A Journey into Medieval Ironmaking

Some years ago, I wrote in these pages about my early research into the technique of smelting iron in a bloomery (Anvil's Ring, Fall 1999). For those of you just tuning in, a bloomery is a small furnace for producing iron (or steel) from its ore. The bloomery produces a mass of iron and slag, known as a bloom, that is immediately forgeable when it's removed from the smelting furnace. (In contrast, the cast iron produced in a modern blast furnace must be further refined before forging.) Bloom smelting is the original method man used to win iron from its ore, from the dawn of the iron age until the late medieval era, when it began to be supplanted by the blast furnace. The bloomery continued to supply man with iron at the fringes of western industrial expansion (e.g. Colonial America, Africa, South Asia), but had pretty much died out by the beginning of the 20th century.

Making my own iron, which I started in 1998 as a bit of a lark, soon became a consuming passion that has lasted for years, as the solutions to each problem encountered raised more and more questions. And every bloom I forged deepened my understanding of this magical stuff we call iron.

Many of my early stumblings through bloom smelting were guided by reading the publications of British and European archaeologists who have attempted to reproduce the process in order to better understand the remains of the bloomeries and iron artifacts they excavated. As I became more successful in my own attempts at smelting, I found that much of what I read about bloomery smelting in these academic publications, though often brilliant, was also often inaccurate, misleading, or just plain wrong. So in 2002, my friend Skip Williams and I wrote a paper challenging some of these ideas, which we somehow managed to get published in the journal of the British-based Historical Metallurgy Society.

Which finally brings me to the point! Last year, the Historical Metallurgy Society invited me to come to England and demonstrate my smelting techniques at their annual conference. To be held at West Dean College in Sussex on September 2 & 3, this was to be their first conference that focused on hosting experiments at the conference, rather than simply reporting on previous work. Thanks to the generous support of you all, through the ABANA Scholarship fund, I was able to scratch together enough money to go. So it only seems right that I write to share with you some of what I did, and some of what I learned, on this lovely and strenuous journey.

The Conference

I was accompanied on this trip by my pals Shel Browder and Steve Mankowski, two fine smiths from Colonial Williamsburg. Over the last few years, Steve and Shel have established a successful bloomery program at Williamsburg. We have worked together for a long time now, and so we knew we made a good team. Their presence on this trip certainly eased the anxiety I felt at the prospect of facing such a group of high-

powered intellects, in a foreign country, with unknown materials, and only the tools we could carry in a suitcase!

We were scheduled to smelt on the first day of the conference, a Thursday, and we knew we had several hard days of work to do before then. Not only did we need to build a furnace, we really wanted to do a practice smelt first, since the clay for the furnace, the air supply to blow it, and most importantly, the ore, were all unfamiliar and all vital to success. We also needed time to make all the tools that we were unable to bring with us.

So we arrived Monday morning in London, bleary-eyed and sleep-deprived after our cheap overnight flight. We were met at the airport by David Dungworth, the conference chairman, and the first of many great new friends we gathered on this trip. David drove us to the Conference site at West Dean College in time for lunch, and then we settled down to work.

The college is an incredible place. It is a craft school housed in a grand mansion built in 1804, surrounded by formal gardens and sheep pastures. They offer courses in blacksmithing, metals conservation, furniture conservation, watch and clock restoration, musical instrument making, painting, sculpture, textiles, you name it. All in the setting of an English country house murder mystery. And not only is the food in the cafeteria excellent, it has a pub attached with yummy fresh beers, ales, and cider!

It's probably not very useful here to give a very detailed description of the conference itself. For those of you interested, the conference proceedings will soon be published, if they aren't already (see the resources at the end of this article). Suffice to say it was an incredibly jam-packed two days, with 8 experimental furnaces running simultaneously, a full slate of lectures, and long evenings of discussion and laughter.

As for our part, we worked our little tails off, and our demonstrations were quite a success. I think the biggest thing we managed to communicate is the importance of a sustained practice, with hard, diligent work, and a workmanlike attention to detail. Our smelts were by far the most successful of the experiments, in terms of the actual production of useable iron. We also demonstrated a small furnace for the rapid conversion of iron to steel (see resources).

The Dig

The conference had ended up being more about teaching than learning for us. But our second week in England was all about the learning.

Our host and guide for this week was my dear friend Jake Keen, another eccentric whose life has been consumed by his passion for bloom smelting. Among other adventures Jake and I have shared, we had spent a month traveling in West Africa in 2008, searching for blacksmiths and bloom smelters. This time, the base camp for our adventure was Jake's own home, but it was an adventure nonetheless.

In wandering Southern England looking for good sources of iron ore, Jake had come across a field near Tisbury, Wiltshire that was littered with large amounts of the black slag distinctive of bloomery smelting. He had put together a team of archaeologists to begin excavating this site immediately after the HMS conference, and I enlisted on this project as grunt labor.

The mapping, geophysical surveys, and excavations over the course of the next weeks revealed a large complex of bloomeries tentatively dating from the medieval period, perhaps the 12th century. These bloomeries had been clay shaft furnaces not unlike the one we had demonstrated at the conference.

The predominant remains of a bloomery operation are large amounts of slag. Because manipulating the chemical composition of the slag is one of the main determinants of the success of a smelt, the slag from an archaeological site contains lots of information about what happened there. Though I have been smelting for years, most of the real bloomery slag that I've seen is slag I made myself, so this was a real opportunity for me to get some clues about how the masters of the past did it.

My only other visit to an archaeological bloomery site was a very brief trip to a massive 13th century bloomery complex in Burkina Faso, where I was so overwhelmed by what I was seeing that I didn't really focus very deeply on the character of the mountains of slag surrounding each furnace. Here in Tisbury, as I learned the basics of mapping, digging and recording an ironworking site, I had many days to ponder the lessons this slag had to tell me.

The first thing that struck me was how incredibly consistent the slag made by these medieval masters was. It was all very dense, iron-rich, free-running slag. In my own smelting, the slag I produced tended to vary more during the course of a smelt. And when I did make slag that resembled the medieval slag, I tended to recycle it through the furnace to get more iron out of it.

The second thing that struck me was the massive size of these slag blocks, weighing as much as 20 lbs. This led me to think these medieval masters were not recycling the slag at all, and they must have been tapping the slag from the furnace much more heavily than my practice had been.

New Directions

I returned from England to the tail end of a large and rather uninteresting architectural ironwork project, and some pretty intense financial pressure. Nonetheless, I was determined to run at least one smelt while the memories of Tisbury were fresh in my mind. I set up my furnace to smelt, and tapped the slag much more heavily than I had ever dared to before. And rather than recycling slag, and letting the bloom cook for awhile without new ore, I kept adding fresh ore until I removed the bloom.

The result was some of the best iron I had ever made. Most of the bloom iron I had made required folding and welding two or three times to make a fairly consistent bar that held crisp edges without cracking. This iron forged into a beautiful bar immediately, straight from the bloom.

Subsequent smelts have begun to fulfill the promise of this heavy slag-tapping regime. This big leap in the quality of iron I can produce was the direct result of my trip to England, and I thank you all for your help in making this possible through the ABANA scholarship fund.

Not long after my return from England, my friend Fred Crist taught a master class at the Virginia Institute of Blacksmithing. The class consisted of the reproduction of one of Samuel Yellin's gate elements. I joined the class for the final evening, when Claire

Yellin brought samples, photos, and films of her grandfather's work. She showed a film of Yellin forging the exact element the class had been trying to reproduce. The class marveled at the ease with which Yellin made this piece, in contrast to the struggles they had gone through to reproduce it. Claire pointed out that it was not only a matter of skill, but also a matter of material. Yellin specified the highest grade of Swedish wrought iron for all of his work. This iron was much more ductile at heat than our modern mild steel is.

Claire showed us a test piece that the shop made to test every shipment of iron, where the iron was split and bent to an very attenuated branching tree shape. If the iron could not do this without failing, the shipment was rejected.

This really brought home to me a realization that has been dawning on me over the last several years, as I've tried to improve the quality of my bloom iron. Our craft, especially the traditionally-oriented segment of it, is severely hindered by the material available to us. Mild steel, especially the run of the mill A-36 that we mostly use, is a very hard and recalcitrant material to forge, compared to high quality wrought iron or bloom iron.

We are repeating forms and using techniques that were developed for nice, ductile, wrought iron, and repeating them in the wrong material. It's like carving an ornate Jacobean chest out of chipboard instead of oak: sure it can be done, but at great trouble and expense, and the result will be stiff, unlively, and likely ugly. Wouldn't it be wiser to simply start with the proper material for what we want to make?

Those of us working on the problems of bloom smelting have been doing it largely to satisfy our curiosity. But now I'm beginning to realize that the real significance of this work might be much more direct and practical. Our recovery of this technology is reaching the point that I can see it is possible to make iron that is vastly superior for forging than anything we can get from modern industry. I'm convinced that we can fulfill that possibility, with enough hard work, thought, and practice from enough people.

Resources:

If you're interested in learning more about bloomery smelting, here are some web resources to check out.

www.leesauder.com

My website, with schedule of classes and workshops, bloom iron for sale, etc.

http://iron.wlu.edu/

An older website Skip Williams and I built, with lots of nuts and bolts info, and links to other sites. We are unable to access this now to update it, and it may move in the future, but you'll be able to find it through my website above.

http://hist-met.org/

Website of the Historical Metallurgy Society. You'll be able to get the conference proceedings through the publications section of this website. Also check out the datasheets in the Resources section.

http://forums.dfoggknives.com/

This lively bladesmith's forum includes "Bloomers and Buttons", where folks discuss smelting and steelmaking. Included in the "Pinned Bloomers and Buttons" section is a description of the steelmaking process we also demonstrated at the HMS conference.

http://www.warehamforge.ca/ironsmelting/

My friend Darrell Markewitz's sprawling web empire, with lots of smelting stuff.