The irish Uillean pipe: a story of lore, hell and hard D

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The irish Uillean pipe is a bellows-blown bagpipe that resembles other baroque musettes (french *musettes de cour*) such as the english Northumbrian pipe and french Musette. According to A. Baines, it appeared in Ireland in the late seventeenth century, in a version somewhat simpler than the instrument known in the present days. It is surely among the most evoluated bagpipes nowadays with a rather complex playing. The lowest note of the chanter has the noticeable characteristic, searched after by musicians, of having two different timbres. One of these, known among musicians as the *hard D*, is strikingly louder and clearer than the other, the *soft D*. The contrast between them is traditionally a much appreciated quality of an instrument. In this paper, we concentrate on this particular note and propose an explanation for the appearance of these two distinct timbres.

1 Introduction

During the XVIIth and XVIIIth centuries, a common type of bellows-blown bagpipes, having a sweet and mellow sound, is present in France and in the British Isles. These instruments were played regularly in several courts in Europe. The baroque Musette[1], having a cylindrical chanter bore, was played in France in scholar music until 1750, with compositions by Boismortier, Hotteterre or Rameau, before the emergence of the classical style, when it fell in disuse. French makers, like Chédeville, at that time mainly gave the musette its "lettres de noblesse", although it can be seen in english and dutch paintings. In the British Isles the playing lore lasted until now mainly for a dancing repertoire and are still long-lived. The Northumbrian small-pipe appeared in the late XVIIth century and probably came under its musette-like form from France to northern Britain. It also has a cylindrical chanter bore but with the low end stopped allowing to play staccato as well as legato. Other bellows-blown bagpipes were in use in Britain : the Lowland Small-pipe and the Highland Small-pipe around Scotland, much less known than the great Highland bagpipe. The irish Uillean pipe belongs to this family of bellows-blown bagpipes of baroque type, but with a conical chanter bore and a two octaves playing range, giving it common features with the baroque oboe. It appeared in the late XVIIth century, in a version somewhat simpler than the instrument known in the present days, and then grew to the modern instrument [2][2] that is now very popular worldwide and is considered among the best representatives of the musical traditions in Ireland.

The focus of our present investigations is on one specific note, the fundamental note of the chanter. It has the noticeable characteristic of having two different timbres, depending on the pressure applied to the bag. One of these, known as the *hard D*, has a timbre louder and clearer than the other, the *soft D*. Actually, according to flute players in traditional irish music, the wooden flutes they play would have this particular sound. Most players wonder about it [1] and are very much in will of getting it in a safe way, which hardly seems to be the case. It appears that these flutes are of conical type and this reinforces the interest of extending to them the present study. From measurements on real instruments, one Uillean pipe and one flute, an explanation for this phenomenon is proposed. After having presented the Uillean pipe itself, experimental results from the open end pressure signals and lip vibrations of the chanter reed are presented and discussed. Results of a similar experiment with a flute are discussed and compared. For the underlying theory, and especially the analogy between bowed string instruments and conical wind instruments, one can refer e.g. to [7].

[1] The name *musette* is a diminutive of the french *muse* and is appropriate due to the sound produced by the chanter

[2] Several historical points are borrowed from A. Baines book

2 Description of the instrument

The irish bagpipe (see figure 1) was originally known as *Union pipe*. In the early XXth century, Grattan Flood proposed that the correct name is *Uillean pipe*, which means *elbow pipe*, elbow being the translation from the gaelic *Uillean* [2]. He also suggested that *woolen pipe* in Shakespeare's *Merchant of Venice* is a transcription of it. All this has been largely controversial since [4, 5] but the name has remained. The Uillean pipe is likely to be among the most complex bagpipes nowadays. The conical double-reeded chanter (figure 2) can have up to four additional keys in order to get alterations from the natural scale (B flat, B, C or the most usual *concert pitch* D). In addition, the instrument has three piecewise cylindrical drones, each with a single reed : tenor, baritone, bass (figure 3) altogether with a set of three closed conical chanters, called 'regulators', each equipped with a double reed and several keys (figure 4), actuated by the musician, that makes them all a small organ suited for simple chord accompaniment, although playing the whole instrument is not that simple. Notice in that respect that tuning and, while playing, keeping in tune the chanter and the three regulators together with the three drones can be really a hard work and calls for skills in reedmaking and tuning that must be constantly kept sharp. The difficulty of playing can be

Figure 1: a) Seamus Ennis, a renowned piper, playing here around the mid-1950s. b) A C-pitch full-set Uillean pipe, made by pipemaker S. Gallagher, NY

Figure 2: C pitch chanter and its cane double reed

Figure 3: Drones and their cane single reeds

Figure 4: Regulators and their double reeds, here made of brass

graded by using only parts of the full instrument, from the *practice set* with no drones, no regulators, useful to beginners, to the *full set* which is the complete instrument. Except for the chanter, all the tubes are gathered in a sole stock and can be controlled to be played or silent, at the will of the musician, that plays seated as one can see on figure 1. This way, the chanter can be played stopped on the knee -using a wash-leather pad, the *piper's apron*- for staccato playing with a rather tricky gracing or opened for legato playing. In the same way as for other baroque instruments, fork fingering is unavoidable. All this makes the playing rather complex as the whole instrument must be controlled by one musician, using at the same time his fingers (with striking stretch in the right hand, especially for *flat sets*) for the chanter ; both arms : one for the bellows and one for the pressure bag ; and one wrist operating the regulators keys, to get the full mellow sound from the seven blown tubes that is very characteristic of the instrument. The overall difficulty of playing and settling the many reeds to play in tune makes it a story of *lore* with sometimes a feeling of *hell* (when out of tune !), not far away from heaven (the *hard D* when everything is in tune and stable), with such an instrument.

The most common pitch nowadays is D -also named the *concert pitch* because it can be played with other instruments- for the lowest note of the chanter, hence the name *hard D*. But other pitches, such as C, or Bb, were most common until the end of the XIXth century and are found again now. In the sequel one will refer abusively to the D pitch although for all the experiments in this work we used the C pitched instrument shown in figure 1, owned by one of the authors.

3 Experiments

3.1 The Uillean pipe

For the experiments, the bag was replaced by a controlled pressure air supply, in order to observe precisely the switching from one regime to the other. Observe first that the hard D can hardly be obtained by a mere crescendo starting from the soft D, because in that case the instrument tends to jump to the second register. In a playing situation, it is usually obtained thanks to an articulation, which usually is a grace note with the finger of the fifth, together with a slight pressure increase on the bag, destabilizing this way the soft D regime in the vicinity of a bifurcation to the hard D regime. Here, one has proceeded in the reverse way : decrescendo once the hard D is established, making the switching to the soft D appear in a clearer manner. In order to try to characterize the

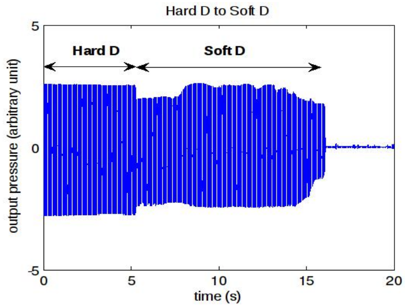

Figure 5: Pressure measured at the vicinity of the first open hole of the pipe. Pressure supply is decreased from 50hPa to 20hPa

difference between the hard D and the soft D some recordings with a microphone fixed on the pipe have been made, whereas the blowing pressure was measured with a pressure sensor. Experiments (see figure 5) show that the hard D is stable for a pressure larger than 50hPa. When making a decrescendo the instrument bifurcates to the soft D for a pressure of about 45hPa. This is clearly a bifurcation as there is no continuity between the two regimes. The pressure signal

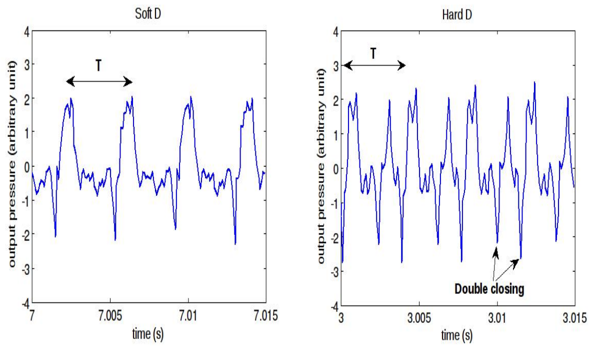

Figure 6: Pressure measured at the vicinity of the first open hole of the pipe. (a) Signal for the soft D regime; (b) Signal for the hard D regime

is clearly different for the two regimes and a double triggering seems to occur in the case of the hard D (see figure 6). Such a double triggering or double Helmholtz motion is clas-

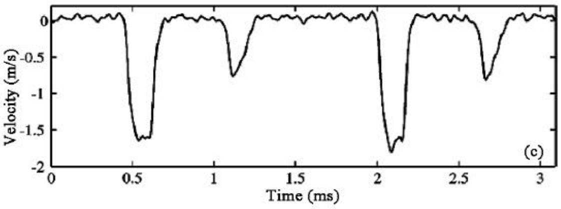

Figure 7: Waveform of reconstructed velocity: double-slipping motion, borrowed from [8]

sically observed in bowed string instruments and have been noticed since Helmholtz [9], Krigar Menzel and Raman [6]. According to the analogy between bowed string and conical reed instruments [7], it is likely that this kind of double triggering might occur on reed instruments. One can compare our results to those of Schumacher et al. (see figure 7 as an example) : it is noticeable that in our experiment, a double closing is observed whereas in the bowed string only a partial slipping shows. However, it is not possible to assess the existence of a double Helmholtz motion only from the radiated pressure. Therefore a second experiment has been made : a special wind chamber with a glass window was built in order to be able to measure the reed velocity with a laser vibrometer (see figure 8). The reed velocity was measured for the

Figure 8: The experimental setup for laser vibrometry measurements

two regimes from which the displacement is deduced by integration (see figure 9). The soft D corresponds clearly to a Helmholtz regime with a short closing episode and a longer opening episode. For the hard D two closing episodes separated by a short opening episode can be observed during one period.

3.2 The irish wooden flute

The soft and hard regimes are also referred to by flute players in the case of the irish flute, apparently under the influence of Uillean pipers. One may wonder whether this is an imitation of what occurs with the Uillean pipe or it is a real change of regime involving a double triggering. As these flutes are piecewise conical it is reasonable to investigate the existence of such a behaviour. In order to try to answer this question, recordings of the external pressure have been made in playing situation. The lowest note (a low D) was played by the musician with an increasing input flow. The first point

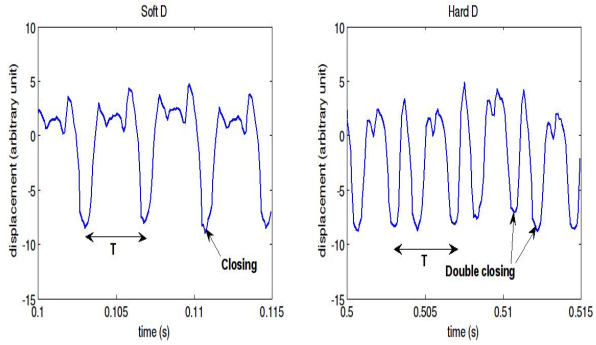

Figure 9: Reed dispacement measured by the LASER vibrometer. (a) Signal for the soft D regime; (b) Signal for the hard D regime

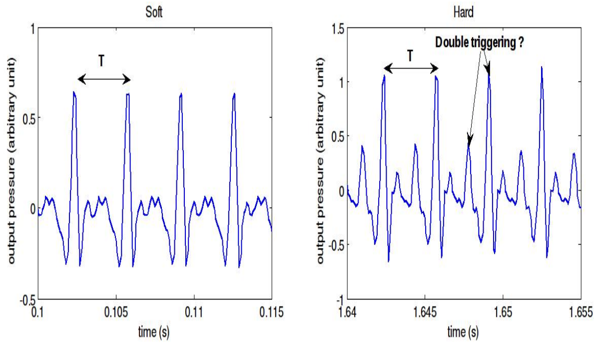

Figure 10: pressure measured at the vicinity of the first open hole of the flute. (a) Signal for the Hard D regime; (b) Signal for the soft D regime

to notice is that a sudden change of regime is not observed as with the Uillean pipe. The change of timbre is less noticeable and seems to be mainly related to the amplitude. However, a change of the external pressure shape can be detected (figure 10) but this is hardly controlled by the player and only surreptitiously observed. It remains that the pressure shape suggests a double triggering. More experiments are needed to validate this interpretation, for example by using the Schlieren method in order to visualize the jet (see for example [3]).

4 Conclusion

In this work, we have shown that for the irish Uillean pipe so called *hard D*, a reed motion can be found, that is equivalent to the double-slipping motion of the bow for bowed string instruments. This comes as a supplementary concrete illustration of the analogy between conical bored wind instruments and bowed stringed ones. For the conical irish flute, although this property is not as evident as for the Uillean pipe, the experiments have shown that it is likely to occur too and thus needs further study. A remarkable point is that this double triggering regime is searched after by musicians and used to obtain a different quality of sound in those irish instruments whereas it is unwanted on bowed string instruments.

Acknowledgments

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