



# SOFA SOUNDS

APRIL/MAY 1986

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Ken Scharabok (513-252-3001)

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## MARK YOUR CALENDAR:

Unless otherwise indicated, all meetings will be held at the Studebaker Homestead on Rt. 202, four miles north of I-70. Guests and the public are invited. Bring items and tools you have made for display. Please don't park on the grass, there is plenty of parking around the production buildings, but please don't block driveways or interfere with plant operations.

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| April 5th, 1 PM  | BUSINESS MEETING followed by a demonstration of the Clayton Knot by Emmert Studebaker. This is one you won't want to miss.   |
| April 12th, 9 AM | Work on the homestead gate. Bring your forging hammers and come prepared to work. Lunch will be provided by SOFA.  |
| May 3rd, 1 PM    | BUSINESS MEETING followed by a review of the techniques used on the Whitaker Workshop project by either Mr. Whitaker or the participants.  |
| May 10th, 9 AM   | Work on the homestead gate. See entry for April 12th.  |
| June 7th, 1 PM   | BUSINESS MEETING followed by a double program. Joe Abele will give a presentation on "Elements of Design in Everyday Blacksmithing" followed by a demonstration on making spoons by Terry Garman.  |
| June 14th, 9 AM  | Work on the homestead gate. See entry for April 12th.  |
| July 12th, 1 PM  | BUSINESS MEETING followed by a horseshoeing demonstration by Dave MacDonald at the U-Forge area. Dave will forge a shoe out of barstock and then use factory shoes to reset the shoes. Does anyone have a really ornery horse we can borrow for this demonstration? Note this is the second Saturday due to the holiday. |
| July 19th, 9AM   | Work on the homestead gate. See entry for April 12th.  |

## Creative & Friendly

August 2nd, 1 PM BUSINESS MEETING followed by a workshop led by Ron Thompson on making an old-fashion beaver trap. Teams will be picked to work on the various pieces.

August 13th - 17th 1986 ABANA NATIONAL CONFERENCE at Flagstaff, AZ. This one should be well worth the trip.

#### MEETING NOTES:

Prior to the February 1st meeting, the Board and Officers met to discuss the upcoming Francis Whitaker Workshop and the 1986 Quad-State Round-Up.

- It was decided to accept ten applications for the workshop. Notices confirming selection will be sent to those fortunate enough to be selected.

- Tentative demonstrators for the 1986 Round-Up have been selected and the Round-Up Chairman, Ken Scharabok, will be contacting them to determine their interest.

Also briefly discussed was the possibility of a Boy Scout merit badge in basic blacksmithing and the desire of the 1986 Ohio State Fair to have blacksmiths demonstrate and exhibit. On the latter, they will have a building to display old hand crafts which is 150' x 60'. They would like two blacksmiths at a time demonstrating throughout the fair. They will also have suitable booth space available for selling blacksmith products. Power will be available and there will be a security guard at night. If interested, contact Mr. Sam Whitaker at 614-466-9044. The fair runs from August 1-17, 8:30 AM to 9:00 PM. Please note that this is essentially the same period as the national conference in Flagstaff. Local contact: Andrew Holly - 513-256-6494.

The raffle brought in a record \$64 to support the newsletter. Sidney member Don Herman won a broom corn fireplace broom made and donated by Findley member Dave McDonald. Rushsylvania member Ralph Van Buskirk won a pair of tongs made and donated by Lima member Bud Rolston. Dayton member Joe Abele won a large meat fork made and donated by Ralph Van Buskirk. Huber Heights member Dick Franklin won a pair of work gloves donated by Covington, OH member Terry Garman. Tim Van Buskirk won a shovel pan made and donated by Emmert Studebaker. I am really pleased to see group members making and donating items for the raffle. It displays their work, provides tools or other items for fellow blacksmiths and helps defray newsletter costs. Thanks goes out to all of you who have made and/or donated items to the raffle.

Keith Sommer brought along a "What in the world..." type iron item as sketched to the right. After the meeting Keith finally advised it was an ox yoke bow spring. The curved wooden bow was inserted through the yoke and then secured with the center stem through the bow and side clips. Sort of an early day cotter key.



Following the business meeting Ron Thompson did an excellent demonstration on sand casting which lasted about 2 1/2 hours and kept everyone's attention the entire time. His demonstration was too technical (and fast) for me to take notes, but Ron agreed to send in a summary (which follows). Attention other groups, Ron will be listed on the next ABANA Demonstrators List update as being available to demonstrate sand and other types of casting.

"At the February SOFA meeting I demonstrated casting techniques and had a wonderful time. As usual, I must have done more talking than demonstrating because I ran out of time. There is just too much subject matter to cover in so short of time and I now realize I should have limited the demo. to just one type of casting. (I would have covered a lot more if the heckling had been less - reminded me of a Blue Jay convention).

((Ron was getting a lot of "sound advice", particularly from Dick Franklin's direction. - ks)).

I promised to try to cover a system which a blacksmith with no experience could use to make castings. The casting kit available from any of the mail-order houses or locally from A&B Rockshop is a good way to get started. However, it is limited in size to fairly small castings. Other than that, it is surprisingly flexible, the sand is reusable, it will withstand all metals up to 2,000°F, it is pretty complete, etc.

For bigger molds, maybe for pouring a repair part out of aluminum or something, I like the self-setting silicate process. It is relatively harmless, containing no exotic organic compounds, and being inorganic gives off no bad fumes when poured. As a group we could probably buy sand in 100 lb bags for about \$4.50 each (not just any sand will do, we need a rounded grain of about 120 fineness). The binder would cost approximately \$3 - \$4 per quart (enough for one bag of sand), and the activator would be about \$3 - \$4 per pint which is enough to use with maybe ten quarts of binder. This is a one-shot deal with the sand being thrown away when used. You would have to supply your own flask and mixer but for about \$12 you could make a couple of pretty good sized molds or several medium sized ones. Clay/Graphite crucibles go for about \$15.

Anyone interested in pursuing the sodium silicate mold system, please contact me at the next SOFA meeting and, if we get enough interest, we'll try to order some supplies. If there is sufficient interest, I'll write up a set of instructions for using the silicate system or maybe demonstrate its use at another meeting."

The following are the sources of casting supplies mentioned by Ron Thompson during his demonstration: Local - A&B Rock Shop, 218 N. Main St., Germantown, OH 45327 - 513-855-6720. They have a good stock of investment casting supplies and the casting kit featured for \$38.75. Riverbend Art Center, 142 Riverside Dr., Dayton, OH 45405 - 513-228-1115. They have investment powder and wax and offer a nine week investment casting course for about \$61. After taking the course you can use the lab for \$.75 per hour. Mail Order - William Dixon Co., 750 Washington Ave., Carlstadt, NJ 07072 - 201-935-0100. Manufacturers of many casting items including crucibles and they manufacture the kit featured by Ron. Rio Grande Supply, 6901 Washington NE, Albuquerque, NM 87109 - 800-545-6566. Famous jewelers supply for silver, brass (manganese bronze) and gold. They also carry many tools. Allcraft Tool Supply, 100 Frank Rd., Hicksville, NY 11801 - 800-645-7124. They carry a good range of tools and related items.

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About a half-dozen members met at the homestead on February 8th to work on the gate. We are concentrating on one side to put in the internal ornamental work and for it to be a pattern for the other side.

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At the March 1st business meeting the following items were covered:

- We will begin a practice of asking people attending for the first time to introduce themselves. We will also provide name tags. Please fill one out and wear it to facilitate name remembering.

- We have a full contingent of ten smiths for the Whitaker Workshop on April 28 - May 2nd. Plan to attend the meeting on May 3rd as it will be a wrap-up of the workshop.

- Plans are progressing nicely for the Quad-State Round-Up on September 27 & 28. Demonstrators lined up so far are Dick Franklin on basic blacksmithing and Al Pendray on pattern-welded and cast Damascus (wootz) blades (see the last issue of SOFA SOUNDS).

Other items needed to put on the Round-Up are also progressing nicely for this early due to the welcomed cooperation of the group in general.

The raffle brought in an additional \$58.50 to support the newsletter. Guest David Jacobs won a pair of vice grips donated by Dayton member Al Holz. Rushsylvania member Ralph Van Buskirk won a hammer head donated by your Editor. Springfield member Joseph Weiss, Sr. won a beautiful pendant knife made and donated by Miamisburg member Scott Shoemaker (Scott also had along another beautiful knife he had made). Spring Valley member William Fleckenstein won a nice water dipper made and donated by Ralph Van Buskirk. New Carlisle member Hans Peot won a tray of assorted rivets donated by Troy member Daryle Painter. Springfield member Charles Weiss, III won a pocket pen-type magnet donated by Kettering member Ham Hammond. Dayton member Joe Abele won an Italian 50 lira coin (with a blacksmith on the back) donated by Huber Heights member Larry Gindlesberger. Huber Heights member Larry Wood won an old hinge donated by Sidney member Ron Thompson which he is adding to his collection. Ham Hammond won a ring donated by your Editor (boy is he going to be surprised when he has it appraised). We are offsetting about 2/3rds of the cost of the newsletter through this raffle - thus keeping your dues the lowest in ABANA from what I can tell.

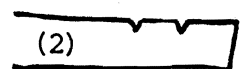
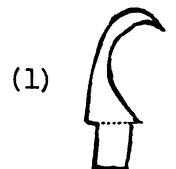
Following the business meeting Hans Peot started his program by giving a presentation on how dependent the U.S. is on foreign governments (some not friendly to us or we to them). He cited the following strategic metals and what country is the principal exporter: Columbium - Brazil, Manganese - South Africa and Gabon, Ferromanganese - South Africa and France, Cobalt - Zaire, Tantalum - Thailand and Malaysia, Platinum (which is now more valuable than gold due to the turmoil in South Africa) - South Africa and the U.S.S.R., Chromium - South Africa and the U.S.S.R., and Titanium - the U.S.S.R. and South America. He noted that this country has almost no stockpile of these strategic metals on hand.

Hans also noted that most merchant shipping is done on ships belonging to the U.S.S.R. or its satellite countries. The U.S. has only a small merchant marine fleet. Another point made by Hans is that one of the reasons good blacksmithing-grade coal (high carbon content, etc.) is hard to find is because most of it is shipped to Japan for use in their steel plants. Japan leads the U.S. in steel making even though it must import almost all of the raw material. At this point someone commented that the coal went over in U.S.S.R. ships and the steel returned the same way, to which Hans agreed.

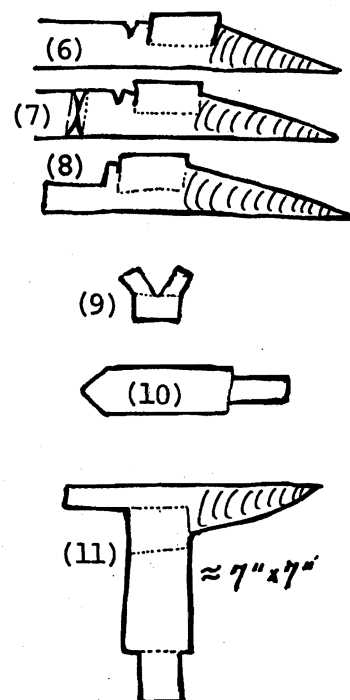
The importance of the above is that the U.S. can be blackmailed by other countries by their threatening cut off these metals or shipping or we may have to accept conditions which we may not like. Note our dependence on South Africa and the U.S.S.R.

Following this presentation Hans (with help from Larry Wood) made what he called a hardy bick but which most people considered a scroll starter. He made it out of an axle shaft of about .6 carbon and other assorted metals. He noted that metals higher in carbon should not be worked as hot as mild steel or they can fracture. He started by putting a hardy hole tenon on the end of the shaft. Once the tenon was completed he cut off enough material to complete the tool and shaped it to that illustrated (1). The base of the tool is about 1 1/4" square flanging out to about 2 1/2" at the curved end.

Following this Hans and Larry decided to make a hardy stake. They started by cutting in grooves from one side as illustrated (2). The shaft end was then drawn out to form a flat bottomed point (3) and (4). The shaft was then turned over and a crease fullered in with the sides drawn out (5) and (6). This crease



will be for forge welding to the hardy shank. The top piece was then cut off of the shaft leaving enough stock to draw out a heel (7) and (8). When completed, the "V" groove looked something like (9) when viewed from the back of the heel. For the hardy shank a groove was put about 1" back from the end, around the shaft and drawn out into a hardy hole tenon. When completed about 4" of shaft behind the tenon was cut off and tapered as shown (10) to match the "V" in the top piece. The two pieces were then forge welded together to form the complete tool (11). On both the bick/scroll starter and stake, the hardy hole shoulder was squared off by hitting it down into a swage block hole of the appropriate size. The hardy hole on the anvil could have also been used. Larry and Hans concluded it probably would have been easier to form the taper on the top piece and put the "V" groove in the hardy shank. Both of these tools will be raffled off at the April 5th meeting.



Keith Sommer brought along part of his collection of old locks to show. He has an impressive collection and gave a tentative commitment to putting a display of them out during the Round-Up.

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On March 8th, a fair number of members got together to work on the homestead gate, concentrating on one side. We hope to have this gate ready for the Round-Up. Larry Wood gave an off-the-top-of-his-head estimate of its value in the range of \$8,000 to \$10,000 due to the number of manhours involved.

#### THIS AND THAT:



The Arrowmont School of Arts and Crafts (P.O. Box 567, Gatlingburg, TN 37738 - 615-436-5860) will offer the course "Blacksmithing: The Tool as an Object" by Glen Gardner from August 11-15. For further info. contact the school.

The group has sold out of its stock of 1986 ABANA calendars. You can still order a copy from Bill Callaway for \$5.00 at 3646 W. Lawrence Lane, Phoenix, AZ 98579. On the calendar, if you know the history of the combination swage block and mandrel on the July photograph, let Stan Strickland know at 1147 Daniel Ct., Stone Mt., GA 30083.

The Anvil's Ring is now under the direction of Robert Owings and Kathleen Hogue (c/o 615 Second St., Petaluma, CA 94952). Take some time and send in an article. They do

not have to be typed as the previous editor received some on lined school paper, cardboard boxes, paper bags and anything else which was handy. Robert and Kathleen will take care of the typing, spelling, smudge marks and coal dust. Submit items you would like to see in the national publication.

Did you know that arc welding was developed, not because it was cheaper than riveting, but that a person could be taught to arc weld properly far quicker than to rivet properly? (By Stan Strickland in the Dec. 1985 ABANA President's Message).

ABANA has now received the proper documentation from the Guild of Metalsmiths in Minneapolis requesting to become a chapter. That chapter will start with 275 members.

The Society of North American Goldsmiths (SNAG) will be holding their national conference August 9-12 at Flagstaff, AZ on the campus of Northern Arizona Univ. - that's

right, just prior to the ABANA national conference. The SNAG exhibits will still be a display during the ABANA conference - another reason to attend.

"1986 ABANA CONFERENCE" T-shirts are available from ABANA T-Shirts, P.O. Box 1203, Bagdad, AZ 86321. Sizes are S/M/L/EXL in gray, green, tan and blue at \$10 each postpaid.

Reminder to start planning your exhibit for the 1986 ironwork exhibit at the national conference. There will also be displays of antique or speciality tools belonging to participants so take them along also.

Ride wanted to and from national conference. Will share driving and travel expenses. Contact Danny Downs, Louisville, KY - 502-239-3843.

ABANA is considering a group tour to the First World Congress of Artistic Smiths to be held in Aachen, West Germany from May 12-17, 1986. For further info. contact Ruth Cook, P.O. Box 303, Cedarburg, WI 53012.

The Penland School (Penland, NC 28765) will hold two blacksmithing classes this summer, June 2-6 by Ira DeKoven and June 23 - July 4 by David Brewin. Contact the school for additional details.

The Siebenthaler Nursery is creating a craft center by renting out stall space to full-time craftsmen. A 20'x36' stall would be about \$90 month plus utilities. They will run electric and water as needed. Shop set-up would be your responsibility. They already have some crafts lined up. For further details contact Dick Powell at 513-278-8697.

Summer blacksmiths needed at Stonefield Village, Cassville, WI 53806 and Penn Alps, Grantsville, MD 21536 (301-895-5985).

Mark Cusac has finished editing the VHS tapes he took of SOFA demonstrators. These will be lent to SOFA members on a "next name on the list, you pickup and return" basis. To be placed on the list call the Editor at 252-3001.

Bulk rivets are available from Park Low, The Rivet Connection, Rt. 1, Box 144, Apex, NC 27502.

The North Carolina Tool Co. (Rt. 1, Box 343, Pleasant Gardens, NC 27313) carries tools and supplies for farriers.

The national office of ABANA regretablely announced the untimely death of Pete Minier, Athens, GA on January 27, 1986. Pete was a long time member of ABANA, past President of the Appalachian Blacksmith's Ass'n and past Editor of The Anvil's Ring.

SOFA members have indicated they would like to see demonstrations on sword making, hammer head making and carving tools (I assume carving chisels). If you can demonstrate these please call Ken Scharabok at 252-3001 as we have open dates later in the year.

I understand PBS has a program on Francis Whitaker. If you see this scheduled locally please notify the Editor so word can be passed around. A PBS program I recommend your catching is "Ben's Mill" about a blacksmith working in an old mill which generates its own electricity.

Richard Postman (10 Fisher Ct., Berrier Springs, MI 49103) is researching the history of anvils and is writing a book on them. If you have an unusual or unidentified anvil, please contact him.

For a current SOFA membership list, send a 22¢ stamp to the Editor.

For you folks going out to the national conference, according to the last issue of the Southwest Artist-Blacksmith Ass'n newsletter, they are having trouble rounding up basic tools for the conference demonstrators. An ad in the same issue is asking about twice or more what the same items would go for locally (e.g., 4" leg vice for \$80 or 100 lb farrier's anvil for \$200). Thus, this may be an excellent opportunity to sell off some of your excess tools.

Attention demonstrating smiths: A recent issue of the newsletter of the Blacksmiths' Guild of the Potomac contained plans for a portable combination anvil and leg vice stand. Much like a portable sawhorse with a post on one end. For a copy of the article send me a 22¢ stamp.

A brand new 50 lb Little Giant trip hammer is being sold by Carol Sakowski, The Unicorn Forge, Rt. 1, Box 50, Barnveld, WI 53507 for \$3,600 (or about 1/3rd of its last retail list price).



The 1986 schedule for the John C. Campbell Folk School (Brasstown, NC 28902 - 707-837-2775) is: March 14-16, Jim Rubley, Knifemaking; April 6-19, Francis Whitaker, Advanced Blacksmithing; April 27 - May 3, Charlie Fuller, Blacksmithing; March 7-9, Ivan Bailey, Blacksmithing; May 21 - June 1, Mark Bokenkamp, Glen Gilmore and Ivan Bailey, Metal Intensive Workshop; June 15-21, Glen Gilmore, Damascus Pattern-Welded Steel; July 6-19, Nol Putnam, Blacksmithing; July 20-26 and July 27 - Aug. 2, Fred Caylor, Fundamentals of Blacksmithing; Sept. 7-20, Mike Rose, Sandcasting; Oct. 10-12, Jim Batson, The Forged Tool: Cutting Edge or Blunt Object; Nov 2-15, Francis Whitaker, Advanced Blacksmithing and Oct. 12-18, David Brewin, Blacksmithing. I believe the pattern-welded blades on the left were made by Glen Gilmore.

A little girl who had spent a week at a dude ranch told her father excitedly, "Dad, I even saw a man who makes horses." "Are you sure?" ask her Dad. "Yes", she replied. "He had one of the horses nearly finished when I saw him, he was nailing on the feet." (Submitted by John Jeffery from The Sunshine Magazine in the newsletter of the Appalachian Area Chapter - ABANA).

The following items are available from ABANA (c/o Ruth Cook, Executive Secretary, P.O. Box 303, Cedarberg, WI 53012):

- Treadle hammer plans including a bill of material, spring instructions, drawings, and construction suggestions. \$6.20 postpaid.

- Towards a New Iron Age, catalog of the 1982 Victoria and Albert International Exhibition of Ironwork. Includes work of smiths from Britian, East and West Europe, Japan and the U.S. along with photos and resume of artists. 100 pages, paperback. \$10.95 postpaid.

- ABANA membership list - alphabetical and zip code listings. \$12.00 postpaid.

- 1986 ABANA Calenders. \$5.00 postpaid.

- Sears 1915 "Tools, Machinery and Blacksmiths Supplies" catalog. 148 pages, paperback. \$7.80 includes shipping. We have these for sale at meetings for \$6.50 while they last.

- Back issues of The Anvil's Ring for \$8.00 each postpaid. Contact your Editor for the issues available.



GROUP BUS TO NATIONAL: Interested in going on a charter bus to and from the nation conference? Is so, contact Ron Porter (RR #1, Bunkerhill, IN 46914) at 317-689-8450 as soon as possible so he can determine if there is sufficient interest to pursue this further. Ron works second shift. Alternative contact point is Danny O'Brien at 317-675-4807. The bus would probably leave from a private residence in the Indianapolis area with adequate room for vehicle parking. Cost will depend on the number on the bus. This could be an inexpensive, comfortable way to attend this conference. Also talk to them if you are interested in the bus stopping at such points as Grand Canyon or the Meteor Crater in the Flagstaff area.

Reminder that there is a can by the finger food and soda table for donations to offset the cost of furnishing these snacks. Our objective is to breakeven on this.

The Feast of the Sainte Claire will be held at Pine Grove Park (1115 6th St., Port Huron, MI 48060) on May 24-25. It is a recreation of 18th century life at Fort Sieur DeLuth. \$15 entry fee is waived if in period clothing. For further info. contact the above address.

PATTERN-WELDING WORKSHOP. Larry Wood will hold pattern-welding workshops on March 22 & 29 if enough people are interested. Contact Larry at 513-233-6751 as soon as possible if you are interested.

The Alabama Forge Council will host a Blacksmithing Workshop and Conference at the Sloss Furnaces Museum, Birmingham, AL from April 25-27. Many demonstrators on a variety of subjects from horseshoeing to pattern-welded steel. For further info. contact Steve Speed, 2429 Kenvil Circle, Birmingham, AL 35243 - 205-834-7202.

If you are interested in demonstrating blacksmithing at the Ohio State Fair between August 1-17, contact Andrew Holly at 513-256-6494 as he is going to try to organize demonstrators for this.

Yellin Foundation Workshop, April 21-26, lead by Francis Whitaker, Jack Andrews and Fred Crist to remake the shop's missing corner gate. Additional demo. on microcomputer graphics and ironwork design. Experienced smiths contact the Yellin Foundation, 5520 Arch St., Philadelphia, PA 19139 - 215-472-3127 for further details.

If you will be vacationing in the Gatlinburg, TN area this summer, the "Arrowhead School of Arts and Craft Faculty and Staff Exhibition" will be on display at the school from May 30 - August 15. This mixed media exhibition will feature work of the 59 distinguished visiting faculty for the summer workshop program at the school and the permanent staff. Artists teaching at Arrowmont come from various studio and university settings across the U.S., with their work representing some of the leading trends in contemporary art. Two and three dimensional pieces will be included in this exhibition with media of clay, wood, fiber, fabric, glass, paper, drawing, painting, metal, jewelry, photography, enameling, basketry and printing being represented. Blacksmith and designer Glen Gardner will have pieces in this exhibition including weather-vanes, which will be the emphasis of his workshop. Gallery hours are Monday-Saturday, 8:30 AM to 4:30 PM. Admission is free. For further info, contact the school at P.O. Box 567, Gatlinburg, TN 37738 - 615-436-5860.

SOME INTERESTING INFORMATION ON PATTERN-WELDED (DAMASCUS) STEEL by Ron Thompson:

Some time ago I had the good fortune to attend a class on hand forging pattern-welded steel put on by Larry Wood. The course consisted of bringing along your own slabs of high and mild carbon steel and your lunch. Under Larry's excellent instruction, six or seven other amateur blacksmiths and I were shown Larry's method of using massive amounts of muscletone to combine the alternating layers of mild steel and



high carbon steel into a billet (or small bar) of pattern-welded steel commonly known as Damascus steel. In fact, pattern-welded is known by so many people as Damascus that I am going to refer to the process as Damascus for the rest of this article.

I had a wonderful time that winter day - wore myself completely out to the point where I couldn't grip my hammer with any force at the end of the day - and ended up with two billets of Damascus. One was made with five layers of steel, two layers of W1 steel alternating with three layers of 1020 hot rolled. The other was made with 01 and 1020. Both had seven welds or 513 layers and I put a twist in the 01 billet for a more interesting pattern effect when I made it into a knife later.

The W1 which I used was a straight high carbon steel of about 1% carbon, manganese and most of the other elements fairly low and uncontrolled. The 01 was again typical with an analysis practically the same as the W1 except it had .25% vanadium and .5% chromium. Many 01 steels have a little tungsten in them (up to .5%) but I don't think the variety I used happened to have any. The low carbon 1020 had a usual .18% to .23% carbon, .6% maximum manganese and everything else uncontrolled or too low to measure. Many smiths have noticed that 1020 is getting harder and harder to come by and is being replaced by A36. The reason is simple. It takes money to refine the carbon to a low level, so A36 has about .3% carbon instead of 1020's .2%. The same is true for manganese, so A36 has a top of .9% manganese instead of 1020's .6% maximum. Steels are considered to be low carbon up to 30 points (or .3%) carbon (so A36 is so classed) but the extra carbon and manganese make it harder, harder to forge weld, and approaches the range which gives it the ability to quench harden whether you want it or not (you usually don't or you would have used a medium or high carbon to begin with).

The reason for this rambling metallurgical discussion is that I took my sample of Damascus and gave it a basic metallographic examination and discovered something I considered very interesting and I thought you might also. A metallographic examination really consists of taking a very small sample, polishing it very highly, etching it with an acid which eats some parts faster than others, and looking at it under a microscope. Our plant's microscope has a camera so I was able to take pictures and share them with you. The acid etch which eats the grains at a different rate from the grain boundaries or the other parts makes a shadowed surface which shows what the structure looks like when you use a microscope.

So what? In order to understand why I found the pictures so interesting, I need to show what the normal 1020 (low carbon), some medium carbon, and some high carbon looks like. Figure 1. shows a photomicrograph (picture of the structure under a microscope) of various grades of steel with carbon levels from low to high. If you attended the SOFA meeting where I gave a metallurgy discussion for blacksmiths, you may recall that I said that carbon will dissolve in molten iron up to well over 4% carbon. Up to .3% carbon in iron will give a type of structure called ferrite. In Figure 1A. you can see the microstructure of a very low carbon steel with all ferrite. Ferrite is very soft. As you go up in carbon you start to get another structure called pearlite. Pearlite is a complex compound composed of alternating layers of iron carbide - also called cementite - and ferrite. Figure 1E. shows a photomicrograph of this laminated structure at high magnification and you can clearly see the layers. The cementite form is very hard - the hardest iron compound - so a layered structure of soft ferrite and hard cementite should give us a medium hard substance and that is what pearlite is, medium hard.

Figure 1B. shows a microstructure of mild steel or 1020 hot rolled. You can see the ferrite as light colored grains and the pearlite shows up as dark areas. The detail is not good enough to see the layers of the pearlite. Figure 1C. shows a .5% carbon steel which would be similar to a 1045 steel. No surprises. Same structure but now the pearlite has taken over and there is not much ferrite left. Figure 1D. shows a .8% carbon steel which is the maximum for pearlite. More carbon than this and some of the structure has to have cementite in it or above 2.0% carbon. It may

1.

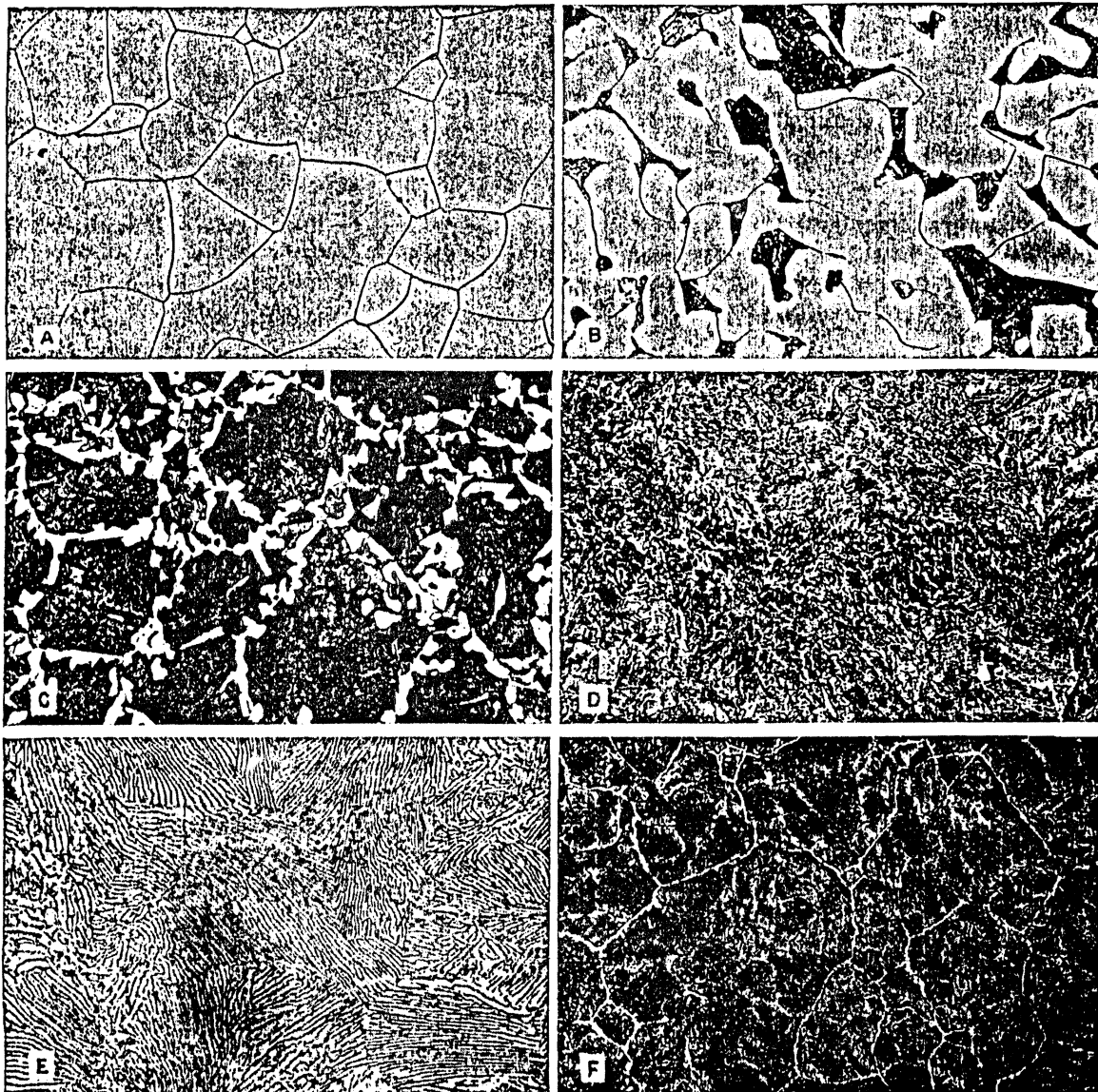
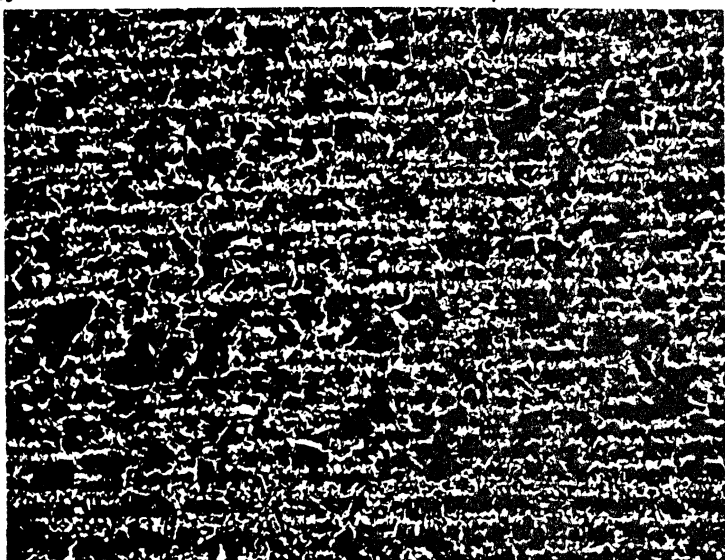


FIGURE 1. Microstructural constituents of slowly cooled carbon steels.

- A, Ferrite ( $\alpha$  iron). All grains are of the same composition.  $\times 100$ .  
 B, 0.25% carbon. Light areas are ferrite grains. Dark areas are pearlite.  $\times 100$ .  
 C, 0.5% carbon. Same as B but higher carbon content results in more pearlite and less ferrite.  $\times 100$ .  
 D, 0.8% carbon. All pearlite.  $\times 100$ .  
 E, Same as D. At higher magnification the lamellar structure of pearlite is readily observed.  $\times 500$ .  
 F, 1.3% carbon. Pearlite plus excess cementite as network.  $\times 100$ .  
 All etched with either pical or nital.

2. Damascus Steel 512 LAYERS W1 & 1020HR 8-27-85

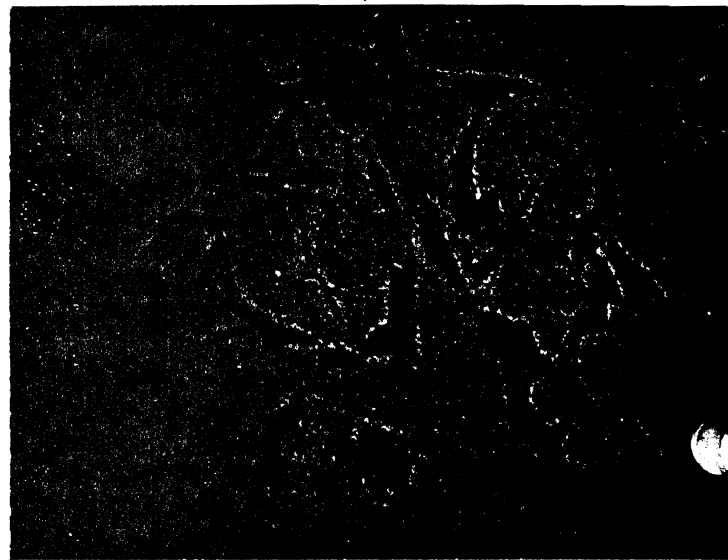


100x-etched (2% Nital) UNHARDENED

R. THOMPSON

3. 114BHN UNHARDENED

etched



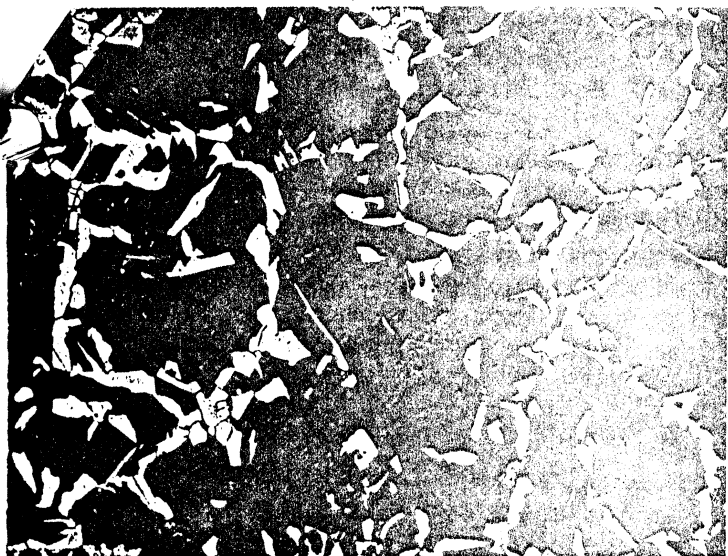
1020 HOT ROLLED 100X

Sample #2

hed

Sample I

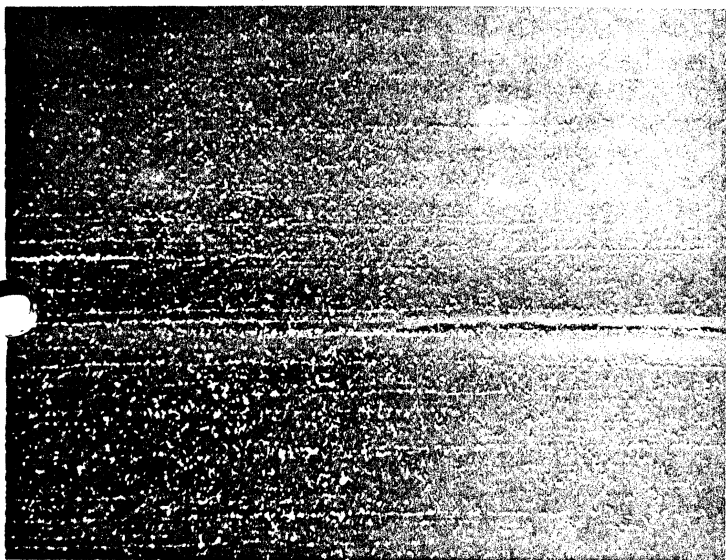
5/30/85



6" 1045 plate HOT ROLL (UNHARDENED) 193 BHN

6. W-1 Tool Steel

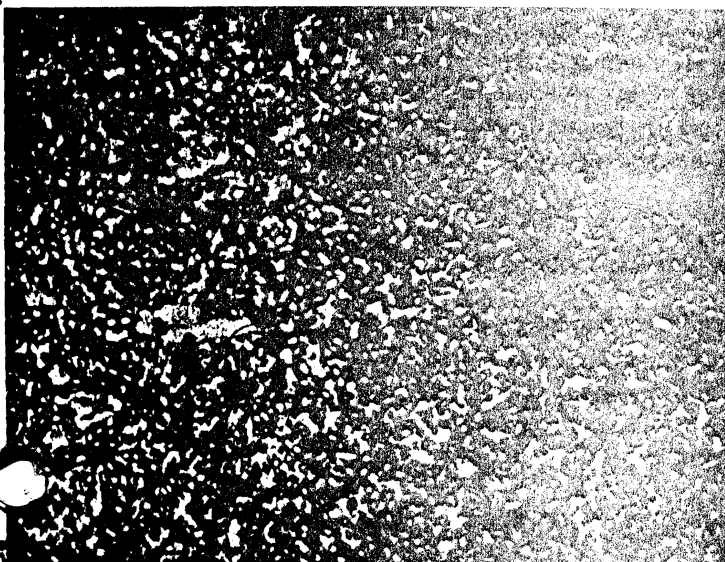
1-5-86



50X-Metal W1 TOOL STEEL UNHARDENED

8. W1 Tool Steel

1-16-86

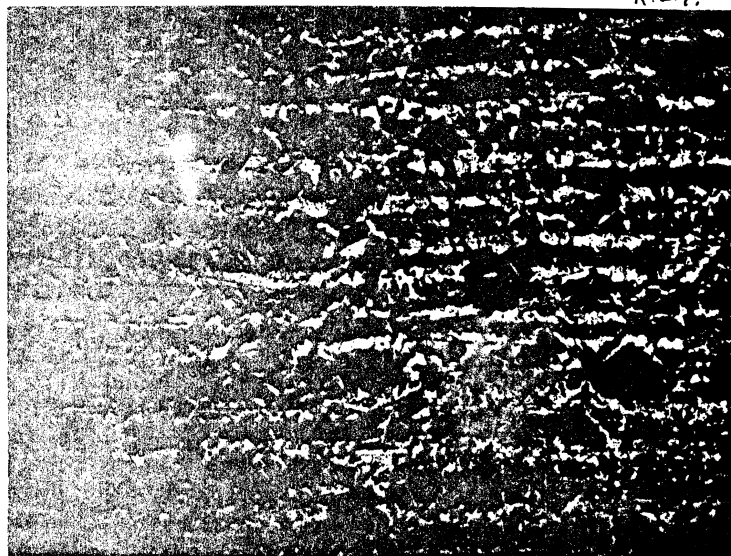


800X ch-Metal ANNEALED SHOWING SPHEROIDAL CEMENTITE

5. Damascus Steel

UNHARDENED

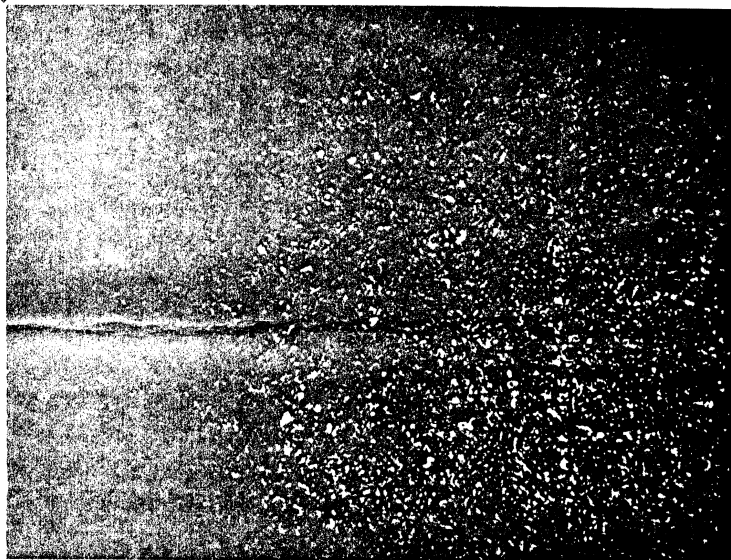
8-27-85  
R.L.T.



200X etched (2% Nital) 512 LAYERS W/ 1020HK

7. W-1 Tool Steel

1-15-86



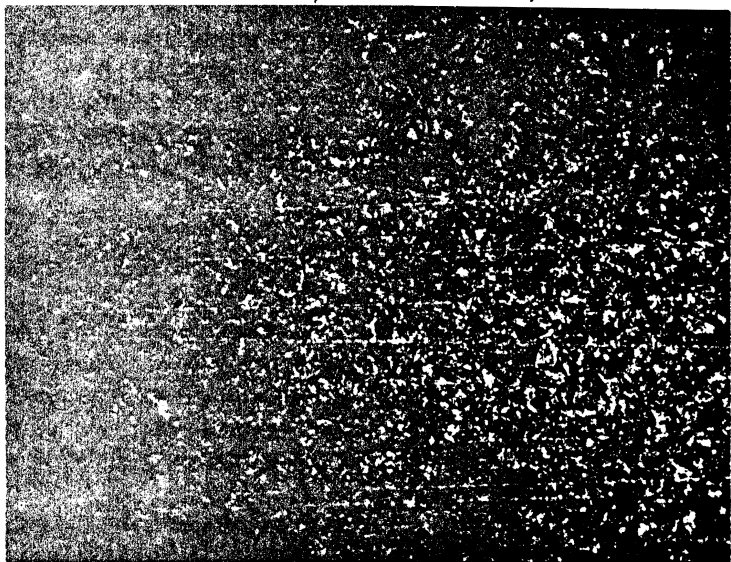
400X-Metal ANNEALED

R. THOMPSON

9. Knife Metal

PROBABLY AIR HARDENING

8-27-85



100X-etched (2% Nital) HARDENED KNIFE



have graphite (pure carbon) and be classed as a cast iron. Figure 1F. shows a tool steel (annealed or unhardened) of about 1.3% carbon. You can see the cementite in the grain boundaries. It looks about like ferrite and can fool you.

Now, what kind of structure did we get with Damascus? Figure 2. is a photomicrograph of the structure. It is interesting in that it is very oriented showing the layers clearly. It is more fine grained than I expected which should give good knife qualities. It is composed of mostly pearlite but has considerable amounts of ferrite and maybe some cementite. This, by the way, is an unhardened piece. The chemistry of mixing 1020 with W1 should yield something which would look similar to the structure of 1045 hot rolled but the forge welding process produces an unique structure all its own - Damascus.

I've also included some other photomicrographs. Figure 3. is 1020 hot rolled from our plant. Figure 4. is 1045 hot rolled, likewise. Figure 5. is the Damascus at 200X magnification. Figure 6. is annealed W1 at 50X and shows a rolling orientation to the grains. It was a ground piece when I obtained it, so it may have been cold rolled prior to finishing. Figure 7. is the same W1 at 400X and shows the fine grain to the tool steel. Figure 8. is the same W1 at 800X and clearly shows some spheriodizing or rounding of the cementite, perhaps from annealing. Figure 9. is a piece of a knife blade I obtained from an old blacksmith, Henry Palmer, at Friendship. He wanted me to look at the structure since he has had very good luck with this steel. It comes from old, worn out, shear blades from a distillery - blades used to grind the mash. I'm not use to looking at too many of these blades, but it looks like a piece of unhardened tool steel. I intend to check some further and if I learn any more about it, I'll let you know.

#### MORE ON POWER HAMMERS:

- Relating to the feature on power hammers in the Feb./Mar. 1986 SOFA SOUNDS, the following is from the Jan. 86 ABANA President's Message: "A formula for determining the approximate size of hammer required for economical forging is as follows: Multiply the area of the largest cross section to the worked by 80, if of steel (or 60 if of iron), and the product will be the required rating of the hammer in pounds. For example, the capacity of a hammer for working 5" square steel billets would be determined as follows -  $5 \times 5 = 25$ ,  $25 \times 80 = 2,000$ , which is the needed rating of the hammer in pounds. A hammer rated according to this rule is an economical size to use, although it can, of course, be employed for heavier work. This is from Machinist Handbook."

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NOTE: Your SOFA membership  
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