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The “trumpet marine”, an instrument between a trumpet and a violin

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While the first part of this work deals with some preliminary musicological aspects of the trumpet marine trumpet, its history and the natural harmonics technique used to play it, the second part is devoted to the physical aspect of the sound produced by the impact of the moving bridge and its relation with the brass like character of the sound. As this brass or trumpet like sound characteristic belongs both to the marine trumpet and the blown trumpet, we have explored their relationship. We show that their main and common characteristic lays on phase discontinuities of the acoustic signal produced, as it is now well known on the blown trumpet by shock waves, when they come directly from the impacts of the bridge on the marine trumpet. Finally we present some remarks on a particular marine trumpet with a peculiar bridge found in Bologne and which belong to an instrument built by the well known instrument maker Rombouts.

1 Introduction

The marine trumpet (Figure 1) is a bowed string that may be related to the oldest monocorde. A very important iconography, from various musicologic sources, (Virdung[1], Praetorius[2], Mersenne[3], among others) and the numerous marine trumpet that can be found in museums show an instrument with one or sometimes two strings, of trapezoidal or rectangular shape.

The most often it is played stand up, bowing the upper part of the string with the right hand when the left hand produces natural harmonics under the bowing point [4]. The main organologic other charateristic of the instrument is a moving or drumming bridge that regularly synchronised by the movement of the bowed string, knocks the harmony table as for the hurdy gurdy.

As the sound of the marine trumpet is very easily heard as if it has been produced by a brass trumpet, the main question and aim of this work has been : how the physical behaviour of such different mechanical systems can lead to a similar perceptive sensation? As a prelimanry point it needs to be answered at a first question intimately related with the first one : what are the behaviour similarity between these two instruments.

The preceeding questions have been explored through a comparison between the signal behaviour of both trumpets. This point achieved and the origin of the phase ruptures found on the signals understood, it gives a perceptual answer to our questions. A brass like sound is characterised by rapid changes, dicontinuities, periodically excited and caused by a non-linear part of the instrument. On the marine trumpet it find its source in the movement of the resonant or flexible bridge.

Figure 1 Filippo Bonanni, *Gabinetto armonico* , Rome 1723 « tromba marina »

2 Some organology about the “marine trumpet”

2.1 The marine trumpet, sea or wind instrument?

This part of our work basically summarize the previous organologic and iconographic work of Cecil

Adkins and Alis Dickinson [5] . The marine trumpet is known in different countries as "*Trumscheit* ", *"Trompa marina* », or "*Nonengeige*". Trumscheit is common between 1511 and 1619. Its obvious german origin is a mixture of "Trumbe" (trump) and "Scheit" (stick). The first part can be understand as coming from "drum", "drummelscheit", and gives a clear relation with the percussive character of the bridge and more generally to a percussion instrument, but it is also the case for the word "trumpet" whose origin is the same. In the case of the marine trumpet both remarks lead to the sound (of a trumpet) and to the percuting or drumming bridge. This makes the marine trumpet clearly different from the monocorde and any other stringed instruments except the hurdy-gurdy. The latin origin of the names "tromba marina", "Trompa", "Trompeta Marina" (Spain), "Trompeta marinha" (Portugal) were used for the same instrument. The first part concerning the sound similar with that produced by a brasse trumpet while the second could be attributed to various significations as : marine (from sea), maria, mariale (from Maria) or more peculiar. *Nonengeige, Nonnenbass, Nonnentrompette* [7] are germanic names that suggests a religious use by nuns as it means violin of nuns or nun's trumpet and seems to have been frequently played in convent (for example in Salzburg).

2.2 Music and the instrument

The normal technique used to play the marine trumpet is that of the so called natural harmonics. From an acoustical point of view it is the only one that allows to change the pitch of the bowed note without changing the behaviour of the drumming bridge or from a mechanical point of view, without changing the force system that is present on the bridge. May this technique of natural harmonics have been common during the seventeenth and eighteenth century? This point is not clear. Some of the trumpets described by Adkins, among them the two present in Bologna, show the inscription of the partial of the string on the neck of the instrument(Figure2). Each point shows the relative pitch with a letter. The scale presented here corresponds to a pitch for the whole string of D 1.[11]. Depending of the length of the string it will be more or less easy to play the highest harmonics.

Figure 2: Detail of the marine trumpet n° 1752, Museo Civico Médievale de Bologna foto A.P. 2004

This will allow a better selection of the highest harmonics: the bigger the instrument, the most secure highest notes, the smaller instruments, the most difficult playing in the high register. The only one teacher of trumpet marine whose name survives was Jean Baptiste Prin , who in the eighteenth century, wrote the « Traité » and la « Méthode de Trompette Marine » with a concerto for marine trumpet and orchestra. In the concerto RV558 in C major, from A.Vivaldi, is written the indication *« violino in tromba marina »*, as in the RV555 in C major, but as far as we know not any consort has never used these indications to play them with a marine trumpet instead of a violin. Some other compositors have integrated the marine trumpet in their works between the sixteenth and the eighteenth century, as Jean-Baptiste Lully , Thomas Kosteletzki , Johann Melchior Gletle, Alessandro Scarlatti y Lorenzo da Castro . Today the instrument is more and more often used, justifying our interest.

3 The mechanical system bowed string associated with a percuting or drumming bridge.

3.1 The drumming bridge

The system that belongs both to the hurdy-gurdy and the marine trumpet can be defined as a mass-spring system connected to the bowed string. The asymetric bridge driven by the string follows its oscillation and depending from its position at rest and the amplitude of the string vibration it produces an impact on the harmonic table. It is basically a non-linear oscillating system as if the movement of the bridge is not limited and free in one direction it is stopped by the table in the other (Figure 3).

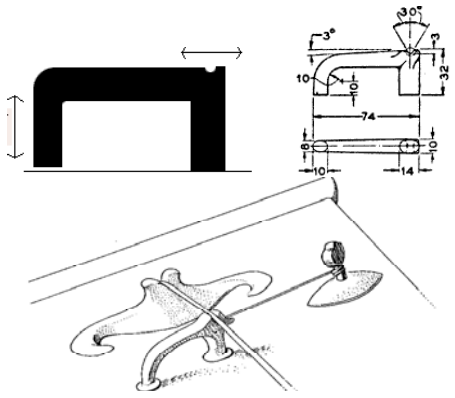

Figure 3: Movement of the drumming bridge, Size of one bridge, Guidon of J.B. Prin drawn by C.Adkins, op.cit.

The use of natural harmonics is very important in comparison with the most normal mode of playing with a finger pressing the string against the fingerboard (pressed mode). This mode of playing produces fundamental perceptive and physical differences. In the case of the marine trumpet the pressed mode leads to a leak of intensity, the impossibility to produce a vibrato and more critical the disappearing of the brass character of the sound.

The point where the string is bowed is very important in the natural hamonics technique, from the point of view of the energy that will be distributed all along the string for all the notes (instead of only on the vibrating part of the string for the pressed technic) . The finger in natural harmonics acts as a mirror for the wave. For each node of the string the displacement and the string velocity are zero, but the sum of forces in the nodal point is not balanced by the finger as it exerts a null force. In the case of a pressed note it is not the case. It implicates that the reflection coefficient for the velocity and the force has to be negative when playing in natural harmonics. In the case of pressed notes the finger exerts a vertical force opposed to the forces that comes from the string (a small one because of the small angle), to limit the vibration only on the vibrating part. The reflection of the velocity is still negative but the reflection of the force positive. The result for the energy, product of force by velocity leads to a different behaviour. The energy transmitted by the string to the bridge is n times lower than those obtained with a pressed note, but in this last case the adjustment of the bridge would lead to a non drumming bridge, or if it is, it can only knock the table for one note and the bridge adjustment must be changed to other oscillating characteristics for each other note.

3.2 The bridge adjustment

The forces that are exerted on the mechanical system string-drumming bridge-harmony table, those coming from the bow, its velocity and the bowing-point produce an equilibrium that allow the bridge to knock the table. It needs a very precise adjustment that allows to obtain the deisred brass like sound. The adjustment of the bridge is realised through a a system called the “guidon” [12] . It allows to adjust the space at rest between the moving foot of the bridge and the table(see figure 2) around 20 micrometers. It gives the musician the possibility to obtain various configurations and to be free to play more or less as a trumpet with that two or more “good adjustments” and to vary the timbre of the instrument, even during a musical piece [13]. In Bologne on a trumpet probably made by Rombouts, a peculiar bridge shows that very ingenious systems have been realised to improve the bridge adjustment.

4 Characteristics of a brass like sound

The work of Joël Gilbert and others [14,15], has helped us to understand the brass like sound of the marine trumpet. Transposing their results to the drumming bridge it becomes clear that the shock waves and their relation with the brass timbre of trumpets [15] can be replaced by the shock produced by the bridge. So the perceptive phenomenon found on the marine trumpet is due to the action of the drumming bridge (figure.4) and to the discontinuities it imposes on its movment. The role of the bridge adjustment becomes evident. The characteritic of a “good adjustment” is revealed on phase ruptures synchronised with the knocks of the moving foot on the signal. This phenomenon is visible both on measurements as well on simulations. On the signal presented on figure 5, the original sound (eight times slower than in the original) the knocks of the bridge are clearly visible on the spectrogram. This non linearity is perfectly compatible with classical scenario than may lead to chaotic features as period doublings (see figure 6) but the phase ruptures are of the same kind as in the trumpet sound (figure 7).

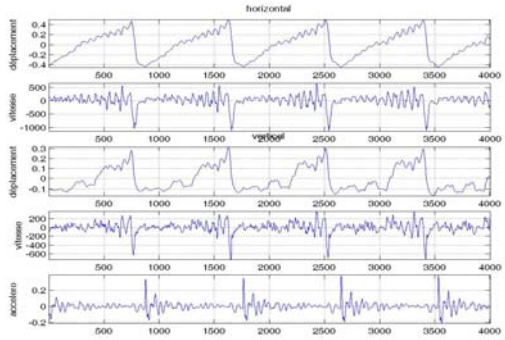

Figure 4: Measurements of the horizontal and vertical dispalcement and velocity of the bridge and acceleration of the table showing the phase ruptures during the slip part of the string movment.

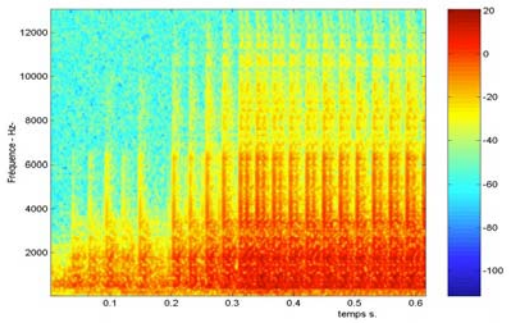

Figure 5 : Knocks on a marine trumpet signal,

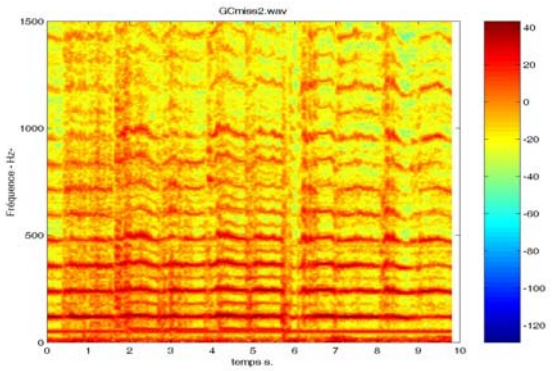

Figure 6 : Period doubling on the marine trumpet

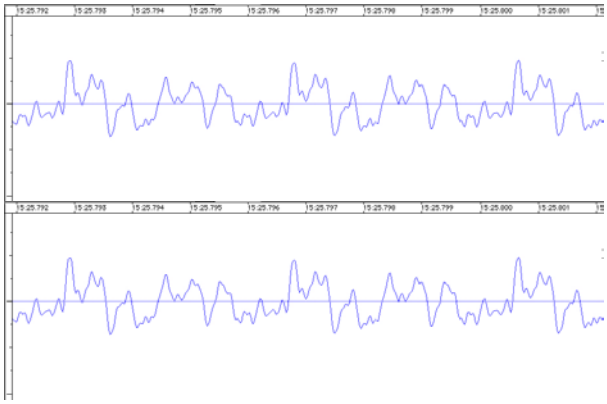

Figure 7: up Phase rupture on a marine trumpet played Linda Bsiri, down Phase rupture on a blown trumpet played by Claire Moulin

5 The case of Bologne trumpet

In Bologne "civico museum" is presented a marine trumpet that has been restored by a cremona violin maker. This violin maker has replaced the original bridge by a new modern one that is a rough copy of a common trumpet bridge but without any notch. His comment was "the original bridge could not work", but the new one also cannot! One of us investigating with museum curators succeeded in finding the old bridge (known by Adkins). The bridge modification occurred around 1991. We will call the original bridge "1991 bridge" while the modified one will be called "1992 bridge". The last one is visible on figure 8, while on figure 9 and 10 we present one photography and a drawing of the 1991 bridge. This bridge presents a very interesting mechanical system of adjustment with a notched wheel, but it is clear that it could not work essentially because an upper part has been lost. This is an evidence if one considers the two slots on its upper part. The reconstitution of the 1991 bridge is today unresolved but some mechanical experiments have been done in Bologne that show clearly it has been designed as a resonant system.

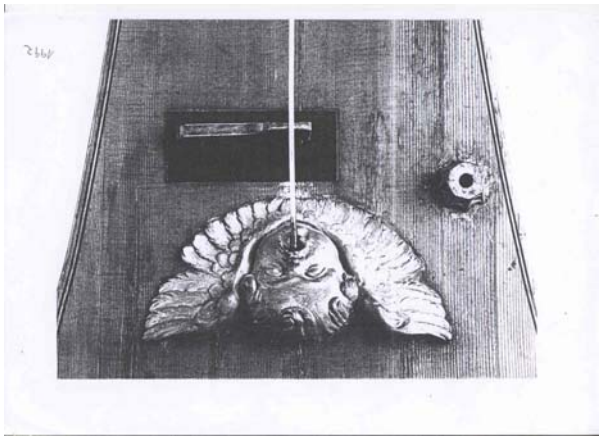

Figure 8 the 1992 bridge of Bologne trumpet

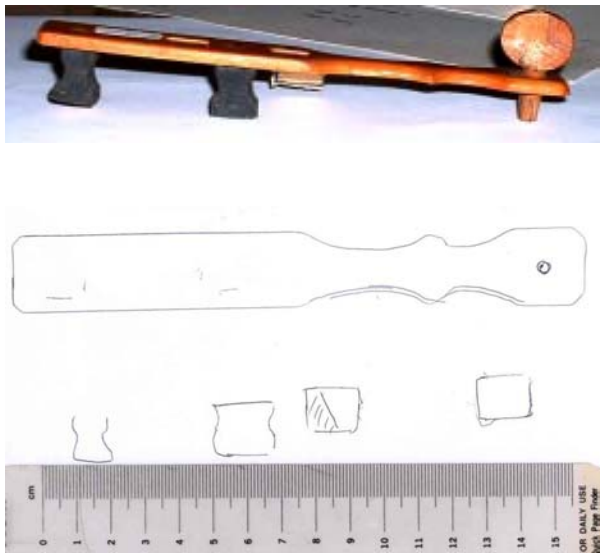

Figure 9 The 1991 bridge

6 Conclusion

The perceptive relation between the wind and marine trumpet can be explained through phase ruptures produced in both case by a non linearity. On the wind instrumpent it is known that the propagation non linearity produces these abrupt changes on the signal and on the bowed one they come from the impact of

the foot bridge. These phase ruptures seem to ba characteristic of a brass like sound.

Preception etymology and acoustics are present and mixed in this quite forgottten instrument. Only the german name “nonnengeige” reveals a bowed string instrument. Our work is in progress wioth experiments with new type of bridge, as the one that has first disappear from the bologne Rombouts trumpet and that one of us has localised in the reserves of the museum with a violin maker comment “does not work”. This last bridge would certainly work if on recover its obviously missing part.. The understanding of the adjustment in the obtention of the brass like sound is one of the points we have to investigate more deeply. It is the obloiged point if one would like to see the rebirth of tihs fascinating instrument in a musical context barock or contemporary.

7 References

[1] Sebastian Virdung, *Musica Getutscht ,* Bâle, 1511, C.N.R.S, 1980

[2] [Michel Praetorius, *Syntagma Musicu ,* Wolfenbüttel, 1619, Documenta musicologica, 1958

[3] Mersenne M., *L’harmonie Universelle* 1636, C.N.R.S, 1986

[4] In french « harmoniques effleurées » : the finger is placed slightly on a node of vibration

[5] Cecil Adkins et Alis Dickinson, *A trumpet by any other name :a history of the trumpet marine*, vol I, II ; Buren, 1991

[6] C.Adkins, op.cit., p.

[7] Curt Sachs, *Systematik Der Musikinstrumente* , 1914, Dover publications, 1964

[8] Françoise Boispoteur, Nicole Pistorno, *La vielle à roue en France,*Aug. Zurfluh, 1996, pag.12

[9] Evugenia Rubina, *Los instrumentos de arco en la Nueva España*, chapitre : *La trompeta marina y otros monocordos*, México 1997, p. 79/ 94

[10] J.H.van der Meer, *A proposito della tromba marina , Arte a bologna,* bollettino dei Musei Civici d’arte antique, n2°, Bologna, 1992, p. 211/ 227

[11] Marin Mersenne, op.cit.speak about harmonious sounds and others unpleasant

[12] guidon: french word used in others languages english, italian etc. It allows to adjust the bridge.

[13] Conclusion coming from the answers of the three following players (Thilo Hirsch, Max Engel and Linda Bsiri)

[14] J. Gilbert for example on the web site http://www.sfa.asso.fr/fr/gsam/jp/cuivres/textes/cuivres.htm

[15] Brian H. Pandya, Gary S. Settles, and James D. Miller , *Schlieren imaging of shock waves from a trumpet* , J. Acoust. Soc. Am. **114**(6) Pt1 Dec. 2003 pp 3364