



TRIBUTE TO JOËL GILBERT

J Kergomard^{1*}

J.-P. Dalmont²

¹ Aix-Marseille Université, CNRS, Centrale Marseille, LMA UMR 7031, Marseille, France

² Laboratoire d'Acoustique de l'Université du Mans – UMR CNRS 6613, Le Mans Université, 72085 Le Mans, France

ABSTRACT

Last year Joël Gilbert passed away. This communication aims at introduce the special session devoted to him during FA2023 by taking a synthetic view of his contributions concerning the acoustics of wind instruments. Being an excellent trombonist, he was very interested in the acoustic functioning of brass instruments. In his PhD in 1991, he studied the relationship between resonance frequencies and playing frequencies. For this purpose, he built many experiments, based upon small modifications of the geometry of a saxophone. Extending methods of nonlinear electronics, he showed that the Harmonic Balance can be used for auto-oscillations, the playing frequency being an unknown. His publications dealt with many subjects, even non-musical, such as animals or internal combustion engines. Of major interest are all papers concerning the development of shock waves in - a trombone, then a comparison criterion for the different types of brass instruments, called brassiness. This result was an original way for studying the wide variety of brass instruments. This was an important part of the book “The Science of Brass Instruments”, an outstanding source of information for both scientists and musicians, recently published with Murray Campbell and Arnold Myers.

Keywords: *brass instruments acoustics, wind instruments acoustics.*

*Corresponding author: kergomard@lma-cnrs-mrs.fr

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1. INTRODUCTION

Joël Gilbert (1963-2022) was an acoustician researcher and trombonist. He worked mainly on wind instruments and more particularly those of the brass family, including elephants!



Figure 1. Joël Gilbert in the anechoic room of the LAUM.

2. JOËL GILBERT CONTRIBUTIONS

The so-called brass instruments produce sound from self-oscillations that only the non-linearities of the lip system can explain. In the publications of J. Gilbert, there are therefore many studies on the thresholds of oscillations, essential in practice for musicians, but also other thresholds, such as those of multiphonics. The thresholds depend on the pressure in the trombonist's mouth, but also on the rather complicated physics of the lips. We find in his work all kinds of experimental studies, visualization, artificial mouths, often carried out with the team of Murray Campbell in Edinburgh or that of Le Mans.

Between instrumentalists and instrument makers, an important question is the relationship between natural frequencies of the lips and playing frequency. This subject has been widely explored for nearly two centuries: J. Gilbert has shown that at least two modes vibration of the lips to realistically model the interaction with the resonator [10, 14, 19, 29, 33, 34]. From the theoretical and numerical point of view, the calculations of regimes (permanent or transient) and their stability remain a challenge. J. Gilbert was one of the first to introduce in acoustics the method of harmonic balance including the unknown playing frequency from methods developed in electromagnetism for microwaves [1, 17].

However, there are other types of non-linearities, which also greatly interested him. With his colleague A. Hirschberg, J. Gilbert studied shock waves in instruments with bells. In a renowned article, the most cited of his articles, they showed that the spectral enrichment in fortissimo playing (phenomenon of brassy sounds) is due to the creation of a shock wave in the cylindrical part of the instrument, and that the phenomenon is much weaker in an instrument whose entry is conical. The study of "brassiness" has given rise to numerous articles [6, 7, 24, 30, 35, 39, 44, 49].

He has not forgotten other non-linear acoustic phenomena such as the creation of acoustic wind in a high-level pipe, or the creation of a localized jet at the exit of a pipe [9, 11, 12, 16, 20, 21]. All these phenomena complicate the modeling. As for the effect of the vibration of the walls, the causes remain discussed. It is interesting for factors and musicians, but although linear, it is complicated [27, 31, 40].

He was also interested in anything that could closely or remotely resemble a trombone: an elephant, a moose, a deer [44, 46, 53], but also a thermo-acoustic engine or an internal combustion engine [17, 26, 45].

Last year he published with Springer with Murray Campbell and Arnold Myers a sum called "The science of

brass instruments", which combines knowledge in acoustics and organology [58].



Figure 2. The science of Brass Instruments, the reference book on the subject by D-M. Campbell, J. Gilbert and A. Myers [58].

3. CONCLUSION

Joël Gilbert leaves a considerable body of work that has opened up many ways of research that are still relevant today.

4. REFERENCES

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