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Rocks versus Clay

The Evolution of Pottery Technology in the Case of San Jacinto 1, Colombia

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What is the role of pottery production as a technology in the process of human cultural evolution? What is the effect of pottery as a selected strategy for food processing or as a form of intensification? These are the kinds of questions we should start to pursue from the perspective of cultural evolution. Studies of early pottery should be focused more on pottery's relationship to mobility and subsistence technology.

The invention or innovation of pottery has been argued to be an indicator of sedentism. It is necessary to reevaluate this relationship and not continue to take it for granted (Reid 1989:172). Part of the assumption that pottery indicates some sort of sedentism is related to two factors: a reliance on ethnographic data to infer past conditions (Arnold 1985), and archaeologists' lack of interest in demonstrating the context of pottery in relation to other aspects of the archaeological assemblage that could confirm or negate a relationship between pottery and sedentism. Part of the problem with the cross-cultural ethnographic perspective is that a strong ethnographic correlation between sedentism and pottery exists (Arnold 1985:109). The correlation is valid for the world today but is not applicable to the time when pottery was initially invented or adopted. In the end, the testing of any proposition has to come from the archaeological record if we want to generalize about the past.

The relationship of pottery to subsistence technology also has to be evaluated. Pottery may or may not be selected as a strategy for food processing and for intensification independent of resource change (see Stahl 1989). We have to ask what changed with the introduction or innovation of pottery. Did pottery have a significant impact on life-style, as is always described in the "before-and-after" scenario of pottery? Human populations knew how to cook without pots for thousands of years, but for some reason cooking with pots is generally considered a "revolution" in the same sense in which the term was once applied to the origins of agriculture. Is the model for a "pottery revolution" logical when viewed from the theories of technological invention, innovation, or adoption? The answer seems to be no. In general, such changes are gradual and can take generations or even centuries (Brown 1989:220). Another old assumption about the relationship between pots and subsistence is that pottery was invented primarily for cooking daily meals. Is this true? It is necessary to demonstrate this relationship.

One of the most appealing models for the origin of pottery is the econometric model of supply and demand developed by James Brown (1989). To test his model, Brown proposes five expectations: (1) there is an experimental period of pottery production that can be demonstrated over a span of centuries, (2) expedient technology should be present in the early phases of pottery production, (3) evidence of a decline in frequency of other technologies should be observed when pottery becomes popular, (4) the performance context in which early pottery is found will be different from place to place even within the same culture, and (5) meeting the demand for containers through other mediums should undermine pottery production in its early stages.

Brown's (1989) proposal follows the tradition of explaining cultural change as a transition between distinct stages. This stage model, however, is of little value for understanding variability in time and space (for a more in-depth discussion of the difference between a stage perspective and a processual perspective, see Drennan 1991:127–28). Brown's experimental period remains an undefined concept, especially when pottery could have been invented in such a short period of time that its development would not even be perceived in the archaeological record. The production of terracottas uses a simple technology that requires a relatively low firing temperature and does not demand the training and technical skills that porcelains demand. Furthermore, it is a technique that can be invented and perfected to a satisfying degree by a single individual. We should not expect to find in the archaeological record any evidence of "experimentation." The problem of technology is not the invention itself; it is how a new product is accepted and how the experience of its production is transmitted and improved upon through time.

In relation to Brown's second point—that expedient technology should appear in the early phases of pottery production—a look at the data available for Colombia (Correal Urrego 1986; Hurt 1977; Wolford 1994) shows that expedient technology (*tecnología* Abrience and Tequendamience) is present throughout the whole sequence from 10,000 b.c. to the European conquest. Brown's (1989:218–19) methodological approach to the cost-effectiveness of ceramics versus other containers such as baskets is very attractive and is partially considered in the model proposed in this paper.

An Alternative Model

In this chapter, a model of the origin of pottery production is presented from the perspective of cultural evolution. The objective is to understand the variability of pottery origins following principles of the evolution of culture as a process of change in which material culture has adaptive value (Bonner 1980; Cashdan 1990, 1992; Dawkins 1976:203–15; Rambo 1991). The present proposal is built partially upon the works of James A. Brown (1986, 1989), Kenneth C. Reid (1984:92–94, 1989), and Margaret C. Nelson (1991).

The origin of pottery among hunter-gatherers is seen as an adaptive strategy brought about by changing external conditions. The most active of these external changes is in the productivity of environmental resources, which is affected by such things as climatic change toward a more arid environment or prolonged dry seasons and concomitant changes such as a shift from homogeneous distribution of resources to patchiness of resources. In other words, changes toward less predictable seasonality of resources would have important consequences for hunter-gatherer adaptations. In order to cope with these changing conditions, a population has several alternatives: (1) move to a more predictable environment not occupied by another group, (2) increase the size of its territory with residential mobility, or (3) be more territorial by controlling different patchy resources through their constant monitoring. Such territoriality would favor a more logistic strategy of mobility. It is expected that this last alternative will be the preferred one, considering that these kinds of environmental changes are gradual and populations can map the distribution of resources as well as practice a spatial-temporal territoriality over the resources.

During these environmental changes, a strategy of reduced mobility would occur, leading to social or economic intensification. Pottery production can become useful, but is not necessary, in such a context. Social and economic intensifications are strategies selected to average out resources in space and time by reducing the risk of unpredictability (Cashdan 1992). Intensification of social activities could involve, for instance, an expansion of social or kin networks through activities such as feasting and raiding parties. Pottery can play a significant role as a symbolic item in food serving or food preparation (e.g., fermentation vessels) during feasting activities. As groups come together, an increase in site size is expected, as is a broader distribution of pottery styles over larger areas, even if group mobility is reduced and more territorial behavior in resource exploitation is observed.

In the case of a trajectory favoring the intensification of economic activities, a shift in focus either to one or a few abundant food resources or just to a new form of processing that enhances the nutritional quality of previously exploited resources would occur. Examples of this sort of enhancement are fermentation and detoxification. This intensification could be expressed in activities related to the processing of such food resources (Stahl 1989). Pottery would be specifically involved in the activities of processing.

Intensification in either of these forms or as a combined strategy of social and economic intensification is seen as a risk management response (see Cashdan 1990; Wills 1992) whereby such activities lend an adaptive advantage to the individual(s) participating in them under the given circumstances. In this context, pottery is just a tool that is invented or adopted to cope with resource scarcity through social or economic means of intensification.

The following are what we should expect in the context of early adoption or initial production of pottery: (1) Pottery is culturally selected for when internal social or economic conditions of the household favor the production of pottery as a response to changing conditions from a predictable to an unpredictable environment. These changing conditions require an intensification of social interactions, such as feasting, and/or of economic forms of food processing/cooking technologies. In both cases pottery will be selected for favorably. (2) The initial use of pottery involves a specialized function that is expected to vary from group to group. In some groups, pottery may have been used to extract oil from nuts; in other groups, it may have had a totally different function such as that of receptacles for the serving of feasts. The specific use is not as important as the fact of the specialized function itself. (3) Although pottery is selected by a group to assist in the process of social or economic intensification, this does not mean that it is competing against or is used instead of other kinds of technologies. It is added to the cultural assemblage because it is used for intensification and is a new form not previously exploited. A later broadening of the uses of pottery could be the result of further internal changes that favored pottery over other technologies of cooking, storing, or other activities. This last point is contrary to the expectations given by Brown (1989), in which competition between pottery and other container technologies or forms of cooking is considered to be the starting point for the development of pottery.

If these expectations hold, we would see certain patterns in the archaeological record. First, to test for internal social or economic conditions, it is necessary to establish which of the two is the selective force that favors pottery production. This can be done by determining whether pottery is found initially in an economic or in a social context of food processing. Economic contexts can be defined by archaeological evidence of cooking activities. Social contexts can be defined by evidence of activity areas that suggest feasting, by elaborate decorative styles, offerings, and associated botanical remains or chemical residues of alcoholic and/or hallucinogenic substances, or by evidence of pottery uses beyond those of normal subsistence activities.

Second, as a result of its specialized function, the earliest pottery is expected to have a reduced diversity of forms. And third, when pottery is initially adopted or invented, its presence or visibility in activity areas should be limited as a consequence of the restricted role it played as a new strategy for intensification. Through time, its presence will increase until the point comes when pottery can compete against other technologies that were at one time favorably selected for. At this point pottery will have a more dispersed pattern, occurring in multiple activity areas.

In this chapter, the first part of this model is addressed by utilizing one of the most overlooked types of evidence of cooking technologies: fire-cracked rocks. Fire-cracked rocks are among the most highly represented archaeological materials; they are used for roasting, stone boiling, and even steaming in earth ovens (Binford et al. 1970; Frison 1983; House and Smith 1975; Latas 1992; Lovick 1983; Wedel 1986). Fire-cracked rocks also have the advantage of being preserved in a variety of depositional environments. By comparing the contexts of fire-cracked rocks and pottery at the site of San Jacinto 1, I hope to present a convincing argument that considers early pottery as part of the process of cultural evolution.

The Case of San Jacinto 1

In order to understand the significance of excavation data from San Jacinto 1, it is necessary first to place it in a general regional context. The preceramic period of this region is not known, the only evidence being surface collections of artifacts representing an expedient lithic technology (Correal Urrego 1986; Reichel-Dolmatoff 1985). Our knowledge of the region is limited to sites with evidence of early pottery. The distribution of pottery in northern Colombia is restricted to the lowlands of the Magdalena River basin, especially along the Dique channel branch and the low mountains of the Serranía de San Jacinto (Figs. 11.1 and 11.2). In this region, the sites of Barlovento (Reichel-Dolmatoff and Dussan 1955), Canapote (Bischof 1966), San Marcos (Plazas and Falchetti 1986), Guajaro (An-

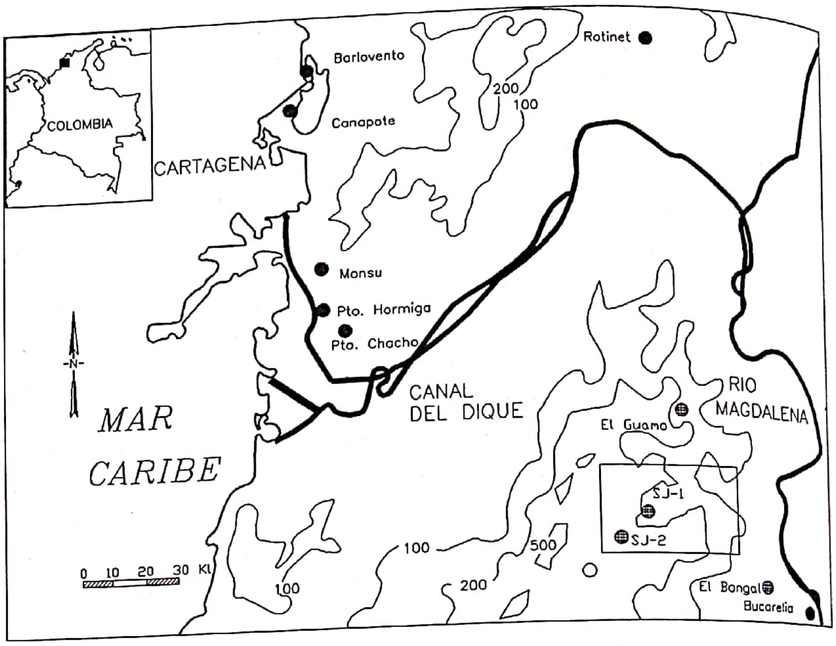

Fig. 11.1. General location of San Jacinto 1 in the lower Magdalena River drainage.

gulo Valdes 1988), Monsú (Reichel-Dolmatoff 1985, 1986), Puerto Hormiga (Reichel-Dolmatoff 1965a, 1965b), Puerto Chacho (Legros 1990; Rodríguez 1988), and San Jacinto 1 and 2 indicate that pottery was being made as early as 5940 ± 60 b.p. (all absolute dates are in uncalibrated radiocarbon years; see Table 11.1 and Fig. 11.3).

Preliminary results of the research at San Jacinto 1 and 2 indicate a sequence characterized first by an early development of pottery that was tempered with organic fiber. Later, in a gradual process, pottery utilizing sand temper was incorporated into the assemblage at sites such as Puerto Chacho, San Jacinto 2, and Puerto Hormiga. Eventually, fiber-tempered assem-

Fig. 11.2. Location of San Jacinto 1 and the town of San Jacinto.

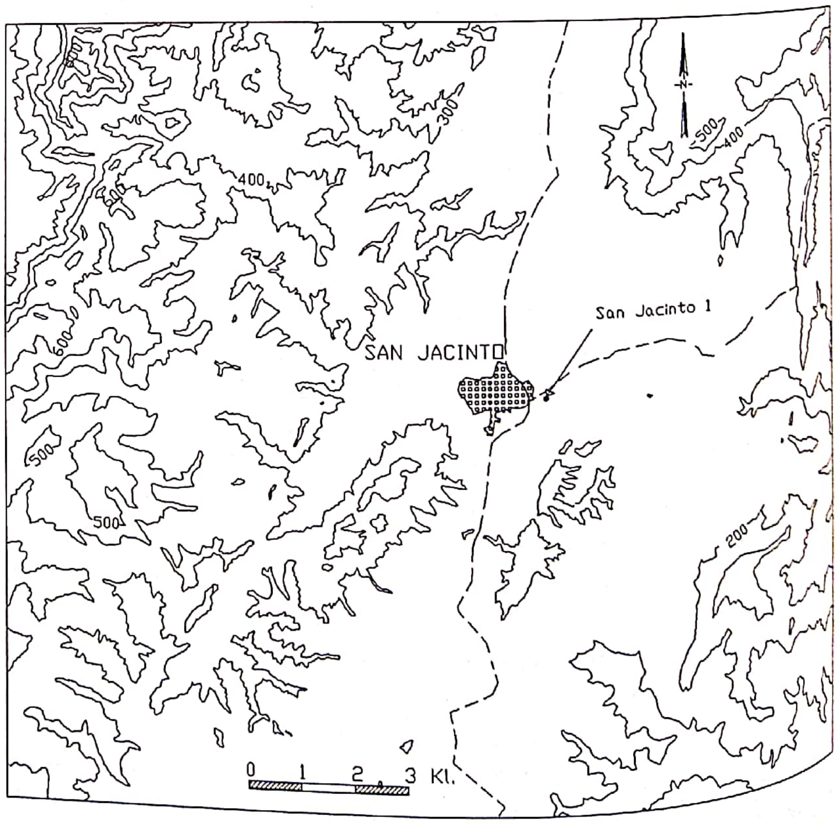

Table 11.1. Early Ceramic-Stage Radiocarbon Dates from Northern Colombia

Site	Radiocarbon Laboratory Number	Material	Radiocarbon Years b.p. (Uncalibrated)
San Jacinto 1	PITT-0155	Charcoal	5940 ± 60
	PITT-0154	Charcoal	5665 ± 75
	BETA-20352	Charcoal	5700 ± 430
Puerto Chacho	BETA-26200	Charcoal	5220 ± 90
Puerto Hormiga	SI-153	Shell	5040 ± 70
	SI-152	Shell	4970 ± 70
	I-445	Shell	4875 ± 170
	SI-151	Charcoal	4820 ± 100
	I-1123	Charcoal	4502 ± 250
San Jacinto 2	PITT-0362	Temper	4565 ± 80
	PITT-0361	Temper	3505 ± 85
San Marcos	BETA-16125	Charcoal	3650 ± 60
Monsú	UCLA-2149c	Shell	5300 ± 80
	UCLA-2149a	Shell	5000 ± 80
	UCLA-2149b	Shell	4200 ± 80
	UCLA-2565g	?	4270 ± 80
	UCLA-2568a	?	4175 ± 70
	UCLA-2568f	Bone	4170 ± 300
	TK-625a	Shell	3240 ± 60
	TK-625b	Shell	3230 ± 90
Guajaro			
Corte 7	BETA-13347	Charcoal?	4190 ± 120
Corte 6	SI-13347	Charcoal?	3800 ± 110
Canapote	Y-1317	Charcoal	3890 ± 100
	Y-1760	Charcoal	3730 ± 120
Barlovento	Y-1318	Charcoal	3510 ± 100
	W-739	Shell	3470 ± 120
	W-743	Shell	3140 ± 120
	W-741	Shell	2980 ± 120

Sources: Angulo 1988; Bischof 1966; Legros 1990; Oyuela-Caycedo 1987; Plazas and Falchetti 1986; Reichel-Dolmatoff 1965a, 1985, 1986; Reichel-Dolmatoff and Dussan 1955.

blages were completely replaced by more heat-resistant and thermally conductive pottery with temper of sand, grog, and shell (see Raymond et al. 1994; Wagner et al. 1994; Wippern 1988). This new technology replaced the older tradition around 4600 b.p., leading to the development of ceramic sequences represented by such sites as Monsú, Guajaro, Canapote, and Barlovento.

The people of this early pottery stage were exploiting diverse microenvironments that favored different kinds of adaptations, from fishing and gathering in estuaries to food gathering inland in grasslands and transitional forests (Oyuela-Caycedo 1987, 1990; Oyuela-Caycedo and Rodríguez 1990; Raymond et al. 1994; Reichel-Dolmatoff 1965a, 1985, 1986). San Jacinto 1 is located in an alluvial depositional environment—in contrast to the estuarine environmental setting—close to a dynamic meandering stream system in the Serranía de San Jacinto (the northern foothills of the Cordillera Occidental of the Andes) at about 210 meters above sea level, on a small plain surrounded by low rolling hills. A bimodal seasonality of dry and wet periods, the latter characterized by precipitation and humidity, is the climatic norm; flooding episodes and vegetational changes are seasonal. The major types of sediments that contributed to the deep stratigraphy of the site are clays and silts and lower percentages of sands. The major lithic resources available to the early populations were sedimentary rocks. The site appears

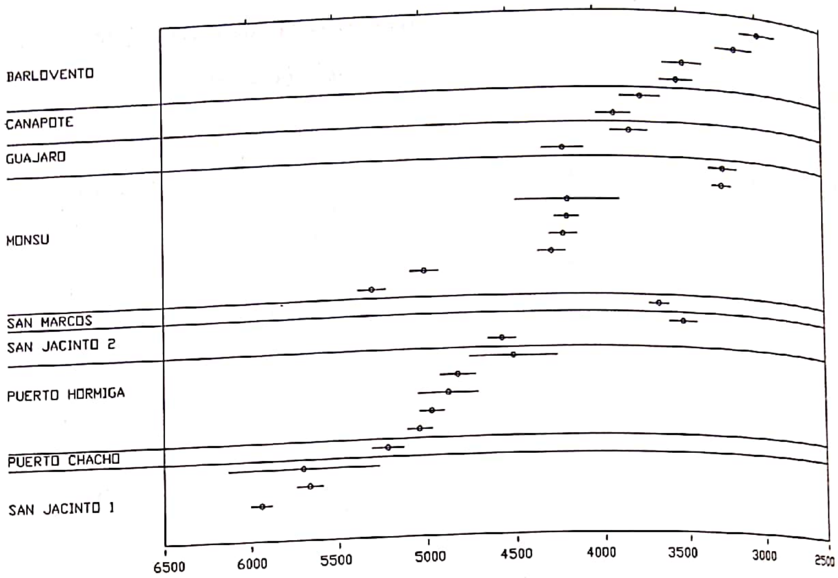

Fig. 11.3. Radiocarbon dates (uncalibrated) from the Early Formative sites.

to have been located at different times in its depositional history in a stream forest gallery, close to a savanna woodland, and in an open savanna.

The site was formed by long-term, seasonal human occupation and reoccupation of a point bar until the dynamic of the stream changed direction. Site activities produced a complex horizontal and vertical stratigraphy and microstratigraphy representing seven living floors of variable thickness and an abundance of features resulting from the seasonal occupation of the site. The living floors are dark bands of ash and charcoal mixed with fire-cracked rocks, stone tools, faunal remains, pottery sherds, and other remains left by the human residents of the site. Each successive cultural stratum is separated from the next by a band of lighter colored, culturally sterile sediment deposited during flooding episodes.

In 1991 and 1992 a large excavation (75 square meters) was conducted at the site (Fig. 11.4). The total area of the site at the largest expanse of its occupation (stratum 9) was close to 380 square meters. At its largest size, the site was occupied by what was probably an

Fig. 11.4. General view of the excavation of San Jacinto 1.

extended family of 10 to 25 individuals. Analysis of the material evidence indicates provisional constructions such as windbreaks or temporary structures at the site.

The initial picture that emerges of early pottery-stage lifeways is that of a population of collectors with a logistic mobility strategy that led to the reoccupation over numerous years of a favored point bar located on a permanent stream. The San Jacinto economy appears to have revolved around collecting and processing seeds of wild grasses and rhizomes by means of a ground stone technology. The diet may have been supplemented by hunting both large (deer and tapir) and small animals that were procured and processed with a diverse assemblage of unifacially flaked stone tools or with an expedient technology.

Because of the seasonality and redundancy of the occupation, it is possible to reconstruct activity areas only for stratum 9, when the nature of occupation changed from short, repetitive visits during the dry season to a more prolonged and stable occupation (for an analysis of soil formation and stratigraphy, see Oyuela-Caycedo 1993; on the nature and evidence of seasonality and redundancy of occupation, see Oyuela-Caycedo n.d.). In other words, the change was from use of the site as a special purpose camp visited frequently during the dry season to use of the site as a more permanent base camp during the last occupation of the place. Stratum 9 clearly is the most recent in formation and corresponds to the last occupation of the site by the people who manufactured fiber-tempered pottery. The thickness of this layer varies between 6 and 16 centimeters. The stratum is found at a depth of 3.0 to 3.75 meters below the present-day floodplain. It is characterized by a clay texture and a color that varies between dark brown (10YR3/3) and yellowish brown (10YR5/4), and it has a high content of phosphorus (460 ppm).

The data used for the present research consisted of weight of pottery recovered in each square meter excavated. For comparative spatial distributions, comparable data were used for fire-cracked rocks. Some exploratory analysis was also conducted to define the best approach for recognizing patterns. The technique used for the spatial variation analysis follows that described by Charles Spencer and Kent V. Flannery (1986). For the computer graphics, however, other programs were utilized (Golden Graphics and Autocad). For determining a correlation value between the two spatial distributions, the standard Pearson's correlation was used (see Whallon 1986).

A comparison of the two sets of basic statistics for pottery and fire-cracked rocks indicates that they are not evenly dispersed over the site (Table 11.2). A multimodal distribution across the excavated area occurs in a pattern that seems far from random. Some squares have lower amounts of pottery or fire-cracked rocks or none at all, whereas others have large quantities. Pottery seems to have a more clearly defined pattern of concentration or clustering than do fire-cracked rocks.

THE POTTERY

San Jacinto 1 pottery is characterized by the use of unidentified plant fibers as temper and by being fired in reduced conditions (possibly in earth ovens). Fiber-tempered pottery seems to have been manufactured mainly by direct shaping and produced by the household for the household (Raymond et al. 1994). Ceramic forms include bowls with incurving rims, jars with spouts, and neckless globular jars with deeply incised and excised handles or luglike handles with excised and modeled zoomorphic motifs (Fig. 11.5). The San Jacinto 1 pottery is characterized by its great diversity in decorative motifs. It might represent an early stage of this technological invention when experimentation with designs appears to be the rule. Each motif is unique, unlike the case in later periods such as at Puerto Hormiga and Monsú, where decoration became repetitive and standardized.

From stratum 9 were recovered almost 9 kilograms of pottery. Together the fragments were found to form a clear pattern of distribution in 53.3 percent of the 75 square meters excavated. Only 42 fragments of pottery rims were recovered associated with this stratum, or 5.9 percent of total pottery weight (Table 11.3). The pottery analysis suggests that in the 75 square meters

Table 11.2. Basic Statistics of Pottery and Fire-Cracked Rocks by Weight, San Jacinto 1

	No. of Squares	Min. Weight (g)/Square	Max. Weight (g)/Square	Mean Weight (g)/Square	Standard Deviation	Coefficient of Variation	Variance/ Mean Ratio
Pottery	75	0	980	119.827	194.961	1.627	317.20
Rocks	75	0	9385	2327.173	1733.544	0.745	16.33

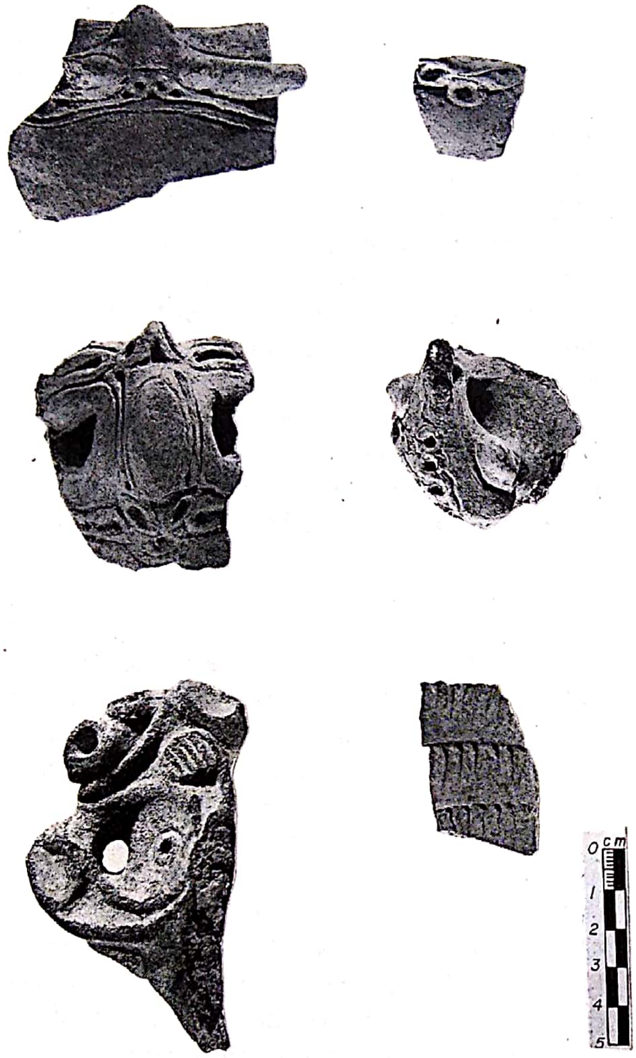

Fig. 11.5. Pottery from San Jacinto 1.

only a few vessels were present, possibly fewer than 10 concentrated in 9 peak areas (Fig. 11.6). The discrete pattern of pottery distribution, which forms clear clusters, does not indicate a direct relationship with site features or with the distribution of the fire-cracked rocks.

The low frequency of pottery also was observable during the excavation of the lower strata. This pattern contrasts radically with that observed at sites such as Monsú and Puerto Hormiga, where pottery is highly visible.

Table 11.3. Pottery from Stratum 9, San Jacinto 1

Pottery Fragments	Weight (g)	Percentage
Plain sherds	8205	91.2
Rims	468	5.2
Decorated walls	15	0.2
Decorated rims	60	0.7
Decorated lugs	239	2.7
Total	8987	100.0

THE FIRE-CRACKED ROCKS

Fire-cracked rocks are the most abundant archaeological material recovered at San Jacinto 1 in terms of number and weight, a pattern common in base camps of collectors (Binford et al. 1970; Latas 1992). A total of 174.5 kilograms (3,511 pieces) of fire-cracked rocks were recovered in stratum 9 (Table 11.4). The mean weight of the rocks is 49.7 grams.

Fire-cracked rocks were found in three contexts: (1) dispersed over the stratum randomly (distributions below 1,000 grams per square meter seem to behave in this manner; only two square meters had no fire-cracked rocks); (2) forming clusters in piles, occasionally up to 9 kilograms of rocks in a pile; these were classified initially as features (most of the peaks observed contain more than 2,000 grams of fire-cracked rocks per square meter); and (3) in the interiors of fire pits or earth ovens (in stratum 9, only four fire pits were identified; such features were mainly associated with strata 10, 12, 14, and 16).

All the fire-cracked rocks were classified according to rock type and composition. Sedimentary rocks account for 89.91 percent of the fire-cracked rocks; the rest (10.02 percent) are composed of volcanic igneous rocks (Table 11.4).

A Pearson's correlation between pottery and fire-cracked rocks in all the excavated units is extremely low (0.083), which suggests that fire-cracked rocks are not related to pottery in the context of cooking activities (see Fig. 11.6). The distribution of fire-cracked rocks indicates a relation with cooking practices such as stone boiling, which may employ other kinds of perishable containers for which we have no direct evidence, such as bottle gourds (*Lagenaria* sp.), "totumos" (*Crescentia cujete*), leather bags, and baskets. Finally, it is clear that the main association of fire-cracked rocks is with cooking activities linked to the features—earth ovens or cooking pits—that were the chief means of cooking food at San Jacinto 1.

Conclusion

The results of this analysis suggest that there is no relationship between pottery and cooking activities as represented by fire-cracked rocks and features at San Ja-

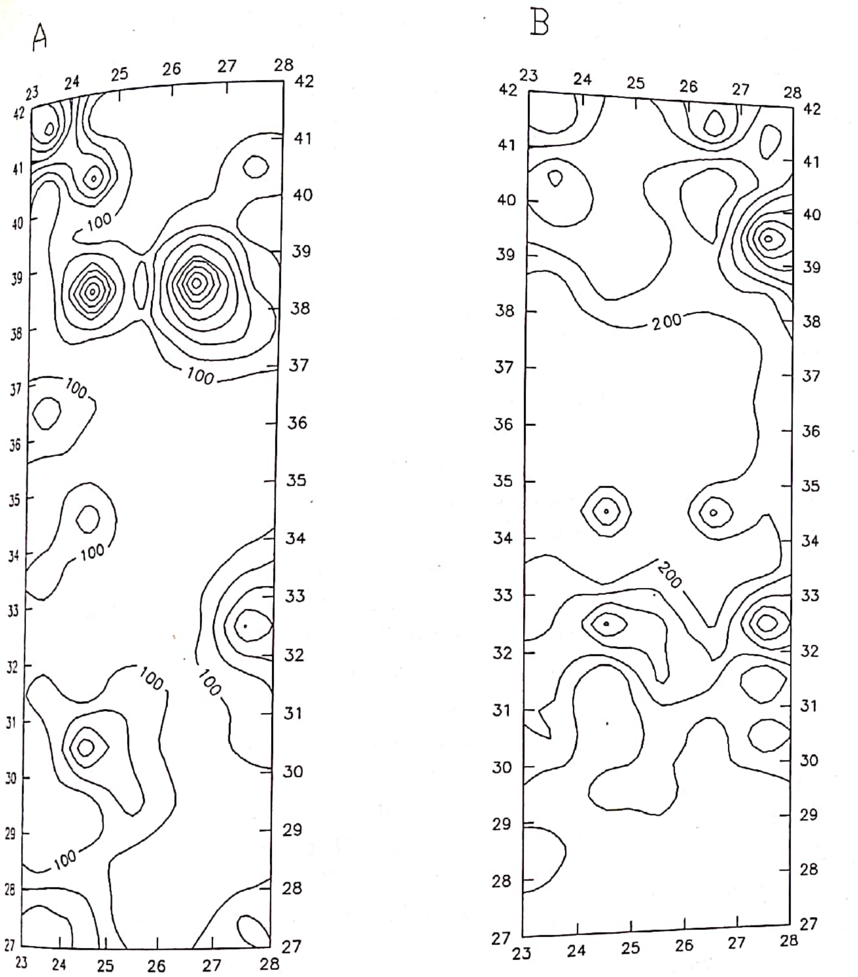

Fig. 11.6. Distributions of pottery (A) and fire-cracked rocks (B) in stratum 9. Pottery concentrations are shown in 100-gram levels, and fire-cracked rocks in 200-gram levels.

cinto 1. This interpretation favors the argument that pottery at this site had a function other than that of cooking.[1] For the moment, we have been able to achieve only partial evidence for the predictions of the model by demonstrating the restricted spatial distribution of pottery as well as its lack of relationship with fire-cracked rocks. Pottery seems not to compete at this point in its developmental process against fire-cracked rocks. The two do not appear to be directly associated with the same activities, as the Pearson's correlation indicates and as the graphics of spatial distribution illustrate. Only with further research will it be possible to demonstrate that competition is a secondary effect occurring later in pottery's process of incorporation.

Table 11.4. Total Weight and Number of Fire-Cracked Rocks in Stratum 9, San Jacinto 1

Type of Rock	Number	Weight (g)
Sedimentary		
Fine-grained sandstone	1427	56078
Limestone	823	36699
Crystal limestone	573	23966
Travertine	336	25735
Igneous		
Rhyolite	78	6008
Granite	6	840
Basalt andesite	268	25212
Total	3511	174538

There is tentative evidence from this analysis for the third part of the model outlined above. The distribution of pottery is limited to 53.3 percent of the excavated squares. Fire-cracked rocks, on the other hand, occur in all but two squares (97.3 percent). Brown (1986:605) notes for Early Woodland archaeology a similar phenomenon: pottery's low site-wide density and its concentration in highly localized areas. The results here suggest a restricted initial role for pottery in its process of incorporation by the inhabitants of San Jacinto 1, as also seems to be the case for the Early Woodland period of North America.

Likewise, the difference between the quantity of pottery and that of fire-cracked rocks is substantial and points to a secondary and limited role for initial pottery as compared to fire-cracked rocks. A later reversal in the visibility of pottery versus fire-cracked rocks at sites such as Monsú and Puerto Hormiga occurred as pottery was more fully incorporated into the inhabitants' activities and as it competed with and took over roles previously filled by other items of material culture such as fire-cracked rocks.

This work is only a first step toward understanding pottery origins as a process for which it is important to address the archaeological context.The data available from San Jacinto 1 will permit us to continue checking the expectations with more hard evidence, but only with further stratigraphic excavation of more recent sites will it be possible to follow the trajectory of the problem addressed here.

Acknowledgments

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Note

1. Other kinds of analyses are currently in progress. One of these is the organic residue analysis of the pottery, which is being conducted with the collaboration of the Department of Biochemistry of the University of Liverpool and Dr. Richard Evershed (Evershed et al. 1992). Preliminary results have not been successful in detecting organic residues (Evershed, personal communication, 1994). We also are pursuing the definition of the use of pottery as well as of the universe of vessel forms and the spatial distribution of these forms at the site. This will allow us to pinpoint in a more exact manner the use that pottery had and will add more evidence for the general aspects of the model. For the moment the evidence seems to indicate that pottery may be more related to social aspects of intensification than to economic factors such as cooking activities.

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