ABSTRACT

The classification of projectile points is a difficult issue as there is no universal classificatory system and work has been informed by a number of theoretical frameworks that have influenced the choice of attributes use to create classes or types. While much of the early work in projectile point classification was concerned with the construction of culture-history and was largely descriptive, later work was concerned with explaining culture change rather than with constructing typology. An exception was the work in Great Basin typology and chronology that resulted in the construction of an identification key to aid in the identification of projectile points from the Great Basin and correlate them with time. The typology resulted in debate about whether or not projectile points, dart points in particular, were truly useful as time markers, or whether they were subject to too much morphological change over their use-lives, with all “types” of dart points being distributed throughout an 8500 year period. The debate has not been truly resolved. In other areas, recent work has used an evolutionary framework to address a number of questions. Analysis of morphological variability has been applied to issues of cultural transmission and changing technology. In addition, digitized photographs of projectile points have recently been used to establish landmarks for morphometric analysis which have been applied to study the organization of lithic technology and in the construction of cladograms. Cladograms constructed from this, and more traditional means, have been used in order to illustrate heritable continuity, and thus patterns of migration and cultural contact. Classification in anthropology has progressed beyond the construction of keys for identification and is instead used to answer questions about chronology, technology, migration, and the transmission of culture. Stone tools are not static artifacts; rather they are dynamic and may change substantially over their use-lives. This fact must be considered in the construction of morphological types or when assigning meanings to these types.

INTRODUCTION

Classification in lithic analysis is a complex problem because there is no universal classificatory system and work has been informed by a number of theoretical frameworks that have influenced the choice of attributes used to create classes or types and also the methods that have been applied in segregating classes because of the questions being asked. Much of the early work in projectile point classification was concerned with the construction of culture-history and was largely descriptive. Later work was concerned with explaining culture change, and more recently, an interest in evolutionary archaeology has applied a biological perspective to understanding changes in artifact form.

Projectile point classification serves several purposes. There are a number of ways to classify artifacts depending on which attributes are chosen to create the classification or typology. Hill and Evans (1972) make the point that no single typology is better than any other, and in fact we must be wary of typologies that become reified. Instead, a multiplicity of types can be constructed for any given set of material and these types can be assigned a diversity of meanings.

This review begins with a discussion of the attributes commonly used for classification and how they are used to construct classes or types. This is followed by a critical review of the application of point typologies to archaeological problems.

ATTRIBUTES USED FOR ANALYSIS

There are a nearly infinite number of attributes that may be used to classify projectile points. Commonly used non-metric attributes include flaking patterns on the face of the point, haft characteristics, notch and base shapes, and edge treatments.

Early work in descriptive classification called for consistent terminology so that readers could develop "…a proper mental picture of the object" (Black and Weer 1936). Classification was accomplished by description of the geometric shape of the point and how the point was modified, whether corner-notched, corners removed, side-notched, etc. Finkelstein (1937) also suggested a detailed taxonomic system with the goal of providing an objective means of forming purely morphological classes. Classification was based on the shape and modification of the haft, the shape of the body of the point, the type of notching present and the shape of the base. It produced a rather cumbersome method of describing a point with a series of letters and roman numerals. With interest in increasing objectivity and the ability to more easily apply complex statistical analyses, metric attributes have also gained importance, including length, width, thickness, and weight. Currently a combination of metric and non-metric attributes is used for classification.

CLASSIFICATION AT WORK

The identification of morphological types has been used to construct regional identification keys. One of the most famous, although not of projectile points, is the Bordes' typology for Middle Paleolithic artifacts. Part of its attractiveness was its apparent objectivity and ability to be applied consistently. It is included here simply as an example of the ways in which types are constructed (Figure 1). Thomas (1981) constructed a key for identifying projectile points from the central Great Basin of North America as part of a larger project involving the identification of temporal types (Figure 2). Its applicability is limited regionally and uses different combinations of attributes to identify types. In his series of books on projectile points in North America, Justice

(1995; 2002b; 2002a) employed cluster types created by clustering similarly shaped points and provides the reader with options for what the point might be. Descriptions of the possibilities help to narrow down what type the point is. His types are based on shape similarity and consider essentially the outline of the point. His key relies on previously identified types, which often have both a morphological and temporal component.

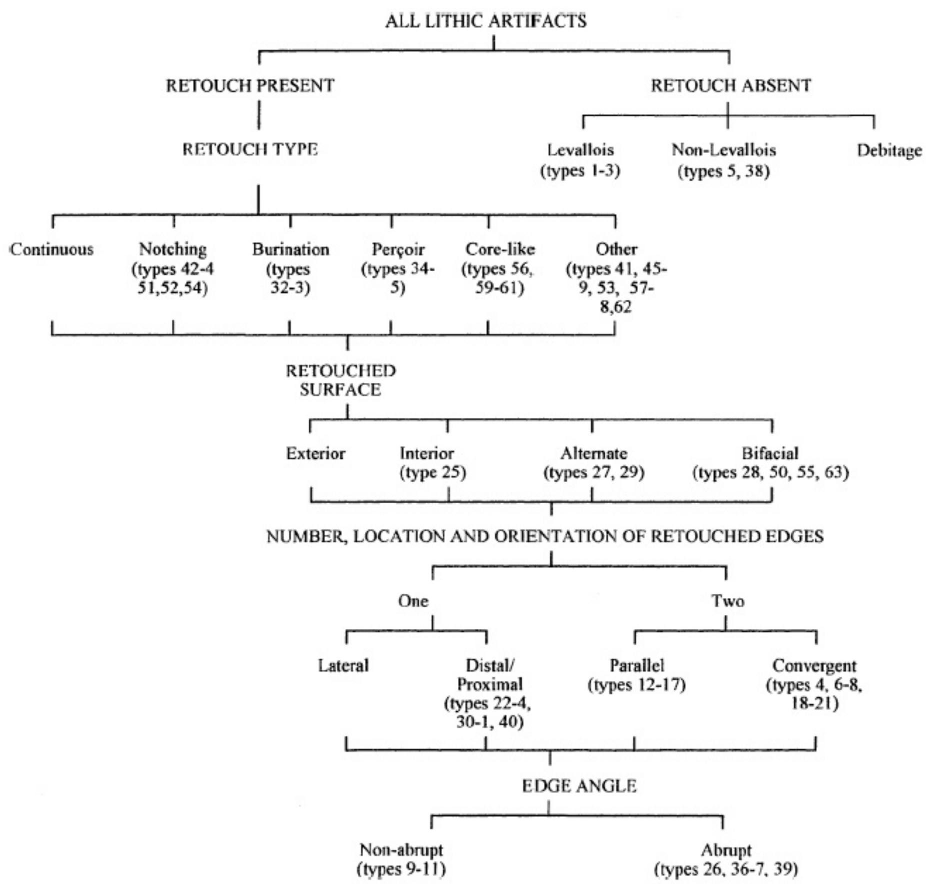

Fig. 1. Hierarchy of variables used by Bordes to define tool types, retouched tools (from Debenath and Dibble, 1994). In this hierarchy, a tool may be defined by as few as one or a combination of up to five attributes.

Figure 1. Bisson 2000:9

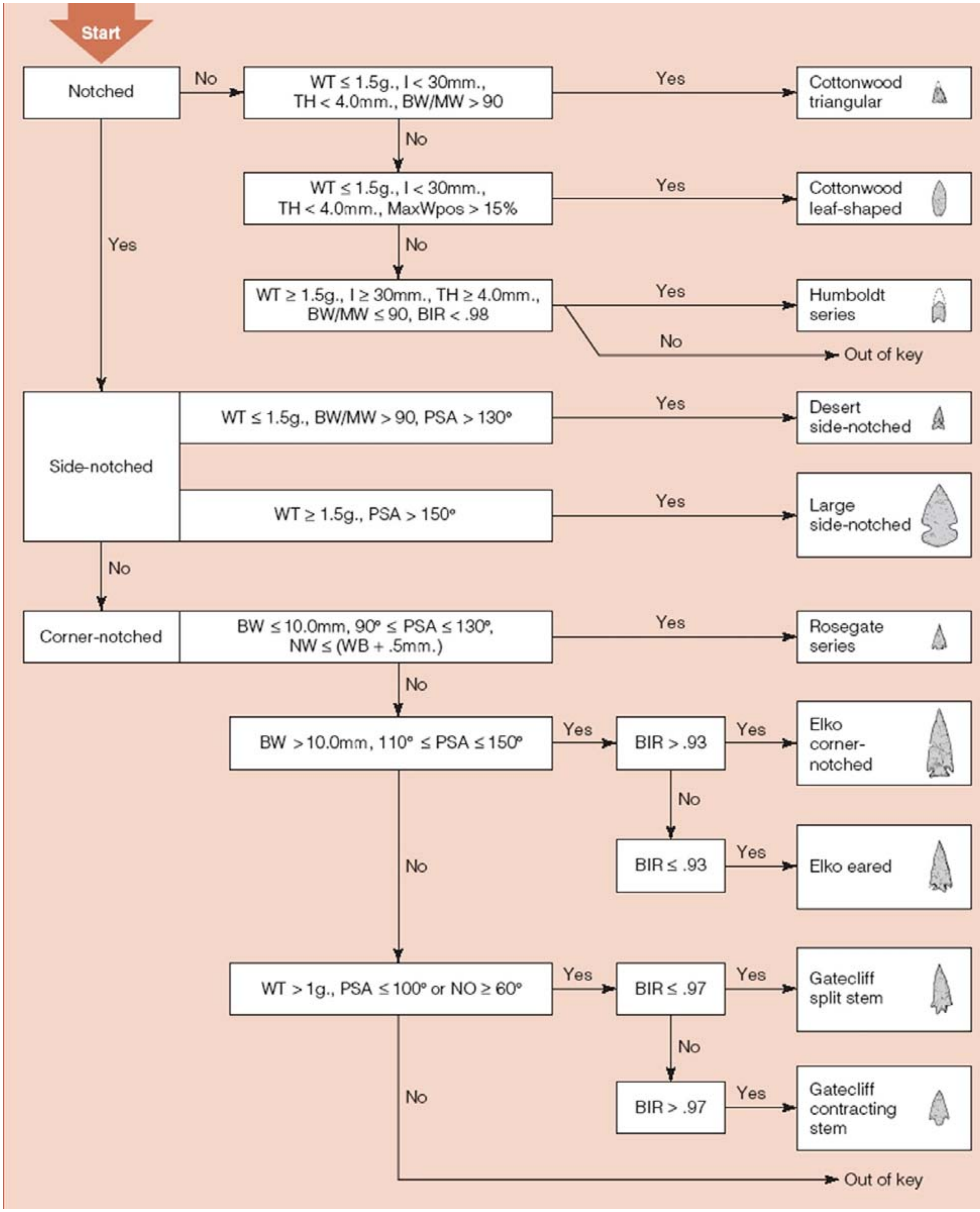

Figure 2. Thomas 2006:219

Morphological types are often used for the construction of culture-history, either as markers of social groups or of time or both. The justification for the use of projectile points in this manner is in the identification of style. When evaluating projectile points, form is influenced by two things – function and style (Jelinek 1976). The expression of style may be considered active or passive (Barton 1997) with active style being a conscious and deliberate choice on the part of the flintknapper and passive style being the result of random variability that is selected for unconsciously and maintained within a social group because flintknapping is learned in a social context. Passive style may be expressed not only in shape, but also in the reduction sequence and the choices the knapper makes when forming the tool. The isochrestic approach (Sackett 1982) to lithic analysis is concerned with identifying passive style in artifacts. The argument is that a large number of options are potentially available to achieve the same goal and that artisans in a society are likely to choose only one or two of these methods. The likelihood is that two unrelated societies are unlikely to choose the same method and certainly not the same combination of methods. This approach to style is particularly well suited to analysis of projectile points by not limiting the definition of style to one of active, self-conscious decisions to delimit social boundaries on the part of the knapper. In this case, style and function are considered together as many styles are seen as being capable of achieving the same function. In contrast, style and function may be considered separately because attributes related to function are selected for by the pattern of resource exploitation (Dunnell 1978; Jelinek 1976). From this perspective there would be smaller differences in functional aspects of some attributes in cultures exploiting similar resources. Style, those choices in how to make a tool, is selectively neutral and in unrelated groups greater differences in style will be seen whereas in groups adjacent in time or space style will be more similar.

In the consideration of functional distinctiveness, discriminant function analysis has been used with success to separate arrow from dart points, useful because bow and arrow technology appeared much later in the archaeological record. It was generally thought that arrow points should be smaller than dart points, but this was a largely intuitive observation. The use of metric attributes of projectile points in discriminant function analysis provided an objective rather than intuitive way to distinguish between the two. Original work was conducted using a collection of combined ethnographic and archaeological stone-tipped arrows and a small (n=10) sample of atlatl points, limited due to the inclusion of only hafted points (Thomas 1978). The analysis found that width was the single most important discriminator between arrowheads and dart points, and length the least important. The research is the first objective method of distinguishing between the two and is easily replicable. It is, however, hampered by a very small sample of dart points. An extension of this work was conducted using an expanded set of archaeological atlatl points to increase sample size (Shott 1997). Again, points chosen for inclusion were restricted to those that were clearly arrow or dart because they were still hafted. Only those points whose attributes could be measured without removal from the haft and were of known provenience were included in the analysis. Discriminant function analysis demonstrated that in all cases, shoulder width was the most reliable variable for discrimination of arrow and dart points. Length is less useful because loss of length can occur through use and retouch. Neck width is also not as useful because not all points are notched. One potential problem is that the sample was somewhat geographically biased with over-representation of the American Southwest in the dart point sample, an unavoidable circumstance given the lack of preservation of hafted points.

Another approach considers the requirements of thrusting spears, throwing spears, spear throwers, and the bow-and-arrow (Hughes 1998) including penetration, accuracy, flight distance, and durability. The justification for this approach was that although small points could have been used as dart tips and large points may have been used as arrow tips, differences in the way the weapon systems functioned would have required distinctively different tips for greatest efficiency. The engineering analysis of the weapons systems allowed the identification of functional traits – those that persisted by natural selection and would distinguish dart from arrow points. Due to variable functional requirements including shaft size, mass, and weapon balance, several attributes were considered to distinguish one from another – tip mass, cross section, and perimeter.

An important reason for distinguishing dart from arrow points and also variability within these functional types has to do with correlation with time and/or culture. The use of projectile points as time markers is not without criticism. One example is the debate about the projectile point chronology in the Great Basin. Considerable time has been spent on testing the utility of projectile points as time markers in the Great Basin because most of the archaeological record is comprised of surface sites that would otherwise be undateable.

CHRONOLOGY IN THE GREAT BASIN

The use of projectile points for chronology developed in the 1950s and 1960s after it was observed that some points throughout the Great Basin had the same order or appearance and replacement over an 8,500 year period (Bettinger et al. 1991). By 1960, the Berkeley typological framework had been established by Robert F. Heizer and his colleagues at the University of California, Berkeley, and it still provides the foundation for projectile point chronology in the Great Basin today (Thomas 1981). A revised projectile point chronology for the central Great Basin was established after a series of projectile points was recovered in Monitor Valley, Nevada (Thomas 1981). These came from both stratified and surface sites with nearly half coming from Gatecliff Shelter – a deep, stratified occupation that produced radiocarbon dated deposits. Temporal types were established using morphological types that were consistently correlated with a particular span of time. The revised typology was based on an assumption of morphological stability at the hafting element of the point. It was assumed that breakage and subsequent maintenance of the point occurred primarily at the distal (tip) end of the point where impact occurred, leaving the haft area intact and therefore the most stable variables for monitoring change through time. A typological key was developed based on the measurement of standardized point attributes (Figure 3). The resulting key used a combination of metric attributes to identify types, and these were correlated with particular spans of time.

The use of projectile points for chronology has received criticism based on the fact that the use and maintenance of stone tools changes their morphology, making projectile point types unsuitable as chronological markers. One critique contends that contrary to the assumption used for the typology, the breakage and rejuvenation of projectile points occurred primarily at the haft end, calling into question the validity of the entire temporal typology (Flenniken and Raymond 1986; Flenniken and Wilke 1989; Wilke and Flenniken 1991). Experiments conducted with replicated points that were then fired at various materials that points in use were likely to have hit if the target was missed demonstrated that breakage actually occurred primarily at the haft end (Flenniken and Raymond 1986). It was suggested that notching of points might have been a deliberate attempt to control breakage, by predisposing breakage at the haft, ensuring that the majority of the point would remain embedded in the prey causing continued bleeding from the wound that would ultimately result in death. The point would then be recovered during butchering and re-shaped into another useful point. This model of use and rejuvenation, the "rejuvenation hypothesis," suggested that all Great Basin dart points

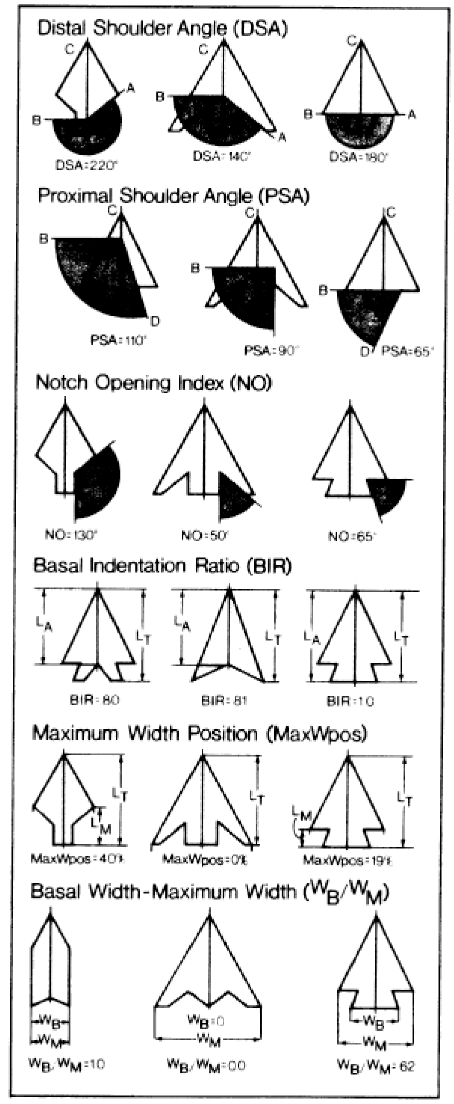

Fig. 3. Standardized attributes for Great Basin projectile points (after Thomas 1970: Figs. 2 and 3).

Figure 3. Thomas 1981:14

could have begun as one of two archetypal dart points, the Elko corner-notched and the Northern side-notched, and that all other dart points were simply varying stages in their use-lives (Flenniken and Wilke 1989). Experiments demonstrated that rejuvenation of dart points after use created sufficient morphological variation to cause them to be re-typed, according to the Monitor Valley typology. A second criticism of the use of projectile points for chronology is that the co-occurrence of dart points in the archaeological record was too easily dismissed. In a survey of several collections of points it was found that types of points used as time markers did, in fact, co-occur, and that the pattern of breakage of dart points was similar to results obtained in experiments (Flenniken and Wilke 1989).

The argument, then, is that all types of atlatl dart points could be found anywhere in deposits dating from throughout 8500-1500 BP, making them useless as time markers. The use and rejuvenation of dart points altered them too much for morphology to be useful in chronology. Instead, it is more likely that these different “types” are different stages of a tool’s use-life. The argument was thought provoking, but was unsupported with clear archaeological data aside from general observations.

In response to criticisms of the use of points as time markers, a test using archaeological data was conducted (Bettinger et al. 1991). It was argued that although experiments had demonstrated that all other dart points could have theoretically originated as two archetypal points, this did not necessarily mean they had. The study proposed that, on average, the archetypal points should be larger than the rejuvenated forms, and therefore a simple test of weight could be conducted because archetypal forms should exhibit the largest mean weights. A database of over 6000 dart points from dozens of Great Basin sites was utilized, and it was found that the rejuvenated forms were consistently larger than the archetypal forms, in direct opposition to the expected results. However, the logic for this test was criticized on the basis that most of the dart points recovered archaeologically were discards, and therefore already exhausted and at the end of their use-lives rather than in varying stages of use-life (Wilke and Flenniken 1991).

The continuing debate prompted another hypothesis, the “rehafting hypothesis” which was the result of consideration of the problem of why the “rejuvenation hypothesis” did not hold (Zeanah and Elston 2001). The “rejuvenation hypothesis” was argued from the perspective of economy and effectiveness, that it was less costly for breakage to occur at the haft, ensuring copious bleeding and leaving most of the point blade intact for rejuvenation and rehafting. Using a similar argument of economy, the “rehafting hypothesis” posited that variation in the hafting element was restricted by the requirements of the haft itself because the haft was too costly to modify or replace each time the stone point had to be replaced. Instead, it was more economical to replace a stone tip, even if the material was not yet exhausted, if the hafting element could not be made to fit the haft properly. This model was tested by comparing the variation of the attributes of the hafting elements of points at two types of sites – single-use sites where retooling occurred after a particular hunting event, and palimpsest sites that were re-used over time. The expectation was that if the “rehafting hypothesis” was correct, less variability of the hafting element of points would be found at single-use sites than at palimpsest sites, and it was found that this was the case, making the use of points for chronology valid, as projectile points would not have changed enough in rejuvenation to change type.

RECENT WORK

More recently, researchers have taken advantage of technology to create classifications and also to facilitate the comparison of attributes to answer a number of interesting questions. The use of digital photography has changed how and what kinds of data are collected while also making measurements more precise. These data have been used to investigate changes in lithic technology and to consider lithic technology within an evolutionary framework.

Traditionally, the collection of quantitative and qualitative data has been done by hand and susceptible to imprecision and subjectivity, particularly when considering degree of expression of a qualitative attribute. Recent work (Buchanan 2005, 2006; Buchanan and Collard 2007) utilized digital photography and the tpsDIG program (Rohlfe 2002) to capture coordinate data by manually marking landmark positions. Coordinate pairs and interlandmark distances were used to delineate the general shape of points. The data obtained using these methods have been used to study cultural transmission through phenetic and cladistic analyses of stone tools (Buchanan 2005), the

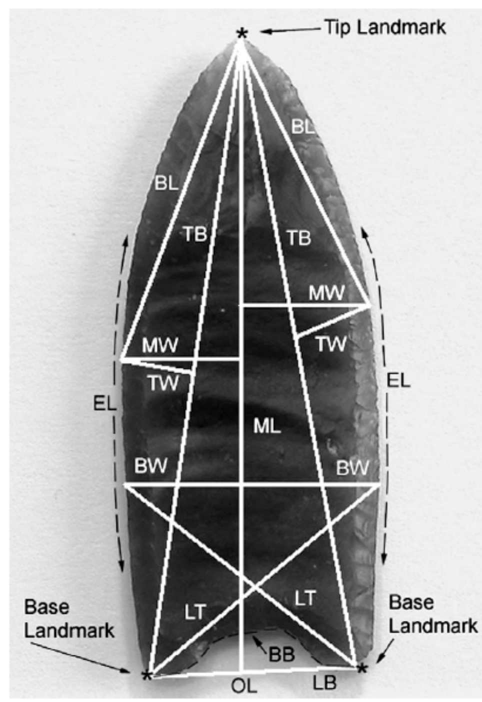

Fig. 2. Folsom point from Shifting Sands (catalog number 34) showing the approximate location where 11 of the 12 characters (character point area not shown) are measured and the location of the tip and basal landmarks. Character initials: EL, edge boundary length; TB, tip to base length; TW, width of tip to base length to maximum inflection position; BL, blade length; MW, maximum width; BB, base boundary length; LB, linear measure of base; ML, midline length; OL, overall length; BW, basal width across first third of point; LT, length from base to 1/3 along opposite edge.

Figure 4. Buchanan 2006:188

organization of lithic technology (Buchanan 2006), and testing hypotheses about the peopling of the New World through cladistic analysis of Paleoindian projectile points (Buchanan and Collard 2007). This method of data collection appears to have the advantage of being very precise, without potential errors introduced by manually measuring. Additionally, homologous landmarks are chosen to ensure comparability between points. However, some of the coordinates are necessarily placed subjectively, with the researcher estimating distances between actual landmarks. The resulting outline provides an approximation of the overall shape of the point.

Recent work in lithic classification has been carried out in an evolutionary framework. Cladistic analysis has been used for its objectivity to create nested hierarchies. Morphometric analysis has been used in the construction of cladograms in an effort to demonstrate heritable, rather than historical, continuity. This work has been limited primarily to early Paleoindian points from the Southeastern United States and the Great Plains (Buchanan and Collard 2007; O'Brien et al. 2001; O'Brien and Lyman 2002). This research has been used to suggest patterns of migration and/or cultural transmission. Morphological variation has also been used to test the hypothesis that the transition to the bow and arrow would have increased variation among antecedent dart points as people experimented with form while trying to find the best one for arrow points (Lyman et al. 2008). Similarly, metrical variation in Great Basin projectile points has been used to study modes of cultural transmission by considering the spread of bow-and-arrow technology and what that may mean about cultural contact (Bettinger and Eerkens 1999).

CONCLUSION

This brief review of the literature has not been restricted to typology and classification per se, but has also attempted to demonstrate how these classifications might be applied. Anthropology has moved beyond the desire to simply create classification for identification purposes. Instead, classifications are a means to an end, used to answer questions about chronology, technological and economic organization, migration, and the transmission of culture. Because of this, classification is not an uncomplicated endeavor. Stone tools are not static artifacts; rather they are dynamic and may change substantially over their use-life. These factors must be considered in the construction of morphological types or when assigning meanings to these types.

References Cited

Barton, C. M.
1997 Stone Tools, Style, and Social Identity: An Evolutionary Perspective on the Archaeological Record. *Archaeological Papers of the American Anthropological Association* 7(1):141-156.

Bettinger, R. L., J. F. O'Connell and D. H. Thomas
1991 Projectile Points as Time Markers in the Great Basin. *American Anthropologist* 93(1):166-172.

Bettinger, R. L. and J. Eerkens
1999 Point Typologies, Cultural Transmission, and the Spread of Bow-and-Arrow Technology in the Prehistoric Great Basin. *American Antiquity* 64(2):231-242.

Bisson, M. S.
2000 Nineteenth Century Tools for Twenty-First Century Archaeology? Why the Middle Paleolithic Typology of François Bordes Must Be Replaced. *Journal of Archaeological Method and Theory* 7(1):1-48.

Black, G. A. and P. Weer
1936 A Proposed Terminology for Shape Classifications of Artifacts. *American Antiquity* 1(4):280-294.

Buchanan, B.
2005 *Cultural Transmission and Stone Tools: A Study of Early Paleoindian Technology in North America.* Dissertation, University of New Mexico.

2006 An Analysis of Folsom Projectile Point Resharpening Using Quantitative Comparisons of Form and Allometry. *Journal of Archaeological Science* 33(2):185-199.

Buchanan, B. and M. Collard
2007 Investigating the Peopling of North America through Cladistic Analyses of Early Paleoindian Projectile Points *Journal of Anthropological Archaeology* 26(3):366-393.

Dunnell, R. C.
1978 Style and Function: A Fundamental Dichotomy. *American Antiquity* 43(2):192-202.

Finkelstein, J. J.
1937 A Suggested Projectile-Point Classification. *American Antiquity* 2(3):197-203.

Flenniken, J. J. and A. W. Raymond
1986 Morphological Projectile Point Typology: Replication, Experimentation, and Technological Analysis. *American Antiquity* 51(3):603-614.

Flenniken, J. J. and P. J. Wilke
1989 Typology, Technology and Chronology of Great Basin Dart Points. *American Anthropologist* 91(1):149-158.

Hill, J. N. and R. K. Evans
1972 A Model for Classification and Typology. In *Models in Archaeology*, edited by D. L. Clarke, pp. 231-276. Methuen, London.

Hughes, S. S.
1998 Getting to the Point: Evolutionary Change in Prehistoric Weaponry. *Journal of Archaeological Method and Theory* 5(4):345-408.

Jelinek, A. J.
1976 Form, Function, and Style in Lithic Analysis. In *Cultural Change and Continuity: Essays in Honor of James B. Griffin*, edited by C. E. Cleland, pp. 19-33. Academic Press, New York.

Justice, N. D.
1995 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference*. Indiana University Press, Bloomington, IN.

2002a *Stone Age Spear and Arrow Points of the Southwestern United States*. Indiana University Press, Bloomington, IN.

2002b *Stone Age Spear and Arrow Points of California and the Great Basin*. Indiana University Press, Bloomington, IN.

Lyman, R. L., T. L. VanPool and M. J. O'Brien
2008 Variation in North American Dart Points and Arrow Points When One or Both Are Present. *Journal of Archaeological Science* 35(10):2805-2812.

O'Brien, M. J., J. Darwent and R. L. Lyman
2001 Cladistics Is Useful for Reconstructing Archaeological Phylogenies: Palaeoindian Points from the Southeastern United States *Journal of Archaeological Science* 28(10):1115-1136.

O'Brien, M. J. and R. L. Lyman
2002 Evolutionary Archeology: Current Status and Future Prospects. *Evolutionary Anthropology* 11:26-36.

Rohlfe, F. J.
2002 Thin Plate Spine Digitizing Program. 2.02 ed. SB Morphometrics Web Page, State University of New York, Stony Brook.

Sackett, J. R.
1982 Approaches to Style in Lithic Archaeology. *Journal of Anthropological Archaeology* 1(1):59-112.

Shott, M. J.
1997 Stones and Shafts Redux: The Metric Discrimination of Chipped-Stone Dart and Arrow Points. *American Antiquity* 62(1):86-101.

Thomas, D. H.
1978 Arrowheads and Atlatl Darts: How the Stones Got the Shaft. *American Antiquity* 43(3):461-472.

1981 How to Classify the Projectile Points from Monitor Valley, Nevada. *Journal of California and Great Basin Anthropology* 3(1):7-43.

Wilke, P. J. and J. J. Flenniken
1991 Missing the Point: Rebuttal to Bettinger, O'connell, and Thomas. *American Anthropologist* 93(1):172-173.

Zeanah, D. W. and R. G. Elston
2001 Testing a Simple Hypothesis Concerning the Resilience of Dart Point Styles to Hafting Element Repair. *Journal of California and Great Basin Anthropology* 23(1):93-124.