6. Technology's Links and *Chaînes:* The Processual Unfolding of Technique and Technician

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ARCHAEOLOGICAL STUDIES OF TECHNOLOGY have been revitalized significantly in recent years by the introduction of an analytic method known as *chaîne opératoire.* André Leroi-Gourhan was the first to name and apply this analytic technique to archaeological inquiry, and today *chaîne opératoire* analysis is employed to detail with extraordinary precision productive sequence(s) and decision-making strategies of raw material transformations, past and present. It is, however, far more than an analytic tool for identifying and describing the material "life history" of artifacts. *Chaîne opératoire* can be a powerful conceptual framework—a methodology—providing technology studies with both the empirical rigor they require and the human face they deserve. In this chapter I argue that *chaîne opératoire* is, at one and the same time, an interpretive methodology and analytic method capable of forging robust inferential links between the material patterning of technical acts and sociopolitical relations of production accounting for them. Although the analytic method of *chaîne opératoire* research is utilized most often to identify the prehistoric mental "maps" (or so-called world views) structuring rule-governed technical activities, as a conceptual methodology (and not simply an analytic method; distinction in Harding 1987), it can be especially helpful in considering the dynamic social milieus and artifice by which material acts were differentially pursued by technicians and variously organized work groups.

This discussion will, I hope, contribute to the revitalization of research on prehistoric technology in two ways. First, it directs attention to some of Mauss's long-forgotten views on technology, in particular his argument that technology is a "total social fact" encompassing more than the material and gestural actions

transforming natural resources into cultural products. The next step is to infuse this redefinition with a healthy dose of contemporary social theory, by taking up the question of social agency (especially gender) that is implicated in expressions of self-interest and social identity through technical means. These ideas suggest some ways that the preservable traces of gestural acts of prehistoric artifact production and use can serve as an inferential link to the social agency of the technicians themselves. The discussion is substantiated with reference to a particular social formation of interest to much of archaeological inquiry, the communal mode of production (CMP). Contemporary examples include cases prominent in ethnoarchaeology, such as the !Kung San (Ju/'hoansi), Chipewya, and Iñupiat, and also the Israeli *kibbutz,* which shares relevant structural commonalities. Two archaeological examples from the French Late Upper Palaeolithic round out the discussion.

THE *CHAÎNE OPÉRATOIRE* AND WHAT'S HIDDEN IN BLACK BOXES

To date, *chaîne opératoire* is primarily an analytic tool successfully applied to two fundamental kinds of research questions. The first and most basic is to identify the sequential technical operations by which natural resources were transformed into culturally meaningful and functional objects (Pelegrin et al. 1988). As a major interpreter of Mauss and Leroi-Gourhan for contemporary interests, Lemonnier (1989, 1992a) describes technical activity as the interplay of five heuristically separated elements: matter, energy, objects, gestures in sequence, and knowledge. Clearly, the first three elements share much in common with classic neoevolutionary theory, wherein a cultural system is only considered as adaptive as its ability to transform matter and energy into efficient and viable cultural (survival) behaviors. The latter two elements of a technical activity, gestures in sequence and technical knowledge, derive from Mauss's concept of *enchaînement organique* (discussed next).[1] Taken together, the study of these five elements is supposed to permit an understanding of the sequential physical actions and decision-making strategies by which matter was transformed into culture-bearing objects. However, this chapter argues that only if we explicitly ask about social agency and the context-specific nature of social relations of material production can we comprehend the anthropological dynamics of technology (Dobres and Hoffman 1994).

Once the technical sequences by which artifacts were fabricated, used, and repaired are identified, *chaîne opératoire* research is employed most often to infer something of the abstract cognitive processes and underlying normative logic systems structuring those acts (see especially Pelegrin et al. 1988; Perlès 1992; essays in Renfrew and Zubrow 1994). Without doubt, the idea that preservable traces of artifact manufacture can be analyzed (through studying its technical chain) to

identify deep-seated mental maps has provided archaeology with a major theoretical and analytic advance by researchers on both sides of the Atlantic (as in Lechtman 1977, 1984).

Nonetheless, a major strand in the web of interwoven social and material "threads" constituting technology lies somewhere *between* the sequential physical gestures of material culture production and use and the abstract cognitive frameworks structuring those activities. This particular thread concerns technicians, technical artifice, and dynamic interpersonal social relations of production (Dobres 1995a, forthcoming; Dobres and Hoffman 1994). For all the current focus on the structural "grammars" and the symbolic dimensions of prehistoric technologies, rarely do we explicitly theorize about the dynamic interactive social relationships through which all this symbolic and cognitive object-making and use took place. Even with more conventional interests in the "organization of technology" (typically pursued through cost-benefit analysis), explanatory models are rarely explicit on the dynamics of self-interested technical agents, the artifice of technical acts, much less the particular sorts of interpersonal relationships implied (Pfaffenberger 1988; Winner 1986). Without explicit attention to the socially constituted nature of technical acts and technical choice (those, for example, through which tacit mental maps were followed so faithfully or by which the physical and mechanical properties of raw materials were discovered or circumvented), neither the material nor mental processes involved will be adequately understood. Another way to think of this is that without attention to the hows and whys of everyday technical agency and the social contexts of those activities, descriptions will be little more than static (albeit sequential) rather than dynamic accounts of anthropological processes played out in and on the ancient material world.

Mauss's Enchaînement Organique *and Technology: A Total Social Fact*

Leroi-Gourhan's concept of *chaîne opératoire* derives from the ideas of the French ethnologist and sociologist Marcel Mauss (1935). As Durkheim's student, Mauss was interested in how social collectives articulated and maintained their mutually shared beliefs and traditional ways of acting in everyday life. Insightfully, he realized that technical acts were an integral part of the everyday way in which cultural traditions were maintained and passed on. At the same time, Mauss was interested in the body of collective knowledge underlying technical acts and how technical *connaissance* and *savoir-faire* were reaffirmed through routine physical gestures. For Mauss, then, technical knowledge involved more than understanding the physical properties (and limits) of raw materials and the practical knowledge enabling artifact production and use. It was also important to understand how technical *savoir-faire* was passed from generation to generation, embedded

with value and significance, and reaffirmed through systems of kinship and apprenticeship. For Mauss, technology was dynamic and social to the core.

As an ethnologist, Mauss was especially interested in the *enchaînement organique* by which natural resources were sequentially transformed into useful cultural objects through bodily gestures practiced in socially constituted milieus. In keeping with Durkheim's lifelong interest in social solidarity, Mauss (1924) believed it necessary to move upward in analytic scale, from an understanding of the individual as *homo faber,* to that of the social collective and the enframing traditions within which individual techniques were practiced. He saw bodily techniques as integral to the everyday reproduction of society; thus he conceptualized technique as firmly embedded in normative cultural tradition (1935). Much like Heidegger (1977), Mauss argued the importance of understanding technical acts as they "unfolded," as they were in the process-of-becoming, for that was a key locus for the simultaneous production and reiteration of cultural meaning and practical action. This physical process of artifact-becoming-in-a-social-milieu is not only central to Mauss's concept of *enchaînement organique.* It is a physical link between artifactual and cultural reproduction that can be of special import to archaeologists. In sum, *chaînes opératoires* are of a decidedly social, collective, and material nature and show that technologies link together social, biological, gestural, and material transformative processes (Schlanger 1990).

Leroi-Gourhan: Methodologist and Evolutionist

It was André Leroi-Gourhan who provided these ideas with much-needed analytic rigor and introduced them into archaeology (Lemonnier 1992b). But in so doing, he also narrowed Mauss's total social fact to its more tangible side. As a student of Mauss, Leroi-Gourhan well understood that gestural sequences were rooted in ethnic traditions and entrenched in communal memory (Leroi-Gourhan 1964a:66). But as an archaeologist, he intellectualized technology at two vastly dissimilar scales: empirical traces of individual technical gestures, and macroevolutionary processes (Lemonnier 1992b:15–16; Pelegrin et al. 1988).

In his more philosophical reflections, Leroi-Gourhan explored the relationship between the somatics (or biology) of technical gestures and the technical act. In particular, he focused on the integration of bodily technogestures with the physicality of objects themselves (especially, 1943, 1945, 1964a, 1964b). But rather than explore how body and object integrated into an inseparable and total *social* phenomenon at the scale of everyday practice (as did his mentor), he concentrated on their evolutionary implications. For Leroi-Gourhan, the first meaningful act of distance and separation was between humans and their (material) technology, for example, in the evolutionary shift from the use of the hand *as* a tool to

the hand *holding* a tool (Edmonds 1990:67; see more generally Ingold, in the Foreword to this volume). In contrast, Mauss focused on the ways *chaînes opératoires* were acquired through connections to the social body, through both direct and tacit education, *savoir-faire,* routinization, and even through self-awareness on the part of the working technician (see also Dobres forthcoming; Heidegger 1977; Ingold 1990, 1993a, 1993b).

Nonetheless, Leroi-Gourhan's introduction of *chaîne opératoire* into archaeological research began a critical and important shift away from the study of artifact morphology, typology, and function and toward an interest in the dynamic "life histories" of artifacts (see also Kopytoff 1986:84; Schiffer 1975, 1992b).

ON THE SOCIAL AGENCY OF *CHAÎNES* AND LINKS

Technologies are dynamic acts of social and material transformation: they serve as media through which social relations and world views are expressed and mediated; they materialize and make concrete people's attitudes about the right (and wrong) ways to make and use things; and, technologies take shape as they "take on" meanings and values by virtue of how technicians engage with each other while taking care of business (see also Pfaffenberger chapter 7 in this volume). In my desire to infuse the archaeological use of *chaîne opératoire* with a more dynamic human face, I find it especially useful, indeed necessary, to bridge the artificial barriers separating the many disciplines interested in technology from one another and from archaeology (Dobres and Hoffman 1994; Dobres forthcoming). Thus, I am in sympathy with philosophers, historians, sociologists, and sociocultural anthropologists who together define technologies as integrated *webs* weaving skill, knowledge, dexterity, values, functional needs and goals, attitudes, traditions, power relations, material constraints, and end-products together with the agency, artifice, and social relations of technicians.

For archaeologists, it is especially important to explore the parallel between technologies as acts of material transformation and technologies as acts of social transformation. As both Marx and Engels (1970:42–45) and Childe (1936) understood, through acts of material transformation people effect their own social transformation. And though this dialectic has long been recognized on a societal (evolutionary) level, theories of ancient technology have been relatively silent on how individual social identities were defined, expressed, and negotiated—that is, transformed—during technical acts. It is on this topic that *chaîne opératoire* can be of special methodological *and* interpretive value.

Contemporary theories of social agency can illuminate some of the above concerns by helping archaeologists understand how ancient technicians might have tried to situate themselves in relation to others while engaged in everyday

technical pursuits (Dobres and Hoffman 1994; see also Cross 1990; Dobres 1995a, 1995b). In general, theories of social agency make sense of cultural practice as routinized and habitual actions in which women and men, children and elders engage on a day-to-day basis. As such, mundane and habitual social interaction lies at the heart of cultural practice and culture change. Modeling daily life at the microscale, therefore, becomes necessary to understanding more macroscale cultural and transformative processes (Marquardt 1992; see example in Roux and Matarasso chapter 3 in this volume). In the course of daily interaction, individuals express various kinds of interests, both personal and collective. In such arenas, the dynamics of interpersonal social relations inevitably lead to tensions and conflicts that require mediation and resolution. Nowhere is this *processual* dynamic more evident than in the daily practice of habitual technical activities.

For example, many ethnographic studies have shown how the agency of gender is inscribed onto the material world of resources and power, thereby affording certain individuals control of the objects produced, control of the technologies and technicians involved, control of the value systems that regulate the status of gendered technicians, and control of both esoteric and practical knowledge (see outstanding examples in Herbert 1993; McGaw 1996; MacKenzie 1991; Schwartz Cowan 1979). Therefore technologies are, at one and the same time, arenas in which agents construct social identities and forge power relations while also producing and using utilitarian objects for practical ends.

The conceptual framework of *chaîne opératoire* can link together the tangible and intangible dimensions of technological practice by regarding techniques as gestures undertaken in the "public" domain. At the same time, the analytic methods of *chaîne opératoire* research make it possible to link the archaeological record, comprised of static yet tangible remains of ancient technogestures, to the dynamic social milieus in which they were practiced. *Chaîne opératoire* research provides an excellent starting point for establishing such links, because it is specifically designed to identify and describe the material sequence(s) of gestural acts through which natural resources were modified (and remodified) into culturally useful objects. The idea in this chapter is that *while* undertaking productive activities, individuals create and localize personal and group identities, making statements about themselves that are "read" by others with whom they are interacting. Technical acts can thus be treated as a medium for defining, negotiating, and expressing personhood.

As Childs' ethnographic study in chapter 2 illustrates, social identity, status, power, privilege, and access to important cultural objects are inseparably interwoven facets of a single complex dynamic. A Toro man cannot "buy" a wife until he has access not only to the means and forces of iron production, but also to the esoteric and practical knowledge and skills necessary to become a viable iron maker. Only when these factors come together in specific times and places in the

life histories of individual men can they acquire wives, a living, and social status. Can we possibly understand the complexity of Toro iron working without making these social dynamics and world views an integral part of materials analysis? Archaeologists need not restrict themselves to the observable present when asking about such processes. As an analytic method, *chaîne opératoire* provides the means for inquiring into such dynamics in prehistory.

Chaîne opératoire is explicit with respect to tracking the material and functional life history of artifacts. But as a corollary, *transforming natural resources into cultural products engenders the life history of technicians* (Dobres 1995b, forthcoming; Heidegger 1977). For example, as but one notable social identity cross-cut by many others, gender is not an immutable social category of person. What makes gender a cultural dynamic—that is, a process not an entity—is that it is *processed* throughout the life cycle (Moore 1986; Wolf 1974). Over the course of their lives, people move in and through salient cultural categories that conflate age, sex, and sexuality in complex ways: newborn, virgin girl, circumcised boy, pregnant wife, husband, skilled craftsman, father, mother-in-law, grandfather, divorcee, widow, and so forth. Gender, especially when conflated with age, has a sequential dimension not unlike a *chaîne opératoire*. Each gendered persona can, and typically does, confer new and different statuses on an individual. More to the point, gendered identities are processed, marked, and negotiated during one's life through the particular way individuals engage with one another while pursuing technical activities. Gender is, therefore, "manufactured" (de Lauretis 1987:9) in ways that resonate with the manufacture of material culture (for another example, see Lechtman's Afterword to this volume).

Attention to the ways individuals negotiate cultural categories does not ignore the fact that there are proscribed normative behaviors communities expect individuals to follow. Nor does it have to mean that social identities are something people consciously negotiate with every breath they take. Here is where Bourdieu's (1977) concepts of *habitus* and routinization are useful. They suggest how the seemingly inconsequential, mundane, and everyday acts of producing and using artifacts serve to habituate individuals to the codified social categories on which expressions of personhood may rest. It is in balancing expressions of self-interest against cultural norms and expectations that the dynamics of social relations of production become especially salient (see Hoffman chapter 5 in this volume).

THE DIALECTICS OF GENDER AND TECHNOLOGY

Once a conceptual parallel is established between making gender and making material culture, it becomes clear just how intertwined they are in everyday life. In particular, as McGaw (1996) and Pacey (1993) show, even what is defined a priori as "technology" stems in large part from gender ideologies and value systems, and that the two are inseparable:

> "Technology," like "economics," is a term conventionally defined by men to indicate a range of activities in which they happen to be interested. . . . Nearly all women's work, indeed, falls within the usual definition of technology. What excludes it from recognition is not only the simplicity of the equipment used, but the fact that it implies a different concept of what technology is about. Construction and the conquest of nature are not glorified, and there is little to notice in the way of technological virtuosity. (Pacey 1993:104)

There are few jobs that are not at least ideologically associated with particular genders, that do not differentially reward the players, and that do not also conjure up gender idioms. For example, in Western industrial societies men build and *mount* bridges, *erect* skyscrapers, and *man*-ipulate natural resources into cultural objects—all of which are unequivocal technical acts that simultaneously serve as powerful idioms of masculinity. In contrast, women's stereotypic share in codified divisions of labor turns on seemingly natural activities: having babies or nursing the young, sick, and elderly—none of which are typically thought of as technical per se, but which define femininity nonetheless.[2]

Significantly, until the advent of male-controlled Western reproductive technologies (in the sense of hard medical implements such as the speculum and, now, in-vitro fertilization), women's reproductive labor was thought of as natural and biological, but not necessarily technical. Yet even so-called natural childbirth has technical dimensions: to deliver a child safely and properly from the mother's womb requires a *chaîne* of biogestural techniques that vary cross-culturally. Such techniques combine esoteric and practical knowledge with practical skill and are supported by a particular configuration of social relationships (be they with midwives, nurses, doctors, nutritionists, or shamans). And as with any technology, the end-product is not limited to the production of a healthy baby; it includes new social positions for the mother and father, as well as the social and material power both gain within their community and from members of their immediate family (for examples, see Wolf 1974; also Childs chapter 2 in this volume). Archaeological theory rests on the largely implicit premise that prehistoric lithic and ceramic production, big game hunting, and architecture all had their technical side. This "hard" concept of technology also suggests that less material and seemingly natural activities (such as childbirth and child rearing) were not properly technical. It is clear, here, that the primacy of the hard and the utilitarian conflates with contemporary gender value systems to define what counts as a prehistoric technology (Conkey and Spector 1984; Gero 1991; Lechtman 1993). This conflation is a

prime example of what Whitehead (1927:73–86) called the "fallacy of misplaced concreteness."

Gender and Technology in the Communal Mode of Production

In the communal mode of production (CMP), the social organization of technological *production* (especially in terms of subsistence) involves material, economic, and political divisions of labor in which women and men differentially participate.[3] At the same time, *reproduction* in such societies involves divisions of labor that are said to derive from "natural" differences between the sexes, and is typically defined as activities reproducing labor itself (that is, biological reproduction) and related "domestic" activities (classic statement in Marx and Engels 1970:52). This distinction between material production and social reproduction, and between so-called political/public and domestic/private spheres leads to another problematic corollary: the kinds of work in which women characteristically engage, such as child rearing and maintenance of the domestic sphere, are neither economic, political, nor all that technical (Hartmann 1987; Pateman 1987; Rosaldo 1980).

Because women's contribution to reproduction in the CMP has not been seen as properly economic, political, or technical, many of their everyday strategies for building networks of influence, prestige, and status have not attracted the same degree of academic interest as the "hard" techniques men practice (Ortner and Whitehead 1981; Rogers 1975). There is one important exception here: where women have been found to contribute significantly to *subsistence*, theorists have noted well that such activities serve as techniques of identity, status, and power. For example, in many post-colonial hunter-gatherer and foraging societies in South Africa and Australia, women have been found to contribute upward of 80 percent of the group's daily nutritional needs through plant gathering and more reliable techniques for hunting and trapping small animals (Hawkes et al. 1989; Lee 1979:253–272, table 9.3). And indeed, in many cases where women contribute the lion's share of daily foodstuffs, they often enjoy an important degree of autonomy and independence that women in other modes of production do not (Lee 1982; Sanday 1981:133–134; but see Bloch 1975 for a sobering counterexample).

RETHINKING TECHNOLOGY: ENGENDERING THE *CHAÎNE OPÉRATOIRE*

Because the social agency of identity is implicated in people's lifelong engagement with their material world, the variety of technical activities individuals undertake should shed light on the sequential nature of their intertwined social and material lives. For archaeologists, making a conceptual link between the two

sequences—one social, the other material—sets the stage for reasonable inferences about the production (and use) of social identities through material production (and use) activities. However, as we intertwine social and material life histories in our technical study of artifacts, we must also broaden what we mean by technology (Dobres and Hoffman 1994; Ingold 1988, 1990; Layton 1974; see chapter 1 in this volume).

For example, in suggesting that archaeologists study a broader set of factors impinging on the structure of hunting activities, as but one "properly" prehistoric technology, Gifford-Gonzalez (1993:190) cogently argues the "need to consider the imperatives of the household in driving field processing decisions." Another way to think of this, as feminist anthropologists have long argued, is that a separation of the "domestic" female sphere (thought to involve food processing, cooking, and care-taking) from the supposedly more "technical" and male-oriented world (of hunting) is a *construct*—a typological distinction arbitrarily separating reproduction from production (Rosaldo 1980). As Gifford-Gonzalez (1993:187–188) puts it, "the lack of attention to cooking and culinary end-products in zooarchaeology is, I believe, attributable to unconscious androcentric bias within the field. . . . This view favors hunting—especially male pursuit, dispatch, and butchery of prey—over just about any other activity involving animals." Following the logic of *chaîne opératoire,* ancient hunting techniques were inseparable from the antecedent value systems and material context(s) structuring them; thus the before, during, and after of "the hunt" was necessarily linked to concerns extending beyond physically killing game (see also Ridington chapter 8 in this volume for an extended discussion of contemporary Athapaskan hunting technologies).

In a study of the contemporary Iñupiat (Inuit), Bodenhorn (1990:55) argues that "hunting cannot be reduced to the catching and slaughtering of animals, but rather includes a whole set of activities, both technical and symbolic, in which the interpendence [*sic*] of women and men is fundamental." Though whale hunting is described in the traditional anthropological literature as an exclusively male domain (because only men go to sea and actually spear whales), from an emic point of view Iñupiat women are directly implicated in and responsible for whale hunts. To ensure men's success on the open sea, the captain's wife must carefully comport herself in proscribed ways around their house; after all, "the whale comes to the whaling captain's wife" (Bodenhorn 1990:61). As well, through her technical skill with an *ulu* (knife) she is charged with "calling up" the whale to be killed by men (Cassell 1988). It is thus the wife's job to attract the whale and, in Iñupiat terms, "to hunt" (Bodenhorn 1993:191). Ask a whaling captain and he will tell you: "I'm not the great hunter, my wife is" (Bodenhorn 1990).

As well, among the Chipewya, "the hunt" encompasses cosmological beliefs, gender ideologies, and gendered (not sexual) divisions of labor (Brumbach and Jarvenpa 1997; Sharp 1991:190). To the Chipewya, what is important about a hunt

is not just the animal killed, but the tasks women perform to process and distribute meat and skins afterward. According to Chipewyan informants, it is the transformation of "raw" meat into cultural products (such as food and clothing) that is valued and gives value to hunting: acquisition techniques and the immediate end-product (meat) are of lesser importance (Sharp 1991). This example recalls Heidegger's emphasis on the "becoming" and processual nature of technology. It also shows why we need to broaden the current Western view of technology beyond practical concerns, efficiency, and material matters. By stressing the overlapping social and material acts of technique and technology, we are situated to put a human face to technological practices, past and present.

POLITICS, IDENTITY, AND TECHNOLOGY IN THE COMMUNAL MODE OF PRODUCTION

A key social dynamic that irrevocably links together material and social transformations is the politically charged nature of technological systems, technical acts, and end-products. Among other things, the politics of technology concern how the social labor of production is organized; who has access to the means, forces, and relations of production; what socioeconomic status(es) are at stake; and who is affected by their implementation (summarizing Bijker et al. 1987; Law 1991; Winner 1986). Studies of contemporary (industrial) technologies offer especially striking examples of technopolitics that link production, power, and personhood, but there is no basis for assuming a priori that such dynamics were not intertwined in the past as well (Bender 1989; Conkey 1991; Dobres 1995a; Gero 1991; Hayden 1994).

Knowledge and Enskilment: A Political Basis for Status

As a general rule, individuals in communally organized societies often gain status, prestige, influence, and power by demonstrating highly valued qualities for all to see. The possibility of a personal basis for position is, of course, offset by the proscribed roles individuals are expected to fill by virtue of their age, gender, kin and tribal affiliations, and so forth. Although fundamental social categories initially define one's identity(ies) and occupations, it is not through them alone that people find their place in the social collective. Such first-order identities are built upon and transformed by virtue of personality, level of skill and talents, personal history, reputation, and the possession and display of knowledge through technogestures. All of these can become the basis of social and material power (Keene 1991; examples in Ingold 1993c; Ridington 1988; Saitta and Keene 1990:205). Thus,

in both tangible and intangible ways, technological practice is directly implicated in expressing political identity in egalitarian communities.

Knowledge, especially, figures prominently as a cross-cultural basis for leadership in nonhierarchical societies (Ingold 1993a, 1993b; Keene 1991; also Ridington chapter 8 in this volume), and it is worth reiterating that technology is the juncture of knowledgeable practice and practical knowledge (Ingold 1990; Schiffer and Skibo 1987). The *concrétisation* of ideas, values, and knowledge in technical practice and end-products provides an outward expression of the metaphors and world views central to, but not necessarily shared equally by, all members of a community (Childe 1956; Lechtman 1984; MacKenzie 1991; Simondon 1958). For example, one of the salient characteristics of most Canadian subarctic egalitarian societies (among them, Cree, Dene, Blackfoot, and Ojibwa) is that social status and the acknowledged capacity and right to leadership roles, however temporary and context-specific, are achieved through participation in vision quests and other forms of knowledge acquisition (Ridington 1988).

Moreover, contrary to both Rousseau's romanticized nineteenth-century view of primitive communism and Sahlins' (1972) neo-evolutionary concept of the original affluent society, people communally organized do *not* always work smoothly toward agreed-upon ends, even in egalitarian societies.[4] In particular, social tensions and acts of contestation during everyday routines of material production and use can become a means for expressing power and influence (Conkey and Gero 1991; Dobres 1995a). In a study of the organizational and power dynamics of production on the Israeli *kibbutz*, Keene (1991:377) shows that

> within the communal mode, the social group as a whole—the commune—serves as the basis for all productive activity. Access to necessary factors of production is guaranteed to all members, and all members participate in determining the division between necessary and surplus labor. *This pattern still leaves room for internal variation and does not necessarily demand material equality or equal access to the means of production.* (Emphasis added)

Anthropologists have paid considerable attention to the ways in which men in nonhierarchical societies develop social and material privilege, for example, through their skills as hunters (Hawkes 1993), through their exchange of women (Meillassoux 1981), and even through the production and subsequent hoarding of technical knowledge and skill (discussed next). Following Ingold (1993c), I suggest that 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. Elsewhere in

this volume, Childs (chapter 2), Hoffman (chapter 5), and Pfaffenberger (chapter 7) show how creating, possessing, and displaying technical knowledge and skill over the course of one's life can translate into social power and status. In communally organized societies, then, one need not have physical control "over" material techniques and products to exercise authority: differential access to techno-scientific knowledge (Schiffer and Skibo 1987), enskilment (Pálsson 1994), and technical virtuosity (Moore 1981; Root 1983) will do as well.

THE POLITICS OF SOCIAL AGENCY IN PREHISTORIC TECHNOLOGY: TWO ARCHAEOLOGICAL EXAMPLES

My comparative study of bone and antler technology at eight broadly contemporaneous Late Magdalenian sites in the French Midi-Pyrénées (ca. 14,000–11,000 years B.P.) identified extraordinarily variable sequential operations of artifact production, use, and repair around the region. Site-by-site, the actual choice of technical sequences used to manufacture, use, and repair harpoons, spear points, needles, and the like was structured *neither* by artifact physics *nor* by functional necessity. The guidelines for making, using, and repairing objects of the same raw material and even those of similar function were not based on objective conditions. Even among similar classes of artifacts retrieved from similar "site types"—such as needles at base camps and harpoons at upland seasonal ibex hunting sites—on-the-ground technical practices varied along almost every measurable attribute (Dobres 1996). Across the region there was no one "best" (or singularly "Magdalenian") way to make, use, decorate, or repair harpoons, points, and needles. Technical decisions were site-specific.

This evidence contradicts the notion that Late Magdalenian hunter-gatherers went about their daily lives faithfully following normative technocognitive maps maintained through a conservative cultural work ethic. Although they may have carried in their heads a roadmap of techniques to get a job done, *in practice* their strategies varied considerably. What, then, can account for these observable patterns?

When technical agents work in communal contexts, they are at least tacitly aware of each other's bodies and actions (Graburn 1976). And as Mauss recognized, when people are so engaged, even subtle bodily movements become a communicative medium. How individuals comport themselves while undertaking everyday technical activities, then, becomes a form of silent social discourse. "The very practice of a technique is itself a statement about identity: there can be no separation of communicative from technical behavior" (Ingold 1993b:438). People express interests of many kinds while making and using material culture, and as a general rule, there is a cacophony of messages communicated through

technical body language. Fortunately, ethnoarchaeological and replicative experiments on the spatial patterning of material *chaînes opératoires* allow archaeologists to delimit with some precision the different contexts in which ancient artifacts were fabricated, used, and repaired on a site-specific basis. Because they were so often undertaken in what I like to call public contexts, where a variety of productive activities were going on simultaneously, ancient technical gestures were surely a total social fact. Intended or otherwise, technogestures so contextualized served as silent codes of discourse localizing identities of various sorts.

The gestural dimensions of Late Magdalenian organic technology can be understood as a sort of body language acted out in differently constituted contexts of social and material interaction. The technical evidence I have identified at individual sites in the Haute-Garonne and Ariège, specifically, attests to a significant degree of choice in how Magdalenian *chaînes* were actually practiced. It further points to the likelihood that in the day-to-day pursuit of such activities personhood was mediated through material means. For example: at La Vache, the highly variable patterning of harpoon barb construction suggests that technicians had individualized strategies for making them either longer, sharper, more curved, or thinner than those of their neighbors; at Les Eglises and Mas d'Azil, only a few bone needles show the successful completion of a highly skilled technique for piercing them with perfectly round eyes, while others betray an obvious lack of competence that those "in the know" could not have failed to observe; also at La Vache, only a few individuals (perhaps one) whittled an extra set of depressions on the base of their spear points, and through this, demonstrated materially (yet without recourse to overt self-aggrandizement) a special knowledge of hafting tricks learned over time. These subtle empirical variations in technical, functional, and morphological attributes imply an individualized level of *enchaînement organique* that would have been both visible and meaningful to one's neighbors, for as Graburn (1976:21) notes: "In small-scale societies where everything is everybody's business, there is little anonymity, and most people would know the details of style, the aesthetic choices, and even the tools of their contemporaries." It seems likely that the sorts of observable differences in Late Magdalenian technogestural strategies practiced on the ground contributed to localizing and materializing the identities and statuses of the technical agents performing them.

In the Paris Basin (also during the Late Magdalenian), French researchers have similarly suggested that technical knowledge was differentially practiced and shared under a system of tutelage they call apprenticeship (Karlin and Pigeot 1989; Olive and Pigeot 1992; Olive et al. 1991; Pigeot 1987, 1990). *Chaîne opératoire* research has been able to identify variable skill levels in blade production at Etiolles (Essonne) and their differential spatial distribution around discretely separated hearths. These data have been used to suggest that a hierarchy of interpersonal relationships (within family units) created and defined differential access to the prac-

tical and manual skills required to fabricate expert blades. Through the extraordinarily rigorous spatial mapping of variable qualities of blade manufacture, retouch, and repair "life" sequences, these mundane and practical endeavors have been resituated in something of their original social milieu. In turn, they have permitted reasonable inferences about the technical agency of ancient technological practice.

DISCUSSION

In these two archaeological examples, the French analytic of *chaîne opératoire* research has been employed to identify a number of interrelated factors structuring Late Magdalenian organic and lithic technology. Keeping the focus on the contours of site-specific social interaction, both studies concentrate on empirical remains to infer the organizational dynamics accounting for them (see also Roux and Matarasso chapter 3 in this volume). While still in their infancy, these two attempts demonstrate that *chaîne opératoire* research can be helpful in elucidating the socially constituted and intertwined histories of artifacts and artifice, products and people, and material actions and sociotechnical agency. Analytically and conceptually, we are now in an excellent position to establish even stronger anthropological links between static artifact patterns, traces of technogestural sequences, and the dynamic social contexts through which they materialized.

The preceding discussion has placed inordinate emphasis on the word *process*, arguing that social identities, subsistence activities, and artifact production all come about through sequentially organized technical activities. Allusion to the process-ing, or transformation, of both personhood and products is intentional, because technology always involves the recursive making of culture, agents, and material culture. For me, this means technical research needs to concentrate more on the *interrelationship* of social and material factors that combine to produce end-products, be they artifacts, the hunt, or individuals. Agents who move in and through specific material activities are embedded in, and thus bring with them, an extensive array of concerns and interests. The implications of technology's links and *chaînes* are ironic: while the material nature of the archaeological record often makes the dialectic of artifact and artifice hard to remember, it is also this tangible body of evidence that serves as our link to the intangible processes once involved.

Technology is no less than a materially grounded arena in which social interaction and contestation mediate the "becoming" of social agents and their artifacts. Thought of this way, technology is the sequential intertwining of social and material experiences best captured in the word *artifice*. Whereas artifacts and gestures take on their social life during productive sequences, social life is made

meaningful and tangible through peoples' sequential processing of their material world. For all their daily and seemingly mundane repetition, ancient technogestures expressed the artifice of personal and group interests, reaffirmed collective memory, and materialized cultural sensibilities. Especially for prehistory, the conceptual framework underlying the pragmatics of *chaîne opératoire* research can be a powerful interpretive tool for understanding how social identities and relationships were constructed and transformed in the technological arena.

NOTES

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1. Quite independent of the French school, Anglo-American archaeologists have developed the notion of prehistoric technoscience (especially, Kuhn 1995; Schiffer 1992a: 134–138; Schiffer and Skibo 1987; see also Keller and Dixon Keller 1996 on "stocks" of technical knowledge).
2. In a later section I consider other less-than-technical (but typically "female-linked") activities, such as cooking and its relationship to "the hunt."
3. The CMP is not synonymous with hunting-gathering-foraging societies (extended discussion in Dobres 1995b:119–158).
4. On informal expressions of power and influence in egalitarian societies, see Cobb (1993), Flanagan (1989), and Keenan (1981), among others.

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7. Worlds in the Making: Technological Activities and the Construction of Intersubjective Meaning

BRYAN PFAFFENBERGER

IT IS A PITY THAT ANGLO-AMERICAN social and cultural anthropologists pay so little attention to technology, tending (as they do) to observe coffeehouses, marketplaces, brothels, and street corners, rather than mines, shops, and boatyards. In all of these places, the boatyards as much as the brothels, culture develops and grows (Hannerz 1993). Yet English-speaking social and cultural anthropologists have all but ignored technology for much of the past fifty years, leaving the study of technology and material culture to ethnographic museums (Pfaffenberger 1992; Sillitoe 1988).

One reason for social and cultural anthropology's inattention to technology is the baleful influence of one of the founding fathers of the discipline, Bronislaw Malinowski (1884–1942). Seeking to put anthropology on a more scientific footing, Malinowski rejected the "purely technological enthusiasms" (1935:I:460) of the collectors, nontheoretical ethnologists, travelers, catalogers, and wild-guess evolutionary theorizers who had previously dominated anthropology. Dismissing their speculative theories, Malinowski (1935:I:460) adopted what he termed an "intransigent position"—in retrospect, a very justifiable one—that the study of technology alone was "intellectually sterile." Parenthetically, Malinowski was to add that a study capable of situating technology in its social context would indeed prove interesting, but this caveat was little noted by his students—or his successors. Shrugging off ethnological museums and the study of technology as well, social anthropology in the United Kingdom and cultural anthropology in the United States proceeded to ignore technology for decades.