



# A History of Lithic Technological Studies in the Paleoindian Archaeology in the United States of America

*Una historia de los estudios tecnológicos líticos en la arqueología  
paleoindia en los Estados Unidos de América*

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## Abstrac

*Lithic analyses have long been at the core of Paleoindian studies in the United States, but despite crucial changes in method and orientation, the earliest typological approaches continue to exert a strong influence on archaeologists' understanding of Paleoindian assemblages. This chapter argues against these normative approaches by advocating in favor of dynamic perspectives on human behavior. It does so by outlining the historical contributions of technological studies to the discipline, from the early European influences to the more holistic frameworks used today. Our discussion underscores three fundamental phases of development, starting with key experimental work on the Folsom point in the mid-twentieth century. This led to an increased focus on the technological aspects of tool production and use. The second phase is heavily influenced by the development of processual archaeology, which had a profound effect on the conceptualization of lithic assemblages. It generated a wealth of systems-oriented approaches focused on the economy of lithic raw materials. Finally, and most recently, the boom in cultural ecological studies has again reshaped this landscape by creating modes of analysis that understand lithic technology as a strategic adaptation rather than a cultural fossil. To integrate these developments within the broader field of Paleoindian studies, we consider seminal papers and their role in heralding new orientations, alongside data illustrating these trends in publication.*

**Keywords:** Lithic analysis; Lithic technology; History of archaeology; North American archaeology; Paleoindian; Clovis; Folsom.

## Resumen

*Durante mucho tiempo, los análisis líticos han ocupado el centro de los estudios paleoindios en los Estados Unidos, y pese a cambios cruciales que se introdujeron el método y la orientación, los primeros enfoques tipológicos siguen ejerciendo una influencia importante en la comprensión de los conjuntos paleoindios por parte de los arqueólogos. Este capítulo refuta estos enfoques normativos y sustenta perspectivas dinámicas sobre el comportamiento humano. Lo hace delineando las contribuciones históricas de los estudios tecnológicos a la disciplina, desde las primeras influencias europeas hasta los marcos más holísticos que se emplean en la actualidad. Nuestra discusión resalta tres fases de desarrollo fundamentales, a partir de un trabajo experimental clave en el punto de Folsom a mediados del siglo XX. Esto condujo a una mayor atención en los aspectos tecnológicos de la producción y el uso de herramientas. La segunda fase está particularmente influida por el desarrollo de la arqueología procesual, que tuvo un marcado efecto en la conceptualización de los conjuntos líticos. Generó gran cantidad de enfoques sistémicos centrados en la economía de las materias primas líticas. Por último, y más recientemente, el auge de los estudios ecológicos culturales ha remodelado nuevamente este panorama al crear modos de análisis que entienden la tecnología lítica como una adaptación estratégica en lugar de un fósil cultural. Para integrar estos desarrollos dentro del campo más amplio de los estudios paleoindios, hemos considerado artículos seminales y su función en el anuncio de nuevas orientaciones, junto con datos que ilustran estas tendencias en la publicación.*

**Palabras clave:** Análisis lítico; Tecnología lítica; Historia de la arqueología; Arqueología norteamericana; Paleoindio; Clovis; Folsom.

The study of Paleoindian lithic collections has, historically, presented researchers with a unique set of challenges. We argue here that the visible changes in research agendas and related theoretical orientations that took place in the second half of the twentieth century mirror the building

of a distinctive identity for American archaeology. The commonality in themes visible among technological studies in the United States of America illustrate its growth, liberation, and increasing independence from European influences, while at the same time underscoring



the unique circumstances of the archaeological record within the USA.

After a long scholarly debate that originated in the late part of the nineteenth century, which Meltzer (2015, p. 85) has colorfully, but appropriately, coined the "Great Paleolithic War", the term "Paleoindian" eventually took precedence in the literature and has since replaced "Paleolithic" to describe the early archaeological record of North America. Even though the controversy over whether the historical development of American prehistory mimicked its Old World Upper Paleolithic counterpart has recently been revived by Williams and Madsen (2020), the fact remains that US archaeologists have recognized that Paleoindian lithic assemblages were sufficiently idiosyncratic to merit the creation of separate research agendas. When and how this chasm came to be is the topic of this essay.

We begin this discussion by outlining the formative years of Paleoindian archaeology (which we define as the temporal stretch that starts with the recognition of a deep human antiquity concomitant with the discovery of the Folsom site in 1926, until the time where a firm chronological framework was constructed via the excavation of the deeply stratified Hell Gap site, in the 1960s). Then, we provide a historical and theoretical context for the rise of technological studies. We chose to focus exclusively on the initial developmental phases of Paleoindian lithic technological studies and outline their theoretical underpinnings. In that formative phase, Paleoindian lithic studies exclusively copied European archaeology. They borrowed and applied typological methodologies developed for the analysis of Old World Paleolithic assemblages.

In order to identify and contextualize the historical shift away from typological considerations, where the artifact is the center of attention, towards a theoretical agenda that encompasses more holistic approaches, we highlight two major directions of Paleoindian lithic studies from the latter part of the twentieth century: replicative studies and the study of Paleoindian mobility. In exploring US literature of Paleoindian lithic technology, our approach will be selective rather than exhaustive. We argue that although fundamentally concerned with technological questions, replicative studies borrowed from the bag of tricks of European typological studies and continued to make the individual artifact the focal point. Because the typological approach failed to include other aspects of archaeological assemblages it ultimately proved unsatisfactory and in the 1970s, under the auspices of a processual agenda, Paleoindian archaeologists started to shift away from a normative approach toward a more holistic one. This novel set of technological analyses integrated systemic approaches and began to explore the nature and scale of Paleoindian mobility. This led to a flurry of publications investigating Paleoindian raw

material economy and transport throughout the 1980s and 1990s and marked the coming of age of lithic studies in the USA as an intellectually independent entity.

### The formative years

*"It may be said with much truth that the archaeologist who studies flaked stones of any country without having made himself familiar with the functions and character of such a workshop is liable to make serious blunders."*  
W. H. Holmes (1890, p. 18)

In the decades that preceded the major breakthrough resulting from the Folsom discovery in 1926 (David J Meltzer, 2015; David J. Meltzer, Todd, & Holliday, 2002), American archaeology was still very much in its infancy: one can equate it to a toddler trying to find its equilibrium, falling and adjusting after each setback, only to build on the renewed confidence and move forward. This was a period during which all claims of Pleistocene human presence in North America had been vetoed by the scientific community, only for new discoveries affirming such to emerge soon after. In that early developmental stage, lithic studies were limited by the scope of the main research question, which was to prove, or reject (depending which side of the trenches the shots were taken from) any site of great antiquity.

The proponents of an American Paleolithic were led by C. C. Abbott, who was adamant that the bifacial pieces found in the gravels of Trenton, NJ, demonstrated that the time-depth of American prehistory was aligned with its European counterpart (D J Meltzer, 1983). The case in favor of the so-called "paleoliths" was made on the basis of both geological context and morphology of the artifacts. Regarding the latter, Abbot's argument was that the shapes of the Trenton artifacts were reminiscent of the European bifaces from St. Acheul (David J Meltzer, 2015, p. 46) and this correspondence in form implied a similar developmental stage in the prehistory of the two continents.

On the other side of the dispute, W. H. Holmes countered Abbot by developing what is likely the earliest technological approach in American archaeology. Instead of embracing the prevailing static typological method to dispute the paleolith argument, Holmes embraced artifacts as the result of a dynamic process. In 1890, after examining 2000 pieces from the Piney Branch locality (DC), he identified multiple stages of biface production and concluded that the so-called paleoliths were unfinished implements. They looked "primitive" because they were preforms (Holmes, 1890, 1892), and were found in gravel deposits because those were exploited as a raw material source throughout prehistory. He concluded that:

"So far have the advocates of a European

classification for American phenomena gone beyond the limits of prudence in the treatment of these so called palaeolithic stones, that a radical change is demanded in the methods of classifying and labeling these objects in many of our museums; and it is to be lamented that a revision of all literature relating to the subject cannot be made in order to prevent the further spread of errors already too deeply rooted in the minds of the people, without offensive criticism of the work of living students." Holmes (1892, p. 297)

Despite a brilliant demonstration that embraced experimentation as well as ethnographic observations (the foundation of a middle range theory, as it came to be labeled by processual archaeology), Holmes did not put to rest the paleolith controversy, nor did he manage to inspire additional interest in technological studies. In fact, lithic analysts were not so much concerned with studying the stone tools themselves as using them as an accessory in the staging of American prehistory. In that formative period of American archaeology, the static normative approach prevailed.

No archaeologists followed Holmes's lead until the Folsom replication studies from the 1970s and '80s, and it is not until much later that American archaeology saw such an emphasis on manufacturing processes and a resurgence of technological analyses. Lithic artifacts were equated to a fossil form that embodied cultural, stylistic, and chronological information identifying a phase in human evolution. Winchell's 1913 attempt to correlate artifacts found in Kansas with French Mousterian tools based on similarities in patina is a case in point. Weathering was seen as a convenient way to measure relative age and Winchell applied this recipe to Trenton. After an examination of the paleoliths, Winchell concluded that they predated the Pleistocene rather than postdated it, as had been suggested by Holmes and his cohort (Meltzer 2015:250). Shortly after Winchell's proclamation on the age of the Trenton artifacts, Leslie Spier and Clark Wissler implemented quantitative studies of these artifacts' vertical spread to solve the quandary posed by the dubious stratigraphic position of the paleoliths (Bowman & Givens, 1996, p. 85). While they demonstrated a unimodal distribution, suggesting they were temporally and culturally distinct from the surface artifacts, these studies could not resolve the question of the age of the deposits of origin.

With no smoking gun, there could not be a tangible Paleolithic to explore, nor, by the same token, was there yet a Paleoindian record. Thus, in the absence of any sort of compendium, archaeologists looked outside North America and emulated research conducted in the Old World. There was one significant difference though. While scholars working in Europe or the Near East, for

instance, had the benefit of deeply stratified sites to build their chronologies and devise their ancillary stone tool typologies, US American specialists had no such localities to rely on (at least not for these early sites). Their work had to incorporate borrowed typologies rather than independently developing their own *in situ*.

Although the discovery in 1926 of Folsom points in association with extinct fauna put to rest the question of human presence in the Americas during the Pleistocene, it also fueled a new quest for early sites that, in turn, dictated the tone of the lithic research conducted in its aftermath. Folsom opened up a temporal gap that needed to be filled. American prehistory had been pushed back by several thousand years with no chronological marker (other than the newly recognized fluted points) that could help identify Paleoindian sites. Therefore, in consideration of the dearth of deeply stratified localities in North America, relative dating via lithic typological comparisons took center stage. In retrospect, the Folsom discovery reinforced the existing trend in American archaeology: it emboldened the search for early sites by giving credibility to claims of great antiquity, while at the same time fostering an even greater reliance on lithic typology.

E. B. Renaud, who taught at the University of Denver (DU) from 1920 to 1948, was a central figure in the development of a Paleoindian point typology. During his tenure at DU, he conducted extensive field work and started a collaboration with local artifact collectors (LaBelle, 2004). The latter proved productive since after the erosion brought by the Dust Bowl, numerous surface finds of Paleoindian points had been made in the sandy blowouts of Eastern Colorado (Seebach, 2006). As Renaud was born in France, he was proactive about promoting the exchange of information between American and European scholars. It is Renaud, for instance, who familiarized the French audience with Folsom (E. B. Renaud, 1928). He later introduced them to his North American Point typology. In 1937, Renaud published a description of five point types in the *Bulletin de la Préhistoire Française*, one of the major scientific journals in France of the time. In the report, he repeatedly connected the American and European archaeological records. There were, for instance, references to the Danish daggers and Solutrean artifacts in his depiction of Yuma points. It all culminated in Renaud calling the early North American record the Upper Paleolithic (E. B. Renaud, 1937, p. 456). The old ghosts of Abbot's American Paleolithic were still alive.

Elsewhere in the United States, lithic studies followed a similar blueprint of relying on European frames of reference to understand American assemblages. An example of this pervasive European influence on American archaeology can be found in Cyrus Ray's assessment of the age of his recently defined Clear Fork complex in Texas:

"Several nationally known students of European

paleolithic implements have stated to the writer that The Clear Fork Culture contains more of the typical European paleolithic forms of artifacts than any other previously found in America, and that if these had been found in Europe they would unquestionably be considered to be of great age. The handaxes, spokeshaves, burins, and grattoirs, have especially been selected by these authorities as representing European paleolithic types." (Ray, 1938, p. 98)

This general approach dominated lithic studies until the rise of processual archaeology. Renaud's influence in shaping Paleoindian typology cannot be understated, as Marie Wormington, one of his students at DU, continued his work. Wormington, a consummate typologist herself, actively promoted the search for early sites. She also trained and influenced many young archaeologists (among them Dennis Stanford, and Henry and Cynthia Irwin) who in turn played prominent roles in Paleoindian archaeology.

One can argue that a typological study of Paleoindian tools, published with one of her protégés (Henry T. Irwin & Wormington, 1970), was heavily influenced by French archaeologist F. Bordes (1955) and the culmination of a normative approach. During these early years, artifact classes were tracked and communicated via "cumulative percentage graphs." Irwin and Wormington used these to argue in favor of a typical signature for each Paleoindian complex they identified, namely: Clovis, Folsom, Midland, Cody, and Frederick. Yet, their approach ignored the then-current Bordes-Binford debate on the meaning of variability between assemblages (Lewis R. Binford & Binford, 1966; Bordes, 1955). Steering away from the controversy, Henry Irwin and H. M. Wormington focused on categorizing the composition of Paleoindian assemblages and their tool classes, with less consideration of why changes occurred over time (Henry T. Irwin & Wormington, 1970). Albeit centered around whole assemblages rather than relying solely on projectile points, their study was still concerned with identifying the respective signatures of given material cultures in order to identify them chronologically within the archaeological record. Irwin's seriation work at Hell Gap soon followed, and was a direct result of his studies in Europe (H. T. Irwin, 1967; Knudson, 2009, p. 30). Their contributions furthered the influence of normative approaches to Paleoindian assemblages that characterized analyses during the early years.

### Replicating Folsom

*"...the most beautiful, practical, highly specialized, and, admittedly, one of the most difficult points to replicate." Crabtree (1966)*

The gradual development of technological thinking in Paleoindian archaeology can be observed in early

Folsom replication work carried out by both academic and avocational archaeologists. The goals of these experiments were largely in line with the normative views of lithic assemblages that had initially taken hold in the US. As the research objective was to successfully replicate the end form of Folsom points, there was no explicit concern for the production stages or use of such technology. Discussion of steps was often an inevitable byproduct of these studies, though. While this research remained typological in flavor, it offered an initial, if limited, springboard for more holistic studies.

While the Folsom type site, with its Pleistocene fauna, established the antiquity of humans in North America, it was another Colorado site, Lindenmeier, that sparked an interest in how Folsom fluted points were made. The fluting process received significant attention early on, as researchers questioned the purpose of crafting a longitudinal channel and admired the skill necessary to produce it (Roberts, 1935). At this time, establishing prehistoric chronologies in the Americas became increasingly important and typology seemed to offer a solution. Fluting as a morphological attribute was easily identifiable, highly idiosyncratic, and modern researchers continue to puzzle over it (Smith & Tune, 2019). The idea of projectile point forms as "index fossils" became widely adopted to solve the puzzle that was Paleoindian chronology, and early typological studies emphasized the contrast between fluted points (Folsom and Folsomoid points) and non-fluted ones (Yuma). Eventually, the growing importance given to fluting as a distinctive characteristic generated interest in its creation process. The flute of Clovis and Folsom points in particular was seen as enigmatic, both in its function as well as in its mode of production.

This new direction in Paleoindian lithic studies was the result of a perfect storm. For one, E. Wilmsen's publication in 1978 of the final report on the Lindenmeier Folsom site and its abundant descriptions of the Folsom preforms, channel flakes and finished points prompted interest in the Folsom point manufacturing process. Simultaneously experimental approaches to lithic analyses enjoyed growing popularity, influenced by European archaeology. The pioneering efforts of Bordes and Tixier in France had found a counterpart in the US under the auspices of D. Crabtree (Johnson et al., 1978; Knudson, 1982).

Crabtree detailed his attempts to replicate Folsom points from the Lindenmeier site in an article that represented an important step in understanding tool production (Crabtree 1966). In addition to describing the morphology of Folsom points, he also discussed probable flaking sequences based on removal scars. The paper marked a stepping stone in his career as a flint knapper (Knudson, 1982). Crabtree's eventual role as one of the foremost American instructors of future knappers also meant that his work had long-term downstream impacts, as it shaped many



archaeologists' knowledge of techniques and methods for making stone tools (Yerkes & Kardulias, 1993). This generosity as a teacher and mentor meant that he was foundational to many "family trees" of flintknapping knowledge transmission (Johnson et al., 1978; SAA, 1989), regardless of whether knappers came from academic backgrounds or not. Indeed, as flintknapping does not require any formal training in archaeology or anthropology, many early Folsom replication studies were initiated by the avocational community.

Like Crabtree, J. B. Sollberger was a highly skilled, self-taught knapper and avocational archaeologists who contributed immensely not only to Folsom replication, but to lithic technology in general. His 1985 description of fluting techniques was a direct response to Crabtree's suggestion that others continue exploring methods of replicating Folsom points: "I hope that the results of my experiments will prove useful and inspire the student of stone technology to experiment further with these techniques," (Crabtree, 1966, p. 22). Sollberger offered another solution to the problem of fluting points, further demonstrating that Folsom points could be produced in multiple ways (Sollberger, 1985). Sollberger's fluting method, which used a clamp jig, provided evidence to counter prior assertions by some knappers that Folsom points were too delicate for such handling (Flenniken, 1978). Frison and Bradley later experimented with replicating Folsom points in their study of the Agate Basin site, based on Sollberger's published methods (Frison & Bradley, 1982, p. 210). The body of work generated by this vein of work collectively highlights how researchers were focused exclusively on the replication of final point forms.

At the same time, these more traditional academics were working on their own replication projects. J. Jeffrey Flenniken (1978), who had asserted that Folsom points could not withstand being held in clamp for fluting (as noted above) revisited the question of Lindenmeier Folsom production. Flenniken's work here demonstrated how, despite its nominal focus on the end products of production, replication experiments also facilitated a better understanding of production as a process. His discussion moved understanding of this process forward by identifying explicit stages within the Lindenmeier assemblage. In his description of these steps, Flenniken used his experimental data to provide estimates of time invested and failure rates. The latter stimulated further work into risk-mitigation strategies by Paleoindian hunter-gatherers (Bamforth & Bleed, 1997; Bleed, 2001; Kelly & Todd, 1988; Odell, 2005).

Around this time, Callahan defended (1977) and published (1979) his M.A. thesis, describing the production of Eastern fluted points. In this work, Callahan introduced production stages based on Holmes' work, and these remain in use among lithicists today (Kolhatkar, 2022; Shott, 2017). Callahan was active within the knapping

community, organizing events and teaching students in the US and abroad (Nami, 2019). While still a graduate student, Callahan reported on a workshop at Sollberger's residence, noting the techniques that resulted from knapping "family tree" lineages (Callahan, 1976, pp. 3, 4). He also suggests that by gathering frequently and sharing techniques, researchers could most effectively gather data regarding lithic manufacture and develop the field of study into a true science (Callahan, 1976, p. 4). This emphasis on ensuring that replicative studies were included in the realm of science is reflected in Callahan's thesis, which reports data such as time invested in manufacture (1979, p. 21) and frequency of edge angles observed (1979, p. 27). Such data is similar to that provided by Flenniken (1978), indicative of a broader trend developing among knappers and researchers at the time.

Akerman and Fagan (1986) later offered a more streamlined method for fluting Folsom points. They worked from the assertion that high failure rates reported in prior studies, such as Flenniken's, must be a result of poorly chosen methods, and thus could not reflect actual Folsom techniques. The authors focused solely on the fluting process and recounted their successes and failures with various lithic materials (Akerman & Fagan, 1986). Like their colleagues, these authors remained exclusively concerned with the final morphology of Folsom. At the same time, Akerman and Fagan's work demonstrated that, however unintentionally, American archaeologists were moving towards more processual modes of thought. The authors acknowledge that:

"The problem of replicating Folsom points accurately and economically has probably involved the efforts of more students of lithic technology than any other aspect of stone tool replication." (Akerman & Fagan, 1986, p. 1)

However, in arguing that the fluting failure rate was simply too high to be correct, Akerman and Fagan inherently contextualized Folsom points within a broader system. This line of reasoning considers that the point does not stand on its own but is incorporated into a larger economy in which people transport stone, rely on it over time, and plan around the possibility of manufacturing failures.

The works described above were all published within a relatively short time—just twenty years, spanning from 1966 to 1986. Over these years, lithicists undertook experiments that vastly expanded knowledge of how stone could be worked into the same shape as known Folsom points. Their goal of replicating the morphology of artifacts is closely in line with a Bordes-infused understanding of projectile points through typologies (Wargo, 2009), but also demonstrates a burgeoning consideration of production steps in the broader context of a stone tool economy. Discussions of projectile points valued recognizable types ("index fossils") most highly,

one consequence of which was a widespread desire to replicate the Folsom form. Researchers were particularly keen to better conceptualize the production and possible uses of fluting, as the contrast between fluted and non-fluted points was thought to be crucial. These knapping attempts were never strictly experiments in the truest sense: they did not seek to control variables and falsify a null hypothesis, but instead hoped to simply try different methods and to record successes and failures (Eren et al., 2016; Jennings, Smallwood, & Pevny, 2021). While they at times offered direct comparisons to archaeological specimens, discussed manufacturing stages, and implied certain considerations of the broader hunter-gatherer economy, explicit consideration of this was typically minimal.

### Processualism and New Directions

*“However, when explanations are sought, the total adaptive context of the socio-cultural system in question must be investigated.”  
(Binford 1962)*

Despite the dedicated efforts of the archaeology research community, replication studies merely demonstrated that there were, in fact, many ways to flute a point. This body of work ultimately failed to provide insights on human lifeways or answer any broad anthropological questions. The narrow pathway that resulted from this early technological approach provided an excellent opportunity for processualism to redirect research goals among Paleoindian lithicists. Processualism differed from earlier culture-history approaches in that it went beyond simply placing artifacts in the correct chronological order and instead sought to explain the processes by which they had ended up in the archaeological record (Lewis R. Binford, 1968). This new avenue of inquiry aimed to formulate research questions about people, rather than objects.

Processualism redirected focus in Paleoindian lithic analyses during the 1970s, 80s, and 90s to consider tool function within the context of an adaptive system. The first task of new processual approaches to lithic analysis was to place the lithic toolkit into the context of a specific cultural system. Later on, the scope of these analyses increased to encompass behavior on a larger scale. As research enthusiastically embraced “big questions” in American archaeology, such as the peopling of the Americas (David J. Meltzer, 2003, p. 540), processualism provided the framework on which the structures of these arguments were built (Amick, 2007; Spiess, Wilson, & Bradley, 1998, p. 221; Trigger, 1991). This work continued into contemporary studies, which have examined networks of lithic sources and inferred reduction trajectories to draw conclusions about Paleoindian life in North America (Bernstein & Lenardi, 2005; Buchanan, Andrews, Kilby, & Eren, 2019; Goodyear,

1989; Pollock, Hamilton, & Bonnicksen, 1999).

Among the first to embrace a more technologically oriented research agenda were Michael Collins and Ruthann Knudson, who both finished their doctoral work (more or less) contemporaneously in the early years of processualism. Their respective dissertations reflect an enthusiastic adoption of new methodologies. The use of the term “processual” had clearly started to be adopted by American lithicists at this point, but to varying degrees: while Collins embraced the term, Knudson did not. They integrated processualism into their work in slightly different ways, but both provided a more holistic view of lithics within the broader cultural system. Each published their dissertation research, Knudson as a manuscript and Collins as a book chapter (Michael B. Collins, 1975; Knudson, 1970).

Both authors previously struggled to arrive at meaningful conclusions through purely normative approaches. In introducing his integration of processualism into lithic analysis, Collins described past attempts at pure typology as “decidedly frustrating,” (M. B. Collins, 1974, p. iv). Knudson, in turn, offered a clear articulation of why these new analytical methods were necessary. She stated that, “the research reported in this paper really began with the realization that the traditional paradigm of Paleo-Indian studies generated little information about cultural systems and human behavior,” (Knudson, 1983, p. 172). Both Collins and Knudson built their research upon a processual foundation, as they inferred behavioral and cultural traits from the attributes of lithic assemblages. Their approaches differed in that Collins’s goal was largely to create, and demonstrate the effectiveness of, a model for analyzing diverse lithic assemblage. Knudson was less concerned with the model-building itself, but rather the results of its application. She aimed to aid in understanding diachronic changes observed in Paleoindian material cultures. At the time that Knudson was writing her dissertation (completed some nine years before its publication in 1983), Binford’s theory papers discussing processualism—now seminal—were recent and even contemporary literature. Knudson explained that her solution to the shortcomings of traditional research was adopting a theoretical orientation concerned with “structural and operational processes,” which allow people to “cope with their physical and social environment,” (Knudson, 1983, p. 3).

As these analytical threads carried American archaeology forward, there emerged a greater emphasis on mobility. From the late 20<sup>th</sup> and into the early 21<sup>st</sup> century, this has been a hallmark of Paleoindian archaeology. The influence of processualism and its role in shaping Paleoindian mobility studies was especially clear in Kelly and Todd’s paper, “Coming into the Country,” (1988). The authors embraced the framing of assemblage variability as an indicator of cultural and technological adaptation,

Formative Years	Replicating Folsom	Processualism and Beyond
<p style="text-align: center;"><i>1926 - 1960s</i></p> <ul style="list-style-type: none"> <li>• American paleolith controversy</li> <li>• Recognizing the early human presence in North America</li> <li>• Typological and normative approaches</li> <li>• Development of chronology based on index fossils</li> </ul>	<p style="text-align: center;"><i>1960s - 1980s</i></p> <ul style="list-style-type: none"> <li>• Fluting as key feature studied</li> <li>• Role of early teachers who influenced technique for knapping “family trees”</li> <li>• Collection of data to make replication studies more scientific</li> <li>• Data generate new questions about manufacture choices</li> </ul>	<p style="text-align: center;"><i>1970s – present</i></p> <ul style="list-style-type: none"> <li>• Goal of understanding how artifacts become part of archaeological record</li> <li>• Consider tool function rather than just form</li> <li>• Integrate into study of human behavior more broadly</li> <li>• Building and testing models of behavior</li> </ul>

**Figure 1:** Key points from phases of lithic Paleoindian lithic analysis discussed.

**Figura 1:** Puntos clave de las fases de análisis lítico paleoindio discutidas.

particularly regarding mobility strategies. Kelly and Todd emphasized “archaeology as anthropology” à la Binford (1962) and formulated research questions that addressed a process, namely the peopling of the Americas. Mobility was presented in this article as a vital component of hunter-gatherer adaptive strategies, in line with larger trends of Paleoindian research. The authors proposed a model describing the peopling process, presented its possible implications for organization strategies that should be visible in material culture, and then tested this against observations in the archaeological record. This is congruent with more general trends in “New Archeology,” which billed itself as a shift toward a rigorously scientific study of the archaeological past.

Compared to the normative typological approaches to Folsom, Lindenmeier, and Hell Gap assemblages during the preceding years, Kelly and Todd’s article reflected an increasing emphasis on the function, rather than the form, of tools in the assemblage. That is, instead of focusing on the morphology of artifacts, the analysis sought to understand what attributes of a tool or toolkit made it well suited to a particular environment and strategy. As computing capabilities have increased, research on Paleoindian mobility has more recently relied on building and testing mathematical models of assemblage expectations dependent on the parameters of possible mobility strategies. These models have provided hypotheses which in turn can be tested against the archaeological record to better understand past human behavior (Brantingham, 2003). In other instances, these studies have also provided data that has

helped archaeologists interpret or contextualize existing knowledge of that record (Ingbar, 1994). Both avenues of inquiry were useful and supported the general movement toward holistic studies, which sought to understand human behavior in Pleistocene North America with an emphasis on mobility.

Together, archaeologists in the 1970s, 1980s and 1990s worked to shift the field away from normative approaches. Researchers began instead to ask more truly anthropological questions. This was done by incorporating processual approaches, which called for archaeologists to consider lithics are part of a larger adaptive system. This work represented the maturation of the field as a discipline distinct from the study of Paleolithic Europe. Instead, American archaeology boasted methods, theories, and goals all its own.

### Conclusion

We have traced the roots of Paleoindian lithic analysis from its early years of borrowing normative typologies from its European counterparts to its current state as a holistic and anthropological field. Establishing the antiquity of human occupation in the Americas and developing a chronology for Paleoindian material cultures signaled the beginnings of Paleoindian and, as such, distinctly American archaeology. This field blossomed as Folsom replication began to explore technological questions, despite its continued reliance of typological methods. As we have illustrated, these studies sought to recreate the final morphology of Folsom points,

but in doing so their authors often revealed new and interesting information about tool production processes. Paleoindian lithic analysis found its stride with the advent of processualism, which prompted researchers to apply systemic thinking to lithic assemblages. Archaeologists at this time increasingly considered tool functionality, rather than just form. This led to an understanding of lithics as a component of cultural adaptations and emphasized how these artifacts informed researchers' understanding of mobility.

We have sketched the trajectory of these developments (Figure 1) through certain publications, which showcase the questions asked and methods used over the years. Because Paleoindian studies were initially beholden to the traditions of European lithic analyses, those methods shaped the early studies at Folsom, Lindemeier, Hell Gap, and other early Paleoindian sites. The discipline slowly broke free of these influences and the growth of processualism provided fertile ground for frustrated archaeologists to sow the seeds of new theoretical orientations. As a result, the field now encompasses diverse studies of raw material sources, subsistence, procurement, transport, and settlement—all of which are key to understanding human cultural adaptations. This holistic approach is much different from the normative approaches initially followed in Paleoindian research. Of course, those questions the authors mentioned herein sought to answer remain open, providing ongoing opportunities to explore the role of technology within its expansive socio-cultural context.

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