THE FLAKE
Stepchild of Lithic Analysis

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"Daddy is this an arrowhead?"
"No, that's just a flake." (circa 1963: conversation between Ele Baker and myself)

As the reader can see from the above dated conversation with my father, I have been cognizant of flakes for the last 40+ years. And "just a flake" describes my perspective of it for most of that time. My focus was on the tool or core, and I considered the flake as only the byproduct of its manufacture. In recent years my focus has changed and I now believe the flake was the most important artifact to its makers and users. Unfortunately, I believe most archaeologists and collectors still view the flake as I previously did. Because of this perspective, I feel their understanding of the lifeways of prehistoric people is often skewed. Therefore, this paper has the purpose of advocating for the flake and attempting to improve its poor reputation. To begin, let's take an abbreviated look at this perceived stepchild of lithic analysis.

My Definitions of Flake and Tool

A flake is a product of a process that separates a piece of lithic material into two or more fragments by the application of force. The subsequent largest fragment is the "not-flake", which is most often called the core, and the lesser fragment is the flake. By convention we say a flake is removed from the not-flake in the sense a baby is removed from its mother. Sometimes more than one lesser fragment results, as is common with bipolar percussion, and then all the lesser fragments are flakes. However, there can be only one "not-flake" after a force application and this is the largest fragment.

I chose to use the term "not-flake" to define all the other lithic artifacts that exist, e.g. retouched flakes, cores, scrapers, spoke shaves, drills, burins, bifaces, projectiles, etc. I did this because I could not find an established single term that was universally understood, so I ultimately chose not-flake. Therefore, the universe of lithic artifacts consists of flakes and not-flakes.

To expound on my definition, imagine a flake, which I will call Flake-A. If a flake is purposely removed from Flake-A, then Flake-A ceases being a flake and becomes a not-flake. The key word here is purposely. If one retouches a flake, it becomes a not-flake after the first tiny retouch flake is removed. However, if a small flake is unintentionally removed from a flake during a functional process, such as cutting or scraping, then the flake remains a flake. It is the intentional removal of a flake from a mass that makes the mass a not-flake. A blade removed from a blade core is a flake regardless of the number of previous scars that may exist on its dorsal face. The same is true of the Folsom channel flake. However, if a flake is then purposely removed from either one, they become not-flakes.

Borrowing from Baber (2003:8), a tool is a physical object that is manipulated by the user to affect change in some aspect of the environment. Basically, a tool is defined by use and not by morphology. Therefore, a flake is a tool if used as a tool.

I am aware that many researchers define flake and tool differently than I have and that is the reason I have defined them here. There are some individuals who do not even consider a flake to be an artifact.

Flake Mass and Shape

I do not intend to discuss flake mechanics or detail the various flake characteristics in this paper. This has been done elsewhere and by many authors. However, I do want to point out a couple of concepts, rarely discussed in the literature, that I believe are pertinent to a better understanding of the flake.

"Theoretical platform thickness and exterior platform angle allow for the comparison of all flakes (masses) regardless of their morphology" (Pelcin 1996:289). In different words, the mass and the shape of a flake are not related. For example, what is the width of the flake in Figure 1? There is no scale so it could be 3 centimeters wide or 10 centimeters wide. The reader would not question the size, because intuitively the reader knows the size of the flake is unrelated to its shape.

Figure 1

Figures 2 & 3 are a second example of the independence of mass and shape. Figure 2 depicts two blade-like flakes. The white one on the right has a damaged dorsal face at the proximal end (top), but its true length is represented because the ventral face is intact. With the aid of digital photography I have depicted these two side-by-side with equal lengths to show the similarity in their shape. However, in reality, the white one is the smaller of the two and this is evident in Figure 3. (Look at the top of the flake in Figure 3. The white one is on top of the brown one.)

Figure 2

Figure 3

Since mass and shape are independent, it follows that they are controlled by independent or different parameters. One of the most obvious parameters controlling **flake mass** is not-flake (core) mass. One cannot create a flake that is larger than its not-flake. In fact, from the definition of a flake, one cannot create a flake that is greater than 50% of its not-flake. So, not-flake mass sets an upper boundary for flake mass. After not-flake mass, platform thickness and external platform angle are almost solely responsible for flake mass. Flake mass increases with increasing platform thickness and/or external platform angle (Pelcin 1996:286).

Flake shape has no relation to mass. It is determined by the surface topology of the not-flake prior to the removal of the flake (Pelcin 1996:284). Consider an analogy of a stick. One can cut it into two pieces and have no effect on either end. The ends can be painted, carved, burnt, or whatever. These ends are pre-cut properties belonging to the original stick, and remain with the two fragments after the cutting is complete. Like the two pieces of the stick, the flake takes with it, on its dorsal face, a piece of its not-flake. If the not-flake face is flat, the flake's dorsal face will be flat. If the not-flake contains a straight, protruding ridge then there will be a straight, protruding ridge on the flake. What is not so intuitive is that the not-flake face topology controls the length-width ratio of the flake. Consider Table 1. As not-flake face topology moves from a flat face to an edge face, the flakes become longer and narrower. There are no discontinuities along this linearity so there is no logic to consider blades or burin spalls as anything other than long narrow flakes.

Table 1

Not-Flake Face Topology	L/W Ratio of Resulting Flake	Archaeological Examples
Perfectly flat, e.g. window glass	0.4-1.0	None. There are only modern examples made in the laboratory. See "Flakes on Flat Faces" (Winn 2003)
Slight domed or raised	1.0-1.5	Levallois
Slight ridge aligned perpendicular to platform	1.5-3.0	Folsom channel flakes and blade like flakes
Well-defined ridge that becomes more symmetrical and the peak more acute	3.0-9.0	Well-defined blades and micro-blades
Edge of flakes and bifaces	9.0-12.0	Burin Spalls

I have said nothing about the type of force application. The reason for this is that there is no measurable difference between pressure and percussion created flakes.[1] The reader may disagree with this statement and point out that percussion flakes are larger. This is true, but this is because their platforms are thicker. Humans do not have the strength in their hands to create flakes above a certain size with pressure. But, if they did, the flakes would be the same size as the percussion flakes. In fact, modern knappers have proved this by creating levered pressure devices, such as the Sollberger Jig, to increase their strength range and make larger pressure flakes. As a result, their products are the same size as percussion flakes for the same platform thickness.

Note 1

In this paragraph I said there was no measurable difference between pressure and percussion flakes. This is true of the flakes in the archaeological record. But, a difference can be detected on flat face flakes created in the laboratory. Pressure flakes from flat face not-flakes average around a L/W ratio of 1.0. Percussion flakes average around 0.5. At this writing I do not know the physical reason for this difference, which ceases to be detectable on non-flat not-flakes.

The Stepchild of Lithic Analysis

The poor perception of the flake that is held by most people is demonstrated in the following examples.

*In 1963 I asked my father to take me arrowhead hunting. This was the beginning of my life-long study of archaeology and more specifically, lithics. The arrowhead hunting process then, as it is now, was to walk the landscape looking for a flake. If a flake was found then the search was concentrated in that area. Ultimately, if sufficiently more flakes were found, a piece of an arrowhead was usually found. And, if we were really lucky, a whole arrowhead was found. The arrowhead was the goal. The flakes had no value other than as an indicator of where to search.

*An archaeological student sits at the kitchen table of an arrowhead collector of many years. One by one the collector brings out each arrowhead, or tray of arrowheads, and proudly tells the student where he found each one and its interesting characteristics. Even if the collector has both arrowheads and associated flakes, the collector will only bring out the arrowheads, never the flakes. He does this because he believes, and correctly so, that the student is primarily interested in the arrowheads.

*Take a tour of an archaeological depository that stores lithic material from excavated sites. At random, select a site and pick through the assemblage. What you will most likely find is that the not-flakes will have catalog numbers and be stored in their individual containers. The flakes will be stored together in sacks that represent their excavated squares and depths. Most likely the sacks will be the original ones that were sealed in the field and have not been opened since that time. If you open a sack, there will be no catalog numbers on the individual flakes, and the dirt will still be clinging to them. From the way the artifacts are curated, it is obvious that flakes represent little importance for the archaeologists.

*Take a trip to a university library and select a couple of site excavation reports from the stacks. Choose one from approximately 80 years ago and another from more recent times. In the older report there will most likely be little or no mention of flakes recovered. The more recent report might record the number of flakes found and possibly there will be some provenance with the counts. There might even be some further description like the percent of the flakes that have cortex. However, it will be painfully obvious that flakes are of a lesser interest to the author than the not-flakes

*During most any weekend in the summer there is a Knap-In somewhere in the United States. And, I suspect this is the same for many other locations around the world where there is a source of knappable rock. A Knap-In is a gathering of modern knappers who get together to break rocks and create stone art and tools. All skill ranges are usually represented and the most skilled individuals are the ones who can produce the thinnest bifaces or arrowheads. The beginners are the ones that can only make flakes. In a sense, anybody can make a flake, so flakes are not desired. Often they are dumped in the waste pile at the end of the Knap-In.

In the above examples I have tried to demonstrate that the flake is at the bottom of an unspoken hierarchy of importance. A hierarchy that is so ingrained and accepted by the archaeologist, collector, and knapper that few recognize its existence. Furthermore, this hierarchy exists worldwide. Consider Table 2, which is reproduced from a table in Grahame Clarke's second edition of World Prehistory (1969:31).

Table 2

Dominant lithic technologies	*Conventional divisions of the older Stone Age*
Mode 5: microlithic components of composite artifacts	Mesolithic
Mode 4: punch-struck blades with steep retouch	Advanced Palaeolithic
Mode 3: flake tools from prepared cores	Middle Palaeolithic
Mode 2: bifacially flaked hand-axes	Lower Palaeolithic
Mode 1: chopper-tools and flakes	Lower Palaeolithic

Only in Mode 1 are flakes listed as part of the technology. Are we to assume that flakes were not created in Modes 2-5? Of course, we don't. But, we do have a tendency to assume that the flake is only a byproduct of not-flake manufacture in Modes 2-5. From that follows the unspoken assumption that flakes were replaced by the not-flakes as the cutting and scraping tools of the more recent technologies.

I suggest that this hierarchy views the flake as only a shaving from the whittler's knife and nothing more. Some of the readers are going to challenge this statement and point out that Debitage Analysis is often performed on assemblages, and I will agree that it is. However, I will argue that Debitage Analysis is the study of flakes and not the study of **the flake**. Debitage Analysis is performed on aggregates of flakes or randomly selected, individual flakes that are intended to represent the assemblage. More importantly, the questions that Debitage Analysis answers concern the stages of reduction of the not-flake or the type of the not-flake being manufactured (Andrefsky 2001). Debitage Analysis is about the not-flake, and not about **the flake**. Refitting and Minimum Nodular Analysis are also concerned with flakes, but again the questions are about the not-flakes.

I believe that this hierarchy produces faulty interpretations of early lifeways. I suggest that in the minds of the original knappers, the flake was at the top of the hierarchy. The flake had an instant cutting edge that was always sharper than any reworked edge. Plus, it was quicker to manufacture a replacement flake than it was to resharpen a dull flake (Bamforth 1986:40).

For the next two paragraphs, let's suppose the flake was the desired product and not the by-product. Suppose the flake without modification was created to be a cutting and/or scraping tool. Now, suppose that when the flake became dull, it was replaced with a new flake in lieu of being resharpened. This behavior would have been possible in a lithic-rich environment. So what would archaeologists say about such a site? Would they notice the high ratio of large flakes to non-flakes?[2] Would they also notice the early-stage, discarded not-flakes (bifaces and/or blade cores), and assume they were broken along the manufacturing trajectory to a finished product? Would they connect these observations with the lithic-rich environment and conclude that the site was a quarry site? Would they conclude that only the knappers, which are often assumed to be the males, had visited this site for the sole purpose of non-flake manufacture and extraction? Would they look at the large flakes for the absence of use wear to support their conclusions?[3]

Note 2
When I discuss flakes as tools, I assume the flakes are large enough to be grasped or hafted. It is obvious there are many small flakes that are too small to be used as tools, and they are the true by-products of lithic reduction.

Note 3
Use wear in the form of random, dinged edges (distal edge of Figure 1) can be seen with the naked eye. Admittedly, not every flake will exhibit this type of use, but enough will so that it is easy to conclude that the flakes at the site were being used as tools.

At a different site, suppose the flake was still the desired product. Suppose the site is located in a lithic-poor region requiring all the knapping material to be transported many miles. At this site, when a flake becomes dull, suppose the user chooses to retouch it to conserve material instead of creating a new flake. So what would the archaeologists say about this site? Would they notice the lack of large flakes and at the same time be excited by the abundant number not-flakes? Would they notice that the material was exotic and conclude it had been imported into the site? Would they connect these facts and conclude that this site was a campsite where various forms of daily life were conducted by both sexes?

In 1986, Bamforth discussed the effects of lithic material availability on the context of lithic assemblages in his paper on curation. However, I was unaware of this concept as late as 1997. This is evident in my January 1977 webpage, "The Paleo End Scraper". A section in that paper was a discussion about the ratio of Paleo End Scrapers to Projectiles at various sites and an explanation for the differences. The explanation I offered was simply that a site with a high incidence of scrapers to projectiles was a campsite. Conversely, I argued that a low ratio of scrapers to projectiles was a kill site. The idea that this ratio might be affected by material availability never occurred to me.

By 2003, my "flake as crap" perspective had drastically changed. This enlightenment occurred because of the opportunity to study lithic assemblages from a lithic-rich region, which was the North Slope of Alaska. Prior to that time my experience had only been with lithic-poor regions of the Plains and Southwest. This paradigm revolution was first visible that year in the paper, "Contrasting the Lithic Technologies of Mesa and Folsom", which Mike Kunz and I presented at the SAA annual meeting. In this paper we argued that retouched and curated tools were associated with lithic-poor regions, and site type had little to do with tool assemblages. In 2004, I wrote the paper, "The Lithic Containers of the Archaeological Record", in which I argued that in lithic-rich regions the discarded bifaces, blade cores, and Levallois cores were the by-product of flake extraction. I then followed with my "Acheulean Handaxe" paper in 2006. Here I again argued that the handaxe was not the desired end product, but just a biface and the by-product of flake extraction. Now, I have written this paper, which also argues that the flake was the desired product of lithic reduction.

Conclusion

My plea to the reader is not a plea to create more work. I do not advocate that each flake be measured, weighed, described and photographed. In fact, I oppose this type of effort with the flake and the not-flake. One gets a great sense of hard work and accomplishment with weighing and measuring, but without a question to be answered, this is a waste of time. My plea to the reader is to raise the flake to the top of the hierarchy of importance when thinking about assemblages. Are tool size flakes present? Why or why not? If yes, do they have evidence of use wear? Why or why not? Are they of local or imported material? These are the types of questions that should be asked and answered if a truer assessment of the activities at a site is to be gleaned.

As I thought about this paper and the concepts I wanted to include in it, I kept asking myself, "when did the flake cease being the primary objective of lithic reduction?" The answer that kept coming to me was "it never did." The flake has always been the desired product from the Lower Paleolithic up to the development of agriculture. This concept crosscuts hominid types, continents, and cultures. The flake was the universal desired tool of all critters that depended on breaking stones to survive and prosper. If the reader accepts this, then a number of theorems or theories follow from it. Assuming all other things are equal, these are:

*Frequency of flakes is greatest in lithic-rich environments. The corollary is the frequency of non-flakes is greatest in lithic-poor environments.
*Less intelligent hominids located themselves in lithic-rich environments.
*Lithic-rich environments were populated first.
*Populations at any given time were greatest in lithic-rich environments.

I will close by suggesting that if one finds contradictory evidence to the above four theories in the archaeological record, then this is an anomaly; an anomaly requiring in-depth investigation and explanation.

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