

- Sieveking, Ann
1976 Settlement Patterns of the Later Magdalenian in the Central Pyrenees. *In* Problems in Economic and Social Archaeology. G. Sieveking, I. Longworth, and K. Wilson, eds. pp. 583–603. London: Duckworth.
- Sieveking, A., and G. Sieveking
1962 The Caves of France and Northern Spain. London: Vista Books.
- Spiess, Arthur E.
1979 Reindeer and Caribou Hunters. New York: Academic Press.
- Thomas Casajuana, J. M., and J. P. de Villalta
1957 Le Ruisseau Souterrain du "Toll." *In* *Qua* 5:11–25.
- Wobst, H.
1976 Locational Relationships in Paleolithic Society. *Journal of Human Evolution* 5:49–58.

the department of Escuintla, near Santa Lucía Cotzumalguapa (Figure 1). The project focused on potential residential areas to obtain economic information about goods and materials reaching households and possibly about some production activities. The roles of both local and long-distance specialization and exchange were of interest because of debate about the possible developmental importance of these factors in the course of Mesoamerican social change (e.g., with reference to eastern Mesoamerica, Coe 1961, 1974; Thompson 1974; Parsons and Price 1971; Rathje 1971, 1972; Tourtellot and Sabloff 1972; Culbert 1974:52–57; Sabloff and Rathje 1975; Freidel 1978; Michels 1979; Blanton et al. 1981:170–221).

Research at El Bálsamo and Description of the Site

El Bálsamo was first investigated by Edwin Shook, who had conducted a major project at the nearby center of Monte Alto (Parsons 1976; Shook and Hatch 1981). At El Bálsamo he and Marion Hatch (Shook and Hatch 1978) analyzed pottery collections, mainly from Mound 1, and provided a sketch map. Shook encouraged more ambitious excavation by C. W. Clewlow, Jr., who worked with several colleagues for three seasons at El Bálsamo, testing major mounds around the plaza, mapping them, and also surveying a number of surrounding fields for surface remains. At Clewlow's invitation, Stark undertook the residential project in 1979 to obtain excavation data from some of the possibly residential remains in fields surrounding the plaza. Although analysis and publication of results from Clewlow's more extensive project are not yet complete, there are preliminary draft reports to which we have referred, and a synopsis of Whitley and Wells's survey in the El Bálsamo environs is included here.

El Bálsamo, like other known Preclassic centers on the Pacific coastal plain, was located in the interior rather than near the coast; it is on a finger of higher ground representing the southernmost extension of the lower piedmont. Although scattered natural mounds of

El Bálsamo Residential Investigations: A Pilot Project and Research Issues

BARBARA L. STARK
LYNETTE HELLER
*Department of Anthropology
Arizona State University*

FRED W. NELSON
*University Personnel Services
Brigham Young University*

RONALD BISHOP
*Conservation Analytical Laboratory
Smithsonian Institution*

DEBORAH M. PEARSALL
*Department of Anthropology
University of Missouri, Columbia*

DAVID S. WHITLEY
*The Institute of Archaeology
University of California, Los Angeles*

HELEN WELLS
*Department of Anthropology
University of California, Los Angeles*

The El Bálsamo Residential Project was undertaken by Stark to acquire economic information about this early center, thought to contain components from the Middle and Late Preclassic (900–500 B.C., 500–200 B.C.). El Bálsamo is located on the Pacific coast of Guatemala in

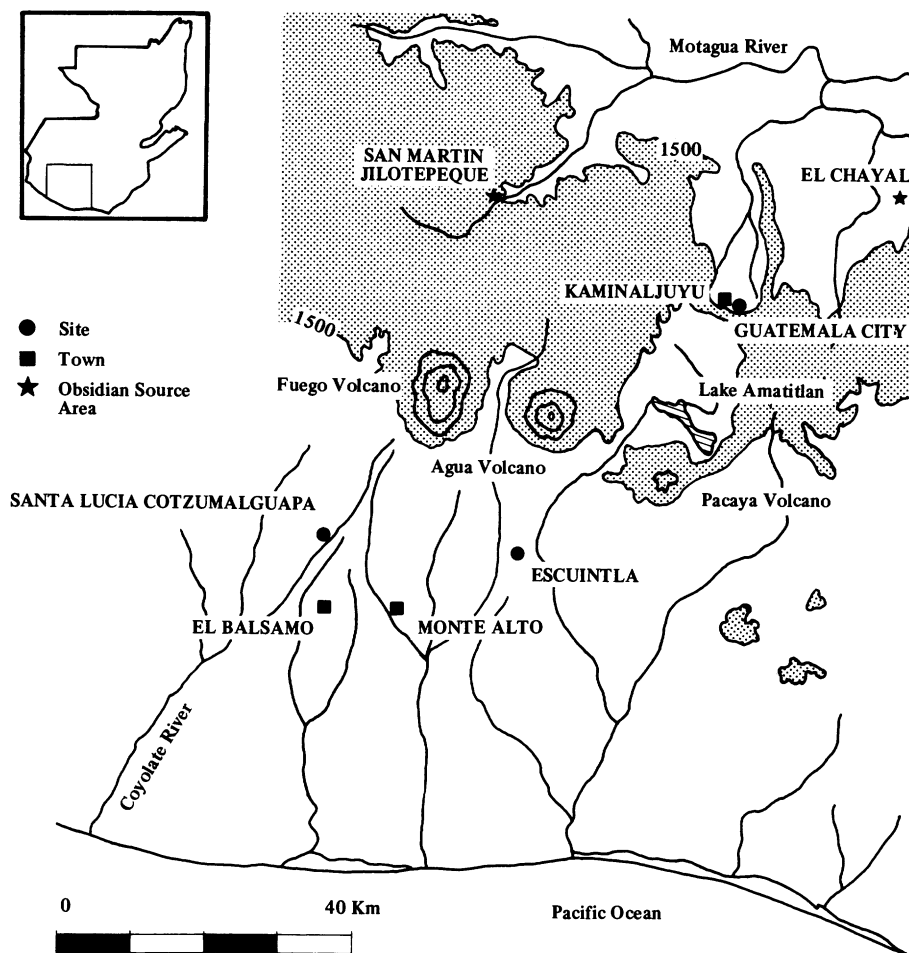


Figure 1
Portion of the Pacific coast and highlands of Guatemala. Inset shows relation to Guatemala.

poorly consolidated sediment (likely lahar deposits, cf., Kuenzi, Horst, and McGehee 1979; S. Self, personal communication) occur on the piedmont ridges, all of the El Balsamo mounds appear to be artificial. Shook (Shook and Hatch 1978) sketched the locations of 16 mounds there and Clewlow's unpublished contour map shows 10. Only the largest mounds were visible in the aerial photograph from which Figure 2 was drawn. The largest mound (Structure 5) is today between 13 and 14 m high. Central El Balsamo is aligned slightly east of north, with the mounds delimiting a long, narrow plaza.

Whitley and Wells surveyed roads,

canebreaks, and harvested cane fields during two weeks in January and February of 1977 as a facet of Clewlow's project (Figure 2). Unharvested mature cane fields in this region are impenetrable without cutting. Approximately 2.73 km² of fields were examined. Road and canebreak covered 13.7 km. Middle to Late Preclassic dates were assigned to 35 sites, primarily on the basis of the commoner diagnostics, El Balsamo and Monte Alto Brown Wares. Most sites whose area could be determined were on or near low mounds or rises. These sites ranged from 100 m² to 160,000 m² in area, with an average area of 12,400 m² (about 110 m by 110 m); only four sites were over 10,000

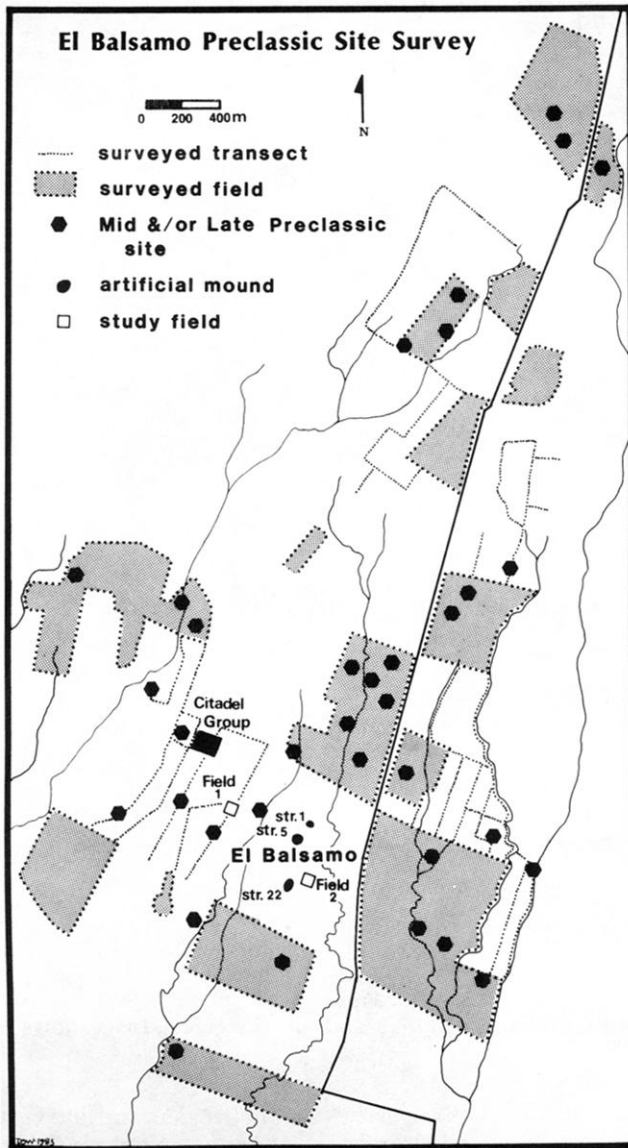


Figure 2
Preclassic site survey near El Balsamo and locations of Fields 1 and 2.

m² in area. The pattern appears to be one of dispersed habitation around the El Balsamo center, with some suggestion of more concentration nearer the center.

Stark's Residential Project, funded only as a preliminary investigation that would lay the groundwork for later, larger-scale work, sampled within two field areas relatively near the plaza, planning to follow out any features encountered. Locations near El Balsamo's center

were chosen because higher-status families might have been located nearer to the plaza, and they might have played a key role in controlling specialist production or processing long-distance goods (cf. Peebles and Kus 1977). In each of the two fields, a 60 m by 80 m area formed the sample universe in which a .2%, stratified (by quadrants), random sample of 1 m by 1 m test units was excavated, plus some adjacent squares. Field 1 (Figure 2) was

chosen for excavation because a modern drainage ditch revealed a buried ash layer there on which lay Preclassic sherds. This was a situation in which features might be readily identifiable. However, the ash surface proved to be quite localized, Preclassic material was sparse, and Field 1 ceramics appear to be mainly Classic Period in date (this ceramic assignment was provided by Marion Hatch). No definite features were located.

Field 2 (Figures 2 and 3), located immediately adjacent to the plaza on the east, contained abundant Preclassic material, as well as cobble constructions. Cobble facings occurred in some plaza mounds excavated by Clewlow; however, the constructions in Field 2 were of two other kinds: (1) linear alignments (fea-

tures 1a, 1b) and (2) a small cobble and earthen platform, perhaps 3 m by 5 m across and 1.15 m high (feature 2a). Three more deeply buried cobble concentrations encountered by test pits (features 1c, 1d, 1e), could have been cobble alignments also, but were not investigated enough to make certain because of heavy overburden. Varying amounts of cultural material formed lenslike concentrations in the deposits.

Field 2 sediments with cultural material were approximately 1.5 m deep (see Stark et al. 1981). The main strata were, from the top down: approximately 45 cm of friable black topsoil; approximately 79 cm of yellow-brown, fine sediment; and, usually, about 45 cm of a grayer, yellow-brown sediment. Below lay a yellow sed-

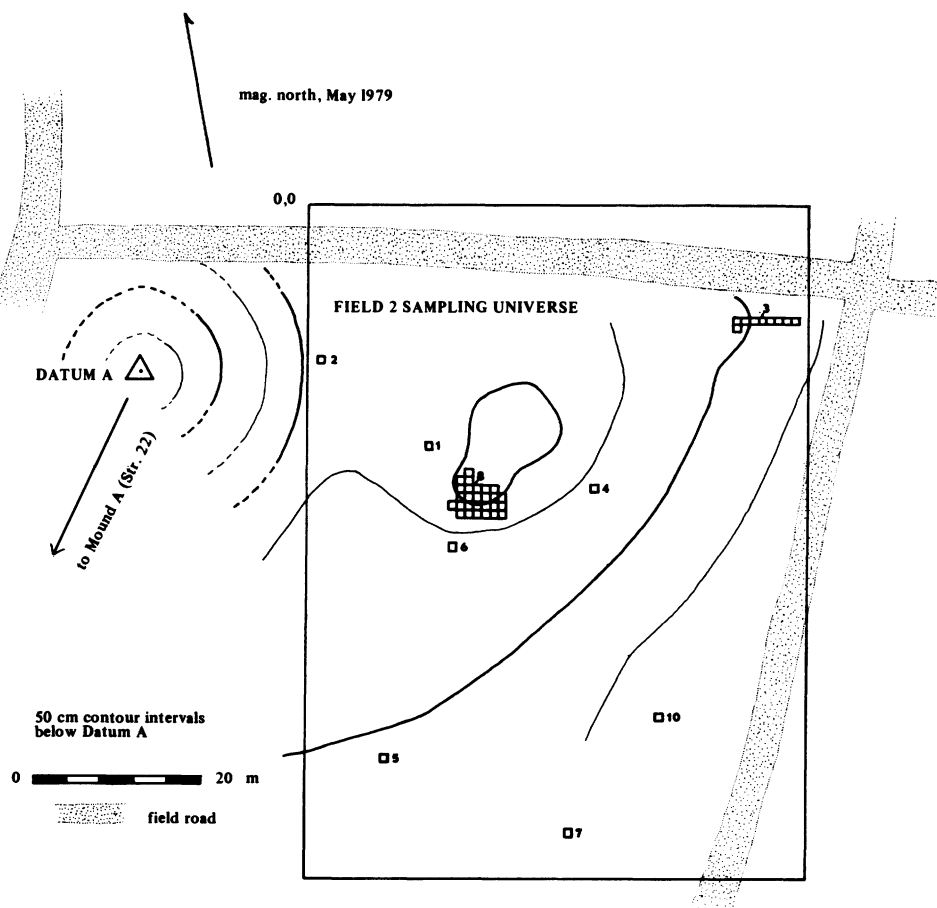


Figure 3
Field 2 excavation units.

iment, itself underlain by a decomposing yellow sandstone; the yellow sediment was sterile except for a rare sherd in the uppermost levels.

Several factors may have contributed to the accumulation of Field 2 deposits. Fine, airborne volcanic ash reaches the area (for example, it accumulated on our plane table map as we worked). Volcanoes visible on the horizon are Fuego (smoking), Agua (historically active), and Pacaya. However, seasonal rains would erode exposed sediments, and the balance of these processes is uncertain. More obviously, cultural factors have played a role—architectural and cultural remains have accumulated in Field 2, especially, we think, from habitations and associated trash.

Cobble alignments we interpret as foundations for perishable walls, a con-

struction method used occasionally today in the area. Feature 1a formed a small rectangular cobble outline open on the east side (Figure 4), interpreted as a room. No adjacent alignments were encountered on the east, south, or west, but we did not extend our excavations far enough north to rule out contiguous room(s). Feature 1b was a longer cobble alignment, and we did not succeed in defining its limits and form (Figure 5). Field 2 might have had completely perishable structures; we encountered very few features there. Higher density trash lenses in the strata suggest activities not marked by cobble constructions.

The feature 2a platform had a cobble and earthen fill, presumably from the near vicinity. The other Field 2 situation possibly involving fill could have been subsequent enlargement (burial) of fea-

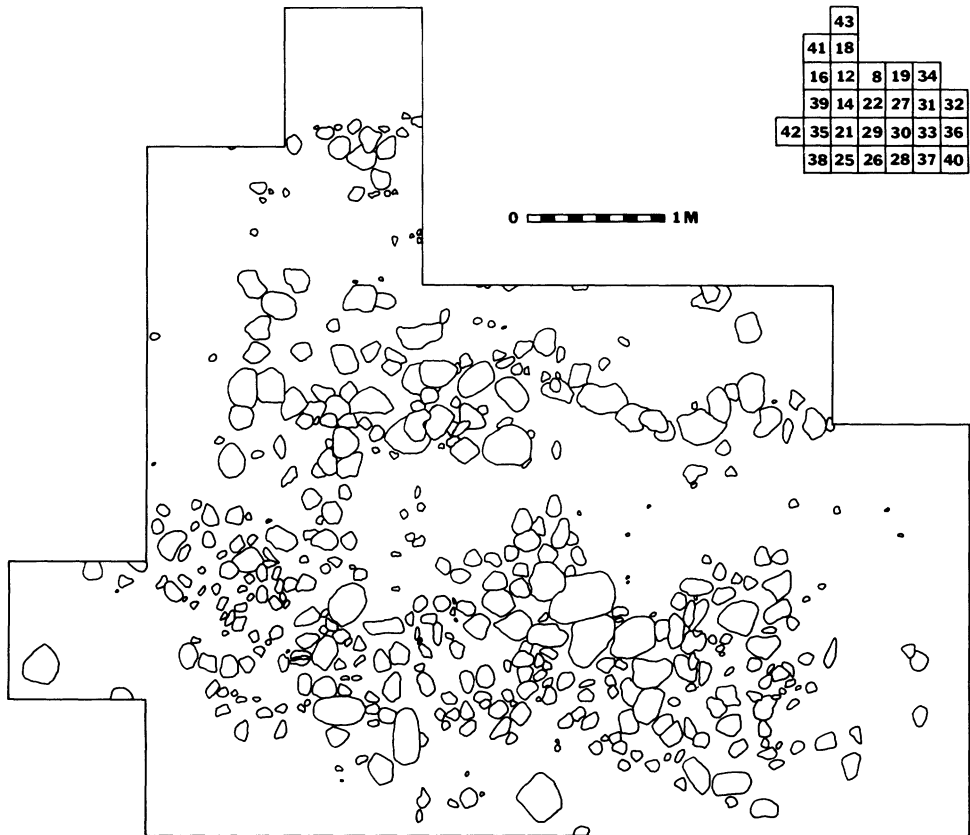


Figure 4
Feature 1a, cobble footings. Inset gives square numbers.

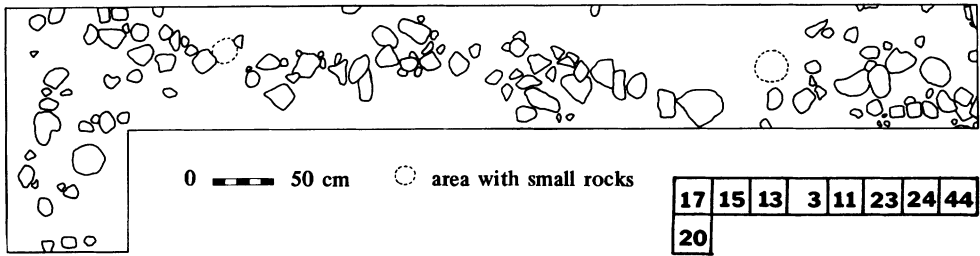


Figure 5
Feature 1b, cobble footings. Inset gives square numbers.

ture 2a. The cobble room alignment of feature 1a is superimposed on 2a, but 2a does not seem to have been constructed to support the later room because the cobble room alignments extend past the limits of the platform.

Whether Field 2 was disturbed by construction of the artificial plaza mounds is uncertain. The source of mound fill for the El Bálsamo plaza constructions is unknown, although Shook's map suggests one possible source area immediately west of the center where the terrain is lower and subject to seasonal drainage.

Further stratigraphic information from El Bálsamo is particularly needed because there is disagreement among scholars about the temporal duration of some of the pottery types recovered in our excavations. El Bálsamo Brown and Monte Alto Brown have been viewed as predominantly sequential (Shook and Hatch 1978), but because of their association in all of our excavation proveniences, we have viewed them as also overlapping in time. (Decorative motifs are key distinguishing attributes.) The chronology of El Bálsamo is of particular interest because it bears on the question of political stability and site hierarchies in the region. It is appropriate to consider El Bálsamo chronology next, followed by our observations concerning ecofacts and the artifact record (lithics and pottery).

Chronology

Shook (Shook and Hatch 1978:1) obtained a relatively early radiocarbon date of $2,975 \pm 95$ radiocarbon years (1025 B.C. uncorrected) from Mound 1 fill.

Shook and Hatch (1978) considered the pottery in the fill to both mixed and transitional because it contained what they considered to be a developmental continuum: Cuadros-Jocotal-related pottery (Coastal Undifferentiated category), El Bálsamo Brown Ware, and Monte Alto Brown Ware. However, Clewlow's mound excavations and our Field 2 investigations provide ceramic evidence of occupation and mound building at a later date than the radiocarbon assay.

The mounds and Field 2 strata contained some pottery that can be cross-dated at Kaminaljuyú (Wetherington 1978a,b), Chalchuapa (Sharer 1978), and Santa Leticia (Demarest 1981) to the Late Preclassic (500–200 B.C.) or later. Monte Alto Brown Ware is thought to date to this period on the basis of extensive excavations at Monte Alto (Shook and Hatch 1978). The unresolved dating issue is whether El Bálsamo Brown Ware completely precedes or partly overlaps Monte Alto Brown Ware. Cross-dating outside the Escuintla area does not resolve this problem because both appear to be local wares; their decorative motifs are particularly characteristic of the Escuintla coast. A related plastic decoration complex occurs on brown ware at Izapa, but only the earlier Duende phase, 850–650 B.C., has been fully published (Ekholm 1969). There appears to be even more motif correspondence with the Escalon Phase, 650–450 B.C., at Izapa (Lowe, Lee, and Martinez 1982:127–129), but this pottery complex is not yet described (see Stark and Heller [1982] for additional discussion of ceramic cross-dating at El Bálsamo).

In any case, the coast-related pottery seems to indicate that El Bálsamo was occupied in the Middle Preclassic, but as yet there is no conclusive evidence of mound construction associated with this earlier occupation. All or a considerable amount of the mound construction at the site occurred in the Late Preclassic, the time during which Field 2 occupation occurred. El Bálsamo thus may have overlapped in time as a center with Monte Alto (Parsons 1976).

Subsistence

Preservation of flora and fauna was extremely poor in the Field 2 excavated areas. Trial pollen analyses were generally unproductive, although Stewart (1981) demonstrated that some montane pollen rain reached El Bálsamo, which adds a complicating factor for any future pollen studies in other parts of the site. No identifiable plant or animal macrofossils were found. Water screening of selected sediments near features was unproductive.

Pearsall examined some of the soil samples originally collected for pollen study to see if phytolith analysis would prove useful. Phytoliths were well preserved and represented an abundance of grass and herbaceous dicotyledons. Possible maize phytoliths were observed, and additional surface control samples were then obtained to investigate whether modern sugarcane, currently grown over most of the El Bálsamo site, produces phytoliths that can be distinguished from maize. Pearsall established that cane phytoliths can be detected, and there remains some evidence for maize in the trial samples. However, the maize identification is still tentative because local wild grasses have not yet been analyzed for phytolith characteristics.

Maize processing was probably the original function of the manos and metates found at El Bálsamo. The two metate fragments from Field 2 were associated with (and probably reused in) cobble constructions. One was associated with the room outline (feature 1a) and the other with a deeply buried cobble concentration (feature 1e). Of the four mano

fragments, two also were associated with these same features.

Other ground stone artifacts were infrequent. From the Field 2 surface came a rounded basalt mortar and a perforated "doughnut" stone fragment. The latter artifact is of uncertain function—one suggested use is as a digging stick weight (see review in Willey 1972:136–137). Stratified deposits also produced a bark beater.

Fiber spinning is another possible activity indicated by Field 2 artifacts. Perforated worked sherd disks found there might have been used as spindle weights, as has been discussed for the Maya area (Willey 1972; Large 1975). Specially manufactured ceramic spindle whorls were encountered as well. The latter are not usually regarded as Preclassic artifacts, but their Field 2 distribution is similar to that of the perforated worked sherd disks, and there was no proportionate component of later ceramics accompanying them (whorls tend to be associated with feature 1a; disks also appear to be associated with features (1a and 2a) but not so strongly, since three of the seven disks were found in nonfeature deposits [Stark et al. 1981]). Both whorl and disk diameters tend to fall between those of Parson's (1972) Type I and II whorls, which she suggests may have been used with maguey fiber, and her Type III whorls, which were probably used for cotton.

Imports

The most productive area of investigation at El Bálsamo was in analysis of imported products and long-distance economic and/or social relations. Obsidian, imported from the Guatemalan highlands, was the only material in Field 2 used for chipped stone tools. A preliminary sample of 12 pieces from Field 2 has been analyzed by Nelson using x-ray fluorescence. The source areas were El Chayal and San Martín Jilotepeque, which were also the source areas for obsidian from Mound B fill analyzed previously by Sidrys and Kimberlin (1979). The Field 2 sourcing was for a bipolar industry, whereas Sidrys and Kimberlin sourced prismatic blades.

Obsidian remains (1,746 pieces) from

Field 2 represent two different technologies: (1) blade production from prismatic cores and (2) percussion and bipolar knapping, apparently to produce flakes. Because Field 2 domestic trash included obsidian blades and flakes, we could not rigorously distinguish strictly production debris from domestic trash. Indeed, knapping may have taken place in and around residences.

Cortex frequency on pieces related to the blade industry was very low (1.9%, 19 cortex-bearing pieces), suggesting importation of preformed cores (Sheets 1978a:42; 1978b:9). Firm knapping indicators (cores, core fragments, ridge blades, 9 pieces) are too infrequent for identification of production locations, although all but one such specimens were found in association with cobble features.

The bipolar industry, first identified by Suzanne Lewenstein (Arizona State University), has been analyzed by Heller. It seems to have been used to produce flakes with usable cutting edges. The cortex frequency is higher for this industry (9.3%, 33 pieces). Nuclei seem to have been small originally, and there is some evidence for application of the bipolar technique to exhausted prismatic cores, perhaps as a measure to more fully utilize raw material.

Potential bipolar production debris (cores, shatter, approximately 180 pieces), was concentrated in the fill of the feature 2a cobble and earth platform and especially in the deposits outside and around the platform; flakes also occur more densely in and around the platform (Stark and Heller 1981). Thus, there is a strong likelihood that bipolar processing occurred near feature 2a. The bipolar industry was not observed in earlier El Bál-samo projects, but this apparent contrast probably is not meaningful. All of our Field 2 material was screened with quarter-inch mesh, but material from earlier projects was not, and thus the evidence may have been lost. Also, many Mesoamericanists are unfamiliar with bipolar technology—we mistook it for other debitage originally.

Sidrys and Kimberlin (1979) and Nelson (1981) have discussed possible implications of changing Guatemalan obsidian

source areas. Growing use of El Chayal obsidian in the Late Terminal Preclassic on the Escuintlan coast could have been related to the growing importance of Kaminaljuyú in the Valley of Guatemala (Sidrys and Kimberlin 1979). Kaminaljuyú is thought to have controlled El Chayal obsidian export (Michels 1979). Nelson (1981) has reviewed evidence that in the Late Preclassic, El Chayal obsidian, which he suggests had been moving through the Pacific coast lowlands and then across the Isthmus to San Lorenzo, was shunted to the Maya lowlands.

Besides obsidian, some pottery vessels appear to have been imported from the highlands. Bishop is currently comparing a sample of El Bál-samo pottery to Kaminaljuyú and El Salvadoran pottery using neutron activation analysis. A similar analysis of pottery from Santa Leticia (Demarest 1981) and Chalchuapa (Sharer 1978) indicated that although several kinds of pottery with distinctive decoration and surface finish closely resemble wares at Kaminaljuyú, in most cases the pottery is locally produced in El Salvador (Demarest 1981; Demarest, Sharer, and Bishop 1981). Demarest and Sharer (Demarest 1981) have proposed that the western Salvadoran upland valleys, the Valley of Guatemala, and Pacific coastal Escuintla were part of a ceramic "sphere" in the Late Preclassic.

However, El Bál-samo data differ from those of Salvadoran sites in the greater amount of movement of highland pottery they imply, especially of the distinctive Sacatepequez White Paste White Ware. When the concentration data for the rare earths and transition elements are considered—those less susceptible to significant variation engendered by volcanically derived inclusions in the pastes—the White Wares from Kaminaljuyú constitute a well-defined reference group (cf., Bishop, Rands, and Holley 1982:302). Using the interelemental correlation information contained in the Kaminaljuyú reference group, calculation of group membership probabilities for the El Bál-samo samples suggests a common source of manufacture. A similar finding is obtained for the White Wares from Monte Alto. Analogously, matching compositions have been

found for analyzed samples of Canchon Fine Incised ceramics from Kaminaljuyú, El Bálsamo, and Monte Alto (Wetherington's [1978b] Verbena Black-Brown Fine Incised). A report on the neutron activation analysis program involving highland and Pacific coast clays and pottery will be prepared in the near future.

As has been pointed out previously (Stark 1981; Stark and Heller 1982), regardless of the balance of importation versus imitation, there was at least close communication between the Pacific coast and highland Guatemala. This is evident in similar kinds of decorated, low-frequency pottery. Close correspondence is not indicated by the coarser, more plentiful "utilitarian" wares. Therefore, it appears that there were both local and extralocal spheres of communication and/or production and distribution.

Two other lines of investigation at El Bálsamo compared the most numerous of the possibly extralocal pottery categories, Sacatepequez White Paste White Ware (SAWH), with possibly local wares, such as El Bálsamo-Monte Alto Brown and Miscellaneous Orange. SAWH apparently had about the same percentage of bowls as did the supposedly local pottery. Nor did SAWH bowls appear to be smaller. Hence, there is no indication that vessels of this type were of more readily transported shapes or sizes (Stark and Heller 1982). However, use of the Shannon-Weaver index of diversity and a significance test developed by Hutcheson (1970) suggests that SAWH is significantly less diverse in lip forms than the local brown wares (alpha equal to .01; Stark and Heller 1982). The greater degree of standardization in lip forms could indicate more specialized production for trade in SAWH. However, neither the examination of vessel forms and sizes nor the diversity analysis are definitive. The vessel form determinations need to be evaluated with more complete vessel information, and in any case the links between standardization and specialization are complex.

To summarize, there are highland imports at El Bálsamo. Imported obsidian seems to have been particularly impor-

tant since it provided all the chipped stone cutting edges. Still uncertain is the extent to which low-frequency pottery represents imports rather than local wares made in imitation of styles found elsewhere. As yet we have no clear evidence of exchanges *within* the Pacific lowlands involving solely lowland products, but this may reflect the combined effects of poor organic preservation and a lack of information about intraregional variation in pottery. Demarest (1981:354) has suggested that some Salvadoran Preclassic pottery may have been exchanged locally among centers there, and it would not be surprising to discover such evidence on the Pacific coast. Some exchange of imported materials among Pacific lowland centers is suggested by Bove's (1981) evidence of variation in amounts and kinds of obsidian artifacts, and he proposes that Los Cerritos was a nodal center controlling movement of obsidian reaching the coast from the highlands.

Control of coast-highland exchange was perhaps one of the important factors contributing to the growth of political hierarchies. However, it appears that highland-lowland economic complementarity and long-distance exchange are not the only factors likely to have played a role in shaping sociopolitical development. The reason is that western Salvadoran ceramic data indicate participation in a communication system with the Guatemalan highlands that affected low-frequency wares, (Demarest, Sharer, and Bishop 1981), yet environmental complementarity between those two areas is less apparent. In particular, the Ixtepeque source seems to have supplied obsidian primarily to the Salvadoran sites (Demarest 1981). Should low-frequency pottery vessels prove to have been status markers, it seems likely that we will have to consider political and social factors that could entail elite communications and relations among centers. Marital and other alliances tied to status aggrandizement, for example, could have resulted in a network of elite contacts.

Discussion

The present archeological evidence suggests that a complex web of economic

(and political) relationships may have been in effect during the Late Preclassic period on the Escuintla coast. The dual sources of obsidian—El Chayal and San Martín Jilotepeque—indicate economic interactions with at least two distinct areas, geographically fairly close to one another but apparently falling within different spheres of political control (Michels 1979). Diverse origins and/or contacts are also suggested within the El Balsamo ceramic assemblage, but this does not necessarily imply a direct relationship between the spheres of exchange of pottery and obsidian. If, as we suspect, the Late Preclassic and Terminal Preclassic periods were a time when a number of independent (relatively) small polities existed on the Pacific coast and in the highlands, then multiple nonlocal commodities with diverse origins may indicate complex and perhaps shifting political and economic arrangements.

Since both Monte Alto and El Balsamo seem to have functioned as centers in the Late Preclassic, one question is whether there was a hierarchical, sequential, or competitive relation between them. They are within 10 km of each other. The greater number and size of carved monuments from Monte Alto (principally boulder “pot-bellies”) suggest it may have been a more important place; however, it has been pointed out that developing social hierarchies in the Escuintlan area may have been highly competitive, and perhaps individual centers did not function as key political nodes for lengthy spans of time (Stark and Heller 1982). If, for example, we were to interpret the pot-belly boulder sculptures, which often show individuals with closed eyes, as analogous to the danzante “conquest gallery” at Monte Albán, then there would be some iconographic confirmation of a competitive political situation. But considering the coarse-grained ceramic chronology, we have no guarantee that nearby sites such as El Balsamo and Monte Alto were actually contemporaneous or hierarchically related as political centers (as distinct from population nodes). At present, ceramic sequences are not sufficiently precise to discriminate whether any centers could reflect political upgees

of, say, only 100 or 200 years, which would not be unreasonable if competitive and shifting political relations were characteristic.

Escuintlan economic data suggest the importance of local, regional, and interregional scale exchanges, and we are beginning to identify some of the diversity and complexity of the exchange record. In addition, there is already reason to suspect that control of long-distance exchange alone will not suffice to explain sociopolitical developments on the Escuintlan coast.

Acknowledgments. The El Balsamo Residential Project was supported by the Joint Committee on Latin American Studies of the Social Science Research Council and the American Council of Learned Societies with funds provided by the National Endowment for the Humanities, the Mellon Foundation, and the Ford Foundation. Supplemental assistance was provided by an A.S.U. Faculty Grant-in-Aid and by the College of Liberal Arts, A.S.U. Laboratory facilities were generously provided by the Centro de Investigaciones Regionales de Mesoamérica. We gratefully acknowledge the many helpful suggestions and contributions of numerous colleagues and students in the course of the analysis and the kind hospitality of Sr. Julio Herrera and his associates during the fieldwork.

References Cited

- Bishop, Ronald L., Robert L. Rands, and George R. Holley
1982 Ceramic Compositional Analysis in Archaeological Perspective. *In* *Advances in Archaeological Method and Theory*, Vol. 5. Michael B. Schiffer, ed. Pp. 275–331. New York: Academic Press.
- Blanton, Richard E., Stephen A. Kowalewski, Gary Feinman, and Jill Appel
1981 *Ancient Mesoamerica*. Cambridge: Cambridge University Press.
- Bove, Frederick J.
1981 *The Evolution of Chiefdoms and States on the Pacific Slope of Guatemala*. Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.
- Coe, Michael D.
1961 Social Typology and the Tropical Forest Civilizations. *Comparative Studies in Society and History* 4:65–85.
1974 Photogrammetry and the Ecology of Olmec Civilization. *In* *Aerial Photography in Anthropological Field Research*.

- E. Z. Vogt, ed. Pp. 10–13. Cambridge, MA: Harvard University Press.
- Culbert, T. Patrick
1974 *The Lost Civilization: The Story of the Classic Maya*. New York: Harper & Row.
- Demarest, Arthur A.
1981 *Santa Leticia and the Development of Complex Society in Southeastern Mesoamerica*. Ph.D. dissertation, Department of Anthropology, Harvard University.
- Demarest, Arthur A., Robert Sharer, and Ronald Bishop
1981 *A Late Preclassic Interregional Pattern and Its Implication for the Development of Complex Society in Southeastern Mesoamerica*. Paper presented at the 46th Annual Meeting, Society for American Archaeology, San Diego.
- Ekhholm, Susanna M.
1969 *Mound 30a and the Early Preclassic Ceramic Sequence of Izapa, Chiapas, Mexico*. Papers of the New World Archaeological Foundation, Vol. 25.
- Freidel, David A.
1978 *Maritime Adaptation and the Rise of Maya Civilization*. In *Prehistoric Coastal Adaptations: The Economy of Maritime Middle America*. B. L. Stark and B. Voorhies, eds. Pp. 239–265. New York: Academic Press.
- Hutcheson, K.
1970 *A Test Comparing Diversities Based on the Shannon Formula*. *Journal of Theoretical Biology* 29:151–154.
- Kuenzi, W. David, Oscar H. Horst, and Richard V. McGehee
1979 *Effect of Volcanic Activity on the Fluvial-deltaic Sedimentation in a Modern Arc-trench Gap, Southwestern Guatemala*. *Geological Society of America Bulletin* 90:827–838.
- Large, Elinor
1975 *Cotton: A Basic Resource for the Classic Maya of the Southern Lowlands?* Paper presented at the annual meeting of the American Anthropological Society, San Francisco.
- Lowe, Gareth W., Thomas A. Lee, Jr., and Eduardo Martinez Espinosa
1982 *Izapa: An Introduction to the Ruins and Monuments*. Papers of the New World Archaeological Foundation 31.
- Michels, Joseph W.
1979 *The Kaminaljuyu Chiefdom*. University Park: Pennsylvania State University Press.
- Nelson, Fred W.
1981 *Obsidian Exchange Networks in the Maya Lowlands*. Manuscript.
- Parsons, Lee A.
1976 *Excavation of Monte Alto, Escuintla, Guatemala*. National Geographic Society Research Reports, 1968 Projects. Pp. 325–332. Washington, DC: National Geographic Society.
- Parsons, Lee A., and Barbara J. Price
1971 *Mesoamerican Trade and Its Role in the Emergence of Civilization*. In *Observations on the Emergence of Civilization in Mesoamerica*. Robert F. Heizer and John A. Graham, eds. Pp. 169–195. Contributions of the University of California Archaeological Research Facility, No. 11.
- Parsons, Mary H.
1972 *Spindle Whorls from the Teotihuacan Valley in Mexico*. In *Miscellaneous Studies in Mexican Prehistory*. Museum of Anthropology, University of Michigan, Anthropological Papers, Vol. 34. Pp. 45–80.
- Peebles, Christopher S., and Susan M. Kus
1977 *Some Archaeological Correlates of Ranked Societies*. *American Antiquity* 42:64–86.
- Rathje, William L.
1971 *The Origin and Development of Lowland Classic Maya Civilization*. *American Antiquity* 36:275–285.
1972 *Praise the Gods and Pass the Metates: A Hypothesis of Development of Lowland Rainforest Civilizations in Mesoamerica*. In *Contemporary Archaeology: A Guide to Theory and Contributions*. Mark P. Leone, ed. Pp. 365–449. Carbondale: Southern Illinois University Press.
- Sabloff, Jeremy A., and William L. Rathje
1975 *The Rise of a Maya Merchant Class*. *Scientific American* 233:72–82.
- Sharer, Robert J.
1978 *The Prehistory of Chalchuapa, El Salvador*. 3 vols. Philadelphia: University of Pennsylvania Press.
- Sheets, Payson D.
1978a *From Craftsman to Cog: Quantitative Views of Mesoamerican Lithic Technology*. In *Papers on the Economy and Architecture of the Ancient Maya*. Raymond Sidrys, ed. Pp. 40–71. University of California at Los Angeles, Institute of Archaeology, Monograph 8.
1978b *Part One: Artifacts*. In *The Prehistory of Chalchuapa*. Robert J. Sharer, ed. Pp. 2–131. Philadelphia: University of Pennsylvania Press.
- Shook, Edwin M., and Marion P. Hatch
1978 *The Ruins of El Bálsamo, Department of Escuintla, Guatemala*. *Journal of*

- New World Archaeology 3:1.
- 1981 Archeological Study of Monte Alto, Guatemala, and Preclassic Cultures on the Pacific Coast, 1972–1977. *National Geographic Research Reports* 13:575–581.
- Sidrys, Raymond, and Jerome Kimberlin
1979 Use of Mayan Obsidian Sources Through Time: Trace-element Data from El Bálsamo, Guatemala. *Journal of Field Archaeology* 6:116–122.
- Stark, Barbara L.
1981 Pottery in Relation to Economy and Social Organization at El Bálsamo, Escuintla, Guatemala. XVII Mesa Redonda, Investigaciones Recientes en el Área Maya. *Sociedad Mexicana de Antropología*. In press.
- Stark, Barbara L., and Lynette Heller
1981 La Producción Residencial de Implementos Líticos. Paper presented at “Obsidian in Mesoamerica,” Centro Regional de Hidalgo, I.N.A.H., Pachuca, Hidalgo.
- 1982 Economic Organization and Social Context of a Preclassic Center on the Pacific Coast of Guatemala: El Bálsamo, Escuintla. In *Archaeology of the Pacific Coast and Highlands of Southern Mesoamerica*, Frederick J. Bove, ed. Manuscript.
- Stark, Barbara L., Ella Mae Stewart, Lynette Heller, Mary Hodge, John Lindly, and Leah Minc
1981 Informe Preliminar sobre Investigaciones de Zonas Habitacionales en El Bálsamo, Escuintla, Guatemala. *Antropología e Historia de Guatemala, Época II*, Vol. 3. Pp. 287–323.
- Stewart, Ella Mae
1981 Apéndice 1, Informe Sobre el Análisis Polínico de El Bálsamo, Guatemala. *Antropología e Historia de Guatemala, Época II*, Vol. 3. Pp. 309–312.
- Thompson, J. E. S.
1974 *Maya History and Religion*. Norman: University of Oklahoma Press.
- Tourtellot, G., and Jeremy A. Sabloff
1972 Exchange Systems Among the Ancient Maya. *American Antiquity* 37:126–135.
- Wetherington, Ronald K.
1978a The Ceramic Chronology of Kaminaljuyú. In *The Ceramics of Kaminaljuyú, Guatemala*. Ronald K. Wetherington, ed. Pp. 115–149. University Park: Pennsylvania State University Press.
1978b Descriptive Taxonomy of Kaminaljuyú Ceramics. In *The Ceramics of Kaminaljuyú, Guatemala*. Ronald K. Wetherington, ed. Pp. 51–114. University Park: Pennsylvania State University Press.
- Willey, Gordon R.
1972 The Artifacts of Altar de Sacrificios. *Papers of the Peabody Museum of Archaeology and Ethnology*, Vol. 64, No. 1. Cambridge: Peabody Museum, Harvard University.

Are Females the Ecological Sex?

STEVEN J. C. GAULIN
LEE DOUGLAS SAILER
Department of Anthropology
University of Pittsburgh

Sexual Selection Theory

Bateman argued that the force of sexual selection could be understood by comparing the amount of variance in male versus female reproductive success (Bateman 1948; Wade 1979). He suggested that differences in the material contribution of the two sexes to the production of the next generation yield sex differences in potential fertility and, hence, differential opportunities for males and females to maximize reproductive success. For example, whenever females make a larger material contribution to the production of offspring than do males (the typical case among mammals), a female's reproductive success is limited by the amount she can *contribute to offspring*. However, a male's reproductive success is primarily limited by the *number of females* he can induce to make contributions to his offspring, rather than by the size of his own small contribution. Trivers (1972) subsequently generalized Bateman's analysis, introducing the notion of parental investment as the appropriate measure of material contribution, and suggesting the kinds of morphological, physiological, and behavioral sex differences that are expected to evolve under unequal parental investment regimes.