Hammering Out an Agreement: Reconciling Processual and Post-Processual Theories of Technology

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In contrast to the essentially processualist understanding of technology that had long dominated material culture studies, in recent years anthropological thought has begun to treat artifice as an inalienably social aspect of human cultural systems. No longer seen merely as evolutionary responses to environmental factors, the physical tools a culture produces are gaining recognition, in both their forms and their uses, as loci for the enactment of social forces. An analysis of metalworking practices, based on both ethnographic and archaeological evidence, may serve to illustrate the degree to which technologies are socially predicated at all stages of the production process. Metal is a particularly apt medium for study in this regard, for at least two reasons: first, it has been worked and wielded by human hands for over seven thousand years, providing a huge corpus of material for comparison. Second, and perhaps most relevant to the present question, metals, by virtue of their combination of plasticity and strength, lend themselves to an unmatched array of forms and applications, and are thus capable of expressing the widest possible range of human intentions.

The so-called ‘standard view’ of technology, as outlined by Pfaffenberger, sees human action upon the material world in purely utilitarian terms.[1] For

1. Bryan Pfaffenberger, 'Social Anthropology of Technology', *Annual Review of Anthropology*, 21 (1992), 491-516 (p. 494).

proponents of this view, technology is an adaptive capacity, catalyzed by physical needs, and independent of social influences. Moreover, in keeping with this evolutionary characterization, it is assumed that technology develops cumulatively, progressing unilinearly toward a perfect homeostasis with its environment. Budd and Taylor note this tendency within archaeometallurgy's typical framing of prehistoric metal artefacts purely as the end result of processes of rational scientific enquiry, an interpretive limitation they trace back to Gordon Childe's sequential scheme of technological progress and his discomfort with 'the underdeterminacy of archaeological evidence regarding the reconstruction of prehistoric social organization'.[2]

A critique of the standard view may begin with the observation that 'needs' are, in many cases, socially defined. 'What seems to us an incontrovertible need, for which there is an ideal artefact, may well be generated by our own culture's fixations'.[3] The values and norms of a society can have an influence as strong or stronger than the autonomic biological systems of a human being in determining what a person 'requires'. Indeed, the choices, either individual or institutional, made in consideration of social factors are often at odds with considerations of health and safety. In turn, as Wilk argues, not only the determination of the proper application of a technology, but also technological change itself can be motivated by such socially-defined needs.[4] The introduction of a new technological capacity carries with it an array of potential applications, the desire and demand for which will determine the subsequent pattern of technological development and adoption.

The social definition of needs is not simply a matter of creating new demands, however, as societies also define the limits of what a person may reasonably be allowed to desire, constraints often determined by social class. Norms governing needs and desires remain largely unconscious until confronted with alternatives to

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2. Paul Budd and Timothy Taylor, 'The Faerie Smith Meets the Bronze Industry: Magic Versus Science in the Interpretation of Prehistoric Metal-Making', *World Archaeology*, 27 (1995), 133-143 (p. 134-136).

3. Pfaffenberger, 'Social Anthropology of Technology', p. 496.

4. Richard Wilk, 'Toward an Archaeology of Needs', in *Anthropological Perspectives on Technology*, ed. by Michael B. Schiffer (Albuquerque: University of New Mexico Press, 2001), pp. 107-122 (p. 108).

those standards, and the ultimate promotion or rejection of a new possibility depends upon the outcome of a contest of influence between those who stand to gain from its adoption, and those whose interests would be undermined.[5] Blakely, for example, interprets the syncretic introduction of Near Eastern smithing deities into Bronze Age Greek religion as part of a euhemeristic process by which new metallurgic technology from the East, with its attendant socioeconomic effects, could be assimilated into Greek society.[6] Budd and Taylor, meanwhile, suggest that the rapid adoption of iron over bronze in Eurasia from the eighth century BCE reflects a pragmatic decision by a theretofore chiefly bronze-working class to foist concerns of ritual contagion attached to the craft onto newly-emerging itinerant ironsmiths.[7] Technological innovation depends not only upon material factors, such as resource availability and extant technologies upon which new ones can be built, but also social context, consisting of entrenched power-structures and normative preconceptions concerning the use of materials and application of knowledge.

Having established that 'needs' are, to some degree, socially mediated, it follows that such needs will not necessarily be of a bio-physical nature, but may relate to psycho-social demands. It is here that another assumption of the standard view, the independence of 'style' and 'function', is revealed to be untenable. As Pfaffenberger argues, style fulfills the human need to give material expression to ideology.[8] Style and function thus form a continuum, in which stylistic elements perform a semantic function, and the superficially utilitarian choices concerning what tasks to perform, and how to accomplish them, are dependent upon the culturally-derived values and norms of the one making those decisions.[9] The opposition of style

5. Wilk, 'Toward an Archaeology of Needs', p. 115.

6. Sandra Blakely, 'Smelting and Sacrifice: Comparative Analysis of Greek and Near Eastern Cult Sites from the Late Bronze through the Classical Periods', in *Metals in Antiquity*, ed. by Suzanne M. M. Young, A. Mark Pollard, Paul Budd, and Robert A. Ixer (BAR International Series, 792, 1999), pp. 86-90 (p. 86).

7. Budd and Taylor, 'The Faerie Smith Meets the Bronze Industry', p. 140-141.

8. Bryan Pfaffenberger, 'Worlds in the Making: Technological Activities and the Construction of Intersubjective Meaning', in *The Social Dynamics of Technology: Practice, Politics, and World Views*, ed. by Marcia-Anne Dobres and Christopher R. Hoffman (London: Smithsonian Institution Press, 1999), pp. 147-164 (p. 149).

9. Pierre Lemonnier, 'Introduction', in Technological Choices, ed. by Pierre Lemonnier (London:

and function parallels the opposition of 'art' and 'technique', 'one instance of the more general dichotomy in Western thought between freedom and necessity'.[10] This dichotomy is a demonstrably false one, as the raw materials and tools to be used in a given technique are often determined by 'the symbolic values [a society] attributes to those elements rather than in any physical necessity'.[11] For example, Sofaer describes how the Bronze-Age pottery industry at Százhalombatta, Hungary, utilized a method of attaching handles to vessels that appears to be a direct borrowing from contemporary metalworking, despite its functional inferiority in the ceramic medium.[12] Marcel Mauss, too, recognized the embeddedness of technique within normative cultural tradition.[13]

'Meaning', then, is not simply expressed through the form of an artefact, but implicit in the techniques of its manufacture and use as well. Like any other cultural system, techniques of production and application are learned, not inherent, and thus carry with them the cultural baggage of the context in which they are transmitted. As Mauss explained, 'any human action on the material world […] is a traditional behavior learned by individuals. We also know that such techniques tend to vary from one human group to another'.[14] Likewise, Hoffman and Dobres contend that 'technology is also about and cannot be divorced from social relationships; knowledge, skill, and contexts of learning; and the construction, interpretation, and contestation of symbols of power'.[15] This being the case, social exigencies seemingly unrelated to technological systems may in fact closely guide how those systems evolve.[16]

Routledge, 1993), pp. 1-35 (p. 10).

10. Tim Ingold, 'Foreword', in *The Social Dynamics of Technology*, ed. by Dobres and Hoffman, pp. vii-xi (p. viii).

11. Lemonnier, 'Introduction', p. 3.

12. Joanna Sofaer, 'Pots, Houses and Metal: Technological Relations at the Bronze Age Tell at Százhalombatta, Hungary', *Oxford Journal of Archaeology*, 27 (2006), 127-147 (p. 135-137).

13. Marcia-Anne Dobres, 'Technology's Links and Chaînes: the Processual Unfolding of Technique and Technician', in *The Social Dynamics of Technology*, pp. 124-146 (p. 127).

14. Lemonnier, 'Introduction', p. 2.

15. Christopher R. Hoffman and Marcia-Anne Dobres, 'Conclusion: making material culture, making culture material', in *The Social Dynamics of Technology*, pp. 209-222 (p. 211).

16. Lemonnier, 'Introduction', p. 2.

The concept of chaîne operatoire, the ‘sequential technical operations by which natural resources were transformed into culturally meaningful and functional objects’, is one possible frame through which to infer sociopolitical relationships from technical acts.[17] For example, Dobres notes that:

> Many ethnographic studies have shown how the agency of gender is inscribed onto the world of resources and power, thereby affording certain individuals control of the objects produced, […] the technologies and technicians involved, […] the value systems that regulate the status of gendered technicians, and control of both esoteric and practical knowledge.[18]

More generally, as Pfaffenberger explains in his discussion of Bronislaw Malinowski's observations among the Trobriand islanders, the integrated cognitive package of knowledge and activities that constitute the chaîne operatoire can be appropriated by a hierarchical authority and directed toward ends that support a certain power structure.[19] Budd and Taylor, for instance, suggest that certain Bronze-Age Eurasian high-status burials featuring metalworking equipment and products may reflect the social power commanded by those in control of valued technological skills.[20] One modern ethnographic account that vividly demonstrates this concretization of power relations within a system of manufacture is that by Childs of the Toro of East Africa. Among the Toro, the ironworking industry is a locus of ideological significations, both reflecting and reinforcing a system of values through the organization and methods of production.

At the most basic level, the mechanical requirements of a Toro ironsmith's customers, generally agriculturists, place certain constraints upon the specifications and qualities of the tools he (the Toro ironworking industry employs men almost exclusively, a significant point to which we will return) forges, and thus upon his own working methods.[21] However, an examination of the successive stages of the

17. Dobres, 'Technology's Links and Chaînes', p. 125.

18. Dobres, 'Technology's Links and Chaînes', p. 129.

19. Pfaffenberger, Worlds in the Making', p. 149.

20. Budd and Taylor, 'The Faerie Smith Meets the Bronze Industry', p. 139-140.

21. S. Terry Childs, '“After all, a Hoe Bought a Wife”: the social dimensions of ironworking among

manufacturing process, beginning with that of actually locating a source of raw ore, reveals technical determinants rooted in ideas of social status, gender norms, and ritual obligations.

The job of finding new ore deposits is undertaken by parties of men, usually those who are older and already married.[22] The reason for dividing labor in this way elucidates much about how the Toro define and control social status. Among the Toro, men are ascribed greater authority than women, and older men more than their juniors.[23] Ownership rights to an iron mine, and the profits from the sale of what it produces, automatically devolve to the person who discovers it.[24] Thus, from the earliest proto-productive phase of the ironworking process, those in a dominant position within the social hierarchy restrict access to participation in order to maintain their technological monopoly and ensure the perpetuation of a status differential. Even the pottery necessary for the smelting process is produced only by men, whereas the Toro pottery industry is typically the remit of women.[25] A similar attempt to control access to an industry and its concomitant material wealth, military power, and social status is implied at the site of Iron Age Oropos, Greece. There, the physical enclosing and reorganization of space in the primary metalworking area, Doonan and Ainian suggest, may have been intended to reestablish the public perception of an aura of mystery from which the metalworkers derived their prestige.[26]

Toro definitions of status, and the norms of behavior associated with them, not only influence access to a lucrative industry, but are also themselves enacted through production processes. By adhering to, and thus reinforcing, the approved ideologies of their society, Toro ironworkers simultaneously ensure their own

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the Toro of east Africa', in *The Social Dynamics of Technology*, pp. 23-45 (p. 25).

22. Ibid., p. 29.

23. Ibid., p. 25.

24. Childs, '"After All, a Hoe Bought a Wife"', p. 27.

25. Ibid., p. 27.

26. Roger C. P. Doonan and A. Mazarakis Ainian, 'Forging Identity in Early Iron Age Greece: implications of the metalworking evidence from Oropos', in *Oropos and Euboea in the Early Iron Age. Acts of an International Round Table, University of Thessaly, June 18-20*, 2004, ed. by A. Mazarakis Ainian (Volos: University of Thessaly Press, 2007), pp. 361-379 (p. 371).

prestige, being perceived as moral exemplars.[27] As Dobres suggests, 'the display and manipulation of cultural metaphors or practical knowledge signified outwardly in the performance of particular gestural techniques are also powerful "mechanisms" for negotiating social identity and status'.[28]

Perhaps most pervasive among the proscriptions respected throughout the ironworking operation are those concerning gender, and more specifically sexual reproduction. During the mining process, all of the participating men are expected to maintain sexual abstinence, and menstruating women must stay away as their implicit failure to conceive is associated with infertility, and is thought to negatively influence the ore's productivity during smelting.[29] The smelting process itself has strong reproductive connotations which are expressed both in constraints upon the participants' behavior, and in the physical technology utilized. As the ore awaits smelting, its owner and his primary wife must observe strict sexual fidelity to one another, and once smelting has begun, all participants are to abstain during the night before they work.[30] It seems apparent that a theory of metaphysical contagion is assumed here, whereby the 'fertility' of the ore is directly related to the continence of those responsible for it. The materialization of the reproductive metaphor is carried on in the physical properties of the smelting apparatus: the paired bellows pots are designated as male and female, decorated with representations of the appropriate genitalia, and situated left and right respectively, the customary positioning of men and women in Toro social situations.[31]

Accompanying each stage of production are sacrifices and rituals overseen by a nyakatagara, a female spirit-medium, to ensure its success.[32] In addition to being the exception that proves the rule concerning the exclusion of women from the ironworking profession—a woman, but placed outside classifications of gender identity by virtue of her special status—the nyakatagara and her duties exemplify the incorporation of ritual considerations into a technical process. Evidence for

27. Childs, '"After All, a Hoe Bought a Wife"', p. 38.

28. Dobres, 'Technology's Links and Chaînes', p. 135.

29. Childs, '"After All, a Hoe Bbought a Wife"', p. 30, 32.

30. Ibid., p. 31.

31. Ibid., p. 32.

32. Ibid., p. 27.

craftworkers taking measures to garner supernatural assistance in their work also appears archaeologically. As noted by Blakely, in contradistinction to her interpretation of the contemporary situation in Greece, noted above, the juxtaposition of ritual areas with sites of metallurgical production in the Near Eastern Bronze Age may well indicate appeals by technicians to divinities who could grant protection during dangerous industrial procedures.[33] Also, whether Blakely's explanation for the Greek adoption of imported religious practices is accepted or not, Doonan and Ainian have suggested, on the basis of architectural features, possible evidence for the spatial association of ritual and metallurgic practices at Iron Age Oropos, Greece.[34]

Socially-determined practices are not, however, simply peripheral to the immediate processes of actually working metals, or performing any other industrial task. Cultural preconceptions about the proper forms of various implements will determine, to a great extent, the classification and subsequent use of any manufactured item encountered. There is potentially little necessary difference, for example, between the shape of a hoe and that of an axe, but their subtle morphological distinctions make their respective functions obvious to anyone who has been acculturated to their uses, and their makers will have such distinctions in mind while shaping them. In other words, ‘technologies […] make concrete people's attitudes about the right (and wrong) ways to make and use things’.[35] Learned technical methods carry with them implicit design assumptions that are often divorced from practical necessity. Also incumbent upon craftspeople are the sometimes competing demands of turning a profit and ensuring future business, both of which bear upon choices made during the manufacturing process. As Keller notes, the choice of materials and degree of care with which a project is undertaken are mediated by the need to balance economic efficiency with maintaining one's reputation as a skilled and reputable craftsperson.[36]

Conversely, technical knowledge may be applied in the course of activities that are not directly related to the manufacture of a finished product. One exemplary

33. Blakely, 'Smelting and Sacrifice', p. 86.

34. Doonan and Ainian, 'Forging Identity in Early Iron Age Greece', p. 369.

35. Dobres, 'Technology's Links and Chaînes', p. 128.

36. Charles M. Keller, 'Thought and Production: Insights of the Practitioner', in *Anthropological Perspectives on Technology,* ed. by Schiffer, pp. 33-45 (p. 36).

case is that reported by Hoffman of the Late Bronze Age site at Son Ferrandéll-Oleza, Spain, where an assemblage of intentionally-damaged bronze blades was found buried beneath a stone tower.[37] As Hoffman explains, the blades were apparently deformed using techniques that imply significant metallurgical knowledge and skill. It is unclear whether they constituted a votive deposit, or were intended to be recovered at a later time, but in either case their willful destruction, carried out by someone with the technical knowledge specific to their manufacture, demands a social rationale, whether it be ritual prescription demanding the objects' nullification, or simply an attempt to discourage the theft of a valuable commodity.

Returning to the example of Toro ironworking, it would seem to clearly fit the definition of a 'sociotechnical system', characterized by Pfaffenberger as a cohesive network of social actors, ideologies, technologies, and environmental resources and constraints.[38] One integral element of such a system is the reciprocal relationship between the organization of labor and the organization of society. On one hand, it is 'technology in concert with the social coordination of labor, that constitutes a human population's adaptation to its environment'.[39] However, as Pfaffenberger goes on to note:

> One can argue that a major rationale for the creation of sociotechnical systems, beyond mere Necessity, is the elaboration of the material symbols that are indispensable for the conduct of everyday life. And one can identify here another form of linkage, as yet unexplored: the linkage between the rituals that coordinate labor and the rituals that frame human social behavior by employing material artefacts as cues.[40]

Sofaer, for example, suggests that the evident transfer of technological knowledge between the ceramic and metalworking industries at Százhalombatta may imply

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37. Christopher R. Hoffman, 'Intentional Damage as Technological Agency: Breaking Metals in Late Prehistoric Mallorca, Spain', in *The Social Dynamics of Technology*, pp. 103-123 (p. 116-117).

38. Pfaffenberger, 'Social Anthropology of Technology', p. 499.

39. Ibid., p. 497.

40. Ibid., p. 505.

close social interaction between their respective practitioners.[41] In the case of the Toro iron industry, as described above, the organization of the workforce reiterates and reinforces ideas about the proper organization of society. The older, male members, dominant in the social hierarchy, primarily control and benefit from the mining and smelting operations. At the same time, values relating to sex roles and the proper functioning of the family unit are communicated both through the proscriptions observed by those involved, as well as the qualities imputed to the material apparatus itself.

Any human activity that involves producing for, or acquiring products or raw materials from other humans is inherently social, in effect forming or redefining interpersonal relationships. The preceding discussion of several metallurgic industries has sought to demonstrate how, in the seemingly straightforward act of making something, people are simultaneously guided by and reproducing parts of their cultural blueprint. That blueprint incorporates the values, beliefs, techniques, relationships, and identity assignments recognized by a group, which are variably interpreted, assimilated, and acted out by its individual members. As Dobres suggests, in the act of material production 'individuals create and localize personal and group identities'.[42] It is obvious that any process of manufacture is constrained by the material environment, as well as the idiosyncrasies of the manufacturer's skill and intent, but it must be recognized that skill, intent, and even the perception of 'natural' constraints are all mediated by the social context in which they occur.

41. Sofaer, 'Pots, houses and metal', p. 137.

42. Dobres, 'Technology's Links and Chaînes', p. 129.