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Studies from Melanesia in Honour of Robin Torrence

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The Cylindrical Stone Adzes of Borneo

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Abstract. This paper provides a descriptive review of a class of stone tools from the interior highlands of Borneo that are formally defined in this paper as 'cylindrical stone adzes.' The implements discussed are all housed in the archives of the Sarawak Museum in Kuching, Malaysia. They form part of an ethnographic and archaeological collection that was largely compiled by Tom Harrisson during his tenure as Curator of the Sarawak Museum from 1947 to 1966. These tools have been described and discussed in previous publications and I add detail to these descriptions that includes a technological and functional assessment. The results of this study show that these tools are a type of hafted stone adze used to process the starchy pith of sago palms. These tools were not in use during the historic period and may have been abandoned within the early first millennium AD, associated with a decline in the role of sago as a food staple.

Introduction

This paper provides a review and discussion of a category of stone tools unique to the highland interior of Borneo that have been variously classified as specialised tools for processing sago (Collings, 1949; Harrisson, 1951a, 1951b), or as tools for cracking hard-shelled nuts (Sellato, 1996). Amongst the indigenous communities of the Borneo highlands, these implements are frequently classified as *batu perahit*, 'thunderstones' or 'dragon's teeth' (Janowski and Barton, 2012): items that have not existed in the living memory of these communities, but have now re-entered the human realm, imbued with supernatural agency and referred to by the Kelabit and Lundayeh people as *lalud,* or life force (Janowski and Barton, 2012; Janowski, 2020). As an object with a living history, some of these tools have been all of these things at one time, or, in their current role, one thing in all times. As museum objects they rarely see the light of day and live on catalogued into obscurity. It seems fitting then, in this volume, to tackle the complexity of these object biographies and to bring these items into full publication for the first time.

The tools discussed here were collected in the field by Tom Harrisson (the original curator of the Sarawak Museum from 1947 to 1966) or sent to the museum on his request (Harrisson, 1951a). At the time of their collection, locals who discovered them had no knowledge of their age or function and regarded them as items created by spirits or natural forces in past times (Janowski and Barton, 2012; Janowski, 2020). These tools are polished, tapered cylinders of stone with a smooth concavity or cup at one end, and a flat, rounded or ridged decoration on the butt (Fig. 1A–D). They vary in size up to 184 mm and 178 mm in total length (Fig. 1A,B). All tools are relatively consistent in their girth (c. 36 mm), ranging between 39 to 54 mm at the cup end. A feature of the entire assemblage is the consistency of their cylindrical shape and their smooth exterior finish (Fig. 1A,B). Most of the tools are fashioned from quartzite, a raw material known to outcrop on the fringes of the upland regions (Harrisson, 1949: 134). A few are made from igneous stone, outcrops of which occur on the southern extremes of the highland region. All pieces in the study sample are well made, with many hours in their initial shaping and final smoothing. They are so well done, that it is not possible to determine what the initial tool blanks were. Did they begin their journey as tools from elongate pebbles? Hand-hewn from larger blocks of stone? That part of their lives remains a mystery.

Keywords: Borneo; stone adzes; swamp sago; hill sago; usewear studies; residue studies
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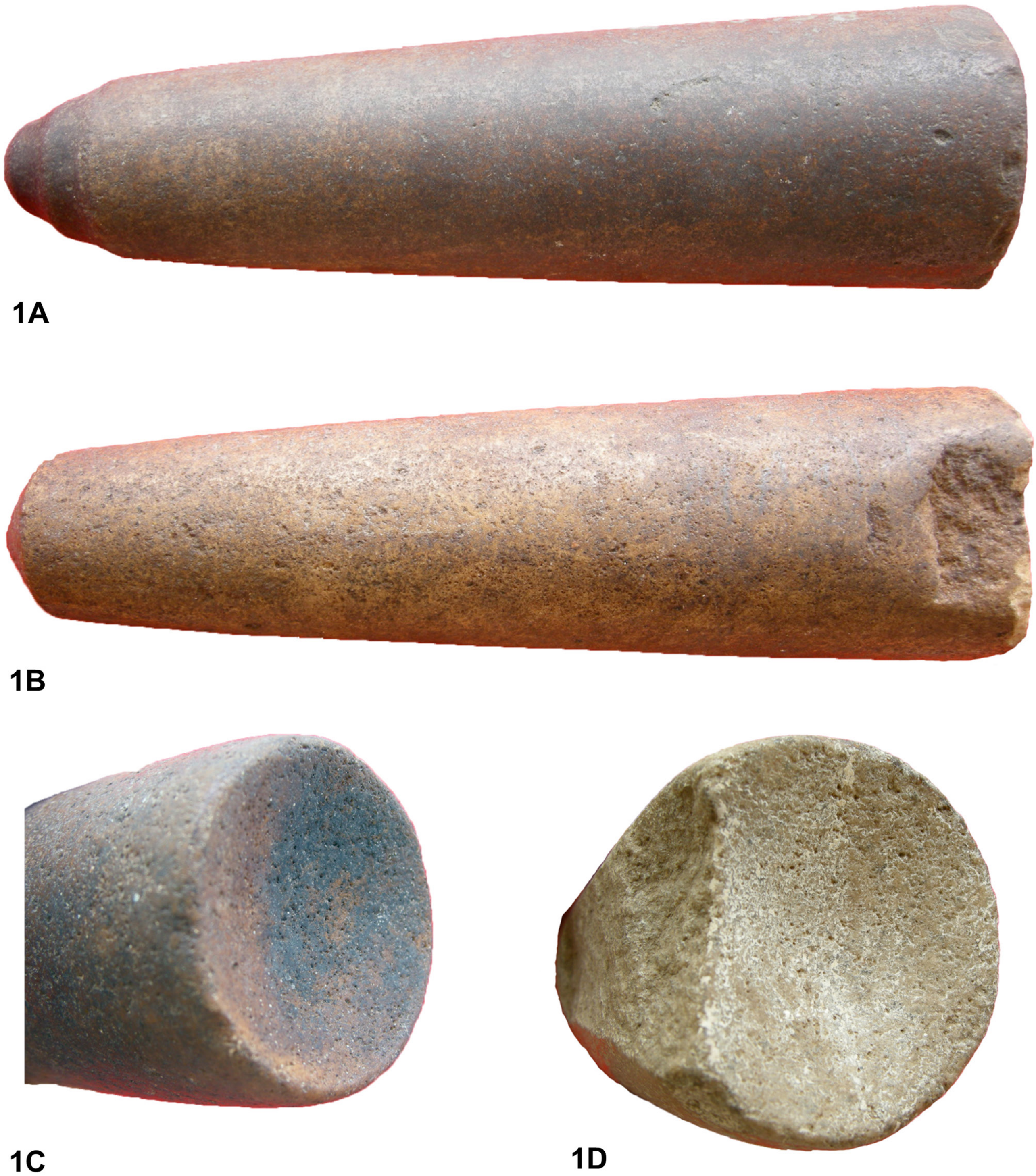

Figure 1. (*A*) #3193. Cylindrical adze (quartzite), from Belawit, Sarawak. Minor edge damage on cutting edge. This specimen has an elaborately shaped butt with tapered grooves. The cylinder is symmetrical and highly polished. Length 184 mm. (*B*) # 3155. Cylindrical adze (quartzite), from Pa' Mada, Sarawak. Typical edge damage on cutting edge. The cylinder is symmetrical and highly polished. Butt is shaped into a short cone. Length 178 mm. (*C*) #3159. Cutting edge (cup) of a cylindrical adze (quartzite), from Pa' Dalih, Sarawak. The cutting edge shows few signs of wear. Blackened area is soot, probably from storage in the longhouse above the hearth. Length 161 mm. (*D*) #3174. Cutting edge (cup) of a cylindrical adze (quartzite), from Pa' Bawang, Kalimantan. There is flaking damage around the perimeter of the cutting edge, with one large flake removal running down ⅓ length of shaft. Butt of this tool has an elaborate finish with tapered grooves and is more weathered and worn than #3193. Length 172 mm.

Distribution of cylindrical sago adzes in Borneo

The study sample (Table 1) was primarily recovered from the interior uplands of Sarawak and Kalimantan, c. 900 to 1000 m a.s.l. (Fig. 2). The vegetation of the uplands is predominantly lower montane tropical rainforest draped over steep, mountainous ridges that rise above 3000 m a.s.l. Between these ridges lie layered palaeo-river terraces, wide riverine plains and swamps. The plains and riparian areas of the study region are home to a number of agricultural longhouse communities, primarily the Kelabit and Lundayeh, and until recently, smaller communities of hunter-gatherer Penan. The Kelabit and Lundayeh are closely related communities, both speakers of Apo Duat, a sub-group of the Austronesian family. They share many cultural similarities including sedentary living in longhouses, cultivation of wet rice (*sawah*) and dry rice using slash and burn cultivation on hill slopes, the erection of stone monuments, and the holding of prestige feasts (Sellato, 2016).

Museum records and local informants state that most of the study sample, commonly recorded as sago pounders, were isolated finds nearby current or old villages. Tools were discovered by locals from streams and stream banks during any activity that moved earth, such as making or maintaining padi fields and gardens or digging postholes. As a type of polished stone tool, they occur in a relatively high frequency in the Sarawak Museum collections, outnumbering polished stone adzes by thirty to one (Harrisson, 1951a: 534). They were originally identified as sago pounders, used in the processing of wild sago palms (Collings, 1949; Harrisson,

Table 1. Location data of cylindrical sago adzes in the Sarawak Museum (SM) found in Sarawak State, Malaysia and Kalimantan Province, Indonesia; *n.d.* = no data.

SM reg. no.	region	geography	collection location	ethnic group
50/138	n.d.	n.d.	n.d.	n.d.
59/97	n.d.	n.d.	n.d.	n.d.
64/239	Sarawak	n.d.	n.d.	n.d.
59/98	Sarawak	n.d.	n.d.	n.d.
50.182	Sarawak	n.d.	n.d.	n.d.
3195	Sarawak	n.d.	n.d.	n.d.
3200	Sarawak	Coastal lowlands	Lawas	Lunbawang
3178	Kalimantan	Interior highlands	Belawit	Lundayeh
3191	Kalimantan	Interior highlands	Belawit	Lundayeh
3193	Kalimantan	Interior highlands	Belawit	Lundayeh
3174	Kalimantan	Interior highlands	Pa' Bawang	Lundayeh
50.200	Kalimantan	Interior highlands	Pa' Bawang	Lundayeh
50.202	Kalimantan	Interior highlands	Pa' Bawang	Lundayeh
50.231	Kalimantan	Interior highlands	Pa' Bawang	Lundayeh
3170	Kalimantan	Interior highlands	Pa' Bawang	Lundayeh
50.184	Sarawak	Interior highlands	Ba' Kelalan	Lundayeh
3196	Sarawak	Interior highlands	Ba' Kelalan	Lundayeh
3198	Sarawak	Interior highlands	Ba' Kelalan	Lundayeh
50.186	Sarawak	Interior highlands	Ba' Kelalan	Lundayeh
3180	Sarawak	Interior highlands	Belawit	Lundayeh
3197	Sarawak	Interior highlands	Upper Trusan R.	Lundayeh
50.213	Sarawak	Interior lowlands	Pa' Tengoa	Lundayeh
50.542	Sarawak	Interior highlands	Kelabit highlands	Kelabit
50.544	Sarawak	Interior highlands	Kelabit highlands	Kelabit
50.545	Sarawak	Interior highlands	Kelabit highlands	Kelabit
65/376	Sarawak	Interior highlands	Bario	Kelabit
64/230	Sarawak	Interior highlands	Bario	Kelabit
64/229	Sarawak	Interior highlands	Bario	Kelabit
64/226	Sarawak	Interior highlands	Bario	Kelabit
3166	Sarawak	Interior highlands	Batu Patong	Kelabit
50.208	Sarawak	Interior highlands	Pa' Bengar	Kelabit
PDH07	Sarawak	Interior highlands	Pa' Dalih	Kelabit
3159	Sarawak	Interior highlands	Pa' Dalih	Kelabit
3164	Sarawak	Interior highlands	Pa' Dalih	Kelabit
3154	Sarawak	Interior highlands	Pa' Mada	Kelabit
3156	Sarawak	Interior highlands	Pa' Mada	Kelabit
65/258	Sarawak	Interior highlands	Pa' Tik	Kelabit
50.173	Sarawak	Interior highlands	Pa' Trap	Kelabit
50.214	Sarawak	Interior highlands	Pa' Umor	Kelabit
50.215	Sarawak	Interior highlands	Pa' Umor	Kelabit
50.216	Sarawak	Interior highlands	Pa' Umor	Kelabit
50.219	Sarawak	Interior highlands	Pa' Umor	Kelabit
50.220	Sarawak	Interior highlands	Pa' Umor	Kelabit
3155	Sarawak	Interior highlands	Pa' Mada	Kelabit
50.230	Sarawak	Interior highlands	Remudu	Kelabit
50.543	Sarawak	Interior highlands	Upper Baram R.	Kelabit
65/260	Sarawak	Interior lowlands	Long Lellang	Kelabit

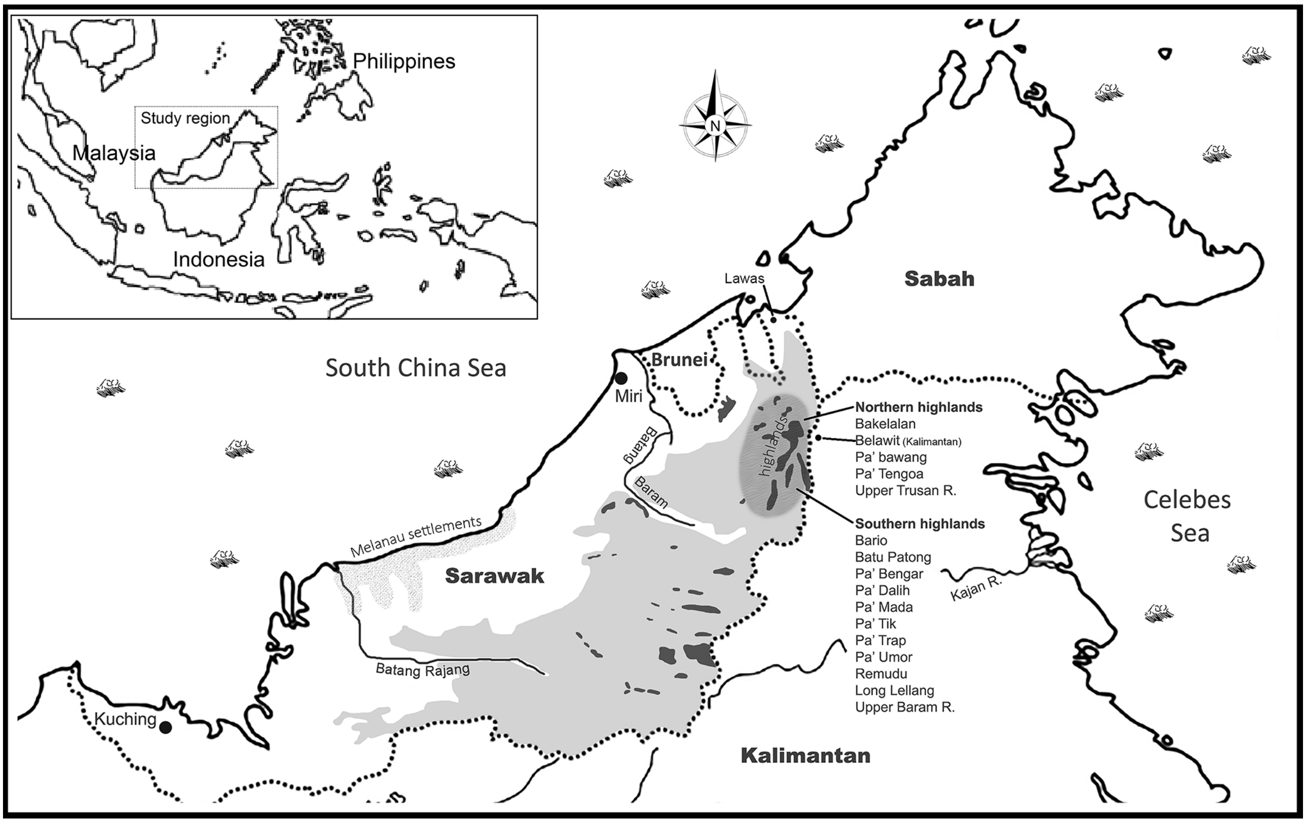

Figure 2. Map of the study region. Sites mentioned in Table 1 are listed for the lowland and highland regions. The stippled area on the coast and hinterland denotes the distribution of Melanau communities that utilise swamp sago palms, *Metroxylon sagu* Rottb. Pale grey landscape shading denotes land between 150–300 m asl. Dark grey shading denotes land above 1200 m asl.

1951a, 1951b), but historically, none of the communities that were the source of these tools claimed to be eaters of sago. Instead, they would state that the hunter-gatherer Penan were sago eaters and that their own primary food staple is, and always has been rice (Barton, 2012).

Sago and sago processing technology

Sago is a common term for the starch-rich slurry that may be extracted from a wide variety of palms that store starch in their trunk. The word sago [*sagu*] probably entered the English language in the middle of the 16th century as a result of explorations in the Moluccas: 'In all the Ilandes of Molucca is founde cloves, ginger, breade of the roote of Sagu, ryse, goates' (d'Anghiera, 2010 [1555]). The term is also used for wet pastes and dried flours of other starch-storing plants such as cycads (Thieret, 1958) and some species of tree ferns (Stonor, 1948).

Ellen (2008) provides an excellent review of the technology used to process sago across the Indo-Malaysian archipelago. He divides this technology into three main groups: pounders, rasps, and scrapers. Our concern is with the class of pounding tools. Rasps are mostly found in the eastern end of the archipelago, known from Sumatra and from the north-west coast of Sarawak, used exclusively in Borneo by one ethnic group, the Melanau (see stippled area in Fig. 1). This group also processes swamp sago palms, *Metroxylon sagu* Rottb., that is likely a prehistoric introduction and only grows in the lowlands (Morris, 1953). Other groups in Borneo exploit known endemic palm genera, primarily, *Arenga* spp., *Caryota* spp., and *Eugeissona* spp. (Ruddle *et al*., 1978; Barton, 2012).

Sago pounders are found across the Indo-Malaysian archipelago and eastwards into New Guinea (Lewis, 1923; Crosby, 1976; Ellen, 2008). They are predominantly multi-component tools made from organic materials (wood, bamboo, rattan, and fibre) or made from organics and stone, and in some cases, iron (Ellen, 2008). In the historic period sago was still widely utilised as a fall-back food across Borneo by rice farming communities including the Dusun of North Borneo (Rutter, 1929: 95–96), the Maloh of west Kalimantan (King, 1985: 154), the Kayan (Rousseau, 1990: 146), the Kajang (Nicholaisen, 1986), the Kejaman (Strickland, 1985), the Iban (Freeman, 1955: 105), Malays of southwest Sarawak (Harrisson, 1970), and the Kelabit (Harrisson, 1959: 66). Unfortunately, no record of the tools used to process sago were recorded in these papers, but it is assumed that they used the wooden adzes used by their hunter-gatherer neighbours, the Penan.

Penan hunter-gatherers living across the interior of Borneo have used a wooden adze, known in Sarawak as a *puloo* to process the pith of split sago palm trunks. This tool has an unusual shape in that the adze blade (made from a single piece of timber) is very long, up to a metre or more, tapered to a narrowing blade, with a very short handle (Fig. 3). The blade is lifted and dropped in repeatedly in a short working arc to chop and pound the fibrous pith. This breaks up the pith which is later transferred to a wooden platform where the starch is washed from the fibres. The platform is layered with rattan mats and leaves (essentially operating as a large sieve), through which water is poured, and then the pith is trampled to release a starchy slurry into the final layer of woven mats where gravity separates out the final wet starchy flour (https://youtu.be/VomE4GN9Z6I).

Figure 3. Wooden sago adze, *puloo*, from the Kelabit Highlands in use to process sago pith from the trunk of a hill sago palm, *Eugeissona utilis* Becc. Photo by Huw Barton, 2003.

Cylindrical stone adzes

The Borneo tools discussed here and those of similar form from New Guinea (Lewis, 1923), should, I propose, be categorised typologically as 'cylindrical stone adzes'. These tools had a particular function reflected in their form and in the ethnographic evidence of their use. Sellato (1996) thought of them as hand-held pounders, the cupped end being used to aid in cracking a nut exocarp, rather than smashing or crushing it, as would occur with a flat-ended pounder. However, closer examination of a wider sample of tools from Borneo and microwear and residue analyses confirm that these implements are cylindrical adzes, designed to cut and separate palm pith. They are directly analogous with tools recorded by Lewis (1923) and Gonthier (1987) from the north-west coast of Papua, also described as sago pounders:

> This [sago palm pith] is then pounded and mashed with a peculiar hammer made especially for this purpose, having at the lower end a cup-shaped depression with sharp edges. This cuts out the pith and mashes it at the same time. The cutting head may be of hard wood, bamboo, or stone, according to the locality (Lewis, 1923: 2–3).

It is not known how standardised these tools were when initially manufactured, but the overall variation in size and the wear patterns suggest that these tools were well maintained and reduced in length over their use-lives. The shortest tool in this sample is 50 mm, which may indicate the limits of their use life as a hafted implement (Table 2). When Harrisson (1951a, 1951b) first described these tools he saw similarities in form between them and conical pounding tools known from New Guinea and Australia (see Postscript), and referred to them in publication as 'sago pounders', though

Table 2. Physical description of cylindrical sago adzes recorded in the Sarawak Museum (SM) archives, Kuching, Malaysia. Dimensions in mm.

SM reg. no.	raw material	length[a]	mid-point width	cup max. diameter	butt height[b]	butt width	description
3154	Quartzite	174	44	47	20	30	Tapered cylinder with rounded butt. Yellow patina. Butt with minor chipping. Cup margin chipped and with reflective gloss.
3155	Quartzite	178	41	47	12	29	Tapered cylinder. Yellow patina. Cup margin chipped and with reflective gloss. Conical butt.
3156	Quartzite	73	0	43	0	0	Tapered cylinder. Transverse mid-shaft break. Cup margin chipped and with reflective gloss.
3159	Quartzite	161	41	40	7	29	Tapered cylinder. Yellow patina. Butt pointed type. Some chipping on butt end and one longitudinal flake scar. Cup end is rounded and with reflective gloss.
3164	Quartzite	130	41	44	0	0	Tapered cylinder. Yellow patina. Break at butt end. Soot blackened.
3166	Quartzite	91	36	54	0	0	Tapered cylinder. Asymmetric working end. Break at butt end. Strongly tapered form. Cup margin chipped and with reflective gloss.
3170	Quartzite	142	41	43	7	30	Tapered cylinder. Yellow patina. Cup margin chipped and with reflective gloss. One large flake removal. Rounded butt with battering.
3174	Quartzite	172	41	46	22	28	Tapered cylinder with elaborate butt. Butt modified with two-stepped and tapered grooves. Large flake removal from cup end.
3178	Quartzite	104	42	40	0	33	Tapered cylinder. Yellow patina. Flat butt, heavily chipped around margin. Cup margin chipped and with reflective gloss. Deliberate secondary flaking from cup.
3180	Sandstone	110	41	40	0	41	Straight-sided cylinder. Flattened butt. Butt with battering. Cup chipped around margin. Soot blackened.
3191	Volcanic	120	37	41	7	30	Tapered cylinder. Fine dressing of tool by pecking. Cup margin chipped and with reflective gloss. Trapezoidal butt
3193	Quartzite	184	44	52	23	34	Tapered cylinder with elaborate butt. Butt modified with two-stepped and tapered grooves. Cup margin chipped and with reflective gloss.
3195	Quartzite	130	53	48	10	30	Tapered cylinder. Trapezoidal butt. Cup margin flaked with reflective gloss.
3196	Quartzite	95	47	50	8	38	Tapered cylinder. Trapezoidal butt. Butt with battering. Cup chipped and pitted in concavity.
3197	Quartzite	133	43	48	0	31	Tapered cylinder. Fine dressing of tool by pecking. Finial flattened by battering. Cup margin chipped and with reflective gloss. Soot blackened.
3198	Quartzite	114	45	53	13	34	Tapered cylinder. Asymmetrically worn at cup end. Cup margin chipped and with reflective gloss. Rounded butt.
3200	Quartzite	135	47	48	6	30	Tapered cylinder. Yellow patina. Reused as a pounder/pestle. Both cup and butt are battered and without patina.
50.173	Quartzite	116	40	41	0	34	Tapered cylinder with flat butt. Butt battered and chipped. Cup margin chipped and with reflective gloss. Soot blackened.
50.182	Quartzite	66	0	47	0	0	Tapered cylinder. Yellow patina. Break at butt. Cup margin chipped and with reflective gloss.
50.184	Quartzite	95	39	38	8	37	Straight-sided cylinder. Recycled as a pounder/pestle. Rounded finial. Cup margin chipped and with reflective gloss.
50.186	Quartzite	99	43	41	12	39	Straight-sided cylinder. Cup margin chipped and with reflective gloss. Trapezoidal butt. Soot blackened.
50.200	Quartzite	76	42	45	0	0	Tapered cylinder. Break at butt end. Cup margin chipped and with reflective gloss. Soot blackened.
50.202	Quartzite	80	36	39	9	30	Tapered cylinder. Small form. Dark patina. Cup chipped around margin. Rounded butt.
50.208	Quartzite	126	38	42	0	30	Straight-sided cylinder. Break at butt. Cup margin chipped and with reflective gloss. Soot blackened.
50.213	Quartzite	105	49	52	10	38	Tapered cylinder. Rounded finial. Butt chipped and battered. Cup margin chipped and with reflective gloss.
50.214	Quartzite	90	34	41	0	0	Tapered cylinder. Break at butt. Cup margin deliberately flaked longitudinally and transversely. Small patch of original surface remains in centre of cup with reflective gloss.
50.215	Quartzite	124	40	42	0	32	Tapered cylinder. Butt battered. Cup chipped around margin.
50.216	Quartzite	102	42	41	0	0	Straight-sided cylinder. Yellow patina. Butt is battered and chipped. Cup margin chipped and with reflective gloss. Soot blackened.
50.219	Quartzite	105	31	35	0	0	Tapered cylinder. Cup margin chipped and with reflective gloss.
50.220	Quartzite	90	36	40	0	0	Tapered cylinder. Cup margin chipped and with reflective gloss.
50.230	Quartzite	117	38	0	15	30	Tapered cylinder with elaborate butt. Butt modified with two-stepped and tapered grooves. Break at cup end.

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Table 2 (continued from previous page). Physical description of cylindrical sago adzes recorded in the Sarawak Museum (SM) archives, Kuching, Malaysia. Dimensions in mm.

SM reg. no.	raw material	length[a]	mid-point width	cup max. diameter	butt height[b]	butt width	description
50.231	Quartzite	73	48	45	0	0	Straight-sided cylinder. Break at butt end. Cup margin chipped and with reflective gloss.
50.542	Quartzite	131	43	56	0	22	Tapered cylinder. Yellow patina. Asymmetric wear at cup end (bevelled). Chipped around cup margin. Flat butt type. Butt end with battering. Water-worn. Soot blackened.
50.543	Quartzite	96	39	41	0	0	Straight-sided cylinder. Break at butt end. Butt is battered and chipped. Cup margin chipped and with reflective gloss. Heavily weathered and water worn.
50.544	Quartzite	100	36	31	0	0	Tapered cylinder. Yellow patina. Original cup broken off. Butt re-worked into new cup. Cup margin chipped and with reflective gloss. Soot blackened
50.545	Quartzite	89	36	30	0	0	Tapered cylinder. Yellow patina. Soot blackened. Original cup end now flat, with new cup at butt end. Cup margin chipped and with reflective gloss.
50/138	Quartzite	50	0	36	0	0	Straight-sided cylinder. Transverse break through butt. Cup margin chipped and with reflective gloss.
59/97	Quartzite	75	0	45	0	0	Tapered cylinder. Transverse break through butt. Cup margin chipped and with reflective gloss.
59/98	Quartzite	98	0	30	0	0	Tapered cylinder. Yellow patina. Original cup end with break. Butt re-worked into new working cup. Cup margin chipped and with reflective gloss.
64/226	Quartzite	130	43	49	8	29	Tapered cylinder. Cup margin chipped and with reflective gloss. Rounded butt type.
64/229	Quartzite	134	41	41	7	35	Straight-sided cylinder. Rounded butt. Cup margin chipped and with reflective gloss.
64/230	Quartzite	119	42	48	13	30	Tapered cylinder. Pointed butt. Cup removed by flaking and battering. Recycled as pounder/pestle.
64/239	Quartzite	133	40	42	0	37	Tapered cylinder. Dark patina with white interior. Sampled at butt for mineralogical analysis. Cup margin chipped and with reflective gloss. Flat butt.
65/258	Quartzite	93	41	44	0	0	Tapered cylinder. Break at butt end. Butt with battering. Broken at finial end. Cup margin chipped and with reflective gloss.
65/260	Quartzite	98	39	42	15	32	Tapered cylinder. Yellow patina. Tool appears heavily weathered (water-worn). Rounded butt.
65/376	Quartzite	88	0	0	0	0	Tapered cylinder. Broken tool split longitudinally. Butt flaked into nosed scraper. Grey patina. Flake scars are without patina.
PDH07[c]	Quartzite	n.d.[c]	n.d.	n.d.	n.d.	n.d.	Tapered cylinder. Pointed butt type. Cup margin chipped and with reflective gloss.

[a] Length measurements were taken from the apex of the butt along the axis of the tool to the cup rim.

[b] Butt height was measured from the first major change in angle at the narrow end of the tool. Butt width at the widest point of the tapered end.

[c] The owner of this pounder would not allow me to take measurements in case my handling of it caused the *lalud* stored in the stone to drain away. This tool was touched to other tool surfaces to transfer 'power' to hunting equipment. Total length is about 200 mm.

there is nothing in his writings to indicate why he thought that this was their likely use. He might have been aware of the paper by Lewis (1923) on sago production on the northwest coast of Papua, though he did not reference it, or he may have had in mind organic types of pounder from Indonesia, where bamboo varieties have a natural 'cup' on their working end. Harrisson had earlier shown a sample of pounding and polished tools to Henry Collings at the Singapore Museum (Collings, 1949), who also drew direct parallels between the conical pounders from Sarawak and those from New Guinea (presumably also known from Lewis' earlier work). While sago production was his interpretation of tool function, Harrisson was also interested in broader typological comparisons with material from Australia described by Robert Etheridge Jnr of the Australian Museum as 'cylcons' or 'cylindro-conical implements' (Etheridge, 1916). Fred McCarthy, also at the Australian Museum, later discussed this typological grouping, referencing a similar tool form in Australia (McCarthy, 1953: 250). McCarthy visited Indonesia in 1938 and met archaeologists there and caught up with his friend H.V.V. Noone, anthropologist and museum curator at the Raffles Museum in Singapore (Khan, 1993: 3). McCarthy and Harrisson were likely in correspondence about these tools at some point as the Sarawak Museum archive contains several 'conical pounders' from Australia, originally from the Australian Museum based on the E. register numbers (Table 3). However, beyond their superficial similarities of form, these tools are functionally distinct.

Bernard Sellato (1996) undertook an earlier study of stone pounding tools (bark beaters, basalt tools from an ethnic group known as the Ngorek, and conical pounders) from the interior of Borneo/Kalimantan that included several specimens reviewed as part of this study (Sarawak Museum registration numbers: #3112; #3119; #3146; #3148; #3193;

Table 3. Sandstone pounders ('cylindro-conical' and 'cornuted' stones) from Australia in the Australian Museum, Sydney (AM). Dimensions in mm.

AM reg. no.	raw material	length	width	cup diameter	description	origin (from register)
E44857-1	Sandstone	270	53	42	Cylindrical implement. Shaft is dressed by pecking and grinding. Cup end is concave and has minor chipping around margin of bowl.	Purch. Estate late A. J. Bentice, 1938.
E21251	Sandstone	363	72	56	Cylindrical implement. Working end is concave and chipped around margin of bowl.	Belali, Warrego River, N.W. of Bourke. Purch. J. Tyrell, 1912
E26613	Sandstone	247	71	57	Irregular, roughly ovate in cross-section. Butt end curves away from main shaft in profile, giving a horn-shape (cornuted stone). Working end is flat, pecked and ground and striated.	Broken Hill District, NSW. Presented to Mining and Geological Museum. Sent to M. and G. Museum with mineralogical specimens by J. E. Hellawell, Mosman, North Sydney, 1921.
E44857-2	Sandstone	n.d.	n.d.	n.d.	Irregular, roughly ovate in cross-section. Butt end curves away from main shaft in profile, giving a horn-shape (cornuted stone). Working end is slightly concave and pecked. Some chipping around margin of cup.	No label, no data.

#3194; #3082). In his review of these items, Sellato proposed their use as nut cracking tools. Specifically, he argued that they were used to crack nuts of *Aleurites moluccana* (L.) Willd., the Indian walnut or 'candlenut', a common name derived from its use in Java and Sulawesi, where it is combined with copra and cotton to produce a substitute fat for candles (Sellato, 1996: 54). There is a note of its use by the Bukit people of the Meratus Mountains in Southern Kalimantan Province of Indonesian Borneo using the fat rendered from the nut for lighting (Sellato, 1996: 54). Sellato's rationale for thinking of these tools as nut cracking implements stems from the knowledge that the candlenut has a very hard exocarp that would require a stone pounder to crack, and his common sense observation that the cupped end of these pounders would be well suited to the task (Sellato, 1996: 52). Sellato interpreted the visible battering around the margin of some of these tools as likely derived from further use as a pestle to mash the nutmeat.

The functional analysis of these tools conducted for this study shows that these tools are not pounders used in this manner but are a primarily a type of adze used to chop plants. The macro and microwear is consistent with that interpretation, as are the organic residues that show processing of starch-bearing palms. There is evidence of further use of these tools as pestles and grinders as well as evidence of chipping and deliberate flake removals. I will argue below that these additional uses are not likely prehistoric but have occurred in their renewed life as *batu perahit* (Janowski and Barton, 2012), after rediscovery by Kelabit and Lundayeh.

Functional analyses

Macroscopic wear

Figures 1, 4 and 5 show the typical form of the cupped end and the typical wear that is visible by eye on the study sample. Macroscopic wear of the cup end shows wear in three groups:

1. Very minor flaking damage, with small, short flake removals on the outer side of the cup, aligned with the shaft, or into and across the concavity of the cup (Figs 1A, 5A,B). These tools are often associated with a highly visible surface gloss (polish), and evidence of rounding (Figs 4C,D, 5A,B);
2. A pattern of intermittent, larger flake scars, especially on the margin of the cup aligned with the shaft (Fig. 1B,D). In some examples, a major section of the tool has broken away (Fig. 1D); and
3. Major flaking around the perimeter of the cup (Fig. 4A,B). Flake scars are typically short with step or hinge terminations.

In all these cases, the polished surface of the cup does not show any other signs of damage, such as pounding or pitting. This observation is important as it is one of the key pieces of evidence, along with the microwear and residues evidence below, that is in direct contradiction to their interpreted use as hand-held crackers of hard nuts as proposed by Sellato (1996).

The pattern of flake removals around the perimeter indicates that periodically these tools were rotated in their hafts during use to refresh the cutting edge. The asymmetric profile shape of #50.542 (Fig. 4E) suggests a working repair to damage incurred by a large flake removal as seen in Fig. 1D. The working edge of #50.542 was ground into a new concave cup (not shown) that has sustained further abrasive wear and minor chipping (Table 2). One of the sample tools has been prepared with cups on opposing ends (#59/98: Fig. 5A,B). During use, this tool suffered a break on the normal working end and rather than discarding the tool, a new cup was ground into the butt end and the tool re-hafted. It is possible that the owner deemed the nature of the break such that regrinding to renew the cutting edge would remove too much material (tool length is 98 mm) and decided that creating a new cup at the butt end was a better working solution.

Depending on the qualities of the raw material, these implements have developed a highly reflective visible gloss on the cup end (Figs 4A, 6A). This is most visible on tools made from a dense, highly siliceous type of quartzite (Table 2). The gloss is either found around the entire perimeter of the tool or may be developed asymmetrically. The gloss is not evenly distributed from the working edge along the shaft but has a sinuous profile. This pattern is consistent with a tool that maintained angled contact with the worked material that sustained wear unevenly at different stages of use. Personal observation in 2003 of the pounding of sago pith by a Penan family, indicated that the labour was shared between husband and wife when one tired, and the pattern of mallet use changed in the hands of each, which caused changes in the wear patterns.

Figure 4. (*A* and *C*) #50.216. Cylindrical adze (quartzite) from Pa' Umor, Sarawak. The cutting edge is heavily chipped and worn. Note that the usewear is entirely around the circumference of the cup, showing that the tool was rotated in its haft. Note also the visible gloss and lack of damage to the remaining cup base (*C*). Cup exterior diameter 41 mm. (*B*) #3191. Cylindrical adze (volcanic) from Belawit, Kalimantan. Note the chipping around the entire circumference and that the cup base is undamaged. Cup exterior diameter 41 mm. (*D*) #3155. Cylindrical adze (quartzite) from Pa' Mada, Sarawak. Visible gloss and minor chipping on the cutting end. Cup exterior diameter 47 mm. (*E*) #50.542. Cylindrical adze (quartzite) from the Kelabit Highlands. Tool is asymmetrically worn on the cutting edge. Note also the implement has been made with a stepped-down taper towards the butt. This suggests that this tool was socketed, with a 'stop' to prevent the haft from sliding forward during use. Length 131 mm.

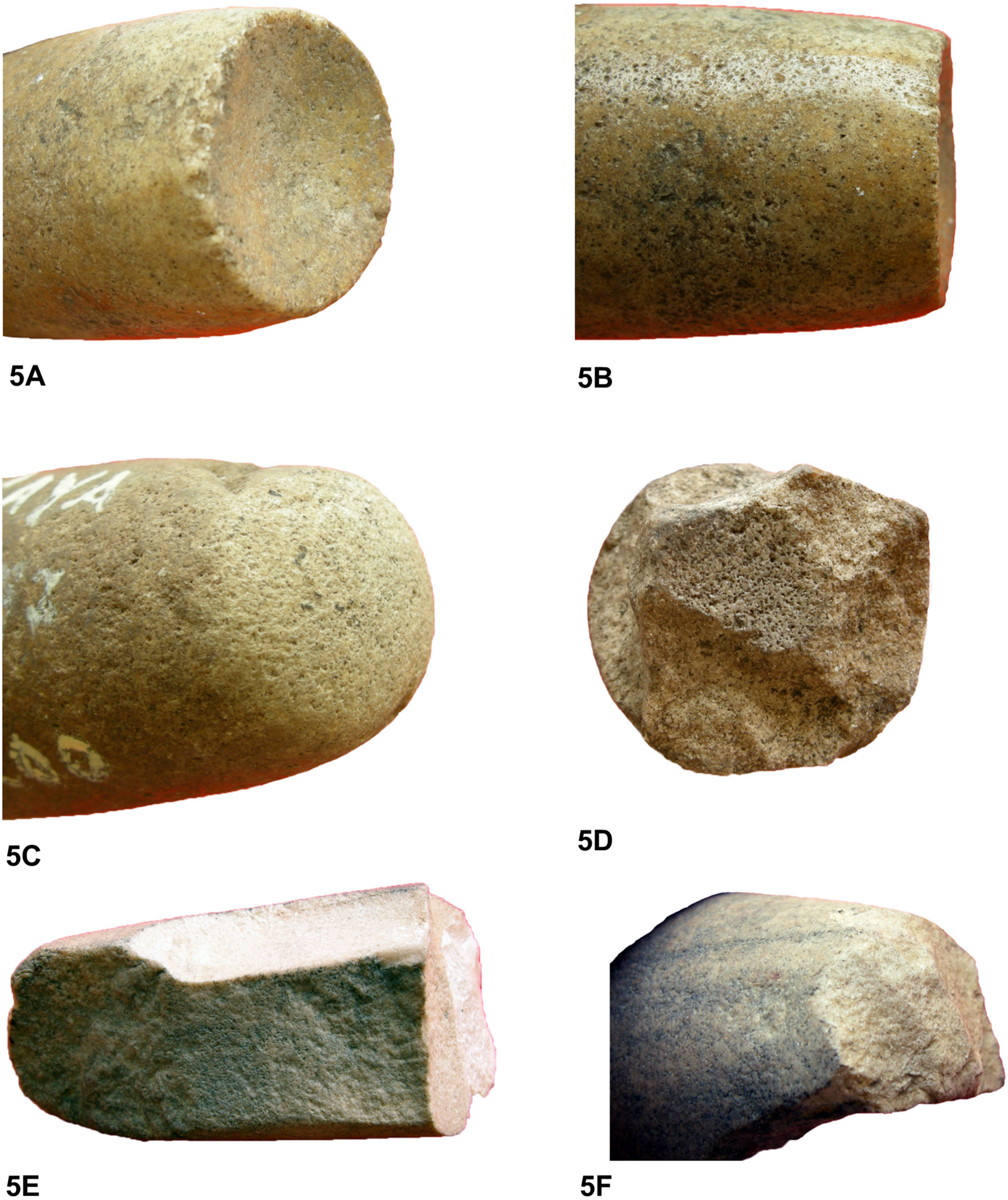

Figure 5. (*A* and *B*) #59/98. Cylindrical adze (quartzite), from an unknown locality, Sarawak. View is of the butt end that has been re-worked into a new cutting edge, which is why the working end is narrower than the shaft. There is minor chipping and visible gloss on the working end (*B*). Cup exterior diameter 30 mm. (*C*) #3200. Cylindrical adze (quartzite), found Lawas, Sarawak. View is of the butt that has been re-used as a pestle/pounder. Butt width 30 mm. (*D*) #50.214. Cylindrical adze (quartzite), from Pa' Umor, Sarawak. Tool has been flaked from the worked edge. Note the residual portion of cup. The flaking is invasive and unlike wear typically resulting from use. (*E* and *F*) #65/376. Cylindrical adze (quartzite), found Bario, Sarawak. This piece has been heavily modified by flaking along the shaft from the cutting edge and across the shaft. The butt end has been flaked into a steep-edged 'nosed' scraper. Flake scars appear younger than the shaft patina and two appear relatively 'fresh'.

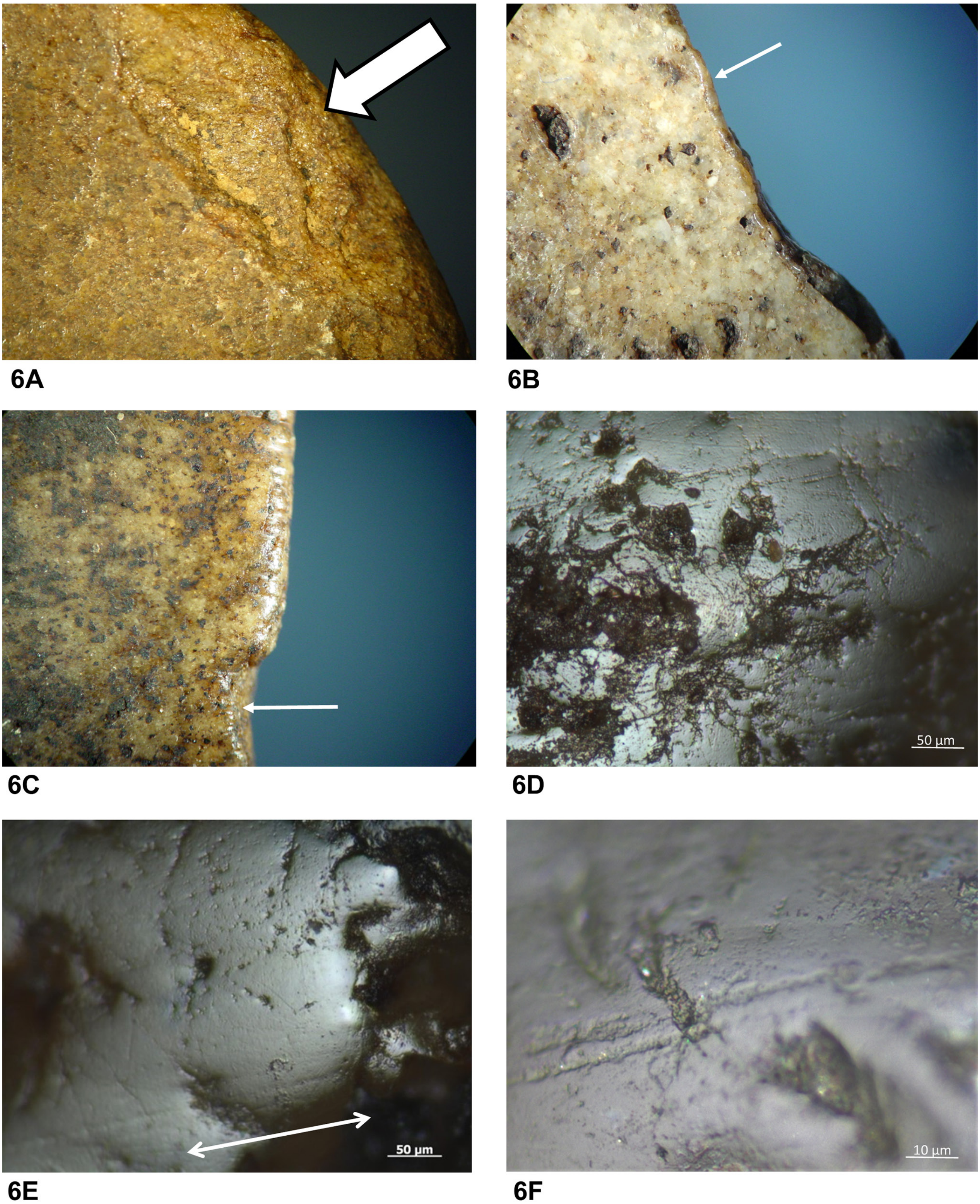

Figure 6. (*A*) #3141. Cup end at ×6.5 magnification. Flake scars with step and hinge terminations. Scars located on the concave end of the tool, consistent with the cup edge contacting worked material in an angled chopping action. Large arrow indicates flake scars and direction of flake initiation. (*B*) #3194. Cup end at ×6.5 magnification. Arrow indicates edge rounding and gloss on the base of flake scars that were initiated on the cup end but run longitudinally along the tool shaft. This shows that the working end continued in use following flake removals and generated new usewear. (*C*) #3189. Cup end at ×6.5 magnification. High gloss polish around the perimeter of cup. Arrow indicates flake scar (bending initiation). (*D*) #3189. High magnification view of gloss polish on cup perimeter (scale 50 µm). (*E*) #3189. High magnification view of gloss polish on cup perimeter. Double-ended arrow indicates orientation of linear features on tool surface (scale 50 µm). (*F*) #3194. High magnification view of striation morphotype that is typical on polish surfaces. Shallow and flat-bottomed (scale 10 µm).

The formation of a gloss or highly reflective surface sheen on these tools is likely a combination of physical abrasion during contact with plant fibres and the physico-chemical processes known generically as 'silica gloss' (Semenov, 1964; Meeks *et al*., 1982; Kamińska-Szymczak, 2002). Explanations of the formation of this sheen or gloss are normally divided into two camps:

1 Physical removal of material by mechanical processes (e.g., Fullagar, 1991 who emphasises the role of amorphous plant silica; also see Kamminga, 1979; Plisson and Mauger, 1988); or
2 Physico-chemical processes with interactions occurring between the worked material and the tool material, creating a new deposit or micro-layer on the tool surface (e.g., Anderson, 1980; Unger-Hamilton, 1984; Anderson-Gerfaud, 1986).

A more recent study of gloss formation on metal and flint tools proposes that the visible gloss on prehistoric tools, which is often different in kind from experimental samples, involves a third, post-depositional process, whereby silica dioxide in soils, replaces hydrated oxides in the tool residue 'crust' following tool discard (Kamińska-Szymczak, 2002).

Microwear

A sub-sample of four tools (Sarawak Museum registration nos: #3127; #3141; #3189; #3194) were further analysed in the Residue and Use-wear Laboratory in the School of Archaeology and Ancient History at the University of Leicester. A stepped approach to the analysis was undertaken (Fullagar, 2006). Tools were given a light clean with ultrapure water to remove surface dust from museum storage. Following this, initial observations were made at low magnification using a Zeiss Stereo microscope (×1.5–50), followed by sampling for tool residues using a micropipette and ultrapure water (see Barton, 2007 for procedure). Lastly, areas identified for high magnification analysis of wear were given a heavier clean using ultrapure water to remove adhering sediment to improve visibility of surface wear. Surfaces were assessed using a Zeiss AxioMAT (× 50–1000) reflected light microscope.

Low magnification analysis of the cup rims revealed short flake scars with step terminations running across the concave surface from the rim; these are consistent with angular, contact-driving flake removals across the cup surface (Fig. 6A). Worked edges also have a high degree of surface polish and edge rounding along the cup margins of these tools (Fig. 6B,C). This rounding was present on all edges analysed and particularly visible on the higher quality quartzite, having an almost 'melted' appearance in some places. At low magnification, the dominant wear on tools analysed is a glossy surface sheen, particularly on the margin of the cup rim, and edge rounding (Fig. 6B,C). This pattern of wear is consistent with the use of these tools on worked material that was softer than the tool material and partially yielding.

High magnification analysis of areas with visible surface gloss reveals extensive, well-developed, smooth use-polish (Fig. 6D–F). The polish surface is domed and undulating; with rounded edges, that follows the irregularities of the tool surface (Fig. 6E). The polish surface may contain faint linear traces or more developed shallow striations (Fig. 6D,E). The general direction of these run perpendicular or roughly perpendicular to the cup margin, consistent with a mode of use of these tools in a cutting or chopping action. Such well-developed, smooth polishes, sometimes referred to as 'domed' (e.g., Xauflair *et al*., 2016: 120) have previously been reported on quartzite flakes from Niah Cave (Barton, 2016) and on experimental tools made from jasper to process palm (*Caryota* sp.), bamboo (*Schitzostachyum* sp.) and rattan (*Calamus* sp.) (Xauflair *et al*., 2016: 120–121).

The micro-polish resulting from *Caryota* processing develops extremely fast, and appears very bright, very flat and very invasive. At macro-scale it produces an intense gloss of the edge which is already visible to the naked eye and is associated with rounding (Xauflair *et al*., 2016: 119).

This evidence is consistent with the use of these tools to chop woody palm pith in the processing of sago. None of the low-magnification or high-magnification observations are consistent with the interpretation of these tools being used as hand-held pounders. Such activities would lead to battering and crushing of the cup margin, rather than the intense glossy polish and rounding that is visible and typical on the study sample.

Organic residues

A study of the organic residues extracted from the previously noted sub-sample of four implements recovered starch granules, phytoliths and plant fibres. Residue extractions were undertaken in the School of Archaeology and Ancient History, University of Leicester, UK following standard extraction protocols (Barton, 2007). Tool extractions recovered starch granules typical of palms (Fig. 7A–D) and globular echinate phytoliths (Fig. 7E,F). Starch granules consist of generic palm types (Fig. 7D) that includes *Eugeissona utilis* Becc., *Metroxylon sagu* Rottb., and morphotypes that are uniquely typical of a minor sago palm, *Arenga undulatifolia* Becc. (Fig. 7A–C).

Cosmological biographies of cylindrical adzes

Old stone tools are important to people in these regions, falling into a broad category of items referred to as *batu perahit* (Janowski and Barton, 2012) and *batu nggau* (Sellato, 1996: 46): objects that were created by natural forces, sometimes lightning, or are stones somehow imbued with the flow of *lalud*—spiritual life forces (Janowski and Barton, 2012; Janowski, 2020). Simply owning these tools may confer benefits to their owners, but these forces may also be accessed by humans in different ways, often through physical contact, to release the flow of *lalud* for human benefit. For example: tools maybe placed in rice barns to increase the quantity of rice; buried in rice fields to increase yield; or *lalud* may be accessed by physical interaction such as washing in water (the water is then used medicinally), rubbing, abrading, and scratching the tool surface, and flaking (Janowski and Barton, 2012; Barton, 2013). As part of his study on these objects, Sellato asked his informants about the function of these conically shaped tools, and while they could readily identify implements such as 'bark beaters'—even those from archaeological contexts—they were unable to provide an interpretation for the conical pounders (Sellato, 1996: 51–52).

Several tools in the collection have been altered by human intervention and by normal post-depositional processes (Table 4). Some show signs of weathering from immersion in a stream or river (n = 3), some have been knapped (n = 3), several used as a pounder or pestle (n = 3) (Fig. 5C), and many are heavily coated in a layer of black soot (n = 10). The accumulation of soot will almost certainly have resulted from the storage of these tools inside the longhouse, either nearby or above the hearth. Kelabit and Lundayeh hearths are central features of the living space constructed on the

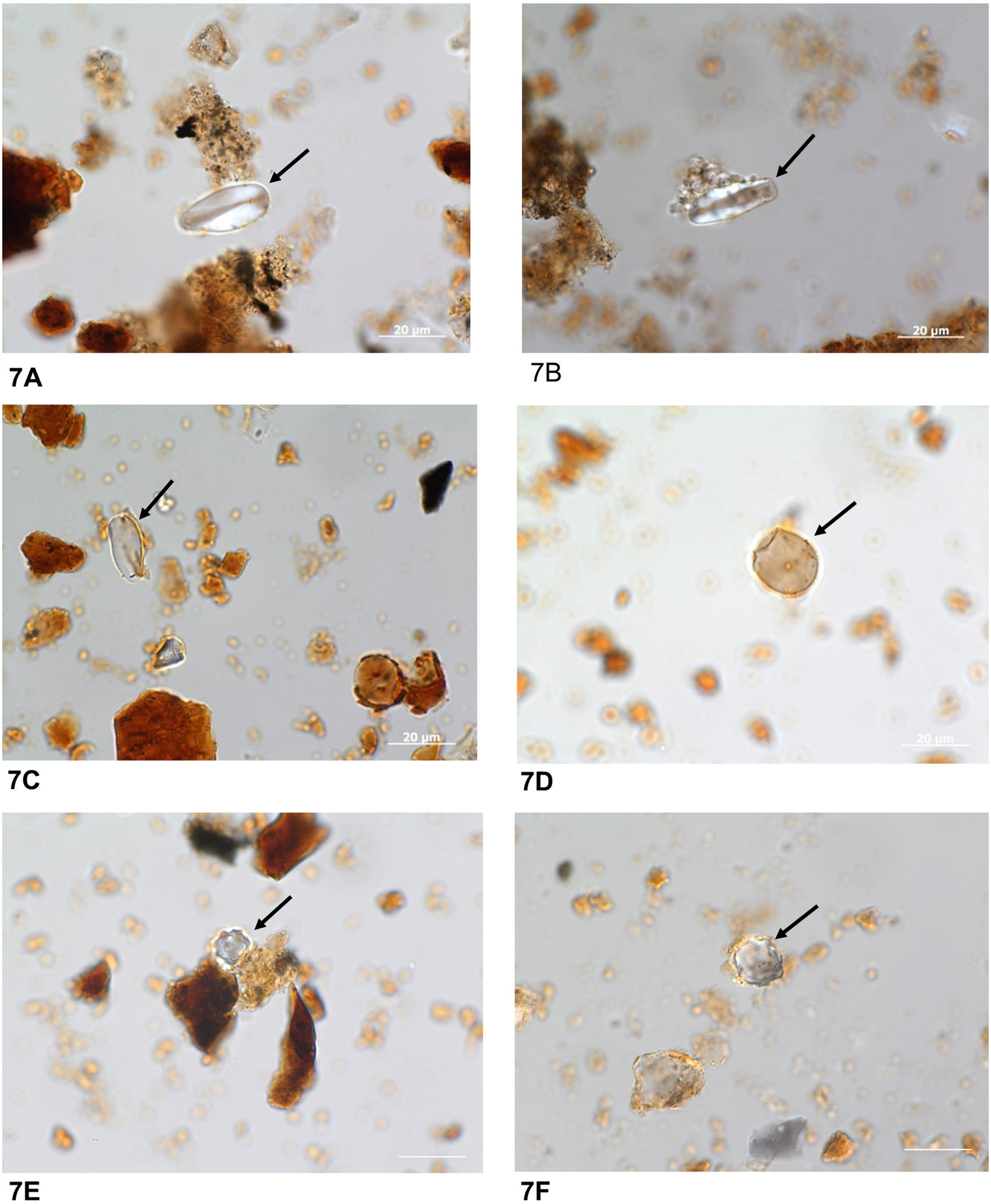

Figure 7. (*A–C*) Starch granules of palm species, *Arenga undulatifolia* Becc.; *A* and *B* in partial cross-polarised light (scales 20 µm). (*D*) Palm type starch granule, likely *Eugeissona utilis* Becc. (scale 20 µm). (*E* and *F*) Globular echinate phytoliths (consistent with palm types), a common type recovered from the cup end of all tools sampled for residues (#3127, #3141, #3189, #3194) (scales 20 µm). Arrows indicate starch granules (*A–D*) and globular echinate phytoliths (*E, F*).

Table 4. Post-depositional modifications of sago adzes in the Sarawak Museum (SM), Kuching, Malaysia.

SM reg. no.	modification from storage in longhouse	other modification (pre museum)
3164	soot	—
3178	—	Deliberate flake removals.
3180	soot	—
3197	soot	—
3200	—	Macroscopic usewear consistent with use as a pounder and/or pestle.
50.173	soot	—
50.184	—	Macroscopic usewear consistent with use as a pounder and/or pestle.
50.186	soot	—
50.200	soot	—
50.208	soot	—
50.216	soot	—
50.214	—	Deliberate flake removals.
50.542	soot	Water-worn.
50.543	—	Water-worn.
50.544	soot	—
64/230	—	Macroscopic usewear consistent with use as a pounder and/or pestle.
65/376	—	Deliberate flake removals.
65/260	—	Water-worn.

longhouse floor with a wooden structure above that is used for drying food products, and storing firewood (Barton, pers. obs., 2007). The storage of these tools above the hearth may have simply been for practical purposes or it may also have been important to associate these tools with a focal area of human life within the longhouse.

Three tools have been flaked (see two in Fig. 5D–F) and each are quite different in how they have been treated. Fig. 5D has a centripetal pattern of removals from the conical end leaving short, thick, flake scars. Fig. 5E appears to have broken during use and the residual end has been flaked along the shaft and across the transverse break. Several flake scars are without patina and thus younger than the original tool break. The butt end of this tool has been modified into a nosed scraper (Fig. 5F). There is some patina on these scars, and this appears to be a modification that occurred at different times.

The physical alteration of these tools is thought consistent with their value as *batu perahit* and the ways in which humans may access beneficial flows of *lalud* noted above. Flakes removed from these objects may also have been removed for use other ways. In one example from Indonesia, flakes of powerful stones were tied to the spurs of fighting cocks to help achieve victory (Barton, 2013: 521). The additional use of these tools as pounders/pestles may also be consistent with their new role as implements capable of transferring power to medicinal preparations or other recipes involving potency such as the preparation of hunting poisons. One informant I worked with in the village of Pa' Dalih, would not let me physically touch a *batu perahit*, that was a cylindrical stone adze (PDH07: Table 2), as he was concerned that my physical interaction with it might drain away its power. This individual was a keen hunter and used the *batu perahit* to sharpen metal blades used in hunting wild boar.

Histories of sago and sago adzes in Borneo

For the Penan of Sarawak, indigenous sago palms are a food staple, primarily using the hill sago palm, *Eugeissona utilis* Becc., but also they consume other minor palms including *Arenga* sp., *Caryota* sp., and *Livistonia* sp. (Ruddle *et al*., 1978). It appears that rice farming communities like the Kelabit and the Iban did once cultivate wild sago palms as well as using them as emergency food when rice crops failed (Freeman, 1955: 105; Harrisson, 1959; Barton, 2012), though locals may give conflicting replies about this when questioned. Today, foods like sago, taro, and cassava, are considered low-status foods in these communities. They may be consumed as snack foods, but their use a food staple would be frowned upon (Barton, 2012: 102), which may explain their reluctance to discuss the palm as a cultivar. Among the Kelabit today, there is no knowledge of using stone tools to process sago palm pith.

Today in Borneo, only one lowland sedentary agricultural community continues to rely on sago palms as a food staple, the Melanau (Fig. 1), and they use the introduced swamp sago, *Metroxylon sagu* Rottb., not the endemic hill sago, *Eugeissona utilis* Becc., which is thought to have been introduced into the region from western New Guinea or the Moluccas (Ehara *et al*., 2015). The date of that introduction is unknown, but the swamp sago palm is now widespread throughout the swampy lowlands of Indonesia, Malaysia and into parts of India (Blench, 2012). Archaeological evidence also shows extensive inter-island transport of obsidian within the Indonesian archipelago throughout the Holocene (Spriggs *et al*., 2011), and of long-distance transport from New Britain and the Admiralty Islands to Sabah in the third millennium BP (Spriggs *et al.*, 2011). The genetic studies on the history of domesticated bananas also reveal widespread interisland exchanges throughout the Philippine and Indonesian archipelagos, ultimately influencing the emergence of domesticated genotypes by at least the mid-third millennium BP (Perrier *et al*., 2011).

Archaeological survey and excavations conducted in the Kelabit Highlands as part of the Cultured Rainforest Project (2007–2010) recovered a range of evidence indicating human occupation of the upland interior from at least the early Holocene (Barker *et al*., 2008, 2009, 2017). A pollen core

(BPG) taken from a palaeo-channel used in rice cultivation, showed evidence of human-induced disturbances including burning, soil erosion and canopy opening dating from at least 7000 to 6000 years ago (Jones *et al*., 2013a). The earliest direct evidence of human occupation in the region comes from an open site on a river terrace called Ruma Ma'on Dakah. Excavations revealed a buried soil horizon and a post-hole associated with abraded sherds of earthenware pottery, a fragment of a polished stone implement and burnt stones. Charcoal in its fill was dated to around 3700 years ago (Barker *et al*., 2017). By 3000 years ago, at the site of Pa' Dalih (core PDH212) there was a marked decline in forest taxa and a parallel increase in open ground and scrub taxa with, a century later, the appearance of echinate (palm) phytoliths and a notable band of charcoal (Jones *et al*., 2013b). A second pollen core PDH223, near the village of Pa' Dalih, showed significant increases in pollen from wild hill sago, *Eugeissona utilis* Becc., at about 2300 years ago, along with evidence of open terrain and increased charcoal deposition (Jones *et al*., 2013b). The presence of this palm near a river channel, along with vegetation disturbance, may be indirect evidence of deliberate cultivation of wild hill sago at this time (Jones *et al*., 2013b). From the site of Menatoh Long Diit, a single fragment of a cylindrical stone sago adze was recovered from sub-surface wall rubble with charcoal providing a relative age of 1700–1500 cal. BP (Beta-280499) (Barker *et al*., 2017: table 3).

Several rice phytoliths, including a rice bulliform, were also recovered from core PDH212 dating from 1790 to 1800 cal. BP (Jones *et al*., 2013b: 715). These dates are the earliest evidence of rice in the highlands and now tie in with the revised dating of domesticated rice from the lowland cave site of Gua Sireh (Datan, 1993). Here, micro CT scans have identified spikelet remains of domesticated rice in pottery that is dated between 2000 to 800 BP (Barron *et al*., 2020: 9). In summary, the archaeological and palaeo-environmental data from the highlands suggest that an indigenous system of plant management, including palm cultivation, may pre-date the arrival of domesticated rice from the Philippines (Bellwood, 2005: 135), and be part of wider regional flows of materials and plants and ideas into and out of the region (e.g., Andaya, 2017; Blench, 2012; Swadling, 1996).

The cylindrical stone adzes from Borneo and swamp sago palms (*Metroxylon sagu* Rottb.) from New Guinea may be evidence of such long-distance relationships along the Indonesian island archipelago. Stone adzes may have been moved from the interior to the coast and to New Guinea, or the adzes could have been moved from New Guinea along with swamp sago to the northwest coast of Borneo and later up-river to the interior, where the adzes may have been adopted into indigenous systems of sago cultivation (Jones *et al*., 2013a). It is also possible that the two types of cylindrical adze in New Guinea and Borneo are independent adaptations of tools made from bamboo internodes, the stone adze being a copy of the natural shaft and cupped end of bamboo tools (see Ellen, 2008). In Borneo, for whatever reasons, these stone tools were abandoned and forgotten, disappearing into prehistory at an as yet unknown point in time, while they continued in use in New Guinea until the recent past (Lewis, 1923). Penan wooden sago adzes are a very different solution to the problem of sago processing—with a metal blade they can be fashioned in a matter of minutes (Barton, pers. obs., 2003). The stone cylindrical pounders by contrast represent a much larger investment in time and expertise in their production. I suspect that these are tools that could have lasted many years of use, possibly even existing as heirloom items.

Conclusion

I suggest that the stone tools discussed in this paper should be termed as 'cylindrical stone adzes.' In Borneo, these tools appear unique to the highlands and similar to tools known from the northwest coast of Papua (Lewis, 1923; Gonthier, 1987). They are not strictly pounders and were likely hafted and used to chop and separate the pith of sago palms. Analyses of the macro- and microscopic wear and organic residues reinforce this interpretation of their function. These tools were used in the extraction of sago flour from palms that included *Arenga undulatifolia* Becc., and possibly *Eugeissona utilis* Becc., by at least the middle of the first millennium AD and possibly by the end of the last millennium BC. Their similarities with the Papuan material are striking and raise further questions about the connections between these regions and of the flows of people, sago, and other things, back and forth across the island archipelagos of Malesia during the Holocene.

Postscript: The Australian cylindro-conical pounders and cornuted stones

Within the Sarawak Museum collections are several Australian conical stone tools stored with the cylindrical stone adzes (Table 3). These tools fit the description of 'cylindro-conical' and 'cornuted' stones by Etheridge Jr (1916). McCarthy (1953) also wrote about these conical pounders, expanding his comparative review with material from Java. It is possible that these tools were sent to the Sarawak Museum in the early 1950s when both McCarthy and Harrisson were writing about their collections and thinking about the diffusion of cultural influences across the island archipelago and into Australia.

Two of these stones fit the description of 'cylindro-conical' (Australian Museum registration nos E44857-1, E21251) and two as 'cornuted' stones (E26613, E44857-2). One of these was not fully recorded in the museum. While these objects share broad similarities in overall shape with the Borneo tools, there are important differences between them that suggest that the visual similarities are more likely outcomes of convergence, arriving at similar forms. It was difficult to distinguish any traces of visible edge damage

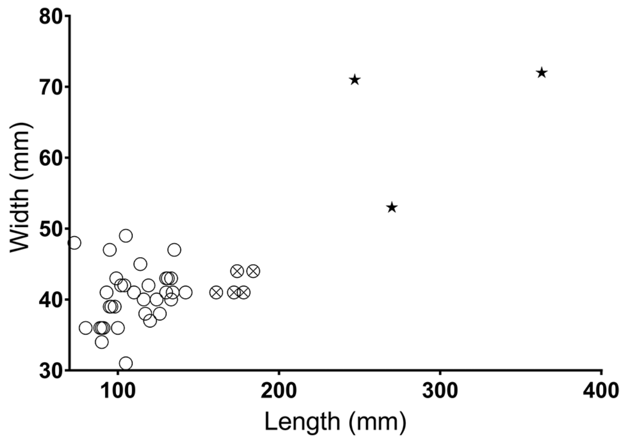

Figure 8. Size distribution of conical stone adzes from the Sarawak Museum archive (open circles). Circles with inset crosses denote tools that appear to be complete or near complete examples with little or only minor physical wear. Stars indicate the conical pounders and cornuted stones from Australia held within the Sarawak Museum archive.

Figure 9. (*A* and *C*) #E44857-1. Large cylindrical implement (sandstone), no locality, Australia. The entire surface has been shaped by pecking and grinding. The shaft is parallel-sided and tapers at one end to a rounded point. The other end has been shaped into a cup that is also pecked across its surface and has chipping around its margin (*C*). Length 270 mm. Cup exterior diameter 42 mm. (*B* and *D*) #E21251. Large cylindrical implement (sandstone), from Belali, Warrego River near Bourke, NSW, Australia. The implement has a similar tapered form to Bornean cylindrical stone adzes and with a concave end opposite the butt (*D*). Margin of the tool has some chipping and modern contact damage from storage. Length 363 mm. Cup exterior diameter 56 mm.

Figure 10. (*A* and *C*) #E26613. Irregular, roughly ovate in cross-section, from Broken Hill, NSW, Australia (coll. 1921). Butt end curves away from the main shaft in profile (not shown in image) producing a horn-shape ('cornuted' stone). The flat working end is pecked, ground and striated. The striations on the base are same as those on the lower end of the shaft and appear to be marks from a shaping tool. Length 247 mm. (*B* and *D*) #E44857-2. Irregular, roughly ovate in cross-section, from Australia. This tool has no label and no collection data. Butt end curves away from the main shaft in profile, giving a horn-shape ('cornuted' stone). The working end is very slightly concave and pecked, with some chipping around the cup margin (*D*). No length measurement available.

on these Australian objects beyond clear traces associated with their manufacture. The clear differences between the Australian cylindro-conical tools and the Bornean sago adzes are their sheer size (Fig. 8), the macroscopic wear patterns, and the sandstone raw materials they are shaped from.

The cylindro-conical tools are parallel-sided along their length and taper at the butt end. The cylindrical stone adzes by comparison are tapered along their length and flare at the working end (having the shape of a cone, rather than a cylinder, see Fig. 1). Like the Bornean adzes, they show signs of pecking and grinding to create their overall form, and both have concave cup ends (Fig. 9). The cup margins of the Australian tools are gently rounded with little evidence of chipping from use. Both show evidence of damage from handling and storage conditions (Fig. 9C–D). The cups of these tools show no obvious signs of working damage. E448571-1 has numerous pits and depressions, but this is consistent with the features on the shaft associated with manufacture rather than use. E21251 has a well-ground concavity that shows no signs of impact damage. The size of these implements suggests that they were probably hand-held rather than hafted. There is certainly no evidence of the kinds of high impact wear on the cupped ends of these tools that would suggest uses similar to those of the cylindrical adzes of Borneo.

The two 'cornuted' stones (E26613, E44857-2, Fig. 10) are quite unusual in their overall form. They are well named, as both have a pointed end that tapers asymmetrically from the main shaft of the piece. The working ends of these implements are either flat (E26613: Fig. 10C) or have a slight concavity (E448571-2, Fig. 10D). Both are made from sandstone. E26613 is a relatively soft stone that has been pecked, rubbed, and scraped into its final form (Fig. 10C). Tool marks from scraping are evident all over this piece and particularly at the flat end (Fig. 10C). It is difficult to determine the type of tool that has left the fine parallel linear traces: perhaps shell. The wide ends of both tools have minor flaking damage around their margins that could be wear from light duty use, and the faces of both retain pecking marks from the manufacturing process. E22613 also has linear scraping marks across the face, suggesting that either the worked material was soft, or that it underwent maintenance after use.

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