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Physics of Baroque Bassoons

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Baroque bassoons differ markedly from the modern instrument. Since the Baroque instrument has only 4 keys, the remainder of tone holes must be within a hand's reach. The holes must be obliquely drilled into the conical bore, making the acoustics both interesting and challenging. Additionally, museum directors are quite reluctant to allow researchers access to these 300-year-old instruments. To acoustically characterize Baroque bassoons a non-linear least squares procedure and precision measurement techniques of physical dimensions were developed. The current study involves 93 original 18th to early 19th Century Baroque Bassoons and 17 reproductions. Tone hole positions "determine pitch" is a characteristic unique to woodwinds. This allows an exhaustive study comparing 47 temperaments selected from English, French, German and Italian temperaments. Including forked fingerings, E-flat and B-flat, enhances sensitivity. Results indicate 5-7 preferred temperaments for each bassoon. For seven of the makers, a study of multiple original instruments allows a unique temperament determination. The model demonstrates the proficiency of 18th century bassoon makers. It is also predictive. In about 25% of the instruments, minor changes to the wing joint dimensions result in a significantly improved "designer" bassoon. The model illustrates bassoon evolution leading to changes in mid-19th century bassoons. The bassoonist's embouchure modifies the double reed volume, which in turn changes conical bore volume, which alters playing pitch and higher harmonics. Since the acoustic model predicts only the 1st harmonic, an impedance calculation using measurements of the conical bore and tone hole positions and shapes was undertaken. This independently yields the playing pitch, harmonics, reed volume and temperament.