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Practical and Prestige Technologies: The Evolution of Material Systems

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Design theory provides a useful means for analyzing both practical and prestige technologies, although the goals and constraints of each are very different. The aggrandizer model of prestige technology postulates that prestige items were essential elements in aggrandizer strategies and that prestige items emerged only under conditions of sustainable food surpluses and included the most important innovations of the last 30,000 years such as metal working, pottery, sophisticated art, and domesticated plants and animals. The aggrandizer model also accounts for the transformation of some prestige technologies into practical technologies.

KEY WORDS: technology; prehistory; prestige; design theory; aggrandizer.

INTRODUCTION

This article is an exploration of the differences and origins of two radically different technological strategies: practical and prestige technologies. It is difficult to overstate the magnitude of differences between these strategies and the profound implications that each strategy has for the evolution of technology as well as for the evolution of cultural systems in general. In fact, the emergence of prestige technologies in the last 30,000 years may be the single most important factor in understanding the exponential rate of technological and cultural change that has characterized human societies as a whole from that time until the present. The loci of innovation have continuously shifted from one region or culture to another over this period depending upon a complex mixture of changes in environments, resources,

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and cultural influences. However, developments at the forefront of technology, wherever that has been, have generally proceeded at an ever accelerating pace.

In the following pages, I define practical and prestige technologies, provide a few illustrative examples, indicate the historical and theoretical importance of each technology, and then discuss how each can be most profitably approached in analysis. As we shall see, the analytical frameworks most appropriate for dealing with each strategy are quite different. While I treat practical and prestige technologies as opposites for the purposes of exposition, some prehistoric objects clearly incorporate aspects of both to varying degrees. Moreover, while I argue that the practical and prestige domains are by far the most important and dominant axes of artifact variability, future research may identify other dimensions of lesser importance.

PRACTICAL TECHNOLOGY

Practical technology corresponds most closely to the general way that the word, "technology," is used in archaeology and other disciplines. As I have previously defined the term (Hayden, 1993a, p. 203), practical technology is meant to solve practical problems of survival and basic comfort. One of the underlying principles in practical technology is to perform satisfactorily tasks in an efficient and effective way. For a given problem, the criteria used in choosing between alternative technological solutions are how effective each solution is and how costly each solution is. While, from time to time, people may experiment with alternative solutions or idiosyncratic personalities may choose solutions that deviate from optimal practical solutions, *in aggregate*, most people can be expected to employ efficient and effective selection criteria when the goal is to solve a practical problem (Schiffer and Skibo, 1997). This is because of the direct link between practical outcomes and survival or discomfort. Time and energy are frequently limited due to conflicting activities or demands or conditions. In the long run, therefore, natural selection should winnow out practical solutions that involve more time or energy than necessary or which solve problems significantly less well than others.

Examples of practical technology include various techniques for cutting down trees (axes, adzes, choppers, mauls and chisels, saws), for carrying items in bulk (baskets, nets, bowls, boxes, skins), for creating adequate shelter (skin tents, bark roofed structures, ice houses, brush shelters, plank houses, adobe houses, pithouses, mat lodges), and many other similar tasks related to obtaining food, protection from the elements, and defense. Prac-

tical technology is logically and empirically a response to stresses in the environment. In most cases, it can be directly related to real survival benefits. The original emergence of technology at the beginning of the Paleolithic is almost universally viewed as a response to environmental pressures for survival in environments that were becoming increasingly drier, less forested, and/or more dangerous (e.g., Coppens, 1994; Schrenk *et al.*, 1993). During the following two and a half million years, there is almost nothing to indicate that the basic practical nature of human technology had changed in any significant way. All technology in the Lower and Middle Paleolithic appears to conform to the same basic practical strategy with rare exceptions such as the use of ochers. Practical technology has continued to constitute the most important component of all technology even up into the industrialized and nuclear eras in the form of mechanized agriculture, heavy industry, communications, transport, data storage, and defense, even if their forms are sometimes colored with added nonutilitarian roles.

Analyzing Practical Technology

In the last decade, considerable attention has been paid to the "organization of technology" (Binford, 1979; Nelson, 1991; Shott, 1986; Bleed, 1986; Torrence, 1989; Bamforth, 1991). Nelson (1991, p. 57) defines the organization of technology as "the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance," including "the economic and social variables that influence those strategies." Unfortunately, in many of these studies, there has been a trend to emphasize highly abstract, untested, or poorly supported theoretical models (especially focusing on the concepts of risk, reliability, and maintainability) and to deemphasize many of the more basic, well-documented factors affecting the organization of technology. This is a problem that I have addressed elsewhere (Hayden, *et al.*, 1996). In attempting to understand the determinants of practical lithic technological organization at the Keatley Creek site in the British Columbia Interior, I was obliged to synthesize both the more traditional approaches centered primarily on raw materials or task performance and the considerations raised by the more recent studies cited above. While the resulting framework that I developed is still in a formative stage of development and will undoubtedly undergo some significant revisions, it nevertheless provides a reasonable starting point for understanding the relationship of various factors involved in the generation of practical technologies.

My approach is structured according to the principles of design theory which Kleindienst (1975, 1979), Horsfall (1987), and Bleed (1986) have ad-

vocated as an appropriate conceptual framework for understanding prehistoric technology. Design theory can show how artifacts "allow actors within cultural behavioral systems to adapt in their environments" (Kleindienst, 1975, p. 383). This approach is in many ways similar to the "*chaîne opératoire*" approach of the French (Sellet, 1993; Perlès, 1992a,b) and the "behavioral chain" or "flow model" analysis espoused by Schiffer (1972, 1975, 1976; see also Schiffer and Skibo, 1987, 1997). Understanding the purpose or goals of a technology is a central concern of all these various approaches. For this exercise, I deal only with chipped stone artifacts, although the framework can be easily adapted to the analysis of other materials such as bone, ceramics, metals, wood, and more recent products.

Design theory is often defined as "a means of creating or adapting the forms of physical objects to meet functional needs within the context of known materials, technology, and social and economic conditions" (Horsfall, 1987, p. 333). The basic premise of design theory is that there is an initial problem to be solved such as killing a deer, crossing a river, making fire, or making a spear. The problem may be dealt with at a very general level such as designing shelter, or at increasingly more specific levels such as designing entrance shapes for shelters or designing attachment devices for structure elements, and so forth. Design theory principles assume that there are different kinds of constraints operating in the developing of solutions for each problem and that tradeoffs between constraints make it unlikely that there will be any single optimal solution to a problem but, rather, a number of more or less equally acceptable solutions that can be conceptualized in a fashion similar to Schiffer and Skibo's (1987) performance matrix. Among the most powerful of these constraints are functional requirements, material properties, availability, and production costs. Once a field of acceptable solutions for a given problem has been identified (via trial and error or actual planning), the choice of which solution is adopted may largely be a matter of culture tradition, ideological values, style, or idiosyncratic behavior. However, most of the constraints leading up to this level of decision are much more consequential in nature and, in the case of practical technology, play an absolutely primary, determining role. See Horsfall (1987) for a more detailed treatment of design theory.

The most critical constraint acting upon the choices involved in making practical technologies, first and foremost, consists of *effectiveness* (Fig. 1) or an object's performance characteristics (Schiffer and Skibo, 1987, p. 599), that is, how well a given solution performs the task it is meant to. It is useful to distinguish four broad levels of effectiveness in most cases. At the lowest level are solutions that fail to perform effectively. In my classes on technology, the problem of opening nontwist beer bottles when no bottle opener is available is one for which many failed solutions can be found

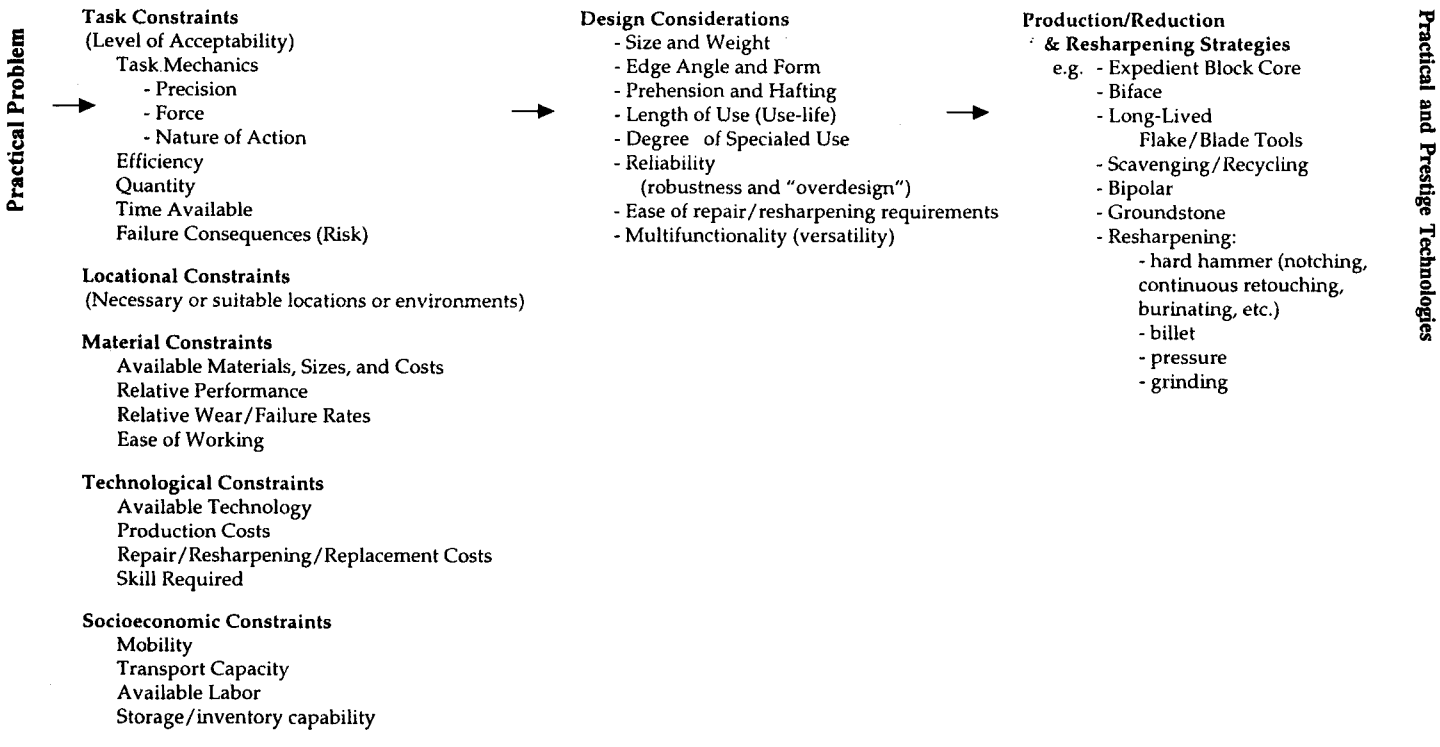

Fig. 1. A schematic representation of the design and production process for practical lithic technology. This is a stepwise, sequential design process that results in the production of a tool. Once it is completed and the tool is tried out, it may lead to evaluation of the acceptability of results and reassessment of various factors, leading to a new round of tool production.

such as using keys or key rings, breaking off the necks, or punching holes in the caps. While this problem may no longer be very common when drinking American beers with twist-off tops, it is still common when drinking non-American beers. At the next level, solutions are minimally effective and acceptable only as single-event expedient solutions when more effective solutions cannot be implemented. For opening beer bottles, this includes prying the crimps out one by one, using flaked cobbles, using thick masses of folded paper, and so on. At the third level, solutions are moderately to very effective. The time and energy expended to achieve a given outcome are viewed as very acceptable. These are the solutions that are generally used in everyday traditional or folk contexts. For opening beer bottles without a bottle opener, these would include using the back of a strong long knife, the tip of a shovel, the sharp edge of a table, and the cap on a second bottle. The highest level of solutions are the extremely effective ones. These solutions generally require special investments in time and energy, and so they are usually not considered worthwhile except where large quantities of materials are to be processed. In the case of having to open beer bottles in the absence of an opener, this would involve making an opener by filing a piece of metal or thick plastic to the appropriate shape. Generally, solutions at the lower levels of effectiveness are deleted from the matrix of cultural repertories.

In the study of chipped stone technology at Keatley Creek, no other factor could be identified as playing a more important role in understanding tool designs and morphologies than effectiveness. Subsumed under the constraint of effectiveness, there are several very critical aspects of task performance that routinely are overlooked and that deserve to be emphasized here. Surprisingly, the most commonly overlooked consideration concerns the *mechanics* of satisfactory task performance: the force required, the precision required, and the kind of movement required. Three other major factors tend to be interrelated: the *quantity* of material to be worked on or procured, the *time* available to perform the task, and the *efficiency* desired. Both the quantity of material to be processed and the time available determine how important efficiency is in the design solution. Hayden and Gargett (1990) have demonstrated that as the quantity of material to be processed per period of time increases, it becomes increasingly economical and desirable to develop specialized technologies that may have high manufacturing or maintenance costs but which have much more efficient performance characteristics for high-volume tasks—an approach originally pioneered by Zipf (1949). Torrence (1989) has emphasized the importance of time limitations for tool designs.

Acceptable task performance must also consider the risk of tool failure or failure to complete the task. For most practical technological activities

(as opposed to ritual, social, or political activities), such consequences generally are not of great importance since abundant time is usually available to replace failed tools or to implement alternative solutions even though they may be less efficient or less optimal in other ways. On the other hand, Bleed (1986) has pointed out that the risk constraints of failure in some tasks such as whaling and hunting can carry major consequences and that, in these cases, such risks can lead either to heavily overdesigned "reliable" tool forms or to quickly repairable, "maintainable" tool solutions.

The other important constraints to be considered in designing a material solution to a practical problem include the following.

Locational constraints: What spatial, climatic or other environmental factors may constrain the choice and effectiveness of various solutions such as the use of weirs, whaling, sleds, wells, and mines.

Material constraints: The availability, procurement costs, and relative performance or wear rates of various materials including their size ranges and other important properties.

Technological constraints: The technology available for undertaking solutions to problems, the relative costs for using the options available, and the levels of skill required for using these options.

Socioeconomic constraints: What constraints exist in a culture's social and economic adaptations such as transport capacity under varying mobility conditions, the possibility and costs of storage or inventorying materials, and the ability to mobilize labor for undertakings such as hunting drives using nets, bridge construction, and many large-scale, effort intensive, or specialized activities. Torrence (1989), Binford (1979), Nelson (1991), Shott (1986), and others dealing with the "organization of technology" have tended to concentrate most of their model building efforts in this area, especially the effects of various mobility regimes.

Taking all of these major constraints into account, it can be assumed that prehistoric people then proceeded to formulate or design various technological solutions to given problems (Fig. 1). They undoubtedly experimented with many solutions on an ongoing basis, but probably chose the ones that empirically worked the best while economizing on cost or effort (generally from the options at the "moderate" to "very effective" level). I have observed this kind of situational, impromptu experimentation among Australian Aborigines, who, given the immediate lack of a specially devised tool for a task, simply used whatever happened to be at hand to achieve a goal even if its level of efficiency was not great. Thus, if no digging stick was immediately at hand for digging down to water in a stream bed, spear throwers, shields, bowls, or simple unmodified branches could be used. This type of behavior appears to be almost universal since it characterizes con-

temporary handymen as much as hunter/gatherers and even primates and birds.

According to design theory, if one wants to create a specific tool meant to solve a specific problem, some of the things that people have had to consider in this design process include the size and weight of the tool; its overall form (for holding or hafting); the edge angle where cutting, scraping, or holding was important; the possibility of hafting; the duration of its use; how specialized the working parts needed to be; whether it was at all desirable to combine two or more functions in the same tool; how reliable the tool needed to be; and how easily repaired or resharpened it needed to be [see Schiffer and Skibo's (1997) use of behavioral chain models as an example of a similar approach].

Finally, deciding what mode of resharpening or maintenance should be used for given technological tasks was a critical feature for the overall tool design considerations in situations of high potential for the attrition of working surfaces. For instance, I have argued that the major modes of resharpening stone cutting tools (direct hard hammer percussion, billet flaking, pressure flaking, and edge grinding) are determined primarily by the quantities of materials being processed, as well as the availability and costs of suitable lithic materials and the need to conserve raw material under high mobility situations (Hayden, 1989).

When all the constraints and all the design considerations are taken into account, it is usually possible to envisage one or more acceptable tool forms that should satisfactorily perform a specific desired task. For scraping a rabbit skin, for instance, a simple hand-held stone side scraper of almost any material would be adequate; for scraping a dozen elk hides over a short period it would undoubtedly be far more effective to develop a hafted endscraper of high quality stone capable of undergoing numerous resharpenings. Once a highly effective tool design has been established (through trial and error, foresightful design, or by other means), it then becomes important to determine how best this tool can be produced and, if desired, maintained for use in repeated tasks of the same nature. It is at this level that decisions occur about what materials to procure and how best to process them for use as desired tools. Are locally available materials suitable or desirable? Are more distant materials within a community's seasonal ranges more suitable or desirable? How many tools are required and what would their transport costs be? Are yet more distant materials more suitable or desirable and what are the costs involved in obtaining them? Is it more economical to bring entire cores back to principal residences or to reduce them at procurement sites and return only with the most suitable tool blanks? What are the desired shapes of these blanks? If cores are brought back, what other products could be used in other tasks to solve

other technological problems? How can the cores be most economically reduced to meet all these needs at a particular site?

Given this framework, it should be possible to reconstruct and assess both the technological solutions (design and production strategies) and the constraints that existed (for a similar approach to ceramics see Schiffer and Skibo, 1997, p. 44). Once these factors have been established, analysts should then be in a strong position to make inferences about the technological problems that gave rise to these solutions as well as about other constraints and decisions that could not be directly measured or estimated. More specifically, the procedure consists of examining the various tool types in an archaeological assemblage to determine, on a task by task basis, such things as

(1) The extent to which cores were being brought to a particular site for reduction or to what degree blanks and preforms were being brought to sites,
(2) The types of tools that were being manufactured from preforms as opposed to core-reduction products at the site,
(3) Whether local or more distant materials were being chosen for tool use and how important these considerations were, and
(4) The overall design features of each tool type (their size, weight, edge shapes, resharpening type and potential) and assessment of their variability in order to achieve a better understanding of the tasks for which they were designed.

By using this framework to work backward through the design process, from finished product to initial problem, it should be possible to reconstruct the logic and structure of the overall technological organization of a tool type, an assemblage, and eventually an entire prehistoric community. It should be possible to address questions of what ultimate technological problems were being dealt with by prehistoric inhabitants, how important they were in terms of the relative time and energy costs invested in their solutions, and what decision criteria were used in formulating these solutions.

While there are still a considerable number of gaps in the empirical understanding of the relationships that are being proposed, a pilot application of this framework to the modeling of the Keatley Creek site assemblage turned out to be very insightful and successful (Hayden *et al.*, 1996). The general conclusions of this study appear robust enough to warrant reasonable confidence in the overall merit of the approach. It should be emphasized that this approach makes sense only when it is applied to individual tool types within a given assemblage or even to individual artifacts, although a detailed individual analysis of all artifacts would be ex-

cessively time consuming and impractical. After all tool types have been analyzed in this fashion, then entire assemblages can be described in terms of the relative importance of specific task solutions as components within the whole assemblages as well as possible interactive relationships between task design solutions.

The design theory approach makes no sense at all when applied to an entire assemblage as a single phenomenon to be analyzed unless the assemblage is entirely the product of a single task such as a lithic scatter produced by butchering a single animal. Such occurrences are exceedingly rare. The analysis and characterization of entire habitation site assemblages as complete entities (e.g., as "expedient" or "curated" assemblages, or "reliable" or "maintainable" assemblages) have been advocated and strongly endorsed by some analysts (e.g., Nelson, 1991; Torrence, 1989; and Odell, 1994, 1996). However, it simply does not make any sense to include tools used for long distance hunting with tools used for drilling beads or making baskets in some global measure of "mobility" or "reliability," or curation." What could such a statistic mean in real terms? Moreover, because the global assemblage approach obscures the most basic design strategies (i.e., what tools were designed to do), they must be viewed as a *major* impediment in any attempt to understand the most fundamental aspects of the organization of technology and of assemblages (Shott, 1996, p. 266; Hayden *et al.*, 1996). Except for Odell, these authors have founded their technological models on worldwide *nonlithic* material culture which provides essentially speculative relationships to the stone tool technologies of the past. These models are not grounded in archaeological remains at all and have never been demonstrated to be either verifiable or directly applicable to prehistoric stone tool assemblages.

I argue that the most productive way to understand tool morphology, design, and technological organization is by analyzing each type of tool in its own terms, identifying the constraints and design strategies represented by each tool type, and then combining these strategies to understand entire assemblages including core reduction strategies used at specific sites and the resultant debitage characteristics. There are many approaches in archaeology that can aid in understanding the tasks that specific tools were being used for as well as estimating use-lives and other important parameters. These approaches include use-wear analysis, refitting studies, synthetic ethnographic analogies or ethnoarchaeology, material science studies and experiments, mechanical engineering, and theoretical design considerations. I fully endorse the combined use of these techniques in conjunction with design theory as part of the study of tool formation processes (Hayden, 1990b). Use-wear is especially important since it can provide information

not only on materials that were worked, but also on the nature of the actions and on the nature of any hafts used.

Due caution must be employed, however, in using some of these approaches since their application can be imperfect and individual tools or even types can have complex, changing, or multifunctional use histories. Moreover, the procedures outlined in the preceding pages are relevant primarily in dealing with items and artifact types that do not bear any indication of having been used as prestige items. In order to analyze and understand the design and technological structure of prestige objects, one must employ a somewhat different perspective that emphasizes other kinds of constraints. I therefore turn to the definition and discussion of prestige technologies.

PRESTIGE TECHNOLOGY

While the distinctiveness of many kinds of prestige artifacts has long been recognized, few researchers have attempted to analyze prestige objects from viewpoints other than technical or artistic ones. Pioneers in this area have included Dalton (1971, p. 14), G. Clark (1986), Clarke *et al.* (1985), Bradley (1984), Costin (1991), Perlès (1992a), and Yerkes (1991, p. 61). The purpose of creating prestige artifacts is not to perform a practical task, but to display wealth, success, and power. The purpose is to solve a social problem or accomplish a social task such as attracting productive mates, labor, and allies or bonding members of social groups together via displays of success (see earlier discussions by Peebles and Kus, 1977, p. 425; Earle, 1978, p. 195; Olausson, 1983, p. 3; G. Clark, 1986, pp. 83, 86–87; Costin, 1991; Perlès, 1992a; Hayden, 1993a, p. 203). Therefore, the logic and strategy for creating prestige artifacts are fundamentally different from the logic and strategy for creating practical artifacts. I suggest that the main goal of prestige technologies is to employ as much surplus labor as possible to create objects that will appeal to others and attract people to the possessor of those objects due to admiration for his or her economic, aesthetic, technical, or other skills. Certainly, the considerable storage of surplus production and labor represented by most prestige items would impress many people by itself. The judicious employment of that surplus labor to create attractive objects could greatly enhance the appeal and the impressiveness of those objects (and their owners) for others. Objects that successfully achieve this goal also make other people want to possess such objects, sometimes even to the point of having them only for their own gratification or self esteem without using them for display. Veblen (1989) and G. Clark (1986, p. 34) have both emphasized the powerful forces that impel many

people to imitate the behavioral and material displays of the wealthy and powerful. However, only Clark is insightful enough to link such imitation to the desire to imitate success, which, after all could certainly be viewed as adaptive in a Darwinian sense. Thus, I would argue, prestige objects are frequently also used to lure individuals and families into debt or reciprocal obligations (see Gosden, 1989). Used in this way, they create or support relationships that make hierarchical economic, social, and political organization possible. Because of their central role in aggrandizers' strategies to create debt, social bonds, wealth and power, prestige items are much more than epiphenomenal reflections of wealth. Prestige items in prestate societies constitute the infrastructure of social and political hierarchies without which those hierarchies would collapse and be impossible to maintain. As postprocessualists argue (Hodder, 1986, p. 151), prestige items do play an active role in the functioning of cultural systems. The generation of hierarchical indebted relationships can be viewed as a secondary intended function of prestige technologies. A tertiary function is clearly served by the very ability of prestige objects to store surplus production and labor in a transformed state, a unique human ability (Hayden, 1994). For the first time in biological evolution, this enabled individuals to use significantly more resources than they could consume by themselves. This is another reason why the emergence of prestige technologies was such a revolutionary development and why prestige items must be viewed as more than passive reflections of power.

The surplus labor invested in prestige technology may be expressed in a number of ways including the use of surplus labor to travel to distant locations in order to obtain exotic and rare raw materials or objects made in distant locations, to create local labor intensive objects such as sculptures or fat pigs, and to produce practical goods that can be exchanged for prestige items originating elsewhere.

A number of material qualities appear to elicit pan-human aesthetic responses or engender positive reactions when used as displays of success and status (Douglas, 1970; Huntington and Metcalf, 1979, pp. 44–60; Kearney, 1984, pp. 110–114). By "pan-human," I do not mean that every person exhibits the same positive reactions to given stimuli but, rather, that in every human population, many or most people do. This is really all that is needed for the model to work and is consistent with what is known of human genetic and developmental variability. On the whole, people seem to respond to certain visual, dramatic, tonal, rhythmic, ritualistic, and gastronomic experiences as inherently satisfying or as indicators of health and success. These apparently innate human propensities probably evolved among mid- or upper Pleistocene hunter/gatherers as emotionally bonding features of subsistence alliances (Hayden, 1987, 1993b), but they are still

very much a part of contemporary emotions and behavior characterizing most people and probably all human populations. In terms of the archaeological types of objects associated with these displays (whether in egalitarian subsistence alliance rituals or in hierarchical feasts), shiny or bright objects such as mica, clear crystals, native metals, teeth, horns, and polished bone or sea shells are some of the most universal to be used to indicate prestige and success. Contemporary jewelry also exhibits these same qualities. A number of people (e.g., Taçon, 1991; Coss and Moore, 1990; G. Clark, 1986, pp. 5–6; Dissanayake, 1988; see also Hamel, 1983) have argued that most humans are innately attracted to, or impressed by, objects that sparkle, shine, or transmit light. Highly colored objects seem to elicit similar responses (e.g., ochers, jades, shells, feathers, textiles, some cherts), as do very elaborate shapes or highly geometrical shapes. Similarly, it can be argued that humans have innate affinities for sweet or rich foods.

In addition to the inherent degree of attraction, the procurement and production costs of items become a significant consideration in choosing to use them as indicators of success or as items that others will also want to acquire (Clark and Parry, 1990). In traditional societies, prestige objects are generally meant to be displayed in public at important events. Therefore objects that lend themselves to public display are generally favored for prestige use (Schiffer, 1992, p. 135; Wobst, 1977). Prestige objects may sometimes also serve as practical objects such as jade adzes or sculpted mauls.

Most prestige items are kept for use and display at periodic important events, while some may be used on a daily basis or are exchanged for other prestige objects. However, an important *subclass* of prestige objects is produced exclusively for a single event which involves either their destruction or their irretrievable loss the first and only time they are ever "used." This subcategory of prestige technology might be termed "promotion technology." Promotion items seem to occur sporadically among transegalitarian groups (perhaps only in the most complex transegalitarian communities) but certainly become more common in chiefdom and state societies. Transegalitarian societies are defined as those intermediate between strictly egalitarian societies (lacking significant private ownership, economic-based competition, social or political hierarchies, or other socioeconomic inequalities between families), on the one hand, and societies organized as politically stratified chiefdoms, on the other hand (Clark and Blake, 1989). Among the earliest candidates for promotion items are formally deposited collections of unused blades placed in bogs during the Mesolithic (Karsten, 1994, Chap. 12; Fischer, 1974) and the deliberately broken prestige items and unused jade adzes of Neolithic Europe (G. Clarke, 1986, p. 45; Bradley, 1984, pp. 51, 56, 110, 113), although I would not be surprised if some of

the elaborate grave goods in Upper Paleolithic burials were made specifically for the funerals. The elaborately buried serpentine and jade ritual pavements of the Olmec at La Venta provide a good example of promotion items at the chiefdom level, while the boast of the Assyrian King Samsi-Adad I, to have raised the "walls of the temple upon silver, gold, lapis lazuli and carnelian," provides a likely example from a state-level society (cited by G. Clark, 1986, p. 87). The elaborate specialty funerary items of Egyptian elites probably constitute the most extreme case at the early state level of social organization.

Typically, promotional technology takes the form of objects made exclusively to be destroyed or buried at elite funerals or other public events. The purpose of promotional technologies is assumed to be the demonstration of the power and success of the political unit to all visiting elites from neighboring polities as well as to members of the sponsoring polity. Without having researched the matter in detail, it is my impression that in egalitarian societies, the special fabrication of such promotional items is extremely rare or nonexistent.

Archaeologists have long recognized, either implicitly or explicitly, many of these distinctions in their treatment of mortuary goods and offerings. My aim is to create a more explicit theoretical and analytical framework to deal with these kinds of objects. The terms "practical technology" and "prestige technology" are somewhat similar to Binford's (1962) "technomic" and "sociotechnic" terms. Rathje and Schiffer (1982, p. 65) use terms that are almost the same as Binford's. However, I have opted for the present terms not only because they are more self-explanatory and easier to use, but also because the theoretical development presented below goes considerably beyond what Binford proposed and differs in some important details from his formulation, specifically concerning the role of aggrandizers and the reason for the development of these technologies. Binford (1983, pp. 221–224) prefers to view status distinctions as emerging from systemic stresses with prestige items only passively *reflecting* already established privileges. In contrast, as argued above, I view status distinctions as emerging from aggrandizer strategies in which prestige technologies play a *key active role* in acquiring power. The archaeological consequences of these divergent views are significant. The stress models mandate that major environmental, nutritional, conflict, or other stresses occur prior to the appearance of significant status distinctions. The aggrandizer model is predicated on the normal and reliable production of surpluses, and therefore no increases in overall morbidity or malnutrition mortality are expected prior to innovations. In fact, more pronounced evidence of feasting involving *surplus* food is expected to occur.

Another difference between the concepts that I use and Binford's is that his sociotechnic category does not mandate that objects carrying social information be labor intensive; some sociotechnic artifacts can be very inexpensive (e.g., Australian Aboriginal string headbands implying full adult status or changes on which sides of a hat tassels are worn after graduation, and changes in color of hats at marriage). Thus, the prestige category actually cross-cuts the sociotechnic category. Not all social information symbolized in material culture may be prestige-related, but in transegalitarian societies, a lot of it is, and many of the materials recovered archaeologically are designed to display power or wealth. Thus, the two classifications often coincide.

Binford's term "ideotechnic" delineates yet another dimension of artifact variability, and one that can overlap prestige technologies very easily as in the case of Australian churingas and extremely exotic items used in rituals. However, ideological symbols are not necessarily prestige objects since they can be produced with very little cost, such as the tying of two sticks together to make a cross. On the other hand, they can be made and are often made, with great investments of time and effort as in the case of Renaissance gold crosses. Where special effort has been invested in the procurement or fabrication of these ritual objects, it can be argued that the primary purpose has become to impress the participants or onlookers, and that therefore these items should also be classified as prestige items. Perhaps there remains a useful category of nonprestige ritual or social artifacts that should be distinguished from practical technology. However, this is a topic for future consideration and will not be pursued here.

The Emergence of Prestige Technologies

Over the last 20 years, I have been exploring and documenting the conditions under which various prestige technologies emerge (Hayden, 1981, 1992, 1993a,b, 1995a). In sum, the flowering of prestige technologies appears to be the hallmark of complex hunter/gatherers and other (horticultural or pastoral) transegalitarian societies. I have also strongly argued that complex hunter/gatherers and other transegalitarian communities can be understood only in terms of their ability to generate surpluses reliably. As discussed below, aggrandizing individuals use a number of strategies to control those surpluses for their own benefit.

There are few indications of aggrandizing individuals, prestige technologies, or other hallmarks of transegalitarian societies among generalized hunter/gatherers or prior to the European Upper Paleolithic. The few items that do occur in the Lower and Middle Paleolithic (such as imported ochers

and pyrite crystals), or in the ethnographic record of generalized hunter/gatherers (such as the stone churingas and rock paintings of the Central Desert Australian Aborigines), may have all been used in ritual contexts that were meant to bond members of subsistence alliances covering large areas. As such they were low in frequency and/or cost and certainly did not involve major amounts of group surpluses and were not predicated on surplus-based competition. Thus, I think it is possible to distinguish, on the one hand, between prestige items made and used in ritual contexts among generalized hunter/gatherers for the purpose of impressing others in order to reinforce subsistence alliances within and between groups (noncompetitive prestige items) and, on the other hand, prestige items made and used for surplus-based competition (including competitive ritual displays) among complex hunter/gatherers and other transegalitarian communities (competitive prestige items). Although there is not much detailed documentation for all the following statements, it is my impression from my own ethnoarchaeological experience in Australia that the elaborate ritual prestige items of generalized hunter/gatherers are rarely if ever recovered archaeologically (Dickins, 1996); that they are generally cached at sacred sites and are rarely, if ever, found at habitation sites (Dickins, 1996); and that such items never seem to be buried with individuals since they are considered the property of the corporate band, ritual group, or descent group, although shamans might conceivably be buried with exotic items of minor value.

In contrast, prestige items that functioned as part of a surplus-driven competitive display strategy are certainly very abundant in graves of high status individuals. These prestige items also frequently represent substantial investments of labor and were often created by at least part-time specialized artists. In addition, such items were commonly kept and used in habitation areas where they sometimes broke or were lost. Although never absolutely abundant, these items clearly occur sufficiently frequently in habitation sites and burials to leave little doubt that they held a significant role in the overall economy and social functions of the communities involved.

It is only in the most complex societies of the Upper Paleolithic, located in the most productive environments, that prestige objects are found on a more regular and lavish basis in occupation sites and burials. One of the most spectacular of these occurrences is the adolescent double burial at Sungir with its thousands of ivory beads, decorations, and combination utilitarian–prestige objects representing tens of thousands of hours of labor investment (White, 1989, 1992, 1993). Aside from the presence of prestige objects, the other independent reasons for viewing some of these Upper Paleolithic communities as transegalitarian complex hunter/gatherers are documented by the Beaune (1995) and Hayden (1992, 1993a,b; Owens and

Hayden, 1997) and include relatively high population densities, seasonal sedentism, storage, evidence of private ownership and wealth inequalities, and the intensive exploitation of seasonally abundant resources. These characteristics all become more developed in resource-rich areas during the subsequent Mesolithic and in the New World during the Archaic as well-documented in the Northwest (Matson and Coupland, 1995; Hayden, 1995a; Hayden *et al.*, 1996).

The catalyst behind all these changes seems to be the technological innovations that made the systematic exploitation *en masse* of new resources (especially fish, grain, and migratory herds) possible, as well as innovations that made the storage of seasonal surpluses possible. More specifically, the technological innovations that were probably of most importance in increasing the extractable and usable amounts of food from given territories include *long-term* storage technology (special drying for pit storage and elevated caches), new fish procurement techniques (nets, weirs, leisters, fishhooks), seed gathering and utilization techniques, boiling, snaring techniques, the use of nets in hunting, atlatls and bows (for mass harvesting herd animals), possibly baskets, and new transport techniques such as sleds and canoes. These technological developments begin in the Upper Paleolithic and develop further in the Mesolithic/Archaic. With domestication, even more new resources were added to local repertories, while new techniques were devised for storing surplus crops, including in the guise of domesticated animals.

Competitive displays of success may have first emerged during the Paleolithic primarily in resource-rich areas where labor shortages for maximizing surplus production resulted in competition for the recruitment of productive members to the most successful economic groups. Labor shortages might be especially acute in the temperate zones where large-scale seasonal migrations of ungulate herds occurred and where large amounts of meat or fish could not simply be stored by freezing but required more laborious thin filleting and prolonged drying of the fillets over smoky fires. Labor would also have been in short supply for the effort-intensive conversion of animal skins into supple buckskin or clothes or for the manufacture of other items that could be exchanged as wealth (see Hayden, 1990a).

The main point of importance is that, both ethnographically and archaeologically, prestige technologies first appear in force and flourish with the emergence of transegalitarian complex hunter/gatherers. Virtually *all* of the major technological advances that are generally associated with agricultural societies occur somewhere in the world *before the advent of agriculture* in complex hunter/gatherer societies. The major advances that occur first among complex hunter/gatherers include pottery, ground stone cutting

tools, metalworking, jewelry, community buildings, domestication (e.g., dogs, gourds, and incidental items), slavery and sacrifice, sophisticated open-ocean watercraft, textiles, and monumental structures and graves (e.g., Morrison and Myles, 1992; Blake *et al.*, 1993; Thom, 1995). I argue that *all* of these types of items were initially developed as prestige technologies and only later evolved into more practical applications. Some of these will be discussed in more detail below. For now, it is important to understand how and why prestige technologies should emerge among complex hunter/gatherers. For this, it is necessary to understand more about the motivations and strategies that may have been used by aggrandizers to promote and control food surpluses and the kinds of environments that favored the success of these strategies.

Aggrandizers and Their Strategies

The major argument that I want to explore here is that aggrandizing individuals seeking to promote their self-interest have been responsible for (1) the development of prestige technologies, including the use of metals, pottery, and domesticated foods; (2) the uncanny convergence of diverse types of cultures toward hierarchically stratified socioeconomic systems; and (3) the remarkable instability and resilience displayed by transegalitarian, chiefdom, and stratified communities when confronted with severe setbacks either in the form of epidemics, starvation, or warfare.

In suggesting that aggrandizers constitute the major forces of change in many human societies, I am following the lead of Cowgill (1975) and Gilman (1981). In order to explore these issues, it is necessary to advance several premises and to clarify the conditions under which aggrandizers can be expected to become active and to create prestige technologies.

The first premise is the notion that aggrandizing personalities occur in all human populations of self-reproducing size [i.e., about 200–500 individuals per Wobst (1974)]. For the present purposes, the proportion of aggrandizers in the total population does not have to be great. A small percentage of active aggrandizers is probably all that is necessary to create major changes under the appropriate resource conditions. Moreover, given reasonable degrees of genetic variability, and variability in personal histories and environments, the occurrence of aggrandizers in all human populations seems relatively assured.

I am defining aggrandizers as people who are ambitious; socially, politically, and economically aggressive; and acquisitive. Elsewhere I have referred to these individuals as accumulators (Hayden and Gargett, 1990), or Triple A personalities (Hayden, 1996). Here I defer to the somewhat

more elegant term "aggrandizer" used by Gould (1982) and Clark and Blake (1994). Aggrandizers manipulate other individuals in order to promote their own self-interest and often act in ways that are contrary to the best short- or long-term interests of the community as a whole. In the most extreme expression of the aggrandizing personality types, there are sociopaths and psychopaths. Aggrandizers have, in effect, an inner motor, an inner drive to increase their own standard of living and their own reproductive success. In order to achieve these goals, aggrandizers are constantly seeking ways to organize other individuals in order to get them to produce more and surrender some produce or labor to aggrandizers. They readily push the limits of their community values and norms when these values do not suit them, and in many cases, aggrandizers operate outside community norms (Shnirelman, 1990). Once firmly established, aggrandizers frequently create separate standards, values, and norms for themselves that differ substantially from those for the rest of the population as frequently documented for industrial and preindustrial elites in many parts of the world. They are inveterate risk takers and often involve many others in their risky ventures. A corollary of these observations is that neither social structures nor cultural norms are immutable. As Shnirelman's (1990), Cashdan's (1980), and Leach's (1954, pp. 8, 10, 221, 262-263) studies demonstrate, social organization and cultural norms can be easily changed and manipulated to suit the perceived self-interest of community members in both egalitarian and transegalitarian societies.

Cashdan (1980) argues that aggrandizers are held in check among egalitarian hunter/gatherers, and they are restrained from behavior that is not in the best interests of the community as a whole. Blake and Clark (1989) discuss the many ways that overly ambitious individuals can be restrained and held in check in egalitarian and transegalitarian communities alike. Indeed, anyone who is familiar with egalitarian or transegalitarian societies will probably be aware of the sanctions, the accusations of sorcery, and the use of limited violence, of theft and intimidation, and ultimately of homicide in controlling excessively demanding or ambitious individuals. Yet Cashdan shows how quickly these sanctions and checks can be modified or abandoned as soon as basic resource conditions improve. Thus, it is unrealistic to view even severe social constraints as significant barriers to the successful use of aggrandizing strategies *as long as favorable, surplus economic conditions can be established.*

The second premise of the aggrandizer model is that a small number of aggrandizers can have systemwide effects given appropriate resource conditions. The rationale behind this premise is based on ethnographic and contemporary observations of aggrandizers actively trying to develop schemes that will seem attractive to other members of the communities, but which,

in effect, place aggrandizers in critical positions of control or give them other sought-after advantages (see Hayden, 1995a). Under appropriate surplus conditions, it takes only one charismatic and crafty aggrandizer to initiate projects that appear to benefit most individuals in a community, but that produce profound social, economic, and political changes of benefit primarily to aggrandizers. As Margaret Mead observed, "The world can be changed by a few dedicated individuals, and indeed that is the only way changes have ever been implemented." Such maneuvering is particularly well documented in New Guinea (Feil, 1987; Sillitoe, 1978; Wiessner and Tumu, 1998a).

My most recent (1995a) study of the diversity of transegalitarian cultures has identified a number of recurring strategies employed by aggrandizers to engage large segments of kin or community in their projects (Fig. 2). These strategies are the keys to understanding how other people in the community get hooked into using and supporting prestige technologies—a topic discussed in more detail by Hayden (1995a). The strategies include

1. the hosting of reciprocal and investment feasting;
2. the instigation of warfare *and* the establishment of peace (both via payments of wealth);
3. the use of wealth to obtain allies in warfare;
4. the use of wealth (surplus) to acquire desirable spouses and more spouses;
5. increasing the value of one's own children through maturation payments in order to obtain more desirable marriage partners for them and subsequent exchanges of wealth;
6. the promotion of investment exchanges (competitive feasts);
7. the use of rare or labor-intensive prestige objects to increase the effectiveness of all the above strategies (Bradley, 1984, p. 46); and
8. the claiming of privileged access, or control over access to the supernatural and rituals.

Not everyone in a community needs to be involved in these strategies for them to occur, for them to be effective, for them to be manifest in the archaeological record, or for them to have effects on basic socioeconomic characteristics of the community. If an aggrandizer manages to persuade even a minority of a kinship or community group that any of the above strategies is to their immediate benefit, then he will be in a strong position to promote many other changes as long as surpluses can be produced on a large and reliable enough basis to support the surplus-consuming activities that he promotes. Surpluses are typically in the form of dried fish or game, domestic animals, or crops. Aggrandizers try to maximize the pro-

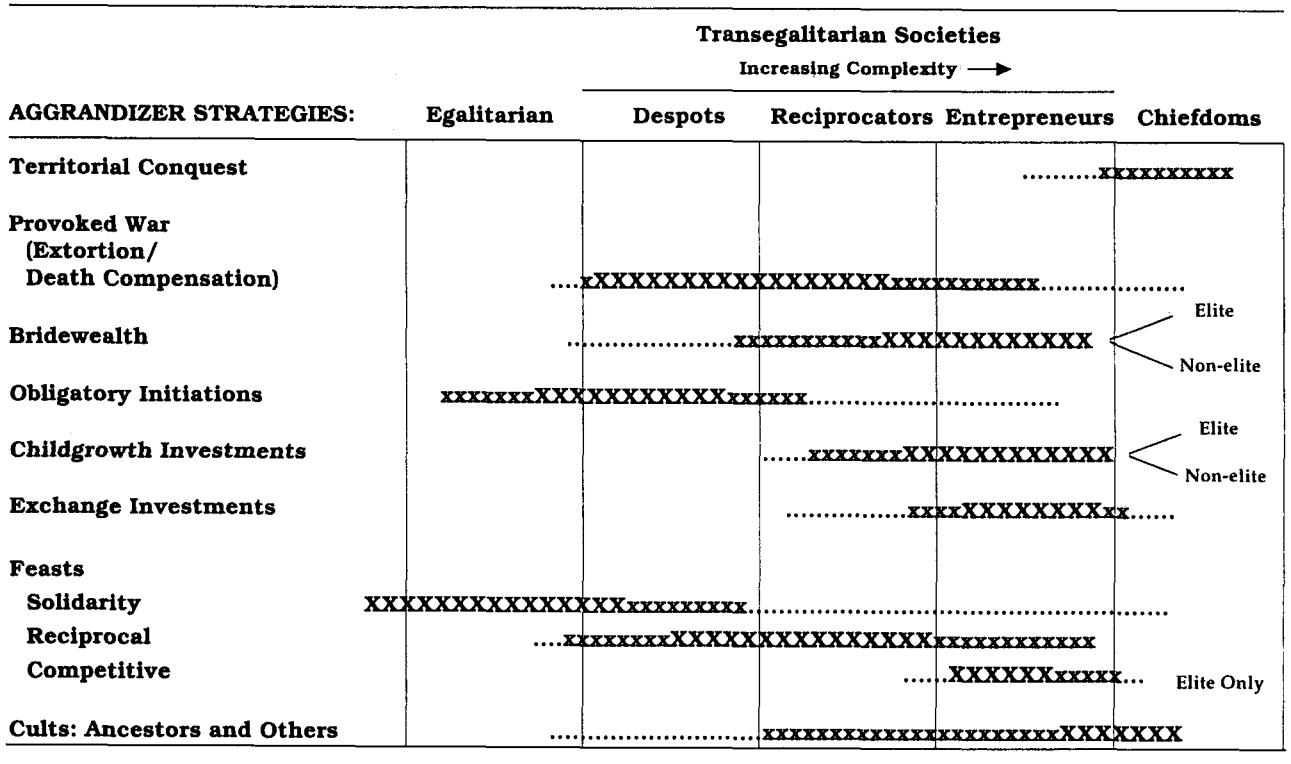

Fig. 2. Proposed major strategies used by different types of transegalitarian aggrandizers to increase their control in communities (Hayden, 1995a).

duction of surpluses and contributions of surpluses from supporters. Contributions are always solicited under the guise of "necessary" wedding payments, defense costs, corporate debts, compensations, or other compelling reasons. The larger the surpluses and contributions for these purposes, the greater the advantages and power of the aggrandizers. Aggrandizers typically promote new values, such as recognition of private property and the importance of specialized training, in order to *exclude* other people from the control over surpluses and to reduce competition for that control. One widespread strategy is for aggrandizers to promote the use of exotic items from distant places as prestige items of value. Such items could not be easily obtained by others (especially by those lacking contacts in distant communities), but exotic items were often promoted as being required for effective functioning in social and political events (Bradley, 1984, p. 46; Hayden and Schulting, 1997). And, in turn, socially "necessary" events involving feasts and gift exchange entailed strong pressures increasing both production and consumption (Blackburn, 1976, p. 242; Blanton and Taylor, 1995).

The third premise for modeling aggrandizers' roles in prestige technologies is that *extractable resource conditions* (i.e., resources that can be extracted with a community's existing technology and labor rather than with hypothetical innovations or population changes) *determine how much aggrandizing or surplus-consuming behavior a community will tolerate.* Under technological and environmental conditions where the extractable food resources cannot yield significant, storable, or reliable surpluses, aggrandizing behavior will be viewed by the community at large as unacceptable, if not threatening (Cashdan, 1980; Hayden, 1992, 1995a). It is only when sufficient, predictable, reliable, and storable surpluses can be generated on a large and normally predictable basis without overexploiting staple resources that aggrandizing behavior will be tolerated and, if the aggrandizer is talented enough, supported by at least some others in the community. A corollary of this premise is that in the long run, the extent to which aggrandizers succeed, in terms of the amount of power and wealth they concentrate in their hands, will be determined by the extent to which surpluses can be generated. Another corollary is that where resource conditions seriously deteriorate for a large proportion of a population, the social system will revert to a more egalitarian form (Hayden, 1996).

The fourth premise is that aggrandizers will vary in the personal qualities important to their success. These qualities include the degree of aggrandizers' motivation, intelligence, creativity, charisma or persuasive abilities, social and ritual skills, productivity, skill in using deceit, ruthlessness, skill in fighting, and competence in economic calculations. As I have argued elsewhere, the scale of analysis undertaken plays a critical role in the type and

strength of material and behavioral patterns resulting from any given causal factor. Variable personal qualities, in particular, will create a great deal of idiosyncratic variability of material patterning and cultural change in the short term and on very local scales. At the scale of short time periods, households, and local communities, cultural change may be most appropriately dealt with by historians and ethnographers. However, when the scale is broadened to include large numbers of people, either multigenerationally (over time) or geographically, it seems clear that the most successful aggrandizers will be very intelligent, charismatic, motivated, persuasive, and perhaps deceitful and ruthless. It is these aggrandizers who establish the most successful cultural transformations; and it is the most successful systems they establish that eventually dominate entire regions, if not culture areas, creating the most lasting cultural changes. If this construct is tenable, then there should be a great deal of regularity, similarity, and even predictability in the cultural developments at transegalitarian and even more complex levels of cultural organization. Aubrey Cannon and I have argued on a number of occasions (Hayden and Cannon, 1982, 1984) that, given the inherent variability in personality between individuals, regularities and predictive trends in human behavior must be sought at the larger scales of analysis (corporate groups, communities, regions, long timeframes) where the central trends of behavior can be observed to dominate. Such regularity is well suited to the archaeological recovery and modeling of long-term cultural change. Whether this is absolutely true can be determined only empirically, but archaeology is replete with examples of cultures from many parts of the world that have followed the same general evolutionary paths of emerging aggrandizers using similar strategies and adopting similar material solutions where resources permit. The premises under discussion seem capable of explaining at least some of these recurrent similarities employing the same perspective that Steward (1968) and Harris (1979) have advocated. Whether apparent exceptions (e.g., Australia) can be accounted for on the basis of the variables under discussion, or differential rates of change (evolution cut short), or other factors in the ecological paradigm, remains to be seen.

The fifth premise for modeling aggrandizers is that some or all of the basic strategies that aggrandizers used to lure other community members into producing and surrendering surpluses actually had important survival and reproductive consequences for supporters as well as aggrandizers. While such consequences for others may not have been of any immediate concern to aggrandizers, the opportunities that they seized upon to promote successful raids or to sue for successful peace, the alliances that they helped create or break, the production of surpluses and wealth that they promoted, the large numbers of supporters that they attracted when successful, and the

ability to obtain fecund and productive mates all conferred critical adaptive advantages on aggrandizers as well as on their supporters and on the community as a whole. In fact, Wiessner and Tumu (1998b, p. 11) explicitly state that the consequences for New Guinean individuals of not supporting the competitive feasts or joining related cults was that they would be unable to obtain brides or allies—both unenviable situations from an evolutionary point of view. Thus, the most common reasons that other people in the community bought into prestige technologies and supported aggrandizer schemes was that nonaggrandizers probably thought that these schemes would improve their success in making better alliances, in waging wars, peacemaking, acquiring wealth, and acquiring desirable productive mates. In egalitarian societies, all of these goals were achieved by other means such as kinship and ritual. The major innovation that aggrandizers introduced was the establishment of surplus and wealth as the basis for all of these undertakings and as a basis for their success. To this extent, all of these developments can be viewed as serving some "function" or having an ultimate "adaptive value" for the community. Communities that could acquire more mates and more allies would clearly be in better evolutionary positions than communities with fewer allies and mates, especially where violent conflicts were prevalent. However, the adaptive advantages for communities were undoubtedly incidental to the immediate self-serving goals of aggrandizers; they were simply the most effective or necessary appeals for motivating others to produce and surrender surpluses. Aggrandizer strategies persisted and spread under conditions where surpluses could be reliably produced because these features gave both aggrandizers and their community of supporters real adaptive advantages, particularly in the initial stages of development, when some communities would have adopted aggrandizers, while others would have lacked them.

If neither the proximate motivations nor the behavior of those that instigated these changes seems ever to have been concerned with the welfare of the community as a whole, it also seems inappropriate to view cultural changes related to prestige technology as developing in response to pressures on subsistence (*contra* Binford, 1983, pp. 208, 221–224; Cohen, 1981, 1985). Quite the contrary, the aggrandizer model views these developments as occurring with the *removal* of subsistence pressures and the establishment of surpluses that were used to further individual self-interests rather than as the result of increasing subsistence pressures which required new forms of adaptation. Virtually all feasting, interregional trade, alliance formation, war, and elite marriages in transegalitarian societies were predicated on, and required, surpluses; and these activities increase in frequency and scale when surplus resource production increases. Under the old functionalist paradigm, the occurrence of higher levels of warfare and the crea-

tion of regional trade immediately *following* the expansion of the resource base is difficult to explain. These situations occur most dramatically with the introduction of sweet potatoes in New Guinea (Feil, 1987; Wiessner and Tumu, 1998a) and steel for forest clearing in Amazonia (Good, 1993). Increased warfare and regional exchange in these situations *are,* however, understandable as responses to increased surplus production under the aggrandizer paradigm. Thus, the archaeological expectations of the aggrandizer model discussed here are quite different from the traditional functionalist/systemic/sociotechnic model proposed by Binford, Cohen, and others.

The apparently universal penchants of many or most people in every human population to be attracted to specific qualities of objects mentioned earlier, combined with the five premises listed above, render intelligible the remarkable convergence of cultural traditions and prestige technologies in disparate parts of the globe to which I now briefly turn for a few examples.

Aggrandizers and the Emergence of Prestige Technologies

I have argued that aggrandizers can be expected to develop prestige technologies as a means to display their control over wealth and labor (i.e., their success), as a means of storing and concentrating surplus food production, and as a means to indebt and reward others for participating in strategies used to establish hierarchical control over wealth and power—in many respects the same principles as modern pyramid schemes. Archaeologically, we can no longer observe these strategies in action, but we can observe the results of their operation and the material remains of their functioning. Thus, prestige technologies are critical links for understanding aggrandizers and the strategies that they used. While many types of material indicators are associated with various aggrandizer strategies [storage and production features, production technology, faunal and botanical remains, settlement patterns, and architecture; see Hayden (1992, 1995a) for more detailed discussions], I focus here only on the prestige technologies themselves. Moreover, space permits the discussion of but a few examples of prestige items to illustrate how aggrandizers created changes in cultural systems. A more comprehensive list is provided in Table I. No single transegalitarian tradition provides clear examples of all prestige technologies, so the following discussion emphasizes some of the most illustrative examples from different parts of the world.

Prior to the European Upper Paleolithic, there are *no* significant indications of any prestige technologies anywhere in the world, although it

Table I. A List of the Most Common Types of Prestige Technologies

Elaborated practical tools [adzes, maces, mauls, and others (Sherrat, 1982, pp. 23–24; Olausson, 1983, pp. 3–8; Cofini, 1992)]
Display metals & stones (G. Clark, 1986)
Elaborate serving containers [pottery, baskets (Brigham, 1906), carved wood, stone bowls, spoons (Carlson, 1991; de Beaune, 1995, p. 125)]
Special foods (domesticated animals and plants, rare wild species, labor-intensive preparations)
Jewelry [shell, ivory, bone, stone, metal beads, pendants, bracelets, and similar items (de Beaune, 1995, pp. 170–179, 247; G. Clark, 1986)]
Carvings [figurines (de Beaune 1995, pp. 185, 213; G. Clark, 1986)]
Special clothing [buckskin, textiles (de Beaune 1995, pp. 75, 167–170)]
Complex boats (Arnold, 1992, 1995; Hayden, 1983)
Drugs & alcohol (tobacco, cannabis, beer, wine)
Body deformations & tattooing as displays of mana and nonmanual labor status (Paine, 1979, p. 42; Handy, 1924) (ear piercing, labrets, head deformation, foot binding, genital mutilations, neck rings, tooth filing or inlays, excessive fattening)
Ecstatic experiences & high pain tolerance [trances, visions, communication with ancestors, and other sources of supernatural power (Schele and Friedel, 1990; Lewis-Williams and Dawson, 1993; Sherratt, 1990)]
Elaborate furniture
Elaborate housing (including plumbing, baths, etc.)
Massive architecture (Beaune 1995, pp. 245, 258; Rosenberg and Davis, 1992; Davis, 1991)
Elaborate burials (Cauwe, 1995, 1997; van Berg and Cauwe, 1995; Blake *et al.*, 1992, 1993; de Beaune 1995, pp. 175–179, 245–252)
Complex musical instruments (de Beaune, 1995, p. 221)
Pet breeding [dogs, birds, cats (de Beaune, 1995, p. 90; Teit, 1909)]
Specialist art (murals, cave paintings, tapestries)
Complex medicine
Elaborate war costumes
Arcane esoterica & elite languages (Leach, 1954, pp. 47, 163)
Slaves
Perfumes & makeup
Complex record keeping & calendars
Organized competitive sports

is entirely possible that some incipient developments may have occurred in Middle Paleolithic times, particularly in game-rich areas such as southwestern France. Even during the Upper Paleolithic, the clear occurrence of prestige technologies is restricted to a few exceptional regions where migrating herd animals could provide large quantities of meat. The Epipaleolithic/Mesolithic/Archaic period witnessed major advances in technology for exploiting yet other food resources en masse, especially fish and seeds. Where these foods were abundant, population increases and prestige technologies followed. These developments occur in the richest environ-

ments for sustainable mass resource harvesting such as the Levant, Japan, coastal and riverine North America, riverine China, and coastal Peru. Some of the major technological advances that aggrandizers appear to have initiated in their efforts to create effective prestige items for their self-serving strategies include metals, stone bowls, pottery, and domesticated animals and plants.

Metals. One of the clearest examples of prestige technologies is the initial use of native copper to create jewelry or other prestige artifacts. In Peru, Northwest North America, and the Levant, copper suddenly begins to be worked during the Holocene. Earlier populations of hunter/gatherers in these areas must have been aware of native copper and its unusual properties. However, native metals were labor intensive to work and shape (Heskel, 1983; Shimada and Griffin, 1994, p. 85), and they were never used until the Holocene in human prehistory. Binford (1962) was one of the first to argue that this was because copper was being used as a social object rather than a utilitarian one and reflected increases in social complexity during the Holocene.

The earliest metal artifacts in the world occur in the early Holocene cultures of Anatolia and the Levant where native copper and lead are first used for beads, pendants, bracelets, and decorative pins (Heskel, 1983; Knauth, 1974, pp. 32–33; Jovanovic, 1978, p. 9). Although other metals such as gold became incorporated into this tradition, the fundamental prestige nature of metal use in this area as well as Europe did not change until the advent of iron smelting in the Iron Age (Eluère and Mohen, 1996; France-Lanord and Contenson, 1973; Antonio Gilman, personal communication, 1997; Muhly, 1996; Shennan, 1982; Rosen, 1996; Heskel, 1983; Bradley, 1984; Darvill, 1987; Fallers, 1973; Randsborg, 1982; Chapman, 1982, p. 50; Rosen, 1996). In all cases, metal working is associated with wealthy settlements exhibiting socioeconomic differentiation (Heskel, 1983).

In the New World, metals never did emerge from the prestige realm even with the quite early appearance of smelting in Peru (Lechtman, 1993, p. 260; Pollard, 1987). The earliest use of metals in Mesoamerica was for the creation of elite Olmec concave mirrors at La Venta, and later for ritual items such as bells or prestige items (Hosler, 1995), while the much later occurrences of copper among the Northwest Coast complex hunter-gatherers ca. 1000 B.P. and in the Adena-Hopewell culture were entirely in the domain of small nonutilitarian sheets, discs, and tubes. Binford (1962) has argued for a prestige role of copper objects around the Great Lakes, even though some of these take utilitarian forms such as celts.

On the basis of these early occurrences, the initial use of copper and other native metals seems to be associated with surplus production, an in-

creased level of control over labor, and a need for a prestige technology. Prestige technologies of this magnitude imply levels of control over labor and resources characteristic of aggrandizers and transegalitarian communities. It is probably because of the similarity in strategies used by aggrandizers, and because of the similarity in basic human perceptions of desirable qualities of objects, that complex hunter/gatherers ranging from coastal deserts to rainforests to boreal environments with subsistence bases as diverse as marine fishing to cereal harvesting, developed almost identical solutions to the need for prestige items. Wherever native copper was available and resources were abundant, aggrandizers used it to display success and attract supporters. The initial attraction of copper was undoubtedly its difficulty to procure, its difficulty to work, its high malleability permitting many different shapes, its shiny luster, and its unusual tinkling sounds when fashioned into tubes (Wheeler and Maddin, 1980, pp. 99–100; Bradley, 1990, pp. 82–83). It was an ideal material with which to transform and store surplus production and labor, especially given its high value per unit weight. The rarest and most costly metals continued to be used in early empires such as China primarily to display prestige (Woskin, 1994). And of course, contemporary societies use precious metals for the same purposes.

Stone Bowls and Pottery. Both stone bowls and pottery appear to have been originally made and used as prestige items in many areas. Like metals, there can be little doubt that the use of stone to make serving bowls or containers is an extremely labor-intensive solution to a simple practical problem. Serving and other containers can be made much more easily of bark, wood, gourds, basketry, or skin. Moreover, thick varieties of stone bowls are cumbersome while thin varieties are fragile, like pottery, and would not necessarily have long use-lives. Therefore, the appearance of stone bowls *before* pottery among many Holocene complex hunter/gatherers and horticulturalists is especially significant. In North America, stone bowls (as distinct from mortars) occur in many complex Archaic-level cultures including the Northwest Coast (Hannah, 1996; Duff, 1975; Carlson, 1993, p. 8), the California Coast (Jennings, 1974, pp. 176–178), the eastern Archaic (Ritchie, 1965; Sassaman, 1993), and some midcontinent riverine regions (e.g., Webb, 1974, pp. 278-279). These bowls are generally used as mortuary items (indicating prestige roles) and, in New York state, decline in importance after the adoption of pottery. Some bowls are elaborately carved, such as the figurine bowls of the Northwest Coast (Duff, 1975). In the Tehuacan sequence in southern Mexico, stone bowls occur from Coxcatlan (Archaic) times onward, and some early forms are tecomate—or gourd-shaped (Willey, 1966, pp. 82–83). This is the same shape used most commonly for the earliest Mesoamerican ceramics, which occur significantly later. In Peru (and many other places), stone bowls clearly appear as a

prestige technology, although somewhat later than the first appearance of ceramics (Gero, 1989).

In the Old World, stone bowls appear before pottery at Ali Kosh, Hallan Cemi, Cyprus, Jericho, and Jarmo as early as 9000 B.C., and some authors even speculate that the use of stone bowls held back the adoption of pottery in these regions [Van Doren Stern, 1969, p. 241; Cole, 1970, p. 45; Rosenberg and Davis, 1992; Perrot, 1968, p. 379; Ronen, 1995, p. 189; see also Sassaman (1993) for a New-World example]. But even after the development of pottery in both the New and the Old World, the making of stone bowls was so labor intensive that they continued to be made and used as prestige items and seldom if ever made the transition to practical forms. Egypt and Tepe Yaya became especially renowned centers of production as early as 3500 B.C. (Hoffman, 1979, p. 274; Lamberg-Karlovsky, 1971, p. 106).

The fact that stone bowl technology may have impeded the adoption of pottery in some cases (or that stone bowls decreased in frequency after the adoption of pottery) implies that *initially* both of these technologies may have played a similar, if not identical, role as prestige objects. That the tecomate vessel shape was common in both early Mesoamerican stone bowls and pottery provides considerable support for this interpretation. They, were, in effect, the prestige equivalents of common gourd containers, and that is why they began as gourd shape forms. I suggest that studies like Sassaman's (1993) analysis of the cooking performance characteristics of Southeastern Archaic pottery and soapstone bowls might be more usefully recast in terms of prestige items or items associated with the preparation of prestige feasting foods or beverages.

A number of recent studies in various parts of the world have indicated that the *earliest* pottery was used primarily in prestige display contexts, most likely as part of competitive or reciprocal feastings. The clearest examples come from the first pottery horizons in Colombia (Pratt, 1998), in coastal Chiapas, (Clark and Blake, 1994; Clark and Gosser, 1995, p. 214), in the Central American isthmus (Hoopes, 1995), in Neolithic western Europe (Shennan, 1986, p. 135; Thomas, 1991, p. 102; Barnett, 1990), in the eastern Mediterranean (Vitelli, 1989; Perlès, 1992a), and in the Near East (Schmandt-Besserat, 1977), to name but a few locations. For a more detailed review of this topic, see Hoopes and Barnett (1995) and Hayden (1995b). Deborah Olausson (personal communication, 1997) also suggests that where relatively cruder types of pottery represent initial forms, such as the thick cooking wares of the Mesolithic Ertebølle cultures of Scandinavia, these may have been used to prepare special foods for feasts and rituals. The adoption of pottery by Ertebølle cultures is not associated with any subsistence change, but fermented residues have been identified from

the interior of some pots (Hulthén, 1977), which indicates their use for preparing alcoholic beverages. Elsewhere in the world, consumption of beer and wine in transegalitarian societies is *always* a social, ritual, and especially feasting act associated largely with aggrandizer activities (Dietler, 1990). An important lesson that emerges from this example is that it is relatively easy for prestige technologies to masquerade as practical technologies when one is dealing only with archaeological remains. On the other hand, it is probably difficult to mistake practical items for prestige items, at least in the regions of origin.

Initial pottery may have been valued as a prestige technology because it required skilled artisans to produce attractive pots, because it was relatively fragile, and because it lent itself to decorative elaboration. It could also be made in various colors and be given high lusters. As with metals, high-quality ceramics still constitute an important component of prestige display in many contemporary societies throughout the world.

Domestication. Even stronger arguments can be made for initial plant and animal domestication taking place as part of aggrandizer feasting strategies (Hayden, 1990b, 1995c). Early domesticates must have been more labor-intensive to produce than the simple gathering of wild plants and hunting of wild game. This is an assumption shared by advocates of population pressure models (Cohen, 1977; Redding, 1988), the optimal foraging models (Winterhalder and Goland, 1992), and the surplus-based feasting models. To obtain exotic, unusually large, unusually fat or sweet species, or species with the other unusual qualities that domesticates represent, it would have been necessary to protect and cultivate wild species carefully. Where beer was valued for feasting, it would have been necessary to cultivate cereals or root crops if they did not occur naturally in sufficient quantity. Jennbert (1984, 1985) has suggested that the first domesticates were used for brewing in Scandinavia, while similar arguments have been made for the domestication of grains in the Near East (Braidwood, 1953; Katz and Voigt, 1986) and can probably also be made for maize, millet, and rice. Critical for identifying the role of aggrandizers in the domestication process is the occurrence of initial domesticates only in situations where prestige technology had *already* developed. And prestige technologies appear predominantly only after early Holocene technological innovations had made the production of reliable surpluses possible in some regions.

In situations where it is possible to distinguish food remains associated with public feasting from domestic food wastes, it is highly significant that the first domesticates are concentrated in the public feasting areas, while the wild foods are concentrated in the domestic areas (Umlauf, 1991). The adoption of maize exclusively as an elite or ceremonial food

in the early platform mound centers of the southern United States (Fritz and Kidder, 1993) similarly is what would be expected from the aggrandizer-surplus model but is incongruent with resource-stress models. Clark and Blake (1994) make parallel arguments for the initial adoption of maize in Chiapas, Mexico, as a high-status food used only infrequently—primarily as part of a feasting complex. Ethnographic observations such as the raising of domestic animals exclusively for feasting purposes in New Guinea, Southeast Asia, the Near East, and elsewhere (Shnirelman, 1992, p. 36; Blanton and Taylor, 1995; Keswani, 1994; Leach, 1954, p. 72; Hayden and Maneeprasert, 1995) also provide an important base of support for this model (see also Hayden, 1990). Linden (1995, p. 411) and Kaelas (1981) make a similar argument for the early Neolithic use of cereals as "luxury or ritual products, in Scandinavia and Germany. To extend the model even further and increase its explanatory power, I suggest that many of the products of the Neolithic "secondary products revolution" (Sherratt, 1981, 1983) probably also began as prestige commodities, including milk, cheese, alcoholic drinks, horse riding and transport, and wool. The initial development of these products must have been excessively time-consuming and labor-intensive, and their first use was therefore probably for prestige and feasting contexts.

Needless to say, like the independent invention of metal working and pottery, domestication emerges independently in different environments from groups with different histories and different lengths of occupation in different geographic areas. It is another example of convergent evolution, the roots of which must be sought at a very basic level of causality such as basic human penchants and the emergence of aggrandizers.

Shells. Although it may seem that shells are more ubiquitous than materials like metals, it is worth noting that in coastal areas, the rarest, most unusual, and most difficult to procure shells such as dentalia were used as prestige items (Barton, 1994). Moreover, shell beads and bracelets often owed their status as prestige items to the high labor costs involved in making them into jewelry. The same considerations apply to the production of bone and ivory beads in inland areas (see White, 1993). The occurrences of this type of shell and bone technology are far too ubiquitous in the prehistoric and ethnographic record of transegalitarian cultures to enumerate. However, it is worth observing that these technologies are very restricted during the Upper Paleolithic and become widespread only during the Holocene, with the extraction of much more abundant and stable resources and dramatic increases in population densities in certain resource-rich areas.

Other Domains. In addition to metals, stone bowls, pottery, and domestication, I believe that compelling arguments can be advanced to sup-

port the notions that aggrandizers were responsible for the development of buckskin clothing since it is labor-intensive to produce and a highly visible prestige commodity. The initial development of buckskin technology seems to have occurred in the European Upper Paleolithic since such a development best explains the dramatic increase in the importance of endscrapers in some Upper Paleolithic industries as well as the appearance of bone needles. For the detailed argumentation of this interpretation, see Hayden (1990b, 1993b). Depictions of tailored buckskin clothes in Upper Paleolithic art further supports this interpretation (Beaune, 1995, pp. 167–168). On the basis of this evidence and the clear presence of prestige items carved in bone, antler, ivory, amber, jet, and stone, there can be little doubt that aggrandizers were alive and very active in some Upper Paleolithic regions of Europe (Beaune, 1995, pp. 179, 274; Hayden, 1993b). At a much later date, and for the same reasons, the labor-intensive production of textiles was widely used for display purposes in many historically documented and undoubtedly many prehistoric cases.

In addition to curried Paleolithic leather technology, craft specialization, and production of prestige feasting foods, there have been a number of suggestions that reliable open ocean sailing vessels were also created by aggrandizers. In some areas such as Polynesia and southern California, these were for the purposes of carrying out exchange (Arnold, 1992, 1995; Hayden, 1983); in other areas like the Northwest Coast, these were for obtaining prestige types of feasting foods such as whale blubber and valuable sea otter pelts. In all cases, the very high costs of constructing substantial boats was underwritten by elite aggrandizers who usually owned and commanded them as well.

The domestication of dogs, slavery, tattooing, and body piercing such as existed throughout the North American Northwest also seem likely to have been the result of aggrandizers searching for increasingly numerous and dramatic display symbols of their success and power. In fact, the breeding of dogs and keeping of slaves are remarkably common among the most complex ethnographic hunter/gatherers (Watanabe, 1983; Mitchell, 1985; Teit, 1909, p. 576; Powers, 1976, p. 22) and the two share many role similarities in complex hunter/gatherers. Many other types of prestige technologies are listed in Table I, some of which began to appear only in more politically stratified societies. In general, the emergence of highly crafted objects can be, and has been, related to the influence, if not the direct creation, of aggrandizers (Clark and Parry, 1990). Clearly, many volumes could be written to chronicle and explain these developments. The aims of the present discussion are much more limited and exploratory.

The Transformation of Prestige into Practical Technologies

While the initial development of all prestige technologies represents the labor-intensive production of items that ordinarily would not be worth the time and effort required for use in everyday practical tasks, it can also be expected that at least some of the craft producers of prestige items would always have sought means to reduce production costs in order to maximize their own benefits. It can also be expected that many aspiring aggrandizers would try to find less costly ways of acquiring the symbols of success and power represented by prestige items. For example, Oldeberg (1974) provides the example of two bronze axes that are finely made and decorated but consist of only a thin layer of bronze over a clay core. Obviously they could be used only for display. Such striving for material emulation by commoners or low level aggrandizers aspiring to higher status is well documented (see Veblen, 1899; G. Clark, 1986, p. 3; Randsborg, 1982; Schiffer, 1976; Shennan, 1982; Bradley, 1984, p. 132; Fallers, 1973; Cannon, 1989) and is probably one of the main driving forces behind periodic shifts in prestige styles and the development of new prestige technologies. The cheapening of the symbols of power essentially forces successful aggrandizers to look for, or to develop, ever more costly prestige items. However, if this trend continues too far, the resulting cheapened prestige technologies may become so affordable that they may even become competitive with, or less costly than, existing practical technologies. At this point, these items are no longer suitable or useful at all as prestige objects and other items must be developed to take their place (see Schiffer, 1976, pp. 189–191).

While the geographical and cultural forefront of these changes has shifted over the centuries and millennia, the net result of this situation has been an exponentially increasing rate of cumulative technological change since the advent of prestige technologies until the present, whether measured in terms of the number of types in a technological tradition (Leroi-Gourhan, 1964, pp. 196–200), the maximum (or average) complexity of technological items (Cotterell and Kamminga, 1990, p. 9), or the information and transformed energy content of items (Odum, 1988). The result has also been the transformation of numerous prestige technologies into practical technologies. Some well-documented or probable examples of transformations from prestige to practical items include textiles, metals, open ocean boats, leather shoes, finely milled grains and white bread, domesticated dogs, plastics, plumbing, ceramics, glass, automobiles, writing, and books. I have argued that pottery and most, if not all, domesticated foods constitute other examples of this process (Hayden, 1990a, 1992, 1995b,c). In the case of food items, initial domesticates would have constituted labor-intensive prestige items used in feasting that were eventually

genetically improved to the point where they were cost competitive with wild gathered or hunted foods. At that point, agriculture began to expand rapidly and domesticates became the main subsistence staples. In the case of pottery, like metals, the development of relatively low-cost utilitarian forms would have made their adoption attractive to members of any community, whether they were hierarchical societies or not. Therefore, today, there are relatively egalitarian groups of hunter/gatherers that use metal knives or axes or ceramic pots, and there are some relatively egalitarian communities that grow domesticated plants or raise domestic animals. However, this is the end product of a long series of technological changes, and the origins of these technologies certainly seem to have been quite different, being restricted wholly to the prestige domain.

Precisely why some prestige technologies give rise to practical variations while others do not is undoubtedly due to a complex mix of factors including changes in the availability of raw materials, changes in efficiency of manufacturing technologies, and changes in value or symbol systems resulting from changes in alliances with different ethnic groups. For instance, G. Clark (1986, p. 10) cites the changes in Roman gemstone shaping technology leading to the replacement of lapis lazuli by emeralds, sapphires, and rubies as high-prestige items. In contrast, diamonds had a relatively low value because they could not be polished until late Medieval times when the cutting of diamonds by controlled fractures was developed.

In almost all of the above examples of prestige technologies that were transformed into practical technologies, *additional techniques were also developed to increase the costs of some products* (including some utilitarian items such as celts, mauls, and clothes) so that prestige items still continued to exist made of the same original prestige materials such as precious metals, finely crafted textiles, finely crafted glass or ceramics, rare plastics, books, boats, automobiles, costly food delicacies, and other items. The ultimate result has been a remarkable increase in the rate of technological, economic, and cultural change, including the emergence of large complex urban societies. The progressive but dramatic increase in the standard of living over the past 10 millennia is also logically the result of this process, although it has undoubtedly been an unintentional consequence of both the artisans and the aggrandizers most responsible for these developments.

As a final note on this topic, it is worth reiterating an observation from the consideration of pottery, namely, that prestige technology (such as brewing apparatus) can sometimes masquerade as practical technology, whereas practical technology is unlikely to be confused with prestige technology, at least in its region of origin.

Evaluating the Aggrandizer Model

Viewing aggrandizers and their aggrandizing strategies as a widespread, if not universal, causal agent of the emergence of prestige technologies under appropriate ecological and technological conditions has a number of advantages (Table II).

First, the model appeals to realistic and very powerful motivations for changes in behavior and technology. The fact that these motivations do not have to be viewed as universal for all people—but can be effective with even a small, highly motivated percentage of the population and a variable proportion of the population which are attracted by rich foods, baubles, bangles, and bright shiny beads—obviates the necessity of defending unrealistic proposals about human nature.

Second, this approach to aggrandizers is a parsimonious explanation of the phenomena dealt with. All that need be assumed is the presence of personality types and human responses to lures that are certainly within the known contemporary range and are widespread throughout the world. Combined with rich resource conditions, aggrandizers can be expected to generate various prestige technologies (on a large scale of analysis).

Third, this approach is a powerful explanatory model for a wide range of cultural changes that were previously viewed as developing independently of each other. The role of aggrandizers in creating numerous types of prestige technologies, new types of socioeconomic organizations, and new community values or beliefs brings unexpected new insights into how and why cultures change over a wide spectrum of environments and initial conditions.

Fourth, no matter what the original environmental conditions or specific histories of groups may have been, once means were developed or

Table II. Advantageous Features of the Aggrandizer Model

1. Involves realistic and very powerful motivations
2. Explanation is parsimonious
3. Explanation is powerful (explains many different phenomena)
4. Reveals and explains unexpected relationships and phenomena (e.g., domestication, pottery, the transformation of prestige to practical technologies)
5. Leads to numerous cases of equifinality, congruent with independent but similar cultural changes throughout the world
6. Accounts for the resiliency of aggrandizive systems
7. Accounts for instability of aggrandizive systems
8. Is consistent with historic and ethnographic cases of elite sponsored innovations
9. Is consistent with contemporary behavior and culture change
10. Is consistent with other well established theories (e.g., nonhuman ecology)

introduced to sustain reliable surplus production, subsequent events proceeded toward generally similar solutions. Thus, whether the initial state involved egalitarian hunter/gatherers evolving new technologies on their own, egalitarian hunter/gatherers receiving introduced technologies developed elsewhere (e.g., high-productivity domesticates), pastoralists augmenting their surpluses by using horses, or impoverished horticulturalists who received more efficient or low-cost technologies or more productive domesticates from elsewhere, subsequent developments were remarkably similar. This is because the underlying motivation of aggrandizers is basically the same everywhere and because the strategies that they find to be successful are similar throughout the world (Fig. 2).

Fifth, once the possibility of sustainable surplus production has been established in a region, and once aggrandizers have discovered successful techniques for getting people to produce surpluses over which aggrandizers could exert some control, and once some portion of the community membership has bought into the aggrandizive system, these systems become extremely resilient to perturbations. Despite periodic uncontrolled population decimations from famines, disease, warfare, floods, or other causes, these systems rapidly reconstitute themselves as soon as production of surpluses returns to normal conditions.

Sixth, competition between aggrandizers accounts for still other aspects of these systems such as their instability and their frequently high levels of violence, with entire communities often being obliterated.

Seventh, the model of aggrandizer-sponsored technological innovation is largely consistent with subsequent prehistoric and historic developments that are much better documented. The first uses of large boats, bronze, iron, aluminum, and many other innovations were underwritten by aggrandizers and all these items were initially developed as prestige items. All of these projects required considerable time and labor to develop, and it is difficult to imagine how they could have originated without aggrandizer backing, which explains why such developments did not begin to occur before the Upper Paleolithic. As Cowgill (1975) and Hobsbawm (1968) argue, it is the lure of gain that creates innovation, and this can occur only where aggrandizer systems are in place and where aggrandizers perceive net benefits to be made. In chiefdoms and states, aggrandizing elites underwrote craft specialization (Clark and Parry, 1990), agricultural innovations, and major practical technological projects (Earle, 1978, 1987; Johnson and Earle, 1987; Stanish, 1994; Urry, 1993, p. 62). Elites promoted these projects out of their own self-interest, presumably in order to increase the production of prestige items, food, and labor under their control (e.g., large-scale irrigation, wet land reclamation, terracing).

Finally, many of the prestige technologies developed in the Late Pleistocene and early Holocene continue to serve prestige display functions in contemporary societies, notably the use of fine leathers and furs, costly textiles, rare metals, fine ceramics, boats, and the consumption of exotic or costly food and drink. Thus, there is a broad consistency over time in human behavior and meaning which not only is parsimonious, but also reassures us that human responses are broadly similar in most places and periods. People are not perpetually plastic.

In essence, I view human cultures as being distributed between two polar extremes and tending to be divided into two great families of systems: those at one end, which are based on limited, essentially unexpandable, and easily overexploited food resources (fundamentally egalitarian hunter/gatherers); and those at the other end which are based on abundant resources that are relatively invulnerable to overexploitation, where there exists the possibility of producing regular surpluses and using those surpluses to enhance the control over labor and resources by certain individuals. These are competitive societies in which private ownership and self-interest play highly significant roles. Obviously, there are many intermediate cases between the extremes. But in broad terms, egalitarian societies seem to have been the only culture type to exist during the first 2 million years or more of human technological existence. There are a few glimmers of transegalitarian social organization and prestige items in the Middle Paleolithic, but the Upper Paleolithic and Mesolithic are clearly the watershed periods for the appearance and spread of these socioeconomic systems. The spread of transegalitarian societies and their interaction with egalitarian societies are a fascinating theoretical topic that only a few researchers have examined (Hutterer, 1976; Junker *et al.*, 1994; Hedland and Dailey, 1991; Eggert, 1992). Transegalitarian societies generally appear to be better equipped than egalitarian societies to take whatever resources they want. They can be expected to expand along well defined resource corridors, such as the agriculturally productive loessic valley bottoms of Neolithic Europe. However, they also frequently leave the less productive parts of the landscape to egalitarian groups and then establish symbiotic relations with those groups in order to obtain hard-to-get forest products (e.g., meat, furs, plants) in exchange for lower-cost technological products or foods (e.g., pottery, starches).

Today, there are few, if any, glimmers of truly egalitarian societies left in the world. There are only transegalitarian and stratified societies. While it is fashionable to view this transition as the result of a biological and genetic change (the replacement of neandertals and archaic sapiens by fully modern forms), or as the result of even more vacuous "societies enriched by aesthetic sensibilities" (G. Clark, 1986, p. 6) it is more parsimonious to

view the transition in technological and economic terms (see Hayden, 1993b).

Clearly, focusing on a single variable such as potential surplus production does not account for many of the other factors that can also influence the social structure, economics, history, and values of a community. Factors such as the need for cooperative labor, the many characteristics of food resources (returns, patchiness, storability, scheduling, and diversity, to name but a few), the preexistence of independent trade routes, and many other factors must also be relevant. Nevertheless, the overriding general importance of surpluses in the success of the Triple A, ambitious, aggressive, acquisitive aggrandizers is, I think, a general pattern that will weather the test of new observations.

Because the logic and goals of practical versus prestige technologies are so fundamentally different, I now turn to how prestige objects should be approached in a design theory analysis. Since some objects can operate in both realms, it is important for analysts to determine from the outset which objects and which attributes represent cost-efficient solutions to a practical problem and which objects or attributes represent unnecessary expenditure of time and effort to embellish or create entire prestige objects.

Analyzing Prestige Technologies

In this discussion I again restrict myself to consideration of lithic artifacts, although the analysis of other materials can certainly be approached using the same basic framework. As with practical technology, prestige technology is amenable to analysis using design theory. While the general approach remains the same, a sufficient number of details change so that the discussion of prestige technologies warrants a separate treatment. The general features that remain the same are material, socioeconomic, and ideological constraints, and design considerations. However, the weighting and importance of the constraints as well as their specific constituents, change dramatically (Fig. 3). The exploration of appropriate approaches to the analysis of prestige technologies is in an even more formative state than practical technologies.

Task and Socioeconomic Constraints. As already noted, the nature of the tasks to be performed is considerably different from practical technological problems. The tasks to be performed in prestige technologies involve the communication of success and other related information such as group membership. In technological terms, this generally involves the display of costly desirable objects, sometimes called "primitive valuables." Given this situation and because of the extreme variability in materials and designs

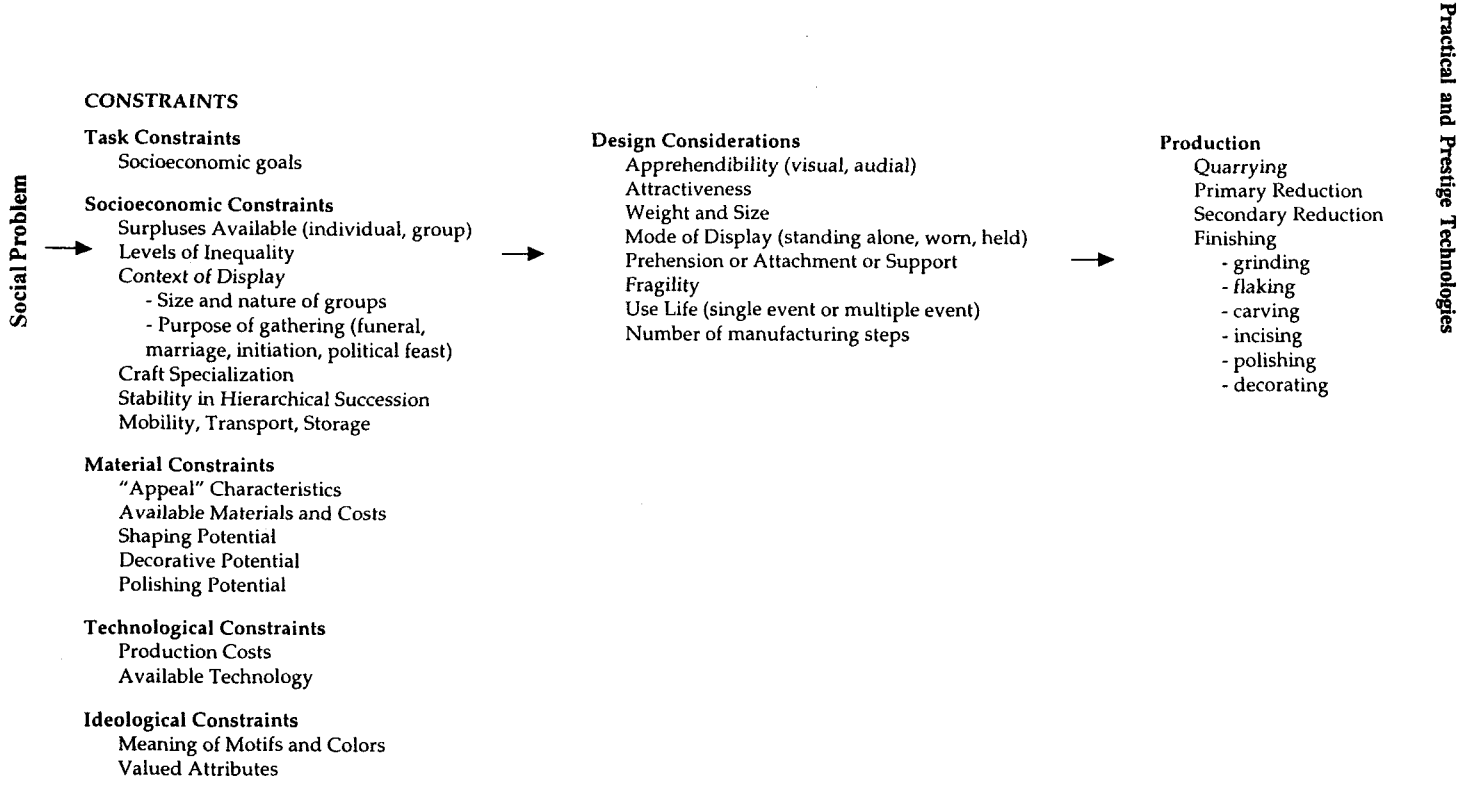

Fig. 3. The design and production process for prestige lithic technologies.

acceptable for accomplishing these tasks, the major constraint on the production of prestige objects is generally socioeconomic rather than any narrowly defined task constraint as with practical technologies. That is, the amount of socioeconomic inequality in a society, the instability of succession to positions of political leadership (Randsborg, 1982), the size and nature of the social groups in which objects are to be used or displayed, the nature of those events (funerals, marriages, or other), and available surplus wealth or labor are probably the most critical factors for understanding the basic design of prestige objects. Socioeconomic factors will also determine levels of mobility and the practical size or weight of transported or stored prestige items, as well as the level of craft specialization that is available for making prestige objects (Clark and Parry, 1990).

At this point, in contrast to practical technologies, it is difficult to apply criteria to prestige items such as consequences of failure (risk), time limitations, efficiency, or quantities of the tasks to be performed. Clearly, we can identify many importance "performance characteristics" of these objects—to use Schiffer and Skibo's (1997) terminology—such as reflectivity, sonority, symmetry, and others; however, it is difficult to quantify or even assess many performance characteristics at present. Many of them are still too subjective. Hopefully, it will eventually be possible to develop some way of assessing relevant notions such as the relative importance of prestige display events and the consequences of failing to impress target audiences adequately. Schiffer and Skibo (1997, p. 36) outline the principles of one promising approach dealing with the exchange or sale of pottery. However, their examples are ethnographic. Operationalizing such an analysis archaeologically would be highly subjective or tautological unless some general principles can first be established, such as the inherent attractiveness of a high luster, a bright color, and other attributes.

There is another type of risk that is common to prestige technologies but probably less frequent or less significant in practical technologies. In addition to the risk of failing to perform a social task acceptably, there is also the risk of losing the entire investment of time, energy, and resources with prestige technologies, and this investment can be quite considerable This risk derives from bad investment decisions, failure to impress (for technological, social, or other reasons), unintended breakage of prestige objects, and bad prestige debts that are never paid due to ruptures of alliances or marriages or the failure of these to materialize.

Moreover, technology plays only a partial, albeit important, role in prestige display events, whereas technology is the major element in successfully completing practical tasks. In successfully undertaking prestige display events and achieving their goals, other factors all play roles as important or more important than prestige technology. These factors in-

clude social skills, dance and ritual skills, psychological skills, skill in combat and the use of threats, oratory ability and charisma, abilities in economic undertakings and financing, arranging marriages, and brokering nontangible benefits such as rights to hunting or fishing territories. Much more work is required to sort out the role of prestige technology amid the panoply of factors implicated in the realization of social goals especially since the success of the task performance may not be known for weeks, months, or even years after the actual event. This is one of the goals of Schiffer's (1992, p. 136) socioscience.

Material Constraints. Given the need to impress individuals and create desires to imitate owners of prestige objects (i.e., to possess similar objects), we can postulate that there are material constraints on the kinds of objects that will innately appeal to the majority of a community or even to significant proportions of its members. These material constraints involve prestige performance characteristics such as the availability and costs of materials (in contrast to practical technologies, easy availability and low costs are not desired traits); the degree to which available materials can be worked into complex shapes, be decorated with complex designs, take on highly reflective surfaces, or take on other attractive qualities; the labor costs involved in working these materials; and the color and brightness of the materials. Labor costs are especially important in these considerations. A Herkemer diamond sparkles like a real diamond; a Lindee star sapphire is like a real sapphire; glass crystal is almost the same visually as quartz crystal. What differentiates these materials is the procurement and manufacturing costs (reflected in purchase or replacement costs), not the physical appearances or other qualities of the materials.

Technological Constraints. Technological constraints also undergo significant transformations from those used in analyzing practical technologies. Production of prestige items is still dependent on the available technologies in other domains; however, there is a much greater tendency to invent new solutions and even create new technological domains such as metal working, when no immediate solutions may be available or evident. Also, in contrast to practical tasks, if the existing technology can produce an object inexpensively, this generally will prevent the item from being accepted as a prestige item unless it is used as a sumptuary item associated with special rights of office and other uses are prohibited. There is no indication for prestige objects that repair, resharpening, or replacing parts plays any role in the design of purely prestige items, although these may be relevant in analyzing objects that are both prestige and practical in nature as with jade adzes, large thin bifaces, copper celts, and bronze swords.

Ideological Constraints. While ideological constraints and traditions of culture values appear to play some role only in the final choice between

approximately equal solutions to problems in practical technologies, ideological and cultural value constraints are frequently among the most powerful in determining the design of prestige objects. This is because there are so many more possible solutions, aesthetic variations, and different symbolic ways of interpreting material representations. Given the number of suitable alternative media and effective styles, the number of acceptable solutions is truly enormous. The major constraints that operate really to narrow down these choices are ideological values (e.g., the importance of hierarchies, the roles of men and women, the importance of ancestors, the value of antiquities), together with specific cultural and artistic values and traditions.

I suggest that because almost anything imaginable can be used as prestige items (provided they exhibit the appropriate psychological and sensory performance characteristics of appeal to sight, audition, taste, smell, or touch) and because there are so few outside constraints on artistic traditions (other than what individuals agree is pleasing), an extraordinarily wide diversity of prestige objects has been generated over the last 20,000 years, including what appear to be the most bizarre body deformations and insertions and other irrational or "weird" practices from our own ethnocentric point of view (e.g., oversized ear and lip insertions, stacked neck rings, female genital excision, foot binding, and others). In the narrow sense, post-processualists, cognitivists, and structuralists may be right that such "irrational" or bizarre practices can only be understood in terms of their specific expression and meaning in relation to the culture that produced them. Trying to account for practices that made no sense to Europeans was, after all, the genesis of cultural and structural anthropology. To understand why stacked neck rings were used, and not large lip plugs or foot binding, we probably *do* have to refer to a specific culture tradition and value system. But in a broader cultural-ecological perspective, all of these different solutions are conveying the same basic prestige message and can be understood as a fundamental, even predictable pattern of human behavior. Recognition of different classes of artifacts such as practical and prestige types, together with an understanding of their differences in purpose, design, and the socioeconomic conditions under which they occur, enables analysts to escape sterile subjective relativism. The cross-cultural and generalizing approach that I and others advocate enables analysts to establish a firm foundation for inferring significant things about artifacts and the societies that produced them. The more cross-cultural and design understanding that we can bring to the analysis of artifacts, the more details we will be able to add to our understanding of past societies. For instance, I suspect that we will be able to identify the essential cultural ecological conditions under which women's marriage value will be augmented by publicly

visible or witnessed events and the kinds of display technology most suitable for such events (tatooing, jewelry, etc.). But that is a topic for future research. The important point is that these practices are not simply incomprehensible relativistic cultural bumberings. They do make sense within a materialist ecological framework.

Design Considerations. As with the structure of practical technologies, all the basic constraints interact to produce *design considerations* for the production of prestige objects but their relative importance is quite different. Performance characteristics to consider in the analysis of lithic prestige items (including native metals) are the contexts of display, the prehension or attachment technique, the number of steps involved in production, the visibility of objects or their "apprehendibility" by large numbers of people, the weight and size, the degree of attraction generated, the fragility, and the visual and the auditory effects (e.g., the tinkling of stone or copper pendants). For nonlithic materials, similar factors can be established (see also Schiffer and Skibo, 1997; Schiffer, 1992, p. 135).

As with constraints, many of the criteria used in understanding the design process of practical objects appear to be of little or no relevance for understanding the design of many purely prestige items. Considerations such as reliability, resharpening, ease of repair, and specialization versus multifunctionality do not have any obvious referents when designing purely prestige items, although with time, some of these concepts may gain currency. For instance, multifunctional items that incorporate both prestige and practical functions may be related to mobility and transport constraints.

Production. Production and reduction strategies can be modeled in a fashion relatively similar to practical technologies. That is, given the decision to make an object of a specific type, and given the constraints involved, what are the most obvious, and perhaps the most efficient, ways of producing an item (in order to obtain the biggest impact for one's available surplus)? Once artisans are committed to produce a given object, it can be expected that at least some of them will seek to maximize their own benefits by minimizing the work involved in its actual production given several options with equal outcomes. Thus, if the use of corundum sands rather than quartz sands can reduce the manufacturing time of jade adzes by 25 or even 10%, and both types of sand are available, we could expect some, if not most or all, producers of jade adzes to adopt this technique in order to be able to increase their own benefits (the number of adzes they could make or their net exchange profits) and to broaden their exchange base, a strategy noted much earlier by Schiffer (1976, p. 190). This seeming contradiction of efficiently using the largest possible surplus leads to a major unexpected development that I have already discussed, the even-

tual transformation of some prestige technologies into practical technologies.

As with practical technologies, many of the constraints, design considerations, and production aspects discussed above can be reasonably measured or monitored in the archaeological record through either experiments, measures of production steps, establishment of the distance to source materials, assessments of display values, estimates of material availabilities, ethnographic observations, or estimates of socioeconomic inequalities or surplus production (e.g., Schiffer, 1992, p. 135). The analysis of the number of production steps involved in making specific types of textiles and ceramics has become standard in these fields for measuring complexity (skill) and labor investment in artifact manufacturing (e.g., Upham *et al.*, 1981, p. 826; Costin and Hagstrum, 1995). Such approaches could very effectively be used in the analysis of other prestige items. Another indicator of prestige status of an item is the distance to the source of which the material it is made (G. Clark, 1986, p. 3; Schiffer, 1992, p. 135). Santley and Pool (1993, p. 181) have observed that practical items rarely are carried for more than 2 days' walk even by commercial traders. On the other hand, there are many examples of prestige objects transported over great distances, undoubtedly because of their concentrated value, if not to actually increase their value. As Bradley (1984, p. 46) notes, suitable prestige objects must be rare or imported or labor intensive to produce.

In the case of pure prestige technologies, use-wear analysis may have little to offer concerning actual use; however, it might be employed effectively in determining techniques used to manufacture prestige items and in establishing approximate manufacturing costs in terms of time and effort. As with practical technologies, by establishing the approximate or relative values of some of these constraints and by making observations on the attributes of prestige artifacts related to these constraints, it should be possible to establish critical inferences about the use purposes and contexts of these objects with reasonable accuracy. And, as with practical technologies, other sources of interpretations such as direct historic analogies, oral traditions, and structuralist analyses of context and meaning may also be useful to understand the overall formation processes of these artifacts including their procurement, manufacturing, use, breakage, and discard.

Given the early state of this type of analysis for both practical and prestige technologies, I have attempted to deal only with extreme cases where objects can be assumed to be entirely practical or entirely prestige in nature. Obviously there are many intermediate cases where these characteristics overlap such as the use of ground stone axes, clothing, sculpted mauls, and decorated antler digging-stick handles or salmon clubs. The analysis of such objects becomes especially complex where the prestige ma-

terials such as metals or jade are actually more effective, but far more costly, than more commonly used materials.

Analyzing such "mixed" artifacts constitutes a problem to be resolved in the future, once the analysis of purely practical or purely prestige objects has become well grounded, although Schiffer and Skibo (1997) have presented a complimentary framework that does incorporate aspects of both in the analysis of individual objects or types of objects. The problem has also been confronted by previous researchers (e.g., Olausson, 1983; Cofini, 1992; Darwent, 1996). I suggest that there are two basic ways of approaching these mixed types of artifacts. First, *attributes* can be isolated and be assigned to either practical or prestige domains and analyzed separately according to the framework most pertinent for each attribute. This would be especially useful where prestige attributes are added onto practical objects as with Sackett's (1986) adjunct style. Surface designs or unnecessary carving of hafts constitute good examples. Second, it may be possible to evaluate the manufacturing costs and benefits (e.g., efficiency) of entire objects, such as groundstone adzes or gourd-shapped pottery vessels, and compare these to parallel manufacturing costs and benefits of more mundane counterparts such as actual gourd containers. The difference in overall costs and benefits of the prestige versus the mundane solutions would then provide some indication of the net "prestige cost" of such objects (see Olausson, 1983, pp. 3, 60–61; Darwent, 1996). Clearly, there are many subsequent problems to be dealt with in such approaches; however, I do not feel that they are necessarily insurmountable.

CONCLUSION

I have argued that, on theoretical and empirical grounds, it makes a great deal of sense to divide the analysis of archaeological (and all technological) items into at least two basic idealized classes: practical and prestige items. Other dimensions may exist (e.g., nonprestige ritual or ideological items) but are of relatively minor importance compared to the fundamental axes of practical and prestige items. Other dimensions have therefore not been considered here. Practical technologies have very different logic, goals, constraints, design considerations, and outcomes than prestige technologies. They should therefore be analyzed using a slightly different framework, although both types of technologies can be effectively dealt with using a design theory approach. I have used this approach in a pilot analysis of an entire prehistoric lithic assemblage from Interior British Columbia with satisfying results (Hayden *et al.*, 1996). Analysis of prestige artifacts is still in the programmatic stage, but because this approach to

technology has been less prominent, even ignored, in prehistoric archaeology, I have concentrated the bulk of my discussion on prestige technology. In both domains there are still many important questions to be answered.

On theoretical grounds, prestige technologies (and debts) are distinctive because they are *necessary parts* of aggrandizer strategies for acquiring power and material benefits in transegalitarian and stratified societies. The emergence of these types of hierarchical societies in the last 20,000–30,000 years is the single most important development since the advent of humanity. Prestige technologies essentially appear to emerge under conditions of reliable surplus production. They constitute a means of converting, storing, and concentrating food surpluses into other desirable forms. This is a *unique human ability* (Hayden, 1994, 1995a), but it has parallels in nonhuman ecology in the form of the concentration of information (organization) in succeeding trophic levels, from plant, to herbivore, to carnivore. Odum (1988) clearly identifies this as the same process that occurs in the development of hierarchical human societies of increasing complexity. He terms this process "transformity" since each step transforms a basic quantity of original solar energy into a new concentrated form used to create a new type of organization. The value of any object can be calculated in terms of the total solar energy. Thus, the present model fits well with the broad ecological principles espoused by leading theorists.

The framework that I am advocating clearly focuses on the competition over economic surpluses (in order to acquire individual self-interested evolutionary advantages) as the major driving force behind the remarkable cultural and technological evolution of the last 20,000 years. Yet investing surpluses in future outcomes is always a risky business with many setbacks and losses. But life, too, is a risky enterprise with no assurances of survival. On balance, successful aggrandizers find that it is to their net benefit to accumulate and invest surpluses, despite risks and losses.

The resulting aggrandizer-based model has many advantages, among which is its unusual scope and power. It explains important aspects of phenomena as diverse as Upper Paleolithic art and endscrapers (Owens and Hayden, 1997; Hayden, 1990b, 1993b), Mesoamerican cargo systems (Hayden and Gargett, 1990), the domestication of plants and animals, and the emergence of many other prestige technologies. There is also an internal mechanism of technological change aside from intensified competition. This mechanism is the cost-cutting by artisans and the lower-cost material emulation by low-rank aggrandizers or nonelites in such systems. The result is the transformation of some restricted prestige technologies to common or practical technologies and the consequent search for new, more suitable, more restricted prestige technologies.

It is also worth noting that if there are certain material attributes that attract significant numbers of people in all human populations, it follows from the aggrandizer model that these features should be commonly recurring elements in many parts of the world where the appropriate raw materials occur and that they should persist through time and characterize contemporary prestige items just as much as they characterized prehistoric prestige items. This statement is not meant to minimize the great importance of local traditions of values and styles; however, it is meant to account for the recurring characteristics of prestige items that developed independently in many different parts of the world—the use of rare sparkling objects such as mineral crystals, the use of rare sparkling metals, the use of finely curried leather and furs, the use of highly polished especially white objects such as bone and shell, the use of textiles, and the use of improved varieties of plants and animals. Thus, the current model provides an important basis for analyzing human behavior in a cross-cultural fashion with considerable time depth. I view all of the above strengths as partial antidotes to the excesses of postprocessual relativism.

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