Technological process in pre-colonial Melanesia

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Technology is a process. As a process, it materialises knowledge, identity and society. In this essay, I introduce the concept of technological process, which draws on the tenets of process archaeology and the anthropology of technology in describing materials and people as dynamic, mutually constitutive lines of flow. These lines are best codified as a *chaîne opératoire* (operational sequence), which allows us to tease apart socially meaningful, diachronic variation and change. How technological process, as a narrative device and interpretive concept, can be uniquely applied to the pre-colonial past in Melanesia is explored through the production and exchange of red-slipped pottery around Madang in the recent pre-colonial past. Common themes in this research, and other case studies from the area, draw attention to unique aspects of the technological process in north-east New Guinea, which involves growth, personification, magic and ritual. This has implications for how we understand technology in deeper archaeological time.

Introduction

In anthropology, theoretical shifts are re-emerging that conceptualise technical action as a central process in the co-construction of knowledge, identity and society (Dobres 2000; Ingold 2016; Wellner et al. 2015; see originally Mauss 1934). Similarly, in the subfield of archaeology, material culture research has become increasingly interested in the entanglements and interactions between people and non-human things, examining, for instance, how technical activities like production and exchange shape substantial aspects of people's cognitive and social ontologies (Gosden 2008; Malafouris 2010). These shifts are influenced by post-structuralism, which sees people and things as mutually constitutive processes or *flows*. Gosden and Malafouris' (2015) recent article most succinctly advocates for this, presenting a synthetic 'process archaeology' as one dialectic between *flow* and *form*. *Flow* being the permanent state of change experienced by people and things, and *form* being ephemeral. From the perspective of process archaeology, the emphasis then shifts away from artefacts, people and environments as static and synchronic *forms* and re-conceptualises these things as dynamic and diachronic lines of *flow*, constantly undergoing making and remaking, binding together and unravelling, always in processes of becoming. These processes underlie all people, materials and technologies. It is timely, then, to investigate the technology of pre-colonial Melanesia—especially aspects of production and exchange, which have been so central to developing theoretical models in the discipline—with these new ideas in mind.

This essay presents ‘technological process’ as a useful narrative and interpretive concept to re-conceptualise how we approach the complexities of materiality and the lived experience in the human past. This builds upon the *chaîne opératoire* as a methodological device to link higher order process theory with micro anthropological/archaeological observations. By forming these links, we can (1) more easily delineate past social groups and communities of practice, and (2) enliven our narratives of pre-colonial technology and society. The approach is illustrated through the production and exchange of red-slipped pottery around Madang in the ethnographic present, the colonial period and the recent archaeological past. I later find commonalities in my own research with other case studies from north-east New Guinea, including the manufacture of *garamut* drums on the Rai Coast and the process of *lalong* canoe building in Astrolabe Bay. I speculate that making *things* in pre-colonial Melanesia was intertwined and inseparable from making ritual, magic, language and reciprocal relationships. It is through the technological process that both non-human things and people were grown and initiated into networks of active interrelationships. I suggest that thinking about technology in this way can be useful in understanding the broader social context of material culture in Melanesia’s deeper archaeological past.

Technology as process

Technology is a generative learning practice, which moulds the parameters of human thought, movement and action (Minar & Crown 2001); it produces embodied knowledge (Inoue 2006; Jørgensen 2013). Central to technical knowledge acquisition is the concurrent interplay of conscious intentionality, embodied knowledge and materials (Lemonnier 1986). It is through this continuous dynamism, tension and energy transfer between mind, body and matter that people internalise and create meaning, constituting their social world (Gosden 1994; Keller and Keller 1996).

Tim Ingold has produced a substantial body of work that builds upon these ideas. He sees this knowledge acquisition as process; as a transformative correspondence between maker and material (Ingold 2013). Materials are malleable and move in response to action upon them, and according to the nature of their own properties (Ingold 2012). In this way, the maker or user is guided in the technological process *with* the material, arriving at different temporary forms together. This is contrastive to what Ingold labels the hylomorphic model, which perceives people imposing form or mental templates on inert raw substances to create different types of finished products. Rather, materials are never finished, but continue to undergo change throughout their life history.

By Ingold’s reckoning, materials and consciousness can then be seen as progressing along life-lines. The ‘artefacts’ and ‘objects’ we examine as archaeologists are simply temporary stoppages or ‘blobs’ along these lines (Ingold 2015:3). If we want to get at the meaningful technological processes along which people and materials have travelled, and which have shaped their social and cognitive ontologies, we must then turn our analytical lens 90 degrees, from horizontal snapshots of blob-jects, to drawing out vertical linear processes. As these lines correspond and become bound up with others they become entangled, which results in mutative networks of interrelations with nodes of connectivity constantly undergoing strengthening and severance (Knappett 2011; Thomas this volume).

Gosden and Malafouris (2015) draw together these trends in anthropology and advocate for a process ontology, through which people, social groups and materials create modes of becoming. They advance three theoretical postulates for applying such a process ontology to a successful 'process archaeology': (1) reality is best understood as modes of becoming rather than states of being; (2) people, objects and things are always in flux; (3) human becoming is understood as transformations between energy and matter. If we think about technology from a process archaeology perspective, technology is not inert and lifeless, but represents distinct lines of flux. It is every process of human action *with* matter that produces, creates, distributes, uses, destroys or in some other way affects the world.

Although Gosden and Malafouris present the higher order theoretical postulates of process archaeology, they are yet to delve into the middle-range linking devices that will allow us to tie these ideas to archaeological material culture. However, Carl Knappett (2005), exploring similar modes of becoming on Bronze Age Crete, has stressed the need for such methodological innovations and advocates for the *chaîne opératoire* approach to describe technology not as concrete and object-centric, focused on temporary *form*, but rather, as a study of techniques, examining the *flow* of technological process.

For analytical purposes the *chaîne opératoire* can be subdivided into phases of procurement, production, distribution, consumption, alteration, re-use and discard (Figure 13.1). Within these phases, a 'technical element' is the smallest analytical unit of study, formed by the interplay between a gesture, an intention, and matter (modified from Lemonnier 1992:31). As technical elements are repeated, through habitual material engagement, the boundaries between gesture, intentionality and matter become blurred, generating embodied knowledge (cf. Malafouris 2008). 'Technical syntax' is a sequence of technical elements in order. The culturally specific arrangements of extended syntaxes, from procurement to discard, compose the *chaîne opératoire*, regulated by broader social and technological conventions. These distinctions are important because technical elements are more fluid in terms of sharing, and are often passed horizontally within or between groups, while syntaxes are more conservative and are likely to be passed from parent to child, teacher to pupil (Apel 2008). For instance, in potting technology, because decorative elements or minor technical variations are less reliant on extended syntaxes, they are more readily shared across social boundaries than vessel forming techniques (Arnold 1985; Mayor 2005). Thus, individual elements may be widely distributed, while syntaxes are usually diagnostic of production groups (Roux and Courty 2005).

By using the *chaîne opératoire*, we are able to look at the in-between of raw materials and 'finished' objects, assembling what Gosden and Malafouris (2015) describe as the 'chronoarchitecture' of action. We then move away from blob-based, classic typological approaches and towards line-based, process methods for material culture analysis, which can more effectively identify social groups working within broader communities of practice, and allow us to flesh out our archaeological narratives.

Figure 13.1. Analytical terminology of a ceramic *chaîne opératoire*.

Source: Dylan Gaffney.

Technological process on the north-east coast of New Guinea

To illustrate how the concept of technological process can be instructive for understanding pre-colonial Melanesian societies, I now turn to pottery-making around the north-east coast of New Guinea. The north-east coast stretches from the mouth of the Sepik in the north to the Markham in the south, and is characterised by uplifted coral, active volcanic islands and tropical coastal plains flanked by steep mountain ranges. It is an important area as it was likely host to early human groups as they passed along the coast into the Pacific 50 000 years ago (Groube et al. 1986), and has subsequently been used as a conduit into the Bismarck Archipelago and the Central Highlands (Gaffney, Summerhayes et al. 2015; Gaffney et al. 2016; Gaffney et al. in press). More recently it has seen increasingly specialised modes of production and exchange leading up to ethnographic contact in the 1870s (Lilley 2017). This involved a number of middlemen trading groups, marginally situated relative to material resources, but at the heart of coastal and inter-island exchange networks (Harding 1967; Hogbin 1947; Sahlins 1974:262–276). One of these trading groups was the Bel (Bilbil and Gedaged) speaking group around Madang, who speak an Austronesian language derived from Proto North New Guinea (Ross 1988). They are organised into nested segmentary groups who operate in cooperative social and material networks around the north-east coast, and were once the hub of the extensive Madang exchange system, using sea-going canoes to distribute their pottery over hundreds of kilometres to the north and east in return for subsistence crops, practical objects and valuables. This exchange network was severely disrupted during the Pacific War when occupying forces destroyed many of the canoes, but pottery-making, known as *vai*, continues into the present.

Ceramic *chaînes opératoires* will illustrate how this specific technological process initiated a broader social world of growth, personification, magic and ritual. This process is examined over different temporal ranges, with each study moving us back deeper through time: (1) the synchronic potting cycle observed ethnographically; (2) the more extended evidence of technological and social change identified ethnohistorically, during the contact and colonial periods; and (3) the more diachronic changes observed archaeologically over the last millennium before present.

Modern pottery production and exchange around Madang

At Bilbil and Yabob villages around Madang, many women produce brilliant, red-slipped, paddle and anvil pottery used as cooking vessels and water containers (Gaffney 2016; Gaffney and Summerhayes 2017).¹ A number of social conventions still govern pottery-making. Only women at Bilbil or Yabob may produce pottery in this manner, so if a woman moves from her natal potting village to a different, non-potting marital village, she will be prohibited from production of ceramics and the sharing of technical knowledge. This convention is called the *vou* and is a form of magic that can be likened to intellectual copyright amongst the Bel groups. Transgression of the *vou* can result in violent retribution.

¹ Pottery-making has since ceased at Yabob Village and only continues at Bilbil. These villages comprise the Bilbil language speakers to the south of modern Madang town.

Today, the potters dig for suitable clay around yam and sweet potato gardens, and collect sand temper from the mainland beaches and river mouths. They carry *bilum* (string bags) laden with these raw materials back to their houses, where the clay is treated and stored in large balls for use. When required, bits of these clay balls will be broken off and blended with the sand temper—forming a mixture called the *isol*. The correct *isol* is essential to the mechanical durability of the pot as it moves through the production process. It is not prescribed by a set recipe or ratio, but is *figured out* by the feel in the potter's hands: the mix that does not stick to the hand and can be rolled easily is preferred as it reduces resistance to the potter's movements. The potter then begins to bring the pot into its primordial form, creating a rim preform. This involves the potter pressing her thumb into a ball of *isol* and throwing it in a circular fashion with her hands, resembling a wheel-throwing technique to form the pot's 'mouth'. This technique is unique to Madang, along with potters around Tumleo on the Sepik Coast, and around eastern Indonesia, which has led some researchers to suggest they derive from a common technological tradition (Pétrequin and Pétrequin 1999). At a later stage, more *isol* is added to the base of the mouth preform and the body begins to take form, using hand moulding at first, later shifting to a variety of specialised paddles and anvils. For most of the potters who have grown up learning these techniques, potting is 'not hard' and procedural body habit seems to coalesce with the material, working itself into new forms with ease as the potter's hands move in response to the wetted *isol* mix.

There are four recognisable shapes produced in repeated *chaînes opératoires*. The *bodi* is a small cooking pot with an everted rim, and an exemplar *chaîne opératoire* is presented in Figure 13.2. The *magob* is a similar cooking pot with incurving rim, the *tangeng* a larger pot used for feasts, and the *you-bodi* a single or multi-spouted water container. However, these 'finished' vessel types are in no way finished. After a preliminary firing stage, vessels can be refashioned and reworked into other forms. Moreover, if an in-use *bodi* is broken, it can be modified around the rim to produce a *magob*. Damaged vessels can also become *su*, and act as supports for fresh pots during cooking. Fragments of these *su* can later be used as lids to retain heat when cooking. And more inventively, damaged *su* can act as flowerpots around the gardens. In the 21st century, the conventional pottery forms have also been actively modified to appeal to Western tourist markets. These modifications include miniaturisation, body perforations and the addition of non-functional spouts.

Lastly, a red slip, called *main*, is applied to the 'skin' of the pot prior to firing. Once fired, the slip hardens from a dull orange to a bright red and the vessel is considered to have become as a young man, just like the young men emerge from the fires of initiation decorated with red paint.

The pots do not become socially inert at the end of the production process, nor does technology, as a mode of engagement between people and things, cease to acquire or create meaning during distribution, use and discard (Sellet 1993; Sillar and Tite 2000). The pottery users, around Madang and elsewhere, engage and create meaningful embodied knowledge during cooking or while storing the pot in such a way that it will not break. As fully initiated pots, the Bilbil and Yabob vessels actively help to generate revenue for the villages, or establish important reciprocal relationships through bride price.

Figure 13.2. A modern *chaîne opératoire* of a Madang-style *bodi*.
Source: Dylan Gaffney.

Colonial-period pottery around Madang

This modern pottery-making is a conscious attempt to maintain *kastom* in the face of the 21st century, as women increasingly find work in town centres rather than in villages. This is interlinked with reinvigorating and relearning *sing sing* dances, canoe making, and other pre-colonial technological processes to assert local identity (Suwa 2005). It is important to note that these ethnographic *chaînes opératoires* are simply the most recent analogues in long technological lines, which have been reworked during colonial disruptions and encounters in the late 19th and early 20th centuries (see Spriggs 2008). Many technological processes, especially relating to ancestor and spirit worship, initiation rituals and magic-making, were forcibly prevented by the Lutheran Church, and German and Australian administrators (Mennis 2006:138). I have elsewhere used ethnohistorical information to outline the interplay between ceramic *chaînes opératoires* and this time of dramatic social flux around Bilbil and Yabob (Gaffney 2018). This not only stretches out the technological process—from a synchronic ethnographic snapshot to longer diachronic flows—but also examines the archaeologically intangible aspects of pottery-making, which were once key to production and exchange.

During the colonial period, the Bilbil and Yabob were forcibly moved from offshore islands onto the mainland, and a number of pottery centres seem to have disappeared. This movement changed the dynamics of raw material procurement as potters could then access materials without having to maintain land use rights with different coastal peoples. This also led to shifts in sand temper selection, as potters chose mainland volcanic sands over calcareous sands from the offshore uplifted islands, although clay sources remained the same.

An examination of Madang-style pots in Australasian museums² and ethnographic accounts (Kakubayashi 1978; Maahs 1949; May and Tuckson 2000:195–196; Mennis 2006; Miklouho-Maclay 1975; Smith 1967; Werner 1911) shows that despite these forcible relocations, procurement shifts, prohibitions on *kastom* and even the attempted introduction of European-style wheel throwing in the 1960s, the technology of the *vai* has remained relatively invariant (Figure 13.3). The only minor modification to forming has been the addition of a carination, formed during paddling, which may have been innovated during World War II while Bel potters were displaced around the north-east coast. Alongside invariance to the ‘traditional’ ceramic *chaînes opératoires*, the Bilbil and Yabob have been highly innovative in developing complimentary ‘tourist’ pottery, which shows how technological processes can either mutate or persist in the face of changing consumers and social upheaval (Gaffney 2018).

Despite formal consistency in ‘traditional’ pottery, the ethnohistorical literature demonstrates that pottery-making did not operate on its own, and was inexorably intertwined with other technological processes such as magic-making. Oral traditions suggest that the clay, temper and slip procurement, along with the collection of firing materials, water and sago paste for polishing, likely required an active knowledge of magic and the local spirit world (Mennis 1980b:24; see also Aufinger 1942; Hannemann 1944; May and Tuckson 2000; Mennis 2006, 2011, 2014). Bel magic revolved around animism and ancestor worship. This invoked the strength of the *tibud* (nature spirits) and the *meziab* (ancestral spirits) in everyday routine. *Tibud* were spirits that inhabited the natural realm: every tree, each point of land, the sea and animals. Developing a familiarity with technological processes required one to learn the *tibud* for different objects and places, and to negotiate these supernatural agents in daily life. The *meziab* were spirits of the ancestors, compiled into a singular social unit with the authority to protect and punish.

2 These museums include (1) The Macleay Museum, University of Sydney; (2) Australian Museum; (3) Auckland War Memorial Museum.

Figure 13.3. Photographs of Yabob pottery-making in 1968 taken by Robin Hide.

(1) a ball of *isol* mix; (2) spinning the rim preform; (3) adding more *isol* to the rim preform; (4) beginning to hand mould the vessel body; (5) beginning to paddle the body; (6) paddling the exterior of the *bodi*. The process is identical to the *chaîne opératoire* recorded in 2014–15 by Gaffney.

Source: Robin Hide, used with permission.

One instance of this is in the anvil stones used by Bel potters in the mid-20th century, which were passed down from mother to daughter, teacher to student (Smith 1967). These anvils contained magical properties necessary for driving out *tibud* from the raw clay. The source of these stones on the Rai Coast was perhaps the home of positive ancestral *meziab* (Tuckson 1966). As such, magic was an integral tool in the pottery production chain.

Pre-colonial pottery around Madang

Bilbil and Yabob pottery-making extends back into the pre-colonial period around 650 years, when the first Bel-speaking migrants moved to the north-east coast (Gaffney et al. 2018), and perhaps before that when Bel-speaking groups lived somewhere around the Bismarck Sea (Lilley 1986; Mennis 2006). Because we know technological knowledge must be experienced to be acquired, and technical syntaxes require extended learning procedures, we can assume that the groups who produced archaeological ‘Madang-style’ potteries were related to those who make

pots today. Especially if the *vou* was used to control which groups could pot, as it was in the 19th to 21st centuries. These archaeological ceramics closely resemble modern and colonial period Bilbil and Yabob pots, and previous researchers have correctly assumed they were made following an unbroken technological process (Allen 1971; Egloff 1975; Lilley 1986).

We can now stretch this technological process back deeper into the archaeological past using assemblages of Madang-style pottery excavated from Nunguri site (TP1) on Bilbil Island, dating from about 550 years before present through to ethnographic contact (Gaffney et al. 2018). I have elsewhere analysed these ceramics to identify the *chaînes opératoires*: the nature of raw material procurement, production techniques, decorating, finishing, use and discard (Gaffney 2016). Here, I highlight some important aspects of this research as they pertain to the diachronic nature of technological process and how this corresponds with broader society.

Geochemical analyses show that a variety of sand tempers from black, white and calcareous beach sands were mixed with locally available clays to produce *isol* (Gaffney 2016:288–302). These clays chemically overlap with the mainland sources used by Bilbil potters today, although some may be closer to those from the modern Yabob area (Gaffney 2016:396). The variation in tempers probably indicates that a number of production groups collected clays from a shared resource zone.

Analyses of the potsherds' forms and manufacturing marks—residual traces from the movements of the potter with the *isol*—indicates that each production group made pots in similar ways, following five distinct forming sequences. However, there was substantial gestural variation within each sequence and a large degree of morphological freedom in how the individual pots took form (Gaffney 2016:415). In the past, people may have been able to identify the pots of specific craftswomen, as they can today. Despite this variation, these five extended technical syntaxes were repeated over time through shared learning frameworks. They are illustrated in Figure 13.4 and show how a variety of *isol* mixtures could facilitate the production of each form. These forms were globular and included: (1) an everted rimmed cooking pot; (2) an everted rimmed cooking pot with external bevelling; (3) an everted rimmed cooking pot with internal bevelling; (4) an incurving pot probably used for cooking; and (5) an inverted and collared rimmed pot for water storage. Many of these forms may have been modified during or after production and it is likely that broken pots were used as *su* to support in-use cooking vessels. Innovations were made to some technical elements and short syntaxes, such as the addition of a bevelling stage to the inner rim in the last 300 years, but the basic roughing out, rim-preforming, paddling and anvilling, have remained relatively invariant over the centuries.

Decorations were also interchangeable within each raw material and forming sequence, and between production groups, despite following set structural rules (Gaffney 2016:337–394). I posit that these pre-colonial production groups were operating within a closely related community of practice. Within this community of practice, there was considerable mobility, translocation of potters and transfer of ideas, horizontally and vertically, which maintained technical variability within the community but prevented divergent threads clearly emerging in different production groups. This would account for substantial variation in form, materials and decoration, but conformity of five common production sequences diagnostic of the Madang-style.

Despite this variation, the application of red slip was an integral and invariant procedure throughout the archaeological deposit. This suggests that connotations with the red paint of initiates may extend deeper back into the pre-colonial past. Both people and pots became active participants in maintaining trade friendships along the coast. This may have implications for archaeologically intangible technologies along the north-east coast and for how magic and ritual were used to bind ceramic production processes together in the deeper past.

Figure 13.4. Five archaeological *chaînes opératoires* represented on Bilbil Island in the archaeological past.

Source: Dylan Gaffney.

Lastly, decorations on archaeological ceramics are dissimilar to 20th century examples. I have elsewhere suggested that appliqué and incised decorations on potsherds from the pre-colonial period would have been further allusions to scarification and tattooing rituals commonly associated with initiation around the north-east coast (Gaffney 2016:411). Just as the skin of the initiate is incised and heals over in rounded swellings, so too do the pots become incised and produce rounded nubbins around their shoulders. It is worth stating that this is not so far-fetched. Many scarification designs amongst Sepik groups are identical to those produced on historical pottery and wooden bowls (see designs in Schechter 2011; Terrell 2011), while the correlations between pottery decoration and tattooing have long been cited (Kirch 1997:131). We here see the mutual growth of initiate and material culture.

Discussion

Having outlined this technological process from the ethnographic present and back into the archaeological past, I now pick out several themes—growth, personification, magic and ritual—which appear to be integral to this technological process. These themes echo other studies from around Melanesia. The most obvious, classic analogy to this is in Malinowski's (1922) description of the Kula network in the Massim, whereby *mwali* and *soulava* shell valuables are seen as active, named participants as they build and reinforce social relations during production and exchange.

In north-east New Guinea itself, James Leach's (2002) ethnographic study of *garamut* drums among the Nekgini speakers of the Rai Coast also shows how technological processes personify active agents. *Garamut* are said to have the voice of a man and, when first created, appear in the village wearing the clothes of a young initiated male. Building on Gell's (1998) description of objects with agency, Leach (2002) calls into question the classificatory schema that separate objects from the processes that bring them to life, and records the *chaîne opératoire* of the drums as they are born, initiated and later even killed (Leach 2015). The very act of *garamut* production brings forth not only the object itself, but a social world of interrelations, producing reciprocal relationships between people and their kin, growing socially efficacious 'men': both in the form of drums and initiated males (Leach 2002). Both forms, brought forth by technological processes, take on the appearance of a man.

The *garamut* production process also involves a deeper understanding of the local spirit world. Firstly, the tree is felled, which involves inciting bush spirits and invoking myth while the axe is swung. Next, the trunk is hollowed. The trunk is marked and cut, which clears the way for spirits to come in the form of birds to 'peck away the inside of the wood' and 'peel off the bark'. Thirdly, decoration is applied. The dangerous spirits are removed by shooting a bird and throwing it from the trunk into the bush. These spirits are then replaced with water spirits, who transform the musical voice of the drums. This signals that the drums are nearing completion, which is accompanied by ritual play activities that transfer the nurturing relationship between men and wives to men and their kinsfolk (Leach 2002).

In a similar example, Mary Mennis (1980a, 2011) has recorded the *chaîne opératoire* of *lalong* (trading canoe) production and use around Madang, based on oral traditions and knowledge from Bel elders who helped their fathers build canoes in the colonial period. To produce these canoes, bush material was collected with the help of the inland people, maintaining crucial, sometimes fragile, reciprocal friendships with these groups. Like on the Rai Coast, and amongst the Bilbil and Yabob potters, magic formed central technological components in these processes of production. All initiated Bel men would use some degree of magic in their everyday routine and the knowledge of how to produce magic was entangled with the technical knowledge of canoe building. Certain Bel groups speaking the Gedaged language were said to possess the

knowledge to make specific magic; the Bilbil speakers, however, could not hull canoes because they did not possess the magic with which to carry it out. This magic was the *vonu*, and this form of intellectual copyright amongst the Bel has strong affinities to other groups around the north-east coast (see Leach 2002).

Associated with this magic and belief was a secret language used in every stage of canoe building: from sharpening axes, to the hulling of logs, attaching the storage compartment, and putting on the sail (Hannemann 1944:5; Mennis 1980b:24). For instance, the Bel would pray to the *tibud* inside a tree before cutting it down to use for canoe production. Aufinger (1942) described two types of secret language used by the Bel: one of metaphor and innuendo; and another of magic words—some borrowed from other languages, others invented—with which people would speak in order to exclude the uninitiated from conversation. The latter was originally created so that sailors could speak freely while on the canoe. Evil water *tibud* were familiar with Bel languages and would listen in on conversations. This could prove detrimental to the trading trip.

Ceremonial displays were also necessary for the trade voyage to commence. Upon departure, the ‘father’ of the canoe would swim out with the canoe and fight it with a branch. The young men would stand on the platform, decorated with feathers and *mal* (loincloths), while the leader would stand in the cabin, drumming the *vongu* drum, speaking magic, and blowing on the conch shell (Mennis 1980b:44). In this context, canoes must be seen as intertwined with the broader social processes of belief, ritual and magic. Without specific magic being enacted and specific ceremonies taking place, the canoe could not take form and be initiated into the social world where, by completing trading voyages, it would reinforce trade friendships, and maintain the movement of materials along the coast (Mennis 2011:11).

Through processes of regular routine action—learning the art of canoe building and sailing—often beginning from a young age (Mennis 1980b:17), men generated and reshaped their bodily knowledge. Pushing the *lalong* out to sea, tethering the sails and understanding the winds and the stars were all part of this technological process, making knowledge and know-how at the interface of bodies, techniques and materials (following Lemmonier 1992). This process also involved learning the magic to negotiate local *tibud* at different points of land and in the water around them. While on trade voyages in the recent pre-colonial period, along with reciting secret words to evade the water *tibud*, men would throw heated potsherds into the waves to quell them (Mennis 1980b:44). It was at this point that two technological processes—pottery and canoes—wove together integrally.

These comparisons hint at a particularly Melanesian way of making objects, which become affective, personified, material actors in an almost literal sense, through technological processes of production and exchange. Emergent from these studies are distinct technological commonalities, featuring processes of growth that involve correspondence with materials, gestures and intentionality, but also magic, spirits, ritual and language. Without these delicately balanced, highly contingent ingredients, many such *chaînes opératoires* could simply not be enacted.

In much the same way as tree crops and tubers are grown in mutually informed, generative processes (Barton and Denham 2018), so too it seems are human and non-human actors grown, many of which survive for us to analyse as artefacts, albeit often in a fragmentary form. This again touches on a particularly Melanesian way of making. It involves growth and initiation into the social world in a very real sense, and results in non-human things that can take on the affectiveness of human actors. It is through technological process—the production of the *garamut* drum, the sailing of the *lalong*, the firing and exchange of *bodi* pots—that a world of social relations is simultaneously grown. And not only do these things grow such relations, but they also take on the physical forms of their human counterparts such as the voice and ears of the drum, the mouth and skin of the pot.

These things are grown into complex worlds of extant but constantly mutating networks (Knappett 2005), where they become bound up between all the other growing and living things (Ingold 2015). These emergent affectivenesses come forth into a world of interrelations involving the correspondence of materials with other materials, people with people, people with materials (Knappett 2007). For instance, in Madang, pots, canoes and magic were bound together during the process of voyaging: sailors would calm the waves and any malignant *tibud* with heated potsherds (Mennis 1980b:44).

Although bringing forth pots was a way of initiating affective things into the world, these regular activities served also to produce female potters, creating specialised knowledge and identities within the production group, and along the north-east coast. Just as the Nekgini create drums, the Gedaged hulled canoes and the Bilbil produce pots, they also create elements of difference. These groups create unique technical knowledge—interwoven with historically contingent and group-specific magic, ritual and spirits—which sets them apart as different from other nearby groups, who produce other specialist products or who focus on root agriculture or fishing. Thus, the regular engagement between people and materials in specific and specialised ways simultaneously produced social boundaries (Stark 1998). These boundaries can be thought of as asymmetries in the networks of technological processes linking people and materials. They can be useful for delimiting specific social groupings or broader communities of practice, where people share ways of doing and making things (Sassaman and Rudolphi 2001). It is therefore within these social boundaries that individual and community identities are continually (re)made and played out. In this way identity is not a static entity but rather part of the process that is always in flux—always being made and remade.

The north-east coast of New Guinea can be seen as a broad community of practice, which shared modes of doing and making. We can identify different social groups by their production processes, or perhaps variations within these processes, but all of these groups were part of the broader mutative network of understanding. All used similar tools of initiation and magic to grow their products, and all understood the value of this magic, especially as it pertained to cultural property rights, and the maintenance of prestige, power and production.

Conclusion

In proposing their process archaeology, Gosden and Malafouris (2015) stress that archaeologists tend to trivialise the very processes that energise and give meaning to the materials that we study. Certainly in Melanesian archaeology, we often remove objects from their human creators so they can be more easily analysed. However, in studying technology as process one can conceive the material and social as being irreducibly linked.

The approach presented in this essay advocates for following the *chaîne opératoire* in order to describe technical and social life in pre-colonial Melanesia—going beyond the artefact as an inert object, and untangling the specific technological processes that bring these materials to life on the human scale. Similar approaches are beginning to be taken up in many studies of Melanesian material culture (see Coupaye 2009, 2016; Ford 2012, 2017; Gaffney 2016, 2018; Gaffney and Summerhayes 2018; Gaffney, Ford et al. 2015; Lagarde and Sand 2013; Leclerc 2016; Pétrequin and Pétrequin 1999, 2006; Szabó 2004). In presenting the case of pottery-making around Madang, tracing this technological process back through time and drawing comparisons with other technological processes on the north-east coast, we see there are commonalities in how groups in this part of Melanesia bring forth material actors, materialise meaning and grow social relationships. Melanesian archaeology is well suited to investigate these processes and contribute to the wider theoretical discourse in anthropology.

So, where do we go from here? Can we track these processes back deeper through time based on commonalities in *chaînes opératoires*? Did Lapita ceramics come into being, acting as affective material actors in solidifying crucial production and exchange relationships between groups, involving magic, intellectual property rights and ritual performance? The red slip of Madang-style ceramics seems to be the last living descendant in New Guinea from Lapita slipping techniques. Does this imply that, along with dentate stamping representing tattooing, red-slipped Lapita vessels symbolised the paints of initiation? Certainly the Lapita face motifs are an obvious indicator that these pots may have been personified in some way, perhaps as ancestor figures (Kirch 2017:96). Further back in time, did technical syntaxes such as the production and exchange of ornate obsidian stemmed artefacts in the mid-Holocene (e.g. Torrence et al. 2009), or even the cutting and grubbing activities associated with waisted tools in the Pleistocene (e.g. Ford 2017), rely on magic words and ritual performance? These questions are purely speculative, and this essay has not tried to tackle them here. But by posing these questions we can begin to enliven many of the archaeological narratives we produce for understanding the human past in Melanesia, examining the fascinating in-between of the technological process.

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