IDEOLOGICAL PRESENTISM AND THE STUDY OF ANCIENT TECHNOLOGY:
PRECLASSIC MAYA LITHIC PRODUCTION AT SAN BARTOLO, GUATEMALA

by

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ABSTRACT

This is a dissertation about technology in both the past and present. In terms of the past, it is a study of ancient Maya lithic production practices at the site of San Bartolo, Guatemala. During the Preclassic (600 B.C. – A.D. 300) the inhabitants of San Bartolo developed a method for producing oval bifaces (i.e., celts) that was fairly unique within the Lowlands. It involved the collection of large quantities of unmodified nodular chert which were deposited in numerous small piles both within and along the bajo margins. Data resulting from typological and aggregate analyses of 36,497 pieces of lithic debitage were used in conjunction with a variety of other data sets to construct a chaîne opératoire for Preclassic oval biface production at San Bartolo. This data in and of itself is significant, as few detailed lithic studies have been published for sites in the Petén. Comparative data sets from Colha are employed to demonstrate that Preclassic flintknappers at the two sites approached oval biface production in significantly different ways. Perhaps more importantly this study demonstrates that the differential production strategies were the result of technological choice rather than environmental or material constraints. This leads to the other focus of this study – technology in the present. A significant portion of this dissertation is concerned with documenting the historical development of the social field of archaeological technology studies. I explore the issue of whether or not dominant themes within archaeological technology studies represent a form of ideological presentism, and the validity of privileging formalist economic models in the study of ancient Maya technological practice.
CHAPTER 1 INTRODUCTION

Introduction

This is a dissertation about technology in both the past and present. In terms of the past, it is a study of ancient Maya lithic production practices at the site of San Bartolo, Guatemala. During the Preclassic (600 B.C. – A.D. 300) the inhabitants of San Bartolo developed a method for producing oval bifaces (i.e., celts) that was fairly unique within the Lowlands. This data in and of itself is significant, as few detailed lithic studies have been published for sites in the Petén. But what is perhaps more significant is that this particular approach to lithic production was the result of technological choice rather than environmental or material constraints. This leads to the other focus of this study – technology in the present.

I first became interested in lithic technology as an undergraduate student. The Buffalo State College anthropology department lacked a lithicist at the time, and so my initiation to the specialization came in the form of Andrefsky’s (1998) manual and countless hours spent with the lithic assemblage from an Iroquoian village site (i.e., the Eaton Site). As I gained more experience in lithic analysis and expanded my familiarity with the literature, I began to transition from a sole focus on identifying tools and debitage attributes to an interest in what sorts of research questions I could address with lithic data. For the most part, the answer to this question appeared self-evident at the time. The literature I had read, written predominantly by North Americans, contained countless examples of lithic data being employed to investigate subsistence strategies, mobility patterns, exchange networks and the like.

It was not until I had a year or two of graduate training under my belt that I realized why the applications of lithic analysis had appeared self-evident; the object of study – technology –
had been preconstructed (Bourdieu 1992). By choosing to pursue the study of lithic technology I had entered an academic (i.e., social) field where research topics and appropriate methodologies had already been socially shaped (Sterne 2003). Lithic studies truly found a home with the emergence of processual archaeology, and as a result processualism represents the dominant theoretical persuasion among North American lithicists. This is not to say that the field of lithic studies has remained uncontested terrain, as there has been significant debate concerning what constitutes technology and how the phenomenon should be studied. Nonetheless, cross-paradigmatic debates have been muted, and there is a clear dominant perspective within Americanist lithic studies. This decidedly materialistic tradition is characterized by the use of the scientific (i.e., positivist) method and formalist economic principles to investigate ancient technologies. This approach also views technology and society as being external to each other (Ingold 1990). I see a very real danger of ideological presentism lurking within this approach (Dobres 2000; Pfaffenberger 1988).

Pippin (1995) argues that when a historically contingent experience is regarded as natural it becomes ideological, and in turn has the effect of narrowing perceptions of what is acceptable and appropriate. Thus, one of the central concerns of this dissertation is whether or not dominant themes within archaeological technology studies represent a form of ideological presentism, where current experiences of the human/technology relationship are projected into the past. Should we automatically assume that people in all times and places acted in rational and efficient ways? Much of the content that follows represents my attempt to view technology past and present with a new eye through an “epistemological break with the ‘common sense’ of technology” (Bourdieu 1992; Sterne 2003:369).
Outline of Dissertation

Before presenting an overview of the content of this study, I would like to briefly comment on its structure and style. The reader who has read other dissertations, or perhaps even written their own, will likely notice the non-traditional format of this study. I dedicate a fair amount of space to the critique of a particular approach to studying technology, and it would be less than sincere to then produce a dissertation which faithfully replicates that style. As an alternative I have intentionally employed a narrative writing style – undoubtedly with varying degrees of success – that attempts to bring the reader along with my thought process in studying ancient technologies, while avoiding the strict theory-method-data formula where possible. I have tried to directly infuse theoretical discussion with data, and vice versa. Those who are looking for content according to a more traditional format (or trying to figure out which chapters to avoid) may find the following summary helpful: explicit theoretical discussions are present in every chapter except for Chapter 4; discussion of archaeological data are presented in chapters 4-6; and, discussions of the methods employed in data collection are to be found in Chapters 5 and 6. In choosing this format I hope to provide the reader with an engaging and enjoyable read. Whether or not I succeed any shortcomings associated with this format are entirely my own.

I would like to begin by explicitly stating that the contents of Chapter 2 do not represent an attempt to reconstruct or uncover an ancient Maya emic perspective on technology. Rather, this chapter is primarily concerned with the shape of contemporary Western views of technology and how these views are reflected in archaeological theory and practice. Clearly the one has implications for the other, but these issues are addressed at a later point. The chapter begins with the premise that there is a dominant ‘Standard View’ of technology within Western society, and that this view is historically contingent rather than the reflection of an objective reality (Dobres 2000; Pfaffenger 1988). To illustrate this point I turn to the ancient Greeks who not only
thought about technology extensively, but were also kind enough to record their thoughts in writing. A discussion of techne entails a demonstration of a markedly different understanding of the relationship between human beings and the material world during technological production and use.

Following the discussion of techne I proceed to deconstruct contemporary views of technology by tracing the genesis of particular components of the Standard View to a series of historical processes. After Feenberg (2003), I argue that the concomitant emergence of a mechanistic view of the natural world and positivism during the Enlightenment caused a drastic shift in Western metaphysics and the emergence of a new ontology of matter. These events are largely responsible for the predominantly instrumentalist flavor of technology within the West. Drawing on Marx and Weber, I then explore how the unique configuration of mechanized production within the factory system which fueled the emergence of capitalism resulted in processes of alienation and rationalization. The long term effects of these processes are evident in the Western fetishized view of technology where the technical is viewed as a domain apart from the social, and in the analytical privileging of rational efficient action. While this first point largely lurks in the shadows of most archaeological technology studies, the second point serves as the explicit foundation of multiple theoretical approaches.

Chapter 2 then outlines views of technology within contemporary Western philosophy which are as follows: determinism, instrumentalism, substantivism, and critical theory. I conclude the chapter by charting archaeology’s engagement with technology beginning with early cultural evolutionary perspectives of the 19th century and ending with contemporary processual and symbolic/structural perspectives. It is shown that archaeology has predominately tacked back and forth between determinist and instrumentalist positions. Furthermore, from
early cultural evolutionary archaeology to processualism, the study of technology has served as a cornerstone of archaeological narratives.

Following the deconstruction of technology in Chapter 2, Chapter 3 begins to chart a path forward by drawing on the work of Marcel Mauss. I use his concept of total social phenomenon to counter the partitive approach to studying ancient technologies that is common within archaeology. His study of body techniques is cited as an example of how technical gestures bridge society and the individual while simultaneously providing a material record of this process. The second section of Chapter 3 introduces the structure (objectivism) versus agency (subjectivism) debate, along with synopses of Giddens and Bourdieu’s attempts to bypass the debate through their theories of practice. Practice theories add an element of agency to Mauss’s techniques, while also emphasizing that technical production is simultaneously social production. The chapter closes with a mention of a social agency and phenomenological approach to technology. This approach represents a synthesis of structuralist-inspired technology studies from within anthropology, insights from the philosophy of technology, and practice theories.

Chapter 4 represents what could be considered the first ‘data’ chapter, as it introduces the reader to the site of San Bartolo and the chert features which serve as the data set for this study. San Bartolo is an ancient Maya archaeological site located in the northeastern corner of Guatemala, in the modern day Department of Petén. The first section of this chapter begins with a presentation of the physical geography of this area before moving on to the history of research at the site. This is followed by a site culture history beginning with the initial Middle Preclassic occupation (1000 – 400 B.C.) and ending with permanent abandonment of the area in the Terminal Classic (A.D. 850 – 1100).
Chapter 4 also introduces the reader to the chert features of the Central Maya Lowlands. These features are relatively small piles of chert nodules, measuring approximately 2-4m in diameter and 20-30cm in height, that dot the San Bartolo – Xultun landscape. Despite their apparent widespread association with bajos, or seasonal swamps, only a handful of studies from surrounding regions (e.g., Becán and La Milpa) have investigated these chert features, and the results have varied. In 2005, along with my colleague Robert Griffin, I investigated 5 chert features in the vicinity of San Bartolo in order to determine their purpose. The final sections of this chapter outline the chert feature research design, and the field methods employed to in their investigation. The chapter closes with summary excavation data for each of the five chert features. Excavations revealed that the chert features were loci of stone tool production during the Middle (600 – 400 B.C.) and Late Preclassic (400 B.C. – A.D. 300).

Chapter 5 begins with a historiography of Maya lithic studies for the purpose of contextualizing my research. It demonstrates that my study departs significantly from the familiar topics of craft specialization, political economy, and exchange that dominate Maya lithic studies. The second section of the chapter introduces the aggregate and typological debitage analysis methods I employ in this study. This section is also methodological in that it examines the historical context from which these debitage methods emerged, and addresses debates concerning their efficacy and validity. The results of the ceramic analysis, conducted by Patricia Rivera Castillo, are also presented for chronological purposes. Excavations of the chert features revealed that not only were they loci of lithic production, but that oval bifaces (i.e., celts) were likely the only tool form produced. A discussion of the spatio-temporal distribution of oval bifaces in the Maya area is also presented.
The final sections of Chapter 5 begin to address some of the idiosyncrasies of lithic production at the San Bartolo chert features. This includes a discussion of how concerns with raw material variability are reflected in the chert feature lithic assemblages, and the relationship between raw material variability and production intensity. Chapter 5 closes by presenting the result of the aggregate and typological debitage analyses.

Chapter 6 takes as its task the reconstruction of the oval biface reduction sequence at San Bartolo. But before doing so, I discuss the dominant approaches to sequential modeling in lithic studies: the Americanist reduction sequence model which is typically part of an Organization of Technology approach, and the French tradition of chaîne opératoire. The choice of approach is extremely important, as one emphasizes the material realm of technological practice and the other takes as its objective the study of the social elements of technology. Moving forward, I present a chaîne opératoire of San Bartolo oval biface production that consists of four general processes. The first phase describes the process of procuring chert nodules for the construction of the chert features. The second phase is concerned with the assessment and testing of chert nodules. The third phase outlines the shaping and thinning processes which from the bulk of production activities. The final component of the chaîne opératoire involves the transport of ‘finished’ celts away from the chert features for use at another location within the region.

Chapter 6 concludes with a comparative analysis of Preclassic oval biface production techniques at San Bartolo and the site of Colha in northern Belize. What the comparison demonstrates is that the two sites, which are located in similar environments in terms of chert availability, developed significantly different methods for producing oval bifaces. I present multiple lines of evidence to argue that these differences cannot be attributed to environmental or material constraints, but instead represent technological choices. Furthermore, I demonstrate that
theories premised upon rational efficient action and maximizing behavior fail to adequately explain the particular form of the San Bartolo oval biface chaîne opératoire.

Chapter 7 marks the conclusion of this dissertation. It includes a brief summary of my empirical findings, and a consideration of some of the theoretical contributions of this study before concluding with a few final remarks.
It is easy to imagine human beings as pre-literate, but it is difficult to imagine them as pre-technological.  

(Nye 2006:5)

There is no such thing as technology in so-called primitive societies.  

(Ingold 1990:6)

There is perhaps no better example of the conceptual “slipperiness” (Matthewman 2011:10) of technology than the opening epigraphs from Nye and Ingold. On the surface, there appears little room for consensus, as being technical is presented as an essential human quality on the one hand, while early societies are said to be lacking technology on the other. It is obvious that ancient societies possessed tools and the necessary technical knowledge to both manufacture and use them, but this is not what Ingold is referring to when he uses the word ‘technology.’ Rather, the crux of his argument is that our contemporary understanding of technology and the web of relations and meanings the concept engenders is unique to the West and Modernity. While in agreement, I wish to add the nuance that even within the West the word ‘technology’ is polysemic.

The implications of a historically contingent understanding of technology are profound, stretching not only from what our narratives say about the past but also to what is deemed knowable, and in turn the research questions that we pursue. As such, I will begin this chapter by presenting a brief historiography of technology in order to illustrate the shifting meanings of the concept through space and time. This in turn will demonstrate that dominant archaeological
discourses on technology are not grounded in a universal understanding of the concept, nor are they inherently superior to alternative approaches that have emerged from the academic periphery. With technology’s conceptual baggage somewhat unpacked, we can begin to explore alternative approaches and interpretive frameworks (Dobres 2000). Of particular relevance to the future of technology studies in archaeology, this chapter will also reach past disciplinary boundaries in order to gain inspiration from technology studies in other fields while avoiding attempts to ‘reinvent the wheel.’ Much of what follows is not about ancient Maya technology *per se*, but rather how contemporary archaeologists understand the technology-society equation and the ramifications this has for anthropologies of technology in the 21st century.

**From Techne to Technology: Etymophilosophical Reflections (or documenting a different technology)**

While sociocultural anthropology and technology have at times been restless bedfellows (Pfaffenberger 1988; Schlanger 2006), technology has always served as a cornerstone of the archaeological project (Dobres 2000, 2009; Trigger 2006). Technology studies have been mobilized to support a variety of theoretical and ideological positions, ranging from 19th century unilineal social evolution (Morgan 1877; Tylor 1865) to contemporary gender archaeology (papers in Wright 1996), and postcolonial studies (Fazioli 2011). Despite its importance to the field, technology is by no means the exclusive domain of anthropology or archaeology. Disciplines which claim technology as their subject matter are diverse, ranging from engineering, history, sociology, philosophy, and the relatively new domain of Science and Technology Studies (STS). How can we explain the apparent “institutional vagrancy” (Schlanger 2006:3) of technology? How can so many fields be studying the ‘same’ thing? In one sense the answer is quite simple; each field approaches an object of study through methods and theoretical frameworks that are unique to that intellectual tradition. In the case of technology this has
resulted in multiple definitions that are constantly contested and negotiated, though certain understandings of the concept hold dominant positions within particular fields (Table 2.1).

Implicit within this multitude of meanings is a more complex answer to the initial question. That is, the partitioning of technology found within academia is a continuation of processes whose origins stretch back to the dawn of the Enlightenment. Documenting the processes responsible for the transition from pre- to post-Enlightenment understandings of the relation between humans and productive activities will be a core objective of this chapter.

**Table 2.1. Definitions of technology (compiled from Mitcham 1978:232).**

<table>
<thead>
<tr>
<th>Technology as/is/like:</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensorimotor skills</td>
<td>Feibleman</td>
</tr>
<tr>
<td>Applied Science</td>
<td>Bunge</td>
</tr>
<tr>
<td>Design</td>
<td>Engineering in general</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Bavink, Skolimowski</td>
</tr>
<tr>
<td>Rational efficient action</td>
<td>Ellul</td>
</tr>
<tr>
<td>Neutral Means</td>
<td>Jaspers</td>
</tr>
<tr>
<td>Means for economic purposes</td>
<td>Gottl-Ottlilienfeld</td>
</tr>
<tr>
<td>Means for socially set purposes</td>
<td>Jarvie</td>
</tr>
<tr>
<td>Control of the environment</td>
<td>Carpenter</td>
</tr>
<tr>
<td>Pursuit of Power</td>
<td>Mumford, Spengler</td>
</tr>
<tr>
<td>Means for realization of the Gestalt of the worker</td>
<td>Junger</td>
</tr>
<tr>
<td>Supernatural self-concept</td>
<td>Ortega</td>
</tr>
<tr>
<td>Human Liberation</td>
<td>Mesthene, Macpherson</td>
</tr>
<tr>
<td>Self-initiated salvation</td>
<td>Brinkmann</td>
</tr>
<tr>
<td>Invention and the Material realization of transcendent forms</td>
<td>Dessauer</td>
</tr>
<tr>
<td>“a provoking, setting up disclosure of nature”</td>
<td>Heidegger</td>
</tr>
</tbody>
</table>

An additional reason for the conceptual flexibility of technology is related to its age.

Though archaeologists study technologies reaching back over two million years into the Paleolithic, the word ‘technology’ is relatively new in the English language, emerging a mere
300 years ago and not entering common usage until the 20th century (Dobres 2000; Mitcham 1978, 1979, 1994; Nye 2006). As Mitcham has noted (1979, 1994), etymology is an ideal place to start when seeking to understand a concept. Any such analysis of technology quickly reveals the rather unique etymophilosophical nature of this endeavor; not only are we charting the historical evolution of a word, but also the history of philosophical thinking about the concept. This information is particularly relevant due to the fact that it demonstrates pre-modern ways of thinking about technology, and conversely that the way we (i.e. the contemporary West) think about technology is quite unique in human history. The following paragraphs will present a brief history of thinking about technology following the periodization scheme developed by Reydon (2012). It is important to note that this periodization is only one of many published approaches (e.g. Feenberg 2003; Franssen et al. 2009), and it is largely an account of Western traditions. It should not be construed as an argument for the existence of a universal understanding of technology at any point in time. Accounts of the history of technology in China (Bray 2013), Japan (Wittner 2013), and the Islamic world (Glick 2013) from a philosophical perspective can be found in the edited volume by Friis and colleagues (2013).

Mitcham (1978, 1994) provides an extremely detailed etymological discussion of technology that stretches into deep antiquity, but for our present purposes technology will be viewed as a relatively recent combination of the Greek root words tekhnê/techne and logos. Techne is most often translated as “art,” “craft,” or “skill” (Ingold 1988:152; Mitcham 1994:117), and in “nonphilosophical literature…is used to refer to cleverness and cunning in getting, making, or doing as well as to specific trades, crafts, and skills of every kind” (Mitcham 1994:118). In classical Greek philosophy techne refers not only to human action, but also a type
of knowledge associated with that action which involves metaphysical speculation about the world (Reydon 2012).

For Plato, all natural things were brought into being by a *demiurge* who gave form to matter in accordance with an eternal pattern, or *paradeigmatos*, which is understood through reason, or *logos* (Mitcham 1989, 1994). In much the same way, when a craftsperson created an artifact it was a process of bring-in-to-being a pre-determined form through the act of mimicking that which existed in the natural world. According to Socrates, every *techne* was necessarily accompanied by *logos*, or rational discourse on the nature of the *techne* (Mitcham 1994:118). In Plato’s later works he further expanded the meaning of *techne* to include knowledge and activities that operate on the nonhuman material world, while excluding purely theoretical knowledge. It is important to note that though the Greeks believed *techne* to have a logical character, they rarely combined the concepts to speak of a *logos* of *techne*; *techne* simply used *logos*. *Logos* is only involved in understanding the form of a thing, it cannot be used to teach or instruct in the activity of making the thing, the “activity qua activity” (ibid:128).

Aristotle believed there were clear metaphysical differences in the manner in which human-made and natural objects came into being, but it was not necessarily tied to the imitation of nature. Rather, these differences were based on the principles of existence underlying entities within the domains of the natural (*physis*) and non-natural (*poiesis*). Reydon (2012:2) clearly illustrates this difference when he states that for Aristotle, the natural realm:

…consisted of things that have the principles by which they come into being, remain in existence and “move” (in the senses of movement in space, of performing actions and of change) *within* themselves. A plant, for instance, comes into being and remains in existence by means of growth, metabolism and photosynthesis, processes that operate by themselves without the interference of an external agent. The realm of *poiēsis*, in contrast, encompasses things of which the principles of existence and movement are *external* to them and can be attributed to an external agent – a wooden bed, for example, exists as a consequence of a carpenter’s action of making it and an owner’s action of maintaining it.
Poïèsis, or the human activity of creating something, always has an associated techne which is imbued with purpose and meaning and directs the correct way to produce an artifact. The “correctness” of the techne is not viewed as a subjective decision, but rather an objective property of the techne itself (Feenberg 2003). Here a distinction between existence and essence needs to be made; the design and purpose of an artifact exists prior to and independently of the artifact or its maker. Thus the essence of the artifact resides within techne, though its existence is realized through human activity (Feenberg 2003; Mitcham 1994).

The ancient Greeks were clearly quite interested in technology from an ontological and metaphysical perspective, but philosophical interest waned when it came to the potential uses of technology or the more mundane aspects of daily production and consumption. In contrast, Roman literature exhibited a greater enthusiasm for the practical applications of the mechanical arts, a sentiment that is undoubtedly related to their reputation as the great engineers and builders of Classical Antiquity. Cicero celebrated the ability of humans to transform their environment when he wrote De Natura Deorum in 45 B.C., followed by Statius and Pliny who penned works that championed technological progress. Writing in the 5th century A.D., Saint Augustine of Hippo marveled at the great skill and intelligence humans displayed through the creation of arts and crafts which not only fulfilled basic needs, but also served as means of enjoyment (Nye 2006; Whitney 1990). The increasing appreciation for technology which characterized Late Antiquity continued into the Middle Ages, along with the view of a world separated into natural and non-natural realms. Crafting continued to be viewed as a process by which natural forms were copied, but now technology was viewed as a means by which man could improve upon Nature’s designs, thus further elevating the importance of the mechanical arts (Reydon 2012).
To further this point, in Hugh of St. Victor’s *Didascalicon*, a book outlining what Medieval universities were to teach their Christian pupils, the mechanical arts were now combined with the traditional liberal arts (ibid.).

While medieval attitudes towards technology were largely a continuation of those of Classical antiquity, events of the late 17th century caused a radical shift in the Western ontology of matter which, in turn, resulted in both an elevated position and fundamentally different understanding of the technical realm (Mitcham 1978, 1979, 1994). This was largely attributable to the new mechanistic view of the world resulting from the scientific revolution, and the work of Galileo, Newton and in particular Descartes. This new mechanical philosophy held that the universe, and all matter contained within it, was analogous to a machine where the individual components had no relationship outside of their current use or function (Feenberg 2003; Mitcham 1994). In contrast to the Greeks, matter was no longer viewed as living in any sense, or of having “any spiritual aspirations of its own” (Mitcham 1979:187); technology ceased to be teleological.

Deemed the “father of experimental philosophy,” few individuals were more instrumental in shaping modern understandings of, and opinions towards technology than Francis Bacon (Dobres 2000:54). It was within his works that technology would come to play a central role in how we come to know the world. In *Novum Organum* (1620), Bacon directly challenged medieval approaches to gaining knowledge of the natural world, especially those grounded in the writings of Aristotle and scholasticism, by proposing a new scientific method based on merging inductive reasoning, empirical observation, and technology. The process of gaining knowledge through observation and experimentation required the production of instruments in order to measure and evaluate results. Technologies which worked correctly provided empirical evidence
that the theories behind them were ‘true’ (Reydon 2012). For Bacon, the importance of technology extended far beyond the realm of natural philosophy and into the project of improving the human condition. In fact, the best technologies were those that had practical application. This was clearly laid out in *New Atlantis* (1627), a book detailing a fictional island state called Bensalem, where science and technological innovation combined to create a utopian world in which all material needs were met, and injustice and inequality were eliminated with no observable negative impact on the environment (Nye 2006). All of this was made possible through man’s domination of nature, and recalls Bacon’s slogan of “knowledge is power.” Where contemporary interpretations of this slogan take the word ‘power’ to refer to political or social power, the original meaning “is that knowledge of natural causes gives us power over nature that can be used for the benefit of mankind” (Reydon 2012:3). The publication of *New Atlantis* had a profound impact upon scholars in the West, inspiring the foundation of the Royal Society of London in 1660, an institution dedicated to scientific knowledge which is still in existence (Nye 2006). However, the allure of Bacon’s theme of progress through the combination of natural philosophy (i.e. science) and technology extended far beyond London as it became central to the Enlightenment idea of progress and the project of modernity.

To summarize the positions presented above, the transition from *techne* to technology which occurred during the Enlightenment involved no less than the emergence of a new metaphysics or ontology of matter. Distinctions between natural/non-natural and essence/existence remained, but the fundamental understanding of these distinctions changed. Whereas for the Greeks *techne* was the realization of objective essences striving towards particular purposes, the new technology of the West viewed the natural world as stockpiles of raw materials awaiting transformation in line with the subjective desire of humans (Feenberg
2003:3). Feenberg (ibid, italics in original) further emphasizes the implications of this contrast in stating that:

For us essences are conventional rather than real. The meaning and purpose of things is something we create not something we discover. The gap between man and world widens accordingly. We are not at home in the world, we conquer the world… The question we address to being is not what it is but how it works.

The ancient Greek craftsperson envisioned the form of an object and brought it into being through skilled practice “while largely remaining incognizant of the procedures by which he [sic] worked” (Ingold 1988:152), and was thus undirected by a logos. In contrast, the work of the modern technician is entirely directed by a logos grounded in the principles of the natural sciences and is independent of any conception of form, or eidos (Mitcham 1979:182). What lies within this distinction is the instrumentalism that underlies much of modern thought towards technology.

Rise of the Machine: Objectification, Alienation, and Rationalization

The dismantling of techne which began during the Enlightenment as a result of metaphysical and epistemological developments continued with the onset of the Industrial Revolution. Hobsbawm (1968:xi) has argued that this event “marks the most fundamental transformation of human life in the history of the world recorded in written documents.” While an argument could be made that the initial period of European exploration and colonization deserves this title, it was the Industrial Revolution which provided the rationalization for the systematic exploitation of non-European peoples and resources. In the European maritime states, the American colonies, and later United States, this event marked a qualitative transformation of a different sort. The emergence of industrial societies in the West was not revolutionary in the sense of its rapidity, but rather in the appearance of a new economic mode of production based
on the factory system (Kivisto 2005). This new mode of production, in turn, resulted from long-term trends of increasingly mechanized production. Before discussing how factories and wage labor contributed to the constitution of technology as an ontologically distinct entity, it is necessary to outline the role of machines in this process.

The ability to use tools to modify our environment has long been considered a defining characteristic of humanity, and indeed the majority of our collective prehistory and history has involved the use of tools. But what lies behind this façade is the reality that machines have come to replace tools as the primary means of ‘making things’ within both industrial and post-industrial societies. This distinction is important in that tools and machines differentially structure how we experience the world. Tools are often thought of as extensions of the human body, or what Kapp (1877, quoted in Mitcham 1994:23) referred to as “organ projections;” the hammer is simply an extension of the human arm and fist. The organ-tool analogy is meant to convey that the work performed by the tool is an extension of human agency, without which the tool would simply revert “to its original condition as an inert object” (Ingold 1990:12). Also implicit within this analogy are the sensorimotor experiences that arise from the human – tool – world equation (Mitcham 1994:167), the antithesis of which characterizes machinofacture. Machines are defined by their independence from human agency (Mitcham 1994:167). Through a bifurcated process humans design and build machines, occasionally service them, and may even be required to operate them, but even in this last instance where a worker is necessary to push a button, it is the machine that is performing the act of creation/production. Ingold (1988:153) argues that this separation between human agency and constructive work is the essence of all things mechanical. In succinct fashion, Mitcham (1994:178) has illustrated how these divergent modes of production shape our experience of the world:
Both kinetically and kinematically, modern machines, as contrasted with traditional tools, involve a qualitatively distinct separation of human beings from their bodies and primordial bodily awareness. Modern machines are base or ignoble in a new way because they alienate us from the sensorimotor, mind-body complex.

This distancing or removal of the human subject from the productive process has the added effect of driving a wedge between the technical and social domains. Whether this distinction is real or perceived will be addressed in Chapter 3. Nonetheless, the increasing complexity and autonomy of machines that preceded the Industrial Revolution can be most fruitfully viewed as a process of objectification rather than complexification (Ingold 1990:11).

Up to this point we have been discussing the role of machines in alienating humans from bodily contact with the world, and as causing the objectification of the technical sphere of action. Both of these concepts were central to the work of Marx, though he defined them in fundamentally different, yet complementary ways. He argued that there was nothing inherently problematic about machines, as they could be used to improve the human condition if guided by the appropriate social formation. Instead, the factory system and associated division of labor which comprised the capitalist mode of production caused alienation through conflict with Bildung.

Bildung, the “core human value in liberal romanticism,” is loosely defined as a process of becoming which can be equated with concepts such as “growing up,” “self-development,” and “becoming who you are” (Berman 1999:9-10). Marx combined this concept with his belief in the Enlightenment ideals of unfettered human creation and personal fulfillment to create a social theory of how the production of ‘things’ in turn produces social relations (Marx and Engels 1970). Marx believed that the essence of humanity was to shape and transform the self and world through creative acts of labor. Labor is essentially a process of objectification, or
Entausserung, as the thing which is created is the objective expression of the subjective design and intentions of the creator (Beilharz 2005:9). Much like the machine, objectification is not an inherently negative phenomenon as it results in self-consciousness; by confronting the objective manifestation of our subjective identities we reaffirm our individuality. Furthermore, when we create objects that are consumed by others we gain fulfillment, as something that is the manifestation of our essential character has fulfilled a need that is part of another’s essential nature (Marx 1977). The capitalist division of labor corrupts the objectification process by denying humans the ability to freely and creatively labor, a process known as alienation, or Entfremdung (Beilharz 2005:9).

According to Marx (1959) there are four degrees of alienation, the first of which involves the worker surrendering control over the object of her labor. Thus she objectifies herself, but not in the manner of her choosing. The second manifestation involves alienation of the worker from the productive process. This form of estrangement precludes the possibility of fulfillment through production and reduces labor to a commodity (Beilharz 2005; Edgar 2008). The demand for unskilled labor replaces the need for the skilled artisan and craftsperson, and the practical knowledge they embody. In the third type workers are alienated from each other as each is evaluated by their “ability to fulfil [sic] a pre-existing function within the production process” (Edgar 2008:9). This in turn has the effect of promoting competition or indifference between workers rather than cooperation. The final aspect involves the alienation of workers from what Marx (1959:31), borrowing from Feuerbach (Held 2009), called “species-being.” If to be human is to creatively labor, then alienated labor denies the worker her humanity (Beilharz 2005; Edgar 2008).
Marx was not the only social theorist who recognized the rupture caused by the emergence of industrial society. Weber disagreed with Marx’s materialist account of the origins of capitalism, but he did concede that the material conditions of capitalism had achieved a critical mass. Weber (1930:123) expressed this view in stating that capitalism “is now bound to the technical and economic conditions of machine production which…determine the lives of all the individuals who are born into this mechanism, not only those directly concerned with economic acquisition, with irresistible force.” The factories of industrial society were not only scenes for the alienation of labor, but also processes of rationalization. Unlike earlier economic forms that were characterized by slow and steady development, the objective of capital accumulation which is central to capitalism encouraged rapid technological development and mechanization. This process of technical rationalization involved the development of technologies and labor processes oriented towards the goals of increasingly efficient and calculable production processes for the purpose of maximizing the potential for profit (Kivisto 2005:403-4). Rationalization was not confined to the factory system, as instrumental rationality came to dominate social action within capitalist society. Instrumentally rational action is both calculating and strategic, involving the use of cost-benefit analysis to choose the course of action that has the highest probability of resulting in the achievement of desired goals (Weber 1978:24).

Whether due to the inherent properties of machines or their use on a grand scale within capitalism, the general theme of the preceding paragraphs has been that industrial production and the organization of labor it requires have in one way or another resulted in some sort of qualitative change in the human-technology relationship. We can contrast our earlier discussion of techne with that of machines, which have been said to separate us from: our senses and by
extension bodies, knowledge of ourselves and the external world, our fellow human beings, and our own humanity. With this in mind it would seem that technology, in this instance manifested by machines, exists as something separate and different from the other realms of human experience. The question which follows is whether these ontological and metaphysical conclusions are valid or simply an illusory framing of technology resulting from historical experience. A simple solution to this conundrum would be to skirt the issue; I study prehistoric technology, therefore the human-technology equation as it is configured within modernity is not essential to this study. In addition to being overly simplistic and false, this answer runs contrary to the theme of this study. As will be shown in Section 2.4, failure to acknowledge our historically contingent understanding of technology carries the danger of presentist accounts of ancient technologies and technicians. The contents of this chapter so far have been concerned with documenting the forces which have shaped the contemporary Western view of technology, and how this view differs from those of antiquity. At this point the discussion will turn to a critical engagement with technology in the present by addressing questions such as: what is the nature of technology, what does it do, and how does it shape our experience of the world, if it shapes our experience at all.

Thinking about Technology: Contemporary (Western) Views

This chapter began with an overview of the origins of philosophy of technology within the Western tradition and an account of certain historical events and processes that challenged early understandings of the human-technology equation. Pre-20th century explorations of technology were largely pursued as a means of gaining knowledge of other phenomenon. It was not until the mid-20th century that a philosophy of technology emerged which took illuminating
the essential character of technology as its prime objective (Reydon 2012). As will quickly become evident, the work of earlier philosophers and social theorist provided the seeds from which contemporary position germinated.

Following Feenberg (1999:9, 2003:4-9), contemporary definitions of technology can be categorized by their perspectives on two central issues. The first concerns the neutrality of technology; is technology value-laden as the ancient Greeks believed, or value-neutral as Enlightenment scholars had argued? Are technologies simple tools or strategies that we employ to satisfy a need, or do technologies create ways of life by framing our actions? Feenberg (2003:4) employs a comparison between a machine and money in order to illustrate the distinction between value-neutral and value-laden technologies:

From one perspective a technical device is simply a concatenation of causal mechanisms. No amount of scientific study will find in it anything like a purpose. But from another perspective this misses the point. After all, no scientific study will find in a 1000 yen note what makes it money. Not everything is a physical or chemical property of matter. Perhaps technologies, like bank notes, have a special way of containing value in themselves as social entities.

The second issue concerns whether or not humans are able to control the evolution of technologies once they have been brought into existence. If we are able to control the development of technical systems, then technology is something which bends to our will. If we are not able to control technological evolution, then technology is autonomous and has its own inherent structure that humans must follow. When the positions taken on these issues are displayed graphically, four distinct approaches to technology can be delineated (Table 2.2).

Instrumentalism carries within it the remnants of the Enlightenment belief in progress through technological evolution. It perceives technology as something which is value-neutral and under human control. Technology is simply something we use to satisfy our needs as we see fit. Winner (1986) has argued that instrumentalist views have led to a situation of technological
somnambulism, where the human – technology relationship is deemed to be simply “too obvious to merit serious reflection” (Pfaffenberger 1988:238). Instead, it consists solely of mundane processes of making and using, both of which are of limited interest only to specialized groups such as engineers and technicians (Winner 1986). As was mentioned in a previous section,

<table>
<thead>
<tr>
<th>Technology is:</th>
<th>Autonomous</th>
<th>Humanly Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>Determinism</td>
<td>Instrumentalism</td>
</tr>
<tr>
<td>(complete separation</td>
<td>(e.g. traditional Marxism)</td>
<td>(liberal faith in progress)</td>
</tr>
<tr>
<td>of means and ends)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value-laden</td>
<td>Substantivism</td>
<td>Critical Theory</td>
</tr>
<tr>
<td>(means form a way of</td>
<td>(means and ends linked in systems)</td>
<td>(Choice of alternative means-ends systems)</td>
</tr>
<tr>
<td>life that includes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ends)</td>
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</tr>
</tbody>
</table>

Figure 2.1. Contemporary approaches to technology (after Feenberg 1999:9).

instrumentalism is a common view in the West that is shared by both the general populace and many scholars who do not specifically study technology (Winner 1986) to such a degree that it has been bestowed the moniker of the “standard modern view” (Feenberg 2003:5), or more simply the “Standard View” (Dobres 2000; Pfaffenberger 1988, 1992).

If technology is viewed as something which operates autonomously in service of value-neutral objectives of efficiency and progress, than it can be characterized as deterministic (Feenberg 2003:5). Proponents of technological determinism support the theory that the implementation and operation of specific technologies require specific social institutions. Under a strong determinism, it is the technology which calls into existence the required form of social
organization and any ensuing social change results from the development of new technologies, or modification to the operational requirements of existing technologies (Mitcham 1984; Winner 1986). Within soft determinism technology is much like a runaway train, where humans may attempt to direct it, though there is no guarantee of success. Despite differences concerning the emergence of technologies, all versions of determinism argue that humans have little to no control over the evolution of technological systems once they have been implemented.

As opposed to instrumentalism and determinism, the remaining two positions are more complex than those sketched in the preceding paragraphs and constitute a significant departure from traditional archaeological discourses on technology. They are relevant nonetheless, as they represent avenues leading beyond basic instrumentalist and determinist positions towards a more nuanced understanding of technology. The first of these positions is substantivism, which shares with determinism the belief in autonomous technological development. In fact, most substantivists are also determinists (Feenberg 2003); the point of divergence for these perspectives is the attribution of value systems to specific technologies that occurs within a substantivist framework. Technologies are not neutral, but rather embody specific values that in turn direct human behavior. Unlike determinism’s vision of progress through technological development, substantivists hold the position that “technology is inherently biased toward domination” (Feenberg 1999:3), and ultimately leads to dystopian social conditions. To place this perspective in context, some of the strongest substantivist arguments can be found in the work of Heidegger (1977) and Ellul (1964).

Feenberg (1999), in presenting his critical theory of technology, argues that while substantivists are correct in arguing that technologies are value-laden, their belief in a singular essence of technology (i.e. domination) is problematic. Critical theorists do not deny the
deleterious, and at times catastrophic effects of certain technologies, but these are largely due to
the failure of humans to develop structures to control technology. As such, the essentialism that
underwrites substantivism is rejected in favor of a view technology that is imbued with values
that are “socially specific,” and plastic (Feenberg 2003:7). Technology has the ability to
improve human life when processes of design, implementation, and use are democratized. In
addition to Feenberg, a critical theory of technology can be found in the work of Marcuse (1964)
and Foucault (1977). What substantivism and critical theory hold in common is the recognition
that the essence of technology, however that may be defined, is markedly different in modernity
than it was in earlier periods.

To what degree are archaeological discourses on technology impacted by these
philosophical perspectives? As will be shown below, the history of archaeology’s engagement
with technology has been dominated primarily by determinist and instrumentalist positions. It
has not been until quite recently that archaeologist have begun explore the substantivist and
critical positions outlined above.

**Archaeology’s Engagement with Technology**

What follows is a necessarily brief and fragmentary history of archaeology’s engagement
with technology. It is largely based on Dobres (2000, 2009) and Trigger’s (2007) works, and
will shift back-and-forth in geographical focus as necessary. Any questions concerning the rigor
of a narrative which employs an inconsistent scale should be at least partially alleviated through
the common themes that emerge regardless of time or space. That is, technology has been called
upon time and time again in support of each archaeological paradigm, and the manner of support
provided by the concept has been reflective of broader social currents. Whereas the first part of
this chapter focused on deconstructing modern understandings of technology, the paragraphs
below will outline how each paradigm employed technology, and in turn the malleability of the concept.

One Hundred Years of Hardware: Evolutionary to Culture-Historical Archaeology

Antiquarianism and early classical archaeology approached technology as a peripheral or ancillary arena of inquiry, but this changed drastically with the emergence of prehistoric archaeology in the 19th century (see Trigger 1996 Chapter 2-3 for discussions of antiquarianism and classical archaeology). From the Old World to New, archaeologists now created typologies based on the morphological attributes of artifacts in order to delineate ancient cultures in time and space. One of the earliest examples, and perhaps the most famous, derives from the refined Three-Age System of Danish archaeologist Christian Jürgensen Thomsen (1788-1865). In an early form of evolutionary seriation (Willey and Sabloff 1993), Thomsen successfully sorted all of the archaeological assemblages that had been collected by the Danish Royal Commission for the Preservation and Collection of Antiquities into discrete cultural units based in part on the perceived technological complexity of the artifacts. Thomsen’s approach to organizing archaeological assemblages quickly spread outside of Scandinavia, particularly through the contract work of Jens Worsaae (1821-1885) in Britain, Ireland, and Scotland (Trigger 1996:121-127). The popular success of Thomsen’s methods can be partly attributed to the degree of fit with the narratives of evolutionary approaches which dominated the natural and social sciences at that time. In line with Enlightenment thought, evolutionary perspectives held that “the hallmark of humanity was the evolution of technology (from simple to complex) and the mastery of culture over nature through technical means” (Dobres 2009:117). Thomsen’s work, which had clearly demonstrated that the technologies used by ancient peoples in Denmark progressed from simple to complex, was viewed as clear support of unilineal social evolution. However,
Thomsen’s perspective was not explicitly evolutionary, but instead viewed the archaeological record of Denmark to represent the migration of different populations or the diffusion of technologies.

In France, an origin for the technological progress documented by Thomsen and Worsaae for the Stone through Iron Ages was extended back into the Palaeolithic by Gabriel de Mortillet (1821-1898). Drawing on his background in geology and palaeontology, Mortillet sought to identify specific artifacts that could act as index fossils (fossiles directeurs), which in turn would allow sites to be dated, their cultural affiliation to be deciphered, and their evolutionary stage determined (Trigger 1996:149). Unlike Thomsen, Mortillet explicitly argued that unilineal social evolution was a natural law, and that all societies progressed through the same stages, though at differing rates. This was based upon the Enlightenment philosophy of ‘psychic unity,’ which held that all humans possessed comparable cognitive functions, and that under similar circumstances societies would evolve along similar trajectories. A number of trajectories, or evolutionary stages, were developed by authors such as E. B. Tylor (1865) and Lewis Henry Morgan (1877), and typically outlined a process beginning in “savagery” and ending in civilization (i.e. European). Contemporary non-Western cultures were viewed as belonging to differing stages along this evolutionary continuum, and as analogs for archaeological cultures.

In contrast to proponents of psychic unity, there was a much darker side to evolutionary perspectives as exemplified by the work of John Lubbock (1834-1913). Lubbock argued that a society’s level of technological complexity (i.e. evolutionary stage) was not simply due to different rates of progression along a continuum, but rather had a basis in biology. He employed Charles Darwin’s (1809-1882) theory of natural selection to argue that over time human groups had evolved differential abilities to utilize culture, and thus master nature. This explicitly racist
proposition provided foundational support for the colonization of indigenous peoples around the world, as it stated that these people lacked the ability to evolve to a civilized state without outside influence (Trigger 1996:171-76).

In short, technology was the prime-mover behind evolutionary archaeology. It was viewed as the key variable which could be employed to empirically determine the evolutionary stage of archaeological or contemporary cultures, and thus the tool by which human history could be charted. Beyond functioning as a marker for evolutionary stages, the complexity of a society’s technology was used to justify the hierarchical ranking of human groups, where the material-poor technologies of many indigenous peoples, such as the Australian Aborigines, were taken to be clear evidence of their primitiveness (Dobres 2009).

Beginning in the late 19th century, evolutionary perspectives witnessed a concomitant critical evaluation and decrease in popularity. Though the origins of this decline were diverse and differed between the Old World and New, evolutionary archaeology’s insistence on coupling technological and human progress provided one of its most critical challenges. Low standards of living and declining working conditions in the factories of Central and Western Europe provided ample fodder for those questioning the merits and desirability of technological progress (Dobres 2000, 2009; Trigger 1996; Mitcham 1996; Nye 2006). At the same time, nationalist sentiment and racism heightened dramatically as increasing industrialization fueled competition for global marketplaces, and attempts were made to shift the perceived origins of economic hardship outside of national boundaries. In the realm of archaeology, these broader social currents combined with a growing awareness of the drastic geographical variability in archaeological assemblages and the emerging concept of culture to point towards ethnicity as the prime-mover of human history (Dobres 2009; Trigger 1996). Archaeologists working within the United States
were not faced with the fervent nationalism that was occurring in Europe. Instead, parallel evolutionary perspectives came under fire from the cultural relativism and historical particularism espoused by Franz Boas (1858-1942) and his students (Dobres 2009; Trigger 1996; Willey and Sabloff 1993). It is within this broader context that culture-historical archaeology emerged.

Culture-historical archaeology shared much with its evolutionary predecessor, including its formalist perspective, focus on technology, and use of diagnostic artifacts as index fossils. However, the new goal was to identify and describe archaeological cultures and their spatiotemporal boundaries, rather than document evolutionary stages of development. The concept of archaeological cultures derived in large part from analogies drawn between ethnographic cultures and spatially restricted suites of artifacts, and Tylor’s (1871:1) definition of culture as “that complex whole which includes knowledge, belief, art, morals, law, custom, and other capabilities and habits acquired by man as a member of a society.” Technology was now considered only one aspect of culture, one which was no more important than any of the other institutions identified in Tylor’s definition. Even armed with a new understanding of technology’s relationship to culture, formal attributes of artifacts and production techniques remained some of the primary means of organizing archaeological assemblages (Dobres 2000; 2009).

The emergence of culture-historical archaeology was a gradual process that was led by the Swedish archaeologist Gustaf Oscar Montelius (1843-1921). Building on the work of Thomsen, Montelius was able to refine the Three-Age system into a number of smaller periods via seriation, which involved chronologically ordered typologies based on the formal attributes of artifacts (Trigger 1996:224-5). A number of European archaeologists independently began to
use Montelius’ methods to identify archaeological cultures and employ them in efforts to project contemporary ethnic identities into the past in the interests of nationalism (ibid). One of the most well-known examples of this practice is the settlement archaeology (Siedlungsarchäologie) of Gustaf Kossinna (1858-1931). Unlike the contemporary practice of investigating habitation sites which shares the same name, Kossinna’s work was concerned with identifying where specific ethnic groups had lived in antiquity based on the distribution of diagnostic artifacts. He argued that this was possible due to the fact that artifacts were a product of culture, and culture was a reflection of ethnicity. “Hence, clearly defined [material] cultural provinces always correlate with major ethnic groups or peoples, such as the Germans, Celts, and Slavs, whereas individual cultures correspond with tribes, such as the Germanic-speaking Saxons, Vandals, Lombards, and Burgundians (Trigger 1996:37).” Kossinna argued that the presence of material culture typically associated with prehistoric Germanic peoples in neighboring countries, particularly Poland and what was then known as Czechoslovakia, provided clear evidence that those lands were the rightful property of Germany. Kossinna’s work was part of the larger völkisch movement, and would later provide the foundation upon which Nazi archaeology was built (Arnold 1990; Arnold and Hassmann 1995). Borrowing from Kossinna, V. Gordon Childe (1929:v-vi) codified culture-history’s object of study when he penned the following:

We find certain types of remains – pots, implements, ornaments, burial rites, and house forms – constantly recurring together. Such a complex of associated traits we shall term a ‘cultural group’ or just a ‘culture’. We assume that such a complex is the material expression of what today would be called a ‘people’.

Unlike Kossinna, Childe (1958) had serious doubts as to the feasibility of identifying ethnic groups in the past based on archaeological materials, as he believed that processes of cultural diffusion and migration would have blurred any such distinctions.
In brief, culture-history’s polythetic, normative view of culture and the methods which were used to define archaeological cultures resulted in a tendency to particularize, rather than generalize and stress the connections between past societies. The outcome of this normative view was that past cultures were viewed as static entities which required the presence of external processes, such as diffusion and migration, in order to explain changes in material culture. As such, culture-historical studies produced descriptive narratives of how artifacts moved through space and time, with little-to-no discussion of the processes driving these changes (Johnson 2011; Trigger 1996). While technology was supposed to be only one among many equally weighted components of culture, it returned to the forefront as archaeologists replaced people with increasingly detailed lists of artifacts and production techniques. In many cases this technological fetishism was grounded in what would later become known as Hawkes’ ‘ladder of inference.’ Hawkes (1954:161-62) argued that in prehistoric contexts technology was fairly easy, though perhaps laborious, to study and understand. At the opposite end of the spectrum were socio-political and religious institutions which were extremely difficult if not impossible to reconstruct. According to Trigger (1996:306), the logic underlying Hawkes’ ladder “is that universal physical laws play a major role in shaping technology, whereas idiosyncratic and highly variable cultural factors influence human beliefs and behavior.” Returning to the disappearance of people from archaeology under culture-history, Dobres (2009:119) echoed the sentiment of Willey and Sabloff (1993) when she stated that “[p]ot sherds, lithic index fossils, and techniques of fabrication became such a fixation by the early 1930s that artefacts [sic] came to stand for entire cultures, such as (in America) the Basket Makers, the Pueblo-Builders, and the Red-on-Buff Culture, and (in Europe) those infamous Beaker Folk.”
Finally, though the explicit role of technology within evolutionary and culture-historical archaeologies differed, both paradigms defined technology as “hardware”; that is, artifacts and the techniques by which they were produced. Dobres (2009:120) points to Kehoe’s (1994:10) concept of “detached constructs” to illustrate how evolutionary and culture-history archaeologies viewed technology as being a domain apart from other social institutions. Archaeologists working within both paradigms never seemed to consider the possibility that artifact forms and production techniques, along with their spatiotemporal distribution, could be explained by reference to social processes such as divisions of labor or cultural values of ancient peoples (Dobres 2000, 2009).

*Functionalist and Materialist Perspectives: Cultural Ecology to Processualism*

Much like nineteenth century Europe, the power and prosperity experienced by the upper and middle-classes of post-World War II America resulted in a resurgence of the Enlightenment idea of technological progress. It was generally believed that the quality of life within societies past and present was characterized by constant improvement, and that technological advances were responsible for this historical trend. Within anthropology these views were combined with a growing dissatisfaction with what was perceived as Boasian anthropology’s inability to explain how cultures changed. Furthermore, the idealist epistemology that supported Boasian anthropology was falling out of favor as the social sciences transitioned to positivist and behaviorist frameworks (Trigger 1996:386-7). The end result of these processes was the emergence of a neoevolutionary paradigm that began as a collection of ecological-functionalist approaches.

Principle among early neoevolutionist was Leslie White, a man Lewis Binford (1972:6) referred to as “the dragon slayer of Boasianism.” White (1949, 1959) developed a generalized or
‘universal’ law for cultural evolution that was driven by technological determinism, and can be expressed by the formula: \( E \times T = C \). In this formula “C represents the degree of cultural development, \( E \) the amount of energy harnessed per capita per year, and \( T \), the quality or efficiency of the tools employed in the expenditure of energy” (White 1949:368). Thus, technology returned to center stage as the prime-mover of cultural evolution, as it was the primary means by which energy was both captured and expended. Within this model the complexity of a culture and its ability to efficiently capture energy evolved concurrently. In one of the first strictly archaeological applications of neoevolutionary theory, Betty Meggers (1960) modified White’s formula to: Culture = Environment x Technology. White (1959:18) was quite explicit about his deterministic views, even going so far as to title a section in one of his books as “Technology: The Basis and Determinant of Cultural Systems.” It is within this section that he (ibid:20) illustrates how social systems are determined by technology through the following formula: \( T(S_b \times P_r \times D) = \text{society} \), whereby technologies related to subsistence, protection from the elements, and defense from enemies determined the form of a social system.

White’s use of mathematical formulae can be seen as foreshadowing later trends in New Archaeology, where the application of such conventions were employed as a means of becoming more ‘scientific’ (Dobres 2000). This trend towards becoming more empirical and scientific was continued with Julian Steward’s (1955) nomothetic theory of multilinear cultural evolution. For Steward, the environment did not directly determine how a culture, or ‘culture core’ developed, but instead limited its evolutionary trajectory to within a specific range of possibilities. Technology, and in particular those related to subsistence, was the primary means by which humans adapted to their environment and by which social systems were shaped. From a methodological standpoint, Steward (1955:39-42) pegged subsistence technology as the starting
point of any cultural ecological analysis as it was “the window between the natural
world…human society and culture” (Richerson 1996:19).

Marshall Sahlins (1960:27-31) argued that the work of White and Steward did not
necessarily represent competing approaches to cultural evolution, but rather different
perspectives that emphasized either “specific” or “general” facets of the same process. Specific
evolution was concerned with how cultures adapted to their environments, while general
evolution outlined the progression of cultures through increasingly complex social arrangements.
Trigger (1996:389) suggests that Sahlins’ dichotomy was an attempt to conceptually separate
evolution and progress, though in practice neoevolutionary approaches continued to be
characterized by unilinear narratives. He also points out that neoevolutionary approaches like
those of Sahlins (1968), Service (1962, 1975), and Fried (1967) were underwritten by a belief
that technologically advanced societies possessed greater selective fitness, and as such were
more likely to evolve into progressively complex forms (Trigger 1996:389). Despite the many
similarities, the materialist positions outlined above represented a significant departure from 19th
century evolutionary perspectives in that they were all deterministic. Whereas early
evolutionists argued that culture change was often related to efforts by humans to improve their
conditions, the neoevolutionists argued that societies strived to maintain the status quo and only
changed in response to external factors. Nonetheless, neoevolutionary perspectives continued
the long tradition of viewing technology as hardware.

Beginning in the mid-1950s, Americans experienced a number of events which began to
dampen the overall feelings of optimism that had characterized post-war America, and which
also called into question the supposed benefits of technological progress. Looming large was the
Cold War and the prospect of armed conflict with the Soviet Union, be it conventional or
nuclear. In contrast to much of the intellectual community in continental Europe, the Second
Red Scare and McCarthyism prevented explicit explorations of Marxist theory by academics and
lay people alike (McGuire 2002). The constant conflict resulting from the United States’
containment policy, especially in Vietnam, combined with a steady cycle of economic recessions
to produce a growing number of protest movements. Of particular relevance to archaeology was
the emergence of the environmental and conservation movements (Trigger 1996:410-11).
Rachel Carson’s *Silent Spring* (1962) is often credited as being the primary piece of literature
which helped launch and popularize the environmental movement. It is in this book that Carson
outlined how technological processes, and in particular the use of pesticides, were wreaking
havoc on the environment and human populations. As for the conservation movement, Paul and
Anne Ehrlich’s *The Population Bomb* (1968) argued that industrial technologies were rapidly
exhausting the Earth’s natural resources, and that current rates of population growth were
unsustainable. These movements were preceded by a belief that the United States was losing
technological and scientific superiority to the Soviet Union, a view that seemed to be particularly
salient following the launch of Sputnik in 1959 (Pauketat and DiPaolo Lauren 2004). Not
surprisingly, developments in anthropology and archaeology mirrored these broader social
trends, as the Enlightenment idea of progress was once again abandoned. Archaeologists now
saw one of their core missions to be the scientific investigation of the conditions under which
complex societies had succeeded or failed in the past, with a view to how this data could
potentially be used in the future (Trigger 1996; Dobres 2009). Human ecology and general
systems theory, particularly in its cybernetics form, provided the backbone of what would come
to be known as the New Archaeology (Dobres 2000).
Historiographies of archaeology often portray the emergence of New Archaeology, or processual archaeology, as a direct and revolutionary response to culture-history led by Lewis Binford. However, this view largely ignores the intellectual debt owed to antecedent neo-evolutionary perspectives, and the fact that many of the themes which would come to characterize New Archaeology were already gaining in popularity by the late 1950s (Caldwell 1959). Furthermore, some have even argued that much of what Binford was railing against no longer accurately reflected the work of many culture-historians (Lyman and O’Brien 2004; Trigger 1996; Webster 2009). Nonetheless, Binford (1962, 1965) is typically credited as having both penned New Archaeology’s first position pieces while also serving as the standard-bearer for the nascent paradigm.

In brief, New Archaeology largely began as a “set of questions” (Clarke 1973:17) arising from a general mood of dissatisfaction with the type of studies that were being produced by culture-historians (Johnson 2011; Trigger 1996). Much of this dissatisfaction can be associated with three interrelated, core issues. First, the particularistic and descriptive accounts of culture-history were perceived as being less than scientific; New Archaeologists wanted to focus on commonalities and long-term general trends across cultures in order to discover “laws of cultural processes” (Binford 1965:205). This aim was to be achieved through the combination of a number of methods, including the use of the hypothetico-deductive-nomological model of knowledge creation, random sampling, and statistical analyses (Clarke 1968; Johnson 2011; Watson et al. 1971). Consequently, this new scientific (i.e. positivist) approach allowed archaeologists to qualify for funding through the National Science Foundation, just as the federal government was increasing available funding in an effort to achieve dominance in the international science race (Pauketat and DiPaolo Lauren 2004). New Archaeologists also took
issue with what they perceived as culture-history’s lack of relevance to the broader field of anthropology due to its normative conception of culture. Though the validity of equating archaeological assemblages to past human communities had been questioned as far back as Childe (1942), it was archaeologists like Clarke (1973) that launched the most forceful and convincing arguments against these simplistic correlations (Johnson 2011). Also of issue was culture-history’s “aquatic view” of culture, whereby diffusion was the primary means through which cultures changed (Binford 1965:204).

Almost as soon as it emerged, New Archaeology, which quickly became known as processual archaeology, began to diversify (Kushner 1970; Trigger 1996:418-44). Nonetheless, one of the central themes which united the various strands of processualism was a new definition of culture as a “homeostatic-seeking system necessarily adapting to external (environmental) stimuli” (Dobres 2009:120). According to Dobres (ibid:120-1), as a result of the conception of culture espoused by processualism:

…technology studies returned to centre-stage [sic] in archaeology. Explicitly conceptualized as the core subsystem most directly impacted by and sensitive to the environment, technology was placed on something of a pedestal, defined as humanity’s primary, but ‘extrasomatic,’ means of adaptation (White 1959:8; also Binford 1965:209, 1968). With recourse to a plethora of technometaphors, culture was likened to a well-oiled perpetual motion machine, or a thermostat, seeking ‘homeostasis’ through various behavioural [sic] ‘mechanisms designed to counterbalance so-called deviation amplifying events (notably, Clarke 1968:48-54).

In much the same way that New Archaeologists criticized culture-history, this partitive, systemic view of culture also looked past human beings by focusing on the relationships between subsystems in order to reconstruct the underlying ecological system (Dobres 2000; Flannery 1973; Johnson 2011). Since culture was an adaptation to the external environment, and technology was the subsystem with which it interfaced directly, “technology gained enormous analytical and explanatory power, for technology explained not only how cultures functioned in
the past but also why they changed” (Dobres 2009:121 italics in original). While most of early processual archaeology’s techno-metaphors that most riled its paradigmatic counterparts have been retired, they remain implicit in contemporary processual approaches.

Seeking the Social: Symbolic and Structuralist Perspectives

By the 1970s a growing number of archaeologists had become dissatisfied with the new orthodoxy of processualism. This movement differed from previous iterations of intradisciplinary tension in that it was not composed of a single alternative approach, but rather a mélange of different perspectives unified largely by their critique of processualism’s model of knowledge creation (i.e. behaviorism) and systemic view of culture. This movement has been neatly package as ‘post-processualism’ by those residing outside of this countercurrent, though few practitioners of these widely divergent approaches would label themselves as such. Processualism was by no means a monolithic entity, but these new approaches were notable for their disregard for disciplinary boundaries, enthusiasm for external theoretical developments, and sheer variety. Much of this outside influence emanated from debates within continental philosophy and social theory, especially those which occurred in France during the 1960s-70s. Some of these traditions, such as poststructuralism and postmodernism, presented challenges to the fundamental core and identity of archaeology as a scientific discipline via the rejection of positivism. Despite the vast swaths of theoretical terrain that remain uncovered, I would like to narrow the focus of the subsequent paragraphs to only a few developments most relevant to the view of technology espoused here.

Structuralism presented one of the earliest challenges to processual archaeology by offering a theory and methodology for “recovering mind” (Leone 1982). There are many variants of structuralism, though most trace their origins to the linguistic turn initiated by
Saussure’s (1983) structural linguistics. Saussure argued that there was an important distinction between the structure of language (langue) and the way that it is actually used (parole). Langue is composed of a system of signs, which in turn are comprised of a signifier and signified. The fact that the association between a particular signifier and signified is arbitrary results in a system where signs are made meaningful only through their (binary) opposition to/contrast with other signs. Thus it is the structure, or langue, which is most important as it actively creates meaning, and shapes both human understanding and action (Ryan 2005:805). Within anthropology the influence of Saussure is most evident in the work Lévi-Strauss (1963) where social structures are viewed as fundamentally communicative and expressive of underlying mental structures. The impact of structuralism on archaeology was that for some Hawkes’ (1954) ladder had been laid flat; “prehistoric thought patterns, long assumed to be irretrievable, can now be approached since no class of artifacts, whether of subsistence or of religion, is any further from the root of the culture than any other: the human mind ordered them all” (Leone 1982:743). Early examples of structuralist analysis in archaeology that received significant attention were Glassie’s (1975) study of Virginian architectural patterns and Leroi-Gouhnan’s (1982) study of Upper Paleolithic cave art, though Hodder’s (1991) The Domestication of Europe is perhaps the most well-known.

Not all who found processual archaeology problematic embraced structuralism with open arms, having instead found the theory lacking along three fronts. First, the ahistorical nature of structuralism is clearly problematic for a discipline that counts time as one of the key variables with which it constructs its narratives. Secondly, structuralism’s model of a closed (mental) system of formal rules lacks a theory of practice whereby agents can reflexively engage structures and also create new ones. This leads directly to the third issue, which is that this lack
of agency lends an air of determinism to the entire framework (Hodder 1982a, 1982b). In a rather unsurprising turn of events, these critics turned to the numerous strands of Marxist humanism for inspiration, which was the very body of thought that structuralism was developed to contest. The resulting positions attacked neoevolutionism, cultural materialism, cultural ecology, and ahistorical variants of structuralism for their lack of human agency, emphasis of stability, and reliance on external (i.e. non-human) factors to initiate change (Trigger 2007:444). Instead it was argued that human agency and intentionality should be privileged, that conflicts between different segments of society serve as significant motors of change, and that ideology was/is pervasive in both the past and present (Miller and Tilley 1984). If ideology is pervasive in the present, then this necessarily brings into question the claims of objectivity that emanate from processual archaeology.

Within the realm of technology studies this kaleidoscope of theoretical persuasions can be condensed into two general themes; symbolic and structural perspectives, and those that emphasize social agency and phenomenology (Dobres 2009). Both of these approaches assert the importance, if not primacy of the social aspects of technology. Neither theme represents a faithful replication of a grand tradition, but instead the selective borrowing of certain themes and concepts in the manner of bricolage. The first of these draws inspiration from structuralism in arguing that the organization of a technology and its associated production techniques are both constituted by and indicative of a culture’s belief system. It is this underlying deep structure or “worldview” (Dobres and Hoffman 1994, 1999) that is primarily responsible for shaping “surface” phenomenon such as tool design and raw material choice, rather than the external parameters of nature (Dobres 2009:124). Archaeologists can begin to approximate an emic perspective particularly in cases where ancient technologies exhibit redundant patterning
(ibid:126). It is interesting to note that this perspective is best exemplified by the work of Heather Lechtman, an archaeologist with processual roots, and Pierre Lemonnier, a French social anthropologist.

Lechtman (1977:4) has drawn upon structuralist principles to argue that “technological style” (*parole*) is the material expression of deep seated cultural structures (*langue*). Therefore, technology is a fundamentally communicative system where both artifacts and production techniques have symbolic meaning. She further argues that though certain technological styles may appear to be tradition-bound, they are not isochrestic (Sackett 1990), and instead are symbolic of “the attitudes of artisans towards the materials they used, attitudes of cultural communities towards the nature of technological events themselves, and the objects resulting from them” (Lechtman 1977:10). These attitudes are most apparent in cases where there is redundant patterning across multiple technologies. Lechtman (1984:35) was able to identify a common pattern guiding Andean metallurgy and cloth production that she has labeled a “technology of essences”.

In brief, Andean peoples greatly valued the colors gold and silver, both of which occurred automatically in items made from these materials. In order to obtain these colors when using a different metal, such as copper, the material had to undergo some sort of modification. Lechtman (1977) notes that the easiest and most ‘efficient’ means of achieving this transformation is through surface coating techniques such as applying a foil, or a thin layer of the desired colored metal in molten form. Instead, Andean metalworkers approached this transformation from a completely direction by introducing the desired color (e.g. gold) into the parent material (e.g. copper) in molten form. This caused the metal with the desired color to be distributed homogenously within the objective material. After cooling, the surface of the new
alloy was chemically treated so that the copper was removed and only the gold remained. Lechtman (1984:30) argued that this complex manufacturing process was guided by and reflective of a broader concern with essences within Andean cultures; “the object is not that object unless it contains within it the essential quality, even if the essence is only minimally present.” Her premise was further supported by the identification of a similar pattern in the realm of textile manufacturing. Andean textile production was dominated by structural design techniques, where the design is incorporated/produced through the weaving process. This method stands in contrast to suprastructural design techniques which involve embroidering design elements onto a completed fabric that serves as a backing. Suprastructural designs can be removed without destroying the textile, whereas the removal of structural designs would result in the destruction of the fabric. Lechtman’s (ibid:31-32) argument is that structural techniques result in the design becoming part of the essence of the textile.

Pierre Lemonnier, working within the French tradition of technologie culturelle, shares many of the themes and structuralist undertones that permeate Lechtman’s studies. His point of embarkation is the critique that most studies linking the technical and the social focus primarily on how technology affects other aspects of society, or what a culture is trying to communicate through their technologies (Lemonnier 1993:2). In the former, technologies are perceived as essentially constraining, as they mediate between the conditions of the natural world and society. In the later there is a tendency to focus on the overt characteristics of the material expression of a technology, such as costume design or color, instead of the bundle of knowledgeable practices that guided the production and use of that technology (Lemonnier 1992, 1993). These reductionist approaches fail to appreciate the degree to which technology is simultaneously enmeshed in all aspects of society (Dobres and Hoffman 1994:219).
At the core of Lemonnier’s anthropology of technology lies the premise that techniques, as in Mauss’ (2006 [1935]) effective and traditional (i.e., learned) action, are means of social production. Whether expressed through gestures or artifacts, techniques are the “physical rendering of mental schemas learned through tradition and concerned with how things work, are to be made, and to be used” (Lemonnier 1993:3). Each technique arises from the interplay of five components: matter, energy, objects, gestures, and technical knowledge. Technical knowledge is culturally conditioned, and as such results in idiosyncratic perceptions of the possibilities and choices for technical action, or what Lemonnier refers to as social representations of technology (Lemonnier 1992:5-6). To be clear, the properties of the natural world create boundaries for techniques, but within these boundaries differences in social representations result in cross-cultural variability in social practices. Once again this is a clear nod to Mauss (2006 [1935]), as he made the same argument when he asserted that variation in techniques of the body (e.g. walking, digging, etc…) were indicative of differences in underlying social logics.

*Chaîne opératoire*, or operational sequence, involves documenting how things are made and used, and serves as the analytical methodology for studying techniques. This concept is discussed in detail in Chapter 6, but at this point it is sufficient to say that temporal and spatial variations in *chaîne opératoires* are explained in reference to broader symbolic systems and cultural logics (Lemonnier 2012). Lemonnier (1992, 1993) has had greatest success making these connections within the realm of ‘technological choice.’ This choice can refer to situations where multiple techniques were known but only one was chosen, when an old technique is rejected for a new one, or innovation was rejected in favor of tradition. In all three cases a technological choice was made, though the choice was not necessarily the result of conscious
contemplation of alternatives. Lemonnier’s ethnographic work among the Anga peoples of Papua New Guinea demonstrates that technological choices are guided by worldviews rather than material constraints. Furthermore, he suggests that the marking of difference, be it individual status or group identity, may be one of the basic functions of technological choices (Lemonnier 1993:19).

In conclusion, the first two sections of this chapter documented how dominant archaeological discourses on technology (i.e., instrumentalism and determinism) emerged out of the historical dismantling of techne. The work of Lechtman and Lemonnier provides a pathway that leads away from the contemporary ‘hardware’ view of technology towards something more akin to techne. They have shown that technologies are not detached constructs, nor can they be reduced to extrasomatic adaptive mechanisms. Technologies are subject to material constraints, such as raw material properties, though these alone cannot account for the constitution of a technological system (Dobres 2009). This is demonstrated in Chapter 6, where it is shown that ancient Maya technicians living in very similar conditions developed different techniques of stone celt production. Instead, technologies are shaped by worldviews and ideas about how things should be done. Furthermore, both authors have demonstrated that in addition to the material expression of a technology (i.e., artifacts), the techniques involved in its production are just as, if not more important in creating and conveying meaning. Perhaps the greatest significance of their work is that “epistemologically, they have ably demonstrated that archaeologists can ‘recover mind’ (Leone 1982) and identify principles of aesthetic value and action through the analysis of redundant empirical patterns (and their variations) within and across technological realms” (Dobres 2009:126). These structuralist-inspired studies have provided the means for archaeologists to move beyond the material conditions of technology, but
they are not without their limitations. The next chapter builds on these gains while also broadening the scale of analysis to include micro-scale interpersonal/human-material interactions that are the foci of perspectives ground in social agency and phenomenology.
CHAPTER 3 LINKING THE SOCIAL AND TECHNICAL

Technology, defined anthropologically, is not material culture but rather a total social phenomenon…that marries the material, the social and the symbolic in a complex web of associations.

(Pfaffenberger 1988:249)

Having spent most of Chapter 2 documenting the dismantling of techne, Pfaffenberger’s comment is particularly germane as it reminds us that a fetishized view of technology is illusory. Stripped of context, the use of any epigraph carries the inherent danger of ambiguity, and so I wish to clarify his sentiment by stating that technology is not merely material culture.

Pfaffenberger’s view of technology as a ‘web of associations’ shares a non-coincidental similarity to the structuralism-inspired studies of Lechtman (1977, 1984) and Lemonnier (1992, 1993, 2012), in that they all owe an intellectual debt to the work of Marcel Mauss. The first section of this chapter explores the work of Mauss and its potential for providing a conceptual alternative to a fetishized view of technology via the concept of total social phenomenon. The second section injects a measure of agency into Mauss’s concept through a discussion of practice theories, including their historical development and major themes. The chapter closes with a nod to perspectives grounded in social agency and phenomenology as representing what I perceive to be the ideal synthesis of a large body of theory.

Technology as a Total Social Phenomenon

It is rather curious that the work of Marcel Mauss has received only minor attention by archaeologists operating outside of francophone circles. He was, after all, a staunch positivist
who eschewed abstract theorizing. He also dedicated a significant portion of his post-Durkheim career to studying a phenomenon which is central to archaeology – technology. Since his epistemological commitments and topical interests mesh so well with processual archaeology, to what can we attribute his relative obscurity? First, there is a general hostility towards French theory within certain circles of American archaeology that is undoubtedly couched within nationalism. This is particularly evident in Americanist lithic studies, where archaeologists have engaged in a largely one-sided debate over the historical primacy, epistemological foundation, and efficacy of the chaîne opératoire approach while simultaneously suggesting that it is simply a reduction sequence model “cloaked in a glamorous new wrapper” (Shott 2004:214). Aside from nationalistic sentiment, which I do not wish to portray as a widespread issue, there are far more elementary reasons for his lack of influence. Mauss conducted intensive research, lectured frequently, was heavily involved in French political life, but was not the most prolific writer. In terms of print, his primary means of engagement with the academy was through reviews of others’ work, though he did publish a single short monograph titled The Gift (2000 [1950]) which has become a core reading within anthropology. Most of what Mauss did write was not available in English until after the 1950s. Even so, I believe that the primary reason for the lack of interest in Mauss stems from his particular conception of human beings and social phenomenon as totalities.

Much of Mauss’s thought can be accurately portrayed as a reversal of the reductionism of his uncle, Émile Durkheim. Durkheim expended considerable effort carving out a niche for sociology as an independent discipline dedicated to the study of social facts. Social facts consist of “manners of acting, thinking and feeling external to the individual, which are invested with a coercive power by virtue of which they exercise control over him” (Durkheim 1982 [1895]:52).
Additionally, Durkheim (2005 [1914]) championed a dualistic view of the human being consisting of an individual bio-psychological and a social component which he termed *homo duplex*. There is a three-fold reductionism manifest within these two concepts: there exist certain phenomena which are uniquely social, these phenomena are the purview of sociological inquiry, and the human being is a dualistic entity. In contrast, Mauss found the artificial partitioning of humans and social phenomena along inter- and intradisciplinary boundaries to be questionable, and instead pursued a totalizing orientation. This is evident in his reassembling of the human subject via the concept of *l’homme total*. The ‘total human being,’ contra Durkheim’s *homo duplex*, is an entity “whose biological, psychological and socio-cultural characteristics make up an indivisible whole” (Gofman 1998:66). Mauss also turned his totalizing gaze to Durkheim’s social fact resulting in the concept of *fait sociaux totaux*, or what I shall hereafter refer to as total social phenomenon (Hart 2007). This concept is introduced by Mauss (2000 [1950]:3) in the opening lines of *The Gift* as a phenomenon in which “all kinds of institutions are given expression at one and the same time.” In this example, the gift and associated practice of reciprocal exchange in Melanesian society simultaneously involves politics, economics, religion, aesthetics, production and consumption, etc…, or the material, corporeal, social, and symbolic realms (Dobres 2000; Mauss 2000 [1950]; Pfaffenberger 1988; Schlanger 2006).

Mauss’s use of the concept of total social phenomenon conveys his epistemological and methodological commitments. In order to understand something “we must follow the example of the historians and observe what is given, rather than split up social phenomena into separate abstractions. The reality is always a concrete person acting in society” (Hart 2007:482). It may be necessary to take a partitive approach to the study of total social phenomena as a heuristic technique, but the researcher must always remain mindful of the synoptic view (Dobres 2000). It
is with these points in mind that I make the assertion that technology is a total social phenomenon that involves more than material transformations. Technologies embody the specific social, political, and economic contexts within which they emerge, and through human technical action these arrangements are perpetuated, contested, and transformed. Scholars working within the fields of Science and Technology Studies (Sismondo 2010), and the social construction of technology in particular (Pinch and Bijker 1999), have consistently demonstrated that the development and successful propagation of technologies as diverse as the bicycle and Bakelite (Bijker 1987) to nuclear reactors (Hecht 2009) are often driven by social factors rather than principles of technical rationality.

The utility of Mauss’s work is not restricted to his conceptual reframing of certain phenomena (e.g., technology) as totalities. In recalling the brief mention of his definition of techniques at the end of Chapter 2 we find both theoretical and methodological means of connecting archaeological data with ancient technicians and their broader social universe. Due to the importance of this concept, its definition will be reiterated along with an expanded discussion.

In his influential paper titled Techniques of the body (Les techniques du corps), Mauss turns his attention to the link between tradition and the body as a means of refining his conception of l’homme total. The majority of techniques he explores do not require or employ instruments (i.e., artifacts), but this should not be construed as an argument for a qualitative difference between techniques involving artifacts and those that do not. Instead, this narrow focus represents Mauss’s attempt to rescue body techniques from the designation of miscellany that had been imposed by his uncle (Durkheim and Mauss 1967 [1903]; Schlanger 2006). Mauss defines techniques of the body as “the ways in which from society to society men [sic] know
how to use their bodies (Mauss 2006 [1935]:78). Furthermore, these “uses are ‘technical’, ‘traditional’ and ‘efficient’: that is, they are constituted by a specific set of movements or forms; they are acquired by means of training or education; and they serve a definite purpose or function” (Crossley 1995:134). In the first part of this definition techniques are presented as embodied knowledge and frames of reference for action. The fact that techniques are traditional (i.e., learned) reveals their social origins. Mauss proceeds to give substance to this argument by documenting cross-cultural variation in body techniques as varied as walking, jumping, digging, giving birth, and even making love. This variation is not limited to cross-cultural comparisons, but also occurs between different genders, age groups, and economic classes within the same culture. He also notes that certain techniques, such as spitting, are not present in every culture which further points to the social rather than biological origin of techniques.

It is the technical and traditional nature of techniques that makes them particularly well suited to archaeological study. Techniques are fundamentally composed of a series of actions, which I will refer to as gestures (Leroi-Gourhan 1993). When executed in the context of material production, gestures often have material correlates which are identifiable in the archaeological record. Numerous methods exist for recording gestures and reconstructing techniques, including the chaîne opératoire approach that is mentioned in Chapter 2 and covered in detail in Chapter 6. Moreover, since gestures are traditional they often exhibit long term continuity. It is easy to file away these remarks as trite; that lithic debitage was produced through human action and that some material culture exhibits long-term homogeneity are not new ideas, nor are they provocative. But what is important to remember is that when we use artifacts to identify gestures and reconstruct techniques we have arrived at the nexus of l’homme total. Dobres (2000:152-153) illustrates this point in excellent fashion:
“At the same time that gestures are part of the physical body of individual technical agents…
they are also part of the body politic. If the corporeal body of the technical agent is the interface
between internalized and externalized realities interpreted through practice, then the technical
gestures practiced by that corporeal body are also internalized (as experientially meaningful) as
they are simultaneously witnessed (and interpreted) by others. Understood this way, technical
gestures, or what Mauss called *les techniques du corps*, becomes yet another site, or interface,
between the materiality of technology, social agency, tradition, and large-scale processes. “

Much like Barrett (2000) argues for agency, the content and color of our narratives does not
change the fact that ancient techniques are enmeshed within this broader web of associations.
Archaeologists can choose to restrict their investigations solely to the material aspects of ancient
techniques, or instead take the synoptic view of technology as a total social phenomenon.

Despite its utility, the concept of technique is not without its problems. Crossley
(1995:135) notes that Mauss correctly treats techniques as “historical and biographical
acquisitions,” but fails to recognize them as “on-going practices which accommodate the
anticipated exigencies of a present and future.” In other words, agents are not automata that
simply execute techniques acquired through tradition, but instead must act based on their
perception of present and future conditions. Mauss fails to provide an account of how agents
transform tradition into competent and knowledgeable social practice. Far from being unique to
Mauss, the themes underlying these critiques are reflective of a broader discourse within social
theory concerning the relation between structure and agency. While keeping Mauss’s conception
of techniques as embodied cultural schemas, it is to this body of theory that I now turn in search
of a more dynamic view technology.

**Linking Society and Technology through Practice**

I would like to preface the ensuing discussion of practice theories with two brief caveats
concerning its overall flavor. First, in anthropology, and especially archaeology, discussions of
practice theories tend to rely heavily upon the work of Bourdieu and Giddens even though the names of Archer, Habermas, Mouzelis, and Sahlins could, and perhaps should be added to the stable. Ortner (2001:275-6) suggests that the popularity of European practice theorists in America is a form of “eurofetishism” resulting from our colonial legacy. I disagree with her assessment, and instead argue that this popularity is attributable to the fact that the agency-structure debate originated in Europe, and remains a predominantly European enterprise (Ritzer 2000). A similar debate exists within the United States and is framed in terms of micro- versus macro-sociological perspectives, but there are important differences. Agency is a property of individuals and as such can be equated to micro-scale actors, though macro-scale social groups also possess agency. Furthermore, both micro- and macro-scale phenomena can embody structure. There has been increasing cross-pollination between the two different frameworks as evidenced by a number of homegrown American practice theorists (e.g., Ortner 2006; Sahlins 1981; Sewell 2005). Nonetheless, the fact that the structure-agency debate stems from a European intellectual tradition explains Americans’ penchant for European theorists.

The second caveat, which perhaps goes without saying, is that the account of the agency-structure issue presented below is largely shaped by my personal experience of the debate. With that said, the narrative would undoubtedly take a different form if told by a philosopher or social psychologist, but many of the core themes and players would remain the same. The most glaring omission is a thorough discussion of the more recent contributions of post-structurationist and critical realist perspectives. I would refer the reader who is interested in this material to overviews by Elder-Vass (2010) and Parker (2000).
To what extent does the traditional aspect of techniques constrain or enable human action? Is it something external to humans that shapes our actions or is it only instantiated in practice? For much of the 19th and 20th centuries, debates within social theory have been largely fueled by the tension between two antithetical social ontologies related to a single question: “is there something social that can be causally effective in its own right and not just as a side-effect of the behaviour [sic] of individual people” (Elder-Vass 2010:2)? Proponents of individualism answer ‘no’, and argue that social phenomena must be explained as having originated from individual action. At the opposite end of the spectrum are advocates of collectivism (sometimes referred to as holism), who contend that the social world is primarily constituted through the action of social groups which in turn shape individual action (Cohen 2005). These positions can be broadly equated with subjectivism and objectivism, or the concepts of agency and structure, respectively, and the manner in which the two are related constitutes one of the central problems in social theory (Giddens 1979). An explication of key concepts is in order before discussing a third perspective which attempts to move beyond this dichotomy through a focus on human action and interaction.

In the most general sense the concept of structure refers to large-scale social phenomena that shape human action. Beyond that the term becomes rather amorphous as attested to by the number of competing typologies of structure (e.g., Elder-Vass 2010; Porpora 2002). López and Scott (2000) present a three-part typology consisting of institutional, relational, and embodied structures. In the vein of Durkheim’s (1997(1893)) ‘collective representations,’ institutional structure refers to the shared knowledge that agents within a society possess that organizes their relations, allows them to communicate, and shapes their expectations of other’s actions. It can be equated with concepts like values and norms. This conception of structure is most evident in
Parson’s systems functionalism and Merton’s general functionalism via the notion of ‘social institutions’ (Elder-Vass 2010). Stemming from Durkheim’s (1997(1893)) ‘collective relationships’, relational structures refer to the ways in which people are tied together into larger collectivities, and the social differentiation and stratification that occurs both within and between collectivities. The relational mode of structure is evident in Radcliffe-Brown’s (1952) variant of structural functionalism. Embodied structures are important in the work of Bourdieu and Giddens, and are discussed below in relation to their work.

During the 1960s-70s, functionalism came under sustained attack from both collectivists and individualists along a number of fronts. One such critique was that the framework presented a tautological account of social institutions; if a social institution exists, it is because it serves a function. Another major critique was related to functionalism’s problem with accounting for institutional/systemic change, especially if it occurred rapidly. Functionalism emphasized the role of institutions in maintaining societal integration, and as such lacked both an internal mechanism for social transformation and a historical account of the origins of social institutions. This in turn lead to the charge that functionalism represented an ahistorical utopia where actors served only as institutional/systemic resources (Parker 2000). Proponents of individualism found functionalism’s reification of institutions as particularly ironic; while human beings were denied any sort of agency, social institutions were imbued with purposes and needs.

Within anthropology three diverse, and in certain cases oppositional, alternatives to functionalism had come to dominate the theoretical landscape by the late 1970s: (1) interpretive or ‘symbolic’ anthropology (Geertz 1973), (2) Marxist political economy (Wolf 1969), and (3) structuralism in both its Lévi-Straussian (1969, 1973, 1978, 1981) and Marxist variants (e.g., Althusser 1971). By focusing on the meanings of cultural symbols, conflict as a driver of
change, and the underlying social logic of structures, all of these approaches represented significant advances beyond functionalism’s concern with social cohesion and reproduction (Ortner 2006). Nonetheless, all of these theories can be associated with methodological collectivism, as they share functionalism’s emphasis on the structural constraint of human action.

In addition to the collectivist approaches just outlined, two general traditions of individualism emerged in opposition to functionalism: the first was based on pragmatism and symbolic interactionism (e.g., Blumer 1969; Goffman 1959; Mead 1934), and the second drew on neo-Kantian and phenomenological perspectives (e.g., Berger and Luckmann 1966; Garfinkel 1967; Schutz 1967; Weber 1978 [1922]). These perspectives asserted the autonomy of agency while denying that agents were constrained by structures. Much like structure, agency is a nebulous term that refers to a general capacity for action. All definitions of agency include the attribution of causal powers to agents, but different theoretical frameworks (e.g. rational choice theory, ethnomethodology, etc…) produced significantly different actors. Weber’s agents were motivated by rational thought and emotions, Mead and Blumer’s agents exercised reflexivity and creativity during the course of social interaction, and the agents of Goffman and Garfinkel were always concerned with how other agents expected them to act in specific situations (Stones 2007). The impact of individualism on anthropological theory during the 1970s was rather muted and was largely restricted to adherents of symbolic interactionism and transactionalism (Barth 1969).

While collectivist approaches had been critiqued for a perceived overemphasis on structural constraint, symbolic interactionism faced the charge that it represented a form of extreme voluntarism. By the late 1970s, the majority opinion within anthropology and social theory more broadly was that the ideal position lay somewhere in the middle. That is, human
action was not completely determined by structure, but nor was it immune to structural forces. It was within this context that a small number of theorists undertook the project of developing a third approach, a relational social ontology, through a synthesis of the strengths of both collectivism and individualism.

*Structuration: (Re)Making of Society*

In many aspects the portrayal of the debate between collectivism and individualism presented in the previous paragraphs is quite antiquated, with few scholars now claiming to reside exclusively in either camp. Instead the consensus is that the relation between structure and agency should be viewed in dialectical rather than oppositional terms, and that any investigation of this relation must focus on ‘practice’, or what it is that humans do. Hence the designation of ‘practice theories’ which is common within anthropology, though ‘structuration’ is more common outside of the discipline. Structuration, in its general social sciences meaning, refers to the maintenance and production of structures that occurs through practice (Stones 2005).

Early practice theories, as represented in the work of Bourdieu (1977, 1984, 1990) and Giddens (1979, 1984) share a number of general orientations, including the conception of a social world populated by actors imbued with agency, but not unfettered freewill; there are forces which both constrain and enable practice. These forces, whether viewed as culture, institutions, or structures, are the historical products of agentive action. Power is also a central concern and is explored in relation to constraint, hegemony and symbolic violence (Ortner 2006). Finally, practice is the process that ties all of these themes together. Beyond these common threads the projects of Bourdieu and Giddens diverge significantly, and as the saying goes, ‘the devil is in the detail.’
Over the past two decades archaeologists have become increasingly fond of the Bourdieu and Giddens citation pairing in relation to practice and agency (Dobres and Robb 2000; Hegmon 2003). What exactly are archaeologists looking for when we cite Bourdieu and Giddens? I suggest that that our intentions are to evoke a model that explains redundant patterns in the archaeological record as a product of traditional or cultural practices (i.e., structure), but that also attributes an active role to past peoples in creating, maintaining, and transforming those traditions (i.e., agency). To be clear, there is no inherent problem with employing structuration theory or Bourdieu’s relational framework on their own terms for these purposes. Nor do I wish to convey the idea that I am opposed to a critical process of mixing, adapting, and ultimately transforming different theoretical frameworks. After all, it is not too difficult to argue that the work of Bourdieu and Giddens represents some of the most impressive synthesizes of classical and modern social theory to date. The point I would like to make is that the uncritical mixing of theoretical frameworks – a prime example being those of Bourdieu and Giddens – can be problematic. While both theorist have the same general project in mind, their approaches are quite different, ranging from a social universe populated by reflexive agents to one driven by pre-reflective, tacit knowledge. It appears that within archaeology the Bourdieu-Giddens citation pairing is frequently employed as a nod to some sort of general methodological relationism. The following sections present synopses of Bourdieu and Giddens in order to illustrate their differences.

In his theory of structuration, Anthony Giddens (1979, 1984) moves beyond the collectivism/individualism dichotomy by arguing that structure and agency are mutually constituted through social practice. An examination of the daily routines of most individuals, myself included, will reveal that they are largely composed of recurrent social practices.
Giddens exhibits the influence of the ‘linguistic turn’ in stating that practices are recursive because, similar to language, they are ‘rule-following’ (Elliot 2009). Sometimes these rules are explicit as in the case of income tax. There is a written, codified system which tells me that it is in my best interests to hand over a certain percentage of my income to the state and federal governments. However, most of the rules that we draw on in the course of our daily routines are not explicit, and instead derive from common sense. Rules are discussed in detail momentarily, but at present it is important note that when Giddens (1984:32) states that practices are ‘rule-governed’, he is not suggesting that rules are a form of determinism which produce specific practices. Rules can be applied more or less successfully, in both appropriate and inappropriate settings, and also present the possibility of acting outside of the rules (Elliot 2009).

Giddens (1984:3-7) states that practice must be understood as a process, “durée,” or “continuous flow” that involves reflexive monitoring, rationalization, and motivation of action as embedded sets of processes. In any social setting knowledgeable agents reflexively monitor their actions and the actions of others, while also expecting to be monitored themselves. For the most part agents maintain a theoretical understanding of intentionality, or why it is they do what they do. The rationalization of action is also the grounds upon which agents judge each other’s competence. Motivation refers to the potential for action, in a vein similar to Schutz’s ‘projects’, and usually lies beyond the conscious grasp of agents. Giddens (1984:xxii-xxiii) argues that while agents are generally knowledgeable about why they do what they do, their ability to discursively report about these various facets of action varies:

“Human agents or actors – I use these terms interchangeably – have, as an inherent aspect of what they do, the capacity to understand what they do while they do it. The reflexive capacities of the human actor are characteristically involved in a continuous manner with the flow of day-to-day conduct in the contexts of social activity. But reflexivity operates only partly on a discursive level. What agents know about what they do, and why they do it – knowledgeability
**as agents – is largely carried in practical consciousness. Practical consciousness consists of all the things which actors know tacitly about how to ‘go on’ in the contexts of social life without being able to give them direct discursive expression. The significance of practical consciousness is a leading theme of this book, and it has to be distinguished from both consciousness (discursive consciousness) and the unconscious.”**

Some instances of practice fall within the realm of discursive consciousness, where agents are able to verbally articulate why they acted in a certain manner. In contrast lies the realm of unconscious motives and cognition that is beyond the reach of the agent. Giddens believes the most of human action is guided by practical consciousness; we know what we are doing and why, but cannot necessarily state these reasons discursively.

Where do the rules come from that agents draw upon during their day-to-day activities, and why are these practices recursive? The structural element for Giddens comes in the form of virtual rules and resources which are held within agents’ memories and only instantiated through practice. In fact, “structure has no existence independent of the knowledge that agents have about what they do in their day-to-day activity” (Giddens 1984:26). Therefore, structure is both the medium and outcome of the practices it recursively organizes. The rules and resources that comprise structure can be further classified as normative and performative rules, or codes of signification which concern the appropriate and successful execution of routines. Resources may be either authoritative in that they are involved with the coordination/control of human action, or allocative if they are based on control of the material world or products (Giddens 1984:xxxi).

Up to this point, what is perhaps Giddens most novel contribution to social theory has been implicit in the preceding discussion – the duality of structure. Giddens asserts the non-identity of structure and agency in arguing that they are mutually constitutive, and thus represent a duality. This perspective stands in sharp contrast to earlier formulations of agency/structure (subject/object) as logically exclusive entities (i.e., dualism). This concept is key to the
structurationist product as it explains the process by which structures are largely reproduced through practice while still accounting for human agency. Daily life is composed predominately of routine actions or practices, the competent execution of which requires the agent to draw upon their stocks of practical knowledge. This practical knowledge consists of previously acquired competencies and experiences. When agents draw upon this resource during practice they reproduce a part of structure (Cohen 2005).

Bourdieu attempts to bypass the antinomies of the social sciences by employing a perspective he labels as both constructivist structuralism and structuralist constructivism. This double label is meant to convey the “dialectical articulation of the two moments (objectivist and subjectivist) of his theory (Wacquant 1992:11). As used here, Structuralism is conceptualized in manner quite different from the original formulations of Saussure and Lévi-Strauss; there are objective structures which exist beyond human consciousness and exert force on agents, but they are not limited to symbolic systems. They are part and parcel of the social world. Constructivism is used to denote the “twofold social genesis” of habitus and fields through practice (Bourdieu 1989:14). These three terms – practice, habitus, and fields – are the core components of Bourdieu’s relational framework. This is an important point to emphasize due to the frequency with which these concepts, habitus in particular, are fetishized. These terms lose their analytical power when used outside of this relational context.

Bourdieu’s theory is one of practice – it is concerned with what people do. But Bourdieu wants to be clear that he does not perceive practice in the manner of Hegelian or Sartrean voluntaristic action; practice does not result from the exercise of unconstrained freewill (Bourdieu 1990), but neither is it rule-governed. Bourdieu takes as his task the explanation of how the world is comprised largely of patterned and predictable practices under such conditions,
and for this he turns to a concept that is synonymous with his name – habitus. The intellectual heritage of habitus can be traced to Mauss’s (2006 [1935]) study of techniques, but it is Bourdieu who has given the concept a central position within his framework, and thus developed it accordingly. Bourdieu (1990:53, italics in original) defines habitus in the following manner:

“The conditionings associated with a particular class of conditions of existence produce habitus, systems of durable, transposable dispositions, structured structures predisposed to function as structuring structures, that is, as principles which generate and organize practices and representations that can be objectively adapted to their outcomes without presupposing a conscious aiming at ends or an express mastery of the operations necessary in order to attain them. Objectively ‘regulated’ and ‘regular’ without being in any way the product of obedience to rules, they can be collectively orchestrated without being the product of the organizing action of a conductor.”

This definition of habitus is a prime example of what many scholars perceive to be the ‘long-windedness’ of Bourdieu (Burawoy 2012). Whether or not this view is accurate is a matter of perception, but what is clear is that habitus is expected to do much of the heavy lifting within Bourdieu’s theory. Parsing the above definition provides conceptual clarity, and perhaps causes Bourdieu’s literary style and phraseology to be a bit less intimidating.

Habitus consists of generative schemes and dispositions that imbue agents with social competence, and as such the concept has a structuring function. This structural component is in turn reflexively structured by the very practices it helps produce, and in this sense it is “embodied history” (Bourdieu 1990:56). A much more simple way to phrase this is that what we have done in the past and what we are doing in the present will effect what we do in the future. The particular shape of one’s habitus is tied to factors such as early childhood socialization, life-long learning, and ultimately the positions one holds within fields. Thus, actors who have had similar experiences and who occupy similar positions in social space (e.g., professions, culture,
etc…) will tend to act in similar ways. Even so, the structuring function of habitus should not be equated with rules, but rather a practical sense which guides agents – “a feel for the game” in Bourdieu’s (ibid:66) parlance.

Bourdieu enlists the concept of ‘field’ to serve as the backdrop of practice. He defines a field as a “network, or a configuration, of objective relations between positions” (Bourdieu and Wacquant 1992:97); these are fundamentally relations of power. Power, and hence position within a field, is dependent upon the amount of capital an actor possesses. In this sense fields are arenas of struggle where actors compete to improve their position through acquisition of capital. Capital refers to that which field participants collectively perceive to be valuable, and this perception differs from field to field. To reflect this, Bourdieu presents four types of capital: economic (e.g., material resources), symbolic (e.g., reputation), social (e.g., relationships), and cultural (e.g., knowledge). The unequal distribution of capital is the basis of social inequality.

Each field is relatively autonomous and characterized by its own doxa and habitus, and the stability of a field is determined by the degree to which field participants ‘buy into’ the doxa. Doxa is “a set of fundamental beliefs which does not even need to be asserted in the form of an explicit, self-conscious dogma” (Bourdieu 2000:16); it is to experience the natural and social world as self-evident (Bourdieu 1977:164). Doxa exits outside of the realm of discourse, for “what is essential goes without saying because it comes without saying” (Bourdieu 1977:165). Acceptance of doxa is essential to the stability of a field, as it entails the misrecognition of the arbitrary nature of the field. This is particularly important in explaining why people in subordinate positions continue to act in ways that perpetuates their subordination. It is because doxa provides the habitus with a set of limits, a “world in which objective probabilities condition the expectations formed and held by individual subjectivities” (Jenkins 2005:69). In some cases
field participants become aware of the arbitrariness of doxa, but they except field conditions nonetheless. A heterodoxy emerges from the recognition of the possibility for competing beliefs and the formation of such beliefs, and entails “a move from practical action to discursive exchanges and the emergence of a field of opinion” (Deer 2008:123). Bourdieu suggests that orthodoxies and heterodoxies would be rare in the ancient world as a result of a “quasi-perfect correspondence between habitus and field conditions (Bourdieu 1977:165).

Social Agency and Phenomenological Approaches to Technology

Since the 1990s there has been a small but growing interest in the “sociality and corporeality of technical production” (Dobres 2009:126), which is a far cry from the hardware view of technology presented in Chapter 2. This perspective, which Dobres and Hoffman (1994) call the social agency and phenomenological approach, synthesizes much of what has been discussed to this point. From the structuralist-inspired studies presented in Chapter 2 it borrows the notion of technologies as social representations of worldviews. Stylistic elements of technologies are not simple isochrestic variation, but materialized attitudes of ancient technicians. Furthermore, this perspective acknowledges that the actual act of technical production is just as meaningful as the result or use of the technology. A social agency and phenomenological perspective also draws on Mauss’s ideas concerning the relation between techniques and socialization. In learning the technical gestures required to make or use something, agents are instructed in normative group behavior. In order the address the ‘mental template’ component of structuralism, this perspective turns to practice theories to emphasize the centrality of agency and the importance of everyday (technical) practices (Dobres 2009). Above all, this approach is “concerned with how technology is part of the dynamic nature of social production and reproduction” as it plays out at the micro-scale of everyday practice (Dobres and
Hoffman 1994:21). This is the perspective with which I view the data presented in the following chapters.
CHAPTER 4 INVESTIGATING CHERT FEATURES AT SAN BARTOLO

This chapter first presents an overview of the physiography of San Bartolo and its immediate environs. Once viewed as an environmentally homogenous entity, the Maya Lowlands are now understood to be mosaic of different physiographic provinces, each populated by numerous microenvironments (e.g., Fedick 1996). Moving beyond traditional bipartite or tripartite divisions of the Lowlands results in more detailed and accurate descriptions of the physical settings of archaeological sites. This finer resolution is desirable not only for comparative purposes, but also as a means of identifying the physiographic nuances that contributed to shaping site-specific and regional histories. Following this is a brief history of research at San Bartolo along with a synthesis of research results in the form of a concise site culture-history. The chapter concludes with a discussion of chert features in the Maya Lowlands and the research design employed to investigate these features at San Bartolo. A summary of excavation data is presented, with the results of the lithic analysis following in Chapters 5 and 6.

San Bartolo: Physical Geography

The ancient Maya site of San Bartolo is located in the contemporary Department of El Petén, Guatemala (Figure 4.1), approximately 30km northeast of the well-known site of Uaxactun. This area of the Central Maya Lowlands, which is also referred to as the Three Rivers Region (Dunning et al. 2003; Garrison and Dunning 2009), lies on the eastern margin of the Petén Karst Plateau sub-region of the Yucatán Platform. As the sub-region name indicates, the high solubility of the underlying Cretaceous – Paleogene marine carbonates (Figure 4.2), which
Figure 4.1. Location of San Bartolo and other sites mentioned in the text.
Figure 4.2. Surface Geology of the Maya Area.
are predominantly limestone, and regional lithographic and structural variation have resulted in a heterogeneous karst landscape that has an abundance of chert nodules (Marshall 2007). Karst landscapes form through the dissolution of soluble bedrock. The eastern boundary of the Plateau is marked by horsts and grabens resulting from normal faults, the scarps of which can exceed 100m in elevation (Dunning et al. 1998). The plateau interior has been shaped by muted normal faults which have produced widely spaced horsts that sit 10-20m above the grabens (Dunning et al. 2003). Similar fluctuations in elevation occur between mogotes and dolines in the plateau interior (Beach et al. 2006) and have resulted in a topography consisting of ridges, hills, and depressions known locally as bajos (Dunning et al. 2003).

_Bajos_, which cover between 40 and 60 percent of the land area in this region, display a significant degree of variation in terms of formation processes and microenvironments (Dunning et al. 2002). The largest bajos, such as the adjacent Bajo de Azúcar and Bajo de Santa Fe, are poljes, or large karst plains which mirror underlying fault trends. The smaller bajos and aguadas represent dolines. With the exception of the coastal grabens, surface drainage is poorly developed, with most of it occurring internally through solution fractures, ponors, and eventually cave systems (Beach et al. 2009; Marshall 2007). Surface drainage is not totally absent, and where present occurs through a series of arroyos, bajo tributaries, and the seasonally dry Ríos Ixcán and Tikal, the confluence of which marks the headwaters of the Río Azul. The bajos are seasonally inundated, as regional drainage systems are insufficient to transmit the 1,200 – 2,000 mm of annual precipitation, most of which occurs during the rainy season (Schwartz 1990).

A detailed discussion of vegetation patterns in the San Bartolo area can be found in Griffin’s (2012) study. For present purposes, regional vegetation patterns can be characterized using Kunen and colleagues’ (2000) three general categories of microenvironment: scrub bajo,
palm bajo, and upland forest/montaña. Scrub bajo is comprised of “thick, low-canopied, thorny scrub,” and is extremely difficult to move through (Kunen et al. 2002:20). In contrast, palm bajo has a higher canopy and a much more open understory. Whereas scrub bajos can occupy many square kilometers, palm bajos tend to occur in small pockets of less than 1km² (Griffin 2012). The upland forest, or montaña, is comprised of a number of hardwood species with a primary canopy reaching between 22 – 37m in height, with a secondary canopy in the range of 10 – 15m (Ibid). The majority of ancient Maya settlement is found in montaña, though Garrison (2007) encountered settlement in the other microenvironments during his survey San Bartolo – Xultun intersite area.

**History of Research at San Bartolo**

San Bartolo was discovered in 2001 by William Saturno during a Corpus of Maya Hieroglyphic Inscriptions expedition. It was during his first visit to the site that he found the now famous Preclassic murals tucked away in a looters’ trench (Saturno et al. 2005; Taube et al. 2010). Shortly thereafter, Saturno formed the San Bartolo Regional Archaeology Project (Proyecto Arqueológico Regional de San Bartolo) to investigate both the murals and the site within which they resided (Castillo and Saturno 2012; Romero and Saturno 2009, 2010, 2011; Urquizú and Saturno 2002, 2003, 2004, 2005, 2006, 2007). Investigations in subsequent years expanded to include other regional sites (e.g. Garrison 2003, 2007; Griffin 2004; Román et al. 2006), with current investigations largely centered 8km to the south at the site of Xultun, San Bartolo’s much larger neighbor (Figure 4.3). In addition to this dissertation, six others have been completed based on work conducted partly or entirely at San Bartolo (Craig 2009; Davies 2012; Garrison 2007; Griffin 2012; Hurst 2009; Runggaldier 2009).
The site of San Bartolo is comprised of 246 structures clustered within a 4km² area (Figure 4.4). There are four main architectural groups aligned along a northwest-southeast axis, all of which contain monumental public architecture. Residential architecture is dispersed throughout the site, though the majority of house mounds are located along the western, southern, and northeastern site peripheries. A small *aguada* is located adjacent to the main plaza, and numerous limestone quarries have been found in close proximity to monumental architecture.
Figure 4.4. San Bartolo site map.
San Bartolo Culture-History

This section provides a brief culture history of San Bartolo in order to contextualize the chert features. While primary reference is made to occupation history and construction activities, these data are informative of social processes such as increasing social differentiation and inequality which in turn would have structured activities associated with the chert features. Chert feature chronological data are presented in Section 5.3, but at present the reader should be aware that the Preclassic events and processes described below were contemporaneous with activity at the chert features. Only limited reference will be made to outside events and broader trends in the Maya area, as the scale of such a narrative is beyond the scope of this study. The interested reader can find a detailed account of San Bartolo’s place in the Lowland geopolitical landscape in Garrison (2007), while a detailed regional culture history can be found in Garrison and Dunning (2009).

Middle Preclassic 1000 – 400 B.C.

The earliest evidence of a human presence in the region comes from Bajo Majunche, which is located approximately 4.5 km south-southwest of San Bartolo. A paleosol dated to 920-800 cal B.C. (Dunning et al. 2005) contained small amounts of disturbance taxa and charcoal, indicating that forest clearing had begun by the opening of the Middle Preclassic (Garrison and Dunning 2009). Water lily (Nymphaea) and cattail reed (Typha) pollen were also recovered, which would indicate that Bajo Majunche, and possible other bajos, were perennial wetlands at least during the early Middle Preclassic (ibid). A soil core from Aguada Tintal, located approximately 7 km northeast of San Bartolo, contained maize, cotton, and manioc pollen that dated to 780 – 410 cal B.C. (2 sigma) (Dunning et al. 2005). While not direct evidence for the
occupation of San Bartolo, these dates fall in line with the establishment and growth of numerous small farming villages across the Lowlands during the Middle Preclassic.

Virtually all of San Bartolo’s Late Preclassic monumental architecture has provided evidence of an earlier Middle Preclassic occupation. To date, the earliest structures that have been identified are the initial phases of the Las Pinturas and Las Ventanas pyramids. The Ixkik substructure (Las Pinturas Sub-7) has a single talud, a north-facing staircase with seven steps, and what appears to be a two-tiered platform top that would have supported a superstructure of perishable materials (Beltrán 2005, 2006). Urquizú (2003a, 2003b, 2005) also discovered Middle Preclassic architectural remains in the form of the Ixtab platform and Bak Na substructure which had a tiered design. Garrison and Dunning (2009:538) noted that these structures, which were most likely contemporaneous, exhibit design elements which were not typical of structures serving a residential function. Other areas of the site where Middle Preclassic ceramics have been recovered include: the Jabalí complex (Pellecer Alecio 2004), the main plaza ballcourt (Urquizú 2002), and the Saraguates group (Rivera Castillo 2006; papers in Urquizú and Saturno 2006).

Figure 4.5. Major architectural groups of San Bartolo discussed in the text.
Late Preclassic 400 B.C. – A.D. 300

As with many Lowland sites, the Late Preclassic represented a period of florescence for San Bartolo as the site grew from a small farming village into a regional capital (Garrison 2007). Starting in the 4th century B.C. the site experienced rapid population growth accompanied by numerous monumental construction projects (Saturno 2009). At 30m in height the Las Ventanas pyramid became the tallest structure at the site and presided over the main plaza which ended with a raised causeway 100m to the south. A ballcourt bounded the plaza to the east while a massive palace was erected on the western edge of the main plaza (Runngaldier 2009). With a mass exceeding 275,000 m³, the Saraguates Complex is the largest arrangement of monumental architecture at the site (Garrison 2007:333). Excavations have revealed that this complex was created by encasing a natural hill within a large, tiered basal platform. Multiple large superstructures ring the periphery of the platform, while the interior plaza is open expect for the presence of a small ballcourt (Davies 2005; Pellecer Alecio 2006a and 2006b; Urquizú and Menéndez 2006, Hurst 2006). Aside from its clear monumental status, the function of this group is presently unknown, though Runngaldier (2009:97) considers it to be an acropolis. An early iteration of the Las Pinturas pyramid also formed an E-Group with an associated ballcourt before being converted to a triadic group at a later date.

The landscape was not the only thing changing at San Bartolo during the Late Preclassic, as the monumental building projects provide clear evidence for social differentiation and inequality. However, evidence from Las Pinturas suggests that the roots of institutionalized social inequality potentially stretch further back into the Middle Preclassic. A plastered block painted with 10 glyphs was recovered that has been dated to 300-200 B.C. based on the radiocarbon dating of associated charcoal fragments. Not only does this demonstrated the existence of a fully developed writing system, a restricted domain of early Mesoamerican elite,
but one of the glyphs has been deciphered as AJAW, “a ubiquitous title in Maya texts that means ‘lord,’ noble,’ or ‘ruler’” (Saturno et al. 2006:1282). While it is difficult to determine whether the inscription is referring to a mythical or historical figure, the identification of the referent of a similar inscription found in the murals dating to ca. 100 B.C. from the penultimate phase of Las Pinturas appears more concrete. The West Wall of the Las Pinturas murals, which have been discussed in significant detail elsewhere (Hurst 2009; Saturno et al. 2007; Taube et al. 2010), contains two scaffold ascension scenes that depict an attendant presenting a headdress to an individual seated on a scaffold. The southern-most ascension scene portrays two different aspects of the Maize God, while the northern-most scene may portray a historical individual (Taube et al. 2010). This coronation scene also contains a series of glyphs positioned between the two individuals, of which the final one translates as AJAW. The preceding glyphs have been difficult to translate due to their early date and lack of clear Classic period analogs, though it is possible that they refer to the name and royal titles of the lord seated on the scaffold (Saturno et al. 2007). Further support for the presence of the institution of divine kingship comes from the Jabali group, a Late Preclassic triadic group located along the western boundary of the site.

What is presumed to be a royal tomb dating to approximately 150 B.C. was discovered under the interior plaza of this group (Pellecer Alecio et al. 2005). Contents included a single individual accompanied by a small greenstone figure set inside of a Middle Preclassic Mamom phase Chac effigy vessel (Rivera Castillo 2005) and a jade pectoral, a well-known symbol of Maya kingship.

For reasons not entirely understood, the momentum with which San Bartolo had grown beginning with the close of the Middle Preclassic had ground to a halt by the end of the Late Preclassic. Whether due to landscape degradation (Beach et al. 2006; Dunning and Beach 2000; Saturno 2009), chronic drought (Brenner et al. 2002; Hodell et al. 2001), or sociopolitical events,
San Bartolo and many other regional sites had been abandoned by the opening of the Early Classic as part of a much larger Preclassic ‘collapse’ (Estrada-Belli 2010).

*Early Classic A.D. 300 - 600*

Current data suggest that the population of San Bartolo and its hinterland had most likely resettled at the site of Xultun by the beginning of the Early Classic. The vast size of Xultun and its numerous inscribed monuments (Ruane 2012; von Euw 1978; von Euw and Graham 1984) attest to the fact that the site emerged as an important regional capital and player in Classic Lowland politics. Tikal Stela 17 mentions a lord from Xultun, while Caracol Stela 16 refers to a woman from the site. Xultun Stela 18 is of particular relevance to regional settlement patterns, as it depicts a ruler named Ahknal who claims to be 33rd in the line of the founder of the Xultun dynasty (Garrison and Dunning 2009:540). Such a long dynastic history would place the origins of the dynasty long before the sixth century A.D. date of the monument. Garrison and Dunning (ibid) suggest that the inscription could be referring to dynastic origins at San Bartolo, or an attempt to promote the antiquity and legitimacy of the previously subordinate Xultun elite.

Though San Bartolo was abandoned during the Early Classic, the site was not completely bereft of activity as fewer than 4% of the San Bartolo ceramic assemblage dates to the Early Classic (Rivera Castillo 2008). Early Classic ceramics were recovered from what can reasonably be called ritual contexts. The majority were recovered from a small one room shrine (Str. 63.) that contained a “pot-bellied” monument (Monument 1) located at the end of the palace’s southern range structure (Craig 2004). The other major deposit comes from the Jabalí triadic group, where it appears an offering of Early Classic ceramics were deposited along the central
axis (Pellecer Alecio et al. 2005). The overall ritual character of the deposits suggests that San Bartolo may have remained an important pilgrimage site during the Early Classic.

**Late Classic A.D. 600 – 850**

As elsewhere in the Lowlands, the Late Classic represented a period of substantial growth in regional population levels. Many sites that had been abandoned since the end of the Late Preclassic were reoccupied, including San Bartolo and the San Bartolo-Xultun intersite area (Garrison 2007). However, the site did not regain the regional prominence it held during the Late Preclassic. Most contexts at the site have produced Late Classic material, though no new monumental construction projects were commissioned. Runggaldier’s (2009) excavations reveal that the palace, which had fallen into significant disrepair during the Early Classic, was refurbished. Pellecer Alecio (2003:81) suggests that some of the stones used to construct a small residential group in the main plaza were actually taken from the Las Ventanas pyramid. Other notable projects during this period were the dredging of the site’s *aguada* (Dunning et al. 2005), and the reoccupation of Las Plumas, an elite residential group located next to the main plaza (Ortiz Kreis and Mencos 2005). The Late Classic reoccupation of San Bartolo is perhaps best represented by the large number of Late Classic house mounds that surround site (Griffin and Kwoka 2005; Runggaldier 2012).

**Terminal Classic A.D. 850 – 1100**

The Terminal Classic (A.D. 850 – 1100) marked the rapid disappearance of elite institutions as part of the wider collapse of Maya cities in the Central and Southern Lowlands (Demarest et al. 2004). The last inscribed stela erected at Xultun (Stela 10) bares a date of A.D.
The collapse of the Xultun dynasty did not result in total abandonment of the area, as rural populations appear to have nucleated around the site (Garrison and Dunning 2009). There is no evidence of a Postclassic occupation at San Bartolo, and the regional in general appears to have been largely abandoned by the end of the Terminal Classic. With this background data in hand, the remaining portion of the chapter presents an overview of previous studies of chert features in the Maya area before concluding with a discussion of the San Bartolo chert features.

**You Say Rock Pile, I Say Chert Feature: Differentiating Chert-Based Features in the Maya Lowlands**

The Maya area is by no means in short supply of piles of rocks. As Willey and colleagues (1965) expanded our gaze outward from site cores, so too did our understanding of the diversity of the ancient Maya built environment. Out of the void that existed between site centers emerged a palimpsest inscribed with house mounds, terraces, berms, check dams, and various nondescript rock piles. Of this multitude, the small piles of chert nodules that dot the Lowland landscape are particularly enigmatic if for no other reason than they have received very little attention from archaeologists. This dissertation represents a small step in remedying this situation.

I first became aware of the existence of small chert features around the periphery of San Bartolo while mapping the site during the 2004-05 field seasons (Garrison and Kwoka 2004; Griffin and Kwoka 2005). These features, which were usually referred to simply as ‘rock piles,’ initially received little attention and were not added to the site map. This decision was based on the fact that it was unclear whether the features were natural or cultural in origin, and that there were a large number of clearly identifiable structures that remained to be surveyed. However,
previous excavations undertaken at a Late Classic lithic workshop (Kwoka 2004), which are discussed in more detail in the following chapter, piqued my interest in the chert features as possible locations of primary core reduction. During the 2005 field season, with the Topcon Total Station in the United States for repairs, I proceeded to investigate the chert features of San Bartolo along with my colleague, Robert Griffin (Kwoka and Griffin 2005).

**Defining Chert Features**

One of the first challenges in this study was moving from an identification of chert features based on local knowledge and familiarity to an explicit definition of the object of study; what exactly was a chert feature, and how was it different from other landscape modifications? Morphology and material composition are two general axes by which various landscape features can be differentiated from one another. In terms of morphology, the chert features at San Bartolo were roughly circular or elliptical in shape, though this was not always immediately apparent due to coverage by litterfall. Chert features had diameters of 2-3m, elevations that did not exceed 10-15cm, and left relatively minute surface signatures (Figure 4.6).

These consistent morphological parameters meant that chert features were easily distinguishable

![Figure 4.6](image)

**(a)**

**Figure 4.6.** Chert feature morphology: (a) wireframe elevation map; (b) surface after litterfall and small vegetation had been cleared (modified from Griffin et al. 2005).
from linear agricultural or hydrologic features, though their similarity to house mounds and associated ancillary structures presented a problem. The precautions taken to avoid sampling house mounds will are in the following section on research design, but it suffices to say that the San Bartolo chert features were generally smaller than regional house mounds in terms of area and elevation.

Whether serving as the finest facing stones or coarsest interior fill, limestone cut from bedrock served as the primary building material for most structures and features in the Maya Lowlands. However, regional differences in geology, especially in the Central Maya Lowlands, provided an alternative building material in the form of chert nodules. Thus, the type(s) of stone employed in the construction of a structure or feature provides a fundamental point of distinction. As the name indicates, chert features were predominantly composed of chert, though small amounts of limestone pebbles and cobbles were present.

In order to avoid confusion in feature identification it is important to differentiate other small piles of rock that have been reported across the Maya Lowlands, and the northern Yucatán Peninsula in particular, from the San Bartolo chert features. In the Northern Lowlands limestone rather than chert was used to construct the small circular or elliptical features which have become known as chich mounds. Investigations of chich mounds have demonstrated that they are distinctly different from the San Bartolo chert features not only in material composition, but in function as well. Kepecs and Boucher (1996) have argued that chich mounds were used in arboriculture as mulch and a means of providing support in the shallow soils of the northern Yucatán Peninsula, a practice which continues among contemporary Maya (ibid; Fedick and Morrison 2004). The key point here is that terms such as “chich mound,” which have been identified as a distinct feature class in one area, do not become catch-all terms in other areas (e.g.
Hageman and Lohse (2003) simply because they exhibit general morphological similarities. This dissertation among other goals demonstrates that the San Bartolo chert features were used in an entirely different manner.

**Previous Studies of Chert Features in the Maya Area**

Despite decades of research in the Maya area, only a handful of studies focused on chert features have been published (Figure 4.7). Much of this is undoubtedly due to Mayanists’ early preoccupation with the excavation of site centers combined with the relatively small size of chert features. The next section functions both as a review of previous research on chert features in

**Figure 4.7.** Sites where chert features have been studied.
the Maya Lowlands and as a comparative data set to determine whether the San Bartolo chert features represent a unique phenomenon. The information provided for each study is dependent upon the amount of detail provided by the authors. The interested reader is referred to the original studies for additional contextual information such as excavation locations and nomenclature.

*Becán and the Rio Bec Region*

The earliest published study of chert features in the Maya area comes from Thomas’ (1981) settlement pattern survey at Becán. Over the course of three field seasons Thomas identified 178 chert mounds, 129 of which were circular or elliptical in shape. These features ranged between approximately 2-8 m in diameter, with most having very little elevation and only a few approaching a height of 50 cm. Four of these features were selected for excavation and were given the designations of Operations 15, 103, 112, and 206. Operations 15 and 103 do not fit the profile of the San Bartolo chert features. Operation 15 involved the excavation of a chert feature that was 6-8m in diameter. It produced very few lithics, no dateable ceramics, and was interpreted as a probable platform for a superstructure. Operation 103 centered on the excavation of a mound 2.5 m in diameter which was comprised of approximately 95% unworked chert nodules. Thomas noted that very few of the nodules showed signs of modification and that there was an absence of debitage. In contrast, Operations 112 and 206 appear to be similar to the chert features of San Bartolo. Operation 112 involved the excavation of a chert mound 2.5 – 4 m in diameter which was dated to the early Late Classic by the presence of Bejuco phase (ca. AD 600 – 730) ceramics. Operation 206 centered on the excavation of a chert feature 6 – 8 m in diameter which was dated to the Early and Late Classic periods. Both of these chert features
where characterized by the presence of “sizeable” (Thomas 1991:92) amounts of debitage and chert nodules displaying primary flake scars.

Based on excavation data and a comparison with other chert features, Thomas ruled out the possibility that these were agricultural features. Instead, he argued that the chert features represented the emergence of stockpiling behavior designed to control access to chert resources at Becán during the terminal Early Classic to early Late Classic periods. He further suggests that the lack of massive Colha-esque (Figure 4.1) debitage deposits and the presence of only one or two primary flake scars on the majority of chert nodules indicate that the chert features were not loci of heavy lithic production. Rather, the large quantities of debitage recovered from most house mounds at Becán point towards households as loci of lithic production. This interpretation is problematic. If access to chert resources was in fact restricted, then one would expect the spatial distribution of debitage across the site/region to reflect this strategy by being confined to a small number of loci (Costin 1991). In this case it is important to emphasize that stockpiling need not equate to control. The chert features at Becán most likely represent different reduction junctures (Binford 1979; Pecora 2001), where lithic production activities occurred at multiple locations. This is not to be confused with the stage (Collins 1975; Magne 1985) versus continuum (Ingbar et al. 1989; Shott 1996) debate.

In 1976, Thompson (1981, 1991) excavated six chert features at Becán as part of his M.A. thesis research conducted under the auspices of the University of the America’s Rio Bec Archaeological Project. These features are described as being comprised of large numbers of chert nodules of varying sizes within a matrix of small limestone debris and very little soil. The geographic distribution of these features is restricted to an area stretching 1 km south, east, and west of Becán’s ditch-and-parapet system. Within this buffer zone chert features were most
frequently encountered at *bajo* margins and in close proximity to residential structures. Three of the six chert features excavated by Thompson appear analogous to those investigated at San Bartolo, with the exception of their Late Classic date. This observation is supported by the presence of large amounts of debitage in association with intact and fragmented celts, and the presence of chert nodules displaying primary flake scars.

Thompson agrees with Thomas’ argument that the chert features represent stockpiling behavior for the purpose of resource control. In contrast to the reduction juncture model of Thomas, Thompson (1991) states that the chert features represent loci where all phases of celt production occurred. He also presents a compelling argument for task differentiation, stating that the presence of nodules of insufficient size and quality (i.e. cherty limestone) within the chert features suggests that those who collected the nodules were not the same as those who later reduced them.

*La Milpa and the Far West Bajo*

Chert features like those from San Bartolo and the Rio Bec region have also been encountered at La Milpa (Figure 4.7). During the process of site survey and mapping, Tourtellot and colleagues (1994) observed large fields of chert nodules along the *bajo* margins, often in the form of linear features or piles. They noted that most of the nodules displayed primary flake scars, which suggests that they had been tested for quality. These observations were later supported by John Rose’s (2000) dissertation research. Though none of the non-linear chert features were excavated, some were noted to have large surface concentrations of debitage. As such, Tourtellot and colleagues (1994) argued that none of the features were residential, but instead were likely foci for the initial reduction of chert nodules into a form that was transported to another location for further reduction.
Shifting geographical focus only slightly, Kunen (2004; Kunen and Hughbanks 2003) conducted a detailed study of chert features during her settlement survey of La Milpa’s Far West Bajo. She divided her study area into two general zones; the interior of the Far West Bajo and a hypothesized agricultural zone which surrounds the bajo. Few features were located within the bajo interior, though Kunen did excavate a total of four features. Chert feature Operation V38A, which dated to the Late Classic Period, produced 2 bifaces, 14 flake cores, 3 core tools, and 2 flake tools. Kunen (2004:30-31) noted that flakes from throughout the reduction sequence were present, but she did not specify what particular reduction sequence. Chert feature Operation V38B produced approximately 100 lithic artifacts, including a biface and flake tool, which dated to the Late Classic through Terminal Classic Periods. The two additional chert features which were excavated within the bajo interior, Operations V72A and V72B, did not provided any datable material. However, a “moderate” amount of debitage was collected though formal tools were lacking (ibid:31).

In contrast to the bajo interior, 222 “rock piles” were recorded within the agricultural area, 7 of which were excavated by Kunen (2004:36). Excavations at Operation V58B, located in Agricultural Zone 1, revealed a foundation of limestone boulders resting directly on bedrock, which was enclosed by a series of unshaped chert nodules. On top of this foundation was a mixture of small chert and limestone cobbles within a clay soil, with the chert nodules displaying signs of heat alteration. Numerous flakes, core fragments, two biface fragments, and an intact biface were recovered. A small number of sherds were also recovered which allowed the feature to be dated to the early Late Classic Period. Operation V59B was also located in Agricultural Zone 1, and was dated to the Early and Late/Terminal Classic Periods based on recovered
ceramics. It was comprised of small to medium-sized chert and limestone nodules, and produced relatively few artifacts beyond a small amount of debitage.

Four chert features were excavated within Kunen’s Agricultural Zone 2. Operation V69B produced no dateable material and was nearly sterile, though the chert nodules appeared to have been thermally altered. A small number of eroded sherds were recovered from Operation V70B along with a number of flakes, a single biface, and two flake cores. Excavations further revealed the presence of a wall footing which consisted of unshaped chert boulders in a clayey-fill matrix located directly on bedrock. On top of this footing was a mixture of chert and limestone cobbles with an almost total absence of soil. Two of the larger chert nodules showed evidence of having been intentionally shaped via lithic reduction. Operation V70C produced no datable material, and consisted of a basal wall of unshaped chert nodules in a reddish clay and gravel matrix enclosing a mixture of limestone and chert nodules. A moderate amount of debitage was recovered along with a biface and five flake cores. The final chert feature excavated within Agricultural Zone 2 was Operation V71C, which was dated to the Early Classic Period. It was composed of medium to large-sized chert nodules that increased in size and frequency with depth. Very few lithic artifacts were recovered.

Kunen excavated one chert feature within Agricultural Zone 3; Operation V73B. This feature was composed of a mixture of chert and limestone nodules that were delineated by a line of cobbles. Very little material was recovered, though a few of the sherds recovered were identified as being Late Preclassic in age. The final chert feature from Kunen’s study was actually part of Robichaux’s (1995) dissertation research. It was located in Kunen’s Agricultural Zone 4, and produced very little lithics and no dateable ceramics.
In summary, Kunen (2004:49) noted a contrast between agricultural zone and *bajo* interior chert features, particularly in the form of retaining walls in some of the former. She suggested that the rock piles served a wide range of functions including foundations for field houses, stockpiles of lithic raw material, and small planting beds.

*San Bartolo – Xultun Intersite Area*

Garrison (2007; see also Garrison and Dunning 2009) conducted a detailed settlement pattern survey within the San Bartolo – Xultun intersite area as part of his dissertation research. The surface remains he encountered were classified either as architectural or resource related. Architectural remains consisted of house mounds and platforms, while rock piles, quarries, *chultunes*, and terraces were labeled as resource remains. During the course of his survey Garrison (2007:164) recorded a total of 280 “rock piles” in the intersite area. Roughly 80% (n=218) were located in the intersite area proper, while 11% (n=30) were located on the San Bartolo periphery and the other 11% (n=32) were located on the Xultun periphery. Garrison’s rock pile category was comprised of two feature classes with relatively distinct morphologies; small, relatively circular piles of chert nodules and long, linear chert features that often had perpendicular branches emanating from the main feature. Garrison conducted limited testing of the small, circular rock piles due to his focus on architectural and agricultural features, and the fact that these features were being investigated at San Bartolo by the author (Griffin et al. 2006; Kwoka and Griffin 2005). Nonetheless, activity at most of the small, circular rock piles can be tentatively dated to the Late Preclassic and Late Classic Periods based on their proximity to architectural and agricultural remains that Garrison was able to successfully date.

In reviewing the above data it is evident that there are a number of commonalities between the chert features of the three different regions. First, chert features are found within all
microenvironmental classes, but they are predominantly located in close proximity to *bajo* margins. In terms of survey area, the above studies represented only samples of their research areas and still reported chert feature frequencies in the 100s. Evidence for stone tool production was encountered at almost all of the Becán chert features, and to a lesser extent at La Milpa. However, Kunen’s (2004) study showed that many of the chert features provided no evidence for stone tool production and must have instead served a different purpose, such as a platform for an outfield structure (e.g. corn crib) or a mulch bed (i.e. *chich* mound). Finally, many of the chert features produced dateable ceramics, albeit in very small quantities. Aside from the San Bartolo chert features and a single example from the Far West Bajo, ceramics dating to the Late Classic occurred with the highest frequency, though Early and Terminal Classic material was recovered as well. With these trends and case studies in mind, I will now turn to the investigation of the San Bartolo chert features.

**Chert Features of San Bartolo**

**Research Design**

While the post-excavation analysis of the chert features has been significantly complex, the initial research design was quite basic due to its exploratory nature. Almost nothing was known about these phenomena, so the project had to begin by addressing the following questions:

1) Did the chert features result from natural or cultural formation processes?

2) Were the chert features exploited by the ancient Maya, and if so,

3) What was their function?
Due to time constraints, it was decided that it would be feasible to excavate five chert features (Figure 4.8). Two core issues guided the selection of specific chert features for excavation, the first of which was concerned with avoiding the unintentional excavation of house mounds, and the second with environmental variability. Some of the smaller house mounds in the region, which were likely ancillary structures, are similar in size and shape to the chert features. Two criteria were used in an attempt to differentiate house mounds and chert features. The first criterion was that no ceramics were visible on the surface. In hindsight, it is unclear if the presence of surface ceramics is a good indicator of whether a feature was a house mound or a chert feature. This conclusion stems from the fact that ceramics were recovered from the chert features, though in comparatively low numbers to other habitational/use contexts at San Bartolo.

**Figure 4.8.** Locations of excavated chert features (SB19A – E).
The second criterion employed to avoid house mounds was that the feature in question needed to be in relative isolation from other structures or features. Again, in hindsight it is unlikely that this criterion is representative of all chert features, as they are often found closely associated with house mounds and other features at Becán (Thompson 1991), La Milpa (Kunen 2004), and even within the San Bartolo – Xultun intersite area (Garrison 2007). What is clear is that the five features selected using these criteria all proved to have served the same function.

The second issue that guided the selection of specific chert features for excavation concerned the desire to investigate the relationship between chert features and different environments. To this end, the chert features yielded important information right from the start, beginning with modifications that had to be made to the original research design before excavations could be conducted. The original design called for the excavation of chert features from each of the three broad environmental classes used at San Bartolo, the purpose of which was to investigate any possible relationship between feature variability and microenvironment. As the project moved from the drafting table to the field, it quickly became apparent that chert features were not present within montaña, and were few and far between within the bajos. Instead, the highest densities of chert features were located within transitional ecotones between the upland montaña and low-lying bajos (Griffin 2012:94). All five of the chert features excavated as part of this dissertation research were located within these transitional zones.

Field Methods

Excavation methods were standardized for all five chert features. Chert feature excavations were designated as Operation 19, with each individual chert feature represented by a suboperation letter (i.e. A-E). A key to the excavation nomenclature employed at San Bartolo is presented in Figure 4.9. Features were excavated using two contiguous 1m x 1m test pits, which
had the effect of forming a 1m x 2m trench across the feature. One unit was placed so that it was bisected by the edge of the chert feature as it was visible on the surface. The other unit was placed so that it fell completely within the boundaries of the chert feature. Arbitrary 10cm levels were employed unless a natural change in stratigraphy occurred, though natural changes were largely restricted to the final levels of each test pit. Published studies sites such as Colha and previous research experience at San Bartolo have shown that variation in stratigraphy will be minimal in instances where the soil matrix contains dense debitage deposits. All test pits were excavated until either bedrock or 10cm of sterile soil had been reached. At least one unit for each chert feature was excavated to bedrock. All soil was screened using ¼” wire mesh. Detailed excavation data can be found in Appendix C.

As for the artifacts, all ceramic material encountered was collected. A summary of the ceramic analysis, which was conducted by Patricia Castillo, is presented in the following chapter. More detailed information can be found in Appendix E. All lithic debitage and bifacial tools were kept and transported by mule back to the field camp for eventual transportation to the San Bartolo laboratory in Antigua, Guatemala (Figure 4.10). The results of the lithic analysis are presented in the following chapters, while photographs and raw data can be found in Appendices A and B respectively.

Data was also collected on the chert nodules which comprised the chert features. This process began by first segregating all chert nodules from the limestone pebbles and cobbles (Figure 4.11). The chert nodules were then sorted into three size classes based on their diameters: small (<5cm), medium (5 – 15cm), and large (>15cm). These three size classes were
then further divided into two groups according to those that displayed primary flake scars (i.e. tested) and those that showed no signs of human modification.

**Figure 4.10.** Transporting lithic debitage to field camp via mule train.

**Figure 4.11.** Sorting chert nodules by size and presence or absence of primary flake scars.

**Figure 4.12.** Weighing tested chert nodules.
All nodules, whether modified or not, were counted and weighed (Figure 4.12). A summary of this data is presented in the following chapter, while the raw data can be found in Appendix D. The composition each chert feature artifact assemblage are presented in Figure 4.13.

**Figure 4.13.** Chert feature assemblage compositions.
Chert Feature SB19A

UTM Coordinates: 16 Q 244085mE 1942210mN  Elevation: 173 masl

Chert feature SB19A was located approximately 20m to the east of Structure 113, which is part of the Jabalí group. The southern border of the feature ran through the center of test unit one (SB19A-1), as shown in Figure 4.14. Test unit two (SB19A-2), which was adjacent to test unit one in a northerly direction, was placed in the center of the feature. Cultural material was encountered in all levels, totaling 454 sherds and 4,813 lithic artifacts. Both units were terminated upon reaching bedrock at approximately 90cm. The bedrock was composed of chert nodules of varying sizes within a soft limestone matrix. While the surface of the chert feature suggested that it was composed of mostly medium to small-sized chert nodules, subsurface deposits included numerous large nodules (Figures 4.15 and 4.16).

Figure 4.14. Test unit SB19A-1. Dashed line shows border of chert feature.
Figure 4.15. Large sub-surface chert nodules. SB19A

Figure 4.16. SB19A excavation profile.
Chert Feature SB19B

UTM Coordinates: 16 Q  244131mE  1940665mN  Elevation: 153 masl

Chert feature SB19B was located to the south of the southern San Bartolo site delimitation. This area had a high density of chert features, though no other structure types were apparent. The western edge of the feature bisected test unit one (SB19B-1). Test unit two (SB19B-2) was placed in the center of the feature, directly adjacent to test unit one. Artifacts were recovered from the levels 1-6 in both units, totaling 267 sherds and 899 lithics. This represented the lowest ratio of ceramics to lithics of any chert feature. Both units were terminated upon reaching bedrock, and as with SB19A the number of large-sized chert nodules increased significantly below the surface (Figure 4.17).

Figure 4.17. Large sub-surface chert nodules SB19B.
Chert Feature SB19C

UTM Coordinates: 16 Q 243911mE 1940870mN  Elevation: 154 masl

Chert feature SB19C was located directly on the southern site delimitation. The western edge of the feature bisected test unit one (SB19C-1). Test unit two (SB19C-2) was placed directly adjacent to test unit one in the center of the feature. Chert feature SB19C is an excellent example of how difficult it can be to detect these features. Figure 4.18 illustrates how even though the chert feature is located directly on the cleared site delimitation, in this case the center of the photograph, the chert feature is barely visible. However, once the presence of a chert feature is suspected, a quick surface examination will often provide evidence of exploitation by the ancient Maya (Figure 4.19).

Figure 4.18. San Bartolo southern site delimitation. Chert feature SB19C is located in the center of the picture, half in the sun and half in the shade.
Cultural material was encountered in the first seven levels of each unit, totaling 20 sherds and 26,077 lithics. SB19C represented the highest ratio of ceramics to lithics, and accounted for 71% of all lithics recovered from Operation 19. Figures 4.20 and 4.21 show the dense concentrations of lithic debitage in the test unit wall profiles. Test unit two was terminated after 10cm of sterile soil, while test unit one was excavated to bedrock at a depth of 140cm.

**Figure 4.20.** Dense debitage concentration in the wall profile of SB19C-1.
Figure 4.21. SB19C. Note the dense concentration of debitage in the trench walls.
Chert Feature SB19D

UTM Coordinates: 16 Q 243786mE 1940655mN  Elevation: 147 masl

Chert feature SB19D was located to the southwest of SB19C outside of the site delimitation. The southern edge of the feature bisected test unit one (SB19D-1). Test unit two (SB19D-2) was placed directly adjacent to test unit one in the center of the feature (Figure 4.22). Cultural material was encountered in the first five levels for a total of 26 sherds and 1,617 lithics. Test unit one was terminated after 10cm of sterile soil, while test unit two was excavated to bedrock.

Figure 4.22. Chert feature SB19D.
Chert Feature SB19E

UTM Coordinates: 16 Q 244522mE 1942180mN  Elevation: 169 masl

Figure 4.23. Chert feature SB19E.

Chert feature SB19E was located to the east of the Las Ventanas pyramid, and to the north of the ball court. The eastern edge of the feature bisected test unit one (SB19E-1). Test unit two (SB19E-2) was directly adjacent to test unit one and was placed in the center of the feature. Artifacts were encountered in the first five levels of both test units, totaling 105 sherds and 3,165 lithics. Large chert nodules exhibiting primary flake scars and a biface fragment were present on the surface of SB19E (Figure 4.23). Test unit one was terminated after 10cm of sterile soil, while test unit two was terminated upon reaching bedrock at approximately 140cm.
CHAPTER 5 METHODOLOGY, METHODS, AND DATA

“Several times each year, I am asked by Maya archaeologists: ‘are you still ‘doing’ obsidian?’ Occasionaly, closer friends ask: ‘why would anyone analyze lithic artifacts?’ One not-so-subtle message behind these questions is: “If you want to advance your career, do something more important and study something less mundane.” (Braswell 2011:1)

A common theme of museum exhibits dedicated to the ancient Maya is that somewhere between the displays of elaborate ceramic polychrome vessels and incensarios, and a diorama or two of a temple or acropolis, one can usually find tucked away a small exhibit on ancient Maya lithics. These exhibits contain the finest examples of: anthropomorphic and zoomorphic eccentrics, bifaces exhibiting nearly uniform parallel pressure flake scars, lustrous jade beads, and perhaps even a few greenstone camahuiles (Love 2010). A large portion of the following discussion is dedicated to the artifact class that is typically absent from lithic display cases – debitage. Though lithic debitage is certainly abundant at many ancient Maya sites, the following pages will demonstrate that the wealth of information these artifacts convey is far from mundane.

Chapter 5 is divided thematically into three complementary sections, the first of which is a brief historiography of Maya lithic studies. This section will assist in contextualizing my dissertation within the realm of Maya lithic studies while also providing the backdrop against which its novelty and overall contributions to the field can be assessed. It relies heavily on Braswell’s (2004, 2011) account, though alternative historiographies of Maya lithic studies have been penned by Fowler (1991), Johnson (1985, 1996), and Sheets (1997, 2003). The second section concerns both methodology and research methods. The section outlines specific analytical methods employed in this study, while also examining their genesis within specific historical and theoretical milieus. The chapter concludes with a presentation of the results of the ceramic and lithic analyses of the chert feature assemblages.
Framing the Analysis: Maya Lithic Studies

Early Lithic Studies in the Maya Area

Initial work in the Maya area (e.g. Maler 1911; Maudslay 1889-1902; Tozzer 1911) largely ignored lithic artifacts, and instead demonstrated a clear bias towards the upper echelon of ancient Maya society through the investigation of monumental public architecture, inscribed monuments, and site plans. The lack of attention lithic artifacts received at this early stage can easily be forgiven when considered within the context of discovering a ‘lost’ civilization, as few would argue that a general utility biface is more captivating than a 40 meter high temple. Unfortunately, this early pattern of neglect established a precedent that characterized lithic studies for the first half of the 20th century. During this era of “big site” archaeology, lithicdebitage was routinely discarded, and little beyond obsidian and chert formal tools were collected, a practice that regrettably continues in some areas to this day (Braswell 2011). Lithic artifacts were often excluded from site reports, and if they were included at all, it was only in appendices accompanied by little data outside of figure captions (Barrett 2011).

The first two detailed treatments of lithic artifacts in the Maya area emerged out of the Carnegie Institute of Washington’s excavations at Uaxactun. Though brief, Edith Ricketson’s (1937) work with the lithics from the site’s Group E excavations moved beyond simple illustration by presenting an early technological analysis of flaked and ground stone tools. Sheets (2003:11) has noted that her treatment of ground stone tools was twice the length of that received by flaked stone implements, and suggested that if Ricketson’s example had been followed ground stone tool analyses would be more prominent, rather than holding their current status as the “poor stepsister to flaked stone analysis.” Following Ricketson’s lead, A.V. Kidder (1947) published the first full monograph dedicated to artifacts in which lithics featured
prominently. His Uaxactun lithic typology tacked back and forth between raw material type, morphology, presumed function (i.e. ceremonial v. utilitarian), and occasionally means of manufacture. This typology was inherently problematic as it represented a hodgepodge of disparate traits, but it nonetheless presented detailed artifact descriptions accompanied by high quality illustrations that could be employed as a comparative dataset by other Mayanists. As such, Kidder’s treatment of the Uaxactun lithics served as the primary template for all subsequent lithic analyses from major projects for the next 25 years (e.g. Coe 1959; Willey 1972; Willey et al. 1995), and continues to shape contemporary lithic typologies.

Despite the upswing in coverage following Kidder’s (1947) work, lithics continued to be viewed as limited in their ability to furnish information about the ancient Maya, particularly in relation to the objectives of culture-historical archaeology. In comparison to architecture and ceramics, Maya lithics were perceived as exhibiting impressive morphological homogeneity over large time spans which would preclude their usefulness as chronological markers. This view was not completely without base, as two of the most common lithic artifacts – prismatic blades (Awe and Healy 1994; Hammond et al. 1991; Hirth 2003; Rice 1984; Rice et al. 1985; Taube 1991; Willey 1972, 1978; Willey et al. 1965) and general utility bifaces/celts (Drollinger 1989; Kwoka and Griffin 2005; Mitchum 1991; Potter 1991; Shaffer 1981, 1985) – made their appearance with early village life in the Middle Preclassic and continued to be used by the Maya into the Colonial Period. Regional chronologies based on stone tools have been successfully established for some regions (e.g. Gibson 1986; Hester 1985; Hester and Shafer 1991; Rovner 1975), though “chronologically sensitive” formal lithic tools are the exception rather than the norm (Johnson 1996:160).
Braswell (2004:178, 2011) has argued that much of the indifference with which lithics were viewed by early Mayanists can be attributed to both the lack of an appropriate theoretical paradigm which could fruitfully tap the potential of lithic data, and a view of economic matters as epiphenomenal to ancient Maya society. This state of affairs underwent a rapid transformation beginning in the 1970’s as processual archaeology began to gain traction in the Maya area.

**Processual Archaeology and Ancient Economics**

Whereas under culture-history stone tools were largely data sets lacking research questions, the arrival of processualism provided a new suite of theories and issues that lithics seemed ideally suited to address, especially those that explored the relation between human behavior and long term economic processes. Processualism also introduced a number of new methods by which these processes could be investigated, such as ethnoarchaeology, experimental archaeology, and the archaeological sciences. The drastic increase in the number and scope of lithic studies in the Maya area, and Mesoamerica in general, during the 1970s mirrored this theoretical and methodological expansion (Figure 5.1). As the first formal gathering of Maya lithicists, the First Maya Lithics Conference (hereafter MLC) is an ideal event from which to anchor a discussion of how processualism promoted the emergence of lithic studies as a
legitimate specialization within the Maya area, and framed research objectives in the following decades.

Held in 1976, in Orange Walk Town, Belize, the objectives of the First MLC (Hester and Hammond 1976a) were twofold. First, members of Norman Hammond’s (1973) British Museum – Cambridge University Corozal Project were to share data on their recent discoveries and work at the northern Belizean site of Colha, with special attention to Richard Wilk’s (1975, 1976) work with the lithic material. The significance of this event was that it marked the emergence of craft specialization as a core theme in Maya lithic studies. Though at this point in time little archaeological work had been conducted at Colha, initial results made it clear that this comparatively small site had been the setting for intensive lithic production on a scale not encountered before in the Maya Lowlands, and that these activities had spanned the Middle Preclassic through Postclassic Periods (Hester and Hammond 1976b).

The second objective of the conference was largely “cartographic” in nature, as it focused on assessing the current state of Maya lithic studies (Braswell 2011:2). To this end, Payson Sheets (1976) presented a succinct yet powerful paper titled “Islands of Lithic Knowledge Amid Seas of Ignorance in the Maya Area,” in which he highlighted gaps in geographical coverage and, perhaps most importantly, outlined future methodological directions for Maya lithic studies. He suggested that Mayanists should embrace emerging functional, technological, and trace element studies, while also attempting to investigate hitherto unknown areas. Ultimately, it was the technological approach which was most enthusiastically embraced with Sheets leading the foray.

In addition to the range of established and lesser-known academics, the First MLC was also attended by the avocational archaeologist and expert flintknapper, Don Crabtree. Crabtree
did not present a paper, but he did provide a flintknapping demonstration during one of the Colha site visits, and it is within this realm that he made foundational contributions to Mesoamerican lithic studies. Both the research questions asked by Mayanists at this point, and the methodologies they employed to investigate them can be traced directly to the experimental replication work conducted by Crabtree (1968, 1972). It was under his tutelage that many of the most prominent New World lithicists honed their craft (Sheets 2003; Tixier 2003).

Sheets (1972, 1975) attendance at Crabtree’s summer lithic field school in 1971 is a case in point, as it was here that he began to employ what he has referred to as a “behavioral” approach in his work with the obsidian from the site of Chalchuapa, El Salvador. In theory, Sheets’ (1975) behavioral model was designed to avoid the imposition of arbitrary taxonomic units on lithic assemblages through the identification of inherent categories derived from discontinuities in the production process. Experimental replication work was also to be conducted as means of assisting the analyst in correctly identifying these discontinuities. In practice, Sheets behavioral approach employed a linear reduction model based on technological attributes, a practice which is often referred to as a technological analysis. Although these models made significant gains in popularity during the 1970’s (Bentley 1975; Collins 1975; Muto 1971a, 1971b), their origins can be traced back to the work of Holmes (1880, 1919).

In retrospect, two major themes permeated Maya lithic studies during the 1970s. First, the Colha papers presented at the First MLC had provided some of the strongest evidence for craft specialization in the Maya area, and thus had fostered a broad interest in identifying specialized production activities in the archaeological record. The second theme involved employing multiple methods, such as experimental replication and technological analysis, to understand how ancient Maya technicians had made stone tools. A review of papers presented at
the Second MLC (Hester and Shafer 1991), which was held in 1982, demonstrates that these themes continued to be important. Sheets behavioral approach had been enthusiastically adopted, as evidenced by the proliferation of site-specific reduction trajectories (Table 5.1).

**Table 5.1.** Proliferation of reduction sequence models in the Maya area during the 1970s and 1980s (compiled from Fowler 1991).

<table>
<thead>
<tr>
<th>Author</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrensen 1976</td>
<td>Aventura, Chan Chen, Santa Rita, Patchchacan</td>
</tr>
<tr>
<td>Clark 1979</td>
<td>La Libertad</td>
</tr>
<tr>
<td>Clark 1981</td>
<td>Paso de la Amada, La Joya/El Chayal</td>
</tr>
<tr>
<td>Clark and Lee 1979</td>
<td>Chiapa de Corzo</td>
</tr>
<tr>
<td>Fowler 1981</td>
<td>Cihuatan-Santa Maria</td>
</tr>
<tr>
<td>Fowler 1983</td>
<td>El Mirador</td>
</tr>
<tr>
<td>Hay 1978</td>
<td>Kaminaljuyu</td>
</tr>
<tr>
<td>Hester 1975</td>
<td>Chinaultla Viejo</td>
</tr>
<tr>
<td>Moholy-Nagy 1983</td>
<td>Tikal</td>
</tr>
<tr>
<td>Johnson 1976</td>
<td>Palenque</td>
</tr>
<tr>
<td>Rovner 1975</td>
<td>Becan, Chicanna, Dzibilchaltun</td>
</tr>
<tr>
<td>Rovner 1974</td>
<td>Mayapan</td>
</tr>
<tr>
<td>Sheets 1972</td>
<td>Chalchuapa</td>
</tr>
<tr>
<td>Sheets 1983</td>
<td>Quirigua, Zapotitan Valley</td>
</tr>
<tr>
<td>Wilk 1975</td>
<td>Colha</td>
</tr>
<tr>
<td>Wonderlay 1981</td>
<td>Naco</td>
</tr>
</tbody>
</table>

The research objective of elucidating the various components of craft specialization increased in importance, including the measures by which specialized production contexts could be identified in the archaeological record (Healan 1992; Hester and Shafer 1992; Moholy-Nagy 1990, 1992). However, some lithicists became interested not only in identifying specialized production, but also in exploring the organization of craft specialists, their political affiliations, and the relationship between specialization and the emergence of social complexity (Aoyama 1999; Clark 1987; Costin 1991; Nelson 1991). Furthermore, there had been a growing interest in the post-production life histories (sensu Schiffer 1972) of stone tools that had emanated from
workshop contexts, and in relating lithic production and consumption to broader issues of political economy and regional exchange systems (Braswell 2004, 2011).

Along these lines, lithicists working in northern Belize began to think about the consumption sphere and distribution network for the mass quantities of stone tools that had been produced at Colha’s many workshops. The result was the formulation of what became known as the producer-consumer model (e.g. Dockall and Shafer 1993; McAnany 1986, 1988, 1989; McSwain 1991; Shafer 1983). In essence, this model argued that if Colha produced surplus tools for export to regional sites, then sites which imported these tools should have debitage assemblages that were reflective of consumption activities such as tool retouch and recycling. The corollary at Colha would be debitage assemblages that were characteristic of tool production. Provenience studies of obsidian artifacts were also conducted with increasing frequency to reconstruct exchange networks (e.g. Healy et al. 1984; Hammond et al. 1984; Rice 1984; Sidrys 1976).

Contemporary Approaches

According to Braswell (2011:5), a new “Technology Stage” has emerged in Maya lithic studies which is characterized by analysts who are comfortable mixing multiple theoretical paradigms in the vein of Hegmon’s (2003) “processual-plus” archaeology. This new era is attributed to the influx of a fresh generation of lithicists who were too young to have experienced the most heated periods of cross-paradigmatic conflict between culture history, processualism, and later post-processualism. Empirical research methodologies remain the central component this approach, but the range of research questions lithic datasets are employed to address has expanded to reflect broader trends in social theory. Braswell’s (ibid) opening chapter of the
published proceedings from the Third MLC is a case in point, as he uses an elementary formu-
lation of actor-network theory to summaries all of the volume’s papers.

But how representative of Maya lithic studies is Braswell’s use of actor-network theory? A review of papers from the Third MLC (Hruby et al. 2011) suggests that his claim of a new “Technology Stage” of Maya lithic studies may have been a bit premature, as craft specialization, exchange networks, and issues of political economy are the themes which dominate the volume. The size, scope, and sophistication of lithic studies have certainly increased as of late, but topically the field has been in a holding pattern over the last twenty to thirty years. As Hruby (2011; Hruby and Flad 2007) and others have noted, the limited suite of topics that Maya lithic studies addresses makes our disciplinary sub-specialization and the knowledge it produces of limited value to the broader field of anthropology and beyond.

Hruby (2011) closes the Third MLC volume by suggesting paths by which Maya lithic studies can simultaneously advance as a sub-discipline and become more relevant. Mirroring portions of my argument from Chapter 2, he states that it is time to reassess the use of formalist economic models in reconstructing ancient Maya economies. A more significant engagement with social theory and an expansion of our gaze beyond the confines of economic issues will also further this cause. This dissertation embraces all of these challenges, and within the context of the preceding discussion it is clear that the resulting product represents a significant departure from traditional Maya lithic studies. However, the utilization of novel theoretical frameworks does not necessarily require new research methods. The following section presents a discussion of debitage analysis methods which will be followed by a presentation of the analysis results.
Debitage Analysis: Background and Discussion

Definition and Historical Development

Odell (2003a:118) has suggested that retouched tools typically represent 3 – 5% of lithic assemblages from prehistoric sites across the world, with debitage comprising the other 95%. The comparative dataset needed to assess these figures would be difficult to assemble, but it is clear that archaeological sites associated with cultures that utilized stone tool technologies share a common feature; site assemblages dominated by lithic debitage. Despite the ubiquity of this artifact class, culture-historians and their predecessors gave lithic debitage little attention. But before discussing the history of debitage studies any further, a definition of the term is in order.

Some lithic analysts have taken the approach of U.S. Supreme Court Justice Potter Stewart when it comes to defining their subject of study; lithic debitage is difficult to define, but you know it when you see it. At the opposite end of the spectrum are those view the concept as akin to a well-travelled road, and thus unnecessary to cover again. Regardless of the ideological underpinning, the result has been that explicit definitions of debitage are often absent from studies of this material (Shott 1994, 2004). Terms such as “flake,” “waste flake,” “debris,” “flake debris,” “byproducts” and “debitage” are employed interchangeably. Further complicating the matter, some lithicists working in the Old World employ concepts of debris and debitage that are based on size and the potential of becoming a tool, terminological nuances that do not have New World analogs (Odell 2003b; Shott 2004). Debitage has been variably defined as “unretouched lithic artifacts with positive percussion features” (Sullivan 2001:192), the “detached piece discarded during the reduction process” (Andrefsky 1998:xxii, 2001:xi), the “waste product of lithic production” (Shott 1994:70, 2004:213), and simply as “waste products” (Whittaker 1994:20). The thematic undercurrent of the above definitions is concerned with
conceptually delineating detached pieces intended for tool use versus detached pieces that are byproducts of the reduction process (Steffen et al. 1998). While acknowledging that artifacts, including lithic debitage, often have complicated life histories, this study employs Andrefsky’s definition of debitage. Furthermore, the term debitage encompasses the multitude of forms taken by detached pieces, including flakes, flake fragments, and what is often referred to as shatter, all of which will be defined at a later point.

The identification of lithic debitage as the byproduct of stone tool production was widely accepted by the end of the 19th century. The geologist John Wesley Powell (1895a:79) had commented on the abundance of quarry sites and “chips” that he had encountered during his exploration of the Colorado River. During his travels in the Uinta Mountains, Powell (1895b:2) witnessed the Shoshone flintknapping various bifacial implements, and noted how their camps were “strewn with…chips… [and] many discarded failures.” At approximately the same time, William Henry Holmes (1894, 1897, 1919) was publishing lithic tool typologies and early reduction sequences that were based on his work with the lithics housed by what was then known as the Smithsonian Institute’s Bureau of Ethnology. In addition to these analytical methods, which continue to be core components of contemporary lithic analyses, Holmes (1894:134) provided the raison d’être for debitage analysis when he stated that “[b]y a study of flakage much is learned of the nature of the work done.” This sentiment, which Sullivan (2001:193-94) has termed Holmes’ Principle, provides the logic of debitage studies by arguing that debitage characteristics provide insights into broader assemblage characteristics, and in turn human behavior. In other words, lithicists study debitage because it informs us about what sorts of tools ancient technicians made, and what techniques they employed to make them. Despite the
interpretive potential of lithic debitage and its sheer abundance, interest in this group of artifacts remained dormant during the first half of the 20th century.

Sullivan (ibid) has suggested that systematic studies of lithic debitage began to emerge in the 1950s and 1960s, though they continued to be of ancillary interest. It was not until the emergence of Cultural Resource Management (CRM) in the 1970s and its coupling with processual archaeology that debitage studies truly gained momentum. CRM archaeology emerged from a series of pieces of legislation that were implemented in the 1970s, including the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and the Archaeological and Historic Preservation (Moss-Bennett) Act. According to this legislation, a number of federal agencies and State Historic Preservation Offices (SHPOs) were now responsible for preserving the cultural patrimony of the United States and her various peoples, and for overseeing the emerging domain of archaeological consulting firms (Green and Doershuk 1998). One of the practical effects of this legislation was that the expanded scope of archaeological excavations caused a concomitant jump in the amount of lithic debitage recovered from archaeological contexts. By the mid-1970s, archaeological laboratories and storage facilities of CRM firms, anthropology departments, and museums had been inundated with massive amounts of debitage. Archaeologists now needed not only a justification for keeping such large amounts of material, but also a means by which to extract information about past human behavior from the debitage. Processual archaeology, and in particular its experimental branch, satisfied both needs through the application of a Binfordian understanding of middle range theory (Binford 1977, 1978, 1981, contra Raab and Goodyear 1984). By using ethnoarchaeological and experimental replication datasets, archaeologists were able to draw
inferences that related present, static forms of lithic debitage to dynamic cultural processes in the past (Larson 2004).

Attribute Analysis

Three broad approaches to debitage analysis have emerged since the 1970s. These approaches can be characterized by the observational scale they employ, and have been designated as attribute, typological, or aggregate analyses. Lithicists may perform only one type of analysis as any debitage study typically requires a significant time investment, though analyses which incorporate multiple approaches are becoming more common (Carr and Bradbury 2001, 2004, 2011). Such is the approach taken in this dissertation, where I have employed both typological and aggregate analyses.

Attribute analysis combines the individual artifact focus of typological analysis and the concern for assemblage level patterns that characterizes aggregate analysis. This is accomplished by examining the distribution of a variable(s), be it continuous or discrete, across an assemblage (Andrefsky 1998, 2001). Aside from the belief that certain attributes are informative of past human behavior, some lithicists employ attribute analyses as a means of addressing the perceived loss of information that occurs when creating debitage types (Odell 2003:125-30). For example, a bifacial thinning flake might be comparatively thin and long, display a lipped, multi-faceted platform, and a dorsal surface exhibiting numerous flake scars and a small amount of cortex. This is quite a bit of information that becomes subsumed within the overarching type of “bifacial thinning flake.”

An example of an attribute analysis that is conducted with relative frequency is the recording of the amount of dorsal cortex present on individual debitage specimens for the
purpose of identifying reduction stages. The initial argument for this correlation was that
debitage from earlier reduction stages would have more cortex than debitage from latter stages,
though further research has shown this relationship to be much more complex (Andrefsky 1998;
amount to identify the earliest stages of reduction, while Odell (1989) found that it was a good
indicator of only the very earliest and latest stages of reduction. Furthermore, Tomka’s (1989)
experimental work demonstrated that dorsal cortex coverage is significantly impacted by the
characteristics of the objective piece (e.g. river cobble or flake blank). Additional examples of
attribute analyses include employing the number of platform facets (Bradbury and Carr 1995,
1999) and platform morphology (Andrefsky 1998, Parry and Kelly 1987) as a means of
distinguishing between bifacial and core reduction, or the type of reduction technology employed
(Whittaker 1994). In terms of broader applications, Odell (2003:129-30) has suggested that
attribute analyses are most ideally suited to discriminating assemblages from different
chronological periods, and identifying site functions. Analyses of individual debitage attributes
are predominantly a North American tradition, with a particular emphasis on the western portion
of the United States (Shott 2003).

**Typological Analysis**

Typological approaches are both the oldest and most popular methods (though see
Whitaker 1998 for critique) of studying lithic debitage, and they operate by classifying individual
debitage specimens into types that are argued to have technological or functional significance.
In addition to the immediate behavioral data provided by types, lithicists employ typological
analyses as a means of avoiding the time requirements (Amick 1989), or the problems of
subjective attribute definitions and observation replicability (Sullivan and Rozen 1985) that are encountered with attribute analyses. Andrefsky (1998, 2001) has identified four frequently employed methods of typological analysis which are variously concerned with application loads, cortex values, technology, or the creation of objective types.

Application load typologies use bulb of force and platform characteristics to determine whether a detached piece resulted from either hard or soft-hammer percussion, or pressure flaking. Flakes detached by hard-hammer percussion tend to exhibit pronounced bulbs of percussion, whereas detached pieces with lipped platforms and diffuse bulbs are often the result of soft-hammer percussion (Cotterell and Kamminga 1987, Crabtree 1972). The inclusion of pressure flakes in load typologies is a more contentious issue as the degree of success with which pressure flakes can be identified is debated. Ahler (1989) has argued that pressure flakes can be identified by their small size and low weight in comparison to percussion flakes, but experimental studies have shown that virtually all types of lithic reduction produce large amounts of small-sized debitage (Ammerman and Andrefsky 1982; Andrefsky 1986).

Cortex typologies operate in a similar manner to their attribute analysis counterparts by focusing on dorsal cortex coverage for the purposes of identifying reduction stages. Debitage specimens are typically classified using a “triple cortex” approach, whereby flakes are designated as being primary, secondary, or tertiary (Andrefsky 1998:111; Potter 1984). Primary flakes, which have dorsal surfaces largely covered by cortex, are detached in the earliest stages of reduction, while cortex-free tertiary flakes represent the final stages of reduction. Many of the same issues associated with cortex attribute analyses remain relevant with typological analyses, especially those related to clear and consistent type definitions, and the impact of objective piece characteristics on cortex coverage.
Technological typologies use multiple debitage attributes to create types which are indicative of the reduction technology by which they were produced. Prime examples of technological types are: bifacial thinning flakes (Shott 1993), bipolar flakes (Flenniken 1981), platform preparation flakes (Johnson 1996), and notching flakes (Titmus 1985). As Andrefsky (1998) has noted, technological types are favored due to the fact that they provide immediate data on past human activities; bifacial thinning flakes indicate biface production occurred at a site, and platform rejuvenation flakes indicate blade production and error recovery.

The fourth and final approach consists of free-standing typologies which emphasize the use of objective criteria in creating types. Sullivan and Rozen’s (1985) interpretation-free approach, arguably one of the most influential and controversial debitage studies, is a prime example of this method. In this case, the authors employed three nominal variables to segregate a debitage population into four types: debris, flake fragments, broken flakes, and complete flakes. They then argued that the type of technology employed had a direct relation to the relative frequency of the four debitage types. For example, they argued that core reduction produced a higher frequency of complete flakes than resulted from tool production. Ultimately, the results have been mixed for what has become known as the Sullivan Rozen Technique (SRT). On the one hand, many of their behavioral interpretations have been contradicted by other experimental studies (Odell 2003:124-25). However, their typology has been extremely successful in the degree to which it has been replicated by other researchers.

**Repurposing Producer Consumer Typologies at San Bartolo**

There is no standardized debitage typology which is used in the Maya area. Instead, lithicists have developed a variety of typologies to suit their needs based on research questions
and background training. The debitage typology that I have utilized combines Shafer’s (1983:239-41) Pulltrouser Swamp typology with Dockall and Shafer’s (1993) Santa Rita typology, both of which were designed to evaluate each sites’ role in the northern Belize producer-consumer model referred to earlier. There currently is no evidence to suggest that San Bartolo participated in the northern Belize lithic exchange sphere in any way. Aside from the geographical and potential sociopolitical barriers to such interaction, the abundance of naturally occurring chert nodules in the San Bartolo-Xultun region, and the extensive evidence of their utilization (Garrison 2007; Griffin et al. 2006; Kwoka 2004; Kwoka and Griffin 2005), demonstrates that the long-distance trade of utilitarian chert tools would have been superfluous. With that said, the Belizean producer-consumer typology is still quite useful for the San Bartolo material due to its emphasis on differentiating between tool production and lithic reduction associated with tool use, maintenance, and recycling (McAnany 1986, 1988; Shafer 1983). While the surface of the San Bartolo chert features showed evidence of past flintknapping activities, the exact nature of these activities was not understood. As such, the producer-consumer typology appeared ideal for determining whether tool production or tool use/maintenance was occurring at the chert features.

Table 5.2 includes the debitage types and type abbreviations used in this study. They combine to form a monothetic classification scheme, where an entity must exhibit a fixed set of attributes to obtain type membership (Adams and Adams 1991:226). All of the attributes used in this typology are largely measures of objective phenomenon and could technically be employed to create a ‘value-free’ typology. However, in this study two or more attributes have been combined to create types that are meant to elucidate some aspect of prehistoric behavior, be it load application, degree of platform preparation, or reduction stage.
Following procedures outlined by Shafer (1983), the four-step method by which the debitage was classified is displayed graphically in Figure 5.2. Each individual piece of debitage from the chert feature assemblages was first classified as either a flake or fragments. Flakes were defined as detached pieces that retained a platform, or exhibited platform remnants. Whether a flake appeared to be broken or intact was not recorded. Fragments consisted of broken flakes without platform remnants and angular shatter. Angular shatter, also known as non-flake debitage, are detached pieces which also lack a platform or platform remnants, and do not have identifiable dorsal or ventral surfaces (Andrefsky 1998:82-83). Only flakes, which accounted for 50.4% (n=18,380) of the total debitage assemblage, were selected for further typological analysis.

After the flakes had been identified they were further sorted according to their bulbar characteristics and classified as exhibiting either a pronounced or diffuse bulb of force.
Replication studies have shown that there is a strong correlation between bulbar morphology and precursor type (Cotterell and Kamminga 1987; Dibble and Whittaker 1981; Tsirk 1979). Pronounced bulbs of force are typically associated with hard-hammer percussion (Crabtree 1972), whereas soft precursors tend to produce a diffuse bulb as a result of compression and bending forces (Andrefsky 1998; Tsirk 1979; Whittaker 1994).

Figure 5.2. Flow chart for typological analysis of the chert feature debitage assemblage.
The next step in the analysis involved the classification of flakes according to platform morphology. Flake striking platforms convey information about the objective piece from which they were detached, and in some cases the core preparation practices of ancient technicians (Andrefsky 1998). The four platform types used in this study were: cortical, single facet, multifaceted, or crushed/collapsed. Flakes which exhibited an unmodified, cortex-covered platform were classified as such. The second and third platform types were determined by the number of facets a platform exhibited. In this study a facet is defined as either a “natural or artificial plane surface” (Crabtree 1972:62), and should not automatically be equated with the “facetting” platform preparation technique (Whittaker 1994:101). Single facet platforms were those with a single smooth flat surface that intersected with the dorsal surface of the flake at approximately a 75° – 90° angle. This type of platform often occurs when the objective piece contains broad flat surfaces, such as with a unidirectional core or flake blank (Andrefsky 1998:95). Multifaceted platforms, also referred to as complex platforms, exhibited two or more facets of varying sizes. Platform preparation flaking and step fracturing from abrasion are two processes which typically result in the production of multifaceted platforms. Flakes with crushed or collapsed platforms comprised the fourth type. Crushed or collapsed flakes were those which had damaged or partially missing platforms, yet provided sufficient evidence (e.g. lateral platform margins and partial bulb of force) to identify the original platform location. Hard hammer percussion produces a high frequency of crushed platforms, and the force resulting from a hard hammer strike will collapse platforms that are too small (Hayden and Hutchings 1989). Whittaker (1994:185) has suggested that the comparatively smaller size of platforms associated with soft hammer percussion results in a high frequency of crushed platforms, and that regardless of precursor type, excessive load application will usually result in a collapsed platform. The
fourth and final step in my debitage classification method was to identify individual flakes as cortical or noncortical based on the presence of absence of cortex on the dorsal flake surface. No attempt was made to quantify the amount of cortex present.

![Technological/Attribute Typology](image)

**Figure 5.3.** An illustration of how new types can be derived from the typology employed in this study.

One of the advantages of the typology employed in this study is that it is collapsible (Figure 5.3). By that I mean that new types, and thus a new typology, can be created by emphasizing single attributes that are normally subsumed within a type that is comprised of multiple attributes. For example, if one is interested in the degree to which platform preparation is represented in the chert feature debitage assemblage, then the ten types which convey...
information about platform morphology can be collapsed into three types: cortical, single, and multifaceted platforms. Furthermore, if one is interested in reduction stages, then the typology can be easily collapsed into two types based on the presence or absence of cortex. This flexibility is essential for accommodating the idiosyncrasies of multiple debitage assemblages. Before presenting the results of the San Bartolo chert feature debitage typological analysis, a brief review of aggregate analysis and its application at San Bartolo is in order.

**Aggregate Analysis**

The designation of aggregate analysis can be applied to a broad range of techniques that employ “non-technological criteria to subdivide the entire assemblage before considering the technology of the assemblage as a whole” (Larson 2004:5). Aggregate analyses result in the production of “assemblage-level summary statistics” which can assist in cross-assemblage comparisons (Shott 1994:87). In popular usage the terms ‘mass analysis’ and ‘aggregate analysis’ are often used interchangeably, but this usage is erroneous. Item completeness (Prentiss 2001), minimum analytical nodule analysis (Larson and Finley 2004; Larson and Kornfeld 1997), and refitting (Morrow 1996) all represent divergent trends in aggregate analysis. Methods which incorporate debitage size characteristics are by far the predominant approach, with most either replicating or employing some variant of Ahler’s (1989) mass analysis technique. A variant of mass analysis was the second method I employed to analyze the debitage recovered from my excavations of the San Bartolo chert features. Before discussing the manner in which I employed this technique, the original applications and objectives of this method will be reviewed.
The allure of mass analysis for archaeologists investigating cultures that utilized lithic technologies is readily apparent. For example, 3.6 m³ of soil excavated from a Late Classic workshop dump at San Bartolo produced 1,500 lbs. of debitage (Kwoka 2004). Depending on the context, scale and intensity of production, it may be unfeasible to analyze every single piece of debitage recovered from an excavation. Mass analysis resolves this issue in providing a method by which large quantities of debitage can be processed en masse while still providing informative data. In brief, the technique of mass analysis (hereafter MA) involves subdividing an assemblage by passing debitage through a series of nested screens of increasingly smaller size. This results in size-graded subsets from which additional quantitative and categorical variables, such as weight and cortex presence or absence, can be recorded.

According to Ahler (1989:87-9), MA addresses many of the problems that arise with individual flake analyses (IFA). Specifically, as an aggregate method MA allows for the analysis of all types of debitage, regardless of flake fracture or completeness. This is significant in that many IFA exclude broken flakes and angular shatter in particular. MA is also a rapid and efficient means of analyzing extremely large assemblages. Case in point, with the assistance of the San Bartolo undergraduate field school students I was able to size-grade all of the debitage (n=36,497) from five chert features in one day. Technological bias related to debitage size is significantly minimized in MA, as depending upon screen size intervals, material resulting from both hard hammer percussion and pressure techniques can be recovered. Finally, MA addresses two frequent critiques of IFA which are tied to issues of replicability and objectivity. Ahler (ibid) argues that the size-grading, counting, and weighing of debitage which occurs during the initial data collection stages of MA does not require the skills of a trained lithicist. In fact, he
states that “virtually anyone trained in elementary lab procedures can record data in a replicable manner” (ibid: 88).

The logic of MA is premised on the reductive nature of stone tool production; be it core reduction or tool production, detached pieces become progressively smaller throughout the process. Furthermore, “it is not possible to remove a flake that has a larger linear dimension or mass than the largest dimension of the objective piece or tool being made” (Andrefsky 2001:3-4). As such, proponents of MA argue that the relative proportions of debitage in each size grade can shed light upon a number of issues, including load application, reduction/production stage, and tool form. In order to make such connections, it is necessary to have debitage control groups produced through replication experiments. To provide a simplified example, a lithicist would produce an ovoid biface from a chert nodule, and then conduct mass analysis on the resulting debitage. The relative proportions of each debitage size grade would then be compared to an archaeological assemblage. If the relative proportions matched between the two assemblages, then an argument could be made that the archaeological debitage assemblage resulted from the production of ovoid bifaces from chert nodules.

While initial applications of mass analysis appeared to bear fruit, subsequent critical evaluation of the method has resulted in the identification of multiple conceptual and methodological issues. Andrefsky (2001, 2004, 2007), an outspoken critic of mass analysis, has suggested that most of the problems associated with MA result from the following issues: replicator variability, variation in raw material characteristics, mixed assemblages, and the validity of diagnostic signatures derived from experimental data sets. In terms of replicator variability, one of the assumptions of MA is that there is congruence between contemporary and prehistoric knapping techniques. Unfortunately, experimental studies have shown this
assumption to be problematic as the individual skill (Shelley 1990), style, and technique (Amick and Mauldin 1997; Bradbury and Carr 1995) of each flintknapper will effect debitage characteristics. Redman (1997) has demonstrated that even when three expert flintknappers produced the same tool using the same materials, significant variation in debitage assemblage characteristics occurred.

In addition to flintknappers’ idiosyncrasies, objective piece morphology and material type will also have a significant impact on debitage characteristics. Andrefsky (2007) reduced two obsidian nodules of different shape and size using bipolar reduction, and then subjected the debitage to MA. He discovered that when compared using relative frequencies, there was significant variation between the size grades even though the same technology had been used to reduce both nodules. As for raw material type, Amick and Mauldin (1997) have shown that flake breakage patterns are often mistaken as behavioral indicators, when in actuality the patterns are often related to mechanical properties of raw materials.

By far the most significant challenge to the validity of MA stems from the issue of mixed assemblages. Even if we were to ignore the preceding critiques of MA, Andrefsky (2007:396) demonstrates that the issue of assemblage mixing would still loom large:

Simply stated, if we assume that debitage produced by the production of similar tools results in similar size grade signatures, and we assume this is true regardless of who made the tools, and we further assume that raw material size, shape, and composition are not an issue, MA must still overcome the problem created when debitage from two different production events are mixed together, as is often the case with archaeological assemblages. For instance, when debitage from the reduction of a biface is mixed with debitage from the reduction of a platformed core, the size grade signatures are no longer discernable or diagnostic.
In contrast to data sets produced through experimentation, archaeological debitage assemblages typically represent a mix of different types of reduction or production activities (e.g. core reduction, biface production, etc…). The degree to which any individual reduction/production activity is represented may also vary. For example, a mixed assemblage may contain 100% of the debitage that resulted from the production of a biface from a nodule, but only the initial 20% of the debitage resulting from the reduction of a polyhedral core. Thus, a mixed assemblage may not only represent different reduction trajectories, but also different proportions or segments of each trajectory (Shott 2004). Debitage taphonomy must also be considered, as natural and cultural postdepositional processes, such as trampling or a cave roof collapse, can impact the degree to which an assemblage is mixed (Rasic 2004).

One final critique of MA concerns the validity of diagnostic signatures produced through replication experiments. This issue is of central importance, as without these diagnostic signatures there is no key with which to ‘read’ the results from traditional MA studies. Several authors (Ahler 1989; Baulmer and Davis 2004; Carr and Bradbury 2004) have successfully identified unique debitage signatures that are diagnostic of specific reduction trajectories through replication experiments in controlled laboratory settings. However, not all researchers have had the same success. Morrow (1997) conducted a replication experiment where he reduced/produced a bifacial core, blade core, a bipolar core, and a Clovis point, and then subjected each debitage assemblage to MA. Andrefsky (2007) conducted an analysis of Morrow’s published data set, and demonstrated statistically that the debitage signature for each replication experiment could have come from a single population. This finding is quite problematic, as it calls into question the ability of experimental data to inform our understanding of the archaeological record through the identification of diagnostic patterns in debitage.
assemblages. Based on the above issues, it is both reasonable and necessary to question the utility of mass analysis and the validity of its results.

**Moving Forward With Mass Analysis at San Bartolo**

Despite the harsh critique in the preceding paragraphs, MA can be an informative method when employed judiciously. Some of the above issues, particularly those related to the mixed assemblage problem, can be mitigated by subdividing the aggregate into more meaningful units, and then subjecting those subdivision to MA. This can be achieved by using minimum analytical nodule analysis (Larson and Kornfeld 1997) to partition the aggregate, or by creating technology-specific subsets through a process of individual flake analysis. The latter is the approach I have taken with the San Bartolo material, first partitioning the aggregate using the typology outlined in the previous section, and then subjecting those subsets to MA.

Another approach to addressing some of the issues with MA is to change what we ask of the method. For example, part of my interest in the San Bartolo chert features stemmed from previous excavations I had undertaken at a Late Classic lithic workshop dump (Figure 5.4). The excavation and subsequent analysis of the material revealed an assemblage characterized by very small debitage (98% smaller than 1 inch), a high frequency of bifacial thinning flakes, and a lack of debitage.

![Figure 5.4. Late Classic lithic workshop dump (after Kwoka 2004)](image)
displaying cortex. Additionally, the presence of a large single facet platform on the proximal margin of many of the biface rejects and preforms indicated that unmodified flake blanks were the starting point of the production process. When all of these lines of evidence were considered together it became clear that a reduction juncture had separated the initial phases of the production process, which had occurred elsewhere at the site, from the workshop production activities (Kwoka 2004). “Reduction junctures are defined as terminations or pauses in the reduction process, at which point partially reduced lithic material is transported away from places of preparation and reduced into usable tools elsewhere” (Pecora 2001:173). My initial thoughts upon encountering the San Bartolo chert features were that they could have been the locations where flake blanks were reduced from chert nodules for eventual transport to the workshop. As stone tool production is a reductive process, a reduction juncture should be reflected in the debitage size characteristics of separate, yet related debitage assemblages. Though cursory inspections clearly indicated that the debitage from the chert features was generally much larger than the workshop material, MA was used as a means of quantifying that difference (Figure 5.5).

![Debitage Size: Chert Features v. Str.86 Workshop](image)

**Figure 5.5.** Debitage size distribution for chert features and workshop contexts.
Subsequent lithic and ceramic analyses revealed that the chert features and lithic workshop were in fact not related, and that flintknapping activities at the lithic workshop occurred at least 300 years after the chert features had ceased to be utilized. Lithic analyses further revealed that the chert features and lithic workshops were characterized by very different reduction trajectories. Based on the critique in the preceding paragraphs we know that establishing correlations between MA signatures and specific lithic production practices is problematic, but this does not detract from the fact that the results of MA suggested that the two contexts represented significantly different flintknapping practices. Of course, MA of archaeological material is not conducted in a vacuum. The context of production, such as a household or specialized activity area, and the overall artifact assemblage (e.g. tested nodules, broken tools, etc…) can provide guidance for the interpretation of MA results. Furthermore, MA should always be but one part of a larger multiple-method approach to any debitage analysis.

The lithic debitage from the San Bartolo chert features was partitioned into nine size grades (Table 5.3) using screens which were custom built. The frames for the screens were constructed from saplings growing in the vicinity of the San Bartolo camp, and various sizes of hardware cloth served as the sorting medium. Root (2004:90) has noted that the openings in hardware cloth can be irregular, with a range of .02” for hardware cloth with a ¼” opening. Even so, the openings never exceed the size classification due to wire diameter. My approach to aggregate analysis was atypical in the large number of size grades I employed, and the large size (e.g. 2”) of the larger end of the spectrum. Based on previous experience and a cursory inspection of material collected during excavation, it was determined that a

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<td>0.635</td>
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<td>1/8”</td>
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more traditional approach employing both fewer and smaller size grades would fail to record much of the variability present in the debitage assemblage. Recovery of debitage 1/8” and smaller was poor due to soil texture, and as such this size grade is surely underrepresented. In hindsight the flotation of soil samples from the chert features would have provided a more accurate representation of the frequency of the smallest debitage.

Chert Feature Chronologies: Ceramic Data

Lithic production activities at the chert features were dated by association with ceramic types derived from the application of the type-variety method (Gifford 1960; Smith and Gifford 1966; Smith et al. 1960; for critiques see Dunnell 1971; Smith 1979). The analysis of the chert feature ceramic assemblage was conducted by Rivera Castillo (2005, N.d.), the San Bartolo project ceramicist. The chert features produced relatively few ceramics (n=872) in comparison to other contexts at San Bartolo, a large portion of had been subjected to significant weathering and were in a state of poor preservation. However, a sufficient number of sherds retained their slip, exhibited diagnostic paste characteristics, or diagnostic vessel forms to be able to date all of the chert features. The following discussion will be limited to noting the presence of particular ceramic complexes, though a detailed analysis can be found in Rivera Castillo’s work.

The earliest levels of chert feature SB19A were assigned to the Middle Preclassic Mamon ceramic sphere due to the presence of material similar to the Jenny Creek complex at Barton Ramie (Gifford 1976), the Tzec complex at Tikal (Culbert 1993, 2003), and the Mamon complex at Uaxactun (Smith 1955a, 1955b). Ceramics from the initial four levels belonged to the Late Preclassic Chicanel sphere based on the presence of material equivalent to the Barton Creek and Mount Hope complexes at Barton Ramie, the Chuen and Cauac complexes of Tikal, and the
Chicanel complex of Uaxactun. The ceramic assemblage from chert feature SB19E mirrors this chronology. Both the Mamon and Chicanel ceramic spheres are represented in the assemblages from SB19B, C, and D. However, an earlier start to lithic production activities is indicated by material corresponding to the Jenny Creek and Barton Creek complexes at Barton Ramie, Tikal’s Tzec and Chuen complexes, and Mamon and Chicanel complexes from Uaxactun.

The Preclassic ceramic assemblage was composed entirely of utilitarian wares. Monochromatic slips were dominant, and decoration was sparse and largely limited to incisions or striations when present. The most frequently occurring forms included bowls, plates, pitchers, and ollas.

To summarize the above, lithic production activities at chert features SB19B, C, and D began during the Middle Preclassic, ca. 600 B.C, which corresponded with the initial occupation of San Bartolo. As the chert features were cultural in origin, their construction must predate production activities, and likely occurred just prior to or in conjunction with initial usage. It is interesting to note that these chert features were clustered to the south of the site along the margin of Bajo Itz’ul in isolation from any noticeable residential structures. It is possible that this area served as a locus of activity for the early inhabitants of San Bartolo beyond stone tool production, perhaps even extending to outfield cultivation. In a later phase of the Middle Preclassic lithic production activities begin to the north of San Barolo at chert features SB19A and E. These two features were found in small pockets of palm bajo, as opposed to the scrub vegetation of the large Bajo Itz’ul to the south. Lithic production activities occurred through the close of the Middle Preclassic (ca. 400 B.C.) and continued until the end of the Late Preclassic ca. A.D. 250. The cessation of activities coincided the abandonment of San Bartolo, and the chert features were not utilized when the site was reoccupied in the Late Classic.
Oval Bifaces in the Maya Area

Analysis of bifacial preforms and rejects recovered from the chert features presented strong evidence for the presence of a single reduction trajectory focused on the production of oval bifaces (Figure 5.6). Of the biface assemblage, 66% have been positively identified as belonging to the oval biface system. A significant portion of the 31% of bifaces that have been classified as “undetermined preform” show strong similarities to other early stage oval bifaces, but I did not feel there was definitive evidence to classify these examples as oval bifaces. As such, I would argue that I have been conservative in classifying only 66% of the bifaces as belonging to the oval biface system.

This formal tool type, which is ubiquitous across most of the Maya Lowlands, is variously referred to as a: celt (Rovner and Lewenstein 1997), oval/ovoid biface (Shafer 1983), general utility biface (Kidder 1947), or chopper (Coe 1959). The terms celt and oval biface are used interchangeably in this study unless otherwise specified. Oval bifaces are defined as those that have “an oval or teardrop outline with a convex wider end,” or bit, “tapering to a narrow blunt end” which is referred to as the pole (Shafer 1983:220). Examples of oval bifaces from San Bartolo are shown in Figure 5.7. As was mentioned previously, the oval biface appears during the Middle Preclassic and continues in use through the Postclassic with minimal morphological variation. However, as is demonstrated in Chapter 6, the morphological homogeneity of this tool form belies the varied regional reduction sequences employed in its production.

Many of the earliest projects in the Maya area recorded the presence of oval bifaces and provided illustrations in accompanying reports (e.g. Gann 1938; Merwin and Vaillant 1932; Thompson 1897), though Kidder’s (1947) Uaxactun monograph contained the first detailed – if
Figure 5.6. Assigned reduction trajectory for chert bifaces and biface fragments.

Figure 5.7. Oval bifaces from chert features, San Bartolo.

Figure 5.8. The ‘Puleston axe’ (after Shafer and Hester 1986: Figure 1).
not brief – treatment of this tool type. Kidder provided preliminary chronological data on oval biface use, noting that they had been recovered predominately from the Mamom phase underlying the Group-E plaza and from Pit 14, a Tzakol phase midden in Group A. At Uaxactun these ceramic phases correspond to the Middle Preclassic and Early Classic periods respectively. He also presented a functional analysis based on macroscopic observation of specimens from both Uaxactun and Benque Viejo. He concluded that polish along bit margins had resulted from prolonged use in soil, and that oval bifaces were probably also used for woodcutting. Kidder’s overall impression of the oval biface was poor, suggesting that the bit end was too dull to cut wood effectively, the pole made a poor pick, and that they were too thick to haft.

A key piece of evidence which furthered our understanding of oval biface use was the discovery of what is often referred to as the ‘Puleston Axe’ (Shafer and Hester 1986; See Figure 5.8). In 1974, Dennis Puleston recovered an oval biface that was still set within a preserved wooden haft from the bottom of an agricultural canal at San Antonio, Belize. The preserved haft element indicated that ancient Maya celts were akin to hatchets, rather than contemporary axes. The length of the haft element, at 41cm, was in line with ethnographic examples which averaged 30-40cm in length (Lewenstein 1987:36). A technological analysis suggested a Late Preclassic date, while polish and striation patterns detected during use-wear analysis indicated the tool had been used to fell trees (Shafer and Hester 1986:4). The restriction to short chopping motions necessitated by the hafting element’s short length would have been essential to preventing excessive load application and eventual shattering of the chert celt (Lewenstein 1987).

Macroscopic and microscopic use-wear analyses of oval bifaces conducted over the last 40 years have consistently pointed to a limited suite of activities. Use-wear traces, consisting of polish and striations, have been attributed to two primary functions which are both related to
landscape clearance and maintenance practices. A gloss or polish has been frequently detected along bit margins has been associated with both prolonged contact with soil (Kidder 1947; Stoltman 1978) and wood cutting (Aldenderfer et al. 1989; Wilk 1976, 1978). Additionally, there has also been confusion as to whether striations along bit margins are the product of repeated contact with soil (Shafer 1983), wood cutting (Wilk 1978), or stone cutting (ibid). Lewenstein (1987) was able to clarify much of this confusion with the results of her experimental use-wear study. She noted that striations only rarely formed on oval bifaces used to cut wood, though these same bifaces exhibited a strong polish. In contrast, oval bifaces employed as hoes or mattocks to work soil only exhibited edge polish after protracted use, and even then polish was minimal and largely restricted to the dorsal surface. Use in soil did produce a large number of striations on both the dorsal and ventral surfaces which were perpendicular to the bit margin, and extended for a significant distance towards the hafting element. Shafer (1983:242) has suggested that these striations can be attributed to the oval biface being repeatedly sunk into a soft but granular material, such as a mollisol containing quartz and sand grains. As for stone working, Lewenstein used two experimentally replicated bifaces to reduce shape a variety of limestone objects. She noted that the bifaces were noticeably battered, required repeated retouch, and may have had a high attrition rate in antiquity. She concludes by suggesting that one of the major causes of oval biface failure would have been fractures within the vicinity of the hafting element caused by excessive load application. The average uselife of an oval biface was estimated to be approximately 40 hours, though fragments resulting from a break certainly could have been recycled into a different tool form.

San Bartolo oval bifaces showed no evidence of wear, including striations emanating from the bit end, bit polish or midsection polish from a hafting element, nor fracture patterns
associated with use. This is not surprising, as the chert features clearly represent production loci. It is unknown what task these tools would have been employed in, though it is reasonable to assume that they would have been used in similar land clearance and maintenance activities. Before discussing the debitage assemblage characteristics of the chert features, a few remarks will be made about raw material selection and the most common types of production failures.

**Raw Material Variability and Preclassic Celt Production at San Bartolo**

Archaeologists often employ the concepts of grain or particle size to describe the quality of chert. Luedtke (1992:70) has noted that the largest quartz grains are a mere 50µ in diameter and cannot be seen by the unaided human eye. Thus, measures of chert quality are actually characterizations of the fracture surface texture. Variations in surface texture result from differences in material porosity, grain size, and the degree to which quartz grains are clustered. Higher quality cherts are those where the above variables are minimized. Unfortunately, there is currently no standardized objective means for measuring surface texture in the field, nor would the usefulness of such data justify more sophisticated means of measurement within a laboratory setting. Lithicists classify chert textures based on personal knowledge accumulated from experience, and the ability to differentiate coarse and fine grained cherts develops quickly.

As for the San Bartolo cherts, a three part classification scheme consisting of fine, medium, and coarse categories was employed. Cherts classified as fine were those that were smooth to the touch, while coarse grained material exhibited a rough and uneven fracture surface. The medium category was by far the most subjective, and consisted of chert which was not completely smooth, but also lacked the rough surface topography of the coarse material. Multiple lines of evidence suggest that raw material variability would have been a major concern
of the San Bartolo flintknappers. Nodular chert is abundant in the San Bartolo-Xultun region, though the quality of each nodule varies greatly. Excavation of the chert features revealed that nodule testing was a primary focus based on the recovery of large amounts of nodules exhibiting only a few primary flake scars. Unfortunately, data on the number of tested nodules is unavailable for chert feature SB19E, but a total of 630kg of nodules exhibiting primary flake scars were recorded for the remaining four chert features (Figure 5.9). It is likely that these flakes were designed to remove cortical surfaces in order to assess the quality of the underlying material. This assessment is further supported by the fact that many of the nodules argued to be indicative of rejected material exhibited very coarse surfaces and/or other raw material flaws such as inclusions or internal fractures.

An examination of the textures of recovered bifaces and biface fragments provided insight on the threshold for whether a nodule would be rejected or selected for the production of an oval biface. Figure 5.10 illustrates that not only did the San Bartolo knappers prefer fine textured material, but that the slightly more coarse material represented by the ‘medium’ category was also deemed acceptable. Even within the high quality specimens, the theme of concern of raw material quality continued to be relevant, as evidence by the oval biface fracture patterns.

Biface fracture types and frequencies are presented in Figure 5.11. The majority of oval biface production failures, or 82%, can be attributed to the occurrence of either bending or perverse fractures. Bending fractures occur when compression at the point of impact combines with outward tension on the face opposite of the striking platform to cause fracture initiation to occur away from the point of applied force (Cotterell and Kamminga 1990). This is essentially a process where the biface becomes flexed when the proximal and distal margins are pulled.
Figure 5.9. Spatial distribution of tested and unmodified chert nodules.

Figure 5.10. Chert feature biface textures.

Figure 5.11. Biface fracture type frequencies.
upward while the center is pushed downward by the percussor (Whittaker 1994:215). This fracture type can be identified by examining the margins where the interior fracture surface meets the exterior surface; one margin should exhibit a right angle and the other should exhibit either a lipped or rolled edge. Bending fractures can be caused by a number of factors, including insufficient support of the biface during flake removal, striking platform which is set too high above the biface center axis, or a misplaced hammerstone blow. Attempts to detach a flake via an overly strong platform can also cause a bending fracture and ultimately production failure (ibid; Whittaker and Kaldahl 2001). Many of the broken oval bifaces from the chert features exhibit thick and pronounced platforms near the points of fracture. While strong platforms have the potential to overstress a biface, they are essential to the production of long flakes which are ideal in both cortex removal and thinning scenarios.

Perverse fractures, which were exhibited by 41% of the biface fragments, are subject to the same platform-related issues outlined for bending fractures. They are characterized by a “helical, spiral, or twisting” pattern, and occur when production errors or raw material flaws cause energy to be “deflected into and through the mass of the object” (Crabtree 1972:82). One of the oval bifaces was clearly discarded due to a perverse fracture that resulted from contact with an incipient fracture plane, while others show strong, isolated platforms in close proximity to the fracture margins.

The remaining 18% of production failures can be definitively attributed to raw material flaws such as vugs or inclusions. Vugs form when the dissolution of limestone leaves internal voids which are then lined with quartz or calcite crystals (Kooymans 2000:35). Foreign material incorporated within the chert nodule, such as a fossilized snail shell, is considered to be an inclusion. What must have been rather frustrating for the San Bartolo knappers is the fact that
there is not a direct correlation between chert textures and the occurrence of internal flaws such as vugs, inclusions, or incipient fracture planes.

**Measuring Production Intensity**

With the rudimentary suite of nodule testing and celt production activities having been identified and dated, I would like to tease out a more nuanced understanding of the duration, timing, and tempo of production practices. A cursory glance is sufficient to detect the large range of chert feature debitage values (Figure 5.12). Chert features SB19B and D combined represent a mere 7% of the total debitage assemblage, while SB19C accounts for 71%. When this variability is viewed in conjunction with use histories spanning approximately 600 – 850 years, the question of how to characterize the level of activity at the chert features arises. Within lithic studies variability in reduction practices over time is typically viewed as an issue of production intensity. Thus, production intensity will be starting point for the following discussion.

*Figure 5.12. Contribution of each chert feature to the overall assemblage.*
Whereas lithicists working in other parts of the world often approach reduction intensity within a behavioral ecology framework (e.g. Surovell 2009), Mayanists have explored the issue almost entirely within the context of craft specialization. According to Costin (1991), intensity is a measure of time spent dedicated to production activities which in turn is determined by the economic factors of efficiency, risk, and scheduling. The various permutations of these variables will result in either part- or full-time specialization. Lithicists working in the Maya area tend to take a more expedient route to addressing production intensity by employing volumetric comparisons of debitage densities. In practice this is most frequently accomplished by using counts from column samples to extrapolate the amount of debitage per m$^3$. Table 5.4 reports the results of this process from multiple sites and contexts within the Maya area, including San Bartolo.

Table 5.4. A comparison of debitage densities encountered at different Maya sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>Density (debitage/m$^3$)</th>
<th>Context</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yaxox Hinterland</td>
<td>1,541,600</td>
<td>Quarry</td>
<td>Ford and Olson 1989</td>
</tr>
<tr>
<td>El Pilar</td>
<td>800,000</td>
<td>Public Space</td>
<td>Whittaker et al. 2008</td>
</tr>
<tr>
<td>Colha</td>
<td>603,000</td>
<td>Workshop</td>
<td>Drollinger 1989</td>
</tr>
<tr>
<td>San Bartolo</td>
<td>219,155</td>
<td>Workshop</td>
<td>Kwoka</td>
</tr>
<tr>
<td>Buena Vista</td>
<td>211,437</td>
<td>Public Plaza</td>
<td>Heindel 2010</td>
</tr>
<tr>
<td>Cabeza Verde</td>
<td>38,620</td>
<td>Household Workshop</td>
<td>Lewis 2003</td>
</tr>
<tr>
<td>San Bartolo</td>
<td>18,626</td>
<td>Chert Feature SB19C</td>
<td>Kwoka</td>
</tr>
<tr>
<td>Cabeza Verde</td>
<td>13,125</td>
<td>Household Workshop</td>
<td>Lewis 2003</td>
</tr>
<tr>
<td>Xunantunich</td>
<td>5,578</td>
<td>Public Plaza</td>
<td>Keller 2006</td>
</tr>
<tr>
<td>Chaa Creek</td>
<td>1,369 - 1,799</td>
<td>Household</td>
<td>Connell 2000</td>
</tr>
<tr>
<td>San Bartolo</td>
<td>810</td>
<td>Chert Feature SB19B</td>
<td>Kwoka</td>
</tr>
</tbody>
</table>

Using the measure of debitage per m$^3$, the San Bartolo chert features fall at the lower end of the spectrum for production contexts. However, there are a number of variables which cause comparisons based on volumetric estimates of production debris to be highly problematic. In one of the cases from the above table the estimate of debitage/m$^3$ was generated from a lens of
debitage that was only 20cm thick. This results in a hugely inflated number that functions to obscure an accurate assessment of production intensity rather than provide a solid comparative benchmark. The ahistorical nature of most volumetric estimates is also questionable, being simply a measure of the amount of debitage present per m$^3$ of soil, without a consideration of variation in accumulation over time. Debitage density estimates also fail to reflect differences in reduction activities. For example, most of the workshop contexts from Table 5.4 were loci of biface production from blanks or preforms, a process which produces large quantities of small debitage. In contrast, the chert features are characterized by comparatively high proportions of large debitage produced in the process of testing nodules and removing cortex. If production intensity were to be approached via weight of debris, then the chert features could represent the high end of the intensity spectrum, as the mass of a single 2” primary decortation flake could be equivalent to numerous ¼” bifacial thinning flakes combined. The essential point here is that production debris densities in isolation cannot be used as templates to identify the intensity of production and the presence of part- or full-time specialization. The current formulation of the density equation is that whichever context has the most debitage is the most specialized.

Returning to the San Bartolo chert features, what can be said about the intensity of production in light of the preceding conversation and the earlier discussion of the ceramic data? It would seem that by any measure the chert features contained fairly small amounts of debitage for durations of use which spanned the Middle through Late Preclassic. This would seem to indicate that none of the chert features witnessed 600-850 years of continues use, but rather periodic cycling between the hundreds of chert features located within close proximity to the site. The frequency with which cycling occurred and the duration of each use period was likely intimately tied to the quality and quantity of chert nodules. When testing activities revealed that
a large portion of stockpiled nodules were poor quality, as was perhaps the case with SB19B and D, the Preclassic flintknappers may have simply moved on to the next chert feature. In contrast, chert feature SB19C may be an example of a stockpile that contained a sufficient proportion of medium to high quality nodules, which as a result was utilized more frequently for longer durations of time.

As will be shown in Chapter 6, the San Bartolo knappers made no attempt to segregate nodules which had been tested and rejected from non-tested nodules. Over time this practice must have eventually resulted in a confusing surface deposit which consisted of unmodified nodules interspersed between rejected nodules and reduction debris. This would have also provided impetus to move production activities to a new chert feature until the existing one had been replenished with a new crop of chert nodules. While each chert feature was not in consistent use for long periods of time, the presence of ceramics suggest that the knappers intend to spend sufficient time at each location to justify the use and transport of ceramic vessels, an artifact class that is not typically considered to be highly portable. Before discussing the results of the debitage analysis, I would like to close this section by suggesting that production intensity requires a conceptual overhaul in relation to what it is supposed to be indicative of and how it is measured.

**Chert Feature Debitage Analysis**

The final section of this chapter will begin to present the results of the debitage analysis. The data lend support to the narrative of the chert features serving as loci of nodule testing and celt production. Additionally, the data reveal that there were some basic differences in reduction activities between the chert features, and that much of this may have been directly related to the
continuing theme of raw material variability. As it stands this information is highly informative, particularly considering the fact that San Bartolo’s chert features represent a relatively novel production context in the Maya Lowlands. Chapter 6 contrasts the chert feature lithic assemblage with celt production contexts at Colha, and it is within this comparative light that the San Bartolo data become truly informative of ancient Maya lithic production practices. Before proceeding along these lines some general observations derived from the typological and aggregate analyses must be presented.

Typological Analysis

A description of the typology employed in this study along with a key to the debitage types (Table 5.2) was presented in section 5.2.4. Relative frequencies were utilized to facilitate inter-assemblage comparisons as the range between the smallest and largest assemblages equaled 25,178 pieces of debitage. The results of the typological analysis have been summarized in Figures 5.13 and 5.14. The first figure is a cumulative frequency graph of debitage types and the second is a histogram displaying the relative frequencies of debitage types for each individual chert feature. Figure 5.13 does not indicate any drastic differences between the debitage assemblages, though when viewed in conjunction with Figure 5.14 and the aggregate analysis data presented in the following section two groupings emerge; one group consisting of SB19B and D, and another group comprised of SB19A, D, and E. Justification for these groupings will be provided throughout the analysis. As I have been arguing that the chert features were loci of nodule testing and celt production, the following paragraphs will focus on how the debitage types are indicative of these practices.
Figure 5.13. Cumulative frequencies of chert feature debitage types.

Figure 5.14. Relative frequencies of chert feature debitage types.
One of the things that is immediately apparent when viewing Figure 5.15 is that the relative frequencies of most debitage types do not vary greatly between chert features. Eight of the twelve debitage types have a within class range of difference that is 0.05 or less. The four debitage types that show the largest range of variation are CSFC, BMFC, BMFNC, and FRAG. If this threshold is expanded to 0.11, then 11 of 12 debitage types fall within this range with only the FRAG type exhibiting a greater range of variation at 0.23. So what does this similar patterning of debitage types tell us? A closer examination of the results of the typological analysis provide a more in-depth understanding of continuity and variation in lithic production practices at the chert features.

Aside from establishing frequencies, no attempt was made to further analyze the FRAG type. In hindsight, additional useful data could have been obtained by recording cortex values, and distinguishing between flake and non-flake angular shatter, though FRAG frequencies did prove to be informative. The FRAG type accounts for the highest portion of each assemblage with a high relative frequency of 0.52 (SB19C) and a low of 0.22 (SB19B). It was my belief that the range of FRAG frequencies were indicative of differing reduction intensities rather than alternative approaches to nodule testing and celt production. The results of a Pearson correlation coefficient computed in order to assess this relationship indicated a strong, positive correlation between FRAG frequency and debitage assemblage size ($r = 1.000, n = 5, p = 0.000$); an increase in FRAG frequency was correlated with an increase in the size of the debitage assemblage.

A wide range of scenarios can result in the production of FRAGS, be they of the broken flake or angular shatter variety. Knappers on the lower end of the skill spectrum may produce a greater amount of FRAGS by consistently missing striking platforms. A scenario where the San
Bartolo knappers were low-skilled individuals who had a difficult time successfully striking platforms seems unlikely, particularly in light of the fact that platform bearing flakes comprise between 42-70% of each assemblage. Instead, I propose two alternative scenarios to account for the high frequency of FRAGS. First, there are a variety of factors which may cause a flake to break after it has been detached from the objective piece, including ground surface impact and postdepositional trampling (Cotterell and Kamminga 1987). Figure 5.15 is indicative of a range of practices that would have resulted in the ideal conditions for both of these scenarios.

The spatial distribution of the tested chert nodules and debitage demonstrates that the San Bartolo knappers either stood, kneeled or sat at the edge of the chert features while testing nodules and producing celts. The positioning of the body at the edge of or slightly over the chert features would have resulted in detached flakes being met with a hard and uneven surface which could have caused numerous flakes to break upon impact. Furthermore, as demonstrated in Figure 5.10, in all but one instance the San Bartolo knappers preferred to toss tested and rejected nodules back towards the center of the chert feature as opposed to dropping them on the
periphery. In either case, tossing or dropping, the force resulting from the impact of the rejected chert nodule with debitage and other chert nodules would have undoubtedly produced additional broken flakes and angular shatter.

Hard hammer percussion is the second scenario that results in the production of FRAGS. This type of load application produces a higher frequency of FRAGS than soft hammer percussion due to the comparatively stronger force of impact required to detach a flake from the objective piece. Of the 12 debitage types, 6 are indicative of hard hammer percussion: CSFC, CSFNC, CMFC, CMFNC, CCC, and CCNC. In contrast, the debitage types BSFC, BSFNC, BMFC, and BMFNC are attributable to soft hammer percussion. Both the CCR/COL and FRAG types can result from both types of percussion. Hard hammer debitage types comprise the majority of platform bearing flakes for 3 of the chert features (SB19A-C) and fall only slight behind debitage diagnostic of soft hammer percussion in the remaining two (Figure 5.16).

![Load Application Represented by Debitage Types](image)

**Figure 5.16.** Relative frequencies of debitage produced by hard and soft hammer percussion.
The testing of chert nodules for quality, which was one of the primary reduction practices at the chert features, would have required the knappers to at least partially remove portions of the nodule’s cortical surface. These primary decoration flakes would have been detached with fairly strong blows from a hard percussor, and thus cortex removal via hard hammer percussion is likely responsible for a significant number of FRAGS.

After FRAGS, the most frequently occurring type was either CCC or CSFC, both of which are indicative of primary decoration and core reduction. Cortical flakes with cortical platforms (CCC) were the predominant non-FRAGS debitage type at SB19A, D, and E, and the second most frequently occurring type at SB19B and C. The highest relative frequency of the CCC type was 0.18 at SB19B, and the lowest relative frequency was 0.09 at SB19E. The presence of CCCs would be expected in any context where the reduction of cortex covered nodules had occurred, though their high frequency at San Bartolo was unexpected. Two of the primary challenges of producing a biface from a nodule are cortex removal and expanding the options for flake removal which are initially limited by the reliance on naturally occurring cortical platforms. Since CCCs represent the initial removals from an objective piece one would expect that their frequency, though not necessarily mass, should be low. By definition CCCs can no longer be produced once the cortical surface has been removed. The high frequency of CCCs at San Bartolo is undoubtedly the byproduct of nodule testing. For example, as Figure 5.17 shows, many nodules had only a few primary decortation flakes removed before they were discarded due to quality issues. It is probable that the nodule shown in Figure 5.18 produced only CCC, CSFC, and possibly FRAGS.

Chert features SB19A and C continued to provide evidence for primary decortation and core reduction activities with the third most frequently occurring debitage types being CSFC
(RF = 0.09) and CCC (RF = 0.08) respectively. In contrast, the equivalent rank for SB19B, D, and E was occupied by types BMFC or BMFNC, or both cortical and noncortical multifaceted bifacial thinning flakes. While this may initially appear to suggest a thematic shift in lithic production practices, I would instead argue that it is once again related to intensity of production, as these three features had the numerically smallest debitage assemblages.

The summary of the typological data presented thus far has been admittedly brief. I have intentionally chosen to highlight the largest inter-assemblage differences while also discussing the predominant types of each assemblage. The remaining debitage types should not be considered peripheral due to the lack of attention they have received at this point, as they are informative of unique approach to celt production of the Preclassic San Bartolo flintknappers. However, these idiosyncrasies are most easily identified when viewed in comparison with data on celt production from other Maya sites. This will be a focus of Chapter 6.

Aggregate Analysis

Before presenting the results of the aggregate analysis I feel it is necessary to quickly revisit the ‘mixed assemblage’ problem associated with this method and address how it impacted...
this analysis. Aggregate analyses that utilize size grades are typically conducted as a means of obtaining data on the size of the objective pieces and the lithic reduction techniques that produced the debitage. Multiple experimental studies have shown strong correlations between debitage size, application load (Henry et al. 1976), and production stage (Ahler 1989). Aggregate analysis has been less successful in identifying the signatures of different reduction techniques within the context of a mixed assemblage. These issues are largely peripheral in the context of this study. First, the typological analysis of individual flakes provided sufficient technological data to identify the types of load application present, and the degree to which different load applications contributed to the formation of the debitage assemblage. Furthermore, the problems associated with a mixed assemblage are mitigated by the multiple lines of evidence pointing towards the chert features being loci for a restricted suite of reduction activities. Raw material in both unmodified and tested form is abundant at all of the chert features. The only non-debitage lithic artifacts recovered consisted of biface fragments or biface rejects, the majority of which were identifiable as being representative of the oval biface system. Thus, the only task assigned to the aggregate analysis was to provide additional data representative of producing oval bifaces from nodules that could be used for comparative purposes.

The details of the aggregate analysis method employed in this study are presented in previous section. Debitage weights and counts were recorded as part of the aggregate analysis, though the weight data was unfortunately lost when the computer the data were stored on failed in the field. This loss of data did not impact the original objective of obtaining data on debitage size characteristics, but did make it impossible to conduct more sophisticated statistical analyses.
Figure 5.18. Relative frequencies of chert features size grades.

Figure 5.19. Cumulative frequencies of chert feature debitage size grades.
(e.g. Ahler 1986; Carr and Bradbury 2004).

Once again data are presented as relative frequencies in order to facilitate inter-assemblage comparisons. The relative frequency histogram shown in Figure 5.19 shows that the data are skewed to the right. This is not surprising, as experimental replication studies have consistently shown that regardless of the variant of core reduction or tool production employed, small flakes are produced with the highest frequency (Andrefsky 2001; Morrow 1997; Patterson and Sollberger 1978; Root 2004). If we recall the size grade data from Figure 5.5, we can see that aggregate analysis using solely size grades was able to detect the differences between production activities at the Preclassic chert features and the Late Classic workshop.

The differences between chert features are more easily detect in the cumulative frequency graph (Figure 5.19). Figure 5.19 supports the identification of two slightly different debitage signatures that was made in the typological analysis section. The debitage size characteristics of SB19A, C, and D are closely grouped, whereas SB19B and D have different signatures. This separation is caused by the fact that SB19B and D have comparatively higher relative frequencies of large debitage and smaller relative frequencies of the smallest size grades, especially the \( \frac{1}{4}'' \) class. As with the typological analysis, aggregate analysis data will be more informative when viewed in comparison to similar data on celt production from other Maya sites that is presented in Chapter 6.
CHAPTER 6 THERE’S MORE THAN ONE WAY TO MAKE A CELT

“Arguing that *chaîne opératoire* should be called ‘reduction sequence’ because of the earlier work of Holmes (1894, 1897) is thus analogous to arguing that modern physics should be called ‘optics’ because of Newton.”

(Tostevin 2011:352)

Sequence models are a ubiquitous feature of archaeological technology studies, and this dissertation is no exception. This popularity is attributable in part to the ease with which these models facilitate the reconstruction of ancient processes from static, discrete artifacts. Despite claims to the contrary, the construction of a sequence model is not a purely objective enterprise and is instead colored by the researcher’s background. The first task of this chapter is to present an overview of the types of information that sequence models convey along with a consideration of how the interpretation of models differs between epistemic communities. Although much of what follows concerns the use of sequence models in lithic studies, the insights provided are relevant to sequential modeling in general.

In Chapter 5 I argued that the San Bartolo chert features were loci of celt production during the Middle and Late Preclassic. Using summary statistics from the biface and debitage analyses I presented evidence for the long-term continuity of production practices, and suggested that the minor differences between debitage assemblages was likely caused by variations in production intensity. Moving forward in Chapter 6, I present the chert feature lithic data in the form of a *chaîne opératoire* that begins with the collection of chert nodules and ends with the removal of finished celts from the chert features. The final section of this chapter takes a comparative approach by drawing upon previous studies of Preclassic celt production at the Belizean site of Colha. The issue at hand is: do the *chaîne opératoires* from both sites represent
unique approaches to celt production, or are they part of a broader Lowland tradition? Given the similar – though by no means identical – environments of the two sites in relation to chert availability, if there are differences can they be explained outside of reference to material conditions? A comparison of the two chaîne opératoires facilitates the identification of strategic tasks which are essential to the successful production of stone celts and technical variants resulting from culturally determined choices (Lemonnier 1992).

**Sequential Tasks: Chaînes and Sequences**

Regardless of paradigmatic affinities, there are few tools archaeologists interested in ancient productive practices have utilized more heavily than the sequence model. The primary objective of these models is to convey the various steps involved in the production of an artifact, though many also include data on raw material acquisition, use life, and eventual discard. Few of these models are identical, and instead are shaped by idiosyncratic archaeological assemblages, theoretical orientations, and national traditions. The particularly powerful influence of these last two variables is illustrated through a comparison of Americanist and French traditions presented below. Before reviewing the intricacies of these approaches I would like to elucidate some of the commonalities of sequence models, tease out the cognitive aspects of the routinized activities they depict, and discuss how aspects of cognition might be materialized in the archaeological record.

Sequence models can be employed within virtually any realm of archaeological inquiry, ranging from ceramic production sequences to diachronic settlement pattern studies. These models have found a special home within lithic studies due to the reductive nature of lithic production and the superb preservation of production byproducts (Bleed 2001). Lithicists
Figure 6.1. Holmes reduction sequence for Chesapeake Bay area (1893:Plate II).
routinely combine analyses of debitage and formal tools to produce reduction sequence models, which standard protocol suggests should be summarized in graphic form (e.g., Figure 6.1). In contrast to other archaeological units and models, sequential models have an inherent temporal component which allows them to “transcend typological classification by showing procedural links between apparently different categories of objects” (ibid:115). The result is a focus on practices rather than artifacts, but this focus is not shared by all researchers. As will be shown with Japanese tradition, many sequence models essentially function as forms of typological classification.

One of the major points of contention between competing approaches to sequence modeling is the degree to which these models provide a window into the emic perspectives of ancient technicians. Sequence models are fertile ground for those interested in the nonmaterial aspects of ancient technologies as a result of their utility in identifying repetitive tasks. Although it is a sentiment which I do not share, deriving worldviews from lithic artifacts requires an interpretive leap which is far too significant for some. Even so, it should be a straightforward case to make that when archaeologist are studying routine activities they are also studying human cognition. This linkage involves no more of an interpretive leap than that made by psychologists; the psychologist *infers* rather than observes the relationships between behavior and cognition (Bleed 2011). Studies of sequential activities within cognitive and applied psychology provide a wealth of largely untapped information that can enrich our understandings of past technologies.

Borrowing from Norman (1988), Bleed (2011:300) presents a bipartite classification scheme for sequential activities consisting of narrow and wide task structures. Narrow activities can be conceptualized as a chain where each individual action in turn leads to another individual
action in near linear fashion. With wide activities agents are confronted by a pool of potential options for action at each turn, and thus conscious thought is required before a decision can be made. Recalling the discussion of practice from Chapter 3, most of the activities that populate our daily lives can be classified as narrow due to their routine nature. It will be shown momentarily that one’s view of the structure of a task, be it narrow or wide, will result in the production of either a teleological or evolutionary sequence model. For example, lithic reduction sequence models tend to portray production activities as narrowly structured (ibid).

What sorts of information about ancient technicians are tied to our sequence models? Bleed (2011:301) identifies three bodies of knowledge implicated in stone tool production, the first of which is that the knapper must possess the necessary motor skills to complete the project. The knapper must also understand how to accomplish each individual action while simultaneously possessing an understanding of how each individual action contributes to the overall process. That some aspects of cognition translate better into the archaeological record than others is illustrated by Bleed’s (ibid:300-302) discussion of certain cognitive aspects of sequential activities – rote, mental models, mnemonics, rehearsal, and production memory. For example, rehearsal involves practicing a production routine for the purpose of committing the individual steps to memory while also developing/improving the motor skills necessary to complete the task. Rehearsal stands in contrast to performance (i.e., production), and archaeological assemblages resulting from these two different practices should be identifiable. Some cognitive aspects of sequential tasks which might not always be quite as obvious can still have material correlates which can be identified archaeologically. Mnemonics, or mnemonic devices, are memory aids designed to facilitate the completion of a task and remind the agent of the actions necessary to do so. These cues are often verbal, but they can also be expressed in the
form of physical/material conditions like the San Bartolo chert features. “Habitualized work
stations and postures…offer a stone-worker both a physical and mental context for how to
proceed.” For the experienced San Bartolo flintknapper the very site of the chert features would
have invoked a mental model concerning what activities were to be done, and the tasks necessary
to accomplish them. Whether or not the archaeological identification of cognitive processes such
as learning and problem solving provide a basis for identifying and understanding the expression
of cultural attitudes and beliefs through technological practice is a matter of significant debate.
These issues are evident in the tension between competing approaches to sequential modeling,
such as the reduction sequence and chaîne opératoire. The impetus for combing Japanese and
Americanist traditions in the following section is that they share more in common with each
other than the French chaîne opératoire approach.

Japanese and Americanist Sequence Models, and the Organization of Technology

In contrast to their European and North American counterparts, Japanese archaeologists
are generally not interested in explicit archaeological theorizing and instead pursue culture
historical objectives (Bleed 2001). To this end, lithic reduction sequences are equated with
cultures and the spatial and temporal distribution of particular sequences are used to reconstruct
occupation histories. The most well-known and refined examples of this procedure are the
terminal Paleolithic microblade reduction sequence models. The identification of gihō, a term
that can be roughly equated with ‘technique’, forms the core of these reduction sequences. Bleed
(ibid:104) notes that this concept is not explicitly defined in the literature because its meaning is
viewed as commonsensical within Japanese culture. In practice this term “refers to a sequence of
linked technical actions associated with highly patterned stone reduction sequences,” which
result from equally routinized behavior (ibid:104). This view is not surprising considering the prevalence of highly formalized practices in traditional and contemporary Japanese culture, with the tea ceremony, martial arts, and calligraphy being prime examples. Once these practices are learned, the objective is to perform them as rote with little to no variation.

The uniquely Japanese understanding of *gihō* as narrowly structured activities has a number of important effects on the construction and interpretation of sequence modes, especially when employed in the service of constructing culture histories. Intra-assemblage variation tends to be hidden or minimized due to the expected formal (i.e., normative) nature of individual *gihō*, while similarities between different *gihō* are ignored. Additionally, the view of *gihō* as highly structured routines overlooks the possibility that there may be spatial and temporal variation within a reduction sequence. These issues are explicitly addressed by the other two traditions.

Japanese archaeologists are hardly alone in developing sequence models which are reflective of academic and cultural traditions. In North America the antiquity of sequence models can be traced back to the close of the 19th century and the work of Holmes (e.g., Figure 6.1). However, it was the emergence of processual archaeology and its associated offshoots that imparted ‘Americanist’ (i.e., American and Canadian) sequence models with their particular flavor. Don Crabtree’s experimental replication studies and the concept of behavioral chains from behavioral archaeology (Schiffer 1972, 1975; Skibo and Schiffer 2001) are responsible for the methodological and theoretical orientation of contemporary sequence models. In terms of method, it is common practice for lithicists to construct reduction sequence models by working backward from experimentally produced assemblages. An emphasis on the material correlates of each individual step of the production process results in the creation of typological categories which are inherently temporal (Bleed 2001). This is evident in Figure 6.2, which is a
Figure 6.2. Fluted biface reduction sequence model Ready Site, Illinois (Morrow1995:186).
prototypical reduction sequence graphic that depicts the production process as a series of stages (for an overview of the continuum versus stage debate see Shott et al. 2011). Processual archaeologists embrace the temporal component of sequence models as a key variable that can be used to investigate the geographic distribution of the behavioral chains of artifacts. It is understood that not all phases of artifact production and use are necessarily represented at a single site. This maxim, combined with processual archaeology’s interest in ecology and settlement patterns, has played a defining role in the development of the ‘organization of technology’ approach.

The ‘organization of technology’ approach (hereafter O.T.) has achieved paradigm-like status as it is now employed either implicitly or explicitly within the majority of Americanist lithic studies (Carr and Bradbury 2011). In its original formulation the O.T. approach is a sequential model that both shares the attributes of and subsumes reduction sequence models. In addition to Crabtree and Schiffer, the O.T. approach leans heavily upon Binford’s (1977, 1978, 1979, 1980) ethnographic work concerning the relationship between behavior and site structure. In an early example of the O.T. approach, Magne (1985) employs the insights of Binford and Schiffer in conjunction with an experimental data set to argue that the prehistoric functions of archaeological sites can be predicted based on the types of debitage and tools present. What is most significant about Magne’s study is his formulation of the phases, or sequences, which comprise the life—history of lithic artifacts: raw material acquisition, tool manufacture, use, maintenance, reuse, and discard (Carr and Bradbury 2011). In a highly influential paper published a few years later, Nelson (1991:57) formally defines the organization of technology approach as “the study of the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and
maintenance. Studies of the organization of technology consider economic and social variables that influence those strategies.”

Nelson also provides a model that illustrates the perceived hierarchical relationship between the different levels of analysis in research on the organization of technology (Figure 6.3a). This model recalls our discussion of processual archaeology’s engagement with technology from Chapter 2, as the overall organization of a technology is ultimately a response/adaptation to external environmental conditions. O.T. studies begin with a consideration of the distribution and performance characteristics of raw materials across a region, and then proceed to reconstruct how prehistoric peoples developed technological strategies and toolkits based upon their ability to successfully facilitate optimizing behavior (ibid:60-62). The O.T. influence on Americanist lithic studies is evident in the high frequency of

![Figure 6.3](image.png)

**Figure 6.3.** Framework for conducting Organization of Technology studies: (a) original formulation (modified from Costin 1991:59); modified framework (modified from Carr and Bradbury 2011:312).
published studies addressing the relationship between mobility patterns and resource availability to the exclusion of topics such as gender, agency, and even exchange (Carr and Bradbury 2011). Subsequent iterations of the O.T. approach (Figure 6.3b) redress the linearity of Nelson’s model while maintaining the focus on the material (i.e., environmental) components of technologies. Some of these attempts to do more than simply pay lip services to social and cultural factors that influence the organization of a technology. For example, Carr and Bradbury cite a paper by Knecht (1997:207), who in turn cites a study by McGhee of Thule hunting technologies. They summarize the findings of this study as being that “sea mammals were hunted with materials obtained from the sea while land mammals were hunted with media obtained from the land. In this case, raw material selection (for projectile points) was based largely on cultural factors” Carr and Bradbury 2011:312). In contrast to the O.T. approach, the tradition of chaîne opératoire takes the social component of technology as its starting point rather than turning to it only after the explanatory power of material conditions have been exhausted.

The French Chaîne Opératoire Approach

In a fashion similar to its American counterpart, the origins of the chaîne opératoire can be traced back to the French antiquarian Francois Jouannet’s and his 19th century study of flaked and ground stone axes. Jouannet argued that the flaked stone axes represented early or unfinished forms of the polished ground stone axes. While his hypothesis in this particular case proved to be incorrect, he was actually comparing Neolithic axes and Achulean handaxes, his general argument that the identification of different stages of tool production provides important technological and cultural data remains valid (Renfrew and Bahn 2005). Chaîne opératoire is both a methodology for studying artifact life-histories and theoretical orientation that emphasizes
the link between culture and technology. Marcel Mauss’s study of techniques, those acts which are traditional and effective, provides the theoretical inspiration for this approach (for a discussion of Mauss see Chapter 3). The techniques involved in the production and use of material culture are documented using “operational sequences” (chaînes opératoires), and spatio-temporal variations in chaînes opératoires are intimately to the particular character of social orders (Lemonnier 2012). It was Mauss’s student, André Leroi-Gourhan (1993[1964]:114, emphasis added) who formalized the definition of chaîne opératoire:

“techniques involve both gestures and tools, sequentially organized by means of a ‘syntax’ that imparts both fixity and flexibility to the series of operations involved.” In subsequent decades chaîne opératoire and the associated concepts of Mauss and Leroi-Gourhan have proceeded in two different trajectories within French anthropology. The first of these is the tradition of technologie culturelle, or the ethnology of techniques, which is perhaps best exemplified by the work of Lemonnier. The second version of chaîne opératoire is a uniquely archaeological enterprise that has developed largely within the context of lithic studies.

Many of the broader themes of Lemonnier’s research program are covered in Chapter 2, and so at present I will narrow the focus of my comments to his use of chaîne opératoire. Lemonnier conceives of chaînes opératoires as consisting of strategic operations and technical variants. Strategic operations are essential to the successful completion of a project, and as such cannot be modified or excluded. However, not all operations are essential. Most projects provide ample opportunity for variation through technological choices (Lemonnier 1993). This relationship is illustrated in Figure 6.4, which Lemonnier (1992:32) explains as such:

“operations a, b, and c must obviously be done before operation d can take place, and if c is the longest operation (c is the ‘critical path’ in operation research), it is the one to be controlled with the most care. But a, b, and c must all be completed before the sequence can proceed to d. Operation e perhaps can be by-passed, if f and g can take place instead, and so on.”
This model clearly depicts a series of sequential tasks, but it is not linear; there is inherent flexibility in relation to technological choice. Technical variants are often expressed through what many (i.e., practitioners of the O.T. approach) consider to be arbitrary, or epiphenomenal features such as style. Lemonnier’s ethnological work in Papua New Guinea provides resounding evidence that the choice of technological operations is reflective of cultural attitudes. For example, he compiled *chaînes opératoires* of gardening and identified three macro-operations: field burning, planting, and building a fence around the field. Burning is the primary strategic task which must occur before planting, but the order that this task occurs in relation to fence building is highly variable; “some groups first burn the felled vegetation in their forest plot, then put a fence around it, then plant it with seeds; others first burn, then plant, then fence;
others still begin by fencing, then burn, then plant” (Renfrew and Bahn 2005:28). Lemonnier attributes the intergroup variation in gardening chaîne opératoire to intentional efforts towards social differentiation.

The archaeological version of chaîne opératoire research retains the interest in the social and cognitive aspects of techniques outlined above, yet it exhibits unique characteristics as a result of its development within lithic studies. This difference is most apparent in the area of methodology, where chaînes opératoires are reconstructed through experimental replication, refitting and diacritical studies. Although chaîne opératoire have been developed for a wide range of material culture, lithic production serves as the focal point of the ensuing discussion. Nonetheless, the general themes are relevant and applicable to other mediums of material culture.

Within chaîne opératoire research, production processes are conceived of as goal-oriented activities, but not as the execution/replication of a mental template (Renfrew and Bahn 2005). Pelegrin (1990:117) describes the production process in relation to both techniques and cognition, and consequently the theoretical framework of the chaîne opératoire approach, thusly:

“Such undertakings [flintknapping]—based on raw material which is never standard, and with gestures of percussion which are never perfectly delivered—cannot be reduced to an elementary repetition of gestures, or to the application of immutable sequences (as a machine would do). On the contrary, the realisation of elaborate knapping activities necessitates a critical monitoring of the situation and of the decisions adopted all through the process. If this is the case, then the capacity to mentally evoke the precise desired product is necessary for successful knapping, but it is not sufficient. The knapper has in mind successive goals, that is, a series of intermediary stages and geometric ‘cues.’ It is in respecting these, and with experience, that the anticipated result may be reached. These intermediary stages form a chain of intentions organized in a ‘conceptual schema opératoire’. They are defined through certain geometric parameters, and they may represent the moment when a particular operation or technique changes to another (Pelegrin 1985, 1988a [sic, 1993]). Between these stages, the actual and the real situation is compared with the corresponding concept and diverse action modalities are evoked in order to correct a given state or to progress in the chaîne opératoire. Using experience, the knapper chooses the (most) adapted action modality—the one which is both possible and desirable.”
In other words, lithic production is oriented towards a desired end-product by a cognitive project. Conceptual schema are developed as strategies for successfully completing the project, and the chaîne opératoire represents the enactment of conceptual schema via technical gestures. Social and environmental factors can impinge upon the process at any stage which may require adjustments via the conceptual schema (Figure 6.5). Regularities in the chaîne opératoire are the result of intentional action, and as such are indicative of the operational scheme. It is within this area, the identification of emic perspectives of projects and operational schema, that some of the most vigorous objections to the chaîne opératoire approach have been raised (e.g., Bar-Yossef and Van Peer 2009; Bleed 2001).

Figure 6.5. Relationship between the project, conceptual scheme, and operational sequence from the knapper’s point of view (after Soressi and Geneste 2011:337).

Returning to archaeological practice, the methodology that underwrites this theoretical model is comprised of a three-part analysis, the results of which are taken to be indicative of
technological choices. The first step in constructing a chaîne opératoire involves an analytical focus on the objects themselves – tools and debitage (Sellet 1993). Artifacts are classified by raw material according to type, quality, and geological provenance. These artifacts are then classified as either “positive” (bifaces/cores) or “negative” artifacts (debitage), and attributes such as cortex value are recorded (Soressi and Geneste 2011:338). In the second phase technical sequences, which are comprised of series of gestures, are used to reconstruct the production process. Technical sequences are deciphered through refitting, experimental replication, and diacritical studies. Diacritical studies are a hallmark of French archaeology, and involve mapping of both the order and sequence of flake removals from a biface or core. The final, and most abstract level, involves using data from the previous steps to make statements about the skill of individual knappers, the knowledge of raw material properties and reduction techniques shared by communities of practice, and the overall technical system of a prehistoric culture (Sellett 1993).

Between Material and Mind: Tensions in Sequential Modeling

Since the 1980s the concept of chaîne opératoire has become increasingly popular outside of France and Paleolithic archaeology circles. Bleed (2001:107-108) provides three reasons for this rise in interest: 1) chaîne opératoire moves beyond descriptive typology by outlining how different artifacts are related; 2) the concept has name recognition; and, 3) some archaeologists find the ideational emphasis of the approach appealing. An outcome of this increasing popularity is that lithicists working within the Americanist tradition are turning a critical eye towards the approach with increasing frequency. The debate concerning the efficacy of the chaîne opératoire approach remains predominantly a one-sided affair, as French
archaeologists have refrained from engagement. Some of this reluctance is a product of the
format of the debate – English language academic journals – but beyond this, additional limiting
factors are unclear. This lack of dialogue results in many critiques being based on
misunderstandings of core concepts, and narrative that leans heavily towards one side.
Americanist critiques of *chaîne opératoire* have focused on epistemological issues related to the
feasibility of recovering emic perspectives from archaeological material, and to a lesser extent
the originality of the concept.

“Anglophone archaeologists have…embraced *chaîne opératoire*, often enthusiastically.
But this repetition seems tactical rather than analytical, a way to register intellectual pedigree
more than an operational method. There is nothing in their use of *chaîne opératoire* that could
not be accomplished as easily and plainly with reduction sequence” (Shott 2003:103). Before
addressing what I consider to be the more substantive critical evaluations of the *chaîne
opératoire* approach, I would like to expand upon the two major components of Shott’s
comments. The first issue concerns the intellectual pedigree of English speaking archaeologist
who utilize the *chaîne opératoire* approach. I suspect that the use of the word ‘pedigree’ in this
context, which carries the connotation of upper-class ancestry, is both calculated and intended to
be disparaging. The growth of interest in *chaîne opératoire* outside of France has occurred
primarily among interpretive, or post-processual due to the emphasis it places upon on the
human element of ancient technologies. Shott, who is a processualist, champions the primacy of
the reduction sequence, a processual concept, with a tone that is reminiscent of the paradigmatic
rivalries from the late 1970s and early 1980s. Even if Scott’s assertion that *chaîne opératoire*
and reduction sequence are analogous concepts was correct, I would not find it problematic to
have different names for the same sequence model which signaled theoretical prioritizing of either material or ideational facets of technology.

Exactly how similar are the *chaîne opératoire* and reduction sequence approaches? Both traditions employ experimental replication studies and ethnoarchaeological data, and are characterized by the use of sequence models to capture particular points or stages in the production process (Bleed 2001). Beyond this the two approaches diverge significantly in terms of scope and high-level theory. Reduction sequence models have developed entirely within the context of lithic analysis, whereas the design of *chaîne opératoire* is oriented towards the study of all forms of material behavior within both contemporary and archaeological settings (Bleed 2001). This is the point Tostevin (2011) is addressing in the opening epigraph of this chapter. Tostevin (ibid) suggests that *chaîne opératoire* shares a much stronger resemblance to behavioral archaeology, with its attention to spatio-temporal variation in the production process (e.g., procurement, production, etc…), and its focus on how material and social conditions frame technological choices. In contrast, reduction sequence models are typically subsumed within an O.T. approach that traces its theoretical orientation to behavioral and evolutionary ecology.

This final point hints at the primary area of tension between the two traditions; what can archaeologist say about the thoughts, intentions, and knowledge of ancient technicians, and what is the epistemological foundation of such narratives? Viewing technologies as social representations, the *chaîne opératoire* approach takes as its objective reconstructing emic views of technical knowledge and practice. An explicit consideration of the intentions of prehistoric flintknappers is absent from the etic approach of O.T. and associated reduction sequence. Proponents of the O.T. approach contended that it is almost impossible to identify ‘intent’ and ‘preference’ in the archaeological record, and the *chaîne opératoire* attempt to do so essentially
results in a teleological model of the production process (Bleed 2001). Bar-Yossef and Van Peer (2009) argue that in some cases French archaeologists are forcing archaeological material into rigid types that are derived from a priori assumptions about what the intended project was. It appears that chaîne opératoire’s interest in mental schema elicits an immediate negative response from many processual archaeologists who consider the ‘mind’ of ancient technicians to be beyond the reach of archaeology. Considering that the extremely detailed methods employed by French archaeologists at the very least match, if not exceed processual archaeology in their empirical grounding, I suggest that the debate is largely a reflection of different epistemic cultures talking past each other.

In the following section I present the San Bartolo oval biface chaîne opératoire. Its appearance differs from traditional French chaînes opératoires of Paleolithic stone tool production, most notably in the absence of particular analytical methods. I have no doubt that my use of the concept is exactly what Shott is referring to in the quotation presented above. While my study explores spatio-temporal variation in different phases of the production process in a manner similar to the O.T. approach, I intentionally use the term chaîne opératoire to signal that I view this variation as predominantly social in origin. In support of this observation I conclude this chapter with a comparison of celt chaînes opératoires in order to identify instances of technological choice.

**Chaîne Opératoire of San Bartolo Celt Production**

The San Bartolo oval biface chaîne opératoire is divided into four phases: procurement, assessment, production, and transport (Figure 6.6). Multiple lines of evidence are employed to identify individual operations when possible. Unlike the Paleolithic contexts where the chaîne
San Bartolo Chert Feature Chaîne Opératoire

**Procurement**
- A. Nodules collected (via basket?)
- B. Nodules carried out of bajos
- C. Nodules deposited along upland bajo margins
  - i. Creation of chert features

**Quality Assessment**
- A. Chert feature scanned for nodules >15cm
  - i. simultaneous elimination of unsuitable nodules
- B. Potentially usable nodules examined by hand
- C. Chert feature examined for suitable hammerstone
- D. Natural platforms identified
- E. Primary decortication begins

**Discard**
- 1. Rejected Nodule:
  - i. dropped at feet
  - ii. tossed to feature center

**Transport**
- “Finished” celts transported away from chert features for eventual use/exchange
- No evidence of hafting on-site

**Shaping**
- A. Cortex removal
- B. Edging
- C. Shaping pole and bit ends

**Thinning**
- D. Limestone/soft hammer percussion
- E. Increasing frequency of platform preparation/edge abrasion

**Production**
- Different Agents? e.g., agriculturalist v. knapper

**Debitage**
- 1. Debitage:
  - i. CCC
  - ii. CSFC
  - iii. CCR/COL
  - iv. FRAG

**Biface & Biface Fragments**
1. Unintentional Production Failure:
   - i. Biface stress fracture
     - a. poor support
     - b. misplaced blow
     - c. excessive force
   - ii. Material flaw
2. Intentional Discard:
   - i. too thick
   - ii. too small after initial shaping

**Figure 6.6. San Bartolo oval biface chaîne opératoire.**
opératoire approach is typically utilized, specialized production contexts are occur much more frequently with the ancient Maya. The ability to identify ‘desired outcomes’ is dramatically improved within the specialized production contexts. At the chert features the conceptual project was the production of a flaked stone celts from a chert nodules. The following data on individual operations, which in turn comprise the chaîne opératoire, are result of the conceptual scheme devised by the San Bartolo knappers to accomplish this objective.

**Procurement**

Excavations of the chert features have demonstrated that they are cultural in origin, and so the chert nodules which comprise the features must have been brought from another location. The limestone bedrock of the San Bartolo-Xultun region contains an abundance of nodular chert. These nodules are brought to the surface through natural erosion processes deriving from the hydrologic cycle, and it is within the bajos and along bajo margins that these processes are most active. The net result is that surface deposits of chert occur with greater frequency in close proximity to the bajos. Although chert is abundant on the surface in these areas, individual nodules are spatially scattered. Thus, the construction of the Preclassic chert features required the collection of nodules from the surrounding area, and the placement of the chert features suggests that the bajos themselves were the primary sources of chert. Figure 6.7 depicts the locations of 3 of the chert features from this study. Two of the chert features (SB19B and D) are clearly located within the upland portion of the bajo-montaña transitional zone. At first glance the third chert feature (SB19C) appears to be located well away from the bajo and well within the montaña, but closer inspections reveals that it is actually located on the margin of a small bajo. There is no evidence for subsurface mining of chert during the Preclassic, leaving only
surface deposits as potential raw material for the construction of chert features.

The physical characteristics of the chert nodules themselves provide clues as to how the nodules were collected, and perhaps even who collected them. Figure 6.8 presents size data for the unmodified chert nodules from four of the chert features, and shows that the chert features are comprised primarily of small chert nodules which are under 15cm in diameter. In many cases chert nodules 5cm or smaller account for over 1/3 of the total weight of the features, which ranged from .97 – 1.84 metric tons. This number is particularly impressive in that it represents only a 1m x 2m sample of the chert features. It is unlikely that the transportation of so many small chert nodules would have occurred by hand, and instead probably required some sort of carrying vessel, such as a basket or net bag. The high frequency of small chert nodules may indicate that the procurement and assessment/production phases of the chaîne opératoire were
completed by different agents. Based on the size of intact and fragmented celts from San Bartolo, I estimate that a chert nodule of at least 15cm in diameter is necessary in order to successfully produce a celt, though this number is pushing the limits of acceptable size. This
size threshold can be used to classify the unmodified chert nodules as either ‘useable’ or ‘unusable’ (Figure 6.9). Of the four chert features for which data are available, the majority of unmodified chert nodules fall into the ‘unusable’ category. Why would the San Bartolo flintknappers transport such a large amount of unsuitable material? A likely scenario is that it was not the knappers collecting the chert nodules, but instead individuals who lacked a clear understanding of the conceptual scheme that guided celt production, along with the associated knowledge necessary to differentiate between a ‘good nodule’ for celt production and a bad one.

Assessment

Chapter 5 presented evidence that indicates raw material quality was a major concern for the San Bartolo knappers. This concern is reflected in the chaîne opératoire by a series of tasks related to the assessment of chert nodules. I further divide this suite of activities into quality assessment and testing operations. The first task of quality assessment likely involved visually scanning the chert features for nodules which fit the operational requirement of being larger than 15cm in diameter, while simultaneously eliminating other nodules as possible candidates for reduction. At some point before, during, or immediately after this task, the knappers likely searched for a suitable hammerstone. Figure 6.10 depicts a chert hammerstone recovered from chert feature SB19C. It is approximately 7-8cm in diameter and exhibits a large number of impact fractures of varying size. The cortex has been removed, and there are also numerous flake scars indicating that it has been intentionally shaped.

The next series of tasks were directed at testing the quality of the chert nodule following the conceptual scheme. By testing, I mean removing a portion of the nodule’s cortical surface for the purpose of examining the texture of the underlying chert. Recalling Figure 5.10, we
Figure 6.10. Chert hammerstone: (a) impact damage visible in center, top to bottom; (b) close-up of impact damage.
know that the San Bartolo knappers preferred medium to fine grain cherts, and as such texture was one of the criteria used to assess the quality of nodules. Since the San Bartolo nodular cherts are covered in cortex, the knapper would have been required to identify and utilize a natural platform(s) for the first primary decortation flake. The CCC (cortical flake with cortical platform) debitage type is a hallmark of primary decortation activities. The reductive nature of lithic production means that the frequency of CCCs should decrease throughout the production process, a claim which is supported by Figure 6.11. While not limited to primary decoration, a large number of single facet cortical flakes (CSFC) would have been produced during this early point in the production process. Flakes exhibiting crushed or collapsed platforms (CCR/COL) and angular shatter (FRAG) are produced throughout the production process, but at this juncture would have been associated with excessive application load. Less than ideal natural platforms may require strong blows to initiate the fracture, while the desire to remove as much cortex as possible with each flake can also promote such a gesture. If the initial primary decoration flakes provided positive results, then the nodule would have been subjected to further operations that I have assigned to the production phase. Nodules which were rejected after assessment were either dropped at the knapper’s feet, or tossed to the feature center rather than being segregated in some fashion (Figure 5.9).

**Figure 6.11.** Relative frequency of cortical flakes with cortical platforms by size grade.
Production

The production phase includes all of the tasks involved in producing a celt from a tested nodule. I divide the production process into two broad operations of shaping and thinning the biface. All of the biface fragments recovered from the chert features, including examples from early in the production process, exhibit little to no cortex. Thus, prior to beginning the shaping process the San Bartolo knappers attempted to remove as much cortex as possible (Figures 6.12). Figures 6.13, 6.14, and 6.15 demonstrate why cortex removal would have been such a concern. Many of the medium to fine grain cherts revealed natural flaws in the form of fossils, vugs, and internal fracture planes. The removal of cortex as early as possible would decrease the potential for surprises and the possibility of production failures at a later point by allowing the knapper to discard flawed nodules. Cortical flakes account for between 64-72% of platform bearing flakes at each chert feature (Figure 6.16).

As both part of, and moving beyond primary decortation, alternate flaking would have been conducted along the margins in order to establish a bifacial edge for eventual thinning. Production failures indicate that the pole end of the celt began to take shape early in the process. At some point in the production process after initial shaping, soft hammer percussion was employed to thin the biface. No limestone hammers were identified during the chert feature excavations, but this could be attributable to poor preservation. During the thinning process the production of bifacial thinning flakes would have increased dramatically. The spatial distribution of the debitage indicates that the San Bartolo technicians conducted their knapping both directly over and at the edge of the chert features (Figure 6.17).
Figure 6.12. Primary decortation of chert nodules: (a) coarse grain nodule rejected after removal of cortex primarily from a single surface (left); (b) fine grain nodules with majority of cortex removed bifacially.
Figure 6.13. Celt pole fragment. Production failure due to internal vug with quartz crystals.
Figure 6.14. Biface fragment with surface populated by vugs and quartz crystals.
Figure 6.15. Chert nodule with cortex removed revealing numerous raw material flaws, including fossilized snail shell and vug with quartz crystals.
Figure 6.16. Cortical debitage frequencies.

Figure 6.17. Spatial distribution of debitage, chert features SB19A-E.
Transport

The transport phase designates the end of the production process. Broken celts and intentional rejects were dropped or tossed back onto the chert feature, while ‘finished’ celts were locally distributed and most likely used in land clearance activities (see discussion of celt use-wear in Chapter 5). The near complete and broken celt fragments recovered from the chert features do not exhibit any evidence of having been used, such as ground or polished bits. Furthermore, no additional tools were recovered that would suggest that hafting elements had been produced at the same location.

The model presented thus far appears to depict a fairly rigid sequential model designed to produce a desired end-product. This is the type of model that Bleed (2001) has termed teleological, but I contest that it is simultaneously teleological and evolutionary. It is teleological in that there is a project which consists of a desired outcome – in this case a celt. Additionally, the very nature of stone tool production requires that there be a certain degree of linearity to the process. One cannot first thin a biface, and then conduct primary decorotation; one must precede the other. But having said this, there is a significant degree of freedom or latitude in terms of how a knapper executes a conceptual scheme. For example, when conducting the initial shaping of a biface, the previous removal of a flake may have left a perfectly strong and isolated platform that can be used for the subsequent removal. In other cases the platform may be a bit too isolated, thus presenting the possibility of a collapsed platform which would result in a failure to remove a flake. The knapper could address this problem by using an abraider to strengthen the platform. These two hypothetical scenarios, which ancient knappers undoubtedly faced quite often, demonstrate how there can be an evolutionary component to a teleological model. The key for the archaeologist interested in the social component of ancient technologies is to identify and differentiate between strategic tasks that are essential to the successful completion of the
project, and technical variants. Which operations are constrained by factors such as the geologic provenance and availability of suitable raw material, and fracture mechanics via the physical properties of cryptocrystalline stone? On the other hand, which operations are shaped almost entirely by human agency via technological choice? In the next section I employ comparative data sets from the ancient Maya site of Colha as a heuristic tool to assist in the identification of the culturally shaped technological practices.

A Comparison of Preclassic Celt Production at San Bartolo and Colha

The site of Colha is located in northeastern Belize in a referred to as the Chert Bearing Zone (Shafer and Hester 1991). The site is comprised of several hundred modest structures spread over an area of 6km$^2$. Colha is most well-known for the over 100 debitage mounds and lithic workshops scattered throughout the site. There is evidence for intensive stone tool production at the site beginning in the Middle Preclassic (1000 – 300 B.C.) and continuing until the close of the Middle Postclassic (A.D. 900-1250). During the Late Preclassic (300 B.C. – A.D. 250) and the Late Classic (A.D 600-850) specialized production occurred on an industrial scale, with Colha serving as the production center of a regional lithic exchange network in northern Belize (ibid).

At the height Late Preclassic and Late Classic specialized production, one of the primary products of Colha’s lithic workshops was the oval biface, or celt. Not surprisingly, Colha has produced a relatively large number of lithic production studies compared to other sites in the Maya area, and as such there are multiple comparative data sets available. In this section I draw upon the lithic analyses of two workshops in order to identify key points of divergence with San Bartolo celt chaîne opératoire. The first comparative data set comes from three different
excavations at Operation 2024, a Late Preclassic workshop excavated and analyzed by Drollinger (1989) as part of his Master’s research. Operation 2006, another Late Preclassic workshop, is the source of the second data set. Initial excavations were conducted by Roemer (1979), while Shafer (1985) conducted a detailed analysis of the lithic data. When dealing with three different studies conducted by four different archaeologists over a span of 35 years, analytical categories are not going to be identical. Thus, in the comparative data figures follow not all contexts may be included due to missing or incompatible data. Fortunately the collapsible nature of the debitage typology I have employed in this study has allowed for comparison.

Furthermore, my aggregate analysis included a greater number of size grades then either of the other studies, but also include equivalent size grades. In a manner similar to the typological data, I was able to combine my aggregate size grades to match those of the other studies.

Figure 6.18 illustrates the oval biface reduction sequence for the Operation 2024 and 2006 lithic workshops based on Drollinger and Shafer’s analyses. In similar fashion to the San Bartolo chaîne opératoire, it is divided into a number of different processes and stages, including procurement, production, distribution, and maintenance. In comparing the Colha reduction sequence to the San Bartolo chaîne opératoire it is immediately apparent that there are significant differences, especially in the way that raw materials were procured and transported. This differences are reflected in the debitage assemblages at both sites. Hester and Shafer (1984) have identified four methods by which the Maya of Colha obtained raw chert. Located within the 3000 Quadrant of the site they encountered numerous shallow oval pit mines, approximately 4m in diameter, which were used to extract nodular chert from the limestone bedrock. The authors note that these pits were far too small to supply all of the chert that would have been
PROCUREMENT
Core preparation and initial macroflake blank

Quarry
Workshop

PRODUCTION

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Early Stage
1. Primary flaking of bit end
2. Primary flaking of margins

Middle Stage
1. Secondary flaking and final shaping of bit end
2. Secondary flaking of margins

Late Stage
1. Final shaping and retouch
2. Haft element?

DISTRIBUTION
Local Network

MAINTENANCE
Locally distributed oval bifaces

Figure 6.18. Colha oval biface reduction sequence (modified Drollinger 1989:106).
required for 2,000 years of intensive stone tool production. I excavated a small Late Preclassic shallow pit mine within the San Bartolo-Xultun intersite area while assisting Garrison (2007:467) with his dissertation research. This demonstrates that this method for obtaining chert nodules was known to the Late Preclassic inhabitants of San Bartolo, even if it was a strategy that they rarely employed. Hester and Shafer (1984) also suspect that the numerous large aguadas at the site formed within abandoned pit mines. At present I am unaware of whether excavations have been undertaken to test this hypothesis. The ancient Maya inhabitants of Colha also extensively utilized chert that had been exposed along the banks and within the bed of the Rancho Creek, a small stream that runs through the site center. Nodules of chert are abundant on the surface, and scattered throughout the site.

At San Bartolo there is no evidence to suggest chert nodules were obtained from any other location than the surrounding bajos/bajo margins. Furthermore, there was no physical or intellectual barrier that prevented the inhabitants of San Bartolo from utilizing pit mines to extract chert nodules. The numerous limestone quarries located within the intersite area and San Bartolo proper, and the Late Preclassic shallow pit mine mentioned above demonstrate that the technique was both known and possible to execute. Based on these factors, it is not possible to argue that the Preclassic inhabitants of San Bartolo employed a surface collection strategy because there was no alternative method to choose from.

Differences between procurement strategies at San Bartolo and Colha are quite different in terms of the processes by which raw material was transported to the work area. To recap, at San Bartolo the nodules were collected, carried out of the bajos, and deposited at a chert feature without undergoing any form of modification. In contrast, Colha exhibits evidence of formal quarrying activities at all of the four different sources of chert described by Hester and Shafer
All of the operations included within the assessment phase of the San Bartolo chaîne opératoire were undertaken at the quarry sites at Colha. The desired outcome of quarrying activities was the production of macroflake blanks which could then be transported to a workshop for further reduction (Figure 6.19). It is clear that whomever conduct the quarrying

**Figure 6.19.** Oval biface and tranchet bit tool reduction systems from Late Preclassic and Late Classic workshops at Colha (Shafer and Hester 1983:528).
activities possessed an understanding of the project of celt production and the operational scheme necessary to establish the conditions for success. This must have included the knowledge necessary to assess chert quality and the suitability of macroflake blanks (e.g., morphology) for celt production. Returning to the chert features, there are no material or environmental reasons why the inhabitants of San Bartolo could not have pursued the same strategy of producing blanks in the field for transport to a more permanent work area. In fact, this is the same exact practice that occurred at the shallow pit mine in the intersite area.

The contrasts between the two sites continue with the production phase at Colha, with the most obvious difference being the scope of the project. Whereas celt production was the sole focus at the San Bartolo chert features, the Colha workshops produced three different tool forms: the oval biface, the tranche-bit adze, and the stemmed macroblade. Hester and Shafer (ibid) state that despite this variety oval bifaces were the most frequently produced implement.

Variation between the celt chaînes opératoires for the two sites is also reflected in the characteristics of the debitage assemblages. For example, relative frequencies of cortical and non-cortical flakes for both locations are given in Figure 6.20. In this case cortex was recorded simply as being present or absent. Cortex was present on between 64-72% of all flakes recovered from the San Bartolo chert features, and only 4-9% of the flakes from the Colha figures support the conclusion that at Colha a reduction juncture separated the assessment and production operations. Consequently, many of the operations conducted at the San Bartolo cherts features were did not occur at the Colha workshops.

A comparison of platform characteristics also shows the effects that the divergent approaches to raw material procurement had on the types and frequencies of tasks conducted at the primary areas of celt production ([i.e., chert features and workshops]
**Figure 6.20.** Relative frequencies of cortical and non-cortical flakes at San Bartolo and Colha.

**Figure 6.21.** Debitage platform characteristics, San Bartolo and Colha.
Platforms were classified as either cortical, single facet, or multifaceted. Cortical platforms are unmodified sections of the cortical surface, and are indicative of raw material quality assessment and primary decortication tasks. Such platforms are completely absent from the Colha Operation 2006 workshop, and account for only 2-4% of platform bearing flakes (hereafter PBFs) at Operation 2024. Single facet platforms are both smooth and flat, and are most frequently produced from the reduction of non-bifacial tools (Andrefsky 1998). Between 38-65% of the San Bartolo chert feature PBFs exhibit a single facet, while the same category accounts for 13-19% of PBFs at Operation 2026, and only 4% at Operation 2006. Multifaceted, or complex platforms are associated primarily with biface production (Tomka 1989). The multiple facets of the platform surface are typically the result of platform preparation flaking and step fractures from abrasion. Multifaceted platforms account for 14-42% of the San Bartolo PBFs, 79-83% of the Operation 2024 PBFs, and 96% of the PBFs at the Operation 2006 workshop. Based on the platform characteristics of the chert feature PBFs in comparison to those of Colha, it is reasonable to suggest that a relatively small proportion of chert nodules progressed beyond the assessment and early production operations at San Bartolo. Platform preparation appears to have been minimal during these processes, whereas an average of 85% of Colha’s PBFs exhibit characteristics suggestive of platform preparation techniques.

Finally, the two different approaches to celt production are reflected in the size characteristics of the debitage assemblages (Figure 6.21). To facilitate comparison the San Bartolo aggregate data have been compressed to fit Drollinger’s (1989) four categories of 1”, 34”, ½”, and ¼”. Using opposite ends of the spectrum as a barometer, the 1” and ¼” size classes represent significantly different proportions of each assemblages. At San Bartolo between 4-32% of the total assemblage was 1/4” in size or smaller, while at Colha this size class accounted
Figure 6.22. Relative frequencies of debitage size grades at San Bartolo and Colha.

for 80-86% of the total assemblage. Debitage that was 1” or larger in size comprised 24-54% of the San Bartolo material, with only 1-2% of the Colha debitage falling in the same size range.

Based on what we know about each sites method of celt production, these figure match expectations quite well. One would expect to find a wide range of debitage size grades within a context where bifacial tools were produced from nodular chert, as is the case at San Bartolo. Conversely, one would expect to find a significant amount of small debitage in contexts where bifacially tools were being produce from prepared macroflakes.

I would like present a few observations on methodological problems I encountered with the use of the chaîne opératoire approach before closing with a summary of the San Bartolo and Colha chaînes opératoires. First, the reader may have noticed that methods presented as central
to the *chaîne opératoire* approach in the literature review, such as diacritical analyses and refitting, are missing from this analysis. This is not an unintentional oversight, but rather a byproduct of applying an approach designed to study Paleolithic stone tool assemblages to a complex society. In the first instance you have lithic scatters from open air camp sites which were seasonally occupied by hunters and gatherers. In the second instance you have workshop dumps resulting from specialized production on an industrial scale for a regional distribution network. There is a clear difference in scale between the two contexts, and this has important implications for the suitability of particular analytical methods. Looking back at the debitage/m³ estimates for production contexts in the Maya area that are presented in Table 5.4, it is difficult to imagine a scenario where a lithicist dumps a couple of million flakes on a laboratory table, and then proceeds to conduct a refit analysis. It is an improbable, if not impossible task. I believe that refitting holds potential for reconstructing *chaîne opératoire* of household lithic production in the Maya area, but these contexts are rarely excavated by lithicists.

Another significant difference is that projects tend to be well defined and less ‘mysterious’ in specialized production contexts. The San Bartolo chert features produced only one tool form, while the Colha workshops produced three, and in both case there were numerous examples of production failures and aborted attempts. In essence, it would be extremely difficult if not impossible to faithfully replicate a French Paleolithic *chaîne opératoire* study in the Maya area. However, this does not mean that the *chaîne opératoire* approach should be abandoned; changes in execution can be made while keeping the theoretical framework intact.

In closing, this chapter has presented comparative data on two methods of celt production employed by the Preclassic Maya of San Bartolo and Colha. Located in similar environmental settings in terms of the availability of chert, the ancient flintknappers followed two very
pathways to producing the same tool. Utilizing a chaîne opératoire approach facilitated the identification of junctures within this process where differences in production strategies were clearly the result of technological choices, rather than material constraints. For example, the choice to procure raw material in a certain way had a cascading effect upon the other components of the operational sequence. If we look at the two production processes through the lens of behavioral or evolutionary ecology, where optimizing behavior is pursued through rational efficient action, then the Colha data make perfect sense. Testing nodules and producing macroflake blanks at the quarry minimizes the amount of energy that gets invested into unproductive resources, and only the useful flake blanks are transported back to the workshop. In contrast, the same perspective has difficulty dealing with the San Bartolo data; a scenario where the ancient Maya traipsed across the landscape with baskets full of unmodified, and likely unusable, chert nodules in tow. Behavioral ecology views this practice as being rife with inefficiencies, but when viewed as a social representation, the San Bartolo chaîne opératoire is completely logical.
CHAPTER 7 CLOSING REMARKS

This final chapter takes stock of the progress made along the two research axes outlined in the introductory chapter. What has this study contributed to the study of ancient Maya technology? Furthermore, what has been revealed about the relationship between contemporary Western understandings of the human-technology equation and archaeological studies of ancient technologies?

Empirical Findings and Methodological Issues

This dissertation has made a number of significant contributions to Maya archaeology and lithic analysis. The excavation of the chert features was designed to answer two general questions: were they constructed by the ancient Maya, and if so, what was their function or purpose? Excavation revealed that the ancient Maya not only constructed the chert features, but that they had also utilized them as loci of stone tool production for approximately 850 years. These findings have a number of implications for archaeological research in the Maya area. Chert features have been recorded in close proximity to bajos within the San Bartolo – Xultun region, Becán, and La Milpa. It is reasonable to suggest that chert features may be a significantly under-reported phenomenon in the Central Maya Lowlands, and that future surveys of sites in close proximity to bajos may encounter these features.

Even in comparison to non-elite residential architecture, let along temples and palaces, the physical appearance of the chert features is rather unimpressive. However, this study demonstrates that the chert features are a perfect illustration of the idiom ‘you can’t judge a book by its cover.’ Not only did the chert features provide data on lithic production activities, they also produced datable ceramics, some of which date to the initial occupation of the site in the Middle Preclassic. Thus, archaeologists interested in site chronologies and lithic production data
may wish to consider incorporating chert features into their research designs. The Middle Preclassic date for the start of activities at the chert features is the earliest of the known examples, with the material from Becán and La Milpa falling predominately in the Late Classic. The reason(s) for this discrepancy in dates is currently unknown.

One of the more interesting facets of the chert feature data is that they provide evidence for specialized lithic production areas at a very early date. Whether lithic production was carried out by craft specialists is a topic for another dissertation. It is clear that production activities at the San Bartolo features did not approach anything near the scale of specialized production activities known from Preclassic Colha. Then again, the more that we learn about lithic production in the Maya area the more it becomes clear that Colha represents an outlier rather than the standard.

In terms of methodology, this study has demonstrated that debitage analysis can be employed to address issues beyond those for which they were originally designed. Both the producer-consumer typology and aggregate analysis methods allowed for an insightful comparison of debitage assemblages from two different sites in the Maya area. This feat is even more impressive when one considers that the data sets were collected 25 years apart. This study also demonstrates the utility of the chaîne opératoire approach in identifying socially shaped variations in production activities. Archaeologists interested in applying the chaîne opératoire approach to the study of technology in complex societies will need to make modifications to this approach due to issues of scale. When dealing with specialized production contexts that contain millions of pieces of debitage per cubic meter, methods such as refitting are not feasible. In the future it would be interesting to faithfully replicate this method in a non-specialized production context, such as at the household level.
**Theoretical Implications**

In this dissertation I have made the argument that the dominant archaeological discourses on technology are situated within a presentist view of the past, and perhaps have more to say about the conditions within which archaeologists are socialized, trained, and practice their craft than they do ancient technologies and technicians (Dobres 1995, 2000). It has been shown that the widespread adoption of principles of optimality and efficiency, which are assumed to have underwritten ancient technical practices, are tied to the emergence of mechanized production and capitalism during the 18th–19th centuries. Formalist economic principles are not universal motivators of human technological practices, and to project this view into the past is problematic to say the least.

I have utilized the theoretical perspective advocated throughout this document in my study of lithic production practices at the ancient Maya site of San Bartolo. Using a *chaîne opératoire* approach I was able to identify specific operations within the production process that were clearly the result of socially shaped technological choices rather than material constraint. In doing so, the San Bartolo data present a serious challenge to approaches which are premised upon insights from behavioral and evolutionary ecology, as the chert features appear to represent an extremely inefficient means of stone tool production. But as Lemonnier (1993:4) argues, some technical behaviors that appear illogical and outlandish are in fact “right and coherent from the standpoint of the social logics of which they are a part.” I do not wish to suggest that ancient peoples never attempted to get the most out of a situation, or do something in an efficient manner. However, I fail to grasp why the role of optimizing principles in ancient technologies is often perceived as self-evident, while claims that the shape of a particular technology is both a reflection of and attributable to the worldviews of ancient peoples is subjected to significant scrutiny or summary dismissal.
APPENDIX A – AGGREGATE AND TYPOLOGICAL DEBITAGE ANALYSES
SUMMARY DATA TABLES

Introduction

Appendix A presents the results of the aggregate and typological debitage analyses in the form of summary data tables. There are a total of five tables, one for each chert features. The first cell of the table contains the chert feature designation, while the remaining portion of the first column is populated by the aggregate analysis size grades. Additionally, the remaining portion of the first row after the chert feature designation is populated by the debitage types. Chapter 5 contains a full discussion of the debitage analysis methods.

Debitage Typology Key

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APPENDIX B: CHERT FEATURE EXCAVATION DATA

Introduction

Appendix B presents the chert feature excavation data in detail, summaries of which can be found in Chapter 4. The artifact descriptions and counts presented below represent those recorded in the field, and as such may differ from the results of the laboratory analyses.

Chert Feature SB19A

**UTM Coordinates**: 16 Q 244085mE 1942210mN  
**Elevation**: 173 masl

**General Description**: Chert Feature A was located approximately 20 meters to the east of Structure 113, which is part of the Jabalí Group. The southern border of the feature ran through the center of test unit one (SB19A-1). Test unit two (SB19A-2), which was adjacent to test unit one in a northerly direction, was placed in the center of the feature.

SB19A-1  
**Dimensions**: 1m x 1m

- **SB 19A-1-1**: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 7 sherds and 218 pieces of lithic debitage were recovered.
- **SB 19A-1-2**: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 11 sherds and 292 pieces of lithic debitage were recovered.
- **SB 19A-1-3**: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 24 sherds and 1,112 pieces of lithic debitage were recovered.
- **SB 19A-1-4**: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 51 sherds and 144 pieces of lithic debitage were recovered.
• *SB 19A-1-5*: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 28 sherds and 113 pieces of lithic debitage were recovered. Also, one biface preform and a biface preform fragment were recovered.

• *SB 19A-1-6*: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 51 sherds, 67 pieces of lithic debitage, and one ovoid biface were recovered.

• *SB 19A-1-7*: A natural level excavated to a maximum depth of 90cm terminating at bedrock. Soil color remained consistent with previous levels. A total of 57 sherds, 38 pieces of lithic debitage, and a biface preform were recovered.

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**SB19A-2**

**Dimensions**: 1m x 1m

• *SB 19A-2-1*: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 18 sherds, 279 pieces of lithic debitage, and a biface preform fragment were recovered.

• *SB 19A-2-2*: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 21 sherds, 1,941 pieces of lithic debitage, 4 biface fragments, and a single obsidian prismatic blade fragment were recovered.

• *SB 19A-2-3*: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 23 sherds and 123 pieces of lithic debitage were recovered.

• *SB 19A-2-4*: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 14 sherds, 389 pieces of lithic debitage, one biface preform fragment, and one biface fragment were recovered.

• *SB 19A-2-5*: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 38 sherds and 76 pieces of lithic debitage were recovered.
- SB 19A-2-6: Arbitrary 10cm level. The soil color was 7.5YR 2.5/1 Black. A total of 92 sherds and 72 pieces of lithic debitage were recovered.

- SB 19A-2-7: Natural level excavated to a maximum depth of 90cm, terminating at bedrock. Soil color remained consistent with previous level. A total of 19 sherds, 57 pieces of lithic debitage, and a celt fragment were recovered.
Chert Feature SB19B

UTM Coordinates: 16 Q 244131mE 1940665mN Elevation: 153 masl

General Description: Chert feature SB19B was located to the south of the southern San Bartolo site delimitation. This area had a high density of chert features, though no other structure types were apparent. The western edge of the feature bisected test unit one (SB19B-1). Test unit two (SB19B-2) was placed in the center of the feature, directly adjacent to test unit one.

SB19B-1

- **SB 19B-1-1**: Arbitrary 10cm level consisting of the humus layer. The soil color was 7.5YR 2.5/1 Black. A total of 26 sherds, 2 biface fragments, and 388 pieces of lithic debitage were recovered.
- **SB 19B-1-2**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 47 sherds, 2 biface preforms, and 288 pieces of lithic debitage were recovered.
- **SB 19B-1-3**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 31 sherds and 316 pieces of lithic debitage were recovered.
- **SB 19B-1-4**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 19 sherds, a Celt, 2 biface fragments, and 392 pieces of lithic debitage were recovered.
- **SB 19B-1-5**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 10 sherds, 2 biface fragments, and 336 pieces of lithic debitage were recovered.
- **SB 19B-1-6**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 166 pieces of lithic debitage were recovered.
SB 19B-1-7: Natural level excavated to a maximum depth of 90cm terminating at bedrock. Soil color was 7.5YR 4/1 Dark Gray. No cultural material was recovered from this level.

SB19B-2 Dimensions: 1m x 1m

• SB 19B-2-1: Arbitrary 10cm level composed of humic material. The soil color was 7.5YR 2.5/1 Black. A total of 19 sherds and 196 pieces of lithic debitage were recovered.
• SB 19B-2-2: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 25 sherds, 1 Celt, and 204 pieces of lithic debitage were recovered.
• SB 19B-2-3: Arbitrary 10cm level. Soil color remained consistent with previous level. A total of 55 sherds, 1 biface, and 312 pieces of lithic debitage were recovered.
• SB 19B-2-4: Arbitrary 10cm level. Soil color remained consistent with previous level. A total of 26 sherds and 515 pieces of lithic debitage were recovered.
• SB 19B-2-5: Arbitrary 10cm level. Soil color remained consistent with previous level. A total of 9 sherds and 75 pieces of lithic debitage were recovered.
• SB 19B-2-6: Arbitrary 10cm level. Soil color remained consistent with the previous level. No cultural material was recovered from this level.
• SB 19B-2-7: Natural level excavated to a maximum depth of 90cm terminating at bedrock. Soil color changed to 7.5YR 4/1 Dark Gray. No cultural material was recovered from this level.
Chert Feature SB19C

UTM Coordinates: 16 Q 243911mE 1940870mN           Elevation: 154 masl

General Description: Chert feature SB19C was located directly on the southern site delimitation. The western edge of the feature bisected test unit one (SB19C-1). Test unit two (SB19C-2) was placed directly adjacent to test unit one in the center of the feature.
SB 19C-1: Natural 10cm level consisting of the humus layer. Soil color was 7.5YR 2.5/1 Black. A total of 5 sherds, 1 celt preform, a large bifacial core, and 91 pieces of lithic debitage were recovered.

SB 19C-1-2: Arbitrary 10cm level. Soil color remained consistent with the previous layer. A total of 2 sherds, 1 celt, 1 celt preform, 1 biface fragment, a large bifacial core, and 195 pieces of lithic debitage were recovered.

SB 19C-1-3: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 7 sherds, 2 bifaces, and 242 pieces of lithic debitage were recovered.

SB 19C-1-4: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 2 sherds and 3,103 pieces of lithic debitage were recovered.

SB 19C-1-5: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 3 large bifacial cores, 2 large amorphous cores, 2 biface fragments, and 3,377 pieces of lithic debitage were recovered.

SB 19C-1-6: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 3,504 pieces of lithic debitage were recovered.

SB 19C-1-7: Arbitrary 10cm level. Soil color switched to 10YR 3/1 Very Dark Gray. A total of 34 pieces of lithic debitage were recovered.

SB 19C-1-8: Natural level excavated to a maximum depth of 110cm terminating upon a soil change. Soil color was 2.5Y 6/1 Gray. No cultural material was recovered from this level.
- **SB 19C-1-9**: Natural level excavated to a maximum depth of 140cm terminating at bedrock. Soil color was 7.5YR 7/2 Pinkish Gray. This level also contained a layer of buried soil. No cultural material was recovered from this level.

**SB19C-2**

- **SB 19C-2-1**: Natural level consisting of the humus layer. Soil color was 7.5YR 2.5/1 Black. One biface, a biface fragment, and 42 pieces of lithic debitage were recovered.
- **SB 19C-2-2**: Arbitrary 10cm level. Soil color remained consistent with the previous level. One large amorphous core and 74 pieces of lithic debitage were recovered.
- **SB 19C-2-3**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 2 sherds and 295 pieces of lithic debitage were recovered.
- **SB 19C-2-4**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 2 sherds, 4 large bifacial cores and 1,996 pieces of lithic debitage were recovered.
- **SB 19C-2-5**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 4,633 pieces of lithic debitage were recovered.
- **SB 19C-2-6**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 1,848 pieces of lithic debitage were recovered.
- **SB 19C-2-7**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 58 pieces of lithic debitage were recovered.
- **SB 19C-2-8**: Natural level excavated to a maximum depth of 70cm. No cultural material was recovered.
General Description: Chert feature SB19D was located to the southwest of SB19C outside of the site delimitation. The southern edge of the feature bisected test unit one (SB19D-1). Test unit two (SB19D-2) was placed directly adjacent to test unit one in the center of the feature (Figure 4.22).
SB19D-1

- **SB 19D-1-1**: Natural level consisting of the humus layer. Soil color was 7.5YR 2.5/1 Black. A total of 24 sherds and 908 pieces of lithic debitage were recovered.

- **SB 19D-1-2**: Arbitrary 10cm level Soil color remained consistent with the previous level. A total of 2 sherds and 812 pieces of lithic debitage were recovered.

- **SB 19D-1-3**: Arbitrary 10cm level Soil color remained consistent with the previous level. A total of 1,004 pieces of lithic debitage were recovered.

- **SB 19D-1-4**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 169 pieces of lithic debitage were recovered.

- **SB 19D-1-5**: Natural 10cm level. Soil color was 7.5YR 4/1 Dark Gray. A total of 51 pieces of lithic debitage were recovered.

- **SB 19D-1-6**: Natural 10cm level. Soil color was 7.5YR 3/2 Dark Brown. No cultural material was recovered in this level.

SB19D-2

- **SB 19D-2-1**: Natural 10cm level consisting of the humus layer. Soil color was 7.5YR 2.5/1 Black. A total of 132 pieces of lithic debitage were recovered.

- **SB 19D-2-2**: Arbitrary 10cm level. Soil color remained consistent with the previous level. One large bifacial core and 604 pieces of lithic debitage were recovered.

- **SB 19D-2-3**: Arbitrary 10cm level. Soil color remained consistent with the previous level. One biface fragment and 1,012 pieces of lithic debitage were recovered.
- **SB 19D-2-4**: Arbitrary 10cm level. Soil color switched to 7.5YR 4/1 Dark Gray. A total of 664 pieces of lithic debitage were recovered.

- **SB 19D-2-5**: Arbitrary 10cm level. Soil color switched to 7.5YR 3/2 Dark Brown. A total of 9 pieces of lithic debitage were recovered.

- **SB 19D-2-6**: Natural level terminating at bedrock. No cultural material was recovered from this level.
Chert Feature SB19E

UTM Coordinates: 16 Q 244522mE 1942180mN  Elevation: 169 masl

General Description: Chert feature SB19E was located to the east of the Las Ventanas pyramid, and to the north of the ball court. The eastern edge of the feature bisected test unit one (SB19E-1). Test unit two (SB19E-2) was directly adjacent to test unit one and was placed in the center of the feature.

SB19E-1  Dimensions: 1m x 1m

- **SB 19E-1-1**: Natural 10cm level consisting of the humus layer. Soil color was 7.5YR 2.5/1 Black. A total of 4 sherds, 1 biface fragment, and 515 pieces of lithic debitage were recovered.
- **SB 19E-1-2**: Arbitrary 10cm level. Soil color remained consistent with the previous level. A total of 17 sherds and 915 pieces of lithic debitage were recovered.
- **SB 19E-1-3**: Natural 10cm level. Soil color remained consistent with the previous level. A total of 66 sherds and 379 pieces of lithic debitage were recovered.
- **SB 19E-1-4**: Arbitrary 10cm level Soil color changed to 10R 3/2 Dusky Red. A total of 8 sherds and 78 pieces of lithic debitage were recovered.
- **SB 19E-1-5**: Arbitrary 10cm level. Soil color remained consistent with previous level. A total of 10 pieces of lithic debitage were recovered.
- **SB 19E-1-6**: Natural level excavated to a maximum depth of 140cm terminating at bedrock. Soil color was 10R 4/2 Weak Red. No cultural material was recovered from this level.
• **SB 19E-2-1**: Natural 10cm level comprised of the humus layer. Soil color was 7.5YR 2.5/1 Black. A total of 3 sherds and 255 pieces of lithic debitage were recovered.

• **SB 19E-2-2**: Arbitrary 10cm level. A total of 1 sherd, a biface fragment, and 284 pieces of lithic debitage were recovered.

• **SB 19E-2-3**: Natural 10cm level. Soil color remained consistent with the previous level. A total of 2 sherds and 299 pieces of lithic debitage were recovered.

• **SB 19E-2-4**: Arbitrary 10cm level. Soil color changed to 10R 3/2 Dusky Red. A total of 4 sherds and 216 pieces of lithic debitage were recovered.

• **SB 19E-2-5**: Natural 10cm level. Soil color remained consistent with the previous level. A total of 40 pieces of lithic debitage were recovered.

• **SB 19E-2-6**: Natural level excavated to a maximum depth of 85cm terminating at bedrock. Soil color changed to 10R 4/2 Weak Red. No cultural material was recovered.
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