ACOUSTICS IN THE
RESTORATION OF ANCIENT
MUSICAL INSTRUMENTS
The restoration and voicing of ancient Organs: a twinship of Europe and Australia

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The restoration of organ pipes represents since the beginning a quite important acoustical aspect that is still unsolved. The positioning, the typology, the dimension of the Musical Instruments characterize not only the organ pipes but also the music that will be played, the acoustics of the church, the tuning of organ pipes. Michelangiolo Rossi wrote music for different typologies of organs, and the modern instruments rarely maintain the original characteristics of the Instruments he played. Therefore the organ represents an instrument which, unlike all the others, has had a language of its own, for each single country.

INTRODUCTION

Throughout the history of European musical achievements there has been an instrument that, unlike all the others, has had a language of its own and yet it has identified itself with each single country where it has been used: the Organ.

The centuries-old tradition of this instrument can boast of five centuries of musical literature, from the Middle Ages to the present age. One needs but name a few of the most important composers: Merulo, Gabrieli, Frescobaldi, Scarlatti (Italy); Couperin, Grigny, Franck, Messiaen, Dupré (France); Cabezón, Arauxo, Bruna, Cabanilles (Spain); Coelho, P. de Araujo, Seixas (Portugal); Bach, Mendelssohn, Brahms (Germany); Sweelinck (the Netherlands); Buxtehude, Bruhns (Denmark); Muffat, Froberger (Austria); Purcell (England).

Many European towns have an incredible number of historical organs and a centuries-old tradition which has been lately revived through many celebrated organ festivals organized.

That is the aim that lead some European towns (Lisboa, Roskilde, Toulouse, Treviso and Zaragoza) to sign the Project for setting up twinship of European Towns with a Heritage of Historical Organs, which is on the basis of other Organ Festival like the Melbourne International Organ Festival.

THE RESTORATION OF HISTORICAL ORGANS

Since the beginning, the restoration of historical organs has always had a particular difficulty among all musical instruments. The voicing of the soundboard and the pipes, the question of the intonation, are always a very difficult matter even if nowadays many efforts are addressed to a proper restoration of historical musical instruments.

FIGURE 1: “Musurgia Universalis”, A. Kircher (1650)
AN EXAMPLE OF RESTORATION

The town of Treviso owns a Nacchini organ built in 1750. The instrument represents probably the best-preserved creature of the Dalmatian organ builder in the region. Due to some refurbishment in the church of S. Maria dei Battuti, in which the organ is located, all mechanical parts of the instrument were disassembled. The sound of organ pipes was completely out of tune, owing to dust. The bellows were different from the original ones, as was the temperament. Zanin conducted the restoring work in 1994.

THE NACCHINI ORGAN

Pietro Nacchini (Nakic) was born in 1694 in Bulico (Bulic), in the (former) Republic of Venice. He modified the building of organs, changing and simplifying the bellows, the pipes, and all the mechanics of the Instrument. He built many organs across the Venetian Republic, from Dalmatia to Istria. Some organs are now still in playing condition, in Pirano (built in 1746), Parenzo (1759) and others. From 1729 to 1760 he was the most important organ builder of Venice, and he had many pupils, such as Gaetano Callido.

The Nacchini organ in Treviso was not strongly modified during the last two centuries. Thus, the organ was not completely rebuilt in 19th Century, when Romanticism forced modifications to the structure of the instruments in order to permit new possibilities for music. This fact allowed a better philological restoration.

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Musical Instruments' Acoustics through the Ages as seen from a Violin Maker's point of view

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Traditionally, lutherie, and violin-making in particular, are considered a fine art. Science and Art have not always been fully compatible, especially in a workshop of this kind, but can show interesting aspects and relations which can be explained from a 'living' experience. Violin and other instrument makers 500 years ago certainly had not the tools we have available today, nevertheless their practical intuitions, enlightened by modern research, were quite often amazing. This article tries to trace, in a non-academic way, a simple history of the possible 'acoustic perceptions', or techniques, used by the luthiers through the ages. Documents, anecdotes and recent theories are reported here as if heard in a real workshop.

DIFFERENT APPROACHES IN MUSICAL INSTRUMENT MAKING

Over the centuries there have always been only two ways for those craftsmen wishing to start musical instrument making, wherever music was made: going to a reputed maker and following all the rules and methods developed by him and his staff (or his tradition) from a practical experience, or taking an instrument considered ‘ideal’ and trying to copy it with the materials, tools and knowledge available to the beginner, trying to understand how it probably works, and trying to modify and adapt the output to the personal use of the musician who commissioned it.

It has been always impossible for anybody in this field to calculate in advance all the parameters involved in the construction, for example, of a violin, in order to get a certain result. The variables are too many and the solutions can be quite different one from each other. This is why our job has traditionally been considered a fine art.

In half a millennium of history of violinmaking things and perspectives have changed a lot in certain aspects, but remained absolutely unchanged in others. We are discussing here what could possibly have been the acoustics for a maker in the past and what it can be today.

QUALITY CONTROL

If violins were only painted boxes we wouldn’t be here. Acoustics science for a maker must have been and can be even today only a tool for having a control over the sound, which is the main function of a musical instrument. But it is interesting to note that it is not the only aspect for someone who has to earn a living with such an activity.

A violin is an extraordinary combination of visual and psychological charm and tone. If science unequivocally determined that a new blue pigment on a fiddle could be a great improvement in the sound of the violin after Stradivari, it would take ages for you to see a blue violin in a concert hall, and, even if there was evidence, no maker would apply such a discovery.

Also, we have to consider that every tonal achievement in a musical instrument in general, and in a violin in particular, must stand the test of time, since it is generally known that the tone is always changing and developing under the stressful conditions of continuous playing.

Acoustics for a musical instrument maker has always been based more on a practical use than a theoretical one.

EARLY TIMES

It is not easy to talk about how the old violin makers could have applied acoustics during the various stages of construction of their instruments, because written testimonials of their beliefs and practices are too few, if not even absolutely non-existent. The craft was transmitted exclusively orally, from master to pupil, or from father to son, and quite often they did not even possess the general knowledge which we would define today as ‘the basics’. Nevertheless, we are still absolutely amazed when we look at the high level of their output, especially if we think about what they actually had at their disposal to measure or to trace its sound connotations.
So, which tools and which kind of acoustics could our old colleagues have possibly used to define and control their quality? Before attempting to give an answer to this question, it would be better to trace a brief overview of what could have been the basics of their possible scientific knowledge.

It is impressive what Professor Carlo Taglini, teacher of Philosophy at the University of Pisa, wrote in 1747 to Signor Marchese Gabriello Riccardi, trying to explain ‘why a violin is able to produce so many and such pleasant sounds’: ‘...the vibrations produced by the violin couldn’t have any effect [on our ears] if we did not have air... which probably we can affirm to be a flowing body, made by very thin and tiny parts, such as spirals, which are neither too hard and tight, nor too loose and flexible, which come in different lengths and are bent in such a way that they form spherical spirals, or small equal globules, leaving some empty space between one spiral and another, some ethereal space or, in other words, if you prefer, filled with light’.

We have not to take for granted that concepts simple for us, like the composition of air and its behavior during a sound transmission, were the same for our ancestors. In fact, they were able to formulate a modern hypothesis on the inner structure of matter and the physical behavior of the tremori armonici only during the 18th century.

In fact, further on in the same text, Taglini mentions the opinion that the transmission speed of the high pitches could be higher than the lower ones, and that ‘...the same sound is stronger and more lively by night than during the day, and more in the winter and in northern countries than in the summer and close to the equator’...’and it is not yet clear if the sound propagation is straight or follows curve lines’.

And later on, when he describes the human ear structure: ‘...and sounds are heard also by means of the air close to the eardrum... where a thin spiral bone tissue is enclosed... and the mentioned small channel is most likely a logarithmic spiral, which certainly helps to enforce sound and to render it more lively’.

At this point it is curious indeed to know if the violin scroll outline was, after all, consciously or unconsciously, designed with a precise acoustic function.

It is a common belief that the starting point of all the acoustic considerations of the old masters was the vibrating string, since it is the string which has practically written the history and the evolution of all the stringed instruments.

Architecture too (with the debated use of the Sezione Aurea), not only for its aesthetics, could have been taken as a strong inspiration by the early makers; after all they were attempting to draw a structure subjected to strong forces and stress, even if the tone must have been their main target.

Certainly, what the early makers were trying to obtain from an instrument was rather different from what we are looking for today. The violin in the beginning was used to double voices and to accompany dancers, so the imitation of the human voice was their first acoustic research. A few very interesting treatises on the violin construction of the 18th century, such as the Bagatella and Marchi are precious to us in order to understand their outlooks.

Unfortunately, their methods are not described in detail, but we can learn that a great importance was given to the violin outline and to the proper proportion of thickness, in order to obtain the desired timbre.

It is possible that early makers developed by experience precise rules in order to maintain these desired proportions and a constant output, despite the many variables involved in the construction process, and it is possible that some were listening to and using in a certain way also the measure of the pitch given by a tapped or bowed free plate, as we use today with modern equipment.

**THE MODERN ERA**

Only during the 19th century, particularly with Savart, Helmholtz and Rayleigh, acoustic research into musical instruments became a science in itself, and even if separated from traditional workshop practices, for the first time makers would have had the opportunity to measure, understand and trace better what had maybe always been done only by ear.

During the 20th century, and in particular when the Catgut Acoustical Society was founded this opportunity become more accessible to the widest public and everybody knows the effort of this society to bring a real acoustic ‘method’ into the workshops.

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Acoustical Aspects of Preserving Historic Musical Instruments

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Restoration and conservation of musical instruments are carried out for varied reasons, including preservation, making old instruments presentable for museum display, and making old instruments playable. In a museum, the conservation of the materials and integrity of historic objects is a recognised priority, but the preservation of the acoustical properties of an object goes beyond the usual requirements of museum conservation work. This paper explores the feasibility of maintaining the acoustical integrity of historic instruments and of recreating the acoustical characteristics of instruments that have fallen into disrepair. The paper draws on case studies.

The terms "conservation" and "restoration" need to be distinguished: they are not equivalent, but commonly confused as the result of similar words in English and in other European languages having different emphases. To conserve an object is to attempt to arrest its deterioration and to preserve it in its most stable state. The museum personnel who do this are, in the English language, "conservators". Restoration, however, is an attempt through technical intervention to return an object to a supposed previous condition. The people doing this work, generally in private practice, are "restorers". In museums, the term conservator has generally replaced restorer, implying the application of scientific principles to the treatment of museum objects, with an emphasis on documentation and research.

Restoration and conservation of musical instruments are carried out for varied reasons, including preservation, making old instruments presentable for museum display, and making old instruments playable. Several texts [1, 2] discuss the policy issues relating to the controlled use of musical instruments in performance and research. It is asserted that “the conservation needs of musical instruments are in no way different from those of other museum objects” [3]. Whereas this may be true as a matter of overall policy, the essential nature of a musical instrument as an acoustical device may well need to be taken into consideration when making practical decisions. When a choice has to be made, priority should be given to preserving acoustically significant characteristics over others such as appearance.

In a museum, the conservation of the materials and structural integrity of historic objects is a recognised priority, but the preservation of the acoustical properties of an object goes beyond the requirements of general museum conservation work. Although most museum professionals no longer restore instruments but conserve them, it is still necessary to know whether conservation measures succeed in preserving the acoustical properties of old instruments. And since work aimed at playability is still carried out on ancient instruments, we ought to know if and when the restoration of historic instruments succeeds in recreating acoustical properties of some historical validity.

Is it feasible to maintain the acoustical integrity of historic instruments, or to recreate the acoustical characteristics of instruments that have fallen into disrepair? Acoustical techniques have progressed, and reports of before-and-after comparisons of measured acoustical properties where restoration has been carried out are beginning to appear [4][5], but the author is not aware of any comparable publications on conservation (or even on the effects of natural changes in materials over time). This lack of acoustical assessment reflects lack of demand from owners and curators; also when an instrument requires intervention, usually several components need treatment, making it difficult to isolate one action and assess its acoustical effects. Every conservation treatment, however skilled, will always interfere with an object’s material properties and thus potentially with the acoustical properties, but to very different degrees. Filling the cracks in a soundboard or a violin body will be very noticeable. Treating surface corrosion of a brass instrument or of woodwind keywork might have imperceptible acoustical effect.

RESTORATION

In 1873 the museum of the Paris Conservatoire purchased an eleven-course lute, now attributed to Johann Seelos (1654-1715). In the 1950s, the museum commissioned a luthier to restore the lute to playing condition. Recent investigation by x-ray has shown that the original barring under the soundboard was replaced with a pattern more familiar to the luthier [6]. Not only had no acoustical measurements (such as modal analysis) been undertaken, but it had obviously
not occurred to the museum to require them, and probably the luthier had either not known or not cared about the effects of his re-building. Most of the research on body plate resonance with which we are familiar had not been carried out at that date, so the loss of information about the original acoustical properties of this instrument can be ascribed to ignorance. This is but one example of deleterious restoration work: most instrument museums have cause to regret most of the restoration work carried out on their instruments by previous generations of restorers. Since there are still many unsolved questions in the acoustics of musical instruments, a cautious approach to restoration is indicated. Acousticians can inform both the restoration and the conservation of historic instruments by prioritising the effects of interventions. It would have helped in the case of the Seelos lute for the museum to have been told that it was of great importance for the barring pattern to be kept, but of lesser importance for the tuning pegs to be of the original material, for example. All restoration involves speculation about the original state, or some former state, of an object. The less well informed the speculation, and the greater the irreversible intervention, the harder it is to justify restoration work on an irreplaceable artifact.

CONSERVATION

In 1976 the soundboard of the 1769 Taskin harpsichord in the Russell Collection of the University of Edinburgh was cleaned. It was then decided to coat its top surface with matt varnish so that any subsequent cleaning could be carried out without the repeating the elaborate and costly procedures of 1976. This process was discontinued after the treble area was coated because it greatly exaggerated the alteration in the colour of the soundboard with change of viewing angle. Also, the acoustical effect of adding the varnish was unknown. Because of the alteration in the optical effect, it was decided to remove the varnish from the soundboard wood and to varnish only the painted areas. That the whole of the soundboard had not been undercoated and that most was untreated was clearly a conscious decision by the maker, and one respected in the 1976 cleaning. The varnish could only be removed with solvent, but initial attempts at dissolving the varnish were only partly successful. The process was repeated a number of times but the darkening of the wood remained, visible to this day. It was agreed by all who knew the instrument that there was a marked change to the treble sound quality as a result of the varnish or, more likely, the solvent used to remove the varnish. For such an instrument, aspects of appearance should be subservient to acoustical properties.

Museums tend to class museum instruments as "playing" or "not playing", these categories can of course be elaborated [7]. However, much research can be done on the acoustical properties of historic instruments without playing them. Wind instruments for example can be sounded by ambient air rather than blowing, and acoustical techniques such as pulse reflectrometry and impedance measurements can be done without any of the risks of playing. Recent studies of brass instruments have involved physical and acoustical measurement of numerous museum instruments. However many museums operating a no-playing policy (and not excepting those employing professional conservators) inadvertently hamper research because mechanical parts such as tuning-slides do not function: they have either been cleaned to remove causes of corrosion and left dry, or have not been cleaned and the old lubricant has hardened. Either way, the slides have stuck and the range of measurements that can be carried out has been curtailed. A regime that kept moving parts in workable order would enable such museum instruments to fulfil their current purpose, the preservation and disclosure of acoustical information.

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The conservation of acoustical specifications: a long ignorance in public collections of ancient instruments

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The heritage concerning ancient musical instruments is very reduce. Even less if we consider public collections. France was a leading country in that field. In 1793, the Conservatoire of Paris had already the project of a public "Cabinet of instruments" able to "serve as models thanks to their perfection". Many countries followed that example. But the collections were mainly preserved with few respect.

Since two generations, with care for education and revival of ancient music, a lot of historical instruments were put back in playing order, while many interventions let often sources of knowledge lost for the future. Today the policy is more respectful, less operative, caring for a scientific knowledge of materials, structures, but also accessories having an essential effect on the sound production: i.e. strings, fittings, linings, or surface treatments, all elements usually destroyed are today studied, referenced, even reproduced identical in partial or whole facsimile. After giving a kind of assessments, the burning question is: how many specimens, with "authentic" acoustical specifications, shall we let to future generations? And what are studying acousticians when they compare without critical organological analysis a so called « Stradivarius violin » with a modern one?

AN AMBIGUOUS HERITAGE

At the time when Chanot and Savart submitted to the Académie des Beaux-Arts experimental violins, bringing to the fore several fundamental parameters contributing to their specification, Paris cancelled the project of a public Cabinet of instruments, able to "serve as models thanks to their perfection". Among four hundred instruments, collected for the Nation with educational aims one generation earlier, only few samples set free from dispersion or even fire. Intensively used in the teaching activities of the Conservatoire, those remaining suffered unavoidable changes caused by their use, the development of instrument making and the evolution of musical taste. The care for an exemplary documentation collected for future generations went out. The registers of reparations written by the instrument makers of the Conservatoire, attest the modification and alteration (new necks of violins) of physical -i.e. acoustical- components of these rare survivors.

In 1864, the French government acquired Clapisson’s collection in order to open finally a public instrumental museum into the Conservatoire. But it was more the "envelop" that attracted this collector, fond of decorative and picturesque instruments; he had no sensibility in the organology and sound specification of his finds. Otherwise this lack of interest save them from restorers. Only their visible and superficial aspect was improved. On the other hand, when the Conservatoire entrust the care of this collection - always increasing - to his "official" instrument makers (between 1872 and 1950), new transformations, too often drastic (modifying bores, soundboards, bracings, fittings), altered definitively their acoustical specifications.

In 1942 a genuine and unique kit (small violin for dance masters) preserved in Paris, signed by Antonio Stradivari, having its original neck, mounting and bass bar, was irreversibly transformed for a broadcast demonstration. During the same period, in the Metropolitan Museum in New York, the soundboard of a very rare Cristofori pianoforte of 1720 endured a quite similar decision. The soundboard, which was said to have been horribly warped, was removed and replaced. Even if Wolfgang Staub, a piano maker employed as a restorer at the Metropolitan Museum testified at the end of the 1970th that "they were very careful about making accurate replicas of anything they replaced", what is remaining today from the original acoustical specifications of this valuable instrument?

REVIVAL OF ANCIENT MUSIC AND FIRST STEPS IN SCIENTIFIC RESEARCH IN THE FIELD OF ORGANOLOGY

In 1947, the foundation in England of the Galpin Society established really the field of organology at the time when many public collections were

beginning to put back some items in playing order. At that time more restorers were specially employed by museums and were sometimes by chance also scholars (like Frank Hubbard from Boston, who published a master work on the history of harpsichord making and opened few later a workshop for the restoration of these instruments in the Parisian museum). If these professionals begun to take in account the inner structure of instruments, the individual history of each item, taking precise measurements, considering technical details having an effect on the sounding result, many interventions were carried with a lot of approximations (like the stringing or fitting). Original plectrums in "peau de buffle" were for ex. replaced and destroyed on an harpsichord by Louis Dumont and Pascal Taskin, part of the Parisian collection, avoiding any further analysis to understand the specific sound quality of this very special stop of late French harpsichords. During these decades, we can also give the example of a lute by Seelos (1699) from which a bracing from his late period of use (18th century) was totally removed and replaced by a non historical one. What can we know from its sound and characterization in such conditions? Very often, during the same period, woodwind instruments presenting important damages from wood worms, were "restored" with epoxy glue, despite the fact that it is irreversible and that it is quite impossible to control the penetration of this product into the galleries. Nobody can be sure that they will be totally filled up and how this action affects the surface of the bore. A unique bass cornetto was treated in that way at the end of the 1970th. It never sounded as expected to allow eventual acoustical measurements and it is definitively lost for the research as reliable source.

In 1974, a precious harpsichord made by Jean-Henry Hemsch (Paris, 1761) and preserved in the state of its last period of continuous use, was purchased by the Conservatoire in Paris for his collection. The 8 stop of the lower manual was mounted with "peau de buffle". And the instrument being in very good condition, the decision consisted in putting it back in playing order. But because musicians wished to have a "classical" use for such a French harpsichord (i.e. with quill plectrums), the historical "peau de buffle" stop was removed. No recording was made before. It means that a great amount of knowledge concerning a very specific sound taste of the late 18th century, at the time of the early pianoforte concurrence, will stay ignored because of this decision.

AN OBLIGATION TO PRESERVE²

Since one generation, professionals acting for public collections are first "conservators" and sometimes restorers. They proposed many different methods to preserve the instruments as an historical source of knowledge in the field not only of technology but also of sound producing and musical practice.

Instruments are preserved in the state they are collected and the decision to put them in playing order is more and more exceptional (the recent museum policy encourages more to maintain in play in order instruments already restored). Some examples are quite characteristic: in the Musée de la Musique, some unique instruments, never "rebuilt", nore restored, but sometimes in "poor" state, are exhibited or preserved as "archeological pieces" to avoid any intervention that could obliterate original details and traces specific of a maker, a school of making and a period. A harpsichord by Vincent Tibaut (Toulouse, 1691), despite his poor aspect, is an exceptional case. Several facsimile of it were built recently, allowing scholars in early building of harpsichord, to dispose in an experimental procedure, the very specific qualities of it, for ex. the acoustical effect of the partly hollox wrestplank.

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Acoustics as a Key to the Understanding of Ancient “Ethnics” Musical Instruments: Some Examples from Argentina

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This paper discusses the importance of acoustics in the study, conservation, and classification of historical and archaeological sound instruments from the so-called ethnic cultures. Clearly, acoustical analyses of musical instruments are important to their proper restoration and reconstruction. However, when dealing with ethnic artifacts no longer in use and about which no contextual or other data are available, an assessment of their acoustical properties is essential to determining their very status of musical or sound instruments. The point is illustrated by a group of controversial artifacts found in several museum collections from Argentina.

The majority of ancient musical instruments from Argentina are preserved in general, non-specific museums, as a part of larger collections of archaeological artifacts from pre- and post-hispanic traditional cultures. At times, some of these instruments have been matter of controversy among scholars from different disciplines. Their provenance, usage, and even their very status of musical instruments have been discussed. In this paper I shall present some instances in which the analysis of the artifacts’ acoustical properties may shed new light on their possibilities as sound instruments.

The first example comes from the field of ethnography and concerns a group of instruments that were the subject of a debate between two americanists, Erland Nordenskiöld and Eric von Rosen, at the beginning of the twentieth century. The objects in question are single open-end flutes without duct, usually referred to as serêres in the musicological literature, and can be seen in Figure 1. A brief summary of the controversy is as follows. In 1918, Nordenskiöld reported these instruments and compared them with an ancient Peruvian weighting scale (Figure 2).

He found a similarity between the whistles and the beam of the scale, and concluded that the scale was “tout à fait analogue à celui qui es actuallement en usage chez les Indiens du Gran Chaco. Il est égale­ment visible que cet objet n’était à l’origine que le fléau d’une balance péruvienne.” He went even further and stated that the beams might have been blown initially in a facetious spirit, and subsequently become whistles: “...mais le fléau des vieilles machines à peser, dégénéré jusqu’à devenir en sifflet, existe encore chez plusieurs tribus” [1].

Von Rosen disagreed with this interpretation, pointing out the inadequacy of supporting a balance from two points and, moreover, the uselessness of practicing a lengthwise perforation to the beam, a procedure no doubt painstaking and time-consuming. He inferred then that “...the unhandy Old Peruvian weighing apparatus shown in fig. 229, is an improvisation of a whistle which, as I aimed at proving in a separate monograph, belongs to a type of open whistles which is widely distributed over the American continent” [2].

At this point I’d like to bring into the debate a detail in Nordenskiöld’s drawing that seems to have escaped von Rosen’s notice, the diameter of the pipes. A close look at the carefully scaled (1/4) drawing shows that the ends of the beam have the same diameter, while in the whistles the distal and blowing end have a different diameter. Hence, the beam’s perforation is cylindrical, while the whistles’ is conical, or more specifically in the form of a truncated cone. There is no need to elaborate on the relevance of the section of the tube in aerophones. There is, however, a further detail that we can add to the discussion. I have personally examined nine serêres preserved in Argentine museums and all of them present this type of perforation which, as is known, makes it easier the production of sound in open end flutes. On this ground I believe that the cylindrical...
beam of Nordenskiöld's weight scale, although clearly improvised, has no relation whatsoever with the conical whistles and that there is no evidence to support the theory that they derived from it.

Our knowledge of archaeological musical instruments may also benefit from acoustics. For instance, some globular flutes from the Aguada culture (ca. 600–900 B.C.) [4], perhaps the most complex prehispanic culture of Argentina, have a distinctive feature that suggests a concern on the part of the Aguada people for the sound quality of their musical instruments. The artifacts are globular flutes without duct, and present 2, 3 or 4 fingerholes. In a previous paper I described these flutes in detail and pointed out their protuberant fingerholes [5], which single these flutes out from those of other cultures. The protuberances not only protrude, flute makers who motivated Leipp's words about the side fingerholes of a tube: “La place et les dimensions des trous dans ces instrumentes résultent de patientes observations et les dimensions et de longs tâtonnements empiriques des facteurs qui réalisent des compromis variés, entre la section et la place des trous en fonction de la section du tuyau, compte tenu des réactions réci-proques des trous les uns sur les autres... “ [6].

Presently I am studying a totally different case. I attempt to demonstrate through acoustic analyses that some bone artifacts usually catalogued in museums and described in the literature as "cornetas" or "trompetas" [7] were not sound instruments. We are doing empirical tests on reconstructions made on the basis of preserved examples (a complete piece and several fragments of its three constituent parts) (Figure 5), focusing particularly on the little usefulness of the carefully crafted mouth piece, with a brim too sharp to be blown like a trumpet, and the effect of different assemblages of the parts on the resulting sound.

These experiences show that despite the manifold studies written by anthropologists, ethnologists, archeologists and ethnomusicologists about ancient ethnic instruments from Argentina, it is crucial to deepen our knowledge of their specificity as sound objects. Therefore, acoustic analysis is indeed a key to a better understanding of ancient, ethnic, musical instruments. It is a ground on which we can base, for instance, a cataloguing decision. It can also offer us meaningful clues about the lore of the instrument makers of a specific culture. Moreover, applying this knowledge will no doubt result in a better conservation, restoration and classification of these instruments. The fragility inherent to its constitutive materials, their age, and the sometimes inadequate conditions under which they were collected and preserved, make replication a prerequisite to their empirical study. In order to do so, we must take into account the very essence of musical instruments, that is, their acoustical properties.

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