REPORTS

ARCHAIC BLADE PRODUCTION ON ANTIGUA, WEST INDIES

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Antigua has substantially more preceramic sites than any other island in the Lesser Antilles. Archaic peoples made extensive use of the high-quality flint that is common on Antigua to produce industries dominated by unretouched flakes and blades. Analysis of the largest excavated Archaic assemblage from the island reveals that flaked-stone technology centered around the production of direct-percussion blades, and that the majority of other flake classes are by-products of blade production. The assemblage's five major morphological classes of blades appear to represent successive stages of core reduction.

Antigua tiene muchos más sitios precerámicos que ninguna otra isla en las Antillas Menores. Poblaciones arcaicas utilizaron extensivamente el silex de alta calidad que es común en Antigua para producir industrias dominadas por lascas y láminas sin retoque. Análisis de la colección arcaica más grande que se ha excavado en la isla revela que la tecnología de silex envuelve principalmente la producción de hojas hechas por percusión directa, y que la mayoría de otras clases de hojuelas son productos secundarios de la producción de hojas. Las cinco clases morfológicos de la colección parecen representar etapas sucesivas de la reducción de núcleos.

Sometime between the seventh and the fifth millenia B.C., groups of Archaic fisher–foragers moved northward from the continental island of Trinidad to colonize the oceanic archipelago of the West Indies (Rouse 1986; Rouse and Allaire 1978). This movement of peoples introduced into the islands a basic cultural pattern that persisted until the arrival of ceramic-using horticulturists from the South American coast during the last few centuries B.C. Although the existence of Archaic cultural remains in the West Indies has been known for decades, excavation reports have been infrequent, and systematic study of the assemblages has been limited. Most of the published investigations of Archaic assemblage composition have focused upon the Greater Antilles and have yielded little information about the interrelation among the preceramic occupations of the various parts of the West Indian archipelago (e.g., Cruxent and Rouse 1969; Figueredo 1976; Kozlowski 1978; Lundberg 1991; Moore 1982; Pantel 1983; Veloz Maggiolo and Ortega 1973). Information has been particularly sparse for the Lesser Antilles, where currently available radiocarbon dates place the first Archaic occupation at late in the fourth millenium B.C. Published studies of preceramic flaked-stone industries from the Lesser Antilles have been very limited in both number and scope (e.g., Armstrong 1978; Bullen and Sleight 1963; Davis 1974; Hackenberger 1991; Harris 1973; Nicholson 1976). Indeed, for the islands between Trinidad and the Virgin Islands, we have no published, detailed study of any of the several excavated preceramic assemblages.

Thus, there remain fundamental unanswered questions about historical relationships among the Archaic groups of the West Indies. Documentation of interassemblage similarities and differences has been constrained by the absence of a standard typological scheme in the region, by raw-material differences among flaked-stone assemblages, and often by the lack of clearly defined artifact classes in published reports. Detailed quantitative data are rare, and efforts at comparison have employed classifications of flaked-stone artifacts based upon gross morphology rather than upon the processes of artifact manufacture that are responsible for the composition of stone-tool assemblages. Investigation of a large Archaic flaked-stone assemblage from Antigua, in the Outer Leeward Islands,

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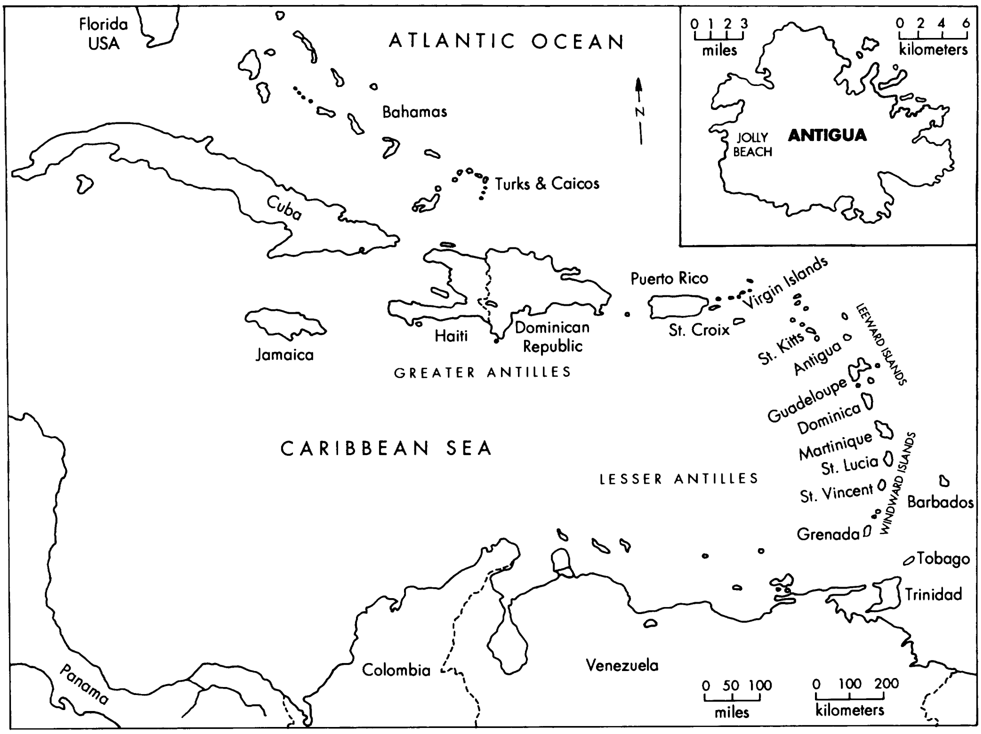

Figure 1. The eastern Caribbean.

indicates that an appreciation of flaked-stone reduction processes may shed important light on variability among Archaic assemblages in the region and contribute to a clearer understanding of developmental relationships among them.

The largest of the preceramic assemblages from the Lesser Antilles was excavated by me in 1973 at Jolly Beach, a single-component shell midden located near the eastern coast of Antigua (Figure 1). The general characteristics of the Jolly Beach assemblage have been described in publications that were focused on other aspects of the site (Davis 1974, 1982). Although this flaked-stone industry is dominated by unretouched artifacts that are highly variable in morphology, it possesses a quite definite typological *structure*. Indeed, most of the major identifiable classes of flaked-stone artifacts at Jolly Beach represent stages in one reduction sequence. Delineation of the reduction sequence reveals that flaked-stone technology at Jolly Beach centered around the production of direct-percussion blades. Although blades represent less than 15 percent of flaked artifacts in the assemblage, a substantial majority of the other flaked artifacts were produced at some stage of the process that led to blade manufacture. Reduction analysis also indicates that the morphology of different blade classes is related to the manufacturing stage at which the blades were produced.

JOLLY BEACH AND THE ARCHAIC OF ANTIGUA

Antigua, the southernmost of the Outer Leeward Islands of the Lesser Antilles, is located in the eastern Caribbean some 418 km southeast of Puerto Rico (Figure 1). Like the other Outer Leewards, the surface geology of Antigua is dominated by limestone, which provides a low rolling topography over the northern two-thirds of the island. This pattern is interrupted in the southern portion of Antigua by volcanics, which appear as tuffs in the southeast and as (primarily fine-grained) magmatic rocks in the southwest, around the extinct volcano of Boggy Peak.

Nodules of marine flint are common in the limestone parts of the island. Although the major concentrations have not been studied systematically, there are indications that the dominant colors

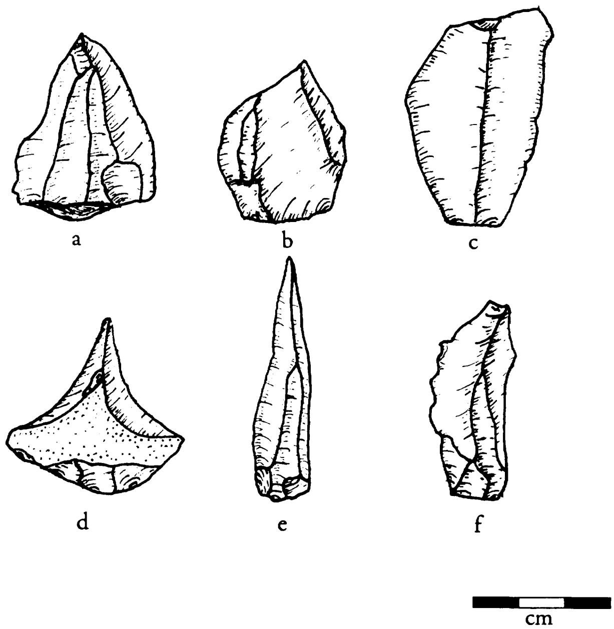

Figure 2. Assorted flaked-stone artifacts from Jolly Beach: (*a*) core; (*b–c*) flakes; (*d*) bec; (*e*) pyramidal blade; (*f*) aggregate blade.

vary among different areas of the island. In any case, flint on Antigua is generally of high quality and is readily available in the parts of the island where Archaic sites are concentrated. Nodules weighing 10 kg or more are not unusual.

The Jolly Beach site typifies a pattern of Archaic settlement on Antigua that is marked by a preference for shallow marine resources (Davis 1974, 1982; Nodine 1990). The site is a shell midden, situated at an elevation of about three meters in a "saddle" between two low hills some 150 m inland from the sea. Over half of the original surface area of about 3,000 square meters (most of which was still intact at the time of excavation in 1973) was destroyed or disturbed by house and road construction during the 1980s.

The 1973 excavations exposed a total of 52 square meters of the site, revealing a largely undifferentiated shell midden with depths ranging between 31 and 46 cm. The overwhelming majority of the recovered shellfish were shallow marine species, mostly associated with either mangroves, shallow rocky bottoms, or reefs (Davis 1982). The diversity of shellfish and of other macrofaunal remains, the presence of ash lenses, and the existence of post molds at the bottom of the midden strongly suggest that the site contains general habitation refuse. Although the excavated assemblage included a small number of well-made ground-stone and ground-shell artifacts, over 99 percent of the 14,800 objects of human manufacture recovered in my excavations were flaked stone, and virtually all of these were flint. A charcoal sample from the bottom of the midden yielded a radiocarbon date of 3725 ± 90 B.P. (Davis 1982). Nodine (1990) reports a calibrated radiocarbon date on shell (*Codakia orbicularis*) of 1589 B.C. from a 1-m test excavation that he conducted at Jolly Beach in 1988 (statistical range not reported). Dates obtained by Nodine for other Archaic sites on the island indicate that the broader Archaic occupation of Antigua ranged from at least as early as 2800 B.C. until the arrival of ceramic-using Saladoid peoples during the end of the last millenium B.C. (Nodine 1990).

GENERAL CHARACTERISTICS OF THE FLAKED-STONE INDUSTRY

In light of the diverse usage of the word "artifact" in American archaeology, I should note that the term is here used in its broader sense to refer to objects known or believed to have been produced

Table 1. Frequencies and Mean Gross Morphological Characteristics of Whole Blades, Jolly Beach Site, Antigua, W.I.

Class	Number	%	Length (cm)	Width (cm)	Thickness (cm)
All whole blades	915	100.0	4.45	1.35	1.07
Initial blades	271	29.6	3.77	1.29	.86
Pyramidal blades	221	24.1	5.16	1.15	.80
Lenticular blades	101	11.1	5.68	1.97	.63
Aggregate blades	169	16.6	4.69	1.54	.92
Trapezoidal blades	17	1.9	3.50	1.21	1.10
Unclassified whole blades	153	16.7	-	-	-

or modified by human agency. Major morphological categories of artifacts in the Jolly Beach flaked-stone assemblage include cores, flakes, blades, and a variety of debitage (Figure 2). Most of these artifacts were produced by direct percussion. This is indicated by the predominance of pronounced Hertzian initiation (Cotterell and Kamminga 1987), noted on over 75 percent of all complete flakes and blades in all assemblage subsamples, and by the dimensions of the striking platforms. While pressure flaking clearly was not a central feature of the technology, the method of removal is in some cases difficult to ascertain; the possibility must be allowed that pressure flaking was used during core trimming, and possibly for the manufacture of some blades during an early stage of the reduction sequence (see discussion of initial blades, below). Finished tools and retouched artifacts of any kind are of very minor importance, representing less than .25 percent of the assemblage. Indeed, retouched flaked stone is restricted to a small number of scrapers (on both blades and flakes, but principally on the latter), an equally small number of burins on blades, and several becs or gravers on flakes. (Use of the term burin here refers to morphological features only, and is not intended to imply deliberate manufacture.)

Most of the pieces in the collection are either blue-gray or honey-colored marine flints, and the majority exhibit patination. In a very small number of cases the patina has been marginally removed during later retouching, indicating some degree of reuse during a later occupation. This evidence is, of course, compatible with the apparent separation of the two radiocarbon dates noted above.

Evidence for both soft- and hard-hammer percussion is present. Soft-hammer percussion is most clearly evident in the thinness, small striking platforms, and planar forms of certain primary blades. Materials available for this purpose were not extensive, but would have included various woods, manatee bone, shell (especially the queen conch, *Strombus gigas*), and even limestone. Decortication flakes and other core-trimming flakes exhibiting nodular cortex on the dorsal surfaces testify to on-site manufacture. At the same time, whole or largely whole flint nodules are absent and, indeed, utilization of the raw material was fairly complete, if rather inefficient (see below). Another indicator of thorough use of parent nodules is the size of expended or discarded cores, which rarely measure more than 6 cm in maximum dimension, and are thus close in length to the blades that are produced during the later stages of reduction (Table 1).

The discarded cores fall into two general categories. Blade cores, defined as discarded cores whose flake scars are primarily due to removal of blades, are roughly cylindrical (Figure 3c–d). The more completely expended blade cores are, of course, generally smaller than those which were discarded at earlier reduction stages due to mistakes or to flaws in the parent material. Moreover, discard of a core earlier in the reduction process typically produces a core exhibiting scars of both blades and flakes, reflecting the fact that the efficiency of blade yield increases in later reduction stages.

All other cores are, by strict definition, flake cores, though some almost certainly represent early stages of blade-core production. Flake cores are not readily subdivided, being highly variable in both gross morphology and size. In general, they are larger than blade cores, and often display remaining nodular cortex (Figure 3a–b).

At a general level, the bulk of the flaked stone represents three broad artifact categories: blades, a wide range of flakes with few apparent target forms, and angular debris. (I am following the standard definition of a blade as a flake whose length is greater than or equal to twice its maximum

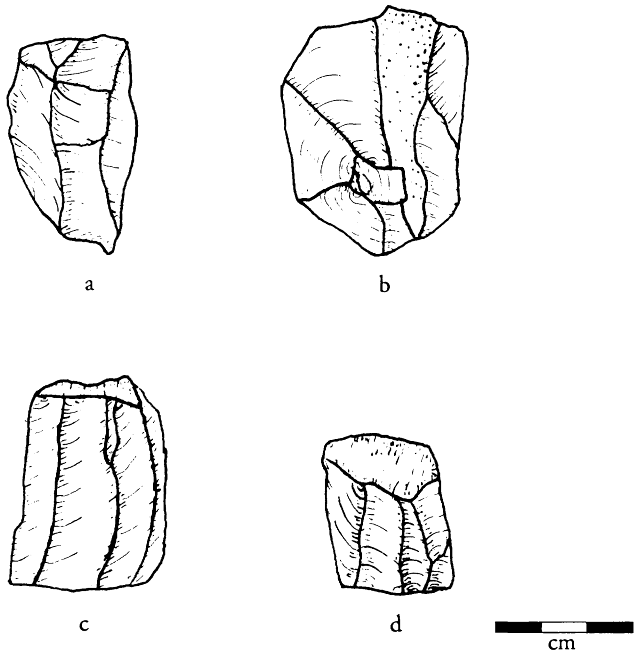

Figure 3. Cores from Jolly Beach: (*a–b*) flake cores; (*c–d*) blade cores.

width. On endstruck blades, the overwhelming majority of blades in this collection, length is measured from the center of the striking platform to the distal point on the piece, and width is measured at right angles to the axis of length.) In the context of the entire assemblage, whole blades are relatively few in number, constituting about 6.5 percent (n = 915) of the total flaked stone. Broken blades comprise another 17.7 percent (n = 2,490) of all flaked stone. Ninety-five percent of the blades range in length from 2.1 cm to 8.8 cm, with a mean of 4.45 cm, an average length/width ratio of 3.34, and an average length/thickness ratio of 4.74. However, length values are continuous within the range, and discrete size classes appear to be absent. Similarly, although several initiation and termination patterns are present in the blade collection, these features show no constant association with other morphological characteristics. Analyses of striking-platform dimensions also fail to reveal any significant correlation with the variables just described, apart from a general correlation between platform thickness and blade thickness. However, blade size does appear to be related to dorsal scar pattern, which in turn reflects the reduction stage at which the blade was removed (see Table 1), as will be discussed later.

Five classes of blades may be defined with reference to dorsal scar patterns. *Initial blades* (Figure 4a) are characterized by two small parallel longitudinal scars originating at a still smaller triangular scar just below the proximal end of the blade. *Pyramidal blades* (Figure 4c) are marked by either three or four dorsal scars that converge to create a crested or pyramidal form on the dorsal side of the blade. In virtually all cases, the point of convergence is closer to the distal than to the proximal end. *Lenticulate blades* (Figure 4b) are characterized by a single long dorsal scar, flat to lenticular in cross section, extending from the distal end of the piece well past the median, often to a point near the proximal end, where it terminates in a small, usually triangular, scar that is adjacent to the striking platform. The flattish lenticular scar is typically bordered by two long, narrow scars along each side. *Trapezoidal blades* (Figure 4d) are defined by their cross-sectional aspect, typically trapezoidal but occasionally almost square. Indeed, certain specimens might more accurately be called "rods," so little do they depart from a perfect square in cross section. Nevertheless, these are in the minority. In all cases, trapezoidal blades exhibit three parallel dorsal scars that taper little if at all toward the distal end of the artifact. It is difficult to imagine any practical use for an artifact

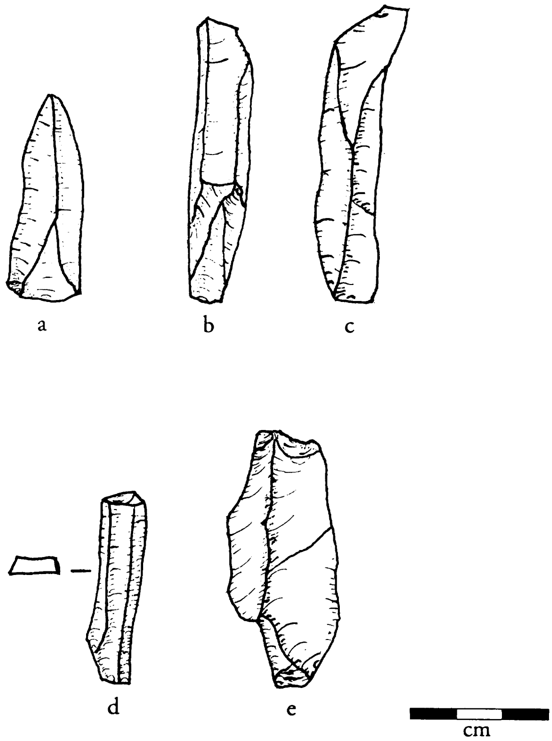

Figure 4. Blades from Jolly Beach: (*a*) initial blade; (*b*) lenticulate blade; (*c*) pyramidal blade; (*d*) trapezoidal blade; (*e*) aggregate blade.

of this shape; indeed, examination of the dorsal surface alone is suggestive of a fully expended blade core. However, the presence of a clear bulb of percussion on the ventral surface requires classification as a blade. A final class, which I call *aggregate blades* (Figure 4e) for want of a better term, is marked by as few as two and as many as six scars of previous blade and flake removals. These scars may be either parallel, convergent, or irregular in arrangement. While the category may appear to be a catchall, there is reason to believe that, like the other classes just defined, aggregate blades represent a specific stage of the reduction process.

Flakes exhibit more variability in plan form and platform dimensions than blades, probably because they were frequently incidental to the intended goals of the reduction sequence. This is not to say that flakes were never target forms at Jolly Beach. However, I have only been able to identify with confidence one target flake category, *semilunate flakes*. These are shaped as the name suggests and, as might be expected, are "sidestruck," and have long striking platforms. Although they typically exhibit macroscopic use wear along much of the distal edge, they are not retouched. It may also be noted that the majority of all flakes and blades show similar marginal evidence of use.

Three other broad classes of flakes, not target categories in themselves, are identifiable in the Jolly Beach assemblage. These are initial decortication flakes, other decortication flakes, and core-trimming flakes. Their characteristics, and the place of each within the blade production sequence, will be described later.

BLADE PRODUCTION AT JOLLY BEACH

The morphologies and frequencies of the various blade and flake classes defined above (Table 1), together with the characteristics of the remaining cores, indicate that the flaked-stone reduction sequence at Jolly Beach was focused primarily upon the production of direct-percussion blades.

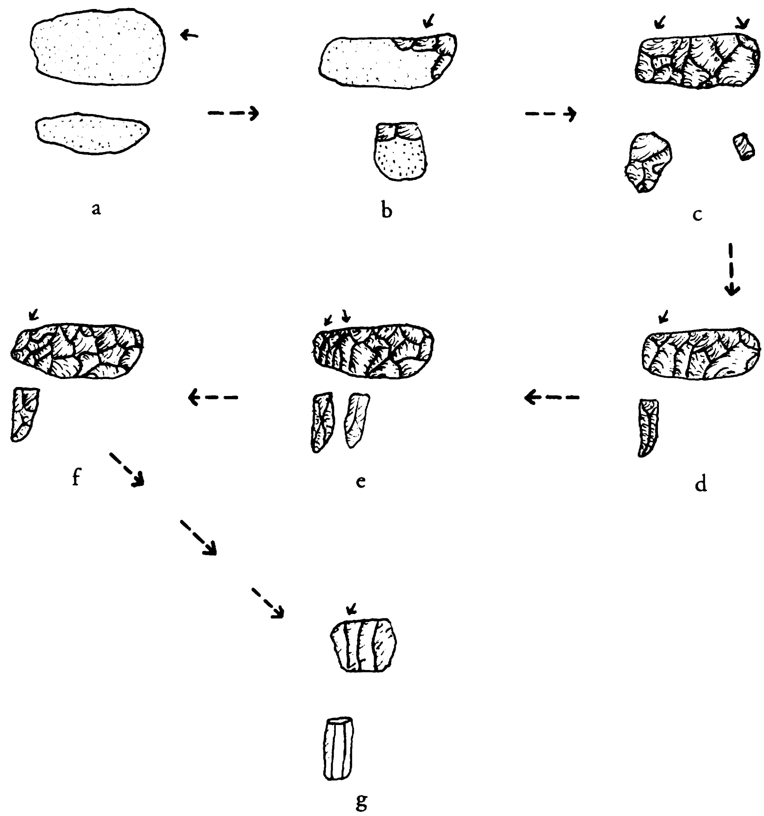

Figure 5. Model of the Jolly Beach blade-reduction sequence.

Although blades themselves comprise only a small part of the total assemblage, blades and the by-products of their manufacture together represent as much as 90 percent, if not more, of the collection.

Replicative studies have revealed that fabrication of direct-percussion blades may be accomplished effectively with a combination of hard and soft hammers. The former are used for initial core preparation, and probably for removal of blades and large flakes, while the latter are employed for finer aspects of core trimming, rejuvenation, and platform preparation. At Jolly Beach, the reduction process began with removal of an initial decortication flake from an elliptical nodule by use of an anvil and hard hammer. The resulting large semiconvex flake left a broad, flat striking platform at one end of the nodule (Figure 5a). It is likely that this procedure was applied to only one end of the nodule, as the ratio of initial decortication flakes to discarded cores is .95.

Although various irregular flakes may be removed at any point from this stage onward, secondary decortication flakes (Figure 5b) represent the next clearly identifiable step in the reduction process. These are more varied in form and thickness, and appear to have been produced entirely by hard hammers. Some number of irregular thick flakes lacking cortex would, of course, also have been produced during this reduction stage.

With most of the cortex removed from the nodule, it was possible to start shaping the core in preparation for blade removals. A combination of hard and soft hammers may have been employed during this stage, and the resulting flakes would have been highly variable in size and plan form (Figure 5c). Signs of previous blade removals would generally be absent from the dorsal surfaces of flakes from this reduction phase. It is possible to produce blades at this stage, although they would not have been common. Such blades are normally quite large and, like flakes from the same stage, show no dorsal evidence of previous blade removals.

The succeeding stage represents the beginnings of regular, deliberate blade production. The first blades removed at this step are here termed *initial blades* (Figure 5d). These blades are similar in dorsal characteristics and plan form to the "first-series blades" which were identified through replicative studies as the first pressure blades in the obsidian-reduction sequence at Tula, Mexico (Healan et al. 1983). In contrast to the first-series blades at Tula, most of the initial blades at Jolly Beach were made by direct percussion, while in the remainder the mode of initiation is indeterminate. Two lines of evidence indicate that initial blades were probably the first category of blades in the reduction sequence. First, these blades never extended along the full length of the core. This characteristic is consonant with removal at an immature stage of development of the core. Second, the scar pattern, as defined earlier, is a product of the removal of blades from a newly prepared core that lacks previous blade removals. Some *pyramidal blades* (Figure 5e) may represent the same stage, but it is clear that they are also among the products of trimming during the intermediate stages of blade production.

Lenticulate blades represent the "mature" stage of blade production, and the phase of greatest efficiency in blade removals. Their dorsal-scar patterns reflect previous successful removals of either first series or pyramidal blades, or of other lenticulates. This "mature" stage, as just indicated, actually involves production of both lenticulate and pyramidal forms.

Direct-percussion blade manufacture requires frequent trimming of the core, both to control overall shape and to prepare new striking surfaces for blade removals. The result of this effort is a large number of flakes of a wide variety of shapes. The "best" blades, in terms of conservation of material as well as straightsidedness, are the lenticulate forms. However, as the core nears the end of its utility, the costs of trimming (represented by loss of flakes and by the danger of irreparable damage to the core) become greater. It is at this stage, I hypothesize, that trimming is moderated to the minimum that is necessary to ensure further production. As a consequence, the products are somewhat thicker than the categories of blades discussed above (Table 1). The resulting targets are *aggregate blades* (Figure 5f).

The anticipated final product of this reduction sequence is an expended blade core, and indeed these are present in the Jolly Beach assemblage (Figure 3c–d). However, these are closely related to a final blade category, *trapezoidal blades* (Figure 5g), which are, in effect, mistakes. As was noted earlier, the obtuse edge angles of these artifacts make them functionally useless as blades. Their sizes and scar patterns strongly indicate that they are, in effect, mistakes—products of efforts to remove blades from a core that had become too small. The result was a longitudinal splitting of the core into two pieces, one of which, because it possesses a ventral surface and bulb of percussion, is technically classifiable as a blade.

In all blade classes, scar origination patterns strongly suggest that blade removal was predominantly bidirectional. For the late stages of the reduction process, this suggestion is reinforced by the shapes of trapezoidal blades and expended cores.

IMPLICATIONS FOR ASSEMBLAGE COMPOSITION

Lithic-assemblage composition must be understood first in terms of the target forms that dictated the processes and by-products of manufacture. Identification of such target forms is especially important in assemblages that are generally lacking in complex retouched artifacts. In the case of Jolly Beach, the principal target forms were blades. This conclusion is supported by several lines of evidence. First, dorsal surface characteristics make it clear that blades were produced from an early point in core reduction all the way through to the point of discard. Second, it is exceedingly unlikely that blades would have been produced in significant numbers by accident. Third, there are very few apparent modal morphological classes of flakes other than blades. Finally, it is clear that direct-percussion blade manufacture produces as by-products large numbers of flakes. The ratio of blades to irregular flakes in the Jolly Beach assemblage fits with expectations for an industry oriented around direct-percussion blade manufacture.

This is not to say that the flakes went unused, nor that all blades were utilized. Detailed consideration of microwear and other evidence of utilization is beyond the scope of this paper, but signs of utilization are clearly present on both blades and flakes, although they are more common on the former. Among flakes, use marks are especially common on semilunate forms.

Finally, while the notion of a "target form" makes a certain intuitive sense, it is best regarded as an analytical construct. As Rozen and Sullivan (1989:172) have noted, "one form may be produced by any one of many different sequences with substantially different characteristics." In the case of the Jolly Beach blade industry, target forms are identified by both standardization and by the low probability that the hypothesized targets would be produced in the observed frequencies accidentally or as by-products. However, target forms may be defined in other ways (see, for example, Baumler 1987, 1988; Ferring 1988), and even quantitatively well-documented modalities do not tell us what was in the mind of the prehistoric knapper.

CONCLUSIONS

Jolly Beach was the first excavated preceramic site in the Lesser Antilles between the Virgin Islands and Trinidad. More recent years have witnessed the excavation of several other Archaic components in these islands (Armstrong 1978, 1980; Nodine 1990). The historical relationships, as well as the continental origins, of these occupations, remain to be delineated. Obstacles to further understanding of such connections include a paucity of systematic study of lithic industries from coastal South America, raw-material differences that constrain interassemblage comparisons within the Lesser Antilles, and a poor understanding of the makeup of individual assemblages.

In the absence of substantial numbers of finished tools, comparisons of flaked-stone assemblages must rely largely upon an understanding of the manufacturing sequences and target forms that these assemblages represent. At Jolly Beach, the chipped-stone industry was focused primarily upon the production of direct-percussion blades. However, the inefficiency of this manufacturing technology yielded very large numbers of irregular flakes, most of them reflecting the need for virtually constant trimming of the core and modification of prospective striking platforms.

This information may stand as a backdrop for future investigations of interassemblage relations in the West Indian Archaic. Yet such comparative research will probably await the excavation of much larger samples than are currently available from most sites in the Lesser Antilles. If the ratio of blades to by-products at Jolly Beach is any indication, small test pits may well yield few, if any, of the target forms that are the keys to the broader reduction sequences.

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