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A Three-keyed Oboe by Thomas Collier

I WAS recently fortunate enough to have, on extended loan, a three-keyed oboe by Thomas Collier of London. This instrument, dating from about 1775, was briefly described by Eric Halfpenny in *GSJ* II, 1949.[1] I soon realized that this beautifully made oboe was also of the highest musical quality. Under concert conditions it proved to have all the characteristics that a 'baroque' oboist most desires—freedom of tone production with just the right tendency for the notes to 'fly'; ease of attack over the whole compass; and an excellent compromise in voicing to combine these capabilities with a good intonation pattern and a 'warm' sound. In making copies of the oboe for my own use I decided to produce as detailed a survey of the original as seemed practicable. The results of this study are described as follows. The end of a joint furthest from the player is termed the lower or bottom end. The centre of a hole is defined as that point at which the hole axis intersects the (produced) exterior surface of the instrument. The right-hand side of the oboe is that which lies to the player's right. Unless otherwise stated all measurements are given in millimetres; ø max and ø min are maximum and minimum diameters respectively; d is a distance from the bottom of a joint to either a hole centre or a point at which the bore diameter was measured.

BORE MEASUREMENTS

The bore measurements are tabulated below. Errors in length are ±1. Errors in diameters vary according to the technique of measurement used. When using cylindrical measuring rods (denoted by 'R') the error is ±0.01, but the diameter given is the minimum in the case of an elliptical bore. When transferring dimensions from the bore to a micrometer using spring calipers ('C') the error is ±0.05 but ellipticity can be measured; and when using internal vernier calipers directly ('V') the error is ±0.03, again with ellipticity measurable.

Dimensions were taken from the instrument while it was in a regularly played condition, but after it had been dried and left unplayed for about a day. 'Wet' diameters were up to 0.7% less than 'dry' bores. After a further year, during which the oboe was played frequently, the bore was partly rechecked (see bracketed figures in the table). No great changes were detected, except for a *permanent* decrease of up to 1.4% at the middle-joint tenon. This phenomenon of 'tenon contraction', caused by constrained swelling during playing, is somewhat worrying.[2] Owners of old woodwinds that are played frequently might be wise to take accurate bore measurements at tenons and sockets (to ±0.03) and to ensure that tenon-and-socket joins are kept on the slack side.

Top Joint (length overall 235)

d	ø min	
2	9.83	V
41	9.40	R
53	9.04	R
66	8.61	R
83	8.28	R
97	7.87	R
109	7.47	R
126	7.14	R
142	6.68	R
167	6.27	R
178	5.92	R
189	5.49	R
197	5.11	R
199	5.00	R
200	4.98	R
208	4.88	R
209	4.90	R
212	4.95	R
212	5.00	R
213	5.08	R
216	5.49	R
220	5.92	R
223	6.27	R
227	6.65	R
231	7.11	R
233	7.47	R
234	7.70	V

Middle Joint (length overall 237. socket depth 23)

d	ø min	ø max	
3	14.48	14.50	V
3	(14.30)		V
4	(14.27)		V
10	(14.20)		V
11	14.22	14.25	V
17	(14.00)		V
21	13.97	14.00	C
38	13.84		C
38	(13.84)	(13.87)	C
49	13.72		C
53	13.67		C
59	13.49		C
59	(13.49)	(13.54)	C
64	13.36		C
72	13.21		C
88	13.16		C
104	13.11	13.13	C
109	(12.98)		C
112	12.90		C
121	12.57		C
132	12.19	12.22	C
162	11.79	11.84	C
165	11.76		C
182	11.40	11.46	C
189	11.20		C
196	11.00		C
207	10.59		C
215	10.57		C
215	15.70		C
218	15.93	16.00	C
221	16.13		V
234	16.38	16.46	V

Bell (length overall 146. socket depth 25)

d	ø min	ø max	
2	40.39		V
5	49.28	49.53	C
14	44.58		C
18	42.04		C
20	40.72		C
25	38.23	40.01	C
31	35.66		C
38	31.90		C
43	29.59		C

d	ø min	ø max	
49	27.94	28.07	C
53	26.67		C
65	24.41		C
73	22.86		C
81	21.59		C
88	20.22		C
94	19.99		C
104	19.76		C
121	19.43		C
121	21.46		C
146	22.10		V

HOLE MEASUREMENTS

The accuracies of the figures below are either ±1 (when using a rule) or ±0.03 (when using vernier calipers or depth gauges). The hole depths were measured along the hole axes and were obtained directly by projecting a vernier depth-gauge rod through each hole until the rod was just visible in the main bore.

Top Joint

	d	ø min	depth
I	95.58	2.79	5.16
II	65.35	2.90	5.08
III	34.49	2.13	4.78
	34.49	2.13	4.78

Middle Joint

	d	ø min	depth
IV	188	3.20	3.89
	188	3.20	3.89
V	155	4.65	4.32
VI	123	4.04	4.39

	d	ø min	depth
VII	78.21	5.72	3.73
	Left—not possible to remove key		
VIII	45.21	+	3.61

+Elliptical. 7.04 measured parallel to bore axis; 6.88 at right angles to axis.

Bell

	d	ø min	depth
IX	95	5.33	3.68
	95	5.33	3.68

The holes are drilled at right angles to the bore axis. The lateral separation of the centres of holes III is 4.39 and that of holes IV is 5.08. The axes of holes III converge slightly on going in to the wall of the instrument from the outside; the same is true of holes IV. The axes of holes I, II, V to IX, on the other hand, all intersect the bore axis.

All the holes are undercut to some degree, but it is hard to quantify these most important details. Visual inspection shows clearly the care that Collier must have taken with the undercutting; the duplicate holes III, IV and VII appear to have quite identical dimensions, as do also the bell holes with here an apparently deliberately duplicated asymmetry in shape.

EXTERIOR MEASUREMENTS

Because of the possible influence of wall thickness (as distinct from hole depth) on tone quality, it was decided to record the outside dimensions accurately. These are displayed in Figs. 1 and 2, with diameters to ±0.03 and lengths accurate to the accuracy of reproduction. For clarity, length data have been omitted, but may be obtained from the diagrams using scaling dividers and working from the joint lengths given above.

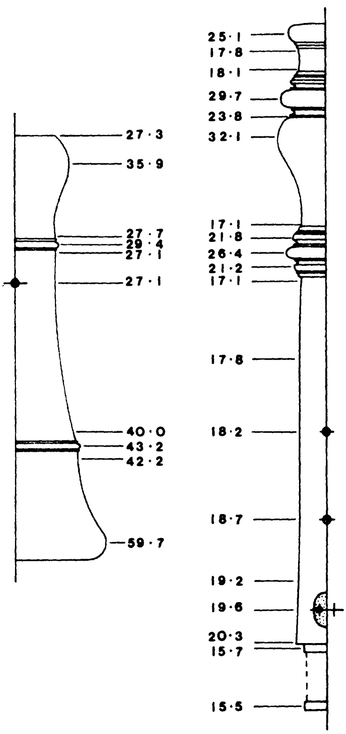

FIG. 1

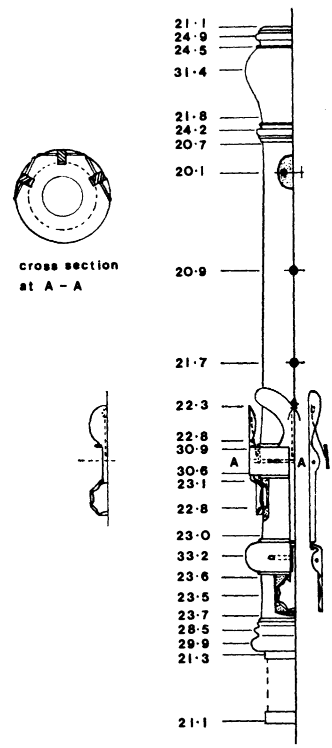

FIG. 2

Also included in the diagrams are drawings of the keywork. The (leaf) springs are rivetted to the undersides of the touchpieces and the free end of each spring slides on a small brass plate set into the upper ring beneath the key pivot. This springing geometry insures that, as the key touchpiece is depressed, the resistance to actuation stays almost constant. This facilitates delicate execution, in contrast to instruments where the positions of fixing and sliding of the springs are interchanged;

in the latter case the actuation pressure rises rapidly as the key is depressed.[3]

REEDS

About two years of continuous experiment under concert conditions was carried out before I arrived at a reed/staple combination that, for me, suited the instrument really well. The effects of significant variations in staple bore, length and conicity were investigated, as were those of cane gouge, reed shape and reed width (working with reeds between 7.5 and 10.5 wide at the tip). The solution I was eventually made to adopt as the most suitable in my opinion was virtually identical to that of a modern unwired English type oboe reed. The scrape adopted is a long 'U' quite devoid of ridges, humps, or hollows, and tapering absolutely uniformly to the tip. The scrape is about 16 long, the unbound cane is about 26 in length, and the tip is 7.8 wide. The staple is essentially of modern English dimensions but is extended at the lower end by 5 whilst maintaining the original conicity. The staple is inserted into the reed well by about 20 until the brass almost touches the bore walls. This formula seems in retrospect quite reasonable in view of the dimensions recommended[4] towards 1800, albeit in France. It is also reassuring to note that Jurg Schaeftlein, principal oboe of the Vienna Concentus Musicus, uses a reed with a tip as narrow as 8.5 on a much earlier Paulhahn oboe. On the other hand, I know of professional players who favour different formulae and yet achieve very similar musical results. No doubt there were equivalent variations of practice two hundred years ago, and it would be most unwise to be dogmatic about the formula that *should* work best on any given instrument (even if it doesn't in professional hands!) on the basis of incomplete and sometimes conflicting historical information.

FINGERINGS AND PITCH

The pitch of the oboe was calibrated using an electronic frequency generator. Great care was taken to blow through the exact centre of each note, and to avoid any correction of tuning that would distort the intrinsic intonation pattern of the instrument.

The following table shows the relative pitches (in cents) of the workable fingerings in the lower part of the compass. The absolute pitch of the oboe centres on $a'=421\pm1$ Hz, in quite good agreement with the value of 425 ± 1 Hz derived for a contemporary English pitch pipe.[5] Pitch measurements were not extended far into the second octave of the compass because it becomes increasingly more difficult to be 'impartial' over intonation in this range.

TABLE

X = uncovering one of twin-holes

			Oboe Pitches	Equal Temperament	Mean Tone
c′			35	0	7
d′			200	200	200
d′♯, *e′*♭			300	300	276,317
e′			390	400	393
f′	1 2 3, 4 6		508	500	510
	1 2 3, 4 6	E♭ key	523		
f′♯, *g′*♭	1 2 3, 4	E♭ key	565	600	586,627
	1 2 3, X 6	E♭ key	615		
	1 2 3, X		618		
g′			700	700	703
g′♯, *a′*♭	1 2 X		796	800	780,821
	1 2 , 4		849		
a′			900	900	897
a′♯, *b′*♭	1 3 5 6	C key	1045	1000	973,1014
	1 3		1045		
b′	1		1088	1100	1090
	1 , 4 5		1106		
c″	2		1203	1200	1207
	2 , 4 5 6		1206		
	2 , 4		1235		
c″♯, *d″*♭		E♭ key	1271	1300	1283,1324
	2 3, 4 5 6	C key	1287		

It is tempting to use these pitch data as clues to the 'state of play' between the temperaments in 1770. For example, if fingerings are selected to fit equal temperament, *d′*, "*e′*♭", *g′* and *a′* are all precisely in tune. Adjustments of between 4 and 15 cents are required to *e′*, *f′*, "*f′*♯", "*g′*♯", *b′*, *c″* and "*c″*♯", but it is fairly easy to achieve these particular humourings. *c′* and "*b′*♭" on the other hand are very sharp, but it is quite practicable to lip them down in to tune. (In contrast it would most certainly be very painful to have to lip notes *up* by 35 or 45 cents!). These 'bad' notes reflect the compromises inflicted by the lack of keywork. Thus when *c′* is overblown an 'octave', the detuning effect of opening hole 1 is insufficient to produce a *c″*♯ of itself, and a further sharpening of the low *c′* is required. Equally, a well tuned *b′*♭ is likely to lead to a flat and stuffy *b′*.

If the pitches are selected instead to fit mean-tone temperament, *d′*, *e′*, *f′*, *g′*, *a′*, *b′*, *c″* and *c″*♯ are all virtually in tune. *d′*♯ and *e′*♭ are 24 cents sharp and 17 cents flat respectively. Since there are no alternative fingerings low down on the instrument, it can be argued that hole VII is tuned optimally to give both a bearable *d′*♯ and a reasonable *e′*♭. It is interesting that the somewhat more common note of *e′*♭ is the better in tune. However, the continual lipping up of E♭ required when playing a flat-key piece in mean tone does lead to some fatigue. *c′* and *b′*♭ are better in tune in mean tone but *f′*♯, *g′*♯, and *a′*♭ are further out than in equal temperament.

To conclude it would seem that in the key of C, the Collier oboe goes better in mean tone than in equal temperament. In keys involving E♭ the instrument is perhaps more easily played to equal temperament. In the main, however, the compromise voicings and the multiplicity of fingerings make it difficult to achieve any clear distinctions. In spite of this the instrument can be played perfectly well in tune because the particular lip adjustments required to give concordance can usually be produced without noticeable fatigue and soon become quite automatic.

ACKNOWLEDGEMENTS

I am most grateful to Richard Maunder for his help and encouragement throughout this study. The electronic frequency generator used was designed and made for me by Keith Page.

NOTES

1 Halfpenny, E., 'The English 2- and 3-Keyed Hautboy', *GSJ* II, p. 10, *et seq.*, example 19 and Plate III C2. Very similar two-keyed instruments by Collier are illustrated by Baines, A. C., in *Woodwind Instruments and Their History*, 1967, Plate XXIX and by Bate, P., in *The Oboe*, 1975, Plate III. For further details of Collier and his instruments see Byrne, M., *GSJ* XVII, p. 93 *et seq.*

2 Measurements I made with Richard Maunder of a Grenser basset horn show bore contractions of 0.25 to 0.50 at tenons (assuming an initially cylindrical bore). Similar observations for boxwood clarinets have been communicated to me by Nicholas Shackleton. Laboratory work by the author (unpublished) and by A. J. Bolton *et al.* (Holzforschung Bd. 28, 1974, Heft 4) has confirmed this effect. The more often an instrument becomes wet, the more is the permanent set expected at the tenons. Uptake of water along the exposed end grain of a tenon can probably be limited by waxing the wood, or by frequently treating it with olive oil. The second method may bring its own problems however (see Montagu, J. P. S., *GSJ* XXIII, p. 143).

3 These observations may be explained readily in terms of the theory of cantilevered beams. Thus the force exerted by a leaf spring is proportional to the lateral displacement of the free end from the equilibrium position. In the Collier oboe the changes in spring displacement when the key touchpieces are depressed are small relative to the total spring displacements needed to keep the keys 'closed' when not in use. The latter displacements are large in order to make up for the small moments of the spring forces about the key pivots, the free ends of the springs being almost under the pivot axes.

4 Warner, T., 'Two Late Eighteenth-century Instructions for Making Double Reeds', *GSJ* XV, p. 25 *et seq*.

5 Byrne, M., 'A Pitch for 1774', *GSJ* XIX, p. 136. The 4 Hz discrepancy between *a'* values could be due to a difference in playing temperature between oboe and pitch pipe. In addition, I tend to prefer a relaxed embouchure and thus a fairly soft reed; use of a harder reed would probably increase the pitch of the oboe by a number of cents.