however, that it show features found only on artefacts from the Sydney Basin, nor that its features are absent from artefacts of north-eastern New South Wales or south-eastern Victoria.

Historical and Field Evidence from Emu Plains/Richmond, NSW

If the artefact's dimensional and formal characteristics are consistent with a Sydney District or Richmond provenance is there any way of testing this further? Could its raw material be specific to a particular location? The spotted pelitic hornfels of which the *Sirius* hatchet head was made is often referred to in early geological literature for the Sydney Basin as 'spotted altered claystone' (Dickson, personal communication) which is noted as a common raw material for ground edge artefacts (Liversidge, 1894). Such rocks do not outcrop in the Sydney Basin itself, but are found as cobbles in river gravels on its western margins, for example, those of the Nepean/Hawkesbury system between Emu Plains and Richmond (Ross, 1976). They presumably come from volcanic contexts in the mountains to the west. The gravels in which they occur may derive from geological contexts of considerable antiquity, pre-dating present river systems. Liversidge commented (1894:233):

> The pebbles of spotted altered claystone, from which many of the weapons have been made, were probably brought from the old river bed cut by the road and railway at Lapstone Hill, Emu Plains; the source of this rock is not known.

Historical evidence becomes relevant here. In the first decade of European settlement exploration centred on the Hawkesbury, given the need to map areas beyond Rose

Hill and to locate desperately-needed arable land. For the expeditions of April and May, 1791, Richmond Hill (Fig.5) was a focal point, being a readily-identified land mark at the upper limit of tidal effect in the river accessible by boat from Broken Bay. Hunter's exploration of 1789 had reached this point. There, Bradley records (July 1789, in 1969: 170):

> ...they got into a very shoal water with very large hard stones (of which the Natives make their hatchets etc) and at the beginning of the falls, they found themselves at the foot of a hill which they ascended...the Governor named it Richmond Hill.

In the April 1791 expedition Philip and his party met with a group of Aborigines in this area (Hunter, 1793:519-520; *cf.* Tench, 1961:228, 234). Colebe and Balloderree, their Aboriginal guides, questioned one old man and from his answers respecting the river '...concluded they had come this journey in order to procure stone hatchets from that part of the river near Richmond Hill...'. Parting from this group Phillip was given two stone hatchets and other implements; he reciprocated with gifts of beads, fish hooks and two small metal hatchets. The Aborigines were said to belong to an inland group distinct from the coastal clans, but the incident suggests that linguistic communication was relatively easy in spite of tensions between coastal people and these inland 'climbers of trees' who lived by hunting. This evidence would give historical support to arguments in favour of a source for the *Sirius* artefact's raw material in the Nepean gravel beds near Richmond Hill.

Such arguments need testing in the field. Accordingly, we visited the Emu Plains/Richmond area to ascertain whether cobble beds still existed in that stretch of the Nepean, and whether they contained spotted pelitic hornfels similar to that of the *Sirius* artefact. We examined and sampled the cobble beds exposed along the Nepean at three locations: near Richmond Hill, at the confluence of the Grose and at Emu Plains (Figs 5-8). We sampled the northern and southern extremes of the area indicated as significant by the historical sources, and by archaeological work in the area undertaken by McCarthy in the 1930s and more recently by Kohen and Stockton. It also seemed important to check the confluence of the Grose, a major stream whose gravels could well contain relevant lithologies. Shaws Creek, to the south, seemed unlikely to be an important source as most of its gravels derive from sandstone areas (Kohen, Stockton & Williams, 1981; Kohen, Williams & Stockton, 1984). The Nepean beds contain both pebbles and cobbles ranging in size from 4 cm to 38 cm. They include relevant material in terms of both the lithologies represented and the shape and size of the cobbles. No evidence of artefact manufacture was noted in the immediate vicinity of the areas sampled. However, given the changes in the local environment as well as in stream flow over the last 200 years, this would not be unexpected. Yet extensive surface stone-working sites were recorded by McCarthy in the 1930s, four near Emu Plains and one at Castlereagh where knapping evidence was exposed along both banks of the river for nearly a kilometre (McCarthy, 1948) (Fig.5). Recently rock shelters at Shaws Creek near its confluence with the Nepean at Castlereagh have been investigated by Kohen (Kohen, Stockton & Williams, 1981; Kohen, Williams & Stockton, 1984) (d on Fig.5). Edge-ground artefacts were recovered in the excavation, their raw material identified as basalt.

Petrology of the *Sirius* Hatchet Head

In hand specimen the hatchet-head is dark green to black, very fine-grained and weakly layered. Petrologically the rock from which the artefact was made is a fine-grained spotted pelitic hornfels, characterised by small clots, predominantly of cordierite, which are not evident on the dark broken surface. The cordierite-rich spots are up to 0.5 mm across and form at least 40% of the rock. Dust-like aggregates of red and brown rutile and spinel are enclosed within the cordierite clots. Flakes of colourless muscovite and green biotite and chlorite are randomly dispersed between the cordierite clots. Small sub-angular quartz clasts, less than 0.3 mm in diameter, are disseminated throughout the rock and indicate its previous sedimentary origin. Slivers and fine granular clusters of magnetite occur in accessory amounts. The hardness of the stone is attributed to the fine grain size and to the strong fabric; it is a product of the recrystallisation of the pre-existing clay minerals in the sedimentary rock.

Based on the mineralogy of the hatchet head and assessing the variability of elemental abundance and mineralogy found in pelitic hornfelses (Joyce, 1970), the cobble from which the artefact was fashioned was eroded out of rocks located in the outer parts of a contact metamorphic aureole.

Possible Source Rocks

Fine-grained pelitic hornfelses do not outcrop in the vicinity of Sydney Cove, where the *Sirius* anchored, nor on the North Shore where she underwent lengthy repairs, but they are found at Hartley (near Lithgow), and in the gravels in the Cranebrook Terrace of the Nepean River (Fig.5). To the south of Hartley, in the valley of the Cox's River (which flows into the Nepean-Hawkesbury River system south of Emu Plains), basic igneous rocks intrude the Bathurst Batholith and surrounding rocks (Vallance, 1969:191). Cordierite-quartz-biotite hornfelses are abundant in the aureole rocks of the Bathurst Batholith (Joplin, 1973:42).

The Cranebrook Terrace was formed largely during an episode of exceptional fluvial activity in the Wollondilly-Nepean Basin prior to the last glacial maximum (Nanson, Young & Stockton, 1987). Cobbles and pebbles were transported from hinterland sources,

most probably down the Cox's River, and deposited over a braid plain close to the Nepean Gorge by a river with a much greater and more variable flow rate than the present Nepean River. Thick basal gravels were deposited until 40,000 years ago when the flow regime changed and the river became laterally very stable (Nanson, Young & Stockton, 1987).

Pyroxene gabbro and granite porphyry cobbles, similar to those in the intrusive bodies near the Cox's River, dominate the gravel beds along the Nepean-Hawkesbury Rivers. Various pelitic hornfelses also make up a substantial proportion of the rock types in the gravels; these are most probably derived from the aureole of the Bathurst Batholith.

In addition to pelitic hornfelses, rock types found in the gravels on the Terrace include rhyolite, brown chert,

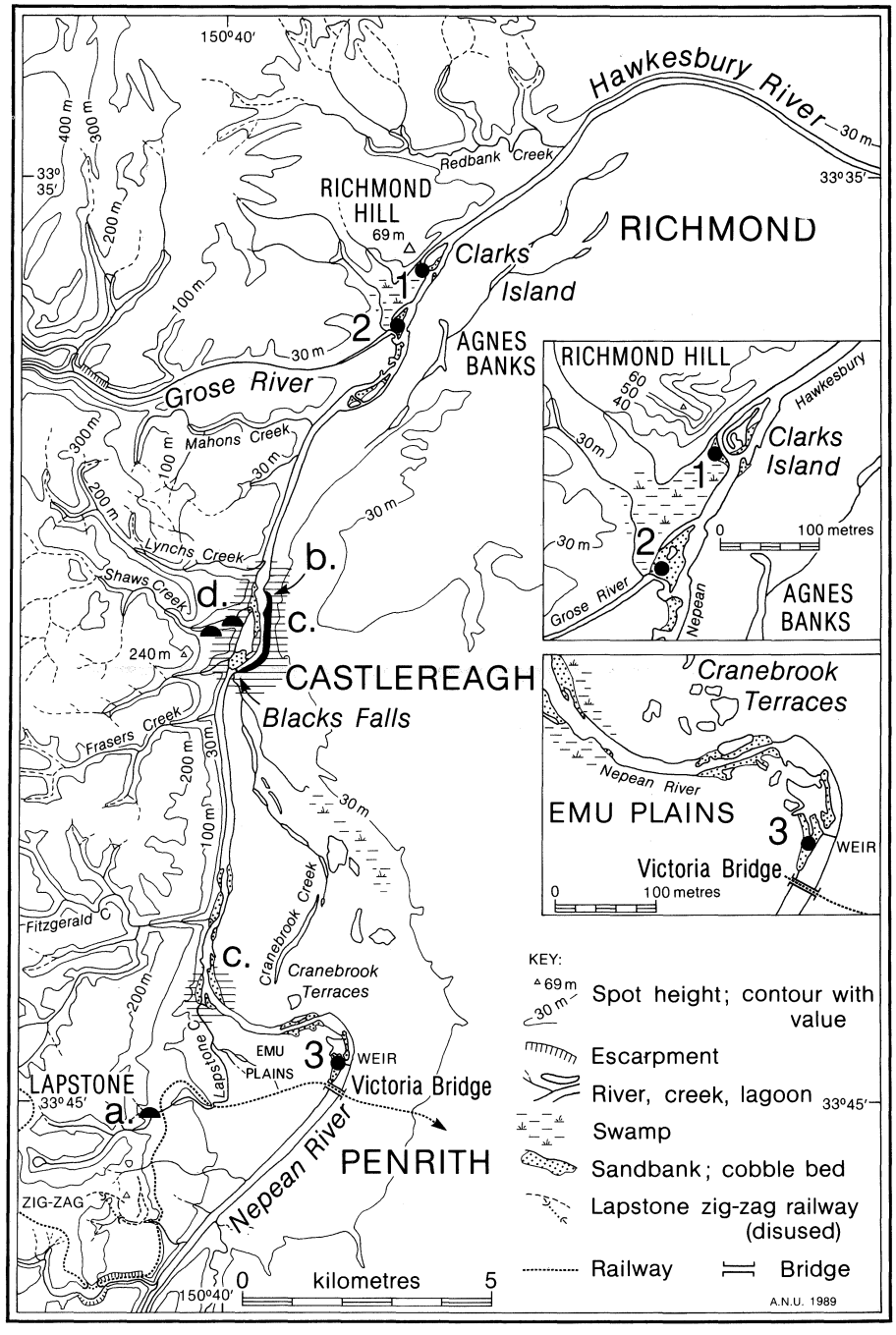

Fig.5. The Nepean/Hawkesbury between Emu Plains and Richmond. The hatched areas indicate locations on which McCarthy recorded surface sites in his surveys. Locations 1, 2 and 3 are those on which cobble beds were sampled in field work for this paper. a: Lapstone Creek rock shelter; b, c: Area of surface sites and grinding grooves recorded by McCarthy; d: Shaws Creek rock shelters investigated by Kohen, Stockton and Williams.

dacite, quartzite, ignimbrite and siliceous mudstone (Nanson, Young & Stockton, 1987). Samples of pelitic hornfels collected from the Terrace below the weir on the Nepean River, west of Penrith (location 3 on Fig.5, see also Fig.8) at the confluence of the Grose and Nepean Rivers (location 2 on Fig.5, see also Fig.7) and from 'Belmont Park' on the river just south of Richmond Hill (location 1 on Fig.5, see also Fig.6) were petrologically examined and compared with the hatchet head from the Sirius.

Petrology of Pelitic Hornfels from Gravels along the Nepean-Hawkesbury

Spotted quartz-cordierite-biotite-magnetite-graphite hornfelses in the gravels below the weir near Penrith (location 3 on Fig.5) have a distinct grey-brown cortex with small indentations where the underlying mineral clots have been preferentially weathered. Broken surfaces are dark green to black but the spots are not usually visible until examined under a microscope. Contact metamorphism of carbonaceous silty shale formed the ovoid shaped clots of cordierite. Sieved through the clots are small flakes of biotite and graphite and granular magnetite. Small flakes of brown green biotite are also developed in clusters between the cordierite clots. Anhedral magnetite grains are scattered evenly throughout the rock. Graphite flakes are less than 0.1 mm in diameter and are concentrated near cleavage and strain planes.

At the confluence of the Grose and Nepean Rivers, (location 2 on Fig.5) the spotted pelitic hornfels contains cordierite, chlorite, muscovite, quartz and magnetite. Clots of cordierite also contain accumulations of fine-grained magnetite crystals and are bounded by flakes of green-brown chlorite.

Further downstream on the Hawkesbury River, near 'Belmont Park' below Richmond Hill (location 1 on Fig.5) the dark spotted pelitic hornfels looks most like the *Sirius* hatchet head. It is composed of intergrowths of biotite and muscovite flakes and opaque minerals developed within cordierite porphyroblasts. The matrix of the rock is characterised by quartz, muscovite and biotite. Accessory magnetite is randomly scattered through the rock as equant euhedral crystals. The degree of contact metamorphism shown by the excellent habit

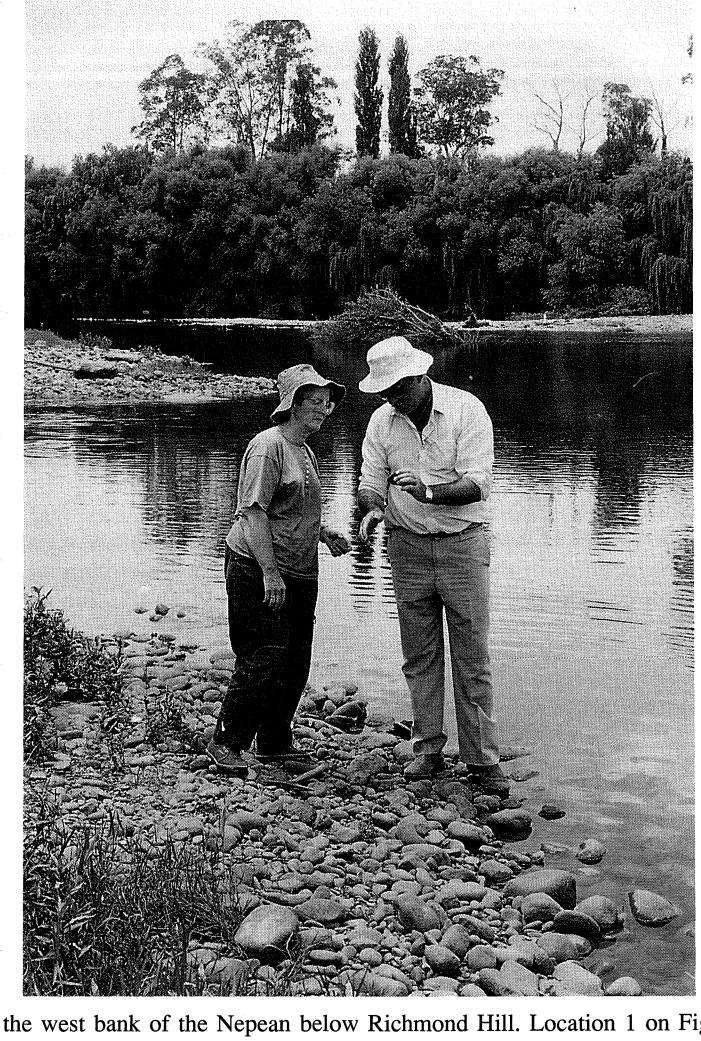

Fig.6. Cobble bed on the west bank of the Nepean below Richmond Hill. Location 1 on Figure 5. Photograph: Isabel McBryde.

of magnetite crystals is slightly higher than that of the other gravel specimens and of marginally higher grade than that the *Sirius* hatchet-stone.

Discussion of the Petrological Evidence

The petrology of the spotted pelitic hornfelses examined from the gravels between Penrith and Richmond does not precisely match the texture and mineralogy of the *Sirius* artefact. The differences are both textural and mineralogical. The size, shape and composition of the clots, though similar in all specimens, are not identical to those of the *Sirius* hatchet. Accessory rutile and spinel are developed in the cordierite clots, and the *Sirius* hatchet contains small amounts of sub-angular quartz clasts. Though the comparison is not exact, the samples share similar geological environments of formation and they may all be derived, therefore, from the same general proximity in the Cox's River Valley, which is the nearest probable source.

An exact likeness between the *Sirius* artefact and the pelitic hornfels in the gravels is not expected because

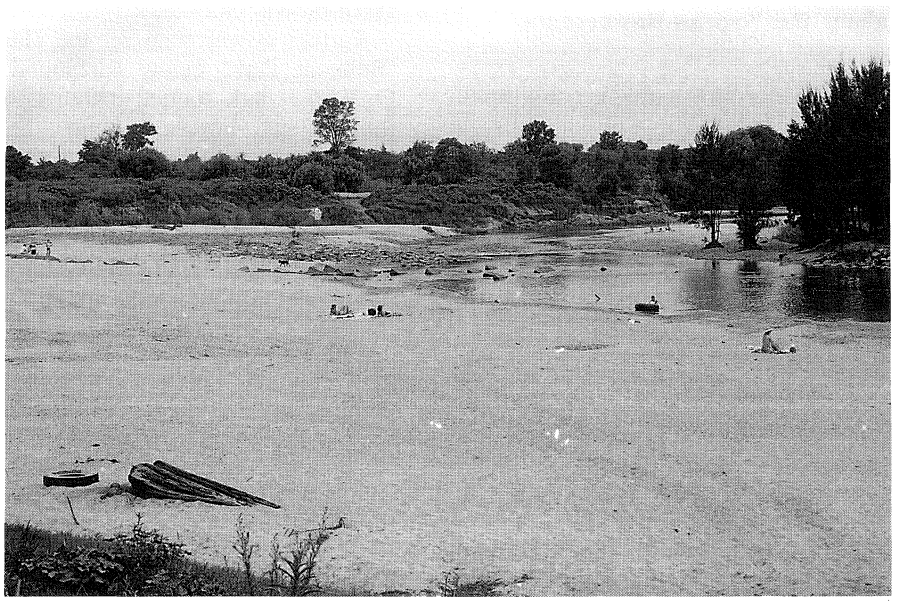

Fig.7. Confluence of the Grose and Nepean Rivers with extensive areas of sand and gravels. Location 2 on Figure 5. Photograph: Isabel McBryde.

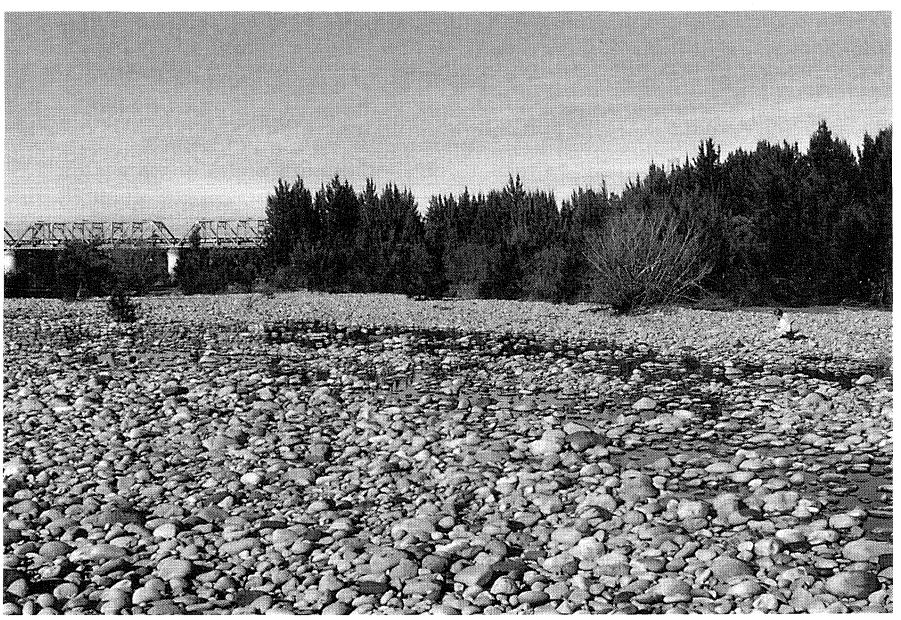

Fig.8. Extensive cobble beds on the western bank of the Nepean at Emu Plains. Location 3 on Figure 5. Photograph: Isabel McBryde.

of the limited sampling from the extensive deposits of gravel, and because the mineralogical and textural range of naturally-occurring pelitic hornfelses is diverse. Spotted pelitic hornfels which develops in aureoles around large intrusive bodies, such as granite batholiths, will consequently have textures and mineralogies which reflect not only the conditions of contact metamorphism but also the original chemistry of the country rocks. Either cordierite or staurolite will be the main porphyroblastic (clot) mineral formed depending upon the aluminium and silica content of the original shale or siltstone. Iron, titanium and potassium in the original sediments will be concentrated in the resulting contact metamorphic minerals such as magnetite, rutile, spinel, muscovite and biotite. The range of potential pelitic hornfelses around the margins of a single intrusion is therefore highly variable, especially if post-contact metamorphic alteration processes, such as retrogressive metamorphism, and metasomatism, have locally controlled the final mineralogy and texture.

As the *Sirius* anchored at Rio de Janeiro and Cape Town on her way to Botany Bay and as the officers may have had contact with those of ships which had visited India, the possibility of the artefact's being derived from these sources needs to be considered from a geological point of view.

It seems unlikely that the artefact was collected from the hinterland of Rio de Janeiro because the igneous and regional metamorphic rocks found there are of higher grade than the *Sirius* pelitic hornfels (Campos, Ponte & Miura, 1974). On the other hand, contact metamorphism is associated with the Cape granites in the vicinity of Cape Town, South Africa. Dense hornfels, slates and argillaceous rocks have developed spotted appearances due to the formation of patches of cordierite (Truswell, 1970:97). It is possible, on geological grounds, for the *Sirius* artefact to be derived from a South African source even though the cordierite clots are often or entirely replaced by micaceous minerals. Samples of hornfels from the aureole of a Cape granite have not been examined petrologically. However, as pointed out earlier in this paper, there is little anthropological evidence to support the proposition that the hatchet head is of South African origin.

In southern India, near the ports of Madras and Goa, the rocks are of the Dharwar Formation and predominantly comprise hornblende, chlorite and mica schists with lesser occurrences of mudstones, argillites, phyllites and schists containing kyanite, staurolite, cordierite and graphite (Pascoe, 1973). Favourable geological environments in which pelitic hornfels could form are found in the western parts of southern India. Gneissic, granulitic and charnockitic rocks, all of higher metamorphic grade to pelitic hornfels, and therefore containing different minerals and textures, are developed on the eastern side of the continent.

Hatchet heads in southern India especially from near Bombay, are more likely to be manufactured from basaltic and doleritic dykes and flows and fine-grained regionally metamorphosed rocks, as these are much more common than the possible localised occurrences of pelitic hornfels. Samples of Indian hornfelses have not been examined but there seems to be reasonable evidence, from the general geology of southern India, to suggest that it is most unlikely that the *Sirius* artefact was collected from India. So, except for the remote possibility of the hatchet head being derived from outcrops near a Cape granite in South Africa, the most probably source rocks are the gravels along the Nepean-Hawkesbury River.

Conclusion

Historical, formal and petrological studies all strongly suggest a source for the raw material for this artefact in the cobble beds of the Nepean River between Emu Plains and Richmond Hill. They also suggest that the hatchet head once formed part of the collection of 'curiosities' of an officer on the *Sirius*. It is an unexpected and intriguing find from an 18th century naval wreck. Yet the artefact has more than just curiosity value as posing an archaeological puzzle; there is also significant symbolic value. It testifies to traditional patterns of technology and the acquisition of raw materials in inter-group exchanges by Aboriginal people of the Sydney Basin. For if this artefact had not been acquired directly from the Aborigines of the Nepean/Hawkesbury but in exchange with a Sydney District Aborigine, then it had already been part of an exchange between members of Eora clans of Port Jackson and the Dharug of the Cumberland Plain. It further symbolises the patterns of contact between Aborigines and the officers of the First Fleet, contact in which exchanges of artefacts, services and food were important to both parties.

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Table 1. Attributes of edge-ground artefacts from coastal regions of south-eastern Australia.

Collections	1	2	3	4	5	6	7
	Sydney District (Liversidge, 1894)	Emu Plains/ Richmond (National Museum of Australia)	Emu Plains/ Castlereagh (McCarthy, 1948)	Lapstone Creek Rockshelter 'Eloueran levels' (McCarthy, 1948)	Tarwin (South-east Victoria) (McBryde Greenstone Project)	Richmond River (northern NSW) (Binns & McBryde, 1972)	Clarence Valley (northern NSW) (Binns & McBryde, 1972)
ATTRIBUTES							
DIMENSIONS (in cms)	n = 17	n = 10	n = 266	n = 9	n = 18	n = 37	n = 22
(i) Length							
mean	12.19	10.99	N/A	11.83	13.48	13.59	13.25
standard deviation	4.45	1.89		1.79	3.40	2.59	3.85
range	8.1 - 24.6	7.7 - 12.7	8.0 - 20.0	9.0 - 13.0	9.6 - 19.8	7.2 - 18.0	10.0 - 20.9
(ii) Width							
mean	7.69	7.58	N/A	7.5	8.05	9.75	9.02
standard deviation	1.38	1.04		1.25	2.24	2.2	2.36
range	5.4 - 10.3	6.5 - 9.6	6.0 - 14.0	6.0 - 9.5	4.9 - 11.9	4.6 - 15.9	3.8 - 15.8
(iii) Thickness							
mean	3.16	2.78	N/A	2.72	3.73	3.7	3.01
standard deviation	1.04	0.72		0.62	0.89	0.73	0.92
range	1.6 - 5.7	1.6 - 3.8	1.25 - 4.0	2.0 - 3.0	2.5 - 5.7	2.0 - 5.2	1.5 - 5.2
EDGE ANGLE		n = 9					
mean	N/A	73.4	N/A	N/A	N/A	N/A	N/A
standard deviation							
range		68 - 80					
FORM/MODIFICATION	n = 17	n = 10	n = 279	n = 9	n = 20	n = 37	n = 22
Hammer dressed	2(2)*	1(1)	7(0)		4(3)	–	–
Unmodified	8(8)	4(4)	130(130)	5(5)	4(4)	5(5)	7(7)
Unifacially flaked	–	1(1)	84(84)	1(1)	5(5)	11(11)	11(11)
Bifacially flaked	2(2)	4(4)	52(52)	2(1)	5(1)	20(14)	4(4)
Grooved	–	–	4(0)		–	1(0)	–
Other	5(0)	–	2(0)	1(1)	1(0)	–	–
No data	–	–	–	–	1(1)	–	–

Table 1 (cont'd).

	1	2	3	4	5	6	7
EXTENT OF GRINDING (over surface length in quarters)	n = 17	n = 10			n = 18	n = 37	n = 22
First	10	5	N/A	N/A	7	6	7
Second		3			4	17	10
Third						12	5
Fourth						2	
No data or N/A	7	2			7		1
PETROLOGY	n = 17	n = 10	n = 279		n = 20	n = 37	n = 22
	Liversidge notes that 14 specimens were made of 'spotted altered claystone'.	Six of these made of spotted pelitic hornfels.	McCarthy notes that hornfels is the material favoured for production of large implements (edge ground artefacts and flaked pebble choppers).	N/A	Pebbles of basalt and other lithologies used. A few exotic greenstones represented.	A wider range of lithologies than in the Clarence collections. 37.8% however are of the greywackes used in the Clarence, presumably acquired by exchange.	54.5% made of greywacke cobbles derived from north-east Tableland outcrops available in the gravels of the Clarence and its tributaries.

* NB. Figures in brackets indicate number of examples included that are made from pebble preforms rather than quarried stone material.

Table 2. Dimensions of two inland assemblages from south-eastern Australia in which ground-edged artefacts made of quarried stone dominate (in centimetres).

	*Albacutya (Vic)** n = 35	*Combaning (NSW)* * n = 36
Mean length	9.72	11.5
Standard deviation	2.05	2.98
Range	6.0 - 13.6	7.0 - 17.2
Mean width	7.02	6.9
Standard deviation	0.81	1.4
Range	5.3 - 8.4	4.6 - 10.2
Mean thickness	3.47	3.9
Standard deviation	0.77	1.28
Range	2.0 - 4.9	2.2 - 8.6

* Data derived from I. McBryde, Greenstone Project.

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