

# Flint Knapping: Pressure Flaking



*Photo courtesy of F. Scott Crawford*

*Compiled/Edited by Michael Lynn*



*Photo of Tim Dillard teaching me at the  
Center for American Archaeology in Kampsville, IL*

Dedicated to all those who have taught someone else about the art of flint knapping, especially to my primary teachers – Bruce Boda, Tim Dillard, Mike McGrath and Steve Nissly. This is my attempt to pay forward.

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# Small Point Pressure Flaking

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**Small Point Pressure Flaking; Edge Preparation Makes It Possible To Drive Flakes Beyond The Mid-Line, Thinning The Preform.**

Here we see the first sequence of pressure flakes on the smooth face of the chip. This surface usually has some curve across the face. Thinning flakes on smooth, curved material, tend to reach across the face nicely. I place the tip of the tool against the edge and build up the load of pressure. Then, snap the tip down while keeping pressure loaded. The flake travels in the line of the force at the instant the break initiates. So, I want the pressure to be reaching toward the opposite edge to produce a long flake removal.

1. Trimming edge to prepare pressure platform.
2. Thick area below the line to be removed.
3. Grinding to prepare the platform at the edge.
4. Pressure on the platform edge in the thick area.
5. The resulting flake stays on the smooth surface.
6. Trimmed and ground opposite edge.
7. Pressure at this second flake removal near the tip.
8. Resulting flake scar near the tip of the preform.

From <http://www.arrowhead-makeyourown.com/>, April 6, 2010, copied with permission from "How to Make Your Own Arrowheads"

# From Beer Bottle to Arrowhead

By Tim Rast

This page describes how to knap an arrowhead out of a beer bottle bottom. This includes breaking a bottle and working with extremely sharp broken glass.

**YOU CAN BE CUT AND SERIOUSLY INJURED.**

**GOGGLES MUST BE WORN AT ALL TIMES.**

**Kids, ASK YOUR PARENTS TO READ THIS PAGE BEFORE YOU TRY MAKING AN ARROWHEAD.**

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Ingredients (required):

1 Beer Bottle (empty)

1 Hammerstone

1 Pressure Flaker

1 Notching tool

1 Leather Palm Pad (or heavy denim substitute)

1 Pair Goggles

1 Pair Heavy Leather Gloves

1 LARGE box band-aids

recommended:

1 hammer

1 tarp

1 file (for sharpening the pressure flaker)

1 abrading stone

1 dustpan

1 broom

## Step 1: Selecting the Bottle

Don't overlook the importance of this first step, finding a good bottle to start with will determine how successful your knapping attempt will be. The best part of the bottle to use is the bottom, because the glass tends to be thicker than the sides of the bottle, and much less curved. So when picking your bottle, pay special attention to the bottom.

1. **Colored glass is better than clear glass.** Its very difficult to see what you are working on when you work clear glass. Amber or green glass bottles work well
2. **Flat bottoms are crucial.** Wine bottles with big kick-ups are not good for knapping. Most bottles have some curvature to the bottom - its best to avoid noticeable concave bottomed bottles in favour of flatter bottoms. (This may entail switching brands of beer - so the decision is not always an easy one)
3. **Avoid bottoms with elaborate embossed markings,** like makers marks, numbers, or other designs. These lumps and bumps can be tricky to get rid of.
4. **Begin with a smaller beer bottle before you try a larger flat bottomed wine bottle.** They are less difficult to hold and its easier to cover a smaller surface with flakes than a larger one. You can work up to wine bottles.

## Step 2: Breaking the Bottle

Now you are going to need to break the beer bottle. You want to break it in such a way that the bottom will not be broken. Throwing it against a wall or rock is NOT a good way to start as the bottom is likely to break. Try wrapping it up in a corner of your tarp or a very heavy plastic bag and hitting the shoulder of the bottle with the hammer. NOTE: Wrapping the bottle up like this contains the mess, it does NOT protect you from the broken glass - The breaking glass can cut through the tarp and plastic bag quite easily. **WEAR HEAVY LEATHER GLOVES.**

Its easier to break a bottle by hitting it in the middle, but you have a greater chance of breaking the bottom if you hit it there, so strike the shoulder. If you don't have a hammer, try a hammer stone. Be very careful.

Alternatively, it is possible to cleanly pop the bottom off of a bottle by putting a nail into it (tip down) and shaking it straight up and down with your thumb over the mouth of the bottle. A bigger nail is necessary for wine bottles. I use a round file as a substitute. If successful, the bottom of the bottle will pop out as a sharp glass disc.

## Step 3: Cleaning the Hanging Glass off the Bottom

Unwrap your broken bottle. Hopefully the bottom will be in one piece. If it is, it will likely still be attached to sharp glass from the sides of the bottle. You will need to trim these hanging shards off, so that you have a nice flat bottom to work with. Hold the bottom upside down so that the shards hang down. **HOLD THE BOTTOM WITH LEATHER GLOVES OR WITH YOUR LEATHER PALM PAD.** Brush the hanging glass off with your hammerstone or the hammer. If you have a stubborn shard, try changing the angle you are holding the piece before you try striking harder. Don't brush too much, you just want the bottom to be flat - too much brushing will make nasty step fractures. Step fractures are failed flakes which break and end with straight edges, rather than gently feathering out. When you are done, look at the bottom and you will see "dents" on the inside of the bottle where you broke the hanging shards off. These dents are *flake scars*.

## Step 4: The Serpentine Edge - Alternate Flaking

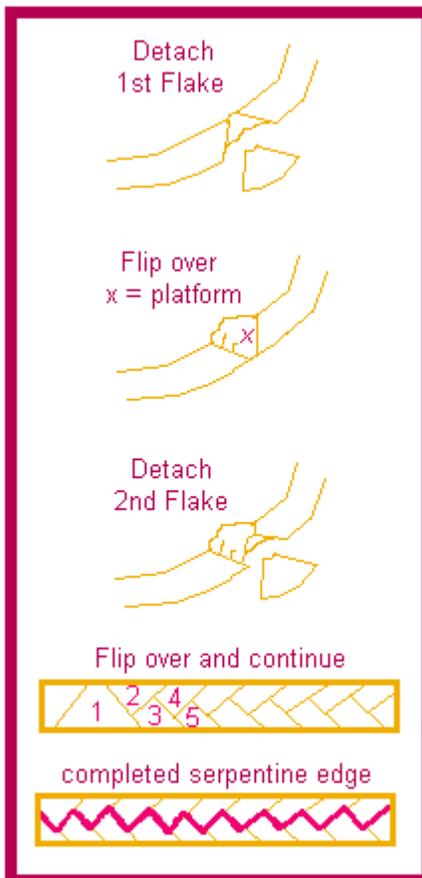
Now the fun begins! To knap an arrowhead out of a bottle bottom you need to 1) make a bifacial edge, 2) cover both faces with flakes, 3) shape it, and 4) notch it (optional). Points 2 & 3 will be discussed in the next section, and you don't have to worry about notching yet. We are going to start by making a bifacial edge all the way around the bottle bottom. A *bifacial edge* is an edge which has been worked on both (bi-) sides or faces. Look at your bottle bottom. If you followed the instructions in step 3, you will only have flakes scars from removed hanging shards on the inside of the bottle bottom, and none on the outside. Pieces worked only on one side are called *unifacial*.



Ok, lay the bottle bottom flat in the leather pad in the palm of your left hand (if you are right handed), and clamp your fingers down on top, to firmly hold the glass. It doesn't matter which side is up or down, just make sure that the edge you want to start working is exposed. You should have a little sandwich in your hand which goes; fingers, leather, glass, leather, palm. Now rest the back of that hand against the inside of your left knee for support. Using your copper flaker, you want to push down on the edge and detach a flake from the underside of the glass. Don't pry the flake off, push it off. You really have to push hard to get a flake to come off. If detaching the flake hurts or bruises your palm, double or triple up your leather palm pad.



The flake removed will look something like a little half cone, and the flake scar will be a negative cone. You can fit the flake back into the scar to see what I mean by a *positive cone* (flake) and *negative cone* (flake scar). Ok, put your flake somewhere that people won't step on it and get back to your bottle bottom.



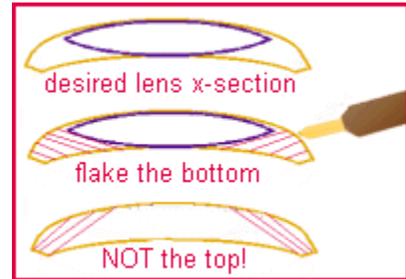
Flip the glass over so that the flake scar that was on the bottom is now on the top. You will use that flake scar as the platform for your next flake. The *platform* is the place where you place the tip of the flaker to push a flake off. You want to place the tip of the flaker to the left or right of the center of the flake scar, so that the next flake you remove will be off to one side of this first flake. Again, push down with the flaker and take another flake off. What you should have now is a bottle bottom, with two flake scars: one on each face. Now flip the glass over again and use the flake scar left from the second flake removal to remove a third flake. Continue to alternate flake around the entire edge of the bottle. When you are done you will have a wavy, bifacial serpentine edge!

### Step 5: Shaping

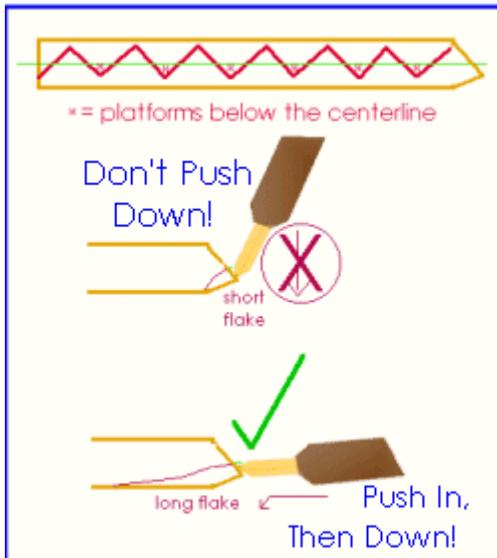
Now you have a wickedly sharp, bifacially worked bottle bottom. It doesn't look anything like an arrowhead yet - why? Its not shaped like one, either in cross-section or outline. The flake scars are only around the edge, they don't cover the face of the glass yet. You need to pressure flake it into shape. To do this, you need to change strategies a little. Instead of taking short chunky flakes off, like you did to make the serpentine edge, you need to take long, flat flakes off, which cover the faces of the bottle bottom, not just the edges. To do this, you change the angle you are flaking. Instead of pushing down, you want to push into the glass.

## Shaping - Cross-section

If you look at your beer bottle bottom from the side, you will see that it is now, more or less, hexagonal. It has two flat faces and steep bevelled edges. It will also have a slight curvature to it, with a concavity on the bottom face and a slightly convex top surface. Arrowheads are, most often, lens shaped in cross-section. To achieve this lens shape, you need to get rid of all the concave curvature of the glass. In the process you will also be covering the blank faces with attractive flake scars. Most of the work you need to do is on the bottom, concave side of the glass. It will be very tempting to remove flakes from the upper, convex side because flakes love to travel across convex surfaces. The flakes you remove from the bottom will be very short by comparison, but that's okay. They will get longer as you work at removing the curvature of the glass. Taking beautiful long flakes off of the upper, convex side of the glass will only make the curvature worse.



To remove the cross-section shaping flakes you will need to use the serpentine edge you've created. Creating the serpentine edge has made a whole series of platforms. The wavy edge zigzags up and down across the centerline of the edge. This is important. Your edge has peaks which are above the centerline and valleys which are below the centerline. (Check Wyatt Knapp's discussion of the "Below the Centerline Concept" for more detail) Your edge looks something like this:  $\wedge\wedge\wedge\wedge\wedge$  You use the valleys as platforms to take off flakes. Look at you glass and find the peaks and valleys. The valleys are the platforms. Imagine the centerline. Now flip it over. Find the peaks and valleys. Find the platforms.

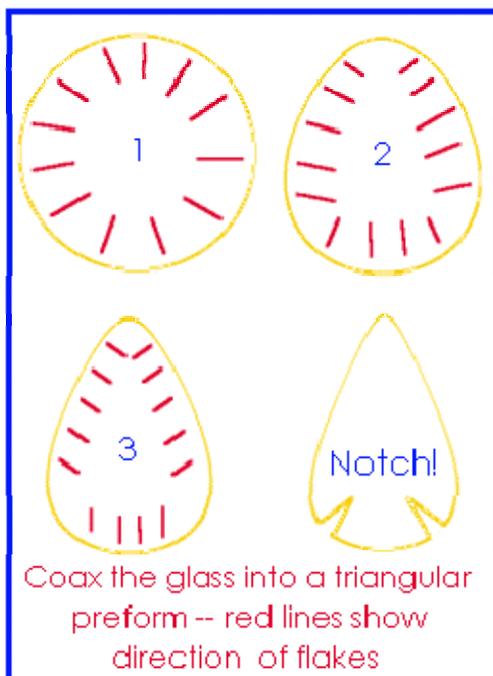


Hold the bottom in your hand, the same as when you made the bifacial serpentine edge. Make sure that the concave face is on the bottom. Find the peaks and valleys. Place the flaker tip against one of the valleys. Instead of pushing down, push into the glass. Push hard, build up a force and then push down a little to detach the flake. Remember push in, then down. Don't flip the glass over. Instead, move to the next valley and remove your next flake. Go all the way around. Then do it again. Don't be discouraged if your flakes aren't very long. You may have to go around the glass 3 or 4 or 5 times before the flakes reach all the way to the center. Everyone's flakes are short the first time around.

As you knap, your edge will get higher and your platforms (the valleys) will become less pronounced. So you will have to make new ones. You can do this a couple of different ways. One way is to use the tip of your flaker to brush up on the edge. This will remove tiny flakes from the upper surface of the edge (WEAR GOGGLES!). This will get rid of the thin brittle

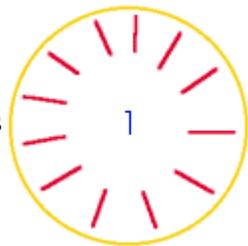
edge, making it stronger and lower. The second way to make new platforms is to grind the edge with an abrading stone. I just use one of my hammerstones. Again, you want to prepare your platforms in the opposite direction that you are flaking. Flip the glass over, so that the face you want to flake is facing up and brush the edge, in a downward motion, with your abrader stone. Flip the glass back over, look for the platforms below the centerline, and keep knapping.

Keep this up until you achieve the desired lens shape. Remember to spend most of your time removing flakes from the concave side. It won't take you very long to cover the convex side with flake scars.



### Shaping - Outline

While you are working on the lens shaped cross-section, you will also want to coax your bottle bottom into an arrowhead shape. There are no hard and fast rules for shaping the outline of your arrowhead. If the bottle bottom is circular you can arbitrarily select a pointy end and a base end. Gradually change your circular bottle bottom into a triangle. If your glass is not perfectly round, look for the longest axis, and align your triangle along that. The first step is to stop thinking about the bottle as a circle and start thinking of it as a chubby triangle. Instead of working around and around in a spiral, work from three directions - in from the two sides of your arrowhead and up from the base. When you abrade your platforms, keep the triangle in mind and work towards that goal.



## **Step 6: Notching**

Wow! You made it - you have a lens-shaped triangular arrowhead. All you have left to do is notch it! The notching tools I typically use are sections of coat hanger mounted in broom handles, which have been filed to a chisel shape or copper wire which has been hammered flat (see the Pressure Flaker Page). Pick the point on the edge of the arrowhead where you want to start your notch. Use your notching tool to create a little nick in the edge, the same way you made your first flake on your serpentine edge. Flip it over. Take another flake off in the same place you took the first little flake off. Flip it over and keep doing it. It's the same sort of process as you used to make the serpentine edge, except you are flaking straight into the body of the piece instead of around the edge. Repeat the process for your second notch.

Tip: I like to make both notches at the same time, rather than finishing one and starting on the second one. I find that they turn out more uniform if I work on them together.

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From: <http://www.cavemanchemistry.com/oldcave/projects/stone/bottle.html>, April 2, 2010, copied with permission

# How to Make Your Own Arrowhead

F. Scott Crawford © 2008. All rights reserved.

## “So Easy The Cavemen Did It ... For Thousands Of Years” ... So Can You, With Practice.

Actually, ancestors of all of us used stone for hunting weapons for a very long time. The use of metal only replaced sharpened stone, bone and wood in the last few thousands of years. And then, in most of the world, the knowledge of “flint knapping” became a lost art. It wasn’t until the Europeans came to the Americas that Old World eyes once again realized the efficiency of stone arrow heads and knife blades.

### MAKING YOUR OWN STONE ARROWHEAD

All knapping begins with a piece of stone. Then you break away the parts of the stone which do not fit the idea you have in mind for the final product. This process is called reduction. The thing is, that once you break a piece off of a stone, you can not put it back. Unlike clay or metal, which can be reshaped, a stone tool is not moldable or bendable or malleable. You break it to change its shape.

To break stone you must obey the laws of physics. I think observant flint knappers first codified knowledge of the physical laws which provide order and predictability to the world around us. Much was discovered by trial and error, and then passed on to students from the masters of stone craft.

For the beginning knapper, making an arrowhead usually begins with a flake of stone. When you order the Knapping Kit from <http://www.StoneBreaker-FSC.net>, it supplies several flakes, or chips, of stone such as obsidian and flint. These may include chert from Oklahoma, novaculite from Arkansas, or flint from Texas, and obsidian from Oregon.

### STEP ONE

Select a chip from the materials in the kit. Also pick up the leather hand pad. It goes in either your left or right hand, as is appropriate, to protect the palm of your hand from small pieces which you will break off the chip. In addition, you will need either the antler tine or the copper tipped flaking tool. You can work on a bench top if you prefer,



Here is the rough raw outline for the arrowhead on the opposite page, laid out on the chip from which it was made.



These arrowheads were made from the flakes in the corresponding position in the scan on the other page. Three of the chips were not made into arrowheads at the time the scans were produced. As you can see, the one brown chip became a broken point, when I applied too much pressure during the flaking procedure. As that examination shows: the edge preparation prior to pressure flaking the opposite side of the trimmed point.

These scans of obsidian flakes and arrowheads show the beginning condition of the flakes, with both sides clean on these two flakes immediately left of this set. You can readily see the smooth side of the flakes, which is the fresh fracture and the ridged side of the flake. The ridges are made by the scars of previously removed flakes off the original obsidian nodule. You can also see the extremely thin parts of the chip along the edge, the parts which need to be trimmed prior to making an arrowhead.

arrowhead. When you look at the smooth underside of the flake you will see a bulbous shape, rounded and slightly higher than most of the flake surface, radiating away from the spot where the stone was struck to knock the chip off the stone. This is called the bulb of percussion.

Usually arrowheads are made with the pointed end at the bulb of percussion, and the base with its notches is located at the other end of the flake. The secret is to use the portion of the flake which is essentially straight. Flakes naturally have some curve, as the chip follows the contour of the original stone surface. Yet, if you look at the flake in profile, from the side along the lengthwise direction of the flake, you can see the natural curve, and you can see what portion of the chip could be used, allowing a straight line to the arrowhead.

### STEP THREE

Now, we will use the antler, tine to trim the chip to the general shape for the arrowhead. Lay the chip on the leather pad on your work bench. Place the smooth surface down.

Then use the side of the narrow end of the tine to begin pressing at the thin edges, along the length of the flake, in a shearing motion along the edge. Hold the antler tine basically parallel with the edge and press down along the edge with the side of the antler. Do not overlap the edge except for a tiny distance, and press down along the edge, breaking off small pieces to trim the thin, curved edges into a straighter line leaving a thicker amount of material along the edge. Just press enough to break small pieces off. You will need to hold the flake in place, but do not press down on it too much, as you can break it. Odds are, you will break some flakes; that is why I am providing 12 flakes in the kit.

This trimming action can quickly provide a flake in nearly the size and shape of your finished point. You can trim it to straight edges in a triangular shape, or to curved edges in more of an oval configuration. Turn the base to fit your shape.

the ridge. This process is called pressure flaking.

This is the primary kind of force which is used to create an arrowhead from a chip of stone. Once you choose a chip, then we will proceed to prepare the edges of the flake so that you can apply pressure along the edge and push off small flakes.

### STEP TWO

Choose which end of the flake you wish to be the point of the

stone. By harnessing this characteristic of knappable stone, we are able to break the stone in a controlled and intentional manner. The same rules of stone breaking at a large size apply to working with smaller pieces of stone. The only difference is a matter of scale. In addition to striking with a hammer stone, by applying pressure at the edge of the stone, at the beginning of a ridge line, we can “push” off a flake along

Now, look at the chip. You will see that one side is smooth, and the other side has some ridges. The chip illustrates how this kind of stone breaks during the knapping process. When obsidian, or flint or chert or the other fine grained quartz stones are struck with a hammer stone or other implement at the correct angle, the resulting curved flake or chip will tend to follow the ridges on the face of the

so you can stand, or you can work in your hand and sit down. For the first time or two you may find working on a bench gives you better visibility and control.

### First, a word about safety.

Use safety glasses and wear leather gloves. Work in an open, well-ventilated area when knapping, preferably outdoors. Flaked stone is sharp. That is the point. Be careful with flakes, chips and tools. Always have a first aid kit at hand.

#### STEP FOUR

Next, you can use either the antler tine or the copper tipped flaking tool to begin sharpening your arrowhead. First, lay the flake down on the leather pad, to support the flake. This should be done so that the smooth face of the chip up, so that the new flake will be removed from the sanded face of the chip. This will allow you to press against the protruding or landing edge of the stone. You will place the point of the tool against this outer edge. But first, you should roughen or grind this edge a little by rubbing the side of the antler tine or a hard, slightly rough stone along the edge. This will rough up the sharp edge, providing better gripping surface for your tool.

Now, hold the piece in position with two or three fingers. Do not press too hard, just enough to keep it in position. Press the pointed tip of the tool against the edge. Generally, this first flake should be taken off at or near the tip end of the point. The force should basically parallel the face of the chip, aimed toward the center line of the chip. Press against the roughened edge and then push a new flake off of the bottom face of the chip.

It takes a bit of pressure, against the edge, not against the face of the flake. You are essentially prying or pushing a small flake off the chip, running from the edge toward the middle of the chip.

After the flake comes off, run over the point so you can see what happened. Your objective is a flake which runs to or beyond the centerline of the rough point. Many times the first flake may be short, but it will produce an edge along which your next flake will travel more easily.

For the second flake, move a little ways down along the edge and repeat the pressure process, overlapping the previous flake a little, so that the next flake will run along the edge left by the first.

Do not press down on the chip too much while you are pressing against the side. Just enough to hold it in position. Too much pressure and you can break the chip at the

place where you are prying off a new flake. I know, as I have done this more times than I like to admit. It takes practice. And to know how much is not too much pressure, will also take practice and experience.

This includes breaking an unknown number of points in the process! Now, continue to remove additional flakes in progression along the edge toward the base of the point. Once you have worked your way along one edge, then work along the other edge on the same surface of the arrowhead. When you finish this side, you have what is known as a unilaterally worked arrowhead. These are often found, where the stone craftsman only flaked the point or blade on one face, and left the other side as a smooth surface, with little or no additional flaking on that side.

**STEP FIVE**  
Prepare the second surface of the point for pressure flaking by trimming along the new edges. First remove the small triangular protruding edges between the new flakes. These are called "detritus" because of their shape. To remove them, press against their outer edge with the tip of your flaking tool. Just enough to break off the little tangles. Then use a shearing motion along the new edge again, in a motion parallel to the edge, pressing from the smooth face, just along the very edge. Just turn off a little bit of the thin edge, leaving a strengthened edge for additional pressure flaking toward the smooth face of the point.

Next grind or roughen up this edge line as you did before with the other side. This gives you flaking tool a better grip at the edge. Repeat the pressure flaking process along the smooth face, beginning at the tip again, and working toward the base.

Now you have a basic triangular or oval shaped arrowhead.

#### STEP SIX

In ancient times, in many parts of the world, you would now be finished. These points were bound into either a split shaft, with glue and/or plant or animal fiber, or into a hollow shaft such as a reed with

glue and fiber. However, many points were also notched to facilitate the binding process.

So, you may wish to notch your arrowhead.

There are many different styles and methods. Side notch, corner notch, base notch, etc. Yet all basically remove material from the edge toward the middle, to make a groove or notch for binding.

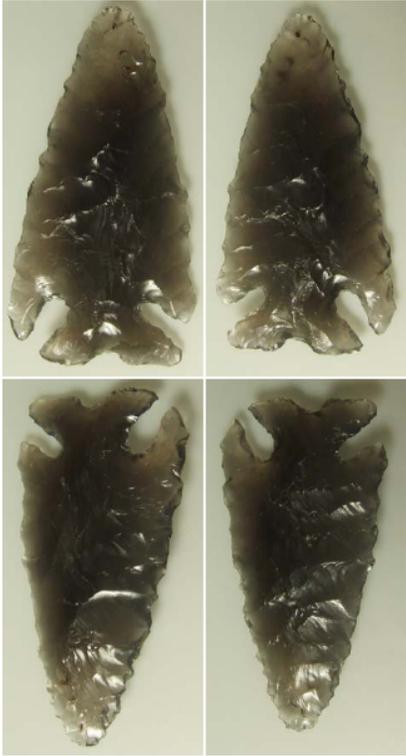
The process is similar to prep-paring for pressure flaking, except that you will do this at just two places, in mirrored positions across from each other so that the point remains balanced and symmetrical.

First, measure where you want the notches, equally up the edge from the base or from the centerline along the base edge of the point, or at the corners. Make a tiny flake at the edge where you want the first notch. Then mark the other.

Use the sharp tip of the copper flaker to rough up the edge inside this marking notch. Just enough to get a grip with the tip. Push a flake off the underside of the point from the marking notch in the direction you want the finished notch to proceed. Turn the point over, rough up the edge of the notch and push another directional flake off from the other side. Repeat this channel flake process at the marking notch for the second notch. This will give you a series of guides for finishing the notches.

Now, turn in the end of the guide channel to create an edge to press out the next flake in the notch. You rough up the edge from one face of the point, then turn the point over to press the new notch flake off by prying against the newly roughened edge. Repeat on each notch until you have the notch you want. Do not allow the tool to touch the corners of the notch when you press inside the notch, as this will break off the corners of the notch, or more. Many knappers work a little on one notch, then the other, so that both notches progress evenly toward completion.

Voilà! You have finished your own arrowhead. Congratulations. Now, do it again. Enjoy.  
<http://www.StoneBreaker-FYC.net>



## Here Are Several Examples Of Authentic, Ancient Arrowheads From Oregon ... So You Can See Some Point Designs & The Stone Materials Actually Used Long Ago.





1. Keokuk Chert chip, bulb of percussion is on the left end. Stone from Oklahoma.



5. Using the side of the antler tine to trim the edge to shape, in a shearing motion.



9. Next flake removed, you can see that the flake broke into a few smaller pieces.



2. Keokuk Chert chip, outer surface of the flake.



6. Holding in position to pressure flake; edge is trimmed and ground for tool grip.



10. Turn the chip over after each flake removal, so you can see the results.



3. Rough trim along both long edges and across the base, to general shape.



7. See where the first few flakes have been pressed off near the tip end of the chip.



11. First run of flake removals along this edge is complete. Examine your work.



4. Using the side of the copper tip to trim the edge to shape, in a shearing motion.



8. Copper tipped flaker in position for next flake removal by pressure.



12. The removal of the flakes takes away most of the edge trim, as you can see.



13. Now the first pass along the other side has been completed. Whole side smoother.



17. A look at the smooth side of the point, while still working rough side, pass two.



21. First full pressure flaking pass along one edge of smooth surface.



14. After the new edge is trimmed again and ground for your tool to get good grip.



18. On rough side, completed second pass along second edge, see the "deltas" at edge.



22. First full pressure flaking pass along second edge of smooth surface.



15. Remove a few flakes to thin the bulb of percussion, and straighten the point.



19. On rough side, "deltas" removed, edge trimmed, preparing for smooth side flaking.



23. First full pressure flaking pass along base end of smooth surface.



16. Trimmed, and a second pass along the first side, removing the rough ridges.



20. Edge trimmed and ground, ready for smooth side pressure flaking.



24. Midway through full pressure flaking pass along second edge of rough surface.



25. Early in second full pressure flaking thinning pass, first edge of rough surface.



29. The rougher side, after another good run of thinning flakes along both edges.



33. This pass of thinning pressure flakes at the base of smooth side, too.



26. Fracture occurred from too much pressure, where chip was curved, also.



30. The smooth side, ready for another pass of thinning flakes along each edge.



34. Base of the rough side of point, prepared for thinning pressure flakes.



27. Trimmed to a new point, straighter now, ready for more thinning flakes.



31. The smooth side, after this pass of thinning flakes along the lower edge.



35. Base of the rough side of the point, after a series of thinning pressure flakes.



28. A view of the rougher side, before more thinning flakes will be removed.



32. Midway through this pass of thinning pressure flakes along the upper edge.



36. Base of the smooth side of the point, after a series of thinning pressure flakes.



37. Base of the rough side of the point, corners trimmed for notching process.



39. Rough side, notches completed, base trimmed for attachment to dart shaft.



40. On the smooth side, notches are completed, base is trimmed to finish shape.



38. On the smooth side of the point, long guide flake in upper corner, for notching.



42. On the originally rough side of the arrowhead, the notches are done, the base is trimmed to its finished shape, and a final trimming series of flakes balances the point.

\$9.95, U.S. postpaid.  
\$10.45, Canada postpaid.

From <http://www.arrowhead-maker.com/>, April 6, 2010, copied with permission

# Using Your Legs When Pressure Flaking

F Scott Crawford © 2009 All rights reserved

## Learning To Use Your Legs Provides Extra Power And Drive To Increase The Success Of Your Pressure Flaking Efforts.

I hold the chip in the palm of my left hand, on a leather pad. I seat the back of my left hand securely against my left thigh, close to my knee, for support.

My right hand is supported against my right thigh. I press the tip of the flaking tool tightly against the ground edge. And I hold the handle of the pressure flaker flat against the palm of my right hand.

By squeezing my legs together, I apply pressure at the tool tip into the mass of the material, with an orientation toward the underside face of the chip, reaching out toward the opposite edge.

While I squeeze my legs together, I also hold my right wrist straight and stiff, to keep the pressure of my right leg all concentrated in the tip of the pressure flaking tool, against the platform edge on the stone. *(Continued ...)*



1. Pressure on prepared edge for rough side flakes.



2. Inspecting the large flake scar on the rough side.



3. Pressure to remove flake near the tip of the point.



4. Another large flake scar, just before the tip.

# Why Use Your Legs In Pressure Flaking? Most People Have A Lot More Available Muscle Power In Their Legs Than Their Arms.

(Continues ...)

While the pressure is fully built up or "loaded", I snap or flick my wrist to initiate the fracture which pushes a flake from the underside of the stone chip.

As the flake releases, the pressure is still on the base of the flake. This helps cause the flake to continue breaking away from the stone, as long as the pressure

is maintained. Of course, this happens in an instant.

The "crack" of the breaking stone is a welcome sound, and an indication of a successful effort.

In the follow through the pressure flaker should land basically in a flat position against the leather pad, not pointing in to the pad. This final position also helps to protect your hand.



5. Ground platform on the opposite edge rough side.



6. Inspecting result of pressure flaking near the tip.



7. A new flake has just released under the chip.



8. Here is the flake scar of the previous photograph.

From <http://www.arrowhead-makeyourown.com/>, April 6, 2010, copied with permission from "How to Make Your Own Arrowheads"

# Why Pressure Flakes Fall Short

by Mark Bracken

There are several things to consider when your flakes fall short of your target or don't run as far as you want. All these tips below are complimentary to each other. They all pieces to the puzzle, they are all important.

1. The first is your **flake path**. What I mean is that you have to choose proper places on the bi-face that lend themselves to longer flakes. These generally are the highest places on the surface of the bi-face or preform. You must be sure that your choosing ridges and or humps to "guide" the flakes down.
2. The second thing is that you have to **grind** or buff up the edge with your abrading stone just enough to support the pressure your applying to the edge. Too much and it will take excessive force to generate a flake leaving you with a broken preform or a sprained wrist. If you do not grind enough, the edge can crush or create a small chip.
3. The third is that there is quite a bit of "body English" or **follow through** with the pressure flaker's or Ishi stick's use. What I mean is that when you peel a potato with a peeler, you follow the contour of the potato. This is because you want to create a shaving that is all one piece. This saves time and effort. So, with using the pressure flaker it is no different. You must guide the flaker in the same way. Place the flaker on the edge and slowly build up pressure, then as the flake begins to detach, with a "peeling" action guide the tool tip with a following through action.
4. The fourth thing is that flakes will travel farther if they are pushed in a **oblique** manner. (remember this critical rule...do not chip flakes down a surface that is concaved. It must have some amount of convexity.) If you can... try not to push them straight into the piece. (or a 90 degree angle from the edge) Flakes will rarely cross the center line on the piece.
5. The fifth thing is to **work in a row**. Like shelling corn of a corn cob. Start at the base or tip (depending on the way your holding it) and chip the flakes off in a row. Each flake following the other's scar. Sometimes you will need to skip an area because there is not a good path for the flake to travel on. With each pass down the preform it will become more uniform with less and less high spots.
6. Keep your flaker **sharp**! Your flaker tip can be a number of different types, paddle, flat, chisel, Pounded round to a point, or pounded round to a point with four square edges. The key thing here is that your contact area must be at a minimum. You can't do good pressure work with a dull flaker point. Remember to pound your copper tips NOT grind them. They will stay nice and hard. It's common for it to be necessary to re sharpen a flaker tip many times before the piece is finished.

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From [http://www.flintknappingtools.com/flaking\\_tips.html](http://www.flintknappingtools.com/flaking_tips.html), March 31, 2010, copied with permission

# Slab Knapping Tutorial

By Mike Tylzynski (aka Idaho Clovisman)

"ok i will go out and turn the edge on a slab and post a picture..give me a few min..hope this helps now once you tell me you got this part i will show you the same slab set up for a complete pass..

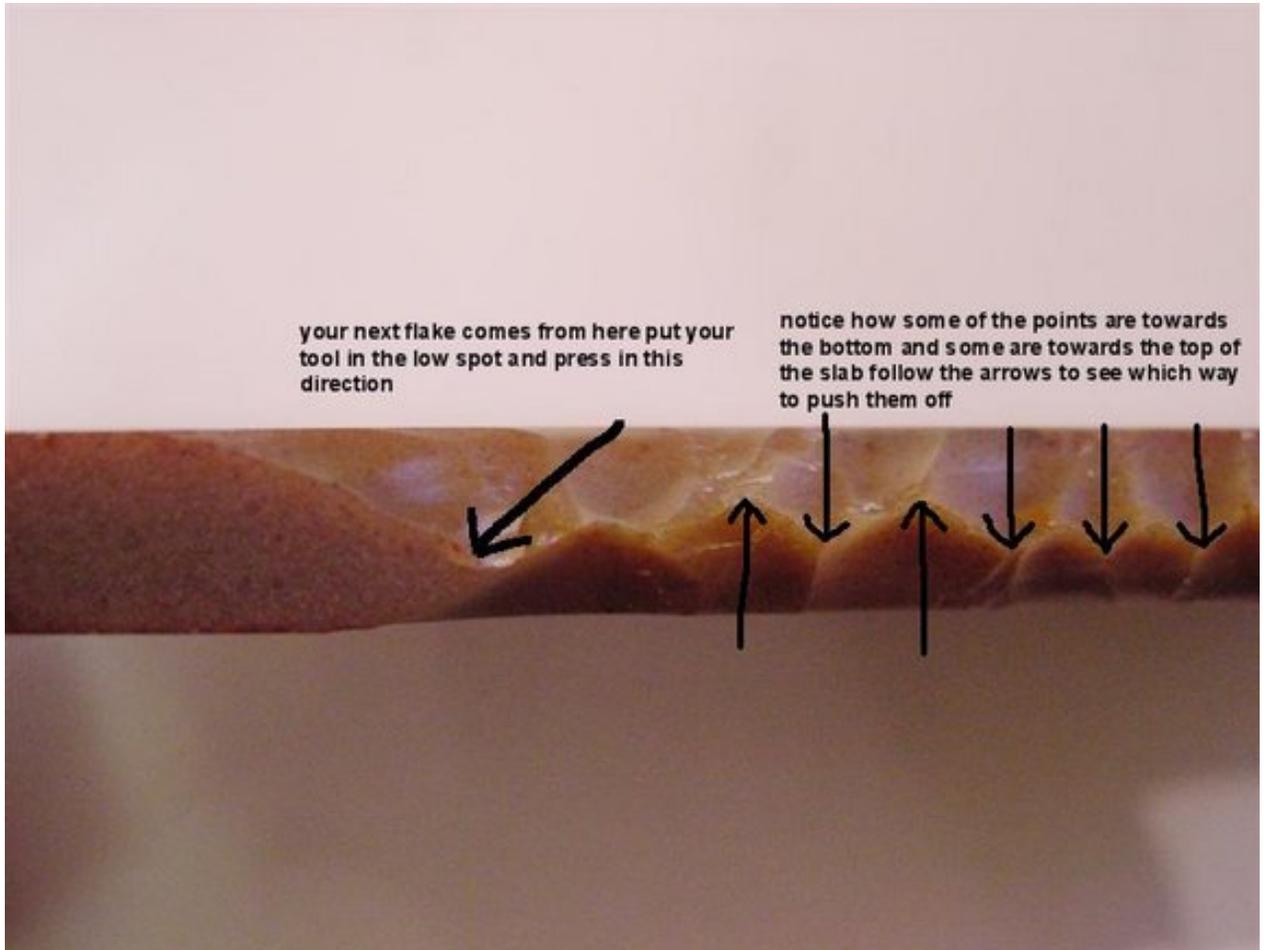


Figure 1

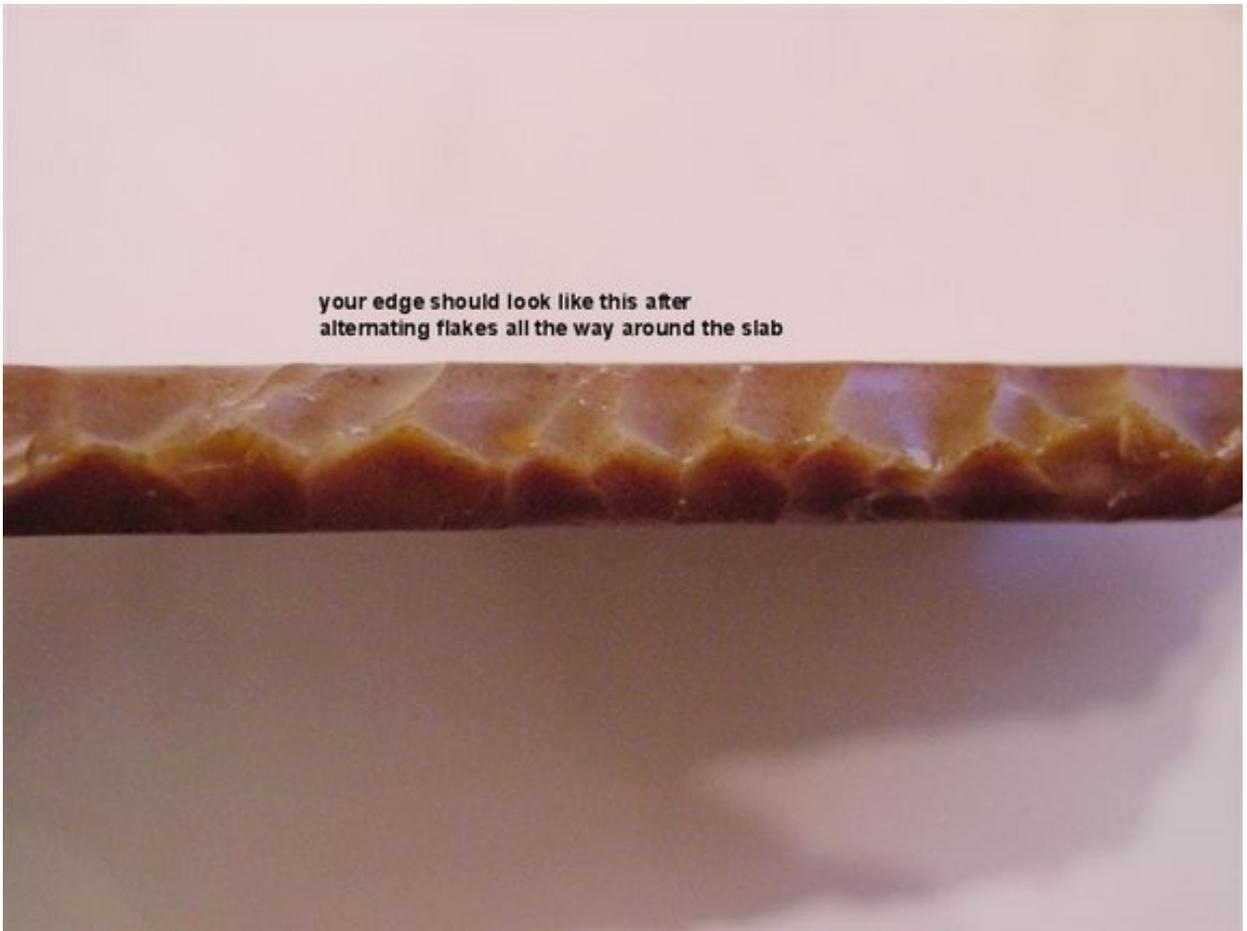
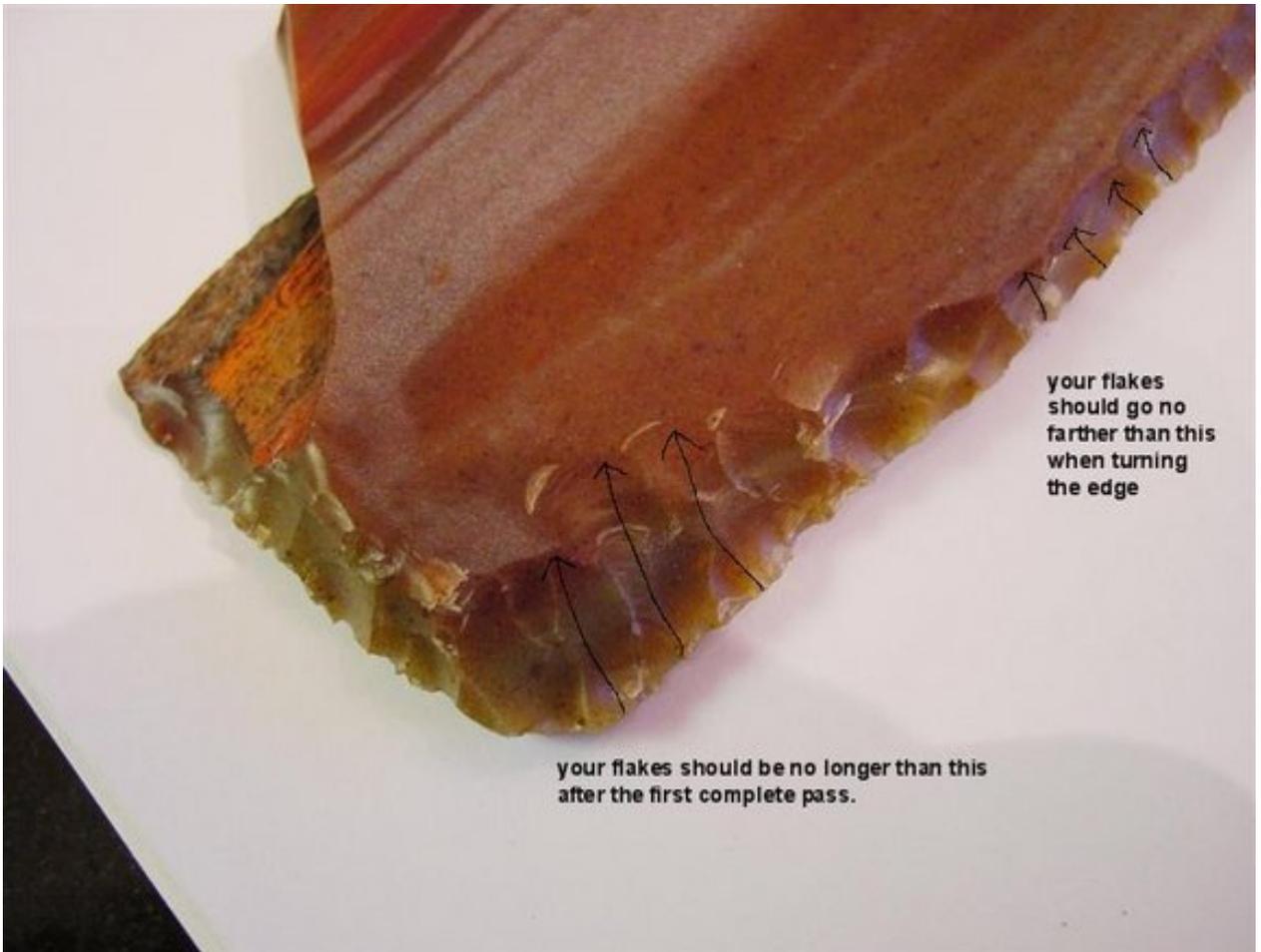


Figure 2



your flakes should go no farther than this when turning the edge

your flakes should be no longer than this after the first complete pass.

Figure 3



Figure 4

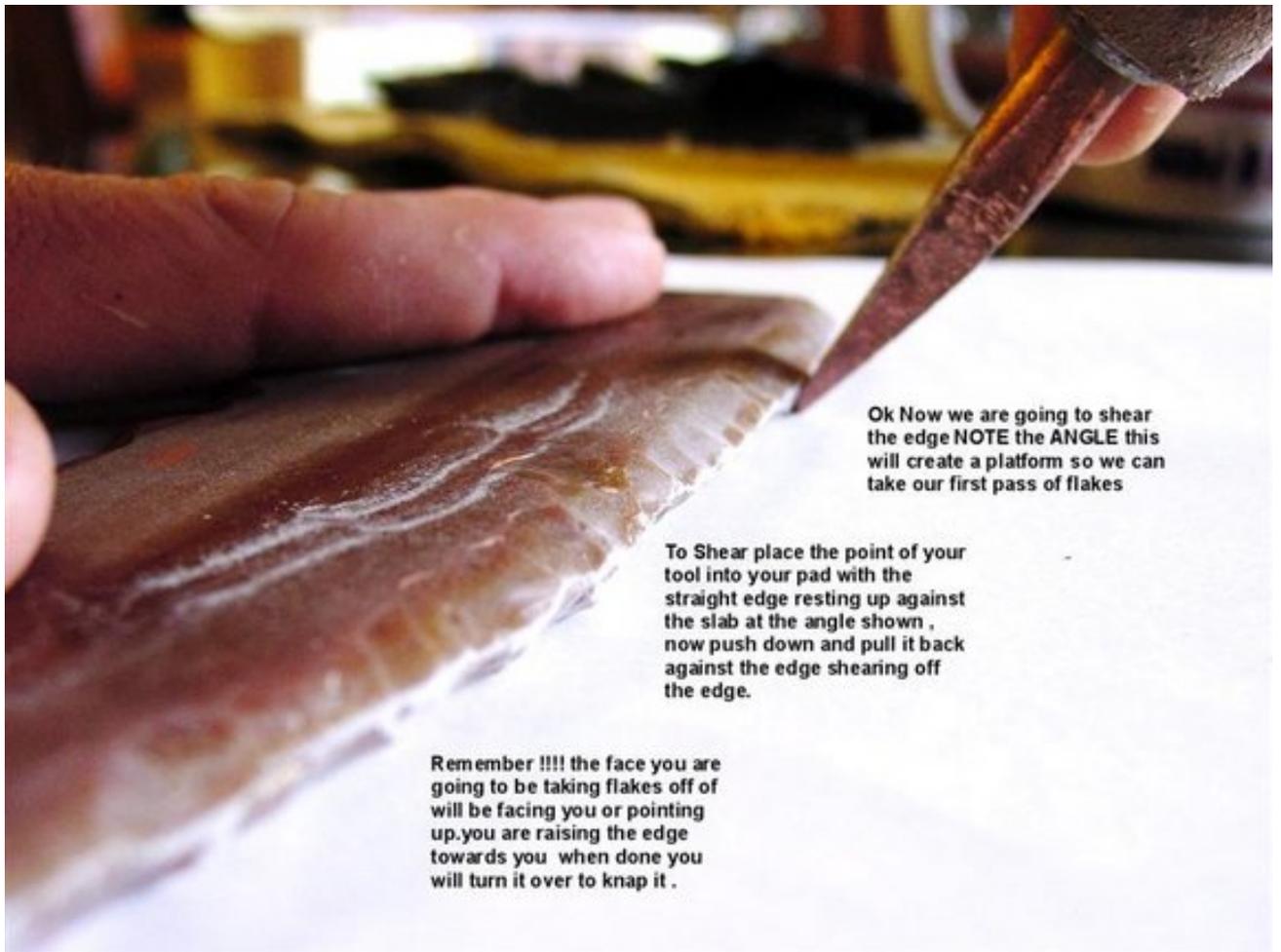


Figure 5



Figure 5a

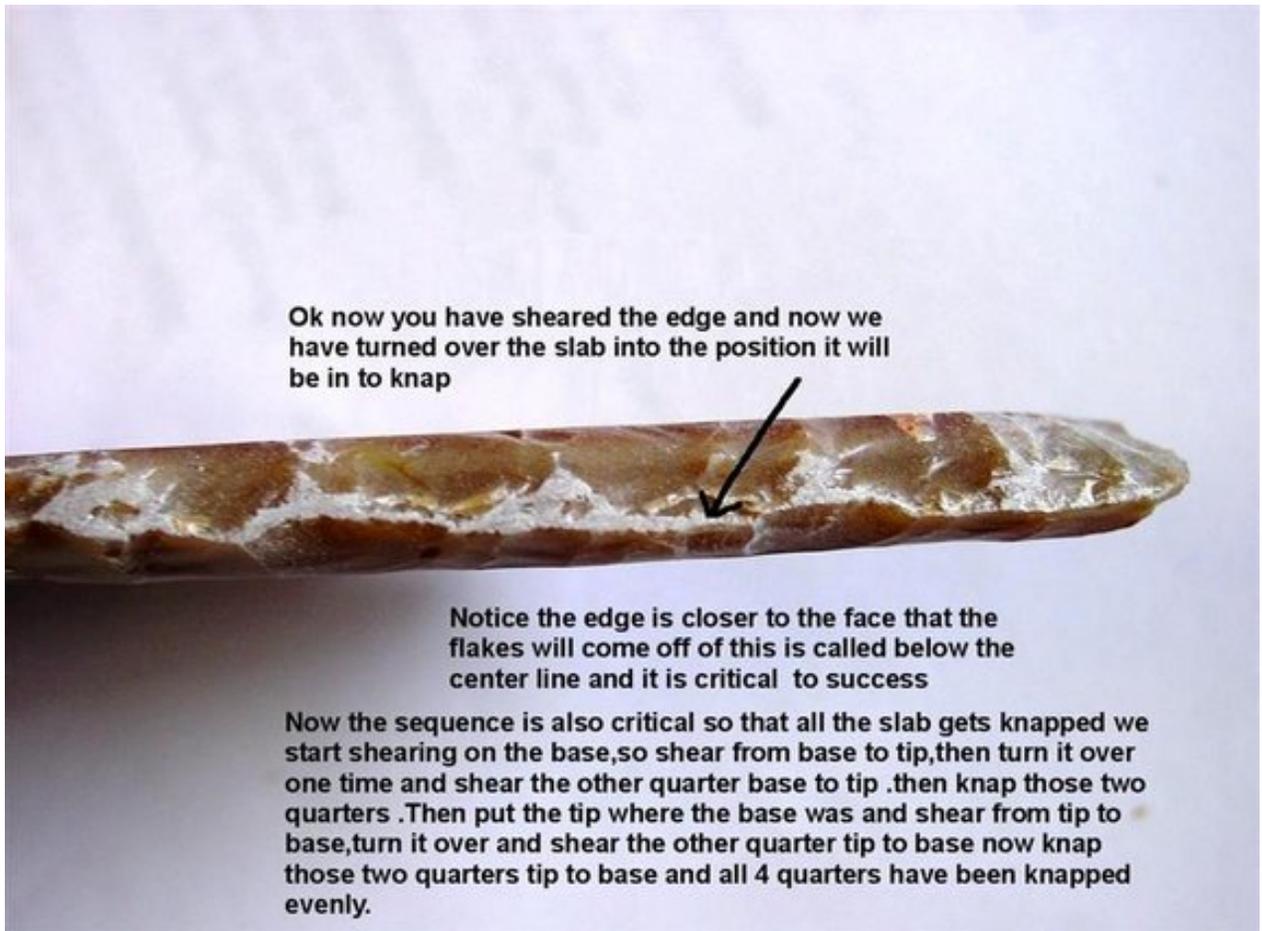


Figure 6



your tool should be sharp how sharp? as sharp as it can be without bending! Notice how i hammered out the tips of my tools i use them as shearing tools too.

Figure 7



Figure 8



Figure 9

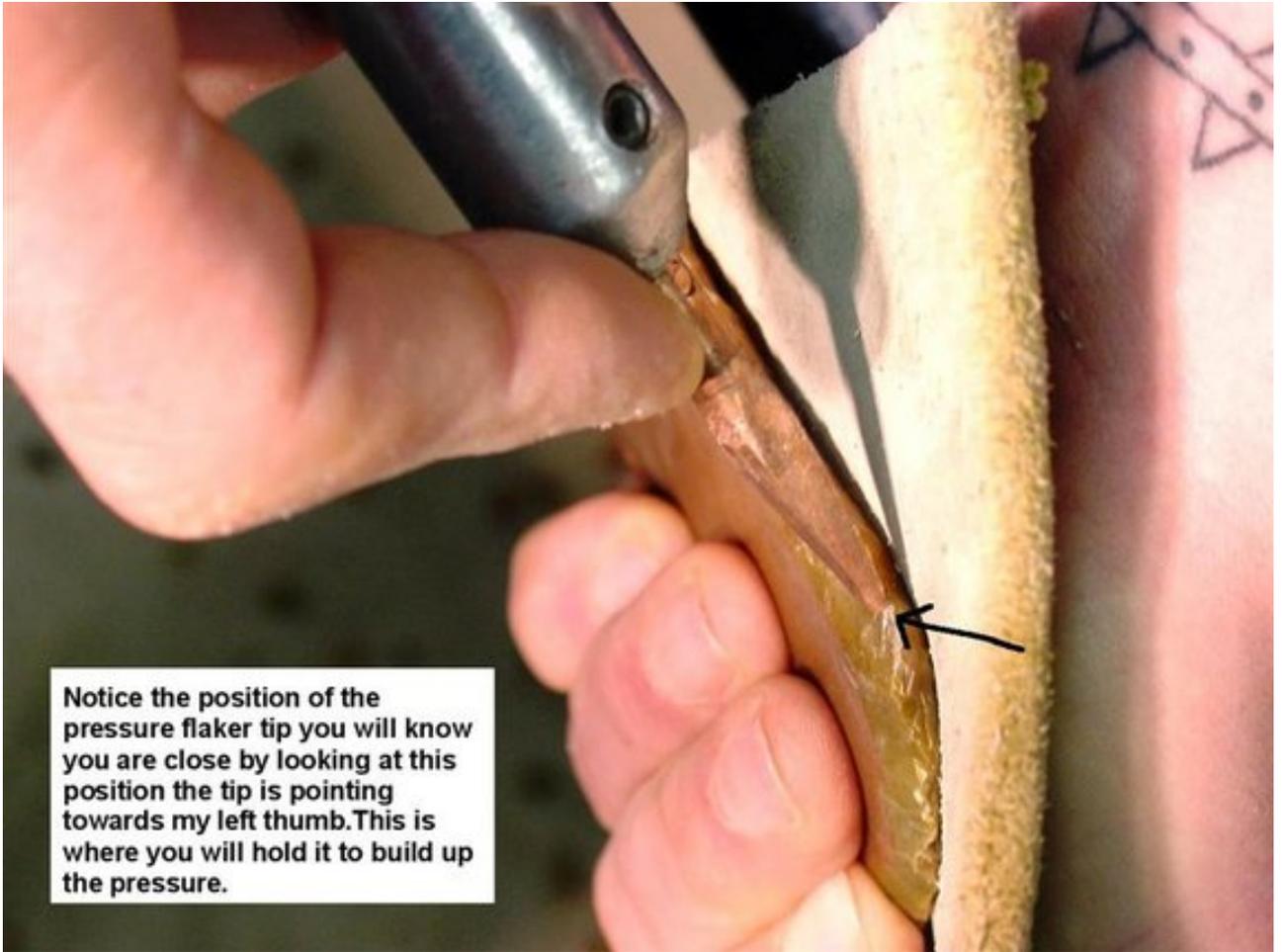


Figure 10



Figure 11

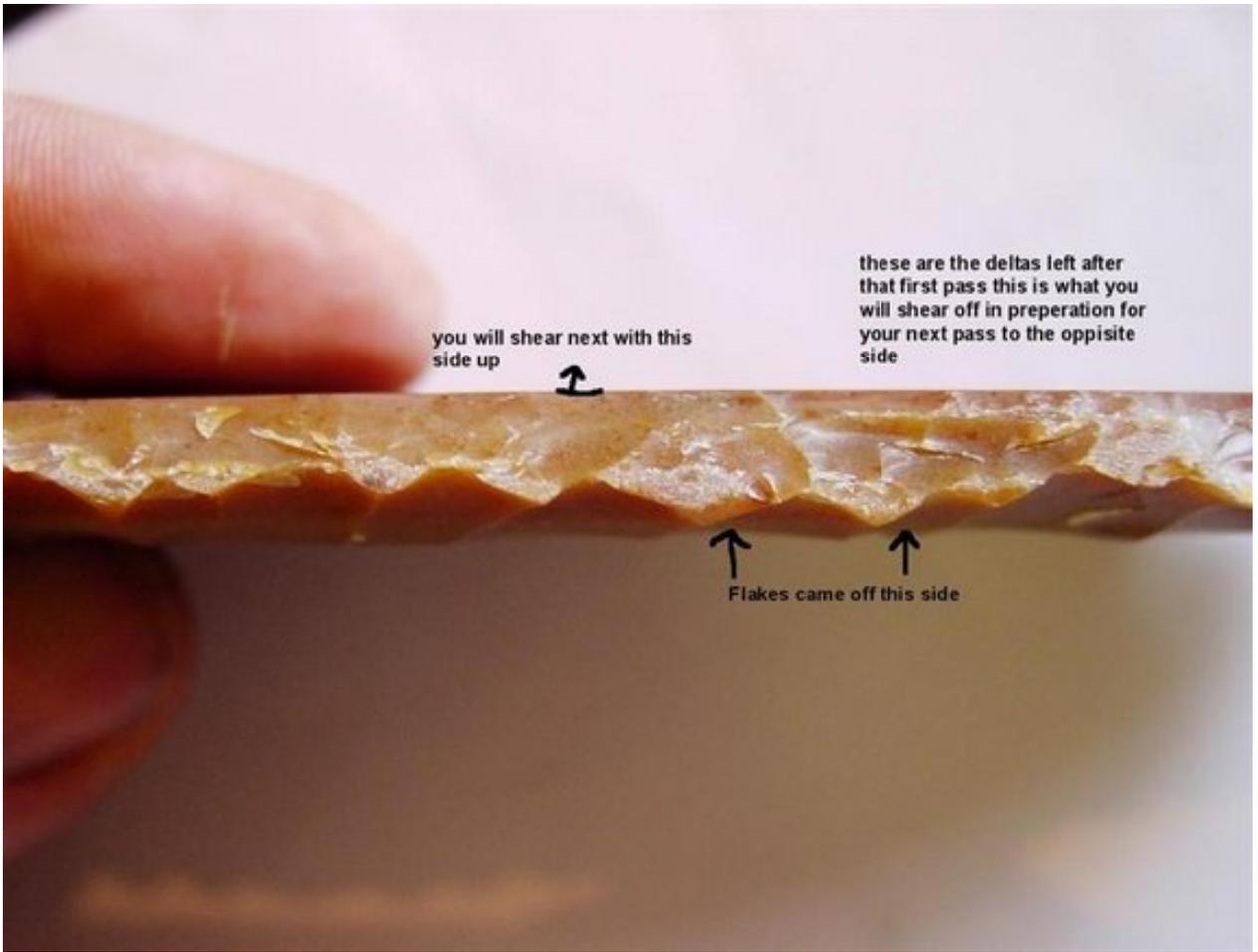


Figure 12



Figure 13"

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# Pressure Flaking a Big Blade from a Slab

By Jim Winn (aka Paleoknapperjim)

The following sequence of pics was taken while knapping a large blade from a slab. The idea is to try to show a successful technique and strategy that can produce a large wide blade using very light percussion and heavy pressure flaking. I did a similar tutorial several years ago, but since that time I have developed a better strategy that is capable of producing wider blades with better success. The following outlines the procedure:

This pic shows the slab before being worked. It measures 15 long and thick. Notice 2 cracks in the lower edge.



P2 I begin by removing the square edge by alternate beveling using a 5/8 thick solid copper billet. Each time a small flake is removed the slab is turned over and another small percussion flake is removed along the edge of the previous flake. This pic shows where I intend to strike to remove the next small flake. Note that the flake to be removed is resting directly and firmly on my leg to dampen the shock to the slab to reduce the chance of breakage. This can be done with pressure flaking also which is less risky but it is very time consuming and tiring. I prefer to just use light percussion.



The square edge has now been removed from the slab. Its rough looking, but the idea here is to just get rid of the square edge so that platforms are created that allow further light percussion to shape the slab. My fingers are pointing to 2 cracks. That edge must be brought in using light percussion until the cracks are gone. Also, only very light percussion can be used next to the cracks or they will run further and possibly break the slab.



The slab now needs to be roughly shaped. Light percussion is used to get the desired shape and symmetry and one side must be chosen to be the first face to get pressure flaked. The goal is to have the edge about 1/8 below the face to be pressure flaked. This picture shows the back face which will be flaked last.



This picture shows the face that we will pressure flake first. Its not perfect, but its good enough! The edge is roughly 1/8 below the face and it has been ground heavily to provide a continuous platform.



I started at the tip and began removing pressure flakes using an Ishi stick. The first 5 flakes do not have to travel far and go nearly to the opposite edge. Now it is time to begin to remove flakes from one edge, then the other. This picture shows the intended flake removal sequence for the next 4 flakes. By removing flakes from one side and then the next, continuous ridges running from edge to edge are created. This allows each flake to travel a bit further. If the flakes are removed down one entire side they will not run as far. That's OK, but if you are trying to maximize the width of the biface it is better to alternate from one edge to the other with each flake. This same strategy works very well with percussion also.



This pic shows the next 4 pressure flakes after they have been removed.



The blade is now flaked to about the midpoint lengthwise. Time to switch to the base and begin removing flakes from the base back toward the midpoint. The advantage of doing this is that it provides an additional opportunity of correcting any short flakes that may happen. For example, if I get a short flake when working from the base toward the mid section I will stop. I then switch back to the mid section and work toward the base and the problem area. It is a lot easier to correct a short flake when doing this. It gives you a second chance to correct the problem by approaching it from the opposite direction.



P9 This pic shows how the Ishi stick is used. Note that the blade is held firmly on a notched rubber pad. My left hand is resting firmly against my left inner leg. My wrist is bent backward so that the Ishi stick force can be applied toward the opposite edge. In reality, the Ishi stick is actually pointing toward the opposite face, in other words, beyond the opposite edge. This is necessary in order to remove as large a flake as possible. Pressure is built up to about the maximum that I am physically able to apply, and then the left hand is rotated very slightly until the Ishi stick is pointing directly at the opposite edge. At that instant the flake will release. This all happens very quickly. It is impulsive. I have seen many knappers building up pressure slowly and straining till they are almost shaking hoping that the flake will release. It usually does not. So they change the angle of applied force till it is pointing toward the face they are flaking. This always results in a short flake. The flake will ALWAYS follow the applied force at the moment it releases.



This pic shows how the blade is supported on the notched pad. Note that the area where the flake is to be removed **MUST** be directly over the notch in the pad. If the flake touches the pad at any point, that area will result in a small step fracture. The flakes are elliptical in shape, and the notch in the pad must be elliptical in shape also. Pads that are bought are generally straight sided. Dont buy em, make your own! You want an elliptical shaped notch that is sized just a bit larger than the flake to be removed. If it is too large, too much bending stress is created and the blade may break. If it is too small the flake will step at the point of contact with the pad. Trust me on this one!



OK, this pic shows the continuation of the flaking process from base to the mid section. Notice the intended sequence of flake removal, from one edge to the other to provide nice ridges for the flakes to follow.



The first face is now completely pressure flaked. All traces of the saw marks have been removed. However, this face is still fairly flat and lacks convexity. Therefore the plan is to remove another set of pressure flakes from this same face to provide additional convexity and also to provide a better flaking pattern.



The edge is still close to the face just flaked. A small billet is used to drive off small percussion flakes toward this face and move the edge closer to the centerline. The goal is to create a platform very close to the centerline for the next set of pressure flakes, and then to abrade it very well.



This shows the blade after the 2nd set of pressure flakes has been removed from the same face .It is hard to see in the pic, but this face now has much better convexity. In addition, we have lost very little width in doing this.



The blade is now flipped over and the small billet is used to bring the platform up to about 1/8 of this face using very light percussion flaking. The platform is abraded and pressure flakes are removed with the ishi stick starting from the tip to about the mid section again.



Flakes are now removed starting at the base and working toward the mid section, to meet up with the others. As we progress along the length of the blade, longer and longer flakes must be removed. To assist with longer flake travel, I often isolate the platforms by removing a small flake on the other side of the platform area, as seen in the pic. This isolated platform will release with a bit less pressure and travel a bit further. It will result in less bending stress being applied to the blade and will reduced the chance of breakage.



This pic shows the flake after it has been removed from the isolated platform. Right on target!



The 2nd face has now been completely pressure flaked. All saw marks have been removed. The hardest part is now over.



The next step is to selectively go around the blade and remove additional sequences of flakes to thin the edge and provide a good contour from edge to edge. In some area the edge may be very thick and more massive flakes will need to be removed. This pic shows such an area. Notice that I am using a finger guard made from leather to support the opposite edge. This not only protects my finger, but it provides support on the opposite edge. As I apply pressure with the Ishi stick I am applying the force directly into my finger support. This greatly reduces the bending stress being applied to the blade and reduces the chances of breakage. This also encourages the flake to travel further, often from edge to edge. The leather provides protection to the finger.



This is one side of the finished blade. It measures  $14 \frac{5}{8}$  long by  $2 \frac{5}{8}$  wide by  $\frac{3}{8}$  thick.



This is the other side of the finished blade.



This is the edge view of the blade.



These are all the tools used to make this blade.



Hope this can be of use...jim winn

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# Flake Over Grind (FOG) 101

**By Tom Dodge (aka peblpmp)**

OK....here goes.....others that FOG may use different techniques but this is what works for me.....



Lots to choose from.....I love cutting rock.....especially obsidian.....every one is different.....in fact, every slice is different



Take a slab, orient it the way you want, mark out the shape and trim with a tile saw. Closer trimming here save diamonds later! I slab my own with an 18" Highland Park.



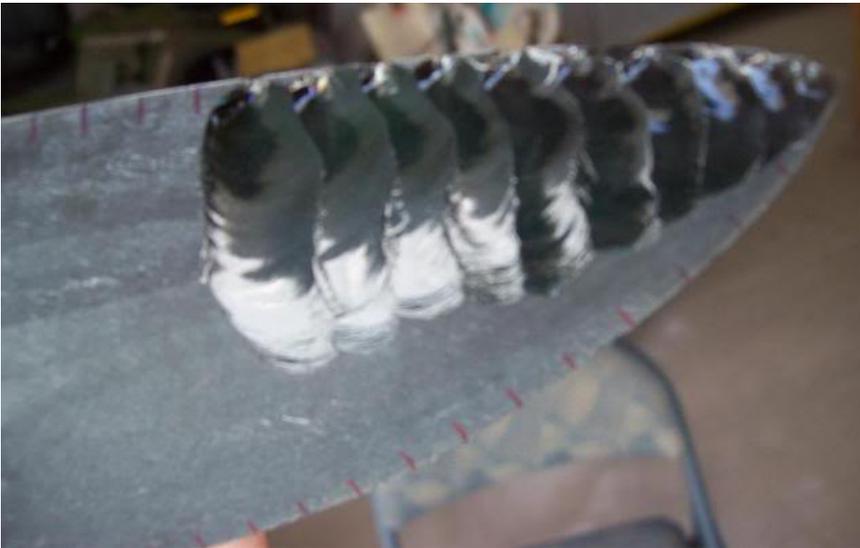
This is the work horse. 10" Poly arbor (very hard to find) with 8" 50 grit wheel and 6" 180 grit wheel.



Grind out the shape then grind both faces into a convex shape. Leaving a median ridge down the middle helps the flakes terminate smoothly. I'm not always successful. Rough it out with the coarse wheel leaving about a 1/16" flat on the edge so you don't rip the edge off. Smooth it out removing all the grind scars with the fine wheel. Start with thicker slabs to allow for grinding removal.



Using the fine wheel, bevel the edge at about 75 to 80 degrees. This edge should be straight with a sharp edge on the side to be flaked. This is your working edge for one face. Measure and mark, if you want to, the evenly spaced flake locations.



With fine abraider, rough up the working edge and leave the powder on as it helps the copper bite the rock. I use a slotted block and an Ishi stick to flake. Start at one end or the other always flaking into the mass (unflaked portion) side of the previous flake. If you miss a flake or run into other troubles, go to the other end and work back to the booboo; this often helps to better remove "islands" of "frog skin" you missed. Run down one quadrant, then abraid the other edge and run down it.

Remember the centerline rule thingy still applies!!! Try to take every flake exactly the same, ie. same angle, same force, same depth, same everything.



First quadrant.....the thinner and misaligned flake are a result of not doing the same thing every time. It is unforgiving and takes a lot of concentration.



Second quad done.....first side finished.



Back to the grinder (fine wheel) and bevel the working edge back the other way to flake the other face. Repeat above, placing the tip of flaker in the middle (the strongest part) of each delta. No measuring or marking needed as the deltas should be spaced just right.



After all 4 quads are flaked, the edge should look like this.



Back to the grinder (fine wheel) and grind down about 1/16 to 1/8" of the deltas on both sides, leaving a fairly sharp edge for the final retouch.



Retouch the edge, careful to not push in and have the flakes run up the flake scar ridges. Just take off the ground deltas. U B done.....



Other side. Not too bad.

Once again I must thank the omnipresent TwoBears for the rock, which is to die for. There is no way to fully capture the amazing deep metallic glowing color of this Mexican obsidian with photos. I love obsidian.

FOG has been around about 3500 years. They (Egyptians) just didn't have diamond grinders. They did have beer. Lots of knappers scoff at FOG knapping for various reasons. I personally could care less. It helps to produce what I want to produce.

Hope this is informative for anyone who wanted to know.

FOGPimp

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From <http://paleoplanet69529.yuku.com/topic/23948>, April 1, 2010, copied with permission

# Parallel Flaking Techniques

*by Jim Winn (February 2002)*

Over the years, I have developed some ideas or beliefs on what seems to work when it comes to parallel pressure flaking. I may be wrong in my thinking, and invite other opinions or suggestions or what works from other folks. I am sure lots of folks may disagree with my ideas, but I welcome hearing from them so that we can all learn and improve our skills. Hopefully, maybe some of the following may be of use to others, or at least provide something to think about. Here they are:

1) Parallel flaking can be done straight in or obliquely. Either will work, but oblique flaking is more efficient for several reasons. First, the flake will travel further in an oblique direction than straight in. Why? Because the convexity is less when traveling at an angle across the face than straight in. In other words, it is flatter. All other things being equal, flakes travel further as the face becomes flatter (unless it becomes concave, or course). There is a negative side to this: Flake terminations are more likely to terminate in a step or hinge as the face becomes flatter, but measures can be taken to prevent this

2) Flakes will travel further and are more likely to have a feather termination when absolutely nothing is touching the flake as it is being removed. This is why I use a slotted hand pad, so that the flake area to be removed is resting over the slot. After each flake removal the biface needs to be moved so that the next flake is resting over the slot. If this is not done the flake will often terminate in a small fingernail hinge at the point where it meets the pad.

3) The biface is less likely to break during heavy pressure flaking when the flakes travel obliquely across the face instead of straight in. Why? There is more mass below the flake diagonally across the flake than straight in. Also, the flake is less likely to overshoot the opposite margin because the distance is greater. There is one time when this does not apply, and that is when removing flakes close to the tip when the flakes are traveling back toward the tip. In this case the flakes travel a shorter distance and great care must be taken not to overshoot and break the tip off. I have found that placing the tip of the biface on the pad (not over the slot) works well to prevent tip breakage until several flakes have been removed. Why? 2 reasons. One is that the tip is now supported and less likely to recoil and snap. The second is that the pad is touching the flake and prevents it from traveling as far. It may terminate in a fingernail hinge, but this can be removed when working the other edge, from the tip to the base.

4) Either an Ishi stick or a simple hand flaker can be used to do oblique parallel pressure flaking. But only an Ishi stick can remove massive long pressure flakes. Why? Because tremendous pressure can be applied with the Ishi stick, using not only the arm and leg muscles, but the chest, shoulders and back also. (In fact the whole body can be used with the Ishi stick in the traditional manner between the legs). The closer to the crotch, the more power that can be developed, and in addition the more stable everything is. I find the hand flaker more suitable on the smaller points where great pressure is not required and I am sometimes able to get more accuracy with it. Also, the hand flaker can be twisted at the moment of flake release to increase the travel of the flake. But the Ishi stick is a must on the big knife blades (unless your doing percussion of course).

5) Beginning knappers sometimes have trouble getting the flakes to travel as far as desired. They place all their strength into it and still the flake peters out short. Why? Sometimes it is a matter of strength, but more often I believe the cause is insufficient support of the biface, such that it rotates in the hand. The knapper is pressing with all his/her strength with the pressure flaker while the hand supporting the biface allows the biface to rotate slightly. The pressure now is directed outward instead of straight in, it travels a short distance but not to the middle of the point and the result is a thicker biface. The cure is to concentrate on supporting the hand holding the biface such that it remains absolutely fixed while the pressure flaker is applying pressure. The pressure flaker must apply force nearly straight in for a long flake and not be allowed to tilt outward. Again, supporting the hand close to the crotch and on the inside of the leg provides great support. If the knapper is straining and allows the hand to leave the inside of the leg the hand supporting the biface has to rely on the arm muscles alone for support and arm muscles are simply not strong enough to provide fixed support (unless you have 20" biceps!). Basically, the flake will obey the rules of physics and travel where ever the force is directed.

6) Parallel flaking is more efficient than random flaking (both on percussion and pressure). I am not saying is it right or wrong, just more efficient. Ancient knappers used both methods and of course random flaking is the only appropriate method when duplicating certain point styles. Random flaking must of course be used in the early stages of biface reduction to remove unwanted mass which is randomly located. However, by stage 3 or so, ridges can become established and oriented so that successive flakes can follow the ridge left by the remaining flake.

7) When doing parallel pressure flaking it is not necessary to travel all the way from tip to base or visa versa until the final set of pressure flakes is to be removed. Just continue the flaking sequence where mass needs to be removed. If you hit a low spot, skip past it and start where the next mass needs to be removed. Otherwise the point will be bent or twisted when viewed sideways. This was a problem I had in the early days when I would keep going from tip to base and then wonder why the point was not flat! Even on the final set of flakes it is not necessary to travel continuously if there is a low spot and often skipping over it will not even be noticeable (unless you are doing FOG, in which case there wont by any low spots anyway). Also, when doing a sequence of flakes, try to adjust the length and thickness of each flake to the amount of mass needing to be removed.

8) Longer flakes are wider flakes. Guess this is obvious! But the spacing needs to be increased between flake removals to prevent the flake from diving into the previous flake scar. I still make this mistake when I don't take the time to inspect each flake removal and adjust the next accordingly.

OK, that is all for now. Lets hear from others. Give me some hell! Really, I know there are probably lots of ways to do things better that I have not thought of, and I think that is what this forum is all about, sharing and learning from one another to improve our skills. Perhaps a folder can be created on pressure flaking tips, another on percussion flaking, fluting, etc.

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From [http://www.flintknappers.com/oldsite/jim\\_winn\\_parallel\\_flaking.html](http://www.flintknappers.com/oldsite/jim_winn_parallel_flaking.html), April 8, 2010, copied with permission

# Micro Flint-Knapping

by Craig Libuse



## Scaling traditional techniques to extremely small sizes

Dan White (pictured) has been able to create his own form of art, based on what was one of the first forms of art—flint-knapping (shaping stone by breaking off chips). He calls it "micro-knapping". Prehistoric cultures learned early on that flint could be chipped to create sharp edges for knives, arrow and spear tips. The ability to make quality points was critical, as it meant the difference between eating and going hungry. Shape and size varied widely based on use and culture, but the technique has changed very little in thousands of years. Old points are popular among collectors, and some modern craftsmen have taken to duplicating the ancient techniques, but Dan has taken it to the extreme small end of the size scale.

Over the last few years Dan has made over 100 miniature stone arrowheads. He uses a stereo microscope to reproduce the stone-age technology of flint-knapping in miniature. After months of experimenting, headaches, and stabbing himself in the fingers, he has been able to develop a technique where he can make miniature stone arrowheads the size of a grain of rice that have all the same proportions and flaking as the full-size originals. Each miniature takes between 1 and 2 hours to complete.

## Tools of a new micro-trade

His tool kit consists of a thick rubber pad, a fine grinding stone, various size small nails/pins for use as pressure flakers and Scotch tape. (He must wrap his finger 4 or 5 times with tape to prevent the smaller nails from stabbing him while flaking). He like to use the most colorful stone he can find for his microscopic arrowheads. First, he starts with a flake of stone about the size and thickness of a nickel. He then begins breaking off large chips with a sharp copper nail to shape the stone down into a bi-facially flaked "pre-form". Once the pre-form is complete it's time to use the smaller nails and pins to shape it down and begin finishing the edgework and notching or fluting. Notching is done with a small nail that has been flattened and sharpened. He makes all the pressure flaking tools with the help of a microscope. Micro-knapping is basically the same as normal flint-knapping in the way each flake has to be removed in a very similar and precise manner.



*Seen here are some of Dan's favorite micro points, described from left to right: 1- A T-drill style point made of Kaolin flint from Oklahoma. 2- Another T-drill style made of opal from Australia. 3- His smallest point- a paleo style fluted point made from Alibates chert from Texas. 4- An arrowhead made from striped opal from Australia. 5- A Dalton-style made from Kaolin from Oklahoma. 6- A "bolen bevel" style point made from quartz crystal from Maryland. 7- A stemmed point made from Brazilian agate.*

### **Scarcity of materials leads to miniature craft**

Dan has been a collector for most of his life and his interest in ancient stone arrowheads is what eventually lead to his pursuit of flint-knapping. When he first started trying to make arrowheads he had no way to get large pieces of flint to practice with, so he decided to make miniature arrowheads using tiny pieces of stone that had broken off some damaged arrowheads in his collection. As far as he knows, he is the first person to ever try flint-knapping under a microscope. Since he had never heard of this before, there was no place to go for guidelines or advice.

It took several months to develop his technique and figure out the right tools to make. After much practice and pain, he was able to make a miniature arrowhead under 2 mm long that has sharp edges and is flaked on both sides just like the full-size ones. His smallest arrowhead was considered for the *Guinness Book of World Records*, but because there is no category for arrowheads or flint-knapping (and they didn't feel like creating one) he was turned down. However, some of Dan's work is in the Smithsonian collection and his smallest piece has been photographed by the Smithsonian's photographer. He has sold some individual miniatures to collectors in the past but would rather keep most of them and enjoy them himself, especially since they are so difficult to make.

### **Early difficulties solved by better tools and techniques**

When Dan first started, his only tools were the microscope, a pin for the notching, a pocket knife and some card paper. He would find the thinnest, flattest chip of stone and then shape the edges down with the tip of the knife blade while holding the stone between his fingers in a piece of card paper. The first 10 or 15 were crude looking and not bifacially flaked (flaked equally on both sides). He used the pocket knife for a while before realizing he could never get the results he wanted (bifacial flaking) with such a hard chipping tool. This is when he started using nails and placing the stone on a rubber pad to get longer pressure flakes.



*One of Dan's arrowheads is shown here attached to a miniature arrow.*

When starting out and trying to teach himself how to make these tiny points, Dan would break two or three for every one he finished. After finally getting the tools and technique just right, he says he can now make two or three (if he's really careful) before he breaks one. According to Dan, "The hardest part is doing the notching and the flute flakes for the Clovis style points. Naturally, most of the breaks happen after much of the work is already finished. If I can get the arrowheads to look good under the microscope, they will look really good to the naked eye, but sometimes I break them on purpose if they don't look just right."

Dan admits that he has dropped a few of them and lost them in his carpet including a couple of his best ones. After spending over an hour looking for one he has to give up in frustration. Even so, he says working this small is worth it.

### Here are several examples of Dan White's work:



Dan's tool kit includes:

- A stereo microscope (it's a lot harder to make micro arrowheads without it but it can be done).
- A pressure flaker with a sharp copper nail for making the pre-forms, and some smaller pins and nails for the finer chipping work. Also there's some clear tape used to protect his finger from being poked by the nails while pressure flaking
- A small grinding stone used to grind the edge of the pre-form prior to chipping
- A rubber pad cut from a tire for placing the point on while chipping. On the pad is a red piece of stone typical of the size and shape he likes to start with.

The penny is to show size. The small hafted knife in the center has a turtle bone handle with real sinew keeping the blade on.



Some arrowhead samples of various shapes are shown next to the tip of a toothpick for size reference.



More small points, all of a similar style are shown next to a penny.



This is Dan's smallest arrowhead, a fluted and bi-facially flaked Clovis-style point that measures just over 1 mm. According to archeologist Dr. Dennis Stanford at the Smithsonian and the people at Guinness Book of World Records, this is the smallest knapped stone arrowhead they have ever heard of. This is the only one he has made this small and says he doesn't think he wants to try it again. He made it several years ago and had to hold it down on his pad using a popsicle stick while flaking it with a special tool he made just for this point. It took about 1-1/2 hours to finish.



These points are all made from Alibates flint found by Dan's late friend George Chapman near Alibates Flint Quarries National Monument, the famous ancient flint quarry in the Texas panhandle. George lived near the quarry and he would send Dan a pile of small flakes he picked up in exchange for a finished point or two. Dan says this is some of his favorite material to work.



These are some of the first ones Dan made from broken pieces of arrowheads. All are made from a thin flake and are only chipped on the edges.



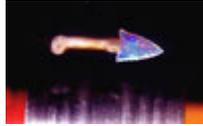
These three glowing "opals" are all made from Australian Opal from Lightning Ridge.



He has only one picture of himself at work with his microscope. It was taken by Val Waldorf in August, 2002 at Flint Ridge, Ohio for the October, 2002 *Chips* publication for flint-knappers. (Vol.14, #4)



Dan has created other weapon shapes as well, from spear points to daggers. The handles were made out of tiny bones found in owl droppings.



A knife with an arrowhead-like point made from fire opal.



A miniature knife of the type chipped from obsidian.

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