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TOWARDS AN 'ETHNO-BIO-PHYSICAL' VISION OF WOOD: ILLUSTRATIONS FROM WOOD USES BY INSTRUMENT MAKERS

Iris Brémaud¹

ABSTRACT: Wood, a material which has accompanied mankind all along its history, and that nowadays finds its place into current environmental challenges, still raises numerous questions regarding its complex physical behaviour and its biodiversity. While the scientific study of wood is still a fairly young (≤ 200 years?) domain, the craftsmen who use wood have developed important empirical or hand-knowledge, due to the expertise that has been transmitted throughout the history of techniques, and/or acquired by individuals through practice and senses.

The objective that we strive to pursue and promote, is to propose an integrated vision of the different conceptions of wood that are carried by wood scientists and by expert wood users/craftsmen. This led us to launch the concept of this WoodSciCraft Symposium in 2014 in Montpellier, France.

In this talk to 2nd WoodSciCraft Symposium in Kyoto, I will present a possible methodology to bridge the craftsmanship uses and knowledge of wood, together with wood physics, with some approaches from humanities and social science, and with exploration of wood biodiversity and variability. The proposed methodology is organised in 5 steps that form a "loop" starting from, and ending towards, craftsmanship utilisation and perception of wood, through steps of wood physical and natural sciences: (1) Surveys with artisans to collect wood knowledge and encountered issues; (2) Identification of underlying physical-mechanical phenomena; (3) Exploration of the diversity and variability of wood species and properties; (4) Physical-mechanical consequences of processes and treatments used in craftsmanship; (5) Analysis of the sensory perception of wood variability and properties by its expert users.

The different steps of this methodological approach will be illustrated by several works that we recently conducted on wood uses by musical instrument makers, with a focus on luthiers of string instruments, and occasionally of other organological families.

KEYWORDS: *Biological and cultural diversity, Craftsmen's surveys, Instrument making, Physical-mechanical properties, Sensory perception, Wood Science and Craftsmanship*

1 INTRODUCTION

Wood, a material which has accompanied mankind all along its history, and that nowadays finds its place into current environmental challenges, still raises numerous questions regarding its complex physical behaviour and its biodiversity. While the scientific study of wood is still a fairly young (≤ 200 years?) domain, the uses of wood by humans through centuries have developed in direct link with its material properties (physico-mechanical, chemical or biological), together with the availability of forest resource and, at the global scale, their tremendous diversity. However, this has up to now seldom been studied from a point of view that would effectively relate in a reciprocal way the approaches from physical and natural sciences, from humanities and social sciences, and from wood crafts-wo-men.

The central hypothesis of the research that we are currently conducting is that the analysis of

craftsmanship's knowledge can help us to progress together into the scientific understanding of wood, due to the expertise that has been transmitted throughout the history of techniques, and/or acquired by individual woodworkers through practice and senses.

Within the current landscape of wood research, this transdisciplinary thematic has been only scarcely approached, or from one side only. Physical and engineering sciences have been concerned with resolving technical issues, in applied fields related to mostly industrial productions on the one hand, or on conservation issues of objects belonging to material (tangible) cultural heritage. Humanities and social sciences have been looking at cultural issues in traditional crafts (anthropology of techniques) and at uses by humans of the botanical resources (ethnobotany). But the link is still very seldom done between wood physical sciences and craftsmanship knowledge or intangible cultural heritage,

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neither on the sharing and cross-perspective of the different modalities of knowledge on the wood-material.

Thus, the objective that we strive to pursue and promote, is to propose an integrated vision of the different conceptions of wood that are carried by scientists and by expert wood users/craftsmen.

This led us to launch the concept of this WoodSciCraft Symposium, that proved to be a success during the first edition held in Montpellier, France, in September 2014, organised by I. Brémaud, P. Cabroler and J. Gril [1]. Indeed, one major point in order to bridge the different visions of wood, is to establish closer relationships between the different wood experts, may they work in a natural/physical sciences laboratory, through field research in humanities, or in a woodcraft workshop.

In this talk to 2nd WoodSciCraft Symposium in Kyoto, I will present a possible methodology to bridge the craftsmanship uses and knowledge of wood, together with wood physics and with exploration of wood biodiversity and variability. The different steps of this methodological approach will be illustrated by several works that we recently conducted on wood uses by musical instrument makers, with a focus on luthiers of string instruments, and occasionally of other organological families.

2 A METHODOLOGY TO BRIDGE WOOD CHOICES AND USES BY HUMAN, WITH WOOD PHYSICS

2.1 DIFFERENT APPROACHES TO BE LINKED

In order to try to establish a stronger connexion between the different visions of wood, I proposed a methodology organised in 5 steps (Figure 1). Of course, this proposed methodology includes steps and approaches that are quite "classical" in wood science and wood physics. But the originality of the methodology that we propose is to always connect the scientific study to the actual expertise of artisans – the approach is organised in a "loop" which starts by collecting the expertise and opinion of woodworkers, and "ends" by checking the relevance for them of measured physico-mechanical characteristics, and their appreciation of studied wood material, through studies of their sensory perception of wood.

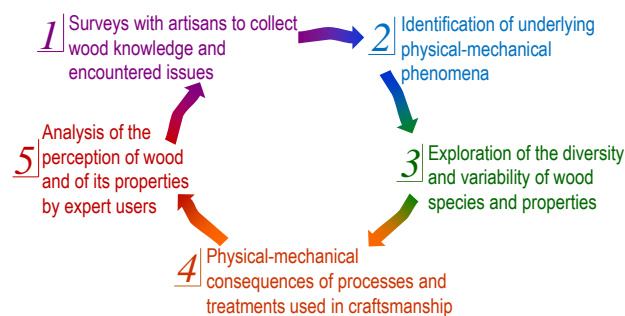


Figure 1: Schematic organisation of the proposed methodology to bridge craftsmanship knowledge together with wood physics

2.2 DIFFERENT SCALES OF WOOD USAGES TO BE CONSIDERED

Of course, wood utilisations in craftsmanship (or artisanship) can be considered along different scales in the temporal (historical evolutions) and spatial (geographical cultures) directions. We have previously discussed some challenges in studying wood physics in link with wood utilisations in some early musical instruments [2], or in comparing wood choices across instruments of different continents [3]. In this presentation, I wish to focus on analyses done in collaboration with present-day artisans, which allows better relating their stated opinions, preferences and experiences about wood, with laboratory-obtained results.

3 ILLUSTRATIONS FROM WOOD USES BY INSTRUMENT MAKERS

The uses of woods by instrument makers is an interesting field to research the interactions between craftsmanship knowledge and wood physical sciences. Indeed, the building of musical instruments combines multiple constraints both on the cultural side (woodworking techniques, visual aesthetics, musical background and playing modes, social context and meaning,...) and on the physical side (stability of slender structures submitted to variable mechanical and hygric loadings, acoustical behaviour, physical repercussions of elaborate woodworking processes and finishes,...).

However, there are also many "myths" surrounding instrument making, especially so in the media and general public. And, from the scientific research side, a pitfall to be avoided is that the "acoustics" issues are often considered as prominent, thus leading to frequent overlooking of all the other, multiple, important criteria of wood appreciation, selection and processing. Therefore, it seems particularly necessary to consider jointly the actual expertise and opinion of instrument makers, together with wood science studies, in order to understand really the complexity of wood utilisation in that field.

3.1 SURVEYING WOOD CHOICES, PROCESSES AND ISSUES OF CRAFTS-WO-MEN

Therefore, the first step of our proposed methodology, i.e. "Surveying wood uses and issues of artisans", is here particularly important. It can be done according to different modalities. For example, in an ongoing study (PhD thesis of C. Carlier), a wide survey with quantitative and detailed questionnaire is conducted with a community of violinmakers. Current results show that luthiers' opinion is much more pragmatic than the "clichés" often seen about this profession. They state wood quality to be essential for the "acoustic quality" of produced instruments, and they rank as most important in their choice some mechanically-related observations, but *in fine* their choice mostly relies on physical and visual/structural criteria [4]. They also believe that wood ageing is more important, from an "acoustical" viewpoint, at a short-term (years/decades) scale than at a long-term one (centuries), long-term being considered important for optical reasons, and they do not believe that ageing alone

can improve an instrument [5]. In other cases, more qualitative surveys, that is, detailed and free interviews with instrument makers, can help to discriminate the most important criteria of wood uses in some specialities that are less studied than violin making. Qualitative interviews can also highlight some complex physical phenomena observed by makers through their specialized practice [6]. However, two keys for this "survey" approach are that: (i) the interviewer has sufficient basic knowledge of woodworking to be a credible interlocutor; (ii) the questions asked can lead to an effective relation with wood science.

3.2 IDENTIFYING UNDERLYING PHYSICAL PHENOMENA

The second step of our approach is to identify the physical phenomena underlying the wood choice and uses by crafts-wo-men of different specialities. In some cases, characterising a "simple" set of physico-mechanical properties is a good enough description. In the case of many scientific researches on instrument making woods, this is based on vibrational properties. However, most of the time, the discourse of the craftsmen reveal much more complex, multi-factorial criteria involved in wood choice and processing. For example, in bow making, the aptitude to heat bending and retention of curvature should also be considered [2, 7]. In some cases, more in-depth analysis of the artisans' discourse is necessary, as some apparently "simple" observations can in fact reveal complex phenomena: this is the case in the work about boxwood deformations in woodwinds' making, presented during this Symposium by P. Cabroler [6]. Finally, a difficulty of this step, in all cases, is that the physical experiments must be, on the one hand, comparable to other scientific findings, while being, on the other hand, representative of workshop conditions – the two types of conditions being generally different.

3.3 EXPLORING THE DIVERSITY OF WOOD SPECIES AND PROPERTIES

The third step of the approach is to explore the diversity and variability of used species and of relevant properties. There is a huge challenge in this step: amongst the 50 000+ existing wood species around the world, mechanical properties are available for about 2 000 species, and for only 500 species in the case of vibrational properties. The systematic characterizations and databases approaches can help to progress in this issue [3, 8]. Furthermore, many specialised crafts employ "precious" and/or "secondary" wood species, which are those with usually the less physical data available. For example, there are very few large studies of the physical/acoustical properties of true rosewoods (*Dalbergia* genus), the most significant works focus on Brazilian and Indian rosewoods [9], although a great number of *Dalbergia* species (and also closely related botanical taxa) are most important in several cultures of instrument making across the continents [3]. Also, local "secondary" forest species are very important in the making of instruments for early and/or traditional musics – but most of the time their physical properties are unknown. Working in

collaboration between crafts-wo-men and laboratories can help in the identification of most relevant species, and in sourcing sample material for tests. We started this task for example through works on early bows [2], and on traditional woodwinds [6]. The within-species variability is also an important point to take into account [4]. Altogether, the magnitude of the work remaining to be done on this topic suggests it should be a long-term and collaborative issue.

3.4 CHARACTERISING THE PHYSICAL EFFECTS OF TRADITIONAL PROCESSES AND TREATMENTS

In many cases, the wood uses imply some treatments or processes. The 4th step of the methodology aims at understanding the physical effects of such craftsmanship processes. The "seasoning" issue is a nice illustration. For example, in general public or media it is often said that wood for violins need to be seasoned for a very long period of time (20 years or so) – but in the survey we conducted, most luthiers actually state that a few years is long enough according to their experience [5]. On the contrary, interviews with woodwinds' maker highlight the importance of long seasoning time – the meaning of this "stabilisation through time" is discussed for Boxwood in the talk by P. Cabroler [6]. Another issue is that of finishing treatments. In string instruments making, the coatings and varnishing are stated as of particular importance – but is that for aesthetic issues, protection reasons, or with some acoustic "goal"? Some studies exist on the acoustical effects of a diversity of historical varnish recipes [10], or on the evolution of effects through time [11, 12]. We recently contributed some results combining the two approaches (various traditional recipes + ageing over months or years) [13], which showed contrasted trends between cultures (Iranian or European) and also suggest that varnish ageing can be considered as part of the "playing-in" effect observed by luthiers and musicians on newly built instruments. The field of study is still very wide: across the continent and cultures, a wide variety of traditional wood treatments and processes are stated, but their physical meaning (optical, stabilisation, or acoustical effects?) remains to be assessed.

3.5 ANALYSING THE PERCEPTION OF WOOD BY ITS EXPERTS USERS

This last point of the proposed methodology aims at "closing the loop", by assessing the actual perception and appreciation of wood (its diversity-variability, physical properties, and occasionally effects of treatments) by crafts-wo-men, in link with their discourse collected in the 1st step, and with characterisations conducted in the following steps. In the field of perceptual/sensory research on wood, a few studies are of a fundamental nature, mostly oriented towards visual and tactile perception senses [14, 15]. But many others are of a "consumer preferences" type, i.e., they are seldom conducted on the perception by expert wood users like artisans. In the field of wood for musical instruments, sensory studies are still scarce, and they often focus on the perception of acoustical properties [16]. However, the

surveys (step 1) conducted with instrument makers insist on the multi-criteria dimension of their choice of wood. In a recent work on the perceptual grading of diverse dense species by instrument makers, it appeared that the species ranking, as well as the degree of correlations between "quality" ranking and mechanical-acoustical properties, was highly dependent on the type of instrument produced by each crafts-wo-man [17]. That is, there is a strong "professional speciality" effect on the perception of wood and wood properties. In our ongoing study (PhD thesis of C. Carlier), resonance wood of spruce and maple is submitted to the perceptual evaluation by violinmakers according to 4 modalities – visual, tactile, auditory, and global. Preliminary results highlight different perception thresholds depending on the senses, as well as "trade-offs" between aesthetical, physical, and acoustical criteria of choice [18]. In the future, perceptual studies with expert artisans should help to better make the link between actual (or alternative) wood uses, craftsmanship issues, and relevant physical properties of wood.

4 CONCLUSIONS

A better communication between the different kinds of knowledge on wood appears to be necessary in order to better apprehend this complex and diversified material, which has been and is of major importance for humankind. Here we have proposed a methodology, which aims at bridging craftsmanship knowledge, uses and perception of wood, with studies of wood physics, mechanics and biodiversity. The 5-step methodology is illustrated by recent or ongoing research in the case of wood utilisations by makers of musical instruments. Some results of this dialoguing approach allow going further into physical phenomena, while answering some questions raised from practice. It is suggested that methodological points issued from humanities or perceptual studies can give better representativeness to wood physical research. Mostly, the different steps still call for a vast amount of research in order to progress in the multi-modal understanding of wood and its uses by humankind. A critical point is the sharing of knowledge between different communities. The success of the approach requires wood scientists to remain humble in front of craftsmanship expertise, as well as to have some knowledge of the specialized vocabulary, which implies at least basic practice of woodworking.

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