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Interaction in Hunting and Gathering Societies as a Context for the Emergence of Pottery in the Central American Isthmus

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The origin and development of pottery in Central America remains a complex issue. New data from South America suggest that pottery was being made by nonhorticultural, semisedentary populations in the Amazon basin as early as 7000 b.p. (Roosevelt, chapter 10) and in northern Colombia around 6000 b.p. (Oyuela-Caycedo, chapter 11). Ceramics were also being manufactured in Ecuador shortly after 6000 b.p. (Damp and Vargas, chapter 13). To the north, the earliest Mesoamerican pottery appears in the context of sedentary populations practicing maize horticulture around 3500 b.p. (Clark and Gosser, chapter 17). Although the Central American isthmus is a geographical bridge between the continents, and dates for its earliest pottery complexes are intermediate between those for South America and Mesoamerica, straightforward diffusionary models fail to account for variability in technology and style. This chapter explores the possibility that ceramic technology appeared as a result of independent invention (or perhaps "dependent invention" as discussed by Clark and Gosser, chapter 17) within the region, emphasizing factors besides basic subsistence considerations.

Current models for the appearance of pottery production in the Central American isthmus can be grouped into ectothonous and autochthonous types. The former link ceramic production to the migration or diffusion of incipient horticulturalists from the north or south (Ford 1969; Lathrap 1977; Linares 1980; Snarskis 1978, 1984) and emphasize similarities among Central American complexes and those of Mesoamerica and South America. Ceramics, which improved the food value of maize, manioc, beans, and other cultigens, are assumed to have arrived together with these species. The emergence of ceramic production was an adjunct to demographic expansion as farming populations to the north and south increased at the expense of indigenous hunters and gatherers.

There is an unmistakable trend in the dates of the appearance of the earliest ceramics from south to north; however, it is difficult (if not impossible) to derive the earliest Panamanian complexes from northern Colombia or the earliest Costa Rican ceramics from Panama. Although ceramic technology may have a South American origin, independent invention is just as plausible as diffusion (Hoopes 1994a). Diffusionary models provide few insights into the distribution of ceramic forms or styles. They are also relatively sterile with regard to questions about why ceramics were used at all.

An alternative, autochthonous model for the emer-

gence of ceramic production in Central America removes pottery from an implicit context within the expansion of horticultural societies and the diffusion of horticultural traditions. Instead, it sees ceramic production as an adjunct to two important processes: (1) the intensive utilization of seasonally abundant wild resources, and (2) symbiotic relationships between sedentary and mobile populations. Specific patterns of social interaction, facilitated by the use of pottery, helped improve strategies for the broad-based utilization of tropical forest resources. The uses of native tree crops made possible by ceramic containers, for example, may have helped to predispose incipient sedentarists to the adoption of exogenous seed crops such as maize.

Geographical Contexts for the Emergence of Ceramics

The earliest pottery in Central America appears in a variety of contexts and regions over a period of about two thousand years beginning around 4500 b.p. The most important of these regions (in order of temporal priority) are (1) central Panama, especially Parita Bay and the Río Santa María drainage, (2) northern Costa Rica, including parts of Greater Nicoya and the San Carlos region, (3) the central highlands of Costa Rica, and (4) the Pacific watershed of southern Costa Rica (Fig. 15.1).

CENTRAL PANAMA

In central Panama, Monagrillo pottery has been found in deposits stratified over Late Preceramic ones at five rockshelters (Cooke, chapter 14; Cooke and Ranere 1992:270). It has been associated with 18 radiocarbon dates from Cueva de los Ladrones, Monagrillo, and Zapotal, ranging from 4800 ± 100 b.p. (TEM-119, Cueva de los Ladrones) to 3180 ± 80 b.p. (Beta-9574, Zapotal). Sherds have been reported from coastal sites with shell middens and from inland sites like Carabalí and Río Cobre, the latter located at over 1,000 meters

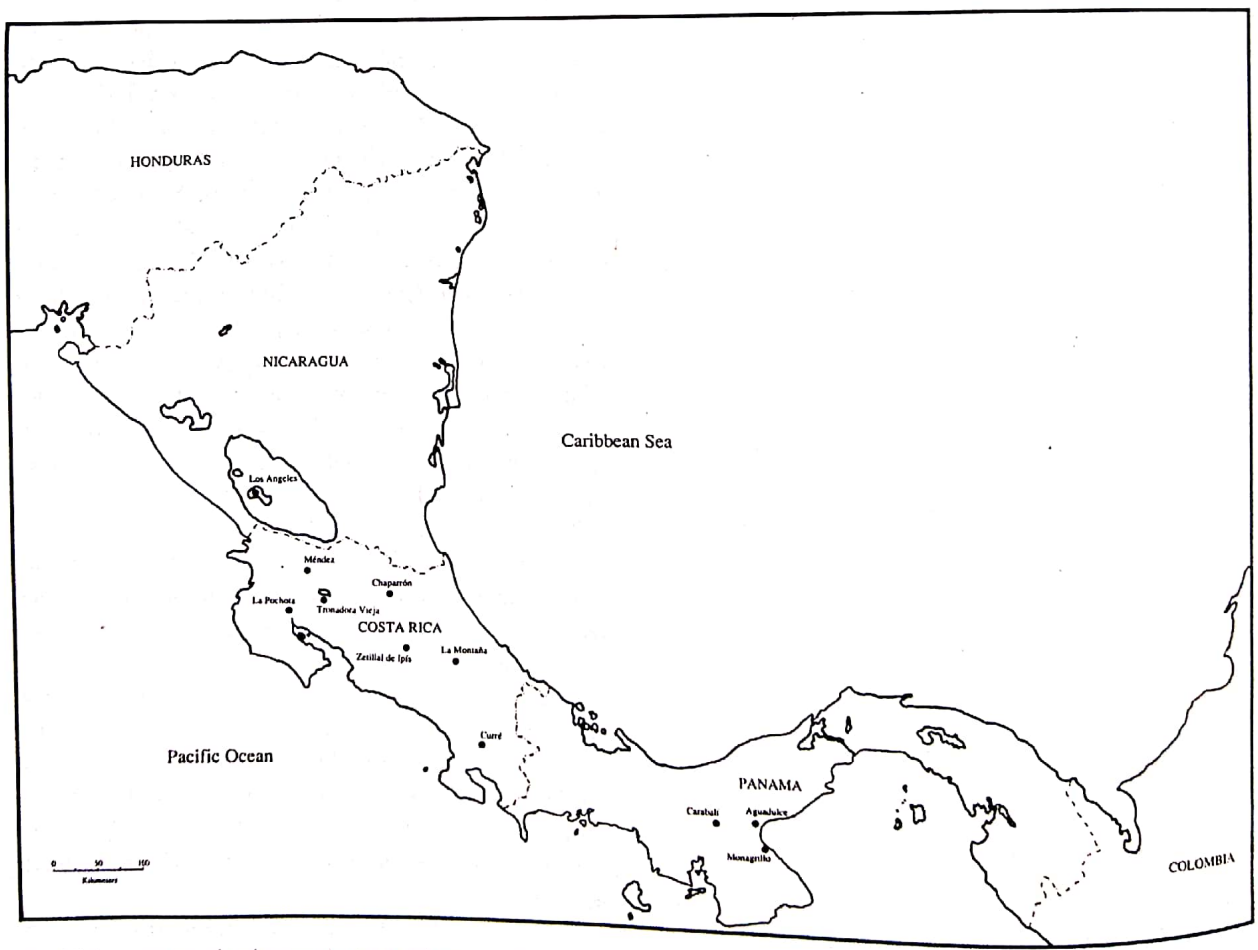

Fig. 15.1. Locations of early ceramic sites in Nicaragua, Costa Rica, and Panama.

in montane rain forest with annual precipitation in excess of 4,000 millimeters. Cooke and Ranere (1992: 270) find Monagrillo pottery sufficiently different from early South American complexes to be considered "completely endogenous." The pottery is extremely simple and unrefined. Its manufacture was probably informal. The principal forms are large, deep bowls with simple, unthickened rims (Cooke and Ranere 1992: Fig. 7). Necks or collars are absent, as are specialized supports or bases. Decoration, restricted to red painted rims and incised motifs, is absent from the earliest examples and rare in later assemblages.

NORTHERN COSTA RICA AND SOUTHWESTERN NICARAGUA

The earliest ceramic complexes from northern Costa Rica are all closely related. They differ, however, from Monagrillo and from early complexes to the north, such as the Barra ceramics of coastal Chiapas, Mexico (Clark and Gosser, chapter 17) and Bostan of coastal El Salvador (Arroyo, chapter 16). Their distribution extends from the Tempisque Valley in Guanacaste province across the volcanic cordillera into the broad San Carlos Plains. They appear in a wide variety of ecological zones, ranging from swamp margins at inland lakes to riverine habitats and islands in Lake Nicaragua.[1] Radiocarbon dates and volcanic tephra strata suggest that Tronadora ceramics from sites on Lake Arenal date as early as 3700 b.p. (Hoopes 1987, 1994b; Sheets et al. 1991).

The discovery near the Tronadora type site of a fluted projectile point manufactured from locally available chalcedony indicates that the Arenal region was first occupied in Paleoindian times (Sheets et al. 1991). Both radiocarbon dates and lithic assemblages document the presence of preceramic Archaic populations. A series of radiocarbon dates in association with aceramic deposits with chipped stone debitage situated below strata containing early ceramics suggests that Tronadora Vieja represents the reoccupation of an earlier, open-air Late Preceramic site by a ceramic-producing Early Formative population (Hoopes 1994b). Although ground stone tools dominated Tronadora lithic assemblages and chipped stone tools were rare, chalcedony biface thinning flakes—more typically associated with Preceramic industries—were found together with early pottery at Tronadora Vieja. These suggest continuity across the Preceramic/Ceramic boundary. The association of pottery with simple structures and with both macro- and microbotanical remains of maize, as well as with fragments of manos and metates, indicates that Tronadora pottery was manufactured by sedentary or semisedentary horticulturalists. At La Pochota, in lowland Guanacaste, a ceramic complex similar to Tronadora has been found in association with a large, rectangular stone mound identified as a habitational platform (Odio 1992:3).

Apart from Tronadora, none of the other northern complexes has been dated directly.[2] Early pottery from the Tronadora, Chaparrón, Dinarte, and Naranjo complexes is known exclusively from fragmentary remains, and only one partial vessel has been reported (Fig. 15.2; Hoopes 1987:Fig. 6.4). Principal vessel types include massive, incurving-rim bowls with heavily bolstered rims; wide bowls with comma-shaped rims; and squat, necked jars. Tall, flat-based cylinders decorated with wide incisions and fine, shell-edge stamping stand out as special-purpose vessels for the serving of beverages. Handles and supports are absent, as are figurines and other clay objects. Decoration is represented by the sophisticated application of thick red slips and paints in combination with a wide variety of plastic techniques that include punctation, shell stamping, reed stamping, wide incision, modeling, scraping, and gouging (Hoopes 1987, 1994b).

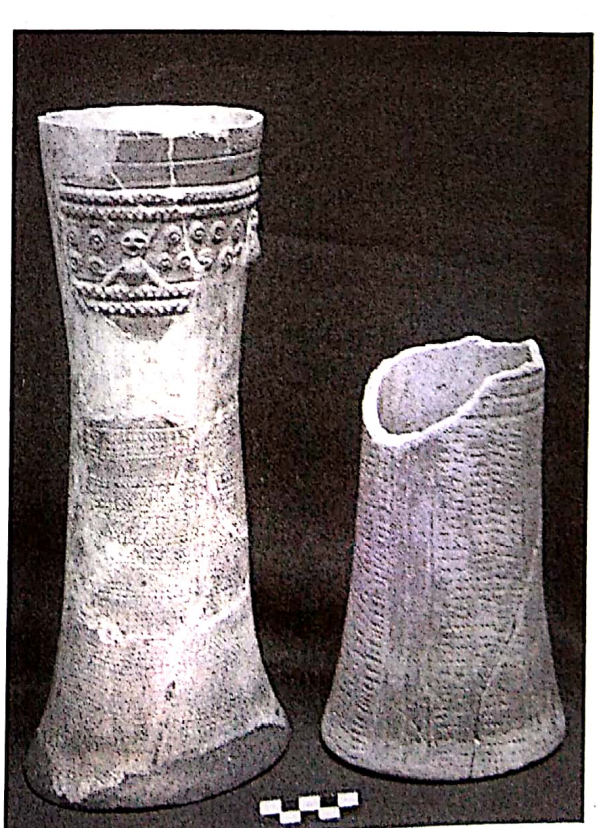

Fig. 15.2. Tall, cylindrical serving vessels from Early Formative complexes at Tronadora Vieja and Zetillal de Ipís.

Central Highlands of Costa Rica

The central highlands region provided the first dated early pottery complex in Costa Rica (Snarskis 1978, 1984). La Montaña pottery, identified at the type site near Turrialba, has been associated with five ^{14}C dates. The earliest is 3465 ± 160 b.p. (UCLA-2113A). Three others overlap from 800 to 400 B.C. at the 2-sigma range, and the fifth dates to the third century B.C. Although the earliest date was initially rejected, similarities between La Montaña and Tronadora ceramics suggest that it may, in fact, be valid. Barba ceramics, closely related to La Montaña, are found in small quantities at sites such as nearby Guayabo de Turrialba, and similar pottery has been reported from Guacimo, Tatisco, Pavas, and Barrial de Heredia (Snarskis 1984:206). Like Tronadora, La Montaña pottery is found in a region that supported hunting and gathering populations from Paleoindian times. The type site is not far from a Paleoindian chert quarry and large Paleoindian and Early Archaic sites near Turrialba (Snarskis 1979). It is situated on a terrace of one of the largest rivers in Costa Rica, in an area characterized by fertile soils derived from volcanic tephra.

Early ceramics from the central highlands of Costa Rica share several modes with northern complexes. The most common vessels are large-capacity, incurving-rim bowls with bolstered rims. Flat-based, cylindrical vessels similar to those from the Arenal region are also known, including one almost complete example from the site of Zetillal de Ipís (Fig. 15.2; Snarskis 1978:Fig. 25a). The ceramics differ, however, from those of the Tronadora and Chaparrón complexes in important respects. Painting and slipping are virtually absent, and vessel forms include *budares*—ceramic griddles that may have been used to toast cakes of bitter manioc.

Southern Costa Rica

The earliest pottery in southern Costa Rica is known as Curré, from sites in the Térraba–Coto Brús valley (Corrales 1985, 1989). Although it is not directly dated, its stratigraphic position and stylistic traits suggest that it appeared around 3500 b.p. Emphasis on plastic decoration, with punctation and shell stamping predominant, indicates relationships between Curré and complexes to the north. Curré's closest analogies, however, are with Sarigua pottery of central Panama. The predominant vessel forms are short-necked jars with outcurving rims. Slipping and painting are absent. Present, however, are flat-based cylindrical vessels decorated with shell stamping of the type found at Tronadora Vieja and Zetillal de Ipís. These distinctive forms are unknown outside of Costa Rica. Although it is the southernmost of the Costa Rican complexes, there are few similarities between Curré and Monagrillo pottery. The former is dominated by necked jars, whereas these are absent in the latter.

Corrales (1985, 1989) has suggested that Curré populations cultivated bitter manioc, a suggestion based on the presence of lithic artifacts interpreted as manioc grater chips. Although Corrales noted that budare fragments were absent, they have since been identified in type collections of Curré pottery. There is little information available on Curré settlement patterns, but the type site is situated in the fertile Río Térraba floodplain. The continuity of occupation at this site is noteworthy. Curré deposits are overlain by those of the subsequent Aguas Buenas complex, and the site is today the location of an indigenous settlement. Preceramic sites have not yet been reported for the Térraba–Coto Brús region.

Preceramic Contexts for the Emergence of Ceramics

One of the most significant problems with the evaluation of cultural contexts for the emergence of pottery in southern Central America is the dearth of information on Preceramic societies. The most data are available for Archaic period populations in western and central Panama. In western Panama, mobile populations occupied wet tropical forests from at least 7000 b.p. The earliest period, Boquete, is characterized by small bands of hunters and gatherers. During the Talamanca phase, ground stone tools suggest the beginnings of forest clearing. In central Panama, estuarine resources were adequate for the support of semipermanent occupations, as indicated by sites such as Cerro Mangote (McGimsey 1956).

In central Panama, lithic, macrobotanical, and microbotanical data indicate that root crops, palms, and other tree crops were important components of the diet as early as the ninth millennium b.p. (Cooke and Ranere 1992:260). At Carabalí Shelter (Valerio Lobo 1985), where the earliest occupations date to about 8000 b.p., carbonized seeds included palm fruits, Sapotaceae (*Sideroxylon* or *Bumelia*), and *nance* (*Byrsonima crassifolia*) (Cooke and Ranere 1992:261; Smith 1988:166). In western Panama, the

earliest macrobotanical remains are fragments of palm fruits (*Scheelia* sp. and *Acrocomia* sp.), nance seeds, and *algarrobo* (*Hymenaea courbaril*) (Smith 1980, 1988) dating to about 6600 b.p. At Aguadulce Shelter, deposits dating to about 5600 b.p. contained many palm fragments, including *pejibaye* (*Bactris gasipaes*) (Smith 1988:166).

The great variety and range of palms in Central America were undoubtedly assisted by human activity. After 8600 b.p. there is a rapid increase in charred grass and in the abundance of palm phytoliths—a pattern suggestive of intentional burning (Cooke and Ranere 1992:257; Piperno et al. 1990). The use of fire to encourage the spread of useful palm species probably increased with their utilization. Creation of a suitable environment and the protection and use of palms represent the first step toward horticulture in Central America.

Cooke and Ranere (1992:261) suggest that Carabalí and similar sites be termed "incipient agrilocalities," where "human populations collected certain plant species intensively and initiated the coevolutionary processes that subsequently led to horticulture." Citing the number of palm and tuberous genera that are probably indigenous to Panama, they remark that it is likely that "indigenous agroecologies that used such genera predate horticultural systems dominated by exogenous cultigens on the Central American land bridge" (Cooke and Ranere 1992:261).

The relationship between ceramics and maize remains problematical. The earliest radiocarbon date for Monagrillo ceramics is 4800 ± 100 b.p. (TEM-119) from Cueva de los Ladrones, and maize phytoliths dating between 4850 and 4750 b.p. and maize pollen from between 4750 and 3320 b.p. (Cooke and Ranere 1992:273) at Lake Gatun suggest that the cultigen was contemporaneous with early pottery. By 4000 b.p., there is evidence for the alteration of forest growth by slash-and-burn strategies that may have included maize cultivation, but there is not enough information to enable us to recognize the formation of specialized horticulture during Monagrillo times. Ceramic use is not accompanied by significant shifts in the kinds of resources that were being used at existing Preceramic sites. In central Panama, household artifacts remain simple (Cooke and Ranere 1992:271), and there are few changes in either chipped or ground stone tools between Late Preceramic and early Monagrillo assemblages. On the other hand, there is evidence for settlement change. Coastal sites increase in size and number during the Monagrillo phase, and there is evidence for simple wattle-and-daub structures (Cooke and Ranere 1992:273).

Monagrillo pottery has not yet been found in direct association with maize. Cooke and Ranere suggest, however, that evidence for increased site specialization during the period of early ceramic production "intimates that some segments of the regional population were becoming larger, less self-sufficient, and more sedentary, perhaps because scheduling, procurement, and manufacturing activities were responding to increasing demands on the land, diminishing opportunities for emigration" (Cooke and Ranere 1992:274).

The Late Preceramic cultural landscape was far from uniform. Monagrillo-style pottery has not been found in either western Panama or southern Costa Rica. Given divergent adaptations in western and central Panama by the Late Preceramic, it can be argued that

> equally strong intuitive cases can be made for (a) a relic (i.e., indigenous) foraging population that survived in humid montane forests above 800 m (too wet for primitive races of maize), while "intrusive" maize farmers occupied the drier foothills, or (b) the economic/ecological fissioning of a homogeneous endogenous population, which led to a symbiotic relationship between a humid forest foraging lifestyle and a more "agrilocal" or horticultural variant in the seasonally dry forests of the Pacific mid-elevation slopes. (Cooke and Ranere 1992:264)

The dynamic between mobile and sedentary populations in the Central American isthmus may also have played an important role in the emergence of ceramic production. Maize, however, may not have been the foremost cultigen in the emergence of early sedentism. It was probably preceded by the utilization of seasonally available tree-crop products, particularly nutrient- and oil-rich palm fruits.

Tree Crops

One of the principal questions about the Archaic period has been the nature of the prehorticultural subsistence base. Tropical forests are difficult habitats for human foragers. In a study of two areas of tropical forest in Costa Rica and Panama, Piperno (1989) noted that (1) wild plant sources with high caloric content, such as starches, are rare, (2) useful plants are widely dispersed, (3) many species produce small fruits, (4) palms and tuberous plants are rare in climax forests, (5) many taxa show unpredictable variability in pro-

ductivity, and (6) a high proportion of wild plants are toxic. In a "pure" foraging economy (with minimal human intervention and simple technology), there would be significant advantage to small, highly dispersed populations.

Smith (1988:170) suggested that "the cultivation of annual crops, maize, and beans was superimposed on an old dietary pattern which relied heavily on palms and broad leafed fruit trees." Among the tree crops subject to intense, periodic exploitation in Central America during the Late Preceramic were palm fruits from pejibaye, *coyol* (*Acrocomia vinifera*), American oil palm (*Elaeis oleifera*), *corozo* (*Orbignya* spp.), and *palma real* (*Scheelia rostrata*). Deciduous trees such as nance, *guayabo* (*Psidium guajava*), *jocote* (*Spondias* sp.), papaya (*Carica papaya*), *cherimoya* (*Annona cherimola*), *guanabana* (*Annona muricata*), and members of the Sapotaceae such as mamey and *chico sapote* are also likely to have been important food sources.

Palms, in particular, were sources of valuable products with both nutritional and social utility. Among these were palm starch (sago) and palm oil, which could provide otherwise scarce carbohydrates and fats. The preparation and serving of beverages such as palm wine, *chicha* beer (which could be made from a wide variety of palm and other fruits as well as pumpkins, manioc, and maize), and cacao probably played key roles in the development of early Central American social systems. Because their production and consumption were dramatically improved with the use of pottery, the development of these products and the development of ceramic systems are likely to have gone hand in hand.

The domestication of palms is still poorly understood. Valuable species such as pejibaye—documented to have hundreds of varieties—are unknown in the wild. Its wild relatives are native to the Amazon, and it is believed to have originated in the eastern foothills of the Andes (Prance 1984:91), but it is still not known whether its introduction to Central America was natural or cultural. Palm utilization, however, may provide a key to understanding the development of pottery in southern Central America.

Gourds were undoubtedly the original containers for preparing, serving, and storing fermented beverages. The most important species in Central America would have been the bottle gourd (*Lagenaria siceraria*) and the tree gourd, or *jícaro* (*Crescentia alata*). Pottery, however, was important because it enhanced the *scale* of food preparation. Large-capacity pottery vessels improved a group's ability to control and plan the availability of fermented products. Through their conversion into beverages, surplus fruits would not go to waste. Palm fruit crops would have provided abundant, seasonal resources to mobile foragers. When fruits were available, there was no significant risk of their overexploitation by small populations. Individual pejibaye trees can produce annually for up to 50 years, and the species is easily propagated. (Spanish records report the existence of plantations numbering trees in the tens of thousands near Sixaola, on the Atlantic coast [Lothrop 1944].) Gathering of pejibaye is not especially labor intensive because all it involves is scaling the spiny tree and cutting loose a bunch of fruit. The fruit, however, must be boiled and peeled before it is consumed. As Chagnon notes (1968:30), "it takes a lot of work to get filled up on palm fruits."

Ceramic vessels would have vastly improved people's ability to exploit abundant tree-crop resources during the period of their maximum availability. Improvements in boiling, brewing, pickling, and storing would have had significant impact on the qualitative and quantitative effects of tree crops on human subsistence.

PALM STARCH

In eastern Malaysia, sago is a staple of the Penan, living foragers who occupy a tropical forest ecosystem that remains mostly undisturbed by previous clearance (Brosius 1991). Sago is also utilized by lowland South American groups (Heinen and Ruddle 1974) and was probably an important staple in tropical Central America. Sago exploitation can provide a stable subsistence base. The Western Penan, for example, are unusual among documented foragers in that they are characterized by (1) bands of 60–200 individuals, (2) long-term occupations of settlements, often for more than a year, (3) long-term stability of band composition, and (4) "what appears to be a nascent form of aristocratic leadership" (Brosius 1991:136). Sago use made it possible for foragers to inhabit tropical rain forests. In doing so, it "influenced the distribution of important faunal resources, placed people within and near faunally rich environmental zones, and balanced conventional patterns of labor input between the sexes in ways that agriculture did not" (Dwyer and Minnegal 1991:209).

PALM OIL PRODUCTION

The extraction of oils from meats and nuts by indirect cooking has been suggested as one of the uses for early

pottery in the southeastern United States (Sassaman, chapter 18). Oils and fats are highly valued among foraging societies, especially where animal resources tend to be lean and highly dispersed. Tropical palms are well known as a source of high-quality oils, and there are a large number of species available for oil production. In South America, *babassu* palms (*Orbignya* spp.), whose kernels contain up to 70 percent oil, have been the subject of both traditional indigenous and large-scale commercial production (Balée 1989; Hecht and Anderson 1988). The most important species for Precolumbian Central American populations was probably the American oil palm. Although palm oil production is possible without pottery, the availability of large-capacity containers would have been a significant contribution to an increase in the scale of production. Palm oil extraction is typically done by mashing fruits and slowly boiling the pulp, then scooping out the oil as it rises to the surface. Pots would have been more durable than gourds in the extraction of palm oil through indirect stone boiling. Direct cooking would have resulted in even more dramatic increases in oil production.

SWEET AND FERMENTED BEVERAGES

The principle of fermentation was undoubtedly known to all tropical hunting and gathering groups. Many indigenous Central American fruits, among them pineapples and papayas, ferment naturally soon after maximum ripeness. Natural fermentation would have been evident among tree crops, when bunches of *Scheelia* and *Acrocomia* palm fruits—with a higher sugar content than pejibaye—begin to ferment on the tree. Integration of ritual alcohol intoxication into community gatherings may have first occurred when indigenous hunter-gatherers consumed fermented fruits toward the end of a season of abundance. Fruits of pejibaye, coyol, and other palms have been used to make a fermented chicha beer by several Central American societies (Johnson 1963; Kirchhoff 1963).

The production of palm wine from sweet sap was undoubtedly discovered during forest clearing, when sap collected and fermented in damaged trunks of fallen palms. The sweet sap of *Bactris* and *Acrocomia* can be collected and fermented as palm wine (*coquelo*). Palm wine, however, is traditionally collected and fermented in the trunk of a fallen tree (Balick 1990). Vessels are required only for serving and short-term storage of wine, but they would have been more important for pickling. Coyol wine must be consumed shortly after fermentation; it turns to vinegar after a few days. Today it is used for making *salsa* with pickled peppers and onions (Balick 1990:90). There is no doubt that pottery permitted a dramatic improvement in early Central American cuisines, and the availability of drink and tasty foods in quantity would have provided a significant incentive for social gatherings.

Competitive Feasting as a Model

Prehorticultural exploitation of Central American tree crops for starch, oil, and beverages, when considered in the context of a cultural landscape marked by societies with variable degrees of sedentism, suggests an alternative to diffusionary models for the emergence of pottery on the Central American isthmus. A modification of the competitive feasting model suggested by Hayden (1990) for the emergence of agriculture can explain an autochthonous genesis of ceramic production, motivated and encouraged by both nutritional and social factors. Whether ceramic technology was invented in a variety of locations or had a single source of origin, early ceramics were undoubtedly first produced in the midst of mobile hunting and gathering societies. Pottery vessels are likely to have enhanced communication and interchange between ceramic producers and nonproducers and were important not only for their specific contributions to the preparation and storage of specific subsistence products but also for their contribution to the diversification of subsistence strategies for *both* mobile and sedentary populations through cooperative interchanges.

There are significant similarities between the processes leading to the adoption of horticulture in Hayden's model and those that would have encouraged the adoption of ceramic technology. As a general principle, Hayden suggests that subsistence innovations related to competitive feasting are most likely to have occurred in rich environments with abundant resources, where the accumulation of resources by individuals would not have threatened the population's survival. This principle would have been especially applicable to strategies focusing on *r*-selected resources (fish, shellfish, certain fruits, and seeds) rather than on *K*-selected species (deer, birds). Early pottery also improved people's ability to exploit seasonally abundant *r*-selected species. Hayden predicts that food production will first appear in areas where obligatory sharing was not essential for survival and where ownership of produced food was "no longer anathema" (Hayden

1991:12). This shift would have occurred where resources were abundant, reliable, and invulnerable to overexploitation. Once undertaken, competitive practices are not detrimental to the resource base. A primary goal of competitive feasting was control over labor. Foods and beverages prepared in quantity are still widely used in Central and South American social contexts as payment for group labor.

Pottery offers significant advantages in the processing of *r*-selected species such as fruits and seeds. It plays a specific role in the preparation of crops like beans and maize, which are easily stored when dry but require softening (and cooking, in the case of beans) to become palatable. It enhances opportunities for food preservation and storage through fermentation and pickling. It also made it possible to extend the "shelf life" of fish and game through the preparation of soups and stews—an important addition to techniques of drying and smoking. Perhaps most important from a social point of view, ceramics greatly facilitated the preparation of large quantities of food and beverages. The largest ceramic vessels from the earliest ceramic complexes in Colombia and Costa Rica have a capacity greater than that of the available gourds. Although chicha is often prepared in wooden troughs, a practice still common in parts of Central America (Johnson 1963:249), it is usually stored in pottery (Kirchhoff 1963:221). One of the most important contributions of storage jars is that they can facilitate transportation and serving to large groups of people.

Hayden (1990:12) predicts that the first domesticated foods should be items suitable for feasting rather than staples, and that they could be expected to occupy a very minor position for a relatively long time in the overall subsistence emphasis within a community. These same factors would have encouraged the emergence of ceramic technology. In the context of an abundant resource, ceramics enhance the functions of storage and serving. As with horticulture in Hayden's model, pottery is more likely to have appeared in the context of abundant than scarce resources. Its production requires a significant investment of energy in the acquisition and preparation of raw materials, vessel manufacture, gathering of fuel and firing, and use and transport of the vessels themselves. Ceramic technology shows a high degree of correlation with sedentism because of manufacture and transport costs (Arnold 1985). A population under dietary stress is not likely to invest in technology that will restrict mobility and require increased investment of energy in nonsubsistence activities. Ceramic manufacture may have been regarded by many mobile, preceramic populations as falling into the same category as early domestication: more trouble than it was worth. It was easier—and probably necessary—to move and find other resources than to stay in one place and make pottery.

Competitive feasting, according to Hayden, encourages cultivation because of the positive feedback received by the organizer(s) sponsoring the feasting activity. Special crops are cultivated because of their specific contributions to feasting. The value of ceramics for feasting-related activities emphasized (1) preparation of large quantities of special foodstuffs, (2) accumulation and storage of these items for high-volume, short-duration consumption, (3) efficient serving of participants, and (4) the vessels' role in impressing participants with the wealth and generosity of the feast's sponsor(s). The quality of "impressiveness" would have been particularly important for the emergence of ceramic styles. It reinforced the identity of the ceramics' producers and either their difference from or their similarity with competitive groups. Persons emulating or imitating the "aggrandizer/accumulators" would copy ceramic styles. Where innovation was valued, stylistic distinction would have served to emphasize differences.

Although Hayden's model concentrates on the effect of competitive feasting on cultivation and domestication, status competition would have affected technology even in the absence of domesticates. The ability to prepare, store, and serve desired comestibles in sufficient quantities for large-scale, integrative consumption does not require domesticated products. Periodic feasting is not an essential subsistence activity. When the technology for taking advantage of natural abundance is improved, however, it can make a significant contribution to the integration of groups and to increasing the efficiency of wild resource use.

THE CASE OF SOCONUSCO

Clark and Blake (1994) suggest that the adoption of Barra ceramics in coastal Chiapas, Mexico, represents an example of the emergence of pottery in the context of early domestication. Early Barra vessels imitate gourds, with an emphasis on vessels used for serving liquids. Their form and decoration suggest ritual significance and prestige value. Clark and Blake suggest that maize was introduced to coastal Soconusco prior to the adoption of ceramics, for the purpose of making chicha. It was a special cultigen grown for its use in competitive feasting activities. Pottery vessels commu-

nicated status through competitive use and display, and their production was enhanced and encouraged by these activities.

In this model, maize is an initial component of competitive feasting activities, with ceramics appearing as a technical and stylistic adjunct. Chicha, however, can be made from foods other than maize—including nondomesticated products. As I noted earlier, palms, present in undisturbed tropical forests (and even more abundant in areas that have been cleared) would have been available to prehorticultural populations. Maize —or any specific cultigen—may well have been *secondary* to ceramic technology in the promotion of rituals of social integration. Changes in food preparation made possible by ceramic vessels facilitated the incorporation of beverages and foodstuffs into social gatherings. The enhanced social interaction made possible by new products (and increased quantities of familiar ones) encouraged intergroup exchange of commodities and information. At a more intensive level, feasting promoted gatherings for the periodic concentration of human labor for projects beyond the capacity of small or dispersed populations. Although beverages like maize chicha and cacao eventually achieved primary importance, they probably appeared in the context of existing, prehorticultural repertoires of similar beverages. The earliest foods and beverages prepared in pottery and served at social gatherings were probably not cultivated products. Maize and cacao, when they entered the subsistence system as prestige products, were elaborated in the context of an already existing tradition of brewing and consuming beverages during ritual exchanges of resources and labor intensification.

Interactions between Sedentary and Mobile Societies

The dynamic of interaction between food producers and foragers was undoubtedly an important one in the emergence of early horticulture. It was probably preceded by interactions between contemporaneous early ceramic and preceramic (or, more accurately, aceramic) societies.

In describing foragers of the Malaysian rain forest, Endicott and Bellwood (1991:181) remark: "If we may venture one modest generalization: an apparent result of the paucity of resources in the tropical forest is that the peoples living off them are opportunistic rather than conservative in outlook. They are ever eager to experiment, to try new ways to improve their lives. And one of the opportunities they are quick to take up is the opportunity to trade for horticultural produce."

The existence of populations producing reliable sources of carbohydrates would have supported the existence of interdependent, semisedentary or nomadic populations who were better able to take advantage of wild game and seasonally available fruits in areas away from sedentary settlements. Exchange between these groups would have permitted a broader exploitation of the entire tropical ecosystem. It would also have counteracted the effects that sedentary populations can have on the availability of game.

The dynamic of interchange between sedentary and mobile populations would have been seasonal, emphasizing the variability of resources available to each group. Ceramics were the technological contribution of sedentary groups, assisting with storage and preparations for gatherings and other integrating activities. Sedentary groups provided the place and the facilities for periodic sedentary-mobile exchange. They also provided the opportunity and context for joint feasting. The advantages conferred by ceramics in preparation and storage increase with quantities of available foodstuffs. Storage is most important when more food is available than can be consumed when fresh, and when there is an incentive to preserve this food for later consumption.

There has been a great deal of commentary on the ability of tropical forests to support "pure" hunters and gatherers (Bailey et al. 1989; Bailey and Headland 1991; Headland 1987). Bailey et al. assert that there is little documentary evidence for societies that rely exclusively on tropical rain forest resources for their survival. They conclude that these ecosystems could not have supported populations of "pure" hunter-gatherers and remark that in almost all known cases such groups have found it advantageous, if not essential, to establish reciprocal relationships with horticultural societies for the purposes of resource exchange. The principal reason for this is a dearth of fats, carbohydrates, and other nutrients in a diet based on tropical forest foraging.

Tropical ecosystems are the most speciose in the world, with large numbers of plants that produce edible seeds and fruits. These plants, however, are most abundant in clearings, along waterways, and at forest margins. In climax forests, most resources are concentrated in the inaccessible canopy. A number of researchers have pointed to deficiencies in protein, fats, and carbohydrates in tropical rainforests. But whereas

extensive Amazonian tropical forests may have been problematical in terms of nutrients, rain forest landscapes in small countries such as Costa Rica and Panama are far from uniform. Periodic volcanic activity created large areas of early succession species. Climax forests on steeply dissected terrain are riddled with openings created by tree falls that are colonized by forest margin species. Furthermore, the geographical extent of any landform is highly restricted. A foot traverse from the Caribbean to the Pacific can be accomplished in a matter of days. As Cooke and Ranere (1992:269) remark: "Living on a narrow isthmus means that one is never very far from the sea and that one can easily go and live on the beach for a while if it is worth the effort." Mobile populations were unlikely to have experienced significant dietary stress. With adequate extractive technologies, rivers, estuaries, and swamps would have provided an abundance of protein from fish or birds. The variety of the Preceramic diet is demonstrated clearly in faunal assemblages from sites such as Cerro Mangote (Cooke and Ranere 1989, 1992; McGimsey 1956), which included estuarine mollusks, marine catfish, deer, raccoons, iguanas, and small reptiles.

In central Panama, Late Preceramic populations appear to have been composed of both mobile hunter-gatherers and "agrilocal" incipient horticulturalists (Cooke and Ranere 1992). Around 4000 B.C., a change in stone tools signals the beginning of forest clearing, possibly associated with incipient root-crop horticulture. The advantages of root-crop cultivation to mobile hunting and gathering societies were great. Manioc (*Manihot esculenta*), *tiquisque* (*Xanthosoma* sp.), arrowroot (*Maranta* sp.), and other root crops did not require the degree of sedentism necessary for maize cultivation, principally because of the self-storing qualities of root crops and their resistance to animal predation. Their cultivation could therefore be undertaken by mobile populations seeking to increase sources of carbohydrates while utilizing abundant but widely dispersed tropical forest resources. In combination with more seasonally available tree crops such as the American oil palm or the pejibaye, tubers would have provided important sources of necessary carbohydrates.

Exogenous seed crops, on the other hand, were more demanding. Races of maize that had been developed in dry highland environments were unsuitable for wet tropical forests without selection and modification. The first populations to cultivate maize in Central America accepted a high degree of risk, which needed to be offset in some fashion. One way this could have been accomplished was through reciprocal relationships between sedentary and mobile segments of the population. Considering that prime hunting season would have coincided with the harvest, such relationships would have benefited from the contributions of both sedentary and mobile strategies.

An important motivation for feasting on the part of early sedentary or semisedentary societies would have been a desire to reinforce reciprocal relationships that developed between segments of the population corresponding to incipient horticulturalists and tropical forest foragers. Resources that could be extracted in sufficient quantities allowed some populations to remain in a given location for all or most of an annual period. The local surplus implied by this pattern would also have attracted the attention of mobile groups reliant upon more dispersed resources.

Early horticulture limited hunting by horticulturalists when crop harvesting and optimal hunting occurred in the same season. On the other hand, forest clearing and "garden hunting" (Linares 1976) would have improved the availability of some species. Mobile populations, always opportunistic, probably encroached upon the territory of sedentary or semisedentary populations when "disturbance" resources, whose availability was enhanced by human activities, were available. Simultaneous use of complimentary resources created a situation in which reciprocal relationships between sedentary horticulturalists and mobile hunter-gatherers would have been advantageous. Feasting is one mechanism that could have promoted exchanges, encouraged pooled labor, and established reciprocal relationships based on the exchange of resources and marriage partners.

The earliest Central American pottery probably appeared in the context of dynamic social relationships between sedentary and mobile populations. An important aspect of this dynamic was the maintenance of ongoing relationships between groups with distinct subsistence strategies. Subsistence strategies of early ceramic producers should be considered within a broad network of social interactions characterized by ongoing, periodic interaction between sedentary and mobile societies. Whether or not sedentarism preceded horticulture, sedentary societies would have been able to concentrate resources in ways unavailable to mobile groups while the latter retained flexible subsistence strategies that brought them into regular contact with a broader subsistence base than that available to sedentarists.

Social gatherings made possible by the preparation and serving of special foods and beverages provided a focal point for interaction between populations with differing subsistence bases. This interaction became especially important as knowledge of species and the technology for the extraction of fats and carbohydrates improved. The availability of surpluses and the need for additional labor may have motivated sedentary groups to use their improved technology for preparing and serving large quantities of foods and beverages in order to reciprocate the contributions of mobile groups within their social network. Regular gatherings, facilitated by ceramic vessels, would have reinforced a continuing dynamic of interaction. Although the contributions of hunters and gatherers declined with the expansion of swidden horticulture and the pressure of sedentary populations on finite hunting resources, competition for the attention of different groups and the diversification of the social landscape became driving forces behind the emergence of regional diversification in artifact styles and subsistence strategies.

There is a great deal of empirical support for the presumption of continued interaction between sedentary, horticultural populations and mobile hunter-gatherers (Bailey et al. 1989; Headland and Reid 1989). Efficient preparation of tree and root crops by sedentary populations enhanced their ability to attract and negotiate with mobile populations for resources prone to local overexploitation by sedentary groups. Sedentarists' ability to prepare and serve surplus carbohydrates, fats, and oils would have attracted the interest of tropical forest hunters, particularly when these resources were scarce in the wild. In situations where the hunter-gatherers were able to obtain a surplus of animal protein, an advantageous reciprocity would result. This type of resource exchange provided positive feedback for an increase in horticultural production as well as the spread of ceramic technology. It would also have motivated hunters and fishers to utilize ceramics to prepare and transport protein resources for exchange. Marine products at the inland sites of Aguadulce Shelter and Cueva de los Ladrones (Cooke and Ranere 1992:268) suggest that utilization of both inland and coastal resources was common.

A Hypothetical Scenario for the Emergence of Pottery

As populations increased, habitats with higher densities of palms and other fruiting trees—the result of gardens and orchards tended by mobile incipient horticulturalists to increase sources of carbohydrates and fats—would have become the objects of competition from different human groups. Establishment of semipermanent communities near these plantings helped protect them from encroachment. Although a portion of the society remained mobile to take advantage of dispersed resources, periodically the group assembled to consume root and tree-crop products. There may also have been a sense of "ownership" of a particular landscape and its associated resources, a pattern suggested by intensive use of quarries as early as the Paleoindian period (Cooke and Ranere 1992:263; Snarskis 1979). Cooke and Ranere (1992:262) suggest that "archaeologists should look for the beginnings of 'provincial stability or instability' in the Intermediate Area long before the introduction of ceramics and the development of sedentary (Formative) villages."

Palm resources and other tree crops tend to be highly seasonal but abundant when available. Toward the end of the rainy season, trees like pejibaye produce enormous clusters of nutritious fruit. In South America, palm species like *Mauritia flexuosa* provide starch (sago) in seasonal cycles (Heinen and Ruddle 1974). Ceramics represented a vast improvement in a group's ability to prepare, consume, and store palm products such as fruits, oils, and starches. Pottery vessels made it possible to process large quantities of fruit without a high loss percentage. Not only would they have allowed for fruits to be cooked quickly and efficiently, but they also increased the percentage of the tree crop harvest that could be processed during a season. As I noted earlier, pottery vessels also facilitated the production of food products such as oils and alcoholic beverages that were valuable to intergroup social exchange.

To return to Hayden's model of competitive feasting, the intensive utilization of tree crops permitted by ceramic vessels was an effective strategy for taking advantage of the seasonal abundance of an *r*-selected resource that was not prone to overexploitation. This assessment also applies to shellfish and other seasonal *r*-selected resources. Ceramics broadened the subsistence base by enhancing social interaction through the introduction of desirable foods and beverages produced and distributed in quantity.

The use of vessels for feasting on wild or semicultivated products would have preadapted communities to the introduction of other status foods and beverages. In historic times, the favored beverages of indigenous Central Americans have been maize chicha and chocolate. In southern Central America, both are based

on exogenous crops that would have been more labor intensive than palm fruits. It is these crops, together with other specialty foods (meats from the hunt? deep-sea fish?), that would have formed the basis for competitive feasting—accompanied by the elaboration of the vessels for preparing and serving feasted foods. Maize and cacao, as special feasting foods, should appear in the context of existing sedentary populations. This corresponds to Cooke and Ranere's (1992:266) interpretation of "the adoption of exogenous plants . . . as the internal adaptive response of segments of a forest-oriented population, which having developed a simple 'agrilocal' ecology based on native palms and tubers prior to 7000 B.P. was predisposed to accept new plant domesticates." The timing of their adoption, however, may have been quite variable. With regard to maize, this model suggests that in agrilocalities favorable for the production of tubers and palm fruits, initial preference for maize would focus on varieties appropriate for brewing.

Conclusion

Past models for the appearance of ceramic traditions in southern Central America have emphasized the role of the isthmus as a land bridge between Mesoamerica and northern South America. As a result, there has been a tendency to interpret prehistoric culture change in the region as a result of the diffusion of innovations from external hearths of cultural development. Current evidence makes it difficult to attribute the earliest pottery complexes to diffusion or migration from culture areas to the north or south. Ceramic production may have arisen locally as a strategy for intensive utilization of tree and root crops in the context of tropical forest hunter-gatherer/horticulturalist interaction. Social factors, in particular periodic feasts that united mobile and sedentary segments of the population, are suggested to have been as important as nutritional advantages in the emergence of ceramic production.

The emergence of pottery in southern Central America parallels, if not accompanies, the adoption of horticulture. Ceramics increased the variety and quantity of foodstuffs available for social interactions. Early ceramic-using societies not only modified the way they used existing resources but also invented new products and increased the scale of their consumption. In some societies, ceramics offered versatility to individual self-aggrandizers (Blake et al. 1992; Clark and Blake 1991) who sought to obtain the benefits of concentrated labor or trade items. They provided an advantage in situations of competitive feasting, where large quantities of food were accumulated, prepared, and served. In other situations, noncompetitive feasting improved by ceramics helped to sustain stable relationships between different segments of the population.

One implication of this model is that ceramic production will first appear in the context of seasonal, rather than year-round, occupations. Another is that early ceramic-producing sites will represent only part of the regional settlement pattern. There may be some overlap of preceramic/early ceramic traditions at sites where regular interchange between mobile and sedentary populations occurred. In southern Central America, the earliest ceramics should precede intensive maize cultivation. Early ceramic sites are also most likely to appear in locations characterized by centuries (and perhaps millennia) of anthropogenically altered habitats with an enhanced abundance of economically useful indigenous tree and root crops rather than abundant hunting or fishing resources.

Notes

1. Recently discovered ceramics from sites east of the lake in Chontales, Nicaragua, may also be related (Espinoza and Rigat 1994).

2. One exception is a date for the Naranjo phase of 3500 ± 60 b.p. (UCLA-2167A), but its association with ceramics is not clear.

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