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Making Excellent Thin Sections for Wood Identification: A Quick and Easy Method—Part I

ABSTRACT—Making thin sections by hand for microscopic wood identification is a precise exercise with often frustrating results. With microtomes being out of reach for most private conservators, it is difficult to produce good sections that include all desired information. Poor sections result in poor analysis, hence the need for an improved method.

This article explores one such method that has had excellent results. The technique combines a resin (developed for making fish lures and currently also used for forensic analysis), an embedding method for cross sectional stratification analysis, and sectioning with a simplified microtome. The method has three major advantages over conventional systems: it is fast, inexpensive (using simple tools and materials), and reliable, generating thin sections that are large enough for wood identification.

1. INTRODUCTION

This article is the first of two parts and introduces reasons for finding a way to make excellent thin sections for wood identification. The second part delves into the development of a technique.

We would like to start our discussion about making better thin sections for wood identification by beginning with two case studies that illustrate the need for an improved technique to augment the traditional approaches. The first case uses traditional hand techniques and is sufficient to obtain the desired results. In the second case, traditional hand techniques did not lead to a definitive answer; thus, we needed a better method.

Before we look at the case studies, we would like to explain our approach to identifying wood and the steps we take. I developed this three-dimensional model some years ago that begins to frame the discussion. As in all good conservation practice, we begin with the least intrusive approach—that is, a macroscopic inspection, which forms the first side of the pyramid. We observe the grain, color, smell in some cases, and density. On the second side of the pyramid, we use low magnification to observe the grain structure and basic cell structure.

The next side of the model involves connoisseurship. Is the sample we are looking at consistent with craft tradition? Are we sure we are looking at original material? Do the trade routes for the wood in question make sense? Finally, we arrive at the side of detailed microscopic evaluation. On this side, we evaluate detailed cell structure in transmitted light and, in some cases, reflected light. It is here that the process breaks down if we do not have adequate sections.

The first step is a detailed look at the wood in question using a stereoscope, or better yet, a high-magnification digital microscope (fig. 1). I find one with a polarizing filter on it is necessary for evaluating surfaces that are coated. It is in this step that one may be able to learn a good deal about the wood structure, making sectioning unnecessary at times. It can also provide information about cell structure on certain planes that make sectioning that plane unnecessary as well.

The next step in the process is selective sampling of the object, where one only removes a thin section from a certain plane. For instance, let us say that softwood is suspected, perhaps the white pine group. Visual inspection confirmed resin canals and a very gradual transition of early wood to latewood can be seen. If a radial surface is exposed, a simple, barely detectable hand sample can be taken and evaluated under high magnification to confirm smooth wall ray tracheids and large window cross-field pitting. In this case, the sampling is minimal, effective, and the answer is obtained.

Following the preceding steps, the next step in the process would involve removing a sample from the wood in question for analysis in all three principal planes. It is here that hand sectioning can be highly effective but also disappointing. In general, the less dense woods are easier to section by hand than the denser woods, like rosewood. If the desired results are not sufficient, a clearer, cleaner, and planer sample is necessary. The final step is to embed the sample. It is here that a microtome is not always available, and therefore an alternative was developed.

Now that the thought process and the steps involved have been presented, let us turn to our two cases. In the first case, a hand section was sufficient, even though it could be improved by having larger and more even sections. In the second case, hand sections were not sufficient.

2. SPOONER CHEST OF DRAWERS

Last year, I was asked by Brock Jobe to evaluate the inlay on this wonderful chest of drawers, attributed to Alden Spooner (1784–1877), as seen in figure 2. The question was straightforward. Is the banding on this chest ash or sumac? The grain structure is consistent with both choices, namely ring porous, no large rays visible, and so forth. The color of ash and sumac are close, even in their unstained or varnished appearance, although sumac can

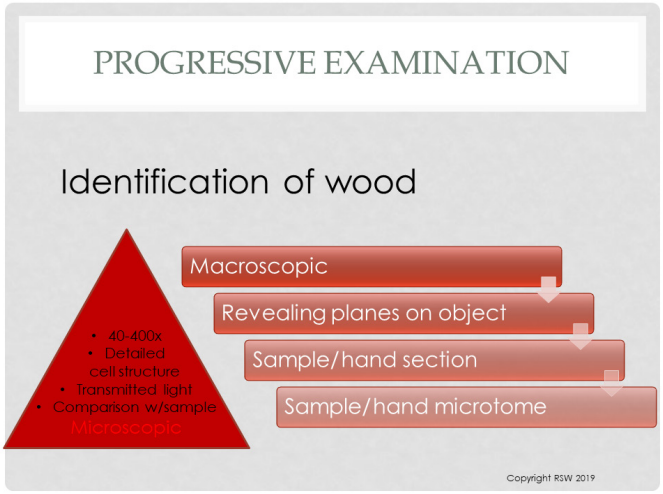

Fig. 1. Progressive process for wood identification.

Fig. 3. Ash versus sumac.

have a bit of a light brown to gray/green look, in contrast to the creamy white color often associated with ash, but they do look similar.

Both are ring porous with approximately the same early wood vessel diameter and number of rows, but it is in the latewood that we draw some distinction. The latewood vessels in ash are relatively few compared with that of sumac, and if we look closely, there is a greater concentration of latewood vessels in the later part of the latewood in sumac, which is not present in ash (fig. 3). Therefore, the goal was to learn (if we could obtain a small sample to compare the cell structure to our known samples) if we would be able to answer the question.

Luckily for me, there was a small piece of the banding that was delaminated on the proper right side of the chest. This occurred at the base level. This was the best-case scenario possible; the banding was easily removed with no damage and could be evaluated, then reattached to the object (fig. 4).

Making a good hand section from this material was almost impossible without destroying the small fragment. Viewed in reflected light, the transverse section more closely matched that of sumac, but I did not have a clear view or a full growth increment. Thus, I removed a small thin section from the side of the banding, and even though the information was fuzzy and slightly out of plane, it did reveal the one detail, specifically the presence of helical thickening in the vessels that allowed for the positive identification of sumac (fig. 5). One last thought was to confirm my assumption of sumac based on the presence of helical thickening by placing the sample under UV light. If it were sumac, it should fluoresce a bright yellow, whereas ash does not fluoresce at all. I placed the banding alongside my known sample of sumac, and both fluoresced a bright yellow. So we had our answer; the banding on the chest was sumac. The point of sharing this case is that sometimes one gets lucky. With a narrow question, a combination of a great sample location, and using a variety of

Fig. 2. Chest of drawers 5.38.11 by Alden Spooner (1785–1877). Courtesy of Old Sturbridge Village, photograph by Gavin Ashworth.

Fig. 4. Sample taken from the base inlay on the proper right side of the chest.

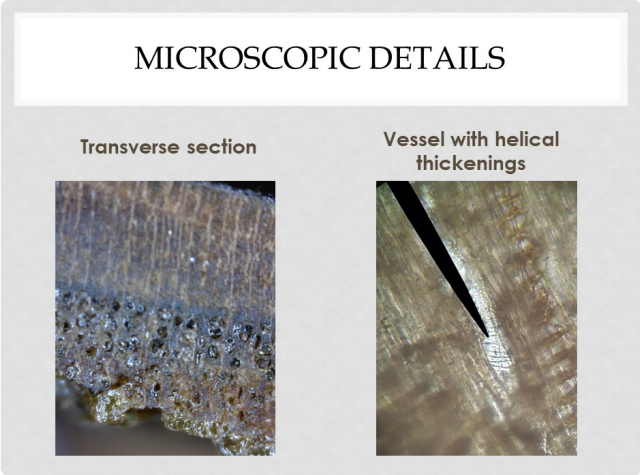

Fig. 5. Helical thickenings present in the vessel element.

techniques, even a poor thin section can be useful and sufficient.

3. DESHON BUREAU TABLE

Now let us turn our attention to a case in which a simple hand thin section was not sufficient to make an accurate wood identification. In fall 2017, the bureau table as seen in figure 6 was on exhibition at the Yale University Art Gallery in New Haven, Connecticut. It was part of the exhibition Art & Industry in Early America; Rhode Island Furniture, 1650–1830. I had the unique opportunity to attend a 2-day forum that included scholars, curators, collectors, and professionals for an in-depth look at the treasures in this exhibition. It was at this event that I first looked at the Deshon table with a critical eye. My initial impression was that the color of the wood was unlike that of mahogany—very pale in comparison to the other objects in the exhibition. Reading the description, the wood was described as "blond mahogany." After taking a closer look, I concluded that one of two things was true. Either I really did not know what mahogany looks like from the cell structure or this was not mahogany as it has been assumed to be and described since the chest's fabrication in 1764. The second thing I noticed was that the pores size did not match the relatively small and diffuse pattern of mahogany. The pores were very large and few per millimeter. In addition, the inside of a drawer had relatively wide bands of pigmentation lines. It was at this point I suggested to Curator Patricia Kane that we seek permission to sample the table for wood identification after the exhibition closes.

After receiving permission to sample the chest, a more detailed inspection was in order. My first observation was that we had a very clear and clean view of the exposed pin on the drawer side. If we now compared the Deshon sample with that of a known sample of Swietenia, the sample did not match the cell structure of mahogany. The macroscopic features that are inconsistent with mahogany are the presence of banded parenchyma; dark pigmentation lines; barely visible ray; and, by comparison, very low density. These can clearly be seen in figure 7.

It was at this point that the removal of a wood sample was necessary for traditional wood identification. Therefore, I removed the lock from one of the drawers and removed the sample along an existing cut in the wood behind the lock plate.

One of the first observations after removing a tangential section by hand from the sample was the confirmation that the cell structure of the rays was inconsistent with mahogany. However, the sample did confirm the presence of uniseriate rays that were unstoried; a feature not found in *Swietenia* spp. Unfortunately, my hand sample was not in plane across the entire field of view under the microscope due to poor sectioning of the sample. Yet, fortunately, my sections got somewhat better for the other principal planes, and I was able to discern and confirm many other features. However, I did not have enough information to make a positive identification of the wood; I was missing something,

Fig. 6. Bureau table 1765, private collection. Photograph RIF685 courtesy of Yale University Art Gallery.

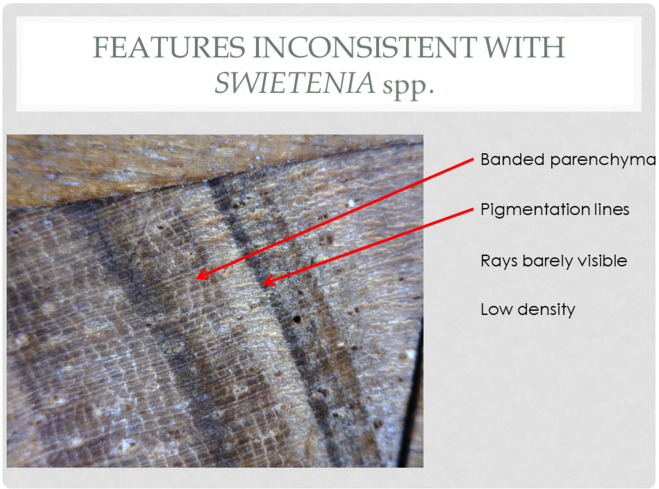

Fig. 7. Features inconsistent with *Swietenia* spp.

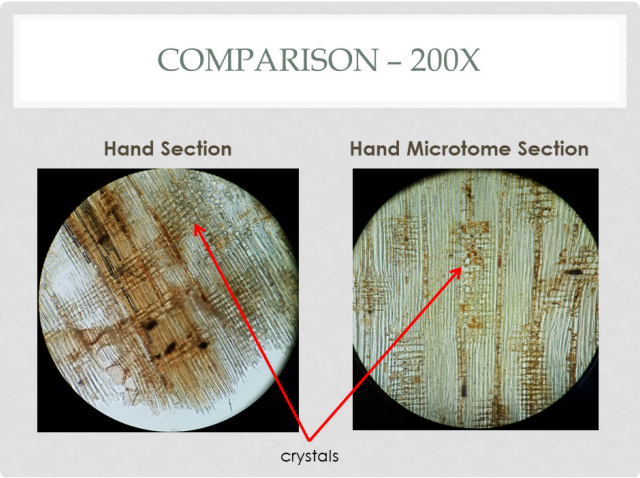

Fig. 8. Comparison of a hand section versus a handheld microtome section—radial 200x.

and this object was too important to make a mistake. It was at this point that I sought the help of Dr. Regis Miller.

I sent the sample to Dr. Miller with a list of what I thought were positively identified cell features for the sample. Note here that even with poor to relatively good hand sections, I was able to furnish Dr. Miller with a lot of information.

The one key feature I missed was the presence of crystals in both the rays and the axial parenchyma. On the left hand side of figure 8, we see an image of my hand section taken again after getting the sample back from Dr. Miller, and it can be observed that the section is not terrible but uneven and the crystals can be easily missed. What is seen on the right hand side of figure 8 is an image of the radial section, made with a hand microtome. This image provided a clear planer view, and the crystals are easily observed.

The "blond mahogany" was as I suspected—not mahogany at all but rather manchineel (*Hippomane mancinella L.*), and the reason I was not able to arrive at this conclusion was due to poor hand sections. Quite honestly, at the time of sampling, I did not have enough experience observing crystals in both ray and axial parenchyma cells.

4. CONCLUSION

The preceding two case studies show that one can arrive at satisfying conclusions for wood identification by a variety of means, sometimes even without actual sectioning. However, when there is a need to section, one would like to have the information as clear as possible. The last case study showed that better sections would likely have led to a faster identification, prompting the need for an improved sectioning method.

Please refer to Rian Deurenberg-Wilkinson's article on the subsequent development of a technique to make better thin sections for wood identification.

AUTHOR BIOGRAPHY

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