Geometry, Proportion and the Art of Lutherie. By Kevin Coates. pp. viii + 178. (Clarendon Press, Oxford, 1985, £40.)

This exceptionally handsome book is intended to show the aesthetic influence of geometry and numerical proportion on the design of lutes, viols, guitars, violins, citterns etc. from the sixteenth century to the eighteenth. It has 31 large plates (in the style of Fig. 1) and more than 140 smaller illustrations and diagrams. It is extremely well written, and it appears to have the virtue, too rare in musicology, of candour, since Dr. Coates seems more concerned to show how he reached his conclusions than to cover his tracks.

There are some brief and very engaging chapters on certain relevant episodes from the history of geometry, on the various kinds of mathematical relation to be sought in the analysis of the author's chosen instruments, and the like. Then he explains his analytical procedure:

> Analysis was begun by first examining the overall measurements—body length, string length, upper-, middle-, and lower-bout widths, etc.—for proportional relationship; this would also entail estimating major ratios like the body-containing rectangle(s), and checking for possible grid-planning. Next, the body outline itself was broken down into its constituent single-radius arcs. The centres of these arcs were located by a simple device, made by engraving a series of concentric circles on a clear perspex sheet of suitable size, and drilling a small hole at their centre; this was laid against the contour in question and moved until the two curves coincided; the centre was then marked. In this manner, any multi-centred curve, or pseudo-ellipse, can be simply resolved into its component arcs. These separate vectors would then be recorded, revealing any geometical design processes such as grids, planning arcs or circles, vesicas, etc., while their arithmetical values, upon generation, might disclose the presence of a proportional scheme . . . A general margin of error of 0.5 mm was employed, although where larger specimens exhibited measurements lying outside this tolerance, yet seemingly related by obvious intention to an overall scheme of proportions, they were so declared, together with the difference of their deviation. (p. 25)

Such clarity removes the book from the level of the coffee table (which its elegance and shape might suggest) to that of the critical reader's desk. The first question that occurs to me is 'Why only single-radius arcs, why no truly elliptical curves?' Gerhard Söhne has found such curves in the design of certain lutes, including a design used by different makers and for different-sized instruments. (His reconstructions are based on the mould rather than the exterior dimensions—a consideration which may well be more important for viols and violins than for lutes.) Dr. Coates's perspex sheet might give way to a set with one for each difference between the two elliptical radii, the circular sheet being labelled 'zero'. No matter that, given enough circular arcs, any curve can be approximated to within a half millimetre or even less: Dr. Coates's very sensible treatment of larger discrepancies shows that his pragmatic use of the sheet is not an end in itself but a way to probe the makers' intentions, so he might agree that a simple elliptical reconstruction should be preferred to an unwieldy circular one. The simpler alternative is more likely to have been used because it is easier to transmit and because, within reasonable limits, simplicity is (and was) aesthetically more touching.

For instance, the extremely complex scheme attributed on pages 48–50 to the Tielke gamba shown in Fig. 1 (Dr. Coates's Plate V) could be simplified by using some elliptical curves, as in Fig. 2, where G is the top of the body and θ in the key stands for the golden ratio ($\frac{\sqrt{5}+1}{2}$). The spoon shapes, reminiscent of seventeenth-century designs such as the one illustrated in Fig. 3—from Serlio's *Extraordinario libro di architettura* (Lyons, 1551)—are geometrically similar. Their linear measurements are in the ratio $\theta/2$, as are the height and width of each half-ellipse. Perhaps more important than these are the simple elliptical curves for the middle bouts (not to mention the elliptical rose). This is merely an illustrative proposal, which Ronald Turner-Smith of the Chinese University of Hong Kong and I worked out from Dr. Coates's drawings and measurements and not from an examination of the instrument; one of its virtues, however, is that it can be constructed on a rectangular sheet of wood hardly larger than is necessary to make the gamba.

FIG. 1

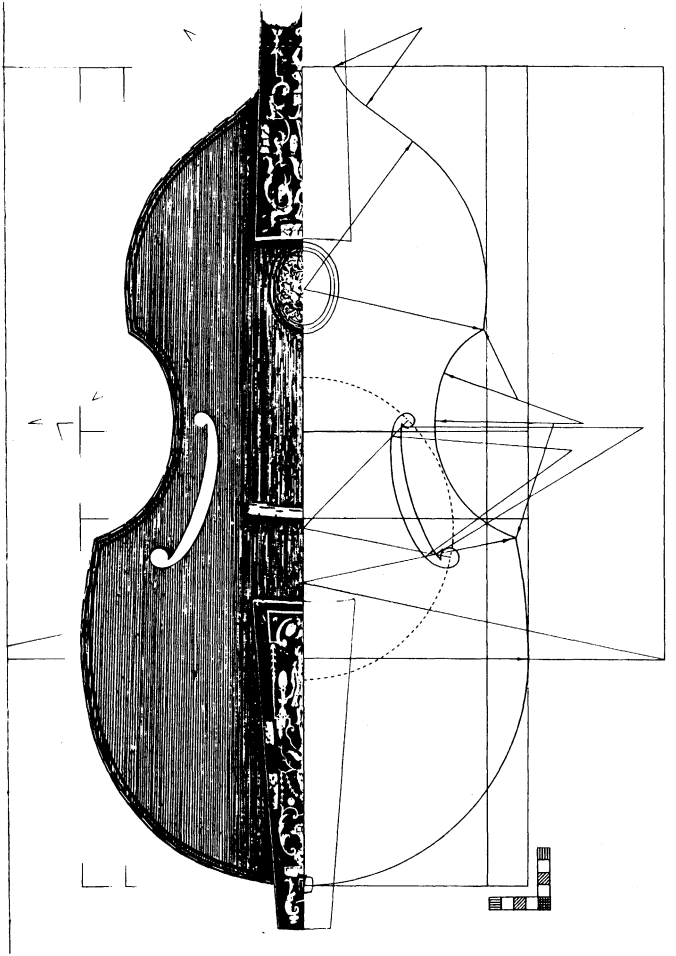
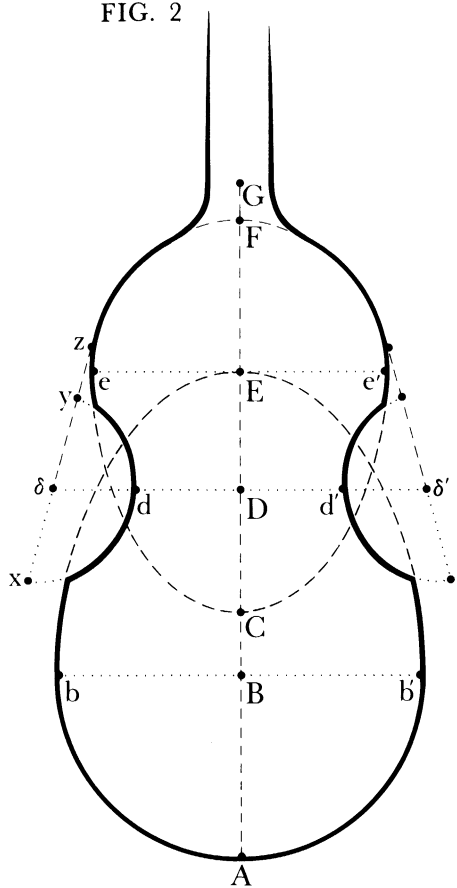


FIG. 2

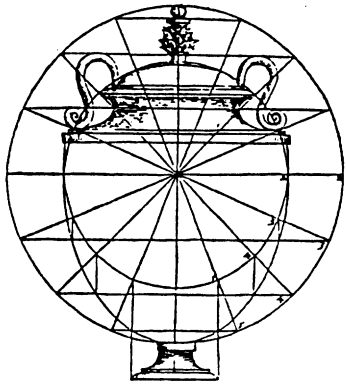


KEY
bBb′, δdDd′δ′ and eEe′ are perpendicular to the axis ABCDEFG. bAb′ and eFe′ are semicircles; bEb′, eCe′ and xdy are half-ellipses. AB = BD = EG = δD = xy = 2δy. θAB = BE = ee′. (So AG = bb′ + ee′.) δy when extended to z is tangential to eFe′; and dd′ = θAG/5.

Some of Dr. Coates's circular arcs are centred rather off to the side, or at points not explicitly related (otherwise) to the designs. A far-off centre need not really imply the use of an immense surface for the final drawing, as a template might be used. But it is always worth while to distinguish merely pragmatic geometrical elements from the aesthetically more interesting kind of 'Pythagorean' design. (Dr. Coates prefers 'Platonic', which I think perfectly legitimate after reading Walter Burkert's *Lore and Science in Ancient Pythagoreanism.*)

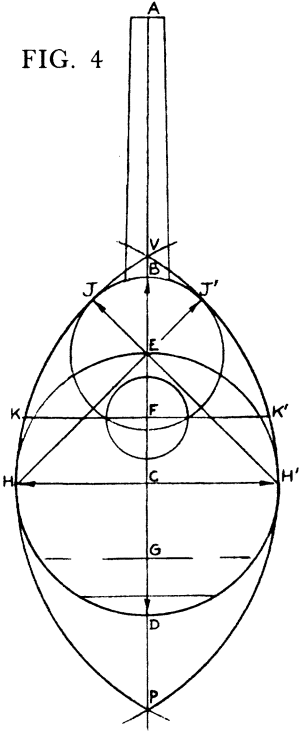
Some occasional mathematical oversimplifications, however, have caused Dr. Coates to miss the likelihood that certain designs involve a tempering, as it were, of

FIG. 3



two theoretically incompatible schemes. For example, on page 109 he says that in Fig. 4 the circles centred at E and C are tangential, as shown, to the circular arcs centred at H and H′ and that the radii from C and E are as 12 to 7. But with HH′ and therefore HJ′ at 24 (twice HC), and with HE at $\sqrt{12^2+12^2}$ (by Pythagoras's theorem), EJ′ should be $24-\sqrt{288}$, which is nearly 7.03. For lengths over 12cm such a discrepancy would exceed a half millimetre.

FIG. 4



Dr. Coates distinguishes categorically, perhaps too much so, between symmetrical and 'naïve' instruments. In his account on pages 23–24 of how he drew the contours of his specimens, the phrase 'symmetrical accuracy being maintained by linking the patterns' (for the left and right sides) suggests that he may inadvertently have suppressed some good data contrary to his premise. I think he might have secured his main point—that calculation has often helped the master luthier find an aesthetically satisfying profile—more firmly by a conspicuous display of discretion in this regard. His comments on page 22 about levels of proof in inferring the original units of measure, and also the caveat on page 164 that his remarkable superimposition of the analysis of one of his instruments upon Leonardo da Vinci's famous drawing after Vitruvius is 'of no specific significance for the instrument concerned', show him perfectly capable of it.

Certain lacunae in the bibliography could be tied to these criticisms: some good secondary sources would have been Abbott and Segerman on the use of circular arcs (*FoMRHI Quarterly*, ii (1976), Comm. 5), Juschkewitsch on medieval mathematics, Panofsky's *Galileo as a Critic of the Arts*, Naredi-Rainer's *Architektur und Harmonie* (2nd edn., 1984) and Söhne on lutes (in Vol. 13 of the *Journal of the Lute Society of America*, Vol. 14 of *Musique ancienne*, Appendix 4 to my *Lutes, Viols and Temperaments* and various articles in German).

None of this is to call Dr. Coates's very substantial efforts wasted. Some of the reconstructions are entirely convincing (to me at least), and those to which someone may find a better alternative will, thanks to his candour about his method, always have the value of showing its pitfalls clearly. The summary of analyses on pages 157–63 may be premature, as he himself implies, but there is much else of interest. I particularly liked the clear distinction (pp. 164–5) between acoustic, ergonomic and aesthetic considerations in the shaping of the instruments, even though the distinction may not always have been salient to the makers.

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