Flint Knapping: Pressure Flaking

Photo courtesy of F. Scott Crawford

Compiled/Edited by Michael Lynn
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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How to Make Your Own Arrowhead
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Slab Knapping Tutorial
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 Flake Over Grind (FOG) 101
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by Jim Winn (aka Paleoknapperjim) at www.flintknappers.com

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by Craig Libuse at www.craftsmanshipmuseum.com
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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.

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.**

It's 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: /\\\\\\\ 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!).
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 of in the same place you took the first little flake off. Flip it over and keep doing it. Its 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.

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

Actually, almost all of us grew up using stone tools. Stone tools were made long before humans appeared on the scene. And, in most of the world, the knowledge of how to make stone tools was passed down from generation to generation. So, the manufacture of stone tools was a natural means by which humans were able to survive in the wild.

One of the most important stone tools that humans used was the arrowhead. The arrowhead was used for hunting, for making weapons, and for many other purposes. The process of making an arrowhead is a simple one, and it can be done by anyone with a few basic tools.

To make an arrowhead, you will need the following:

- A rock
- A knife
- A hammer
- A file
- A saw

Now, let’s get started.

First, find a suitable rock. This rock should be hard and have a flat, smooth surface. The size of the rock will depend on the size of the arrowhead you want to make.

Next, use the hammer and file to shape the rock into the desired shape. You can use your imagination to create any shape you want. The key is to make sure that the edges are sharp and smooth.

Once the shape is complete, use the saw to cut away any excess material. This will leave you with a rough shape of the arrowhead.

Finally, use the file and knife to smooth the edges and to make the arrowhead sharp.

Now, you can sharpen the arrowhead by sharpening it on a stone. This will give the arrowhead a sharp edge that will allow it to be used for its intended purpose.

So, there you have it. Making your own arrowhead is a simple process that anyone can do with a few basic tools. With practice, you can make arrowheads that are just as good as those made by the cavemen.

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STEP FIVE

Here are several examples of authentic, ancient arrowheads from Oregon... so you can see some point designs & the stone materials actually used long ago.

STEP FOUR

Next, you can saw the sides away near the bottom of the flake tool to begin shaping your arrowhead. First, lay the flake down on the leather pad, to support the flake. This should be done with the smooth face of the flake up, so that the raw flake will be removed from the edges of the chip. This will allow you to grip against the protruding or leading edge of the stone. You will place the point of the tool against the stone edge. But first, you should cushion or ground the edge of the stone by rubbing the side of the stone on a soft, slightly rough cloth along the edge. This will round up the sharp edge, providing better gripping surface for your tool.

Next, hold the piece as you would with your thumb. Do not use too much pressure at first, just enough to keep it in place. Place the pointed tip of the tool against the edge. Generally, the first flake should be taken off at or near the tip of the point. The stone should basically parallel the face of the chip, as near as possible to the centerline of the chip. Force against the ground edge, and push the new flake off of the hammer face of the chip.

Use a straight, against the edge, not against the face of the flake. You are essentially trying or pushing a small flake off the chip, coming from the edge toward the middle of the chip. After the flake comes off, two over the point as you can see what happened. Your objective is a flake which will be to beyond the beginning of the rough point. Many times the first flake will be short, but it will provide an edge along which your next flake will travel more easily.

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

Do not push down on the chip too much while you are removing the side. Just enough to hold it in place. Too much pressure and you can break the chip at the place where you are giving off a new flake. I have, at my distance, done more times than I like to admit. It takes practice. And to know how much, or not too much pressure, will also take practice and experience. This includes breaking an unknown number of points at 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 the edge, then push along the edges on the back surface of the arrowhead. When you finish this side, you have what is known as a carefully worked arrowhead. These are often found, where the stone is formed only flaked the point on cloth, and then left the other side as a smooth surface, with little or no additional flaking on that side.

STEP FIVE

For the second refinement of the point for percussion flaking by removing the remaining edges. First remove the triangular protruding edges between the new flakes. These are called "cliffs", because of their shape. To remove them, push against their smooth edge with the tip of your flaking tool just enough to break off the little triangular. Then use a cleaning motion along the new edge again, in a motion parallel to the edge, peeling from the smooth face, just along the edge. Just turn off a bit of the thin edge, leaving a strengthened edge for additional percussion flaking forward to the smooth face of the point.

Next push the smooth tip up this edge line as you did before with the other side. This gives your flaking tool a better grip at the edge.

Repeat the percussion 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 most cases, in many parts of the world, you would now be finished. These points were handed into yellow plate or black, with glue and/or pine or sawdust, or into a hollow shaft such as a reed with glue and fiber. However, many points were also needled to facilitate the backing process.

So, you may wish to attach your arrowhead.

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

The process is similar to preparing for percussion flaking, except that you will do this at this two places, in maximum positions between each other so that the point remains balanced and symmetrical.

First, remove where you want the notches, equally up the edge from the base at from the oblique along the base edge of the point, or at the curve. Make a hole flake at the edge where you want the first notch. Then mark the other.

Use the sharp tip of the copper flaker to break up the edge near the marking notch. Just enough to get a gap with the tip. Push a flake off the notches from the point from the marking scratch in the direction you want the flaked notch to proceed. From the point again, rough up the edge of the notch, and push another diagonal flake off from the other side. Repeat the percussion flaking process at the marking notch for the second notch. This will give you a series of guides for finishing the notches.

Now turn to the end of the guide channel to create an edge to your edge into the next flake as the notch. You rough up this edge from one face of the point, then turn the point over to rough the next flake off. Rough against the newly ground 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 pass across the notch, so this will break off the corner of the notch, or more. More frequent use of a little or a notch, then the other, so that both notches progress smoothly toward completion.

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

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

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

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

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

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

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

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

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

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

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

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 smooth.

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

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

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

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

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


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

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

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

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

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.

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

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

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

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

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

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

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

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

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

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

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.

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

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.

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.

From http://www.arrowhead-maker.com/, April 6, 2010, copied with permission
Using Your Legs When Pressure Flaking

By spreading my legs together I apply pressure at the heel, and I use the mass of my body to drive the flint onto the stone. When the pressure is high enough I grip the stone with my left hand, and focus on the right."
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.

1. Ground platform on the opposite edge rough side.

5. Resulting result of pressure flaking near the tip.

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

7. Here is the flake scar of the previous photograph.
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 you 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) Fakes 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 you 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.

From http://www.flintknappingtools.com/flaking_tips.html, March 31, 2010, copied with permission
Slab Knapping Tutorial

By Mike Tylynski (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 edge should look like this after alternating flakes all the way around the slab
Figure 3

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

your flakes should go no farther than this when turning the edge.
Ok now this is what your slab should look like after you have taken all the highs and lows off pretty much a straight line in the middle of the slab. Now we are going to move the edge to the face we are going to take flakes off of.
Figure 5

Ok Now we are going to shear the edge NOTE the ANGLE this will create a platform so we can take our first pass of flakes

To Shear place the point of your tool into your pad with the straight edge resting up against the slab at the angle shown, now push down and pull it back against the edge shearing off the edge.

Remember !!!! the face you are going to be taking flakes off of will be facing you or pointing up, you are raising the edge towards you when done you will turn it over to knap it.
Ok now you have sheared the edge and now you need to grind it and I mean grind it! Note the angle of the grind stone this is to set the angle of the platform so your tool can have a place to push hard without breaking off the edge before the flake is ready to be knapped off.
Ok now you have sheared the edge and now we have turned over the slab into the position it will be in to knap

Notice the edge is closer to the face that the flakes will come off of this is called below the center line and it is critical to success

Now the sequence is also critical so that all the slab gets knapped we start shearing on the base, so shear from base to tip, then turn it over one time and shear the other quarter base to tip. Then knap those two quarters. Then put the tip where the base was and shear from tip to base, turn it over and shear the other quarter tip to base now knap those two quarters tip to base and all 4 quarters have been knapped evenly.

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
these are the tools i use you may use antler or whatever adapt and use what works for you but remember that certain ways work better than others try them all before you make up your mind as to how you will do it.
position is critical notice the left hand is locked against my left leg, the slab does not move! i am holding the slab with just fingertips. My right hand is locked into place and my right elbow is locked against my side. All i have to do is lean over that loads the pressure onto the platform when i have enough pressure i just move my right leg towards the slab and the flake detaches. ;)

DO NOT bend either wrist when trying to detach the flake if you hold the position shown all your upper body is leaning into the pressure flaker transferring the energy to the slab when you move that right leg it will detach...no magic here just good fundamentals the creator gave you a knapping machine use it.....:)
Notice the position of the pressure flaker tip you will know you are close by looking at this position the tip is pointing towards my left thumb. This is where you will hold it to build up the pressure.

Figure 10
All right we have now taken the first complete pass off of the slab the flakes are about 3/4 of an inch long, no longer! They are evenly spaced.
Figure 12
Well we just sheared off those deltas from the last picture and flipped it over now if you look down the slab you will see that with just one pass we are building convexity into it and this is what we want imagine if all 4 quarters were done the only flat spot would be in the middle, and this to will go away as you make your flakes longer with each pass and it will take mabye 4 passes to cover this slab....:)

Ok in closing out this chapter I need to tell you the formula for slab work. It is that your slab needs to be 6 times as wide as it is thick or 6 to 1, so if your slab is 1/4 inch thick it has to be 6 inches wide. If your slab was 1/2 inch thick it would need to be 3 inches wide etc etc. This formula works out so that there is enough width to thickness to create the correct convexity....when you are done your point will not look like a slab....mission accomplished. good luck.

Figure 13"
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 alternated 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. Don’t 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 5/8 long by 2 5/8 wide by 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

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, of 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 then 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, 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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