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A review of basic procedures for an organological examination of plucked-string instruments

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ABSTRACT

With the growing number of people interested in instrument-making and in playing historic instruments, we find more and more people wanting to study these instruments. Museums and private collections sometimes allow interested parties to study them but more often than not access is very limited in order to better preserve the artefacts. One strategy for allowing access to the information is to make a detailed study of the instrument and to record the level of detail desired by the most demanding user (usually the instrument restorer or maker). The nature of a musical instrument, the hygroscopic wooden structure and the effect of the tension of the strings make this task more complicated than examining a static object. Very old instruments have often undergone restorations or repairs and these interventions must be recorded as posterior to the date of construction. This paper will propose a method and tools to document these instruments. This is an extensive set of guidelines which will help scholars to standardise this complicated task. The method described uses relatively simple tools but it should be noted that much more sophisticated techniques are being borrowed from other fields. A detailed examination of an instrument can help in its identification, aid in teaching lutherie, facilitate an appraisal, or simply record the condition of an instrument as part of cataloguing it. Another important use for this documentation is for making an authentic reproduction of the instrument which can then be played allowing the original to be preserved in optimum conditions.

1. Motivation and aims

This paper will provide a tool for museum curators, conservators, collectors and appraisers with which they can examine a plucked string instrument in an organised fashion. There are some scientific techniques which are not readily available to those who have access to the instruments but the following procedure uses tools which can be purchased at relatively small expense or made quite easily. The information collected and the photographs, drawings, descriptions and recordings resulting from a study will be important additions to the documentation of the instruments in question. The authors have identified a lack of literature on this subject and perhaps even an unwillingness to share information about how to fully document instruments and would like to contribute to filling this gap.

2. Introduction

The circles of instrument-makers, restorers, museums, appraisers and musicians all intersect when we speak of historic instruments. Each group is interested for different reasons but without a doubt everyone would like to study these instruments. The more important instruments are locked away with very limited access but these are precisely the ones that everyone wants to study or play. Museum curators, conservators and collectors are in a unique position to study these instruments but might not be aware of what an instrument-maker is looking for when requesting to study an instrument. These recommendations should serve to bridge the gap between these two groups and allow the valuable work of the museum staff to be more useful to restorers and instrument-makers. A detailed examination of an instrument can help in its identification, allow a posterior reproduction, aid in teaching lutherie, facilitate an appraisal, or simply record the condition of an instrument as part of cataloguing it. The resulting documentation will be sufficiently detailed to allow an expert instrument-maker to build an authentic reproduction of the

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instrument which is probably the best way to allow players access to period instruments. Each end user will require a different level of detail so it is important to get the most information possible even if some of the data are not deemed important by the examiner. This article intends to show one procedure for examining an instrument based on the experience of guitar-makers who also work restoring historical instruments. As there is no accepted standard for examinations of this type, the following procedure might serve as a starting point for the elaboration of a standard procedure.

Before listing the tools that will be helpful for a complete description, a few precautions and indications will be offered. Following these sections, the treatment of each of the different parts and features of the instrument will be described.

3. Preliminaries

We are dealing with fragile objects, easily cracked, scratched or damaged by tools or surfaces. These instruments are part of our cultural heritage and if you are allowed access to them someone trusts you to ensure that nothing is altered while in your power. Obviously an instrument should never be even partially dismantled just to examine a joint or an interior. Often the very method or sequence of assembly is historically important and any work done might cause information to be lost. A work area free of obstacles, a soft surface and avoiding metal edges are things that should be kept in mind. Using paper rules (verified for accuracy), covering metal edges with paper tape and then subtracting the thickness of the tape from the final measurement and using plastic or wooden tools to transfer measurements to the metal callipers are good techniques. A profile gauge for example can be used to transfer the shape of the neck to paper but some card stock should be placed between the gauge and the neck. The slight inaccuracy caused by the card is certainly preferable to the alternative of marking the instrument. Some museums insist on the use of cotton gloves but it should be noted that clothing should never be introduced into the opening of an instrument because it can snag on a delicate part. Be precise and mark the position where the measurement has been taken, for example: Is the string height measured right below or on the twelfth fret? Is the height of braces measured right at the front edge of the bridge position or at the saddle position? Relative humidity and temperature should be recorded at the time and place of measurements and the margin of error should also be stated. The units of measurement should be stated at the beginning and respected throughout. Each measurement should be repeated several times in order to avoid errors and to obtain mean values and standard deviation.

Some of the principle aspects which should be taken into account when documenting an instrument are: dimensions and the relationships between the different measurements. The thicknesses of the plates used. The three-dimensionality of the instrument: arching, doming, the contours of any curved pieces. The materials used and the decorative elements. For a complete examination of the instrument the strings should be removed, if the saddle, nut and pegs are not firmly fixed they too should be put aside. Even if an accurate drawing is made the recorded measurements should take precedence over the dimensions shown graphically on the drawing. Paper can be damaged, can shrink or can be incorrectly photocopied.

4. Tools and techniques

Measuring tools per se should include: a protractor, a graduated jewellers magnifying glass, feeler gauges, a good metal rule for comparisons, a vernier calliper to calibrate improvised tools and a magnet-based thickness gauge designed for completed instruments. Some tools will have to be made by the examiner such as paper rules (verified for accuracy), a wooden straightedge, a second straightedge with cut-outs if necessary, various lengths of wood and a chisel for cutting them down, various wedges, a wooden calliper, a wooden depth gauge and relieved bed for resting the guitar face down for drawing the outline. A large sheet of paper on which to draw the outline of the guitar and a pencil cut lengthwise are helpful here. The remaining tools necessary are: an inspection mirror protected on the edges, drawing instruments, a profile gauge and a tuning fork. Images of the exterior should be taken with a camera with a polarising filter, interiors with a small camera with a short focal distance (e.g. an endoscope) and lighting will be provide by a small flexible shaft flashlight and a LED lamp. A voice recorder, masking tape, two small, strong magnets, books on wood identification, some support for the neck of the instrument and a thick material to provide a soft surface will round out the list of materials for the procedure.

5. Architecture and geometry

A good place to start is by drawing the outline of the instrument. The shape of the instrument is important for aesthetic reasons but also because the volume of the soundbox is of great importance in determining the mode [1]. A large sheet of paper should be affixed to the bed and minimal cut-outs realised (bridge and fingerboard) so that the paper stays flat and the edges of the top of the guitar make contact with the bed (see Fig. 1 left). The outline should be realised with a half pencil pressed against the sides in order to reduce errors to a minimum. In the case of most Spanish-made instruments the traditional method of assembly starts from the top meaning that the top is the outline that will vary least from the original design of the builder. The outline of the back is often noticeably different because the guitar was built without a mould or just because the wood of the sides is not perfectly curved. It is useful to record these differences but any work on the shape should be based on the top shape. A square can be used to find differences between the top and back outline as well as deformations of the sides.

The other thing that should be traced by outlining is the headstock (or at least the crest). Another method of tracing the headstock and its openings is to place paper over it and to use “rubbing” with a pencil to make a copy of the shape. This is especially useful if the headstock is relief-carved.

When the top plate is very thin the resistance and the function of the instrument can be compromised. The bracing of the top allows the builder on the one hand to reinforce the weak top; the inertia of the top is modified locally by the braces to control the flow of tensions and the stress concentrators. On the other hand, increasing the soundboard mobility increases the pressure flow gradient inside the soundbox. Finally, adding a localised mass obviously modifies the vibrating behaviour of the top and in turn has an effect on the sound.

The internal bracing structure of the top can be highlighted in a darkened room by placing a LED bulb (low-temperature) inside the instrument unless the age or species of wood makes it opaque to light. Spruce usually allows us to use this technique although it does become more opaque with age. Actually visualising the bracing this way is interesting but using a paper rule on the outside of the guitar with a light shining from inside is quite imprecise. This is only permissible when there is no better way because the lines are not well defined through the top and shadows are projected and vary according to the position of the light source (see Fig. 1 centre).

The position of the braces in relation to each other are best measured using short lengths of wood which can be progressively cut to size until they fit between the two elements or by making a gauge

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