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1 Craft Specialization: Issues in Defining, Documenting, and Explaining the Organization of Production

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All economic systems have three components: production, distribution, and consumption. Archaeologists often assume that their tabulations of recovered goods constitute adequate discussion of consumption (but see Michael Smith 1987; Brumfiel 1987; and Costin and Earle 1989 for more focused studies of consumption). Production and distribution have received more explicit investigation. While most archaeologists recognize the necessary link between the two,[1] distribution—usually discussed as "exchange"—seems to receive more systematic attention in the archaeological literature. In some instances (e.g., Blackman et al. 1989; Johnson 1973; Morrow and Jeffries 1989; Torrence 1986), production is studied primarily as a way to understand the mode of exchange.

The imbalance in attention is undeserved, not only because production has just as important a role in society as does distribution but also because it may be that production is easier to study *well*. Exchange networks often cover large areas. As Torrence (1986:139) has pointed out, "It may seem obvious to the point of being trivial to emphasize that all aspects of an exchange system are unlikely to have taken place at a single one of its nodes." Production activities, in contrast, are apt to be localized. Therefore, spatially restricted data sets are more likely to contain the data appropriate for studying a fairly complete production system than to contain data representing a complete distribution system. Equally important, exchange events are invisible in the archaeological record, while production events often leave a clearer and more easily interpreted record in the form of debris, tools, and features, if not the products themselves.

This chapter has two primary goals. The first is to review and critique the ways in which archaeologists have defined the organization

of production. To date, we have not developed a unitary vocabulary or even a definition of the object(s) of our study. This is unfortunate, because at best it has led to continual "reinvention of the wheel" and at worst to a lack of comparability among studies, which poses an obstacle to cross-cultural syntheses. The second goal is to review and critique the various methods recent archaeological studies have utilized to define and document the organization of production. We are fortunate to have a wide variety of data—from tools and debris associated with production to the relative standardization and efficiency characterizing an industry—that can inform us about production systems in ancient cultures. These data, however, must be used appropriately. We have been altogether too insensitive to what our data actually measure and to their relationship to specific aspects of the organization of production. A methodological point I will stress in this paper is the need for comparative material. Specialization is a relative state, not an absolute one. In our studies of the material correlates of the organization of production, we are most often dealing with quantitative, rather than qualitative, data. Because of this, we need multiple samples. A single index or calculation—of density, diversity, whatever—means little by itself.

Explaining the Organization of Production

It is not my purpose to present a detailed summary or critique of explanations for the organization of production and the evolution of craft specialization, since this has been done in other publications (e.g., Brumfiel and Earle 1987; Costin 1986, n.d.). However, our studies must never lose sight of the fact that production is embedded in political, social, and/or economic systems (D'Altroy and Earle 1985; Johnson 1973; Trigger 1974). It is also shaped by constraints and opportunities in the environment (D. Arnold 1975; Matson 1965; Rice 1981). In addition, certain aspects of the production process itself are key to understanding the organization of production (van der Leeuw 1977). The most important of these are (1) the distribution of raw materials; (2) the nature of the technology; and, to a lesser extent, (3) skill and training. In sum, accounting for the form of production requires a fairly detailed understanding of the natural and social environment in which it functions.

Furthermore, production systems should not be studied in isolation from their complementary economic systems, distribution and consumption. Together, distribution and consumption inform us of the economic, social, and political contexts of production. Consumption patterns characterize the demand for the product. The *nature of the demand* defines the function of the products under study and the socioeconomic roles of the people using them. The *level of the demand* describes the number of items in circulation and the number required to satisfy the demand crowd. The *logistics of distribution* identify the way in which producers acquire raw materials and transfer finished goods to their consumers. The *rationale* of the producer/supplier identifies the primary stimulating force behind production and distribution.

The Organization of Production

Production and specialization are not the same thing. Production is the transformation of raw materials and/or components into usable objects. Specialization is a way to organize this production. The characteristics that distinguish it from nonspecialized production—generalized or the Domestic Mode of Production (Sahlins 1972)—are the amount of time spent in the activity; the proportion of subsistence obtained from the activity; the presence of a recognized title, name, or office for the person or activity; and the payment in money or in kind for the products of the specialist (Rice 1981; Tatje and Naroll 1973).

Ever since Evans' (1978) important work on Chalcolithic craft production, archaeologists have been sensitive to the need to operationalize any definition of specialization, emphasizing the tie between behavior and the material record it leaves behind. A number of archaeologists have proposed definitions of specialization. Rice (1981: 220) defined specialization as regularized "behavior and material variety in extractive and productive activities." Tosi (1984:23) defined it as "variability in output per capita for a given product within the population sampled." I (Costin 1986:328) use the definition "the regular, repeated provision of some commodity or service in exchange for some other." Muller (1984) emphasizes the distinction between site specialization—where a single, short-term activity is carried out by an entire social group to meet its own consumption needs—and producer specialization—where an individual gains part

or all of his/her livelihood through participation in a specialized activity. All would agree that some division of labor by sex and age within the household is basic to all human societies and must be excluded from the definition of specialization.

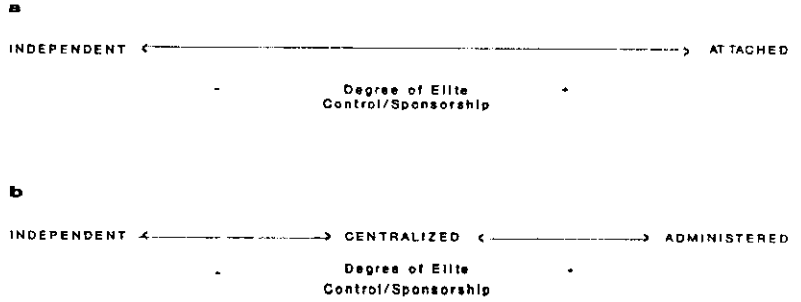
Central to these definitions is the understanding that the specialist household does not produce all the goods it consumes, and that its productive activities are in some way regularized and predictable. Clark and Parry (1990) prefer a broader definition that includes all production in which the goods are transferred from the producer to a non-dependent. As such, they include ad hoc manufacture and modification of goods included in prestation or gift exchange systems such as !Kung *hxaro*. With such a loose definition, "specialization" is present in almost every society. A more useful definition connotes a specific set of social—as well as economic—relationships, where sociopolitical integration is in no small part dependent on the fact that people are economically dependent on one another (Durkheim's [1984 (1893)] "organic solidarity"; Kristiansen 1987:33; cf. Muller 1984:491). Thus, I would argue that specialization is a differentiated, regularized, permanent, and perhaps institutionalized production system in which producers depend on extra-household exchange relationships at least in part for their livelihood, and consumers depend on them for acquisition of goods they do not produce themselves.

Because the key element of our definition of specialization involves variability in productive activities, it is fairly straightforward to operationalize archaeologically. Differences in productive activities should translate into differential distributions of the materials and artifacts associated with production. The unit of analysis can be the household, community, social class, or time period. How we actually recognize these patterns in our data will be discussed below.

Specialization is not a single organizational state, nor is it a present/absent condition. As such, specialization has two primary characteristics. First, it has *degrees*. This term refers to the ratio of producers to consumers. For any product, there may be few or many producers relative to the total consuming population. A product that has a high number of producers in relation to consumers will have a low degree of specialization, while a product that has relatively few specialists in proportion to consumers will have a high degree of specialization.[2]

Second, specialization can be organized in many ways; there are many *types* of specialization. Although specialization has been described as a "continuum" (Brumfiel and Earle 1987:5), it is best seen as multidimensional. In recent years, there has been a proliferation of typologies and terminologies to label and describe a wide variety of production operations. This trend is encouraging because it signals a shift from unilineal explanatory models toward construction of models that recognize multiple causal pathways.

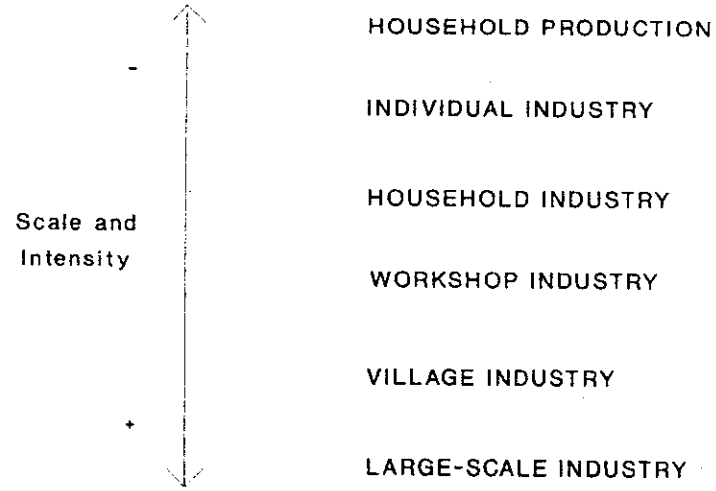
Figure 1.1. Typologies of specialization based on elite and institutional involvement in production. (Based on [a] Earle 1981 and [b] Sinopoli 1988)



A highly influential statement was Earle's (1981) distinction between attached and independent production. Earle made the fundamental distinction between production of special, high-value goods for elite consumption and production of utilitarian goods for broad distribution. His relatively simple distinction has been adopted by many others (e.g., Brumfiel and Earle 1987; Clark and Parry 1990; Gero 1983; Russell 1988). Sinopoli (1988) follows Earle but proposes a tripartite typology that highlights the degree of elite or administrative management of production (Figure 1.1).

Other well-known typologies are slightly more complex, focusing less on administration and sponsorship, and more on scale (size of the work unit) and intensity (relative part- or full-time specialization). The most often cited typologies are those of van der Leeuw (1977) and Peacock (1982). Van der Leeuw's six-part distinction centers primarily on differences in the scale and intensity of production (Figure 1.2). These two characteristics are seen as covarying. Peacock's (1982) eight-part typology concentrates on similar variables while also taking into account (1) the geographic organization of production and (2) the recognition that governments or elites may

Figure 1.2. Typology of specialized production based on scale and intensity of production. (Based on van der Leeuw 1977)



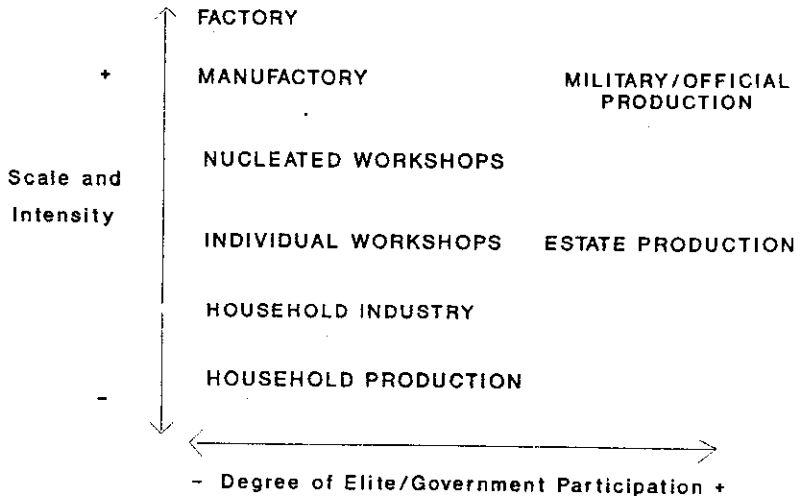
sponsor and/or manage some productive activities (Figure 1.3). Other typologies, drawing explicitly on the work of van der Leeuw and Peacock, have been presented by Rice (1984) and Santley et al. (1989), among others. Tosi (1984) characterizes variability in the organization of production based on (1) the allocation of labor spatially (intra- and intersettlement) and socially (uncentralized and centralized control) and (2) the size of the activity area at which production takes place. He does not, however, present an explicit typology of different kinds of production.

This proliferation of typologies has its drawbacks. First, each scheme focuses on the dimension of variability most in keeping with the author's theoretical orientation and available data. Thus, there is a lack of comparability in different studies as we each carve up the universe in different ways. Cross-cultural work suffers as a result.

A second drawback is the proliferation of different terms to refer to the same basic organizational phenomenon. For example, Santley et al. (1989) introduced the term "tethered production" to label what others have generally come to refer to as "attached specialization" (Brumfiel and Earle 1987; Costin 1986; Earle 1981; Gero 1983; Hagstrum 1985, 1989). Sinopoli (1988) calls this same type of production "administered production."

Third, there is the unfortunate use of the same term to describe two different kinds of production. For example, the term "attached specialization," as first suggested by Earle (1981) and then developed by him and others (Brumfiel and Earle 1987; Costin 1986; Gero 1983; Hagstrum 1985, 1989; Russell 1988), was defined as production on command for elites and the social and political institutions they control. The key was the reference to a situation in which elites sponsor the productive process in order to control the distribution and consumption of high-value, high-status goods. Clark and Parry (1990) use the term to refer to any production sponsored by people or institutions other than the craft specialist or his/her family. Here, the focus is on the alienation of labor, such that the individual artisan has lost control over the final distribution of the product, regardless of who controls the productive process (e.g., governing body or "private" entrepreneurial boss). The key distinction in Earle's definition, between elite and general *demand*, is lost. This has implications for explanation, since central to Earle's work is the theme that attached specialization develops as a part of political processes, while independent specialization evolves to meet utilitarian, economic needs (Brumfiel and Earle 1987).

Figure 1.3. Typology of specialized production based on scale, intensity, and degree of elite/government participation in production. (Based on Peacock 1982)



A final problem with some typologies is that they are empirically derived from a limited data base, often a single case study. As such, they are often formally or semantically limiting. Ideally, typologies should be extracted from a wide range of ethnographic, historic, and archaeological cases in order to make them as universally applicable as possible. Furthermore, the typology should have some basis in theory, reflecting the social, economic, political, and environmental conditions under which different forms of production are expected to arise. Thus, the framework will be both descriptive and explanatory.

It is possible to develop a typology with broad ethnographic and archaeological applicability by abstracting from previous work four general parameters that describe the organization of production. The first considers the nature of control over production and distribution. I call this the *context* of production. The second parameter describes the relative regional *concentration* of production facilities. The third parameter focuses on the *scale* of the production units, taking into account both their size and their constitution. Finally, the fourth parameter measures the *intensity* of production, or the degree to which it is a part-time, as opposed to a full-time, activity for artisans (Figure 1.4).[3]

Taking into account the social, economic, political, and environmental variables that affect parameter values (to be discussed below), I have proposed an eight-part typology for the organization of specialist production (Table 1.1).[4] The types, described in more detail elsewhere (Costin 1986, n.d.) are the following:

Individual specialization: autonomous individuals or households producing for unrestricted local consumption

Dispersed workshop: larger workshops producing for unrestricted local consumption

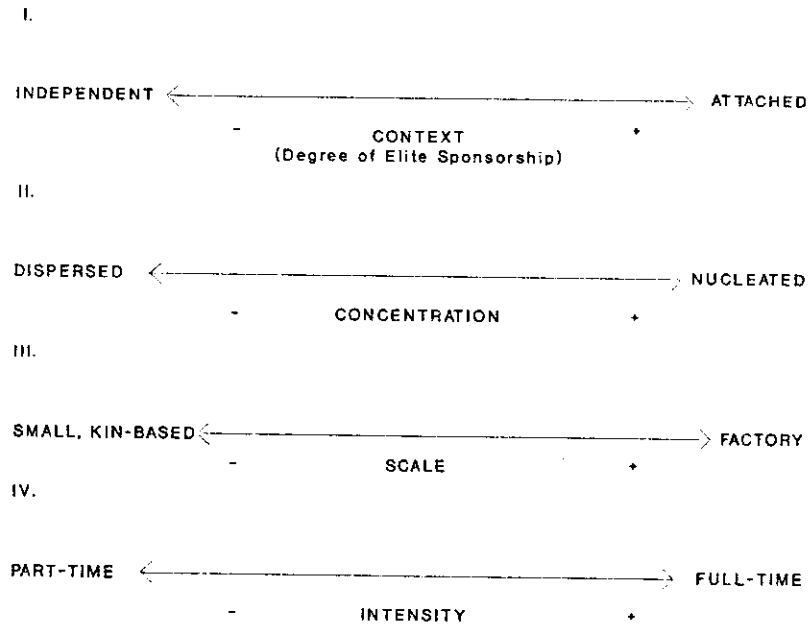
Community specialization: autonomous individual or household-based production units, aggregated within a single community, producing for unrestricted regional consumption

Nucleated workshops: larger workshops aggregated within a single community, producing for unrestricted regional consumption

Dispersed corvée: part-time labor producing for elite or government institutions within a household or local community setting

Individual retainers: individual artisans, usually working full-time, producing for elite patrons or government institutions within an elite (e.g., a palace) or administered setting

Figure 1.4. Four parameters that characterize the organization of production.



Nucleated corvée: part-time labor recruited by a government institution, working in a special-purpose, elite, or administered setting or facility

Retainer workshop: large-scale operation with full-time artisans working for an elite patron or government institution within a segregated, highly specialized setting or facility.

While typologies are important for their organizational value, what is more basic for archaeological studies is our ability to distinguish among the parameter values—to describe and characterize production accurately—and to understand why different parameter values occur under different social, economic, political, and environmental conditions, so that we can explain *why* we have found the type of production we have so carefully described.

I shall now define and describe the four parameters in slightly more detail. Detailed ethnographic and archaeological examples, as well as a thorough discussion of the key social, environmental, and political variables that determine the values of these parameters, are

Table 1.1.
Multidimensional typology of specialized production based on the four parameters that characterize the organization of production.

	Context		Concentration		Scale (Composition)		Intensity	
	Attached	Independent	Nucleated	Dispersed	Labor	Kin-based	Part-time	Full-time
Individual		X		X		X	(X)	(X)
Dispersed workshop		X		X	X			X
Community		X	X			X	(X)	(X)
Nucleated workshop		X	X		X			X
Dispersed corvee	X			X	(X)	(X)	X	
Individual retainer	X		(X)			(X)		X
Nucleated corvee	X		X		X		X	
Retainer workshop	X		X		X			X

Based on Costin 1986.

presented in other works (Costin 1986, n.d.). How the parameters are identified in the archaeological record is taken up in the second half of this chapter.

Context

The context of production describes the affiliation of the producers and the sociopolitical component of the demand for their wares. Attached production is sponsored and managed by elite or governmental institutions or patrons. The work of attached specialists is upon "command" (cf. LaLone and LaLone 1987). In contrast, independent specialists produce for a general market of potential customers. Their activities are governed fundamentally by the general principles of supply and demand, although politics, taxation, and social conventions may affect their activities.

In preindustrial societies, attached and independent specialists usually produce different types of goods. Items manufactured by independent specialists tend to be utilitarian. They are obtained and/or used by most—if not all—households on a frequent basis. Examples include food preparation tools, cooking and some serving vessels, clothing, tools used in basic household maintenance and subsistence activities, and basic household furniture. No restrictions are placed on the distribution of the products of independent specialists; in the most extreme cases all members of the society may be viewed as potential customers. Independent specialization, by making goods available to all who want them, serves to broaden consumption. Suppliers are most often driven by profit or efficiency motives, while consumers most often make consumption decisions based on cost, quality, sociological factors, or some combination of these. Both suppliers and consumers will be best served by a production system that minimizes production and transaction costs.

Attached specialists produce several types of goods of key importance within the political economy and the status, power, or control structure of the society. These include luxury and wealth items, weaponry, and wealth-generating goods. Usually, only a limited portion of the population has access to these products. Because control over production translates into straightforward control over distribution, active sponsorship of production may be the most effective way to limit the distribution of emblems of power and prestige, maintain a monopoly of force, or prevent the growth of competition if the goods

are a source of revenue. Attached specialization serves to restrict consumption because the patron-client relationship determines timing and level of product availability; the cost, quality, and form of the products; and ultimate distribution among the population.

In dealing with the issue of control, we must be careful to state explicitly the rationale for controlling the industry. In the eighteenth century, the French government attempted to monopolize the gunflint industry by prohibiting the passing of information on techniques of manufacture. Torrence (1986:77) implies there was an economic motive to this prohibition, although she does not demonstrate how the French government "profited" (in a strictly economic sense) from such controls. The situation could also be interpreted as an attempt to control arms production, which is key in maintaining a monopoly of force. Similarly, despite his discussion of revenues and coercive power as strong incentives for controlling production, Feinman (1980, 1982, 1986) does not address the issue of why an administration would want to control production of specific kinds of ceramic wares.

Independent specialization evolves under conditions different from those which promote attached specialization (Brumfiel and Earle 1987). The conditions that permit the development of independent specialization are primarily economic. Most important, a sufficiently large demand must be available to support the specialist(s) (Haggett 1966; C. Smith 1975). Such a market may be the consequence of dense population, regional political integration and peace, or inexpensive modes of transportation. Second, independent specialization—as a form of efficient, intensified production—may be promoted by increasing population density (Feinman, Blanton, and Kowalewski 1984; Runnels 1985). Finally, independent specialization may evolve under conditions of unequal resource distribution, especially when individuals or communities lack sufficient subsistence resources (agricultural land, water, or pasturage) to sustain themselves (D. Arnold 1985; Rathje 1971; Rice 1981; Sanders 1956).

In contrast, the primary factors promoting attached specialization are social and political (Brumfiel and Earle 1987; Tosi 1984; Trigger 1974). The most important is the presence of an elite class. By definition, there can be no attached specialization in egalitarian societies. Attached specialization appears to evolve along with social inequality, as a means for elites and governments to supply themselves with special, high-value goods, to finance their activities, and to control the ideology and technology of power.

It is most advantageous to characterize the demand before trying to define and explain the organization of production. If the nature of the demand determines many of the features of the organization of production (including cost parameters, levels of output, appropriate technology, and the exclusivity of distribution), then it follows that any one product will have an optimal mode of production and similar products with similar demands will be produced in similar ways (cf. Stigler 1968). Significantly, "competing" producers (those supplying the same category of goods to the same market) will be organized in the same way. Thus, it is intriguing that Santley et al. (1989) apparently found the same ceramic wares produced in different kinds of facilities at Matacapan, Mexico. It would be most rewarding to examine whether different vessel types (which can be expected to have different demands) were produced at the different locations, or if perhaps there were temporal differences among them, indicating a change in the organization of production over time.

Concentration

This second parameter characterizes the geographic organization of production. Here, the focus is on how specialists are distributed across the landscape, and their spatial relationship vis-à-vis one another and the consumers for whom they produce. At one extreme are specialists who are evenly distributed among the population. Every community, or every part of a community, that meets certain demand size criteria will be served by specialists. At the other extreme, specialists are aggregated such that many producers or workshops are located at a single community within a region. In the latter case, not all communities are served by resident specialists. The implication is that the products of these nucleated specialists must be exchanged on a regional or interregional basis. The amount of nucleation is always relative to the areal extent of the society or region under study.

A number of factors related to consumption and distribution affect the spatial arrangement of production activities. Although both the social and the natural environments are important, conditions tend to differ, depending on whether production is attached or indepen-

dent. There is a strong correlation among environmental diversity, territoriality, and independent specialization. Often production will be nucleated because a community can exploit efficiencies associated with locating production close to a resource that is unequally distributed in the environment (D. Arnold 1985; Nicklin 1979; Rice 1981; Sanders 1956).

We cannot underestimate the importance of transportation in determining the relative concentration of specialists, especially for independent producers (cf. Haggett 1966; Hagstrum 1989). In all types of economies, transportation can add significantly to the "price" of a finished object, either as a cost passed on to the consumer by the producer/distributor or as a cost incurred by the consumer after acquiring the object. Weight, bulk, and distance all contribute to transport costs; we should expect a fairly direct correlation between product size and mass and the mean distance between producer and consumer (for any given mode of transport). This will be true both between different classes of goods (e.g., textiles and ceramics) as well as for different types within single classes of goods. For example, Hagstrum (1989:347) suggests that producers of large ceramic storage jars should be more dispersed than those making smaller, more lightweight cooking pots, because the latter are easier to transport. Transport costs include acquisition of raw materials and the disposal of waste products—not just distribution of finished goods—and in many industries the transport of raw materials, debris, and finished products must be balanced in determining the location of production.

Producers may be more nucleated in economies with formal markets and marketplaces. The presence of regular markets permits producers and consumers to live farther apart by providing a formal setting in which they can be guaranteed a meeting (Hagstrum 1989). Nucleation near markets benefits producers because it shifts transport costs and risks from the producer to the consumer.

Finally, informal cooperation among producers (informal sharing of expensive tools or facilities and "loans" of scarce labor) may have a synergistic effect on nucleated production, even when production units maintain their independence in terms of operation and marketing decisions.

Among attached specialists, the degree of nucleation varies with overall needs to control raw materials, technology, the quality of the output, finished inventories, and final distribution. Most attached producers are nucleated to some extent because they will produce

near their patrons, and wealth and power tend to be concentrated in central places (cf. C. Smith 1975). The production process and the disposition of raw materials and finished goods are most efficiently monitored by having artisans work and/or live in direct association with their patrons. The ethnographic and historic records are remarkably consistent in their descriptions of the physical association between patrons and the specialists who produce goods for them (e.g., Lucie-Smith 1981; Morris 1974; Murra 1962; Sinopoli 1988).

Scale

The third parameter describes the composition of the production unit. It encompasses two related variables: size and principles of labor recruitment.[5] Size reflects the actual number of individuals working in a single production unit. The principles of recruitment reflect the way craftspeople are brought into the production system. At one extreme are small, individual or family-based production units. At the opposite extreme are the wage-labor forces of the industrial West, where employment is contractual in nature and based on skill and availability. The ethnographic literature illustrates the range of size and recruitment principles in traditional craft industries. In family-based industries, labor is recruited on the basis of biological or marital ties (Lackey 1982; Stolmaker 1976). Children are taught necessary production skills and are incorporated into the production process. As production units grow in size, new labor is recruited first among distant, fictive, and adoptive kin. With further growth, nonrelated individuals are added to the work force (Kleinberg 1979).

One of the assumptions made in many studies is that there is a necessary link between the nature of the demand and the scale of production. For example, Torrence (1986) repeatedly implies that large-scale facilities indicate profit-oriented (independent) production. This is not the case; both independent and attached facilities can be large or small.[6]

For independent specialists, the primary factor determining the scale of production is efficiency. The relative efficiency of a workshop is itself a function of the technology used and the level of workshop output. If per-unit costs can be lowered through sharing of expensive technology, or by dividing tasks among many workers—specializing within the workshop—then workshop size will rise to

take advantage of these economies of scale (Rathje 1975). Larger workshops, with higher output, may be able to exploit certain marketing strategies. In the absence of any of these factors, there may be little advantage to large workshops, as the space and coordination or administration they require are costly overhead that affects "profits."

In contrast with independent production, the production units of attached specialists vary in scale depending primarily upon the need for supervision and, to a lesser extent, on the level of output required. In general, the workshops of attached specialists will be larger than those of independent producers, because it is easier to supervise a larger work group operating in a single complex—to control for quality and slippage[7]—than many smaller groups working in separate locations (Goody 1982). The same economies of scale that characterize large independent producers may also accrue to large attached workshops, which may be important to patrons if craft products are manufactured primarily to generate revenue for the government or elite.

Intensity

The final parameter that characterizes the organization of production is the intensity of specialization, which reflects the amount of time producers spend on their craft. At one extreme is casual, part-time specialization where commodity production or labor service is used to augment basic domestic production of subsistence products. In contrast is full-time specialization, where the household subsistence provider(s) work(s) exclusively at one task, exchanging its products for all other goods and services used by the household.

Three economic factors—efficiency, risk, and scheduling—determine whether production is part- or full-time among independent specialists. Several factors can make full-time production more efficient than part-time production. The first is the ability to routinize production, in essence setting up a "mass" production line, even if all tasks are completed by the same individual. If devoting more time overall to production yields proportionally greater output or lowers per-unit costs, then full-time producers will have a competitive edge over part-time producers. The second factor affecting relative efficiency is capital investment in technology. Where the initial investment in technology is high, but can be spread over the entire output,

it will be more cost-efficient to keep the tools and equipment in operation as many hours as possible. Therefore, technologically more expensive industries will require more full-time specialization in order to be cost-effective. Skill and training also make full-time specialization more efficient. As training and skill become prerequisites for production of certain kinds of goods, it is more cost-effective to train and maintain fewer, full-time workers.

Risk is the second factor that determines the intensity of production. Independent producers can be characterized as risk minimizers who will, if possible, combine economic strategies to remain somewhat generalized. Brumfiel (1987), following Hicks (1987), argues that independent specialists remain artisan-farmers because instability of marketed food supplies makes reliance on markets for subsistence products risky. Thus, if independent craft specialists can combine craft production with agricultural production, they will remain part-time specialists (cf. Hagstrum 1989). However, peasants can maintain such a semi-generalized strategy only when technology is simple or inexpensive. When increasing returns to scale confer a significant competitive advantage to full-time producers, part-time producers will be compelled to turn to full-time production,[8] for the simple reason that their goods must be "priced" to compete in the market. Producing overly expensive wares is often the riskiest strategy of all.

Scheduling is the third factor that affects the intensity of independent production. It is often suggested that peasants initially adopt part-time craft production to supplement agricultural production (Hagstrum 1989). As such, it is most intensively pursued during periods when agricultural demands are at their lowest. However, some external force may impose scheduling conflicts that require the artisan-farmer to choose between these two economic pursuits for more intensive exploitation. Such conflicts can arise from many economic, social, and political factors, including pressure to expand craft production into the agricultural season in order to increase household "income" (to be used to pay taxes or tribute or to acquire desired consumer goods) or from the introduction of irrigation agriculture (which is often a year-round activity). In these cases, some artisans will opt for more intensive—full-time—craft production.[9] The effects of scheduling—and, to a lesser extent, of risk—are of course contingent on the household sexual division of labor and the gender of the artisan.

In nonindustrial economies, there is a greater tendency for attached specialists to work full-time at their tasks than for independent specialists to produce crafts full-time. A number of factors contribute to this. First, attached specialists receive their livelihood from revenues generated by tribute collected by their patrons. Thus, they are not as subject to the vagaries of market food supplies as are independent specialists (Brumfiel 1987). Second, since the production of many items supplied by attached specialists requires considerable skill, it is more efficient to employ relatively fewer full-time artisans than to train and supervise many part-time producers. Finally, patrons may engage craft specialists full-time in order to monopolize them and discourage moonlighting, especially for "unauthorized" consumers, which would disrupt the otherwise carefully orchestrated flow of special goods.

Identifying the Presence and Organization of Specialists

Archaeologists have available to them two general kinds of evidence for reconstructing the organization of production: direct and indirect. Direct evidence consists of materials that identify the specific place where production occurs. Indirect evidence, in contrast, yields information about the organization of production without implicating its exact location. The remainder of this chapter discusses these data and demonstrates how they can be analyzed to yield a full description of the production system, which is necessary for explaining why production is organized in a particular way. At times, we may be able to identify the specific type of production; at other times the data may permit only a discussion of the degree of specialization.

Direct Evidence: Production Loci and Debris

Identifying production loci and the presence of specialists. The most straightforward way to identify the organization of production is to locate places at which production took place. Primarily, we identify communities where production took place. Under ideal depositional and preservation conditions, we can identify the specific locations within the community where craft goods were manufactured. The appropriate data include raw materials, debris, tools, and facilities associated with production. The most commonly recorded data indicating pottery production are wasters, firing pits, kilns, molds, scrapers, unworked clay, and pigments. For lithic production, data include the tools used in production (hammer stones, flakers, and punches) and debris (blanks, cores, broken or misshapen rejects, and other debitage). For textile production, the primary evidence consists of tools used in manufacture, including needles, spindle whorls and blanks, spinning bowls, and very infrequently loom furniture such as weights and shuttles. For metal production, the most common items are slag, ingots, crucibles, furnaces, and scrap. In general, debris and waste are the primary material recovered; tools tend to be curated or made of perishable materials, and facilities are rare. Many studies have focused on direct evidence (e.g., J. Arnold 1987; Clark 1986, 1987; Costin 1986; Feinman 1980, 1982; Russell 1988; Santley 1988; Santley et al. 1989; Shimada 1978; Shimada et al. 1983; Stark 1985; Tosi 1984).

Because the identification of manufacturing activities most often involves portable objects, site formation processes have a profound effect on our inferences about the organization of production. The assumption is that our evidence is recovered from primary-use contexts and that these activity areas yield the full range of associated artifacts in their original concentrations. However, the ideal situation is rarely encountered. Many raw materials are perishable. Others—such as clay, tempering materials, unworked stone, and pigments—may go unrecognized during excavation of the surrounding matrix. Tools are often curated, reused elsewhere, and/or made of perishable materials. Production areas are usually cleaned up periodically, ridding them of concentrations of debris. Evidence of production remaining after such cleanups is often small and/or located primarily in corners and along walls. The following discussion is predicated on the assumption that the excavator has considered formation processes and can identify the specific social and depositional contexts from which the data were recovered.

Thorough studies of production also can become complicated where fabrication of a single product takes place in stages at different loci that may be far apart (cf. Schiffer 1975). In lithic production, some processing is often done at or near the quarry or mine (cf. Russell 1988; Torrence 1986). In metal production, ore is often smelted in one location while object fabrication is completed in another.

Similarly, in textile production, yarn and thread may be prepared in one place while weaving takes place in another. When we recover evidence for production, we must ask if we have evidence for the full range of production activities (from the procurement of raw materials to the final product); there is no guarantee that all stages of production will be organized similarly. This requires a fairly full understanding of the technology before the organization of production can be studied.

Many archaeologists have argued for the presence of specialists' work areas at least in part on the basis of particularly high densities of finished artifacts (e.g., Feinman 1982; Feinman and Nicholas 1988; Spence 1967). However, concentrations of specific artifacts may represent high usage in a special activity or special-purpose refuse disposal rather than production. Careful analysis of use wear may allow us to distinguish between workshop debris and that of other specialized locales. The percentage of used artifacts should be low in production contexts. Citing Spence's conclusion that 42.6–88.2 percent of all obsidian blades recovered from Teotihuacan "obsidian workshops" were in fact used, Clark (1986) argues convincingly that areas yielding high densities of obsidian tools were workshops where such tools were used to manufacture other items, rather than primary obsidian workshops. In my own analysis of an unusual concentration of cooking vessels at the Wanka site of Tunanmarca, I compared the percentage of vessels with carbonized organic encrustations (an indication of use) recovered from this unusual deposit with the percentage of carbonized cookware found in household contexts. Although the percentage of carbonized sherds from domestic settings was fairly low, the fact that none of the sherds from the specialized location had visible evidence of use yielded statistically significant results. On the basis of these data and the ashy character of the matrix of the deposit, I concluded that the deposit represented a midden associated with ceramic production (Costin 1986:188–94).[10] Careful analysis may also show that items recovered from production loci are different from those at consumption locations. Russell (1988) argued that chert blades were more variable at the production locations than at consuming households, because only "perfect" examples were distributed.

The recovery of data associated with production does not in and of itself identify specialization. Recall that the definition of specialization focuses on *differential* participation in economic activities. The key, then, to identifying specialized production is the recognition of a differential distribution of the relevant artifact class or classes across appropriate analytic units (communities, households, time periods, etc.).

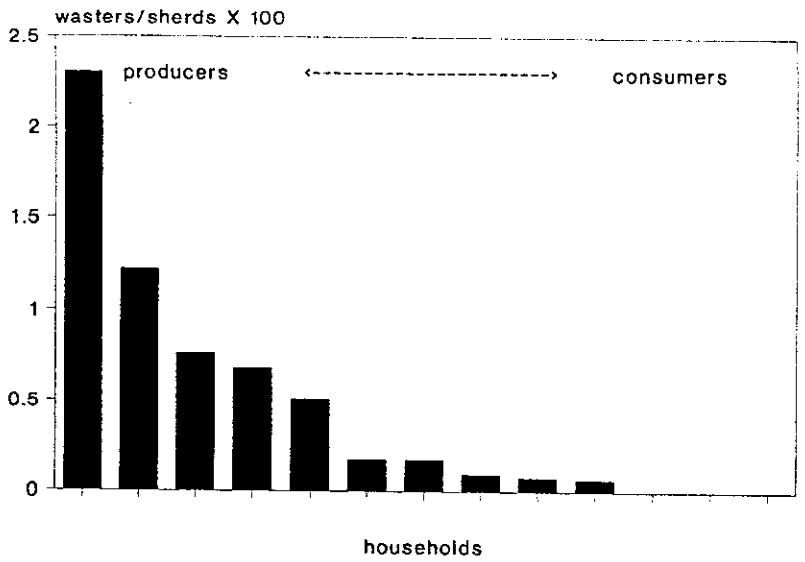
A number of methods can be used to express the concentration of production debris. Because our archaeological definitions of specialization focus on the ratio between producers and consumers—with a ratio of one:one defining generalized production and anything greater than that indicating specialization—the best measures contrast quantities of production debris with an index of items consumed or a measure of population. In all cases, two or more analytic units (households, communities, etc.) must be compared. The best indicators of specialization will be differential ratios between production debris and consumed products (Costin 1986), unfinished and finished products (Russell 1988), unused and used goods (Costin 1986), densities of production debris and some generally and uniformly used item (Brumfiel 1976; in press), densities per capita, or number of production loci per capita (Feinman 1982). Places where specialists work will have relatively high ratios, while consumer locales will have relatively low ratios (Figure 1.5). In cases where ratio data are not available, densities or ubiquity can be used, but in all cases these data must be standardized to even out the effects of variable intensity of data recovery. We must also justify why the higher quantities of production debris do not simply reflect a higher consumption rate within the producing unit (e.g., a household with more family members requiring more cooking vessels overall or a community with a larger and more dense population requiring more blades overall).

Ratio data are most useful because they control, at least in part, for rates and processes of cultural deposition. Households of specialists and their dumps, for example, can be expected to have more similar ratios of the relevant artifact classes than will specialist households compared with consumer households or specialists' dumps compared with general consumer dumps.

Ultimately, what specialization refers to is an ever tighter focus on a narrow range of productive/economic activities. As archaeologists, we often infer the development of or an increase in specialization when relatively fewer people work to supply the population with a given product or service, or, more accurately, when we identify fewer production units in a later period than in an earlier one.

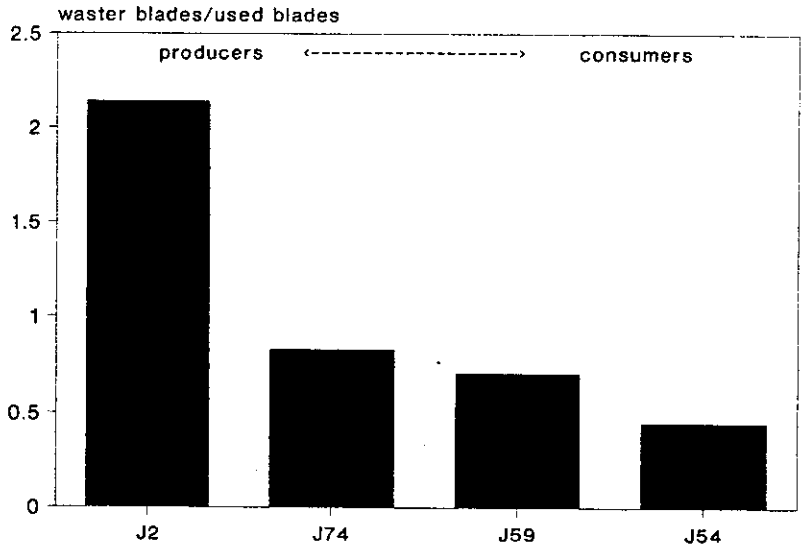
Figure 1.5. Quantitative data indicating producer vs. consumer locations. (Data [a] from Costin 1986, Table 7.1; [b] Russell 1988, Table 4.9; [c] Brumfiel n.d.)

a.



When the changing count of production units is used correctly to argue for the development of specialization, two criteria should be met. First, the number of producers must decrease relative to any possible change in demand for the product. Dwindling demand may lead to fewer producers, but this does not necessarily indicate more specialization. For example, in the Mantaro Valley of Peru today, ceramic vessels are being replaced by plastic and metal containers and cookware. At the same time, fewer villages (and fewer families within those villages) are making pottery (Hagstrum 1989). Archaeologists of the future will note that there are fewer production loci in the second half of the twentieth century than in the first half. However, it would be wrong in this case to conclude that the decrease in production loci in and of itself indicates an increase in specialized production. Feinman (1982, 1986) correctly argues for an increase in specialization when the ratio of production loci to consuming population decreases (fewer producers per number of consumers = greater specialization).

b.



c.

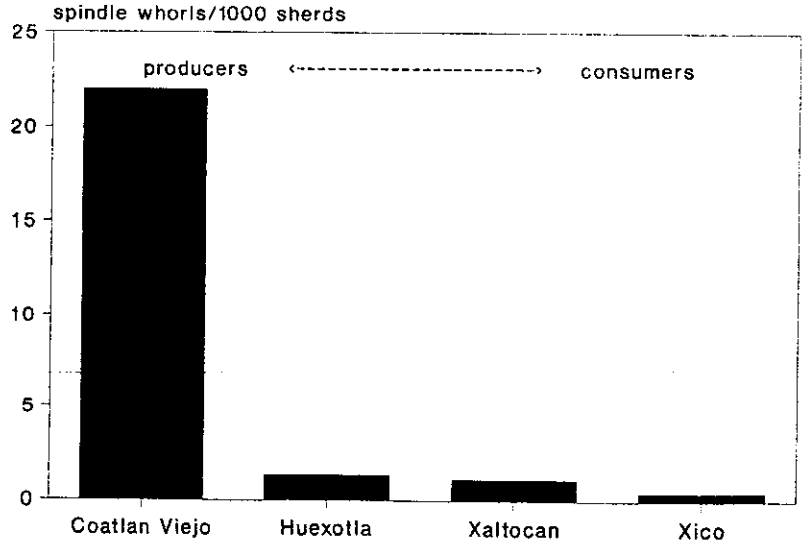
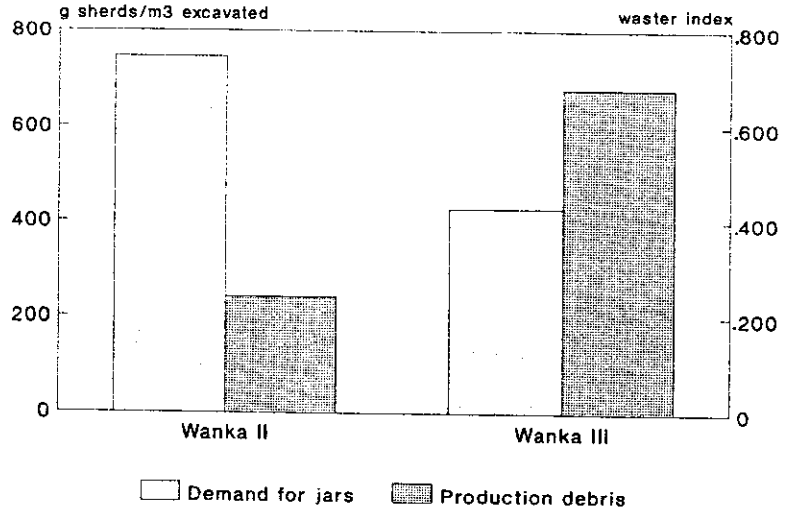


Figure 1.6. Comparison of production debris and demand for storage jars among the pre-Hispanic Wanka of Peru.



Second, not only should debris be more restricted in its areal distribution—indicating fewer production loci/units—but the index of debris should increase in the remaining production locations, indicating that output increased for the remaining producers. An example should illustrate this point. In my own work in the Yanamarca Valley of Peru, I addressed the question of the effect of Inka conquest on the production of local goods (Costin 1986). The data show that demand fell somewhat for local-style storage jars after the conquest.[11] At the same time, the number of communities producing these jars decreased from two to one. However, I would argue that this change reflects increasing specialization, not just the decrease in demand, because the density of production debris (measured as a ratio of production debris to consumed goods) increased dramatically in the remaining production loci (Figure 1.6).

The degree of specialization then, to say nothing of its particular form, is recognized by the differential distribution of production debris, and increasing specialization is indicated by a decrease in the number of producers per capita over time (all other things, especially

consumption, being equal). One last word of caution is in order here. Changes in the degree of specialization involve a changing ratio of *artisans* to consumers, not merely a change in the number of locations where production occurs. Depending on the scale at which we collect and analyze our data, our analyses of changing degree of specialization may be more or less accurate. For example, the number of communities producing something can decrease; this is interpreted as an increase in specialization (e.g., Costin 1986; Feinman 1982, 1986). However, the total number of communities at which a good is produced can remain constant while the number of facilities and individuals decreases through changes in scale and intensity—for example, in the shift from part-time, household-based to full-time, workshop production. Yet the archaeologist who did not collect data on the size of production units may miss the second example as one of increasing specialization.

Identifying context. Attached and independent specialization can be distinguished by the location of production activities. The workshops of attached specialists most often are physically associated with elite domestic structures or government facilities. Their workshops also may be physically separated from other activity areas, in places where access can be easily monitored or restricted. The presence of large numbers of administrative artifacts (such as seals, documents, etc.) also may indicate elite or governmental involvement in production. Explicit facilities, boundaries, and even force may be employed to protect valued resources and control production facilities. In contrast, the workshops of independent specialists will not be found in direct association with elite architecture or in restricted locations. Small-scale, independent production is often directly associated with commoner domestic architecture. As the scale of independent production increases, manufacturing may be moved to separate facilities but, unlike the workshops of attached specialists, access to them will rarely by restricted, because restrictions are costly and difficult to maintain.

To justify inferences about the sociopolitical context of production, it is imperative to demonstrate that the artifacts were recovered from primary, use-related contexts. High densities of debris are not always indicative of the primary location of production. Certain dangerous and/or noxious types of debris—such as obsidian and other sharp stone flakes—will be systematically removed from the

production area and deposited as far as possible from human traffic. A consideration of depositional processess has recently led to a reevaluation of the evidence for obsidian production at Teotihuacan. Originally, it was argued that apartment compounds and other facilities yielding high densities of obsidian debitage were the workshops of obsidian specialists (Santley 1984; Spence 1967). Recently, it has been suggested that some apartment compounds were in fact abandoned prior to the deposition of the debris, and that at least some of the debris represents special-purpose middens (Clark 1986; Santley, personal communication 1989). If we thoroughly understand the production process, it should be possible to distinguish work areas from middens associated with production through measures of artifact diversity and disorganization (cf. Schiffer 1987) as well as through the relative percentage of complete tools recovered. However, in the absence of special-purpose production facilities (features), when debris is dumped "significantly far away" from the actual workplace, it may be impossible to securely identify the context of production.

To identify context, the production debris and its defining features must be directly associated with one another, not simply observed at or recovered from the same site. Feinman (1982:183) correctly argued that in Oaxaca "administered production" would be found at settlements with large mounds—for him, a defining characteristic of higher-order administrative centers. However, Feinman's data—derived from surface collections—rarely indicate that production was directly associated with the mounds or with administrative architecture, rather than simply located in the same communities where administrators resided/worked. The distinction is important, because we expect a wider variety of activities—political, social, and economic—at higher-order sites, but cannot expect that all of them will be under the direct control of political elites. We are likely to find independent producers working at higher-order sites if this is where markets/distribution channels are located. Feinman's work, therefore, on a methodological level, demonstrates one drawback of relying on surface materials where precise architectural context is lacking.

Measures of the context of production other than actual association are suspect on empirical grounds. Torrence (1986:144) suggests that attached specialists, because they are "noncommercial," will generate less debris, presumably because their output is lower. However, it is quite possible to have "factory"-level production of materials for state consumption/distribution. Similarly, the size of the facility is insufficient for determining whether production is attached or independent. Torrence (1986:passim) implies that all large-scale production must be "commercial" (viz. independent). However, we have many examples of large production facilities that were clearly government administered, including the massive weaving complex at the Inka administrative center of Huánuco Pampa in Peru (Morris 1974) and the palace industries of the Mycenaean world (Killen 1964; Shelmerdine and Palaima 1984).

In summary, the location of production helps to distinguish between attached and independent production, because the overriding concerns of the producers and suppliers will usually manifest themselves physically. Control—a central concern in attached specialization—will manifest itself archaeologically through architecture and spatial arrangements aimed at segregating production activities and restricting or monitoring the flow of personnel to the facilities. Independent specialists—driven by the need to produce in the most cost-efficient manner possible—will forgo such expensive strategies unless they are the only way to perserve a monopoly or market share.

Identifying concentration. The identification of the relative nucleation or dispersal of artisan production requires a regional approach. When production debris is found at a limited number of sites, one can infer nucleated production. In contrast, with dispersed production—where artisans are found in all communities—production debris will be distributed fairly uniformly throughout the region. Identifying the concentration of production requires identification of production at the site level only, rather than the precise association between production and particular kinds of architecture necessary for identifying social context. It is thus more amenable to analysis of surface-collected materials than are context and scale.

The regional organization of production has been addressed to only a limited extent in the archaeological literature, perhaps because systematic discussions of craft production have not been an integral part of most regional studies. Notable exceptions are the Valley of Oaxaca and Ejutla Settlement Pattern projects (Blanton et al. 1982; Feinman 1982; Feinman and Nicholas 1988) and the Upper Mantaro Archaeological Research Project (Costin 1986; Earle et al. 1987; Russell 1988).

Feinman (1982, 1986; Feinman and Nicholas 1988) had access to data from surface collections made over a 2,672 km² survey block. He relied on tools and higher-than-normal densities of finished products to identify ceramic, shell, obsidian, lithic, and textile work areas. Through fairly straightforward mapping procedures, Feinman demonstrates a differential distribution of production debris across the survey block, suggesting that production of different craft items was concentrated in different parts of the region.

The Upper Mantaro Archaeological Research Project excavated data from fewer sites (seven) in a more restricted area (80 km²). Individual households were sampled, yielding information on both production and consumption. In my analysis of ceramic production, I compared the distribution of wasters and pottery-making tools with the distribution of used products (Costin 1986). Russell (1988) also used the ratio of production debris to finished products to identify the location of prismatic blade manufacture. In both cases, debris was determined to be differentially distributed among sites, indicating relatively concentrated production.

Is it possible to identify this dimension of production if only a single site is studied? Perhaps. Torrence (1986) suggests comparing the estimated number of objects produced at a site with estimates of the total number of those items consumed at the site. If the number of items produced is greater than the number used, this certainly suggests specialization for a market beyond the community at which production takes place (cf. J. Arnold 1987). Santley et al. (1989:127) suggest that the products of the ceramic-producing site of Matacapan, Veracruz, were distributed throughout the southern Gulf Coast area, because examples "identical to types at Matacapan" were reported throughout the region. Clearly, their important discovery represents a manufacturing phenomenon far different from anything recovered or reported in Mesoamerica. Nevertheless, two other complementary types of data would rigorously confirm the interpretation that Matacapan was a regional production facility. The first is chemical or petrographic information supporting the hypothesis that the wares recovered throughout the region were made by the same production group (these data are in fact in preparation and are eagerly awaited). The second is clear evidence that no production debris associated with those types has been located at consuming communities outside of Matacapan.

In summary, despite the fact that the concentration of production is rarely addressed explicitly in the literature, it is perhaps the easiest parameter to characterize. Even distribution of production debris across a region—relative to population—indicates dispersed production, while uneven distribution indicates nucleated production.

Identifying scale. It is ironic that scale is one of the most misidentified aspects of production in the archaeological literature, since both components of this parameter should be relatively easy to determine. The size of the production unit is inferred from the size of the production facility. We infer the constitution of production units from the context within which production takes place. Family production units will work within or adjacent to their own domestic space (for example, the craft workers at Snaketown [Seymour and Schiffer 1987]). In contrast, workshops staffed by unrelated individuals will be located in nondomestic space (for eample, the ceramic workshop at the site of Galindo [Bawden 1982]).

We must be careful not to confuse the size of the community at which production occurred or the areal extent of the debris with the scale of production. For example, Santley et al. (1989) interpret the large production area of Comoapan at the site of Matacapan, Veracruz, as a single large-scale facility (manufactory) because of the wide extent of production debris (in this case, kilns and waster dumps). Yet there appears to be nothing in the way the features are arranged to suggest that the firing activities were coordinated, as would be expected if this were a single production unit. It is equally possible to interpret the deposit as a special-purpose firing area—located away from habitation because of the noxious characteristics of firing—used by a large number of independent production units. This may be an example where nucleation (the aggregation of many [small] independent production units) has been confused with scale (which relates to the size of specific, autonomous work groups).

Two issues regarding the identification of the scale of production must be made clear. First, it is essential to keep in mind the distinction between a production *locus* and a production *unit*. A *production locus* is a place where manufacture takes place. The term can be used to indicate either a community where a commodity is produced, without specifying the number of producers or workshops (general), or the actual work area at which production takes place (specific). In

contrast, the term *production unit* is always used in a specific sense, implying not only a place (facility) but also some element of discrete organization. It is the unit that we must identify when studying the scale of production. In all but the best-preserved cases, this may be impossible to do with surface materials alone; we should not be reluctant to say so.

Second, we must work under the assumption that there is a correlation between the structure of behavior and the structure of the material record. The more highly structured the organization of production (e.g., into workshops or factories), the more highly organized the space in which those activities took place should be. This can be seen in several archaeological examples where independent (ethno)historical documents outline the structure of the industry, and the archaeology reveals the structure of the space. For example, at the large textile complex at the Inka site of Huánuco Pampa, the various stages of textile production were carefully organized within a single compound (Morris 1974). Similarly, at Roman brickyards in Europe, workshops were structured and bounded spaces, and their associated kilns—although not always built at the same time—were arranged as discrete complexes, often sharing walls and/or a common roof area (Peacock 1982:137–42).

Several studies have suggested that scale can be measured by output (e.g., Clark 1986:43). When output is low, it is reasonable to rule out large-scale facilities. High output, however, does not indicate a particular scale, because large quantities of goods can be produced by a few large facilities or many small ones. Furthermore, output is a function of much more than the size of the work unit. Specifically, output per production unit is a function of the number of producers, the intensity of production, and the particular technology. Output per site or region is a function of all of these factors plus the number of production units.

Identifying intensity. Intensity is the most difficult parameter to identify archaeologically. A number of proposals have been suggested, but few stand up to scrutiny.

Many authors (e.g. Becker 1973; Brumfiel 1976, 1987; Spence 1981, 1984, 1985) argue that the relative density of production debris can be used to distinguish among part- and full-time workers. Relatively concentrated amounts of debris are said to indicate full-time production, while sparse amounts indicate part-time production. Such

generalizations are insufficient for a number of reasons. First, for most industries, we rarely have quantifiable data on the amount of debris generated, and are therefore hard-pressed to know how much material truly represents part-time as opposed to full-time production.[12] Second, "low" and "high" density are relative terms. Comparisons among several analytic units (sites, houses, etc.) may allow inferences about the relative intensity of production in different periods or places, but a single measure is meaningless. Third, density most correctly measures output, and, as discussed above, output is a function not only of intensity but also of the total number of artisans and of the technology.

There is no straightforward, simple correlation between the density of debris and the intensity of production (just as there is no necessary relationship between density and scale) because many variables determine the amount of debris. These include the number of workers, the percent of time spent working (daily and/or annually), and the percent of all debris generated that is represented by the deposit being analyzed (workshop debris may represent only a fraction of all debris generated, while a midden context might yield a relatively higher proportion). In archaeological studies, all too many of these are unknowns, meaning that multiple scenarios can yield the same results. For example, Torrence (1986) initially suggests distinguishing between part- and full-time obsidian specialists by calculating the number of hours required to produce the amount of debris recovered and comparing this with the length of time it took the deposit to accumulate. However, as she later acknowledges, such an approach is flawed because it lacks a key element of the equation: the number of workers contributing to the accumulation. Three thousand person-hours of debris might be generated by one knapper working full-time (six hours/day, five days/week) for a year, or two or more knappers working part-time (either a few hours every day, interspersed with other economic tasks, or more intensively for part of the year, especially during the agricultural off-season). The problem is compounded for obsidian—and other crafts that generate dangerous or large amounts of debris—because the by-products are dumped away from primary production loci. While the primary context of production does give some indication of the number of workers (since workshop size and number of personnel should be correlated), it may be difficult to calculate the number of loci sharing a specialized dump or a general midden, since

the presence of a dump alone tells us little about the social context and size of the production loci.

I have suggested (Costin 1986) that the most effective way to identify the intensity of production is to identify the range of economic activities in which an individual or household participated. Where production is household-based, this method is theoretically effective. It involves little more than looking at the catalog of tools used in a full range of extractive and productive activities (including acquiring and processing food, household maintenance, and production of tools necessary for these activities). Households that yield evidence for both food production and craft production arguably worked only part-time at their craft, while households with a limited range of productive activities represented were probably full- or nearly full-time craft producers (see Earle et al. 1986; Costin 1988b). Unfortunately, we often lack inventories that are detailed enough to document the range of activities engaged in by specific craft-producing households. Furthermore, such an approach will not be effective when production is not household-based, as in the case of large-scale independent production and most forms of attached specialization.

Indirect Evidence

Data are said to indicate the organization of production indirectly when the exact location of manufacture cannot be pinpointed. Indirect data are recorded from the finished objects themselves, rather than from the features and artifacts associated with their production. They are presumed to measure key characteristics of specialized production. Several types of indirect data are used regularly by archaeologists. These include the recognition of large numbers of more or less identical or standardized items; proficiency (skill) in manufacture; efficiency in manufacture; and the identification of spatially discrete regional variations or falloff curves in the distribution of particular artifact types. The first step in any study using indirect data must be an examination of our assumptions about the system, to make sure we are correct in expecting its products to manifest these features. In other words, how can we be confident that a specialized system should produce standardized—or labor-efficient—goods? We can be most certain by understanding the social, technological, and natural milieu in which production occurs.

Because the indirect data cannot identify specific production units

or loci, I prefer to use the term "production group" when referring to the entities these measures identify. The term implies some form of cohesion—a number of producers sharing a technology, raw materials, or workshop, for example—without suggesting their relative independence from one another or implying the size or structure of the work group.

At best, most indirect evidence for the organization of production provides information on the relative degree of specialization—in these cases on the ratio of production groups to the total population. They rarely yield unequivocal evidence for the context, scale, or intensity of production.

Standardization. One of the arguments used most commonly to establish the presence of specialization is the identification of large numbers of highly standardized products, which are interpreted as the products of a single (or limited number of) production unit(s) (e.g., J. Arnold 1984, 1987; Barnes 1987; Rice 1981). Standardization is usually assumed to be an integral part of specialization for two reasons. First, specialized systems have fewer producers; therefore, less individual variability (caused by unconscious motor habits and skills, consciously made decisions regarding form and decoration, and/or the use of a wider range of raw materials) will be manifest in the assemblage (Hill and Gunn 1979; Peacock 1970; Rice 1981; Torrence 1986). Second, standardization—a result of routinized or "industrialized" production—is expected to reflect cost-cutting strategies (e.g., Rathje 1975; Torrence 1986). As archaeologists often incorrectly consider all specialized systems to be competitive and cost-conscious, standardization is viewed as a logical result of basic economic forces.

While ethnographic and experimental data often (but not universally) support the correlation between specialization and standardization (Clark 1986; Hardin 1979; Hill 1979; Miller 1985; Sinopoli 1988), we must be sensitive to several issues. Most important, standardization can be the result of one of several different processes (cf. Rice 1984:111 on sources of variability in ceramic assemblages). Regardless of the number of producers, wares might be standardized because it is more efficient to produce this way (requiring less conscious decision making on layout of design, for example), or because consumers demand it (in cases where style communicates important information about social status, group affiliation, etc. [Hodder 1983]).

In the latter case, producers in a competitive situation may have little leeway for individual variation because of consumer demand for a standard product. Distributors or government regulation may also pressure producers to manufacture standardized goods. Economic benefits other than efficiency can accrue from producing standardized goods in a competitive, commercial market: they are easier to cost and price to the consumer (Torrence 1986:197), and they are often easier to store, package, and transport (Clark 1981:8; Sidrys 1977).

Whether or not standardization is an appropriate measure of specialization depends on the type of object, the technology, its function, and the nature of demand. We cannot lose sight of the fact that different kinds of goods are often geared toward different markets, some of which demand individuality and others of which may tolerate or demand standardization. The appropriateness of standardization as an indicator of specialist production is contingent in part on what is motivating consumption choices in each particular case. In general, the products of attached specialists should be distinctive and individualistic (cf. Earle 1982). Thus, standardization may be of little help in identifying some kinds of attached specialization. For independent specialists, if we can demonstrate that cost is key, we should expect producers to lower their "costs" in part through the institution of a routinized production process, which will result in more standardized products. In these cases, a lack of variability can be interpreted as indicating specialist production. In contrast, in situations where style attributes communicate social status and affiliation, standardization is socially, not economically, mandated, and an analysis of stylistic variation may not yield adequate information on the number of producers.

After it has been demonstrated that standardization will, in fact, be an appropriate measure, it is then necessary to choose carefully the variable or variables that will best reflect the organization of production (rather than some other aspect of social structure). I would argue that gross formal and stylistic diversity within an assemblage is not the best level of analysis for studies of standardization (contra Feinman, Kowalewski, and Blanton 1984; Rice 1981). First, both large and small concerns, specialized or unspecialized, are equally capable of producing a variety of stylistically or formally different wares. Second, variability at this level often reflects sociopolitical processes or functional concerns, rather than economic organization. We should expect different ranges of diversity in different contexts—for example, elite vs. commoner (Costin and Earle 1989; Otto 1975); household vs. public; centers vs. dependent communities (Feinman 1982); utilitarian vs. ritual—and in different chronological periods.

The logical choice, then, is to confine our studies to aspects of variability that reflect unconscious patterning, motor skills, subtle differences in technology, and slight differences in raw materials. Variations in material composition, technology, and style have all been addressed. The appropriateness of attributes varies from culture to culture. Most often, metric variables are chosen. Conclusions are significantly strengthened when two or more independent sets of variables are analyzed and yield complementary results (e.g., Bishop et al. 1988).

Many archaeologists treat measures of standardization or variability as though they were qualitative, testing for the presence or absence of specialization. In fact, what standardization really measures is the number of production groups in relative terms. Two or more analytic units (sites, regions, phases, or types) must be compared in order to examine the relative degree of specialization in each.

Various exploratory data analysis techniques are used on the data. One set of techniques isolates discrete subgroups of objects, which are interpreted as the products of different production groups. These techniques can range from the simple (such as visual inspection of histograms and binary scatter plots; e.g., Sinopoli [1988]) to the more complex (cluster analyses, factor and principal components analyses, and discriminant analyses; e.g., Bishop et al. [1988]; Blackman et al. [1989]; Costin [1986]; D'Altroy and Bishop [1990]). Many subgroups (i.e., modes on a histogram, clusters, or factors) indicate a low level of specialization, while a few subgroups indicate a relatively high degree of specialization. These data are ambiguous only when we try to use them as a qualitative measure to ask, Was production specialized or generalized? More correctly, the relative number of production groups among analytic units will inform us about the relative degree of specialization in each.

The degree of assemblage variability also has been reported through simple statistics, such as standard deviations on a mean (Davis and Lewis 1985; Sinopoli 1988), as well as more complex statistics, such as diversity measures (Rice 1981, 1989). High standardization is interpreted as mass production at relatively few production locations (a

high degree of specialization), while high variability is interpreted as small-scale independent workshop production (a low degree of specialization; e.g., Sinopoli 1988).

The diversity measures, which attempt to put a single numerical figure on the degree of specialization, are somewhat more ambiguous. Again, however, this is primarily because too many archaeologists have failed to provide appropriate (or any) comparative materials. For example, in Torrence's (1986) otherwise excellent study of obsidian production and exchange, she provides no appropriate comparative sample for her obsidian blade standardization. She calculates her indices for the entire data set—undifferentiated spatially or temporally—which leaves her nothing to compare them with.

Torrence (1986:161) suggests that we should be able to develop absolute scales against which to measure individual results, as though we could quantify the amount of standardization expected of all craft producers at some degree of specialization. Whether it is possible to devise such universal scales is highly debatable, even when technologies are "similar"—as Torrence, for example, considers the Aegean and Mesoamerican obsidian industries to be. There are just too many variables in primitive technologies for which we would have to control. These include subtle differences in raw material composition (which may affect precision and control during the manufacturing process), environmental differences (which also affect the production process), and cultural acceptance of variability.

Relative standardization simply measures the degree of specialization. Large-scale production, per se, need not in and of itself require or promote standardization. Rather, the two tend to co-occur; thus we interpret standardization as indicating increasing scale of production (e.g., Rathje 1975; Torrence 1986). However, to recapitulate, what standardization properly measures is the relative number of production units, regardless of their size. Archaeologists have also assumed that standardization can indicate the context of production—that is, identify "commercial" or independent production—because it is often associated with cost-saving strategies. While it is true that independent producers are cost-conscious in their competitive environment (while competition is never an element of attached specialization, because attached specialists have a guaranteed consumer), we cannot automatically assume that standardization equals independent specialization. There are cases where the products of attached specialists are highly standardized (e.g., Inka-style pottery).

Efficiency. Efficiency—or economizing behavior—is also considered a key feature of specialized production (Hagstrum 1985; A. Smith 1950 [1776]; Torrence 1986). It is a relative measure of the time, energy, and/or raw materials expended in production per unit of output. Efficiency is often seen as linked to the amount of competition in the economy, and therefore as a measure of the number of production groups. There are two views of the connection between competition and labor investment. On the one hand are those who view competition as an essential element of all independent specialization (short of monopoly control). Thus efficiency—measured as low-cost production—is considered an essential strategy for effective survival in a specialized system. The more efficient (cost-cutting) production is, the more highly specialized it must be. On the other hand are those who argue that as systems become more specialized, they become less competitive, because there are fewer producers vying for the business of the consuming population. In this view, producers in highly specialized (and therefore noncompetitive) situations lower their energy expenditure, in part because there is no need to produce a "superior" product. In contrast, weakly specialized economies will be marked by greater competition, which leads to greater energy expenditure in the form of product *elaboration* as specialists try to differentiate their wares from the products of their competitors and thereby attract customers (Feinman 1982; Feinman, Kowalewski, and Blanton 1984; Foster 1965).

To resolve this debate, we must accept that competition, specialization, and efficiency are not always and inevitably linked. Furthermore, we must recognize that, as with standardization, labor investment may not directly reflect characteristics of the economic system nearly so much as it is prescribed by aspects of social or political organization. The key issue is why energy is expended in the elaboration of even utilitarian objects. The answer is simple: the "additional" energy is expended because the objects carry social information that the consumer wishes to broadcast (Gero 1989; Pollock 1983). To the extent that the consumer considers this information essential for defining his/her social affiliation, he/she will be willing to "pay" the extra costs incurred during production. In such situations, no matter how "competitive," producers may not be able to significantly reduce their energy input without compromising the social information the artifact must carry in order to be acceptable to the consumer. In contrast, where objects carry little social infor-

mation and cost is the key factor in consumer decision making, in highly competitive situations we should expect producers to lower their "costs," best measured by the archaeologist in terms of time or energy expended.

In sum, there may be social, political, or economic reasons behind the relative efficiency or labor intensity of a production system. Feinman, Kowalewski, and Blanton (1984) have identified a correlation between decorative elaboration, energy expenditure, and political fragmentation/unification within ceramic complexes recovered in the Valley of Oaxaca. They attribute this to the amount of competition among potters and therefore consider it a key aspect of the economic system. However, specific styles were associated with particular regions, and Feinman, Kowalewski, and Blanton argue that this reflects competition among local lords asserting local autonomy. Since makers of different styles generally served different markets, the *potters* were not in competition with one another. Thus, variability cannot be explained as primarily indicating economic conditions. While Feinman et al. correctly identify the region as less specialized during periods of political fragmentation, they do so for the wrong reasons: competition during these periods was more likely political rather than economic.[13]

The assumption is often made that relative energy expenditure can be used to identify the context of production. Many archaeologists argue that relatively high energy expenditure is a clear indicator of attached forms of specialization—where competition is never an element because producers have a guaranteed consumer—while efficiency is a defining characteristic of independent specialization—because producers manufacturing for a market in which price determines product desirability want to minimize their costs (e.g., Clark 1986; Gero 1989). However, the relationship is neither quite this straightforward nor is it universal. Attached production may involve efficient technology and organization, especially if it is viewed primarily as a revenue-generating activity for elites. Similarly, high-labor luxury items may be produced by independent specialists in societies where there are no sumptuary restrictions and the only factors that determine consumption are the wealth of the consumer and personal preference.

Given the foregoing discussion, I suggest using relative efficiency to identify the degree of specialization only in cases of independent

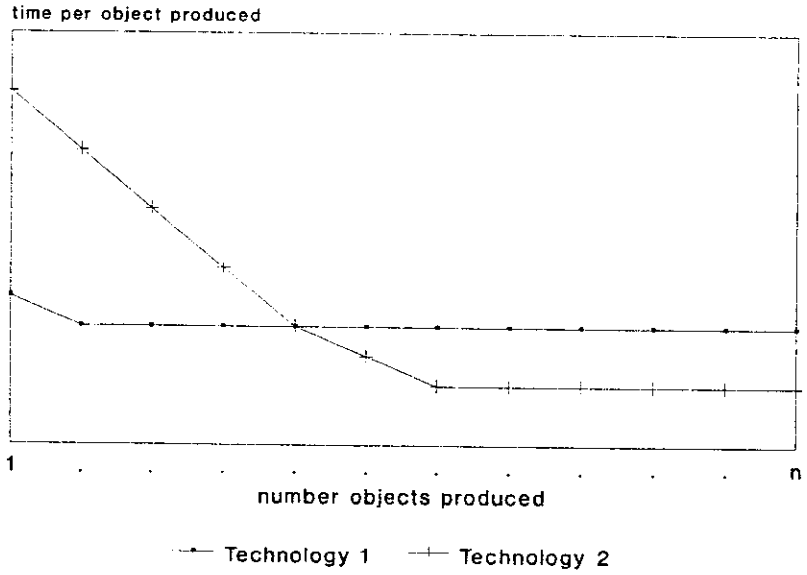
specialization where goods convey little social information. Efficiency has been measured in several different ways. The most common is standardization (e.g., Davis and Lewis 1985). The relationship between standardization and efficiency was discussed above. It is important to remember that standardization and energy expenditure are not *necessarily* linked. For example, Inka-style pottery is highly standardized—not only within a region but throughout the empire—and yet is very labor intensive (Costin 1986; Hagstrum 1989). Furthermore, as Torrence (1986) has pointed out, flexible production techniques—which may yield less standard products—may be the most efficient strategy in some situations.

A more effective way to measure efficiency is to estimate labor input. Although we cannot directly observe ancient artisans, ethnoarchaeology and replication studies provide useful information on time and energy expenditure in various crafts (Feinman et al. 1981; Gero 1989; Hagstrum 1985, 1989).

Perhaps the most overlooked aspect of the relationship between specialization and efficiency is the fact that certain technologies will be efficient only at levels of production which imply specialist production, that is, a producer must make far more objects than he/she can use personally in order for the tools and techniques to be efficient. For example, Clark (1987) has shown that there is little difference in the per-unit cost of lithic flake tool production, regardless of output. In contrast, he demonstrates that it takes a skilled knapper roughly ten to fifteen minutes to make the first blade from a prepared core, but only four minutes to make an additional ten to twenty blades if there are no errors. This is many more blades than would be consumed by a single household per year. Therefore, the blade technology makes sense only when the knapper produces for many consumers, that is, is a specialist. Thus, by demonstrating that blade technology is efficient only with specialized production, Clark makes a strong case for the nature of the organization of production wherever we find blade technology. Similar arguments could be made for other technologies, such as the potter's wheel. A shift from one technology to another, then, can be interpreted as increasing (or decreasing) specialization (Figure 1.7).

Skill. A third type of indirect data suggested as an indicator of the degree of specialization is the skill level of the producers. This is

Figure 1.7. Comparison of relative efficiencies and economies of scale of two hypothetical technologies.



cited for both the elaborate, labor-intensive products of attached specialists and the utilitarian products of independent specialists. For the former, there is an assumed correlation between skill and the intensity of specialization: that the most competent or highly trained workers will capitalize on these assets. Similarly, for utilitarian products, students look to the number of apparent errors in the production process, arguing that specialized workers will make fewer errors (J. Arnold 1987). The implication in all studies is that skill will be positively correlated with specialization, and therefore industries with fewer mistakes or more uniform products will be more specialized than those characterized by a large number of mistakes or less command over the productive process.

Although skill is often cited as an indicator of specialization, it has remained a primarily subjective criterion mentioned in passing, without active research (e.g., Muller 1987; Rice 1981). One exception is Hagstrum's (1989) work with ceramic production in the Mantaro Valley of Peru. She argues that Inka pottery is more uniformly fired than is the local pottery, and hence is the product of more highly skilled and more highly specialized artisans.

Regional variation and falloff curves. When large regions are considered in a study of production, it is often possible to determine whether different parts of the region were served by different production-distribution systems. This approach involves identification of regional variants of a good. This type of analysis is similar to analyses of standardization because it uses a variety of techniques to segregate the products of different production groups. Regional variants should be defined initially through materials/compositional analysis, with technological and stylistic criteria used secondarily. Analysis techniques similar to those discussed above for standardization are used most often. As with studies of standardization, the underlying assumption is that different production groups manufactured each variant (Johnson 1973; Neff et al. 1988). Unlike the analysis of standardization/variation discussed above, both gross and minor variations are appropriate data. The study of regional variation also differs from standardization studies in that information on the spatial distribution of the products of these groups is a major focus of the analysis.

Regional variation provides us with a measure of the degree of specialization on a broad scale because we can assume that the different variants will be the products of different production groups (cf. Costin 1986; Johnson 1973; Kristiansen 1987; Muller 1987). During periods with few regional variants, we infer a high degree of specialization, with relatively few production groups. Similarly, periods characterized by many regional variants reflect a low degree of specialization because there are relatively many production groups serving the same region.

Because the study of regional variation combines data on the relative number of production groups with information about the spatial distribution of their wares, the identification of regional variants and style zones also provides some information on the relative concentration of production. In a few cases, data are specific enough to allow identification of site-specific production. For example, Bishop et al. (1988:321) concluded that paste composition was different enough among villages sampled on the Hopi mesas to indicate site-specific manufacture. This is a clear case of relatively dispersed production. More generally, conclusions are drawn on a regional basis. If we assume an efficient distribution system—with most consumers acquiring goods from the producer closest to them—then we can estimate the relative dispersal of specialists throughout a region.

With many small, discrete zones, we can infer relatively dispersed production for the broader region as a whole (although within a single style zone production may be nucleated or dispersed). When a broad region consumes a homogeneous product, in all likelihood production is more concentrated. By looking at the degree of standardization within a single style zone or regional variant, it may be possible to further approximate the degree of specialization by estimating the relative number of production groups for each variant. In the study of Hopi ceramics cited above, the clays were variable enough and the analysis detailed enough to isolate multiple production groups within villages (Bishop et al. 1988:325).

Closely tied to studies of regional variation are studies of the relative densities of particular variants. Here, relative abundance is used to locate areas of production, the rationale being that materials will be densest closest to their source. Such an approach has been used at both the site (Fry 1979; 1980) and the regional (Bishop 1980; Rands and Bishop 1980) level. These density (or falloff) distributions most correctly identify areas of high *demand*. Goods are often consumed most heavily near their points of manufacture because they are relatively less expensive there (given high initial supply and a virtual lack of transportation costs).

However, not all goods are universally consumed closest to their point of production. This is especially true where relatively cheap transportation, specialized demand, and/or other economic considerations make it feasible or desirable to move large quantities of goods. For example, a number of Mesoamericanists (including Blanton [1985]; Brumfiel [1980]; and Feinman and Nicholas [1988]) have suggested that craft production was shifted to rural areas on the peripheries of major polities in order to encourage production of agricultural foodstuffs (which incur even greater transport costs than most craft goods) in core areas. This system would have required large-scale transport of the craft products of the peripheries to the core areas, where demand was highest. Such a system would be most efficient for goods such as textiles and lithic tools, and perhaps some high-value goods with more restricted demand. In my own work I suggested that storage jars were produced at a dependent community, based on the high density of production debris (direct evidence) recovered at the site. Yet storage jars were consumed more heavily at centers, when a higher proportion of elites (who controlled stored commodities) lived (Costin 1986). Thus, a falloff model would have incorrectly identified the location of storage jar production.

From the foregoing discussion, we can conclude that falloff curves will be most effective indicators of the organization of production when analyzing goods that are costly or difficult to transport and/or appeal to the broadest possible demand.

Final comment on the indirect measures. An underlying theme in the discussion of standardization, efficiency, skill, and regional variation has been the caution that these characteristics are often related to the organization of production in a somewhat oblique way. Thus, when using these data, it is necessary to suggest (and preferably to demonstrate) why they are appropriate to the particular case. The most effective studies will lay out clear expectations as to why these indicators are considered a rational response to particular environmental conditions and market demands. It is insufficient merely to demonstrate the feature and then conclude specialization. No study of production should be made in the absence of a theoretical framework about the causes of specialization. This is a double imperative when using indirect data, because the theory sets out the basic assumptions about the conditions that provide the justification for the nature of the final interpretation.

Summary and Conclusions

Specialization is best defined as differential participation in specific economic activities. Whenever there are fewer producers than consumers of a particular good, we recognize specialized production. Rather than being a single way to organize production, specialization—as a means to meet different kinds of demands under different distribution restraints—can take on many forms. Specifically, four parameters—context, concentration, scale, and intensity—can be used to describe the way production is organized.

Because our definition of specialization focuses on differential behavior, it is relatively straightforward to operationalize archaeologically. Specialization is identified in the archaeological record by a differential distribution of debris, tools, and facilities associated with production. Depending on the specific type of specialized produc-

tion, such variability in the recovery of these data will be manifest among households, social classes, social contexts, communities, and/or regions.

Under certain circumstances, the products of specialized production systems will exhibit certain features such as standardization, efficiency, skill, or regional variation. The key to using these data effectively to argue for the presence of specialist production is in demonstrating that they are appropriate *economic* responses to social, political, and environmental conditions. Studies of these indirect data will rarely yield information on the specific organization of production, but they will inform us of the relative degree of specialization for a product specifically and in the economy generally.

I hope this chapter will encourage more people to study production, and to study it well. The organization of production is relatively easy to study, because production events are visible in the archaeological record and are often localized. Data are abundant and varied. The study of production is suited to both household archaeology and regional studies. The difference between a mediocre study of production and a stellar one is the care and precision with which we connect our data, the contexts in which they are recovered, and our theories about the conditions that promote particular kinds of production.

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NOTES

1. Hence, titles such as "Specialization and Exchange in Complex Societies," "Prehistoric Production and Exchange," and "Production and Exchange of Stone Tools."

2. However, a "highly specialized" economy will be one that has relatively many different specializations and a relatively large percentage of the population pursuing specialized activities, while an economy that has a low degree of specialization will have relatively few specialized offices or products and numerically few people pursuing specialized activities.

3. This parameter must be considered part of a complete characterization of a production system, with the caveat that, as discussed below, the intensity of production is difficult for anthropologists to define, and extremely difficult to identify archaeologically.

4. Although there are sixteen possible combinations of the parameter values, as discussed elsewhere (Costin 1986), some parameter values cannot logically co-occur because they are promoted by conflicting conditions, while a few are expected to co-occur because they are promoted by the same conditions.

5. Some authors (e.g., Rice 1984:180–83) use the term "scale" to refer to both aggregate levels of labor employed and quantity of output to meet the needs of the entire consuming population. They assume a correlation between workshop size and *total* output required by the society. While it is a truism that larger, more complex societies will need larger-scale production in the sense of requiring large quantities of goods, it does not follow that this demand must be met by facilities employing large numbers of full-time workers.

6. Examples of small-scale attached production include the palace woodcarvers of Benin (Ben-Amos 1971); large-scale attached production is exemplified by textile workshops in the Inka empire (Morris 1974; Murra 1962) and Mycenaean Crete (Killen 1964). Examples of small-scale independent production abound in the ethnographic literature (e.g., Foster 1967; Kleinberg 1979; Hagstrum 1989); large-scale independent production is also documented in the nonindustrial world (Peacock 1982).

7. Slippage is disappearance of expensive or controlled raw materials and finished items.

8. Or they may be forced out of craft production altogether and into the wage-labor market.

9. Others, under favorable conditions, may opt to intensify agricultural production. The net effect is a more specialized economy.

10. Rather than, for example, ordinary kitchen midden or debris associated with the large-scale feasting characteristic of late pre-Hispanic Andean societies.

11. These were replaced to some extent by Inka-style wares not produced by local specialists.

12. The issue of identifying the length of time required for the deposit to accumulate creates yet another sticky problem.

13. This is another case where an explicit statement of the nature of the demand would help predict the organization of production. My comments are based on the supposition that these wares would be produced by attached or administered craftsmen, in part because they apparently served a "political" function.

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