Viking Age Knife Handle and Sheath

by Danr Bjornson

January - February 2004

I did not make this project for any specific A&S tourney. I made it because I wanted an authentic Gotlandic-style Norse knife. However, I burned my fingers a few times in the process of forging some of the tools and iron rings that were necessary to the project, so I decided that it fit the parameters of "things made with heat" for the Tourney of Ymir 2004.

Summary

Archeological finds all over Scandinavia support the idea that a knife was a common implement. Viking Age graves nearly always include a knife, positioned as if it were worn on or suspended from the belt. Gotland's location in the Baltic Sea made it a major trading center. Dozens of knife artifacts have been found in the grave fields of Gotland, with highly decorated sheaths. These knife sheaths were the inspiration for this project.

My primary source is a collection of photographs of many Gotlandic knives and sheaths dating to the Viking Age. The knives share similar characteristics. A sheath covers the entire length of the knife, and a loop in the handle to enables the knife to be withdrawn. The sheath consists of leather cut to fit around the knife, held together with brass sheet, often decorated, that was riveted in place. The metal sheet often forms a protective end cap. Additional sheets of metal are sometimes used to reinforce the top of the sheath, and other bits of metal are riveted along the edge to hold everything together. One or more iron rings attach the sheath to a chain or strap suspended from the belt.

I cut the wood for the handle from a pear tree in my back yard. I purchased the knife blade and brass sheet, and made the rivets from copper wire. I used steel nails and wire to make the tools and rings I needed. I used both hand tools and power tools for various parts of the project.

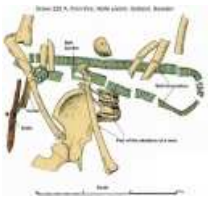
There were many steps to this project. I purchased a knife blade and modified it by grinding and acid-etching, to more closely match the Gotlandic blades' appearance. I carved a wooden handle and attached it to the blade. Then, I designed the sheath, cut the leather and metal, decorated the metal, and riveted the sheath. I also formed the iron rings, forged a spade bit to drill the handle, and made chasing tools to decorate the sheet by forging and grinding them.

I learned many things making this sheath. I did not let the wood cure long enough before using it, causing the sap to boil a bit during the heat-setting process. I learned some basic forging to make the required tools. I experimented with rudimentary acid-etching. I developed a wire-wrapping technique. I ran into a problem when I discovered, after assembling the sheath, that the brass sheet was coated in lacquer, and correcting this taught me several things. Finally, I learned to decorate sheet metal using the chasing technique.

Historical Documentation

There are many archaeological finds of knives in the Viking world. In the Norse culture, a knife was an everyday object that can be found in the graves of both men and women (Carlsson 6). The knife was usually placed near the belt area of the body (Carlsson 7).

This drawing shows the position of the knife in one such grave (Carlsson).



Note the decorative belt separator near the knife and comb. Such a piece of hardware, integrated as it is into the belt, must have been the attachment point for something the man carried at all times. The sturdiness of the separator further suggests that the attached object had a bit of weight to it. This object could have been a purse or a knife sheath, or both.

The apparent distance between the knife and the belt suggests that the knife was suspended below the belt, from a strap or chain.

Knife Handles

Usually, only the metal parts of a knife survive hundreds of years. This knife is from a female grave at Ihre in Gotland (Carlsson). All that remains are the blade, tang, and remnants of silver wire wrapped at the end of the handle nearest the blade.

A closer look at the same wire wrapping shows that the silver appears to be wrapped very carefully, one coil next to the last.

The ends of the coil, visible in the upper left part of this image, show the end tucked under the coil. Archers use a special knot to secure the ends of the string when wrapping a serving. The string is left as a loop under the coils and, when wrapping is complete, the free end goes under this loop and the loop is then pulled tight between the two ends, binding the string under the now-tightened coils. In making this project, I learned that this knot, with modifications, would work for wire wrapping.

In some cases, the blade is better preserved. An example is shown below (Carlsson), where it is possible to see the blade's shape clearly. The back of the blade has a slightly curved shape.

On rare occasions, some of the wood survived. One such example from a female grave is shown below, from several angles (Carlsson).

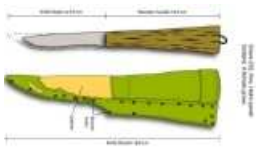

This view of the back of the handle also includes the bronze sheath, where the leather has been reconstructed to show how the bronze plates would have originally looked.

This view of the handle, as well as the bronze sheath components, clearly shows that it is not round but has an oval cross-section.

Knife handles tended to be about 10 cm long, regardless of the size of the blade. Men tended to have larger knives than women.

Sheaths

The sheaths have a similar problem as the blades -- only the metal parts tend to survive. The drawing below (Carlsson) shows the basic parts of a Gotlandic sheath. The sheath is long



enough to cover not only the blade, but the handle. This requires an iron ring in the handle to help remove the blade (Carlsson 9), though such a ring is not seen on the artifacts previously pictured. The dimensions shown here are typical of a woman's knife. The man's knives had similar size handles but the blades varied in length from 10 to

40 cm (Carlsson 7). The sheath is covered with thin bronze sheets, often decorated. These bronze sheets stiffen the leather, protect the end, reinforce the sheath opening, and provide attachment points for the rings from which the sheath hangs. Rivets hold it all together, usually placed all along the edge where the leather folds meet. The exact cut of the bronze sheets varies from one sheath to another.

One example of a sheath still in position around the knife is shown here from a female grave (Carlsson). This sheath has a tip protector, two reinforcing sheets that wrap around the stress points of the sheath (the hilt and pommel positions

of the knife), and side plates that join the other sheets together along the length of the handle. Note also that, in this example, the tang projects from the back of the handle. If this knife had a ring, it was probably attached here but has rusted away. Note also the larger hole near the middle of the side plates, where a ring or chain attached, to suspend the knife from the belt.

Another view of the same knife shows the oval shape of the handle. It is clear that the bronze sheets are very thin, and the side plates were folded over the reinforcing sheets prior to riveting.

The thickness of the sheath where the side plates join suggests that a somewhat thick leather was used in making the sheath, or that a welt (extra strip of leather) was laid in the seam. A welt would prevent the blade's edge from catching when the knife was inserted into the sheath.

Some decoration, in the form of "step pattern" cut-outs, can be seen along the inside edge of the side plates. There are also some simple chased lines visible along the edges of the plates. The decoration is very simple on this example.

A better view of the thickness of the metal, and the distance between the side plates, is shown in this picture of a sheath mount, still riveted together, from a female grave (Carlsson).

The side plates are somewhat less than 1 mm thick, and the distance between them is about 4 mm. This thickness is about equal to 3 thicknesses of 7 oz leather, which supports the possibility that a welt was placed between the edges of the leather.

Decoration

Sometimes the decoration was more complex than the simple lines in the example above. This close-up of a bronze end cap (Carlsson) shows a pattern made by rows of marks made by a technique called chasing. It further shows that the artist planned the locations of the rivet holes, as the decoration goes around them. It would, in fact, be easier to perform the chasing and drill the rivet holes before assembling the sheath.

Another example of complex decoration is shown in the side plate below (Carlsson). Below the hole for the suspension ring is a "step pattern" cut-out. Decorating the surface of the side plate are rows of triangular punches with 3 raised dots in each. This could be done with a triangular punch with 3 holes, a tool which would have been difficult to make. It is also possible, though unlikely, that the triangle was punched with the chasing technique using a triangular punch and then the 3 dots were punched from the back side using the repousse' technique. For this artifact, it appears that the craftsman applied the decoration with no thought as to where the rivets would go, because some of the rivet holes pierce the decoration. Finally, the edges of the step patterns have thin slits cut parallel to the edge. These cuts extend beyond the corner, doubtless an error made by the craftsman. These cuts make it clear that the step pattern was cut with a saw and, furthermore, that the vertical cuts in each step was made before the horizontal cuts. This side plate also shows the large hole for the suspension ring that was sometimes used to attach the knife to the belt. As with other examples, this hole is located near the middle of the side plate.

The techniques for making these decorations included sawing, filing, chasing and, perhaps, repousse'. While there are no written sources from Viking Age Scandinavia to explain how the Norse did these arts, works from later time periods can fill the gaps in our knowledge. The technology of metalworking is believed to have changed little during the Middle Ages. The main advances during that time were in the use of chemicals for parting, assaying, and pigments (Agricola 354), so it is likely that most other tools and techniques from later periods could be applied to the Viking Age.

Theophilus, a 12th-century monk, described how to make files (93) and chasing punches (92) by forging, grinding, and case-hardening iron (91, 94, 95). He describes shaping sheet metal with shears (155). He also describes chasing and repousse', where sheet metal is placed on a yielding surface and struck with a punch to produce indentations (156-157). Theophilus describes how to make and use chaser's pitch (129-130), a mix of pitch, wax, and a mineral powder such as powdered tile. Leather on a smooth anvil works as well, though it fails to hold the work stead as pitch can do. He also describes hammering metal into sheet metal (150, 156), a labor-intensive process that I was unwilling to attempt for this project.

At the Danish National Museum, I saw an assortment of tongs, pliers, hammers, chisels, files, gravers, and other tools that were likely to have been used in carpentry but some of which could also be used in metal working. The museum display did not provide any information as to where these tools were found, but the display was in the Viking Age wing of the museum. The Mästermyr find, from Sweden, also has similar tools (Arwidsson 12-17).

Finishing the metalwork consists of shaping, smoothing, and polishing. There were many abrasives available in period, chosen by their availability and effectiveness on the material being worked. Theophilus describes the process of shaping with a flat hone (102) or flat sandstone (189). He describes a variety of files (93) and wire brushes (86) for shaping and smoothing harder metals such as brass and bronze. He describes smoothing as done with a piece of oak covered in ground charcoal (102) or fine sand and cloth (152). He describes polishing with a cloth covered in chalk (102) or powdered clay tiles and water (128), or saliva-moistened shale followed by ear wax (115). Biringuccio describes shaping as done with files, smoothing with cane dipped in powdered pumice (366) or sand and water (390), and polishing using tripoli powder (366, 374), or a wheel of copper or lead covered with powdered gems (122), emery (123), or lime (372).

Bronze or Brass?

The sheath artifacts pictured above are described as being made of bronze. My theory, however, is that the metal used for the knife sheaths from Gotland was probably brass, rather than bronze.

Copper alloys are classified by the proportion of lead, tin, and zinc they contain. High levels of tin create bronze, while high levels of zinc create brass, with gunmetal in between. After lying in the ground for centuries, these alloys all tarnish and become coated with green copper oxide. The differences between them are no longer apparent without careful analysis.

I asked Professor Carlsson (the author of the source for these artifact photos) about this, and he stated that he was not certain what alloy was used for the sheaths. He referred me to a metallurgist, whose article clarified that copper alloy artifacts from Sweden and Denmark were predominantly brass, not bronze (Söderberg). Analysis of crucibles from Coppergate, another Norse site from the same time period, have shown that craftsmen tended to use whatever alloy they had, but brass was much more common than bronze (Bayley, 807). My experiments with hammering bronze into sheet have shown that it would be extremely labor-intensive, because bronze is much harder than brass and requires more frequent annealing. For these reasons, I believe the artifacts were made of brass rather than bronze.

Materials and Process

To modify the knife and create the sheath, I used elements from the artifacts shown above.

Knife Handle

I cut the wood for the handle from a pear tree in my back yard. I then sealed the cut ends with wax to allow it to cure slowly and minimize cracking until it was time to use. Pear wood is fairly hard, light in color, with a barely visible grain. The handle came from a knotty branch, so it has some interesting grain patterns.

I shaped the handle using an axe, chisels, drawknife, knife, and sandpaper, in that order. In period the smoothing function I performed with sandpaper would have been done by scrapers, but my limited ironworking skill precludes making a scraper for multiple-radius curved surfaces that the handle would require. When the handle was done, I drilled it as deep as my drill bits would allow. By oscillating the drill bit and scraping with a tiny chisel, I was able to widen the opening to accept the tang, which was thin and tapered from the blade down to the end.

The modern drill bits were not long enough to reach through the length of the handle, so I used a long steel nail to make a spoon bit. I forged the end into a rough spoon shape, then ground it until the edges were sharp. This created a spoon bit long enough to reach through the length of the handle. It worked remarkably well, penetrating nearly as fast as a modern drill bit, though it required frequent removal of the sawdust compared to the modern twist drill bits which remove the dust automatically.

I purchased the knife blade. It was made in Sweden from polished carbon steel and its profile is similar to the Viking Age knives, but the back was too angular and the blade too polished to be really authentic. The blade I purchased had a very long tang, and I needed a way to anchor the ring to the handle, so I decided to run the tang all the way through the handle and drill it for the ring. I annealed the tang, forged the end of the tang flat, and drilled a hole for the ring. To make the blade more authentic, I ground the back into a smooth profile. Then, I drew a pattern on the surface with a block of wax and soaked the blade in vinegar. The wax resisted the acid, and the result was an acid-etched blade that resembles pattern welding, at least from a distance. I finished the blade by giving it a light coating of wax to protect it from casual handling.

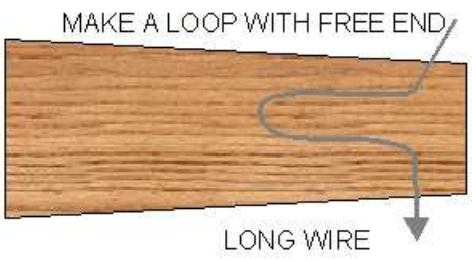
I heated the tip of the tang red hot and pounded it flat, then drilled a hole for the ring. I heated the tang again, and heat-set it into the drilled handle. I wrapped steel wire around a mandrel and sawed through the coil to form the handle ring, which I set into the hole I had drilled in the back of the tang.

To finish the handle, I applied 3 coats of beeswax. For each coat, I vigorously rubbed beeswax into the wood, then polished it smooth with a linen cloth. Beeswax protects the wood from both moisture and dryness, and would have been available to a Norse craftsman. It has the added advantage that when you hold the knife for a minute, the wax softens slightly and sticks to your hand, improving your grip on the handle. The disadvantages of this kind of finish are that it must be rewaxed periodically, and it has a tendency to pick up dirt and dust. I also decided to wrap the handle with wire, because it seems to have been a common handle decoration and I had the materials handy. I applied and polished the first 2 coats of wax, and rubbed the 3rd coat on, prior to wrapping the wire.

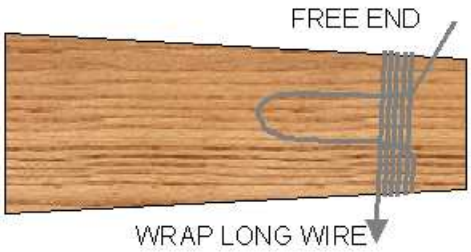
Wrapping the wire was the most challenging part of making the knife handle. As mentioned in the documentation above, my theory was that the artists used something similar to the knot used by archers in wrapping string servings. After some experimentation, I discovered a similar technique that is effective and gives a result much like the artifacts. I used 24-guage nickel wire left over from a previous project. Nickel has an appearance similar to silver, resists tarnish better, but is much harder and thus more difficult to use.

Begin with a 24-guage (0.5 mm) wire about double arms' length. Clamp the knife blade in a vise with the handle out, preferably hanging off the edge of the workbench for easy access.

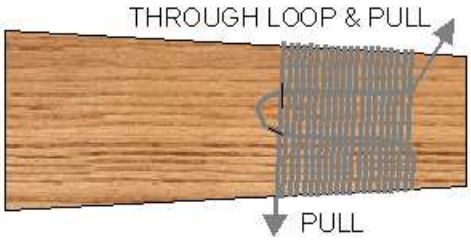
First, make a loop with the end of the wire as shown to the right. The loop should be a gentle curve, 2 or 3 inches from one end of the wire. It should lie along the handle, pointed away from the blade. Wrapping away from the blade makes it easier to wrap and to keep the wire tight.



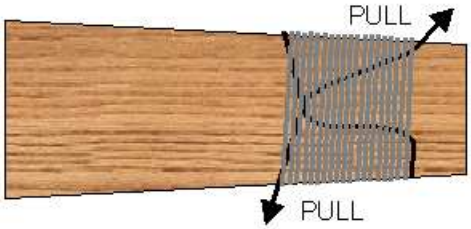
Start wrapping the wire away from the free end. Every 2 or 3 turns, pull the long end tight while you snug the wrappings tight against each other with your fingernails, so each wrap lies next to the previous wrap. When pulling the wraps tight, slide them away from the blade because the taper gets larger in that direction, tightening the wraps.



When you get near the end of the loop, or your long wire is getting short, slide the end through the loop (over then under) as shown to the right. You must resist the temptation to get "one more wrap." You need the two ends to be long enough to grab securely, with pliers or by twisting them onto small dowels. Pull the long end down firmly, and at the same time grab the free end (the one with the loop) and pull it very tightly.



The loop will slide under the wire wrappings, pulling the long end with it, as shown to the right. This tightens the wrappings as it pulls the ends underneath. The free end (upper wire in the diagram) will most likely break off. You can then cut the long end (lower wire in the diagram) close to where it comes out from under the wrappings and tuck it back under. After wrapping the wire, I polished the 3rd coat of



beeswax. This completed the knife handle. The wrapped wire makes the handle more attractive and easier to grip firmly.

Sheath

I purchased the brass sheet used to make the sheath, because making my own sheet metal would add dozens of hours to the project. I used brass instead of bronze because it is more easily available in sheets, and because I think it was probably the actual material used as discussed previously. The artifact photos show that the original bronze sheet was very thin, so I used the thinnest brass I could find.

The leather was left over from another project. I made the rivets from 10-guage copper wire. I used forging, grinding, and case-hardening to make the chasing tools from steel nails.

I began by tracing the knife's profile onto some card stock, the same approximate thickness as the brass. I cut this out, folded it around the knife, and carefully cut it down until I had a reasonable fit. I then traced this pattern onto leather and repeated the process, folding the leather around the knife and trimming until I had the fit I wanted. I then pinned the leather in place.

I measured the leather, with the knife inside, to determine the dimensions of the sheet metal pieces, and cut more cardboard to test the fit. I arbitrarily decided on 1 inch as the basic width of the side plates and reinforcing plates, because it gave the correct sense of scale compared to the original artifacts. I also decided on a simple rectangular shape to the side plates for this, my first knife sheath. I also made an end cap from cardboard. After checking these measurements, I cut the sheet metal into the 5 main parts needed: side plates (one long piece), 2 reinforcing bands, the end cap (roughly crescent-shaped), and 2 small rectangular rivet-holders.

The next step should have been to decorate the metal using the chasing technique. In my enthusiasm, unfortunately, I bent the end cap, side plates, and one of the reinforcing bands to shape before I realized I had not yet decorated them or drilled the rivet holes. Bending the end cap was the biggest challenge. To solve it, I cut some scrap wood into the same shape as the sheath end and used that as a form over which I bent the metal. Bending the other parts to shape was easy with square-jaw pliers. Chasing would have been easier while the metal sheet was flat.

As a chasing pattern, I used a simple row of triangles. The end cap's wooden form became the yielding surface on which I chased the decoration for the end cap. A rectangular strip of wood served the same purpose for the side plates. For the pieces that I had not yet bent, I used a thin strip of leather on the anvil as a chasing surface. This was my first attempt at chasing, and I had problems with the tool wanting to slip if I failed to hold it straight or hit it squarely with the hammer. This was mostly due to my inexperience, because the brass sheet was too thick for really good results, and because I had not annealed the brass. Since all the pieces except the end cap are reversible, I put the best-decorated parts to the right side of the sheath, where they are visible when the knife is worn. I also chased my signature rune into the left side.

I assembled the sheath, with the knife still in it, marked the drill holes with a center punch, and drilled the rivet holes. Generally, I drilled one hole, sank the rivet, realigned the leather, and drilled and riveted the next hole. When one piece of brass was done, I moved to the next. This procedure takes longer, but I have found it works better in keeping everything aligned properly. The exception was the side plates and reinforcing bands, which had to be done all at once. This was the most challenging part of the assembly phase. My experience with rivets was, to this point, limited to making combs and repairing my armor. Unlike antler, wood, and steel, the brass showed hammer marks for every time I missed the rivet -- I had no idea my

aim was that bad. To remove these, I used some polishing wheels (white, black, blue, and pink) in my drill press. In period, they could have removed such marks to the same level of detail using sticks or cloth dipped in abrasives as previously discussed, but I wanted to save myself a dozen hours of work.

Polishing away the hammer marks revealed a problem -- the brass sheet had been lacquered, so the polished areas shone brighter than the non-polished areas. I had to disassemble the entire sheath and burn away the lacquer, which also annealed the brass, making it much easier to work with. I then used a vinegar solution to pickle the brass back to its normal color. I tried an experiment where I copper-flashed the brass in the pickle. This gave it the exact color of bronze, but I decided it would be too vulnerable to tarnish, so I polished the brass with the blue and pink polishing wheels back to its yellow color. Finally, I reassembled the sheath with rivets and polished out the hammer marks, taking care not to damage or discolor the leather. This added a couple of hours to the project time and was a valuable lesson. In the future I will anneal any brass sheet that I use before working with it, which will burn off the lacquer and make it softer.

The exact means for suspending the sheath from the belt is not clear from my research. It may have varied. I decided to use an iron ring, which I could document, attached to a simple loop on the belt. As with the artifacts, I located the ring near the middle of the side plates so the knife hangs at a pleasing angle. I heated a steel rod until it glowed a dull orange, wrapped it around a mandrel, and sawed through it to form the suspension ring. Then, I cut a brass strip, drilled it, folded it, and riveted the leather loop in place, giving it a half twist so it would hang from a belt without twisting the knife. I decided not to decorate the brass on the suspension loop.

Conclusion

It took 4 hours to make the knife handle, 1 hour to modify the blade, and 4 hours to finish the handle, plus an hour to make the groove and wrap the wire. The sheath took 1 hour to measure and cut the leather, 2 hours to measure and cut the brass, 3 hours to chase the brass, 3 hours to drill and rivet it all together, and an hour to polish it. I do not include the time to disassemble the sheath, remove the lacquer, re-polish, and reassemble it. Making and attaching the suspension ring took another hour, for a total of 21 hours.

For my next knife sheath, I plan to do several things differently. By annealing the sheet metal, I will have an easier time working with the metals and be able to experiment with more advanced decoration. Annealing the copper wire will make riveting easier. The pear branch will be further cured with less sap to boil out and stain the wood. I will have to find a way to protect the brass after annealing, since removal of the lacquer makes the brass very vulnerable to fingerprints during decoration and assembly.

Bibliography

Agricola, Georgius, trans. Herbert & Lou Hoover, De Re Metallica, Dover Publications, NY, 1950, ISBN 0-486-60006-8. This book covers the 16th-century techniques of metallurgy, including the technological, legal, and safety aspects of surveying, timbering, mining, refining, smelting, and alchemy.

Arwidsson, Greta, and Berg, Gösta, The MasterMyr Find: A Viking Age Tool Chest from Gotland, Larson Publishing, Lompoc CA, 1999, ISBN 0-9650755-1-6. This book describes all the tools and objects from this extraordinary find, and would be of great interest to anyone who works in wood, bone, antler, or metal.

Bayley, Justine, Non-Ferrous Metalworking from Coppergate, from The Archeology of York, Vol 17 The Small Finds, Fasc. 7 Craft, Industry and Everyday Life, Council for British Archeology, York, 2000. ISBN 1.872414.30.3. This small book in the Archeology of York series focuses on the evidence for gold, silver, copper, lead, tin, and alloy crafts from the Coppergate site in York.

Biringuccio, Vannoccio, trans. Cyril Smith and Marth Grundi, Pirotechnia, Dover Books, New York, 1959, ISBN 0-486-26134-4. This translation of a sixteenth-century work contains a great deal of information on metallurgy and casting.

Carlsson, Dan, Viking Knives from Gotland, Sweden, ArkeoDok, Sweden, 2003. ISBN 91-973304-5-0, order from www.arkeodok.com. This CD, like the others in the series, offers high-quality artifact photos in an easy-to-use gallery and a good research paper to explain the subject matter.

Söderberg, Anders, Analyses of some Scandinavian early medieval cast objects, Sweden, 2000. In response to an inquiry, he sent this article to me. It originally appeared on his web site, http://members.chello.se/vikingbronze

Theophilus, trans. John Hawthorne and Cyril Smith, On Divers Arts, Dover Books, New York, 1979, ISBN 0-486-23784-2. This translation of an early twelfth-century treatise on painting, glassworking, and metalwork is one of the foremost period sources for researchers of these arts.

Various museums in Denmark. In the summer of 2000, my lady and I traveled to Denmark and visited the National Museum in Copenhagen, the Viking Ship Museum in Roskilde, the Viking Museum in Ribe, and the research/reconstruction sites at Fyrkat, Trelleborg, Jelling, and Lehre. This trip gave us ideas and research for years of projects.

Back to Danr's A&S page.