The Limits of Scientific Wood Identification

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Overview
Scientific wood identification (SWI) by light microscopic analysis (often called microanalysis) can play a critical role in establishing the value of personal or cultural property by determining definitively the material from which the property is made, and, based on that material, suggesting the likely provenance of the item. The heady allure of such power often results in people approaching wood microanalysis with unrealistic expectations. Such expectations have been fostered by some pseudo-scientists who make dubious claims but have no peer-reviewed scientific publications to vouch for their methods (the gold-standard by which such things are judged.) Appraisers, collectors, and hobbyists can too easily fall victim to the smooth salesmanship and techno-babble of such individuals. This article presents the state of the art for the limitations of scientific wood identification by the light microscope, and also presents a short table of desirable and undesirable traits in a wood identification expert, particularly for personal property.

SWI Process
Scientific wood identification depends on observing the cellular characteristics of wood at a variety of scales, and with an accompanying variety of tools ranging from the naked eye to the light microscope. SWI is differentiated from a hobbyist's identification of wood in large part by specific botanical details. Whereas a hobbyist has a connoisseurship of wood, sometimes even an excellent connoisseurship, their determinations rely on what are generally personal observations that they cannot articulate or communicate independent of the sample in question. By contrast, SWI uses specific, codified botanical details, the enumeration of which is both beyond the scope of this article and available elsewhere (IAWA 1989, IAWA 2004, Hoadley 1990, Panshin and deZeeuw 1980, etc). Ultimately, SWI depends on comparing unknown specimens to wood specimens from a properly constructed reference collection.

Scientific Names are Critical
SWI is typically accurate at the generic scale, in some cases at the subgeneric scale, and in a minority of cases, at the species level. In even rarer cases for temperate woods, but more commonly for tropical species, SWI may be accurate only at the suprageneric level. What this means in plain English is that analysis by SWI would give you results as seen in Table 1. A genus is a group of closely related species, and a species is defined on the basis of its flowers, fruits, and leaves. (Note that the word species, like deer or sheep, is both the singular and plural. In biology, there is no such things as a specie.) For example, all the oaks in the world belong to the genus Quercus, and all the pines to the genus Pinus. Spruce, while related to pine, is a different genus, Picea. Individual species within any of these genera are defined by acorns, leaves, cones, needles, and the like, not by wood. Use of the latin botanical names (the scientific name) is the professional standard for reporting wood identification results, as this makes the accuracy of the results explicit. For example, Table 2 presents a series of conventions for reporting an identification result with the scientific name. In each case, the identification is becoming more specific, and the way in which the name is written changes slightly to imply the correct result.

The Limits of SWI Come From the Wood
In the preceding paragraph, reference was made to the level at which SWI results are generally accurate. This limitation in accuracy comes from the structure of wood itself, not from a lack of effort on the part of wood identifiers. Wood was one of the first materials examined when microscopes were first invented over 300 years ago, and what we learned fairly early on is that within a genus (for example the genus Acer, the maples) the total variation across the genus is similar to the variation within a single individual, or within a species. What this means, simply, is that if you look at the wood structure of a single maple tree from the base of the trunk to the tip of each branch, and from the center of the tree out to the bark, you find nearly as many different sizes and shapes of the component cells as if you looked at twenty samples from each of ten different species of maple. This demonstrates the fundamental truth of the situation; for most genera, species-level identification by SWI is not possible.

Provenance is Determined by the Scope of the Question and the Presence of Endemic Woods
Since species-level identification is generally not possible, any determination of provenance will have to come from separating woods at the generic level. For this to provide useful information regarding provenance, a wood endemic to a given area has to be present. The genus that includes tulip-poplar (Liriodendron) is native to the United States, and absent in Europe, though the genus is present in Asia. The North American species is endemic to the United States, as is the Asian species to Asia. In comparing American and Europe, however, Liriodendron is an American wood. In most cases an appraiser would be asking "Is it American, or European?" not "Where on earth did this come from?" The former question implies certain simplifying assumptions to the wood identifier, whereas the latter is much more difficult question to answer. When the same genus exists in both North America and Europe, things can become more complicated.

For example, if you have a chest of drawers made with wood from the red pine group (a subgeneric level of accuracy), provenance cannot be definitively determined, as there is a North American species of red pine (Pinus resinosa), a European species (Pinus sylvestris), and several other species from other areas in the world, none of which are separable by SWI. If, on the other hand, the wood were a species in the white pine group (also a subgeneric level of accuracy), then an appraiser might conclude that the item is American, as there is a species of white pine east of the Mississippi commonly cut and used, Pinus strobus, and no European species in the white pine group grows large enough to produce timber of sufficient size to make a chest of drawers. Again, there are white pines elsewhere in the world, but if the question is "American or European?" then the answer is likely to be clear. The report from your wood identifier should look something like: "Specimen A is a species in the white pine group," and it may also include additional information such as, "Assuming an eastern North American origin, the specimen is eastern white pine (Pinus strobus)." It would then rest on the appraiser's shoulders to substantiate the likelihood of an eastern North American origin, by providing additional information.

Summary
The limits of SWI are based on the botanical details of the world as we find it, both in terms of the distribution of species around the world, and the structure of wood itself. The biological limitations of SWI impose certain limits on the inferences that can be made on the basis of wood identification; a professionally competent wood identifier will explicitly state these limits, using scientific names to present their determinations in a way that indicates the correct level of certainty or uncertainty, as determined by the limits of SWI.

References
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Panshin, A.J. and C. deZeeuw. 1980. Textbook of wood technology. 4th ed. McGraw-Hill, New York, NY.
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Table 1. Botanical scales of analysis for SWI with examples and scientific names.

Scale of accuracy	Common example	Botanical nomenclature	Provenance?
Suprageneric level	Fruitwood	Pyrus/Malus/Prunus etc	No
Generic level	Birch	Betula	No
Subgeneric level	White oak group	Quercus, white group	No
Species level	American black walnut	Juglans nigra	Yes

Table 2. Conventions in writing and interpreting scientific names.

Scientific name	Correct Interpretation	Provenance?
Juglans sp.	A single piece of unidentified walnut	No
Juglans spp.	Several pieces of unidentified walnut; could be many species	No
Juglans aff. regia	A specimen that looks much like European walnut	Maybe
Juglans cf. regia	A specimen that is mostly likely European walnut	Maybe to Yes
Juglans regia	European walnut	Yes

Table 3. Good and bad traits of wood identification experts.

Favorable	Unfavorable
Admits limitations of knowledge, methods, etc	Asserts that everything can be done
Expresses results precisely, employing scientific names	Uses common names or vague language to express results
Avoids making inferences for the client	Will identify provenance for client
Carefully explains specimen requirements	Promises results for any specimen
Refuses to speculate outside area of expertise	Will make guesses regarding age, etc