New Jersey Blacksmiths Association
"EAGLE"

N.J.B.A.

NJBA Volume 11, Issue 4 02/01/07

Editors Soapbox

Well I was getting spoiled by all that warm weather we were having. Unfortunately as I write this I have just spent the day working outside and it was COLD to say it nicely. Well if the cold hangs around for a while Eric Cupers Shop is a very nice indoor meet so mark your calendars and get out to Eric's and some of the other meets.

Larry Brown, Editor

Upcoming events for 200

Get you calendars out and mark these events down. Please bookmark our web site and check for meet information. Remember most of our meets have an "Iron in the Hat" drawing, so be sure to bring something.

February 17th
Meet at Eric Cupers shop in Easton, PA. (Right over the boarder)

March 25,26
Joint meeting with FURNACE TOWN BLACKSMITH SHOP demonstrator will be Mike Linn. Information on page .

April 28 2007
Demonstration meet at Historic Speedwell in Morris County - Open hammerin/demo. Coordinator with David Macauley. Information on page .

April 28 and 29
A-Days at Delaware Valley College in Doylestown. Doug Learn is the contact, information on page .

May 19 2007
Hood Workshop, David Macauley is the coordinator. Information on page .

February Meet at Eric Cuper's Studio

On Saturday, February 17, I would like to invite everyone out to my studio in Easton, PA for another winter meeting. I plan on demonstrating several forging techniques including the forge welding of my squid forms. This involves pipe forging and about a dozen forge welds so safety glasses are a must. Tailgating is welcome and the heaters will be on. Hope to see you there!
The address is:
1301 Lynn Street
Easton, PA 18042
Any problems finding my shop, call: 908-642-6420 or 610-438-8694

CUPER STUDIOS
Eric Cuper, Artist Blacksmith

Cuper Studios specializes in architectural, functional, sculptural, hand-forged ironwork and restoration.

Eric Cuper, the founder of Cuper Studios, holds an MFA in Blacksmithing from Southern Illinois University at Carbondale. While at SIU, Eric won the prestigious Rickert-Ziebold Trust Award, a senior competition in art and design. He was also the First Place winner at the James Renwick Alliance student competition. His work Odyssey was auctioned to benefit the Renwick Gallery of the Smithsonian Institute. Eric's work is exhibited and collected nationally. His art has been published in Dona Meilach's books, Architectural Iron Work and Fireplace Accessories.
Directions and more information on page 3.

The NJBA Web Site!

The NJBA Web Site is up and running at:

http://njba.abana-chapter.com/

The Newsletter is at:

http://
members.bellatlantic.net/
~vze25jcc/index.htm

Official NJBA Address

NJBA
P.O. Box 224
Farmingdale, NJ
07727-9998

Rather than use room in the newsletter, All correspondence between ABANA and NJBA is now being posted on the NJBA web site. If you cannot access it there, contact me and I will send you copies

NJBA Board of Directors

Eric Cuper's meet continued:

Directions:

Assuming everyone is coming from the east. Get to 78 or 22 west from wherever you are coming from. 78 and 22 merge for a while. Take the last exit in NJ, which is 22 into Phillipsburg. Take 22 all the way through Phillipsburg, through the toll (75 cents) into PA. You are taking the very first exit immediately off the bridge so stay to the right out of the toll. Exit right and stay to the right on the exit ramp and pass under 22 until you come to a stop sign at Larry Holmes Drive. Turn left onto Larry Holmes Drive. You pass McDonalds and WaWa on your left. Take the first left onto Lehigh Drive immediately after the WaWa strip mall. My shop is on the corner of Lehigh Drive and Lynn Street. It is the first white building on the right, my shop may be entered through the green door. Parking is available in front of my entire building and all up Lynn Street but please do not park in the driveway on the left side of my building, it is an active driveway for a delivery company.

You may also take 78 west into PA (also a toll) and take the first exit in PA. I do not know the street names but turn right at the end of the exit and follow the signs for the Crayola Factory/ Canal Museum/ or Attractions. These signs will bring you to a light with McDonalds on your left. Turn left at this light and take the next left onto Lehigh Drive as above.

Furnace Town Blacksmith's Guild Joint Meeting & Workshop 24th & 25th March, 2007

Cost is $35.00 if registration is by 14th March $45.00 thereafter

Saturday night dinner is $15.00 extra

Mike Linn is the Demonstrator

Mike is a proficient blacksmith from Alabama. His demo is aimed at the beginning and intermediate smith. Saturday will be many short projects, while Sunday will have fewer but longer projects. Saturday includes, coffee and doughnuts in the morning, all-day demo, lunch (both days), **Iron in the Hat**, please bring something. Auction and the flashy wit of Ray Noble and David Hutchison. The demonstration continues into the afternoon. The Saturday evening dinner will be at the Eby's house which is on Rt 12 near Millville Road in Snow Hill. (maps will be available)

We will have a table of Norm Larson's books for sale. Tailgate sales are encouraged.

Registration form on page 5.

December Holiday Party

Once again Marshall and Jan hosted the Holiday Party in their home. The party was a success and well attended. The food and camaraderie was excellent and enjoyed by all.

Many thanks once again to Marshall and Jan for their hospitality.

Historic Speedwell April 28th

NJBA has been invited to demonstrate at Historic Speedwell Park in Morris Plains. This is the historic site of Speedwell Iron Works and the estate of it's owner Stephen Vail and also listed as "The Birthplace of the Telegraph" . We are asking Smiths of all levels to try to attend to help in this demonstration.

Directions;

From the South take Rt287 N to Rt 510 W to Rt 202 North From the south, you would come out of Morristown heading north, and Speedwell would be on your right. From the north, you come out of Morris Plains, about 1/2 mile south of Hanover Avenue, it is on your left.

The coordinator is David Macauley

Sad News

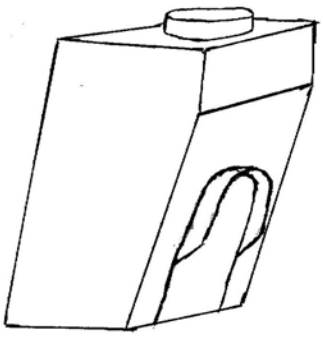
Sad News that Dona Meilach, author of many books on the works of a wide range of blacksmiths has died of cancer.

Little Giant Rebuilding Seminar!

Please join us for the 15th annual Little Giant Rebuilding Seminar! We will host 2 classes, Friday, March 16 through Sunday, March 18 or Friday, March 23 through Sunday the 25th, 2007. This is in Nebraska City, Nebraska and led by Sid Suedmeier, Please call 402-873-6603 or email sid@littlegianthammer.com for more information.

Forge Hood Workshop May 17 at Marshall's Farm

NJBA is organizing a forge hood workshop for May 19th. We are making the same design as last time but we are looking into making them out of stainless steel this time. The price has not been set as of yet and more information will be in the next newsletter or contact David Macauley



A-Days at Delaware College

Four years ago, with support from NJBA and PABA, I approached the A-Days student steering committee through an alumnus to see if they would be interested in including blacksmithing in A-Days. The steering committee approved our participation and thus the tradition was borne. Over the ensuing years, the popularity of the demonstration has grown. I have learned much history of blacksmithing at the college, with the course being taught up to about 1953, when the lack of demand and shift to a more disposable society, mechanized farming and a change in educational emphasis ended the blacksmithing course. Each year, at least one older alumnus will approach the tent and remark about learning blacksmithing in the basement of Allman Hall. Additionally, one of the past presidents of the college, still strong at over 80 years of age, taught blacksmithing and always comes by to say hello and tell stories of those times. One of my goals is to sit with him and record his memories of that time to preserve this part of that history. Perhaps this year.

During demonstrations, we make small items that demonstrate basic techniques while allowing a running discussion with the crowd. Because of the structure of the event, we cannot sell any items, but I have brought items from my collection of traditional and contemporary iron, both of my own work and of others, to show the public the range of the craft. I also bring copies of the NJBA newsletter, PABA newsletter and ABANA publications with membership applications and other information. This is a very good venue for recruitment and exposure of these organizations and I hope that they pick up one or two members from this effort.

Over the past two years I have made small 'horse shoes' to give to the attendees and last year, made and gave them to the steering committee members. While small, these tokens of appreciation have brought much good will to the organization from the students (and more than one set of teary eyes and a hug) and have made returning each year all the easier for me and the crew. And who is that crew? Each year my two sons and I have been there, along with NJBA, PABA and ABANA member Brent Reeb. The most patient woman in the world, my wife Fawn, has also lent her organizational expertise and help in all things to make this event work and allowed pieces from her collection to be displayed. Other members have helped through the years and I thank them for their support.

So it is time again to organize this event, and I am asking for assistance and demonstrators. If you wish to spend a pleasant day or weekend in Doylestown, supporting a great group of young adults and demonstrating the most noble of crafts, please contact me by e-mail (cjfdlearn@verizon.net) or phone (215.489.1742). Thanks

THE BLACKSMITHS' GUILD of THE POTOMAC
Spring Fling April 20-22, 2007

We again invite you to join us in a return to the traditional SPRING FLING, two and a half day event with demonstrations, tailgating and story telling. The **Berryville Ruritan Fairgrounds** gives us ample tailgating and camping space. The motels are but 8 miles west. This year we have an internet link to download your own SPRING FLING PDF PACKAGE. Go to our web page www.bgop.org on that page click on the Spring Fling Link that will take you to the page with the spring fling PDF

Furnace Town Blacksmith's Guild

Joint Meeting & Workshop

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Saturday night dinner is $15.00 extra

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We will have a table of Norm Larson's books for sale. Tailgate sales are encouraged.
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Registration form:

NAME / s _____

ADDRESS _____

CITY / STATE / ZIP _____

PHONE / EMAIL _____

Blacksmithing Workshops and Classes:

Peters Valley Craft Education Center
19 Kuhn Rd., Layton, NJ 07851 (973)948-5200
pv@warwick.net www.pvcrafts.org

Academy of Traditional Arts
Carrol County Farm Museum
500 South Center St. Westminster, MD 21157
(410)848-7775 (410)876-2667

Touchstone Center for Crafts
R.D.#1, Box 60, Farmington, PA 15437
(724)329-1370 Fax: (724)329-1371

John C Campbell Folk School
One Folk School Rd.
Brasstown, NC 28902
1-800-365-5724 www.folkschool.com

Brookfield Craft Center
286 Whisconier Road
P. O. Box 122
Brookfield, CT 06804-0122
203.775.4526

Business Members

We would like to thank those who joined with our new Business Membership category
Please show them our support

John Chobrda, Pine Barrens Forge
231 Morrison Ave., Hightstown, NJ 08520
609-443-3106 JChob@earthlink.net

Grant Clark, GWC Forge
PO Box 158 Perrineville NJ 08535
732 446-2638, 732 446-2638

Eric Cuper Artist Blacksmith
109 Lehman Lane, Neshanic Station, NJ 08853
908 642-6420 ericuper@msn.com

Bruce Hay, Jr.
50 Pine St., Lincroft, NJ 07738

Jayesh Shah, Architectural Iron Design
950 S. 2nd St., Plainfield, NJ 07063
jay@archirondesign.com

Louise Pezzi, Blacksmith

Search

I am looking for a
#250 fisher anvil in good shape.
If you have one for sale or run across one, contact me; Larry Brown, NJBA Editor. (718) 967-4776

Open Forges

We are looking for members who are interested in opening their forges up to members as a open forge. This does not have to be a weekly forge as is Marshall's the others can meet once or twice a month. Please contact, Larry Brown, Editor.

We want to encourage all to join us at:

Monday Night Open Forge in N.J.

Marshall Bienstock is hosting an open forge in his shop at 7 pm almost every Monday night (Please call ahead on holidays to make sure , (732)780-0871)

Open Forge in Long Island

Sunday from 10:00 am to 6pm.
Starting the 1st Sunday in November until the end of April. Please call ahead to confirm and get directions. Ron Grabowski, 110 Burlington Blvd. Smithtown, NY (631) 265-1564

BLACKSMITH TOOLS FOR SALE!
John Chobrda

Has a large selection of tools for sale.
Anvils – Forges - Leg Vices—Blowers
Tongs – Hammers
Will also repair and/or resurface Anvils
Call John for prices and availability
Evening 609-610-3501

From The Bituminous Bits, The Journal of the Alabama Forge Council

Scottish Dirks

By Mitch Latsch

I was lucky enough to receive an AFC scholarship and chose to take a class at John C. Campbell Folk School on Scottish Dirks taught by two World-Class Bladesmiths - Dr. Jim Batson, assisted by Chuck Patrick.

I am not much of a bladesmith and decided to take the class to learn more about blade making and metallurgy, while learning to make a truly significant historical blade. I got more than I bargained for - not only did I get to forge an array of blades but learned how to forge a fullered groove in a blade and how to perform differential hardening. I took lots of notes and offer them here for those that might value the information.

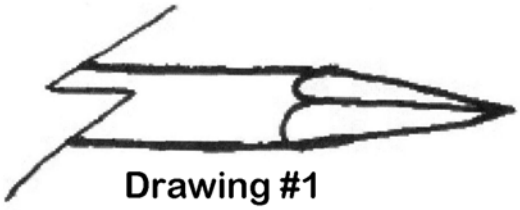
Jim Batson began by providing several references for books that provide much information regarding the Scottish Dirk and the Sgian Dubh (pronounced Skin-Doo). The dirk is a large handled, long bladed weapon used in long ago for close quarter battle. The Sgian Dubh is a small handled shorter knife that was used mainly for everyday type chores. The following publications and organizations provide additional information on the Scottish Dirk.

"The Scottish Dirk" by James D. Forman
Scottish Swords and Dirks - by John Wallace
Oregon Knife club. org
Genealogical Society of Moultrie (Moultrie, GA) (Information on Scottish Clans)
Vince Evans - Shoco, AZ Has a very good website for methods of making sheaths (Site address may include "vevans")
"The Sorrows of Culloden" includes 3 or 4 dirks that are very good

Several of the students in the class were relatively inexperienced at forging so the first thing we were shown is how to forge a small blade - the Sgian Dubh. Chuck Patrick demonstrated the complete forging of one small blade (about 4 inches long). The idea was to get those that had less forging experience used to forging and fire management fundamentals. Both Chuck and Jim assured the class that the practice would be invaluable when it came time to produce the longer, larger Dirk blade as the degree of difficulty of forging a blade increases exponentially with the blade length.
Chuck's demo went something like this -

Start with a good piece of steel - this steel was a length of (approximately 7/16 inch round rod) 1095, etc. I say etc. here because many blades can be made of old files or other good quality steel. Modem day bladesmiths will start with a new piece of very good steel, so they know what is going into their blade and the quality is unquestioned. In days of old, blades would have been made of old steel tools and broken swords, in the case of the Scottish Dirk. I discovered this fact accidentally, later in the week when I observed to Jim that I had "messed up" one of my blades by extending the fuller groove all the way down the blade into the tang area so that a hollow will show when it is handled. The reply that this was actually rather authentic startled me, and upon explanation Jim informed me that many old dirks had been forged using broken sword pieces and since many swords had the fuller groove the full length of the blade, the dirk that was forged from it would have had a fuller extending into the tang area, just as my blade had ended up.

Let's get back to the demonstration - first draw a point on the tip of the steel rod like this:

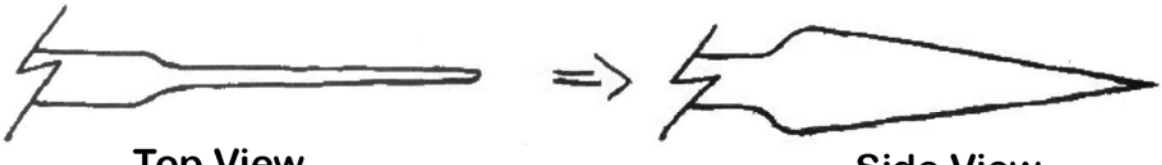


Drawing #1

Then flatten out - 4 - 5" of the rod, which is longer than the blade since you need material for the tang to be drawn from.

Drawing #2

Now start forging to shape - taper the flattened area into somewhat of a spear point shape. See below:



Drawing #3

Be aware that when the blade bevel is forged, it will gain about 1/3 of the original of the width of the flattened blade so plan ahead or the blade will be massive. The point here is to not make the flattened area too tall top to bottom or the blade will be very wide instead of having a long slender taper.

Now forge the tip a little thinner. This is so that it will form a distal taper.

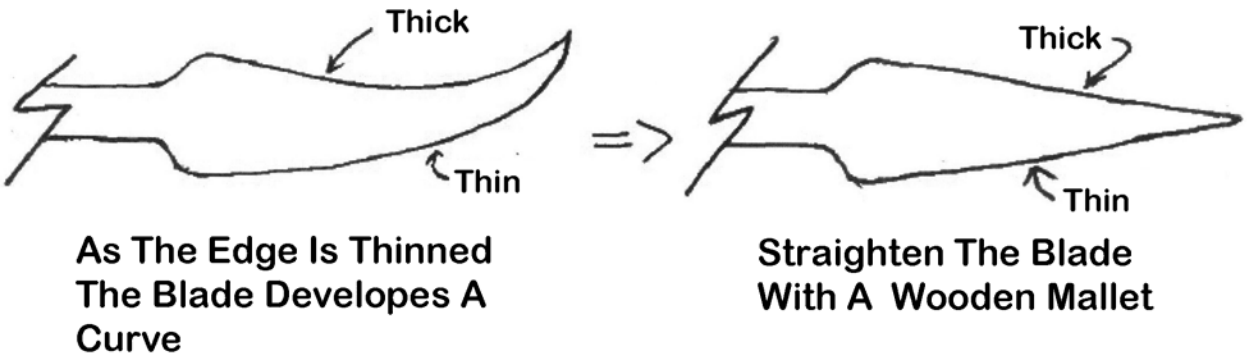
A distal taper is where the blade AND tang taper in both the thickness and the width (2 dimensions) away from the thickest point on the blade which should be located at the junction of the blade and the tang. Ideally, the taper should start at the junction of the blade and the tang and should gradually taper to the point of the blade with the thickest part of the blade being located at the junction of the tang and the blade. Be aware that the tang is tapered too, such that the thickest part of the tang is also located at the junction of the tang and the blade. We will get into that more in a little bit.

After the blade is tapered from the base of the tang to the tip, the blade can be beveled from back to edge with the edge being thinned and the back of the blade being left its full thickness.

To properly accomplish the bevel start at the tip of the blade and forge a blunt bevel all along the edge. Then forge the bevel in subsequent heats until the sides of the blade are totally flat with the bevel extending all the way from the edge to the back of the blade all the way from the tip to the tang of the blade. Actually there is no tang on the blade, as of yet, but that comes next.

When forging the bevels, make sure that the back of the blade is left thick enough to allow removing imperfections when finishing, you know - hammer marks.

As the bevel is forged, it is easy to see that the blade curves away from the thinning edge. Since you want to end up with a straight backed blade, it needs to be straightened during the forging process. To straighten the blade, place the heated blade's edge on the anvil and use a wooden mallet to straighten the blade. This method tends to cool the edge where it touches the anvil and prevents the edge from deforming much, and the wooden mallet will not deform the back of the blade much. Note that if you hammer hard, you WILL make the edge fold over, so hammer lightly and take your time, the blade will straighten while only blunting the edge ever so slightly.

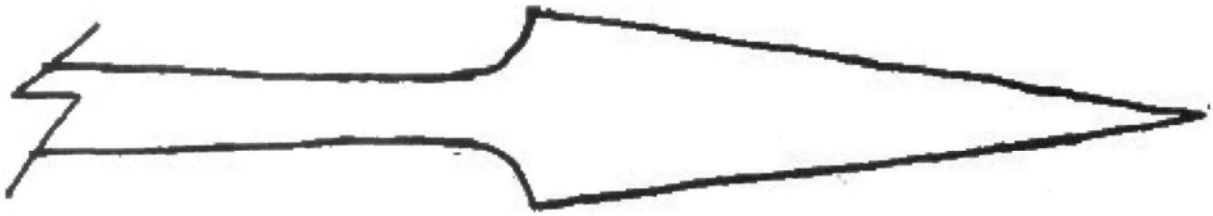


Drawing #4

Note that the blade should be about 95% finished at this point. After finishing the forging and straightening of the blade, fuller down at the point where the base of the tang is to begin, using a 3/8 inch diameter fuller. Leave the tang about 3/8 inch tall, top to bottom where it is fullered. This leaves a lot of material to work with when the tang is forged which results in a strong tang, and it is easier to take material off later than to put it back, or to have a weak tang as a result of excessive thinness.

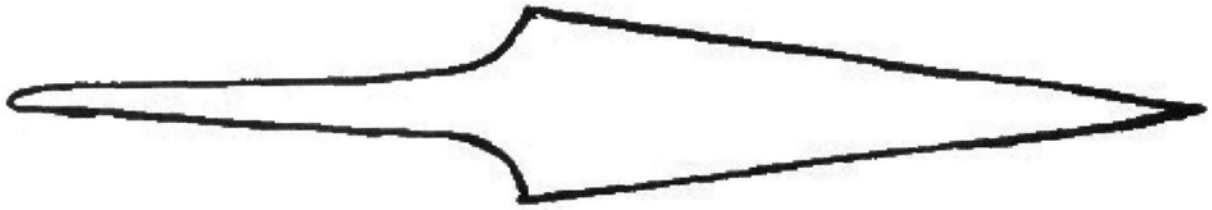
Drawing #5

Then flatten the base of the tang to straighten out the fuller cuts.



Drawing #6

Continue to flatten and draw the tang out before cutting off and drawing the tang into a taper to the point. Make the tang thinner as well to form the distal taper on the tang as well as the blade. Again, this taper is in two planes thickness and width, with the heaviest metal being at the base of the tang.



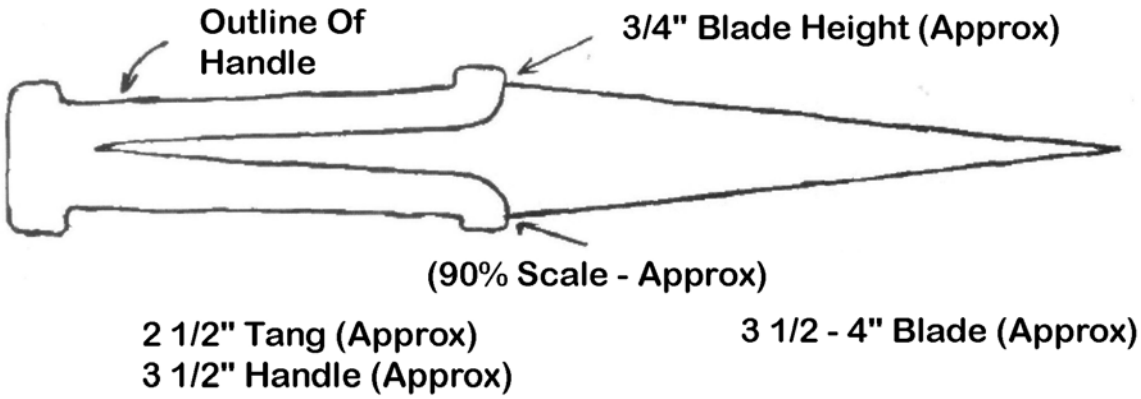
Drawing #7

-A good rule of thumb for tang lengths is to make the tang 415 (80%) as long as the blade if a wood dandle is to be installed and 3/5 (60%) as long as the blade if making an antler handle.
-After the tang is done it is time to finish the last 5% of the blade.
-Check for straightness from BOTH ends. Make sure the blade is straight. Check that edge is in center of the blade. Make sure it is centered.
-Check that the point of the blade and the point of the tang have the entire blade/tang in one straight line between them - again, from BOTH ends.
-After the blade is fully shaped, it is time to normalize the blade so that it may be worked and finished.
-To normalize the steel, bring the knife to critical temperature - just below a scaling heat (approximately 1650 degrees F) then let it cool down over approximately 5 minutes in still air to a black heat (- 1000'F).
-Then lay the blade on something with NO water on it to finish cooling - not on a cool piece of iron either. Let it air cool to room temperature.
-Be careful not to handle it roughly while at the higher temperatures as it will change shape and waste all the work that was just put into it to get it straight and true.
-Normalizing leaves the steel soft enough to work with files

DESIGN CONSIDERATIONS FOR THE SGIAN DUBH HANDLE:

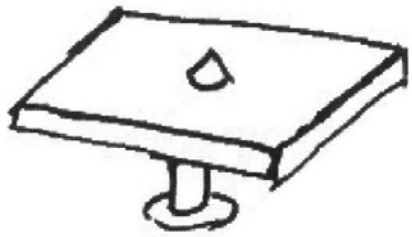
Jim TRACES the blade five different times. This gives him up to five opportunities to change the design before he starts actually making the handle. Trace the blade and tang, add any reflective surfaces that are to be included in the blade, trace in the shape of the handle and the top/bottom view of the handle. All this tracing will allow visualizing the look of the final finished knife, including the blade and the handle so that with five design attempts the best possible overall look can be achieved.

Other considerations, in the design of the Sgian Dubh is that the tang should be about 2 1/2 inches long, the blade 3 1/2 to 4 inches long and the depth of the blade, top to bottom at it's widest point should be about 3/4 inch. The total handle length should be about 3 1 /2 inches long. See the drawing, below.



Drawing #8

Sgian Dubh



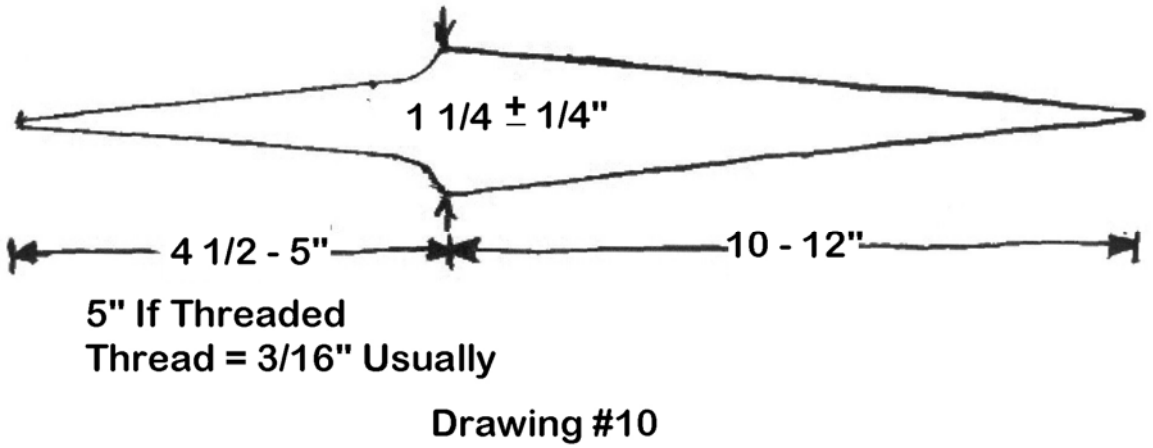
Drawing #9

I learned an interesting technique (trick?) for drilling a hole exactly in the CENTER (or at least in an exact desired location and line) of the handle. Take a small square of plywood and drive a large nail through it, leaving the nail point sticking through the plywood a quarter of an inch. The plywood/nail mechanism is used as a center, similar to the center used on a lathe. Insert the correct sized drill bit into the chuck of a drill press and run the bit down to the drill press's platform. Place the plywood mechanism on the platform and line up the tip of the drill with the point of the nail and firmly clamp the plywood mechanism to the platform. Mark and center punch BOTH ends of the handle material for the line of the hole that is desired - I marked the center of the top and bottom of the wood piece I was to use for the handle. If one is using a piece of antler or other non-uniform material, the punch marks may not be centered. Anyway, this method insures that the hole that is drilled in the handle will be in a direct line with the points that are punched in the ends of the handle material. After we made Sgian Dubh blades and handles for practice we began learning the finer points of the design and manufacture of the Scottish Dirk.

First, the dimensions for a Dirk:

The back, base of the blade should be at least 1/4" thick. The tang should be about 4 1/2 to 5 inches long (5 inches if the tang will be threaded to install the handle) and the blade should be 10 to 12 inches long. If the tang is intended to be threaded, usually a 3/16" diameter thread is used. This means you should leave a slightly larger diameter cylindrical end on the tang so that it can be filed round and then threaded.

To forge a Scottish Dirk first begin by forging a point on the end of the file, bar or rod. Note that one should use a large enough piece of iron so that the thickest part of the blade can be formed without upsetting or welding. Jim provided 1/2 inch (maybe 7/16 inch) round 1095 steel for the class to use, which was plenty large enough. I have begun some blades since then that I have used files to forge. I would



Drawing #10

suggest that if using a file, make sure it is a fairly thick file, even if not a full 1/4 inch thick. You will find as you forge the width of the file down the material gets thicker - since you are actually upsetting the material when forging the width narrower.

Back to forging a Dirk blade:

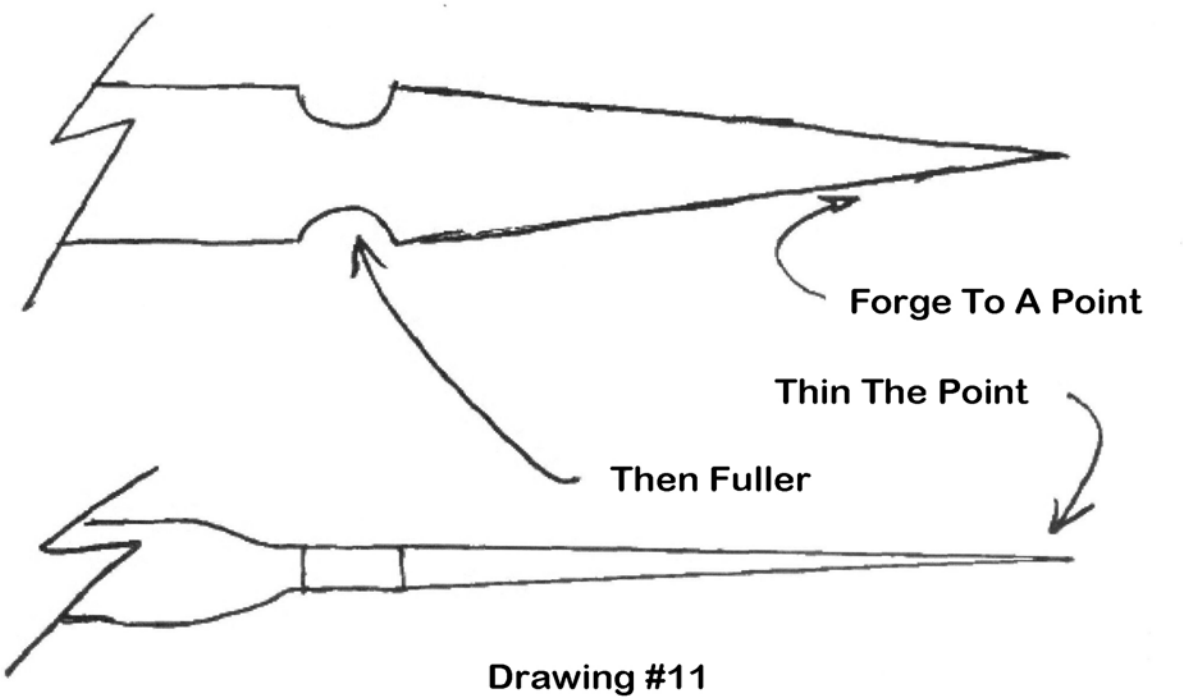
First forge a point on the end of material to form the tip of the blade. In subsequent heats forge the blade into a long slender taper all the way from the tip to the area you plan on fullering to make the tang. The width of the blade from top to bottom at this point will be narrower than the finished blade, since as you forge the bevel the blade WILL get considerably wider. After tapering the width from tip to tang area, forge the thickness thinner so that you make the tip very thin and taper thicker up to the tang area. This completes the distal taper for the blade. Forge the bevel all along the blade beginning with a blunt taper along the blade's edge on the first pass, and then in subsequent heats continue forging the bevel, flattening the sides of the blade until the bevel extends the entire width of the blade (edge to back) along the entire length of the blade.

NOTE: make sure you leave the back of the blade a little thicker that the finished blade is desired to be when forging is complete. This allows you to thin the blade to straighten it, if for some reason after beveling the blade there is a lot of curving left in the blade. You will be able to straighten it by forging the back of the blade thinner.

As the bevel is forged and the blade curves up at the tip, keep in mind the straightening techniques described above in the Sgian Dubh using a wooden mallet on the curved back of the blade and with the edge of the blade held against the anvil. Remove the curvature as things progress since it gets harder to straighten without damaging the blade edge as the edge gets thinner. Once you have rough forged the entire blade - start at the base of the blade and smooth, straighten and thin any thick areas all the way to the tip.

For those that want to fuller a groove down the length of the blade, now is the time to do that. To forge the groove, take a 1/4 inch round rod and bend the end over. When used to make the groove the rod is used with the end turned up. Hammer the rod into the blade on a line that extends from the tip to the top of the tang OR in a line to the clip pane rather than the tip. The groove will be nearly parallel to the back of the blade and will not extend to the tip but will "fade out" before it extends to the tip. The tip of the 1/4 inch rod is turned up to keep the end of the rod from digging into the blade in the bottom of the groove. This results in a smoother bottom to the groove and makes it easier to finish the groove. Now that the blade is just about totally forged, it is time to fuller down for the tang. To accomplish this

use a 1/4 inch diameter round rod and hammer it down into the edge of the bar (or file) at the base of the blade, flip the blade over and do the same on the other side. Make sure you leave about 3/4 inch width at the start of the tang for the Dirk, it is a long blade and tang and therefore requires a strong tang to be able to withstand the magnified forces resulting from that length.



Drawing #11

That is all you need to fuller for a dirk.

Cut off for the tang about 1-1/2" down from the fuller (or at least make the cut far enough down to allow a good strong, long tapered tang to be forged - again, it is easier to take material off later than to put it back). This is the material you will need to draw out the tang.

Now let us review. You should point and thin the blade BEFORE you fuller for the tang. This is so that you will not have a thinned (can you say weaker?) area on you blade while you are forging on it. Have you ever forged a leaf after necking it down to separate the material to make the wide leaf area, and then have it break off while you were forging on it? I have and it is infuriating. Well if you do the thinning first, you are inviting disaster. So, forge the blade first and then fuller for the tang, draw the tang and clean it all up - do it in that order and you will have a much greater success rate and a much stronger tang, too. Jim went over some of the finer aspects of the art (or science?) of metallurgy for the class. I will try to cover the basics here. We were using 1095 steel on our blades, the same material used to make modern files. 1095 steel is mostly iron with 0.95% (95 points) carbon content.

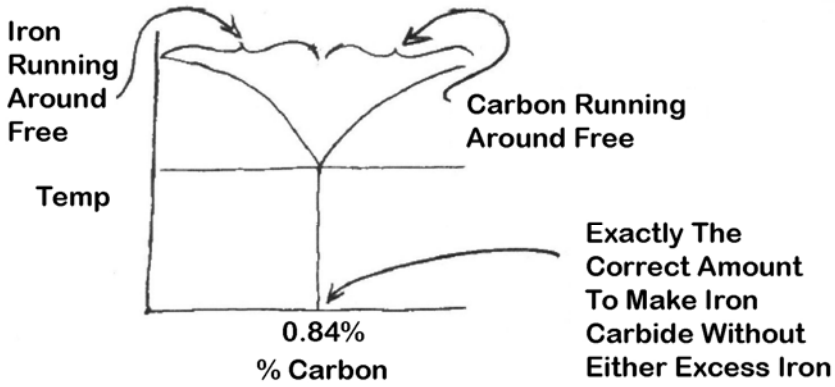
Jim reported that dirks of old had been made of steels in the ranges for 1070 to 1040. In other words, they had a carbon content of 0.7% (70 points) down to 0.4% (40 points).

Then Jim got to the good stuff. These steels are known as water hardening steels. Other water hardening steels available to modern blacksmiths are WI and W2, 1084 and 1084 with Manganese. He used the words "cherish them" when talking about the modern steels.

Being a little more specific - W 1 is 1% (100 points) carbon, otherwise it is the same as 1095 steel. W2 is basically the same as W 1 except it has some Vanadium content which is a grain refiner. A small grain structure is very desirable in blades as it makes them have greater toughness and less brittleness tendencies.

Jim seemed to have a great appreciation for 1084 steel. He said "it is the best of the 10 series steels, they just quit making it." There is still some of it out there but the supplies are drying up. He justified his assertion that this is the best steel by informing us that 0.84% (84 points) carbon in iron is the exact amount to fill the crystalline structure carbon occupies in steel without have a surplus or a shortage of carbon in the matrix. This results in the best metallurgical mix for hardening and tempering.

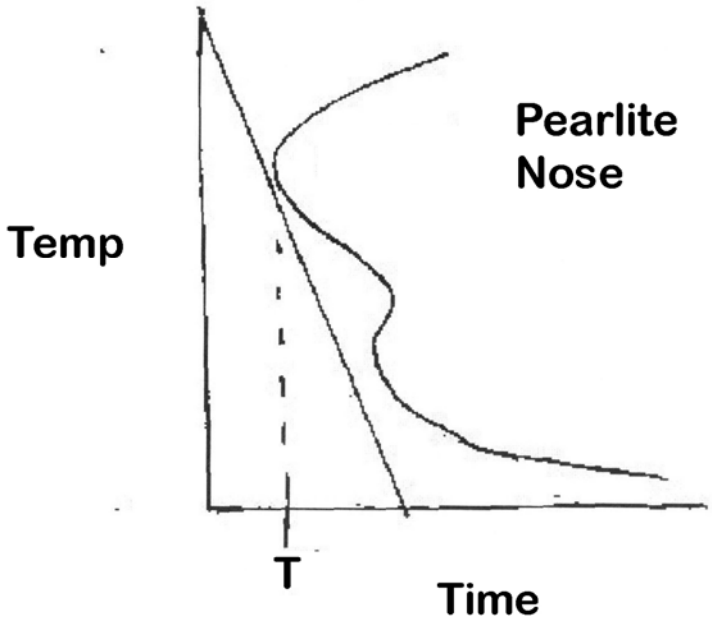
Lastly Jim stated that 1084 with Manganese was "the best steel there is, and here is why." He then started drawing a equilibrium phase diagram for iron and carbon (see the diagram below). For those of you who know what an equilibrium phase diagram is, this will be easy, for those that do not, I will TRY to explain as best I can. **REFER TO THE DIAGRAM BELOW - drawing #12.** In the case of this diagram, the term "phase" signifies where the solution is a solid or a liquid. Basically the diagram represents a graph of temperature versus carbon concentration in iron. View the carbon concentration in iron as if you had a solution of carbon in iron. There is a point where the graph has three regions that meet at one point. The region above the curves signifies the temperatures above which the solution is a liquid (molten) at varying concentrations of carbon in the liquid phase. The inclined curves represent the temperature at which the solution will melt at a given carbon concentration. If you view the solid steel cubic matrix as having a certain number of "holes" available for carbon to fill, the two regions on either side of the bottom of the curves represent the solid form of the solution with varying amounts of carbon in the solution. The region to the left of the vertical boundary between the two lower regions represents the solid solution with less than enough carbon to fill all the "holes" in the solid matrix, and the region to the right represents the solid solution with more carbon than is necessary to fill all the "holes" in the solid-matrix. The vertical line between the two lower (solid) regions is the concentration of carbon in the solid solution that has exactly enough carbon to fill the "holes" in the solid solution matrix. The condition where you have exactly the concentration of carbon to fill all the holes" without having an excess of carbon in the matrix is called the equilibrium concentration, in this case. Guess what that concentration is? It is 0.84% (84 points) carbon. Thus the reason 1084 steel is the perfect steel for making blades. Manganese makes the 1084 even better, since as mentioned above, it makes the grain structure in the finished piece finer and therefore better for use in blades.



Drawing #12

For reference, critical temperature is reached in steel when the molecules are heated to a point that they are vibrating (on a molecular level) so violently that they no longer line up with each other and therefore have no polarity. This means that a magnet will not stick to the iron after it is brought above the critical temperature. In steel, this temperature is about 1650 degrees F - approximately a cherry red. That is why so many old recipes for hardening and tempering tell you to bring the piece up to a cherry red before quenching.

Next, Jim drew another drawing on the chalkboard. The curve was a time-temperature transformation curve, and looked like Jimmy Durante's nose and upper lip in profile (looking left). See the diagram below - Drawing # 13. The vertical axis on the graph represents temperature and the bottom axis represents time, and thus the name. The transformation part of the curve's name comes from the curve representing the time and temperature relationships for various forms of steel to form. If the steel is cooled slowly it allows the formation of pearlite, which is soft, if it is cooled quickly pearlite is not allowed to form and the steel gets very hard and brittle. The nose part of the curve is called the "pearlite nose" and tells you how fast you must cool the steel to make it harden well. Here is where it gets interesting. The temperature for the pearlite nose for most steels (if my memory serves me) is about 900 degrees F. For 01 steel (oil hardening) the time to the pearlite nose temperature is 9.8 seconds. For 1095 steel the time is one second. So what does this mean? Well, if you want to totally harden 1095 steel you must cool from the critical temperature to below the pearlite nose temperature (about 900 degrees F) in less than one second. To totally harden 01 steel you must cool from the critical temperature to below the pearlite nose temperature in less than 9.8 seconds. Now if you look closely at the figure below you may notice that if you start the sudden cooling with the steel temperature higher than is really needed to be at the critical temperature - say another 100 degrees higher - you will actually have a harder time getting below the pearlite nose temperature in the allotted time. This is why it is important to not start the quench at a temperature that is significantly above the critical temperature.



Time T = 9.8 Seconds For O1 Steel
Time T = 1 Second For 1095 Steel

O1 Is Softened By Annealing
1095 Is Softened By Normalizing

Drawing #13

Conversely, to soften steels (say you want to file a blade - do you normalize, or do you NEED to anneal?) the pearlite nose can guide you in that timing as well. For instance if you want to soften 1095 steel, you can accomplish it by taking much longer than one second to pass below the pearlite nose temperature - this can be accomplished by normalizing, but with 01 steel you must anneal it - so that you pass below the pearlite nose temperature over a period of time much longer than 9.8 seconds. Remember this metallurgy as you will need to recall it when I discuss the hardening and tempering of the blade a little later in this article.

For future reference, 5160 steel has a five second pearlite nose. Think about this - Jim told us that because of this intermediate time, you can get edge hardening from air cooling or even in vermiculite. In other words if you are using 5160 for a blade you would need to be careful when annealing or normalizing so as to NOT have a hard edge. You normally anneal or normalize before you file and work on finishing the blade - and you want it soft.

The basic three step method of hardening and tempering a blade is:
First, normalize - bring the blade up to the critical temperature and then air cool (or anneal it if it is steel with a long time to the pearlite nose temperature).
-Note that Jim and Chuck told us to bring the blade up to a blue heat (about 600 degrees F) before heating up to red. This is because of stresses that may have built up inside the metal - by warming up slowly, steel loses one half its strength at 600 degrees and. this means there will be much less of a chance of cracking or breaking if you heat it slowly.
Second, harden - quench the steel in oil. Some steels can be quenched in water, but why take a chance on cracking or breaking a blade you have a lot of work in by quenching too fast? A light oil works just as well without the risk.
Third, draw the temper - after cooling bring the blade back up in temperature slowly to relieve some of the brittleness and impart toughness to the blade. Jim sated that Rockwell C 59 (or 58) is best for BLADES, since if they are any harder you will have to use a diamond sharpener.
I will go through the exact process we used for hardening and annealing these blades in a few paragraphs, but for now we will have a few suggestions on making dirk sheaths.

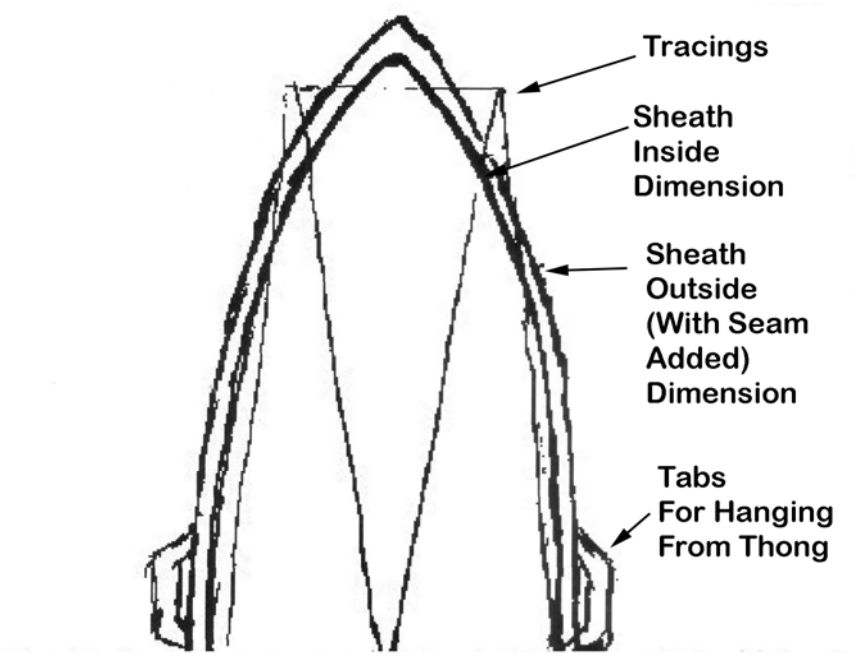
Sheaths:

Make the sheath BEFORE you put the final finish on the blade - the blade will rust since you will be wetting the leather.

First, trace the blade - both sides - mirror images onto a large piece of kraft paper (think brown paper bag) to make a pattern. You will use the pattern to cut the leather to the proper size and shape. Add 3/8th inch all the way around the pattern to allow material enough to sew the seam. Also add a tab on each side of the top of the sheath to allow a loop to be made at the top of the sheath for hanging from a thong, or maybe a belt. Make sure to leave enough extra (but not too much) to allow for the leather to shrink after wetting. See the drawing below for the details on laying out the sheath pattern.

Buy OAK tanned leather for your sheath. It forms well when wetted and tends to hold its' shape well after it dries. Cut out the pattern You may try to test fit the paper pattern to the blade if you like, but realize that the pattern has to account for the thickness of the leather, so the pattern may seem to fit larger than a piece of leather cut the same size. When forming the sheath, the seam goes in the back. Notice that the tab for the thong loop will also be in the back, in line with the seam.

Hardware can be added for a fancy sheath, and Jim discussed several possibilities along with methods of fabricating and attaching them. It seems more like jewelry work, but the effect to the overall package can be profound. We did not make sheaths, but did learn quite a bit about their manufacture.



Drawing #14

Now, back to the important topic of hardening and tempering.

The method we used to harden and temper these blades is called differential hardening, and here is how we accomplished it. Keep in mind that by the time you are ready to heat treat the blade should be at least 95% completed and FINISHED. The only finishing needed after the hardening and tempering process will be the final polish and then the hafting.

Basically, the differential hardening process involves hardening the tip and edge of the blade by quenching only those parts in oil, and then tempering (relieving the hardness) the entire blade using a torch. At his point I must mention that I assume that the blade was normalized or annealed to enable finishing work to be completed. It is important to normalize or anneal before performing the quench step.

To perform the quench in oil - prepare a pan of oil long enough to allow the entire blade and tang to be put into it. Make sure you have a long enough pan, and then put a "crutch" on the bottom of the pan of oil so that only about 1/2" of the blade edge will sit in the oil. The "crutch" is something that will sit in the bottom of the pan and the blade will rest on it as it is being quenched, and will hold the blade at the correct depth in the oil. Remember you are only quenching the edge (and the tip, of course), not the entire width of the blade. When your oil quench tank is set up the blade will need to be heated to the critical temperature before being quenched. It is IMPORTANT to heat evenly on both sides of the blade to prevent it from warping. It is also important to not bang it against anything, including the coke in the fire or the forge itself, for the same reason - these are long, thin blades and will bend very easily while hot. Use extra care to handle gently and you will not have to repeat this process because of a bent blade.

As stated earlier, another precaution that Jim and Chuck practice is that they heat the blade to a blue heat before bringing it up to a red heat. The reasoning is stated a few paragraphs above. While heating do not heat the tip until you are ready to go to the quench tank, this will help avoid burning the tip of the blade accidentally.

When the entire blade has been brought up to the critical temperature including the tip, pull the blade from the fire, and if it is above the critical temperature you will see "shadows" dancing in the color of the blade. This is actually the metal molecular structure changing from one type of cubic structure to another. Wait until the shadows disappear (do not let the blade cool off much). To me the "shadows" look like the Northern Lights dancing in the metal. When the "shadows" disappear it means that the met-

all at the same cubic structure, and if the blade was a little above the critical temperature when you brought it out of the fire, you wait until all parts are right AT the critical temperature and then you QUENCH.

To perform this particular quench, the tip should be quenched first for a count of three, then place the edge of the blade on the crutch and hold there on the crutch until the back of the blade goes black in color. At this point you have hardened the edge and tip of the blade. Immediately after the back of the blade turns dark put the entire blade into the oil and watch the bubbles rise from the hot blade to the surface of the oil. This shows that there was still a lot of heat in the back of the blade, and as a result it will be much softer than the edge.

After the quenching in oil is complete - stick the entire blade into Vermiculite to cool slowly. An interesting note is that Chuck had us stick the blade into the vermiculite vertically. I think that this not only allowed a lot of blades to be put into the vermiculite at one time, but also minimized the stresses and forces imposed on the blade while inserting them.- The "stabbing" motion of inserting the blades did not require any bending or twisting forces in the blade. This is important as there evidently is enough stresses built up during the quenching of steel that there is the possibility of the blade cracking or breaking. If I recall correctly, I think we tested the hardness of our edges before inserting into the vermiculite by running a new, sharp file across the edge to assure that it would bite and not skate on the one hand, but not dig into soft metal on the other - just as a double check. After the blade has cooled to a warm temperature (one you can touch), it is time to temper the blade. This is accomplished by first polishing the blade to a bright finish, and then using a propane torch to heat the BACK of the blade so that a blue oxidizing color moves from the back towards the edge of the blade. Stop tempering in an area then the blue color runs to the edge of the blade.

The blue color signifies a temperature of about 500 degrees, which is exactly the right temperature for tempering 1095 steel. Start at the tang and heat the back of the blade until the blue color moves to the edge of the blade and then progress further down the blade and so forth until the entire blade is tempered. BE CAREFUL near the tip, since it will heat very quickly and get TOO soft if you accidentally heat it to much. I repeat, be careful at the tip so as to not overheat it!

Pay attention to where you point the flame of the torch. If you hole the flame so that you heat the back of the blade but the flame travels forward to the edge, you will heat the edge faster than the back and get the edge too hot before you realize what you have done. This means you will have a soft spot on the edge which is undesirable. Point the flame away from the blade's edge at all times.

After tempering, once you can repeat the process of tempering a second time if you want to assure that the temper is absolutely right. Just polish the blade once again and re-temper as described above.

To get to the final finish, polish one last time or if you prefer, just leave the blade blue.

Chuck Patrick was asked about how the handles were held on in the old days. Chuck explained that a substance called Cutlers Pitch was used to hold handles on, or pewter was poured into the handle with the tang in place to secure the handle.

Chuck then gave a demonstration of pouring pewter to secure a handle. First, buy a NO LEAD, gravity pour pewter. He gets his from Nye in New York City. Pewter melts at about 350 degrees F and this allows a Kraft paper dam to be used to hold the pewter in place. So, place the tang into the handle where it is to be permanently located, and tape a heavy kraft paper dam around the front of the handle ate the same time plug any hole in the back of the handle sot paper dam will not leak out and you are ready to pour. Make sure all the holes are closed as the liquid pewter will surely run out if they are not plugged.

To melt the pewter, first heat the ladle and then put the pewter into ladle and keep heating the ladle until the pewter melts. Slowly pour the pewter into the dam, and when it is full pour any remaining pewter onto a cool metal surface to save for the next pour.

I highly recommend this class for those who are interested in the traditional methods of forging and finishing a Scottish Dirk. I love the history and the methods that our brothers practiced in days of old.

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