

Raising the Bar

Lithic Analysis and Archaeological Research in the Southeast

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When I was asked to provide comments on the collection of lithic analysis papers presented at the Southeastern Archaeological Conference (included within this volume), I did not realize the extent to which lithic tools and debitage had been overlooked in the region as a medium for interpreting past aboriginal practices and behaviors. According to the session abstract, the goal of the lithic symposium and this volume is to highlight contemporary methods and theory in lithic analysis to encourage researchers in the Southeast to integrate lithic data into their site interpretations. After a quick perusal of the literature for the region, it was apparent that very few Southeast lithics-related publications have appeared in the national peer-reviewed literature (Daniel 2001; Shott and Ballenger 2007); slightly more lithic research occurs in regional journal venues (Carr and Bradbury 2000; Franklin and Simek 2008; Peacock 2004); and other contributions are found in edited volumes not necessarily focused specifically on lithics in the region (Anderson and Sassaman 1996; Carr 1994a; Henry and Odell 1989; Johnson and Morrow 1987). Similar to the case of Mesoamerica and the American Southwest, there is a relatively low proportion of lithics-based research relative to ceramics and architecture.

Such a trend comes as a surprise to me. However, I have been hooked on stone tool technology since the sixth grade when I first began looking at Louis Leakey's Oldowan pebble tools and wondering whether the broken cobbles in my local creek could have been made by *Australopithecus*. I have since come to believe that all of those boyhood "pebble tools" were made by rushing water during spring floods. However, I also think that many of them look exactly like Leakey's Oldowan tools and that stone context and composition are just as important as stone condition and configuration when studying stone tool technology. In other words, where the raw material comes from and its flaking

properties are just as important for interpreting stone tools as the shape and wear found on the specimen.

The goal of this collection of essays is to stimulate researchers in the Southeast to recognize stone tools and debitage as important research data that can be used in parallel with more popular archaeological materials. With that goal in mind, I provide comments on this collection of lithic research framed around some of the issues the authors have chosen to address in their particular studies, while at the same time recognizing context, composition, condition, and configuration.

Lithic Technological Organization and *Chaine Operatoire*

Several chapters in this volume emphasize an approach toward understanding lithic data using what is called Lithic Technological Organization (LTO). The concept of LTO has been used in archaeological investigations for more than 30 years since its introduction by Binford (1973, 1977) in the 1970s. It has been variously defined by practitioners (Kelly 1988; Koldehoff 1987; Nelson 1991; Shott 1986; Torrence 1983), but all generally agree that it refers to the manner in which humans organize themselves with regard to lithic technology in the context of social, economic, and environmental contexts (Carr et al. this volume). I consider LTO a strategy that deals with the way lithic technology (the acquisition, production, maintenance, reconfiguration, and ultimately discard of stone artifacts) is entwined within the daily lives and adaptive choices and decisions of tool makers and users.

A classic example of the use of LTO is found in the contribution of Thacker, Hardison, and Conklin in this collection. Here they explain how a major shift in settlement practices between the Early and Middle Archaic in the Uwharrie Mountains of central North Carolina can be understood by looking at stone tool provisioning tactics. They adopted a model of LTO developed by Kuhn (1994) that examines the manner in which toolmakers provision themselves with stone tools. They show that Early Archaic populations tended to provision individuals and that Middle Archaic populations shifted to the provisioning of places and that these differences were required as a result of how the two populations used the landscape. Early Archaic populations were more mobile, choosing to move from location to location more frequently, and the later populations tended to stay longer in one place. Such differences in residential mobility were reflected in stone tools and debitage found during each time period at their investigation site (31MG328).

Tentatively, Thacker and colleagues suggest that the change in settlement strategy is linked to environmental change, but that remains to be assessed.

However, this is a classic example of how LTO can be employed to more effectively interpret past aboriginal activities and adaptive strategies.

The Potts chapter emphasizes methodological and interpretive problems between individual flake analysis and size grade data when dealing with a raw material such as quartz with poor chipping quality. However, I think this chapter brings up another important issue related to LTO that is often overlooked. It demonstrates that stone tool technological choices are not predetermined by some kind of mental template or by cognitive intents of prehistoric toolmakers as is often argued by proponents of *chaine operateire* (Audouze 1999; Boeda 1995). Some researchers who advocate *chaine operateire* as a method of conducting lithic analysis believe it is possible to link specific operational chains of tool production with different cultures of the past and that human thought patterns are intelligible from stone tool technology: "It is felt by many today that technopsychology in particular provides a pathway to the cognitive minds of prehistoric knappers and that it is one of the most informative and meaningful ways of conducting lithic analysis" (Bar-Yosef and Van Peer 2009: 105). Many feel this view of *chaine operateire* is the primary difference between the concepts of lithic reduction sequences and *chaine operateire*. Of course, lithic reduction sequences and LTO are not the same things so I will not dwell upon this debate (see Shott 2003). However, in my opinion this view of *chaine operateire* is contradictory to an understanding of LTO.

LTO embraces the possibility that aboriginal toolmakers adjust, adapt, and respond technologically to their social, economic, and environmental contexts. Past aboriginal cultures may strive to produce stone tools in uniform mental images, but contextual factors such as raw material package size, abundance, and quality (Andrefsky et al. 1999; Ashton and White 2003; Dibble 1995; Kuhn 1991), as well as circumstances of production such as unanticipated tasks, will play a significant role in tool production and consumption processes (Tomka 2001; Wurz 2002). The cognitive or technopsychological linkages to tool production expressed in that view of *chaine operateire* (note that Bar-Yosef and Van Peer do not accept technopsychology either) act to limit our ability to understand the contexts and situations that can be so important for understanding the conditions under which stone tools are made, used, modified, and discarded. The Potts chapter is a great example of how regional contexts of lithic raw material can influence stone tool technology. The majority of cores and debitage recovered from the Madison Park site (1MT318) were from locally available raw materials (quartz). However, the majority of unhafted bifaces (69.1 percent) and hafted bifaces (80.5 percent) were made from non-quartz material. The data are not displayed to determine whether such trends are significant, but it is probable that raw material differences in tool type relate to tool function and perhaps to the context of site use. The main thrust of

this contribution emphasizes a comparison of methodological approaches, but the overall results show the importance of contexts in a study of LTO.

Chaine operateire as used by Franklin and colleagues in their chapter is very much in agreement with my use of LTO as reviewed here. They view *chaine operateire* as a holistic approach toward understanding stone tools. Nothing in their analysis suggests to me that they are advocating a technopsychological interpretation of their data. They advocate an approach that uses multiple lines of data and analysis. Such approaches usually increase the reliability of interpretations. It is surprising that their different lines of analysis produced so many analytical contradictions. We do not know whether the contradictions in data analysis are the result of bias in one technique over another, or whether there is something underlying the trends that actually relate to prehistoric behavior. I think their analysis could have explored this in more depth. Unexpected or contradictory results are really interesting and they help us to better understand how we might interpret and analyze data. Such results require us to ask additional questions of our data, and they open new areas of inquiry to help account for initial contradictions.

The Bradbury and Carr chapter also advocates an approach that uses LTO. In this study the authors suggest that the prevalence of blade technology in Paleoindian times and its absence in Early Archaic times along with the prevalence of bipolar technology in Early Archaic times might best be understood by examining these trends through an LTO lens. Of course, they begin their thesis with an appropriate review of the terminological and identification problems archaeologists have had with these kinds of technologies and suggest that some of the patterning in these two technologies may relate to such problems. However, they advocate bipolar technology as a strategy used to conserve lithic raw materials based upon preliminary data associated with raw material sources and the occurrence of this technology on Early Archaic sites. They further suggest that blade technology better fits the Paleoindian mobile pattern of adaptive strategy and may not be present in Early Archaic sites because of a change in this strategy.

I think that Bradbury and Carr may be on to something here with regard to looking at such technologies using perspectives associated with LTO. Their opinion about use of bipolar technology and limited quantities or limited actual sizes of raw materials makes sense and others have said similar kinds of things about adoption of bipolar technology (Andrefsky 1994b; Goodyear 1993). Table 12.1 provides an example comparing sizes of bipolar and freehand artifacts. The six Washington state sites (45PO) show significantly smaller bipolar cores as compared to freehand cores from the same sites. The Vail, Debert, and Shoop site data include unnamed bipolar objects that may be flakes taken from bipolar cores; however, they are shown to be much smaller (3.7, 3.6, and 5.1 cm,

Table 12.1. Size of bipolar and freehand artifacts

Site	Mean Size of Bipolar Cores (cm ³)	Mean Size of Freehand Cores (cm ³)
45POI37	38	165
45POI38	29	1,519
45POI39	46	1,320
45PO 140		3,003
45POI 41	59	180
45PO 144		2,544

respectively; Shott 1989) than the listed bipolar cores and much smaller than the freehand cores. These data conform to Bradbury and Carr's listed data.

Related to this topic is the Sain and Goodyear chapter that explores Clovis blade technology at the Topper and Big Pine Tree sites. They show that Clovis blade technology from the South Carolina Coastal Plain looks different from Clovis blade technology from the Mid-South and from the Southern Plains. They also suggest that there may be differences in the two sites based upon use and retouch found on Clovis blades and based upon raw material package size.

Given our experimental work with blade and bifacial flake cutting edges (Rasic and Andrefsky 2001) and other experimental studies (Prascimunas 2007), blade technology is no more conservative than bifacial technology with regard to providing cutting edge amount. Some may argue that Clovis blade technology is centered in the Southeast (including Texas in this region), given the high numbers of Clovis blades and blade cores at sites from this region (see Beck and Jones 2010; Faught 2006, 2008; Yahnig 2004) relative to other regions of North and South America. In fact, Clovis technology may have originated in the Southeast and spread throughout the continent from here. This is an interesting topic related to human colonization of the Western Hemisphere and the nature of human colonization in general, and it may perhaps only be definitively addressed by lithic analysis.

Lithic Raw Materials and Human Organization

Another topic that intersected many of the contributions in this volume deals with lithic raw material provenance, abundance, size, and shape as these relate to human land-use strategies and technological practices. I have been interested in the relationship of lithic raw materials and human organization for the past several decades (Ammerman and Andrefsky 1982; Andrefsky 1994a, 2009) and still believe that it is one of the most important factors related to

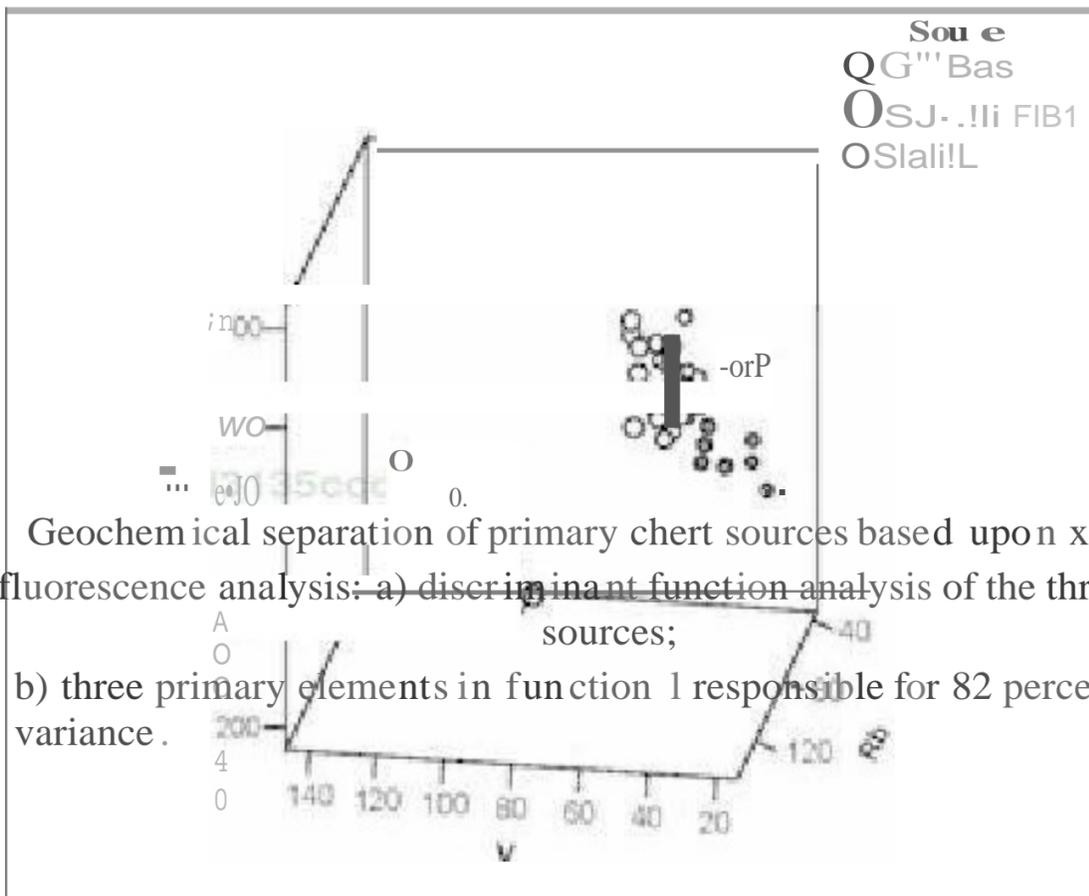
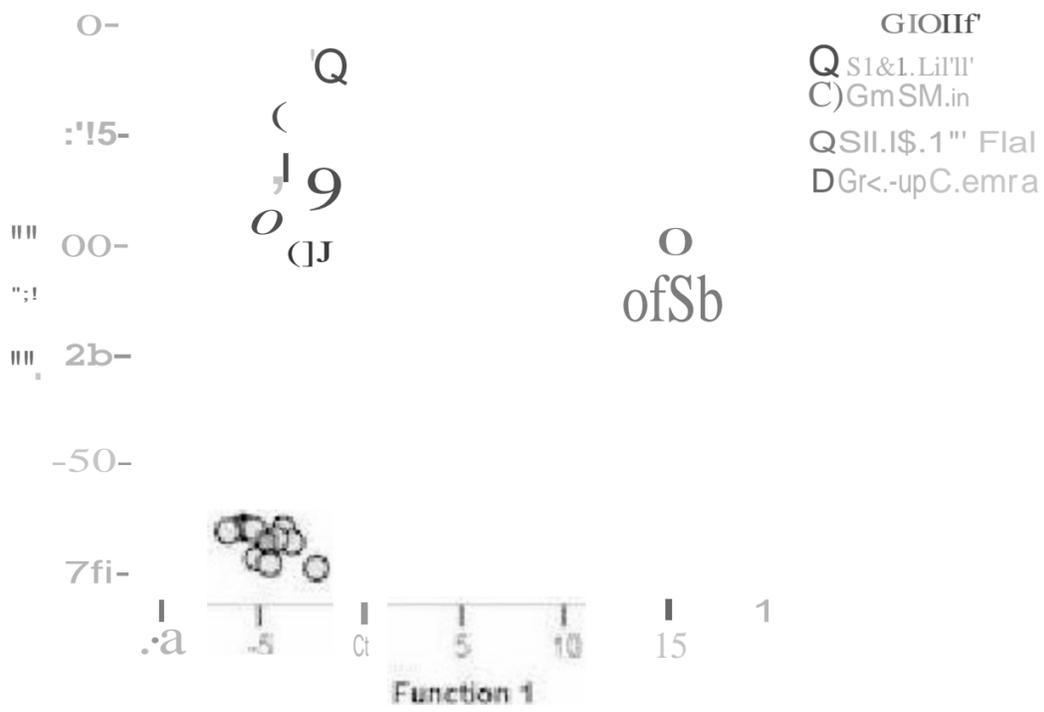
technological variability in stone tools and debitage. Many of the factors we often recognize as diagnostic for reduction stages or sequences in debitage are directly related to raw material size, shape, and configuration. For instance, cortex amount is often used to assess reduction stage (more cortex= earlier stages, and less cortex= later stage). However, cortex amount is directly related to the kind of raw material harvested by toolmakers. Chippable raw material in the form of angular talus debris may have little or no cortex on it and debitage produced from reduction of these materials will have little or no cortex on it regardless of the stage of reduction. Similarly, debitage size may have more to do with the size of the raw material nodule than with the stage of reduction. This was effectively demonstrated by Kuhn (1991), who showed that centripetal and platformed core technologies were selected on the basis of available nodule size. Archaeological studies of lithic raw material have been effective for helping researchers understand artifact functional effectiveness (Bamforth 2003; Brantingham et al. 2000; Hofman 2003; Terry et al. 2009), retouch intensity on tools (Andrefsky 2008b; Bradbury et al. 2008; Milliken and Peresani 1998), aspects of risk management (Beck et al. 2002; Braun 2005; Soressi and Hays 2003), and core technological strategies (Ashton and White 2003; Brantingham and Kuhn 2001; Roth and Dibble 1998).

Contributors to this volume have not neglected the importance of lithic raw materials in contemporary research in the Southeast. Many of the chapters just discussed under the topic of LTO certainly fall within the lithic raw material arena. The contribution by Cooper focuses upon the shift in chert source location use from the Late Archaic to Fort Ancient times at a site in eastern Kentucky. He shows that both temporal occupations used broadly the same technology, but the change in procurement patterns emphasized a shift in other aspects of their adaptive strategies. Edmonds (*this volume*) studied differences in debitage size categories to show that nonlocal lithic raw materials were often found in only microdebitage sizes. Based upon *this* patterning he notes that nonlocal lithic raw materials were probably more often brought onto his study site (Cork site) in the form of finished or late-stage tools. The Potts chapter also emphasizes differences in lithic raw material type and relates such differences to technological variability associated with raw material differences. All of these examples are important contributions toward an understanding of past aboriginal land use in the Southeast and move forward the original goal of this collection of lithic studies.

One of the areas that lithic researchers really need to make some progress on relates to establishing diagnostic signatures for chert locations. As Cooper notes in his chapter, "Kentucky cherts have a wide range of variation, even within the same geologic formation." He further concludes, "In an area with as much raw material diversity as Kentucky, and in the Southeast in general, fur-

ther development of chert type collections and chert type definitions can add finer resolution to our view of settlement patterns, social networks, and migration patterns, as well as changes in these systems through time.' I could not agree more with his assessment. This is not just an issue with chert sources in the Southeast; it is a global problem. In their study of Scandinavian chert Hogberg and Olausson (2007) note that there is as much within-source heterogeneity as there is between-source homogeneity with regard to characteristics such as color, structure, translucency, and cortex condition, among other characteristics. They also found that Scandinavian chert had the same kinds of problems with geochemical characterization as most other cherts found throughout the world—geochemical signatures were not diagnostic to location. This is not surprising since most cherts form in ancient submarine contexts that cover thousands of square miles and undergo multiple phases of genesis over thousands of years (see Luedtke 1992). However, not all cherts form in these kinds of contexts. Geochemical methods may be helpful in determining chert provenance on materials that have undergone relatively isolated genesis due to silica precipitation from unique sources such as volcanic vents truncating sedimentary deposits. Figure 12.1 shows scatter plots of three separately collected chert sources in southern Oregon roughly 50 km distant from each other. Even though two of the chert sources are macroscopically identical, they are geochemically diagnostic due to differential local formation processes (Andrefsky et al. 2010). Figure 12.1a shows the separation of the three chert sources via discriminant function analysis. Figure 12.1b is a scatter plot of the first function accounting for 82 percent of the variance and listing the three most diagnostic elements for the separation of sources. These geochemical differences were obtained using an x-ray fluorescence analyzer that explored multiple trace elements before discovery of vanadium, rubidium, and titanium as locationally diagnostic indicators.

The Southeast, like most other areas of the world, needs to begin assessing its chert source locational issues before making sweeping statements about human land use, migration, and tool-stone associations with exotic and local proximities. In many cases, regional lithic researchers can probably effectively identify chert by macroscopic characteristics. However, to my knowledge, this has seldom been evaluated with a blind test, nor have such descriptions been uniformly stated and published for use by others working in the same region. Finally, some chert sources may be so large and cover such an enormous region that source designation to that region is meaningless with regard to migration of people and transport of tools from one site to another, since in many cases the distances between sites are less than the potential distance encompassed by the chert source area. As noted above for the Scandinavian study, it is almost impossible for lithic researchers to effectively identify chert from



Geochemical separation of primary chert sources based upon x-ray fluorescence analysis: a) discriminant function analysis of the three chert sources; b) three primary elements in function 1 responsible for 82 percent of the variance.

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various sources using macroscopic, microscopic, or geochemical techniques. Such identification difficulties must almost certainly be compounded when examining archaeological specimens with no cortex and perhaps no mineral inclusions. Such identification challenges are probably even more difficult with microdebitage.

Methodological Considerations

Several of the contributions within this volume focused on issues with implications beyond lithic analysis in the Southeast. These might be characterized as methodological or analytical studies that certainly apply to lithic studies from the region, but they have significance for all lithic analysis even if they were framed from examples taken in the southeastern region.

Certainly the Price chapter falls into this category. Here a case is being made to consider the kinds of information being lost or the kinds of misinformation being created as a result of artifact collection techniques that disregard small artifacts as a result of large mesh sizes being used to collect data. Price persuasively builds a case that most archaeological investigations in the Southeast are biased by using 6.35-mm (.25-inch) mesh to sift site deposits. She shows that minimally 60 percent of artifact inventories falls below the 6.35-mm mesh size and is seldom recovered. Price's examples not only include debitage vital for flake debris aggregate analysis, but also small hafted bifaces, drill tips used for bead making, raw material diversity, and microdebitage studies. This 60-percent loss of data is increased to over 90 percent when considering the very small fraction often lost in 3.17-mm (.125-inch) mesh but recovered in 1.58-mm (.0625-inch) mesh.

Other areas of the United States already require recovery of artifacts via 3.17-mm screen and many investigators go beyond this and recover a constant volume sample from each stratum that is later screened through nested geologic mesh sizes to recover materials partitioned into extremely tiny individual sizes such as grass seeds and insect body parts. One way investigators can increase systematic recovery of the small fraction without increasing costs by 60-90 percent is to effectively sample their materials and then extrapolate from that sample to the larger collection. As researchers begin "thinking bigger" by "collecting smaller" materials, such as DNA samples, residues on tools, and microliths, our ability to understand past activities and behaviors shall become better informed and more believable. Price's essay is a wake-up call for all archaeologists. We deal with a nonrenewable resource that is destroyed every day by land development, erosion, and probably most frequently by archaeologists who are neglecting a large proportion of this resource.

Recent investigations at sites with very early components such as "pre-Clovis"

have led many archaeologists to ask rather elementary questions about lithic artifacts such as, What defines a stone tool? or, Has this rock been intentionally modified by a person living long ago? or, What does evidence for stone tool use look like? In many regards the Pevny chapter begins the process of dissecting these questions and looking at the empirical evidence to help address such questions. Pevny emphasizes the potential effects of taphonomic processes on lithic artifacts. She explores the characteristics found on stone artifacts that relate to geochemical weathering, soil sheen, heat exposure, trampling wear, and other postdepositional processes. Such taphonomic processes are not new to lithic analysts (Ackerman 1964; Gifford-Gonzalez et al 1985; McBrearty et al 1998; Rasic 2004), but it is surprising that many do not consider such processes when assessing tool use or even tool definition. Her contribution makes us think about how we should look for these kinds of wear and eliminate such "noise" from intentional retouch and use damage found on such artifacts. Her study also reminds lithic researchers that there are many other kinds of wear that we need to be cognizant of such as screen damage, baggage and transport wear, and human contamination from washing and handling of ancient artifacts.

Many of the chapters presented in the volume allude to tool production stages or sequences. For instance, Potts discusses various production trajectories for biface reduction, bipolar core reduction, and freehand core reduction among others. She uses debitage size grades assessed through aggregate analysis in an effort to recognize these production trajectories composed primarily of assemblages of low-quality quartz. Franklin and colleagues also attempt to recognize reduction stages using mass analysis of debitage sizes, even though they advocate and demonstrate multiple approaches to assemblage analysis. Cooper's study also uses multiple lines of evidence, but one of his techniques is to determine reduction stages via mass analysis. Interestingly, the Miller and Smallwood chapter actually explores the concept of biface production as a staged process versus a continuum; however, these authors do not examine debitage size or debitage at all. Even though the focus of their chapter is an assessment of stage versus continuum in the production of Clovis bifaces (incidentally, they find that both may be applicable), I find a different aspect of their contribution more relevant to the goals of the conference symposium and this volume. For the authors to effectively evaluate stage versus continuum they have had to develop a new index for assessing degree of biface production (flaking index). The degree of biface production is intimately linked to artifact curation and the manner in which artifact curation is used within LTO. Other lithic studies have focused on curation indices as measures of tool use (Andrefsky 2006; Clarkson 2002; Quinn, Andrefsky, et al 2008), but Miller and Smallwood have developed the index for tool production (not use). This certainly will be a

useful technique that can be used in a longitudinal manner with debitage studies that seek to understand production or reduction sequencing. I cannot wait to apply their flaking index to my control samples of bifaces from experimental studies (Williams and Andrefsky 2009; Wilson and Andrefsky 2008) and to assess this against independent measures of aggregate and individual flake analytical procedures.

Summary

This collection is a good cross section of contemporary lithic research. It will encourage those archaeologists currently sympathetic to the potential contributions of lithic analysis to explore their data in more detail. It may even stimulate those researchers who think very little about the value of lithic data to begin more systematic studies. I certainly hope it does both.

However, for many archaeologists, lithic data sets represent extremely limited packages of information that can contribute toward a greater understanding of human behaviors, lifeways, and past adaptive strategies used by different social systems. To motivate such researchers toward a more enlightened view of lithic analysis, it will take extremely interesting questions framed in parsimonious models, with reliable and believable analysis. We cannot expect researchers to embrace interpretations of lithic data that simply imply mechanical relationships about broken rocks. For instance, many archaeologists will not become excited about statements such as "this debitage assemblage indicates that early-stage core reduction probably occurred at this site" or "early-stage or late-stage or perhaps both stages of reduction were conducted at the site." Of course, there are researchers out there like myself who find such statements fascinating, and such statements stimulate me to attempt to eliminate the uncertainty within those statements. However, my guess is that most archaeologists and even more non-archaeologists would find such research conclusions somewhat lame.

Lithic analysts need to recognize that lithic artifacts (tools and debitage) are simply tools to help us better understand the people and communities that made and used those artifacts. We need to emphasize the broader archaeological issues that we wish to address and understand, and then systematically demonstrate how lithic analysis can help investigators arrive at such understanding. Yes, we need to do the nitty-gritty complicated research to better understand aspects of stone tool technology (such as taphonomic processes, breakage patterns, wear analysis, debitage shape characteristics, flake pattern analysis), but we must also make sure to connect these investigations to the broader questions that we are also interested in understanding. If we do not lose sight of these larger questions, then we shall certainly stimulate researchers in the Southeast to integrate lithic data into their site interpretations.

Several of the chapters in this volume have done an excellent job in stating how their investigations relate to such broader goals. All of the contributions in this volume have emphasized the potential importance of lithic analysis for a more comprehensive understanding of past aboriginal lifeways and behaviors in the Southeast and within a larger arena. This volume makes an exciting statement about Southeast archaeological research. I am pleased and honored to have been asked to participate with the original group of scholars in Mobile, Alabama. I am confident that this volume will help lift the research bar for lithic analysis in the Southeast and beyond.

Acknowledgments

I have presented here some data on chert source location analysis. I thank my colleagues Jennifer Ferris, Nathan Goodale, Justin Williams, and George Jones for helping me collect, x-ray, and analyze the chert presented here. I wish to thank Phil Carr, Andrew Bradbury, and Sarah Price for inviting me to participate in the conference and for allowing me to contribute my opinions to this volume. All three were great hosts and I learned much from our conversations and exchanges during my visit to the Southeast.