VII
Tuning and tradition: the earliest Northumbrian bagpipe chanters and their relationship to the study of archaeological bone pipes

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SUMMARY

The Society possesses in the W. A. Cocks collection of bagpipes a resource of international significance, of interest not only to practitioners of traditional musics but also to students of the antiquity – and archaeology – of music in Britain. Several are clearly ancient, maybe from as early as the sixteenth century; but none has been dated scientifically, and the origins of the tradition remain a mystery. Finds of wood and bone from the East of England reveal a preference for reed-voiced pipes of similar length and narrow bore, in everyday use during the Middle Ages, the Anglo-Saxon period and even Roman times. How these relate to Northumbrian tradition is not yet certain, but the sound they produce is strikingly similar. Close inspection of the finger-hole margins of some finds reveals traces which indicate deliberate tuning; such purpose is reflected in some remarkable features of tunings of the Society's pipes.

INTRODUCTION

Amongst the important collections of Northumbrian and Borders antiquities belonging to the Society of Antiquaries of Newcastle upon Tyne are many historic bagpipes, formerly the collection of Mr W. A. Cocks, master clockmaker of Ryton in Tynedale, and given by him to the Society in 1971 (Bibby-Wilson and Moore 2003). They form the core of the Society's extensive holdings of bagpipes and related material which are today preserved and displayed in the Bagpipe Museum at the Chantry, Morpeth, Northumberland.[1]

W. A. Cocks should need little introduction in these pages and neither should the traditions of Northumbrian pipe-making and playing which his collection particularly celebrates and documents (Clerevaulx Fenwick 1859; Charlton 1930; Askew 1932; Mullen 1984; elsewhere Cocks 1925; Cocks and Bryan 1967). The collection is our most important single resource for their history, and indeed has come to occupy a central place both in the revival of piping in the region and in the consequent resurgence of audience interest in their sounds and music. It is perhaps the unique, sweet tones of the Northumbrian pipes themselves that have done most to ensure such popular appeal. From it has emerged a widespread recognition of their value as key ingredients in the North-east's cultural heritage and regional identity. But the pipes have relevance further afield too. The collection's importance is acknowledged internationally both by practitioners of traditional musics, especially of piping, and by students of the antiquity of popular music in Britain and Europe. This paper now offers an archaeological perspective on this historical theme, and considers some aspects of the pipes which seem to bear directly upon research questions current in the finds-based study of our earliest English music.

Several sets of the Society's pipes possess simple key-less chanters of turned ivory, much worn and polished, which are variously estimated to date from the 17th century or earlier (fig. 1). They are clearly ancient; however, it is difficult to determine exactly how ancient since they lack identifiable makers' marks and none has yet been subjected to scientific dating. Early documentary records too are meagre and are so fraught with ambiguity as to offer little

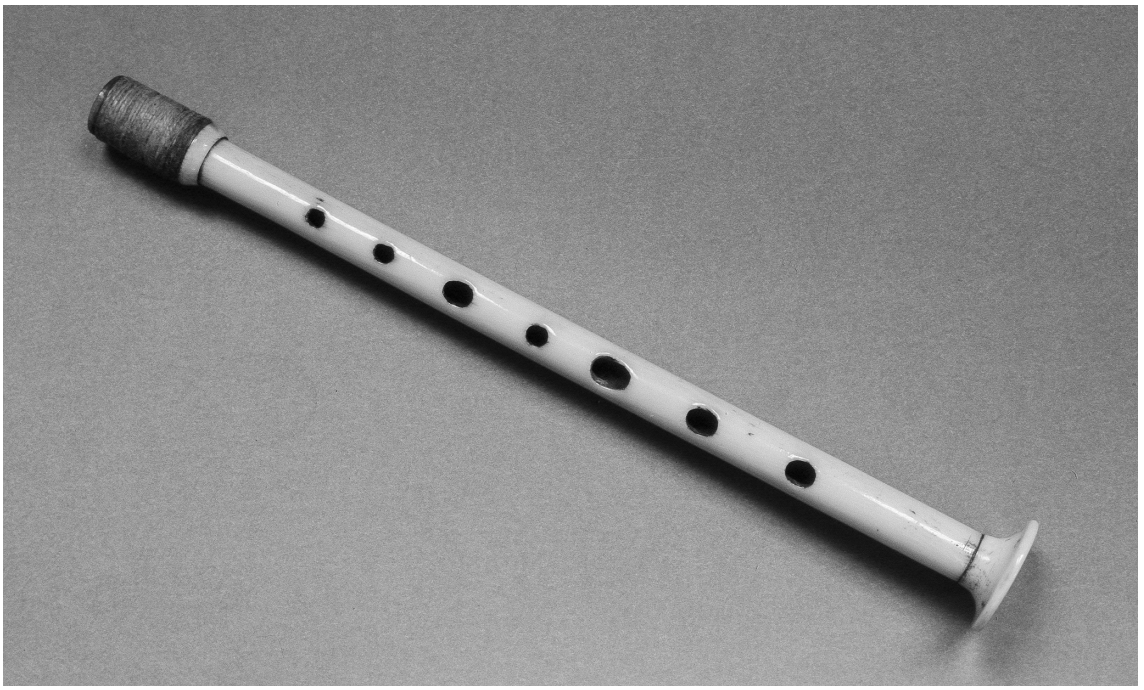


Fig. 1 Ancient bagpipe chanter (melody pipe) of turned ivory, from the W. A. Cocks Collection, Society of Antiquaries of Newcastle upon Tyne. Morpeth Chantry, Bagpipe Museum, accession no. 1 WACocks. Date uncertain, believed to date possibly from the 17th century or earlier. Length 188 mm, bore 3.1 mm (⁹⁄₆₄ in). Photograph: G. Lawson, courtesy of the Society and the Museum.

decisive contribution. Consequently, although several plausible theories have been put forward to explain the ultimate source of the tradition – from independent invention to adaptation from some Scottish or Continental prototype – its precise origins and evolutionary kinships remain shrouded in mystery.

ARCHAEOLOGICAL PARALLELS

A major difficulty facing scholars in their search for this lost historical context has been a conspicuous lack of archaeological finds. Northumbrian piping has, as yet, no local archaeological record of its own. No excavation in the region has produced the slightest fragment that could be associated with it. Perhaps it would be over-optimistic to expect such traces to survive in any quantity. Nevertheless, post-excavation research elsewhere in the British Isles suggests that we should not be surprised if – some day – some did. Evidence is already accumulating from a range of different archaeological contexts for several other kinds of medieval musical activity, ranging from mouth-pieces of horns and trumpets to the frames of *Jews' harps* and various parts of stringed instruments. Most significantly, amongst medieval finds of wood and bone there are now many simple wind instruments of whistle- and flute-kind, of which perhaps the most familiar – and musical – are 'bone flutes with finger-holes'.

Instruments of this sort are found surprisingly often in England and Wales, just as they are on the nearby Continent, and have been the subject of periodic discussion in the

archaeological literature since the first reports of Vincent Megaw in the 1960s (see for example Megaw 1960; 2000; also Lawson 1982; Lawson and Margeson 1993). Ranging in date mainly from the later Anglo-Saxon period (around the 10th century) to the late medieval, they are shaped typically from the ulnas ('forearm' wing-bones) of large birds such as swan or goose, or from tibias (shin-bones) of sheep or goat. Such faunal distinctions have recently been argued by the present writer to represent not simply the opportunistic use of different, musically adaptable bones, selected more or less randomly, but rather quite discrete musical choices and traditions: many of those of bird ulna representing the precursors of the penny-whistle and post-medieval three-hole 'tabor-pipe', and many of those of sheep/goat tibia corresponding to the medieval block-flute and the plastic 'school recorder' (Lawson 2004). All these are, of course, only distantly related to bagpipes. However, amongst miscellaneous residual materials which do not fall conveniently into such familiar categories are some instruments, and fragments of instruments, which appear to possess a quite different and altogether more relevant character: that of *reed-pipes*, sounded not with a blown jet of air, like flutes, but by means of an inserted vibrating reed, like an oboe – or a bagpipe chanter. Could these relate in any way to the origins of Northumbrian tradition?

Significantly, the new finds are all made from a material rarely used in making bone flutes: deer (or in one case sheep) metatarsus. This is a slender, elongated bone from the animal's foot, which has a long, straight, narrow cavity well-suited to the acoustics of reed-voicing but whose epiphyses (the solid ends which bear the joint-surfaces) are not so readily adaptable to use as the ends of a flute. In particular their manufacture has involved no provision for that all-important feature of medieval duct-flutes, the D-shaped sound-hole close to the proximal (mouth-piece) end, which enables flutes to make their characteristic, airy sound. Instead they require the insertion of a reed. This new type has so far been evidenced in three scientific excavations: at Thetford in Norfolk (Lawson 1993), at Ipswich in Suffolk and at Raunds in Northamptonshire (Lawson, *forthcoming*). All are in the East Midlands or East Anglia, regions in which bone pipes of other kinds are well represented. That they must indeed constitute a discrete group is supported by a number of additional distinguishing features which they share and which the others do not: in particular, unusually extensive external working (shaved smooth using the maker's knife) and a deliberate, so far unexplained chamfering around one end (fig. 2). They are very reminiscent of bagpipe chanters. Could this be more than just coincidence? Could they indeed be the very chanters of ancient English bagpipes?

The evidence connecting them with bagpiping, as such, remains inconclusive in the absence of accompanying components. In each case only the bone tube itself survives. Nowhere, even in the post-medieval period when we know for certain that bagpipes were popular in Britain and Ireland, have remains been identified of bags or bellows, or of the wooden stocks and ferrules which would have united them with their various tubular components. Tantalisingly, the bone pipes themselves bear indications that they were intended to be inserted into hollow structures of some kind, at one end; but whether into the stocks of true bagpipes or just the reed-protector caps or horns of traditional reed-pipes like the Scottish *stock-and-horn* or the Welsh *pibcorn* we cannot yet say. Both are theoretically possible, at least as far back as the twelfth century. But whilst such a date range would accommodate the Raunds find, the earlier we seek the stronger the supporting evidence seems for free chanters and the weaker seems the support for bags.

The earliest evidence that the air-reservoir principle was known in Northumberland seems to occur in the thirteenth century, in the carved detail of a recently republished grave-slab at St Michael's church, Ford (Ryder 2003, 101, no. 2 and 127, fig. 16.2). The first convincing illustration, in any English region, of a chanter with bag firmly attached is probably in the hands of one of the Psalmist's musicians

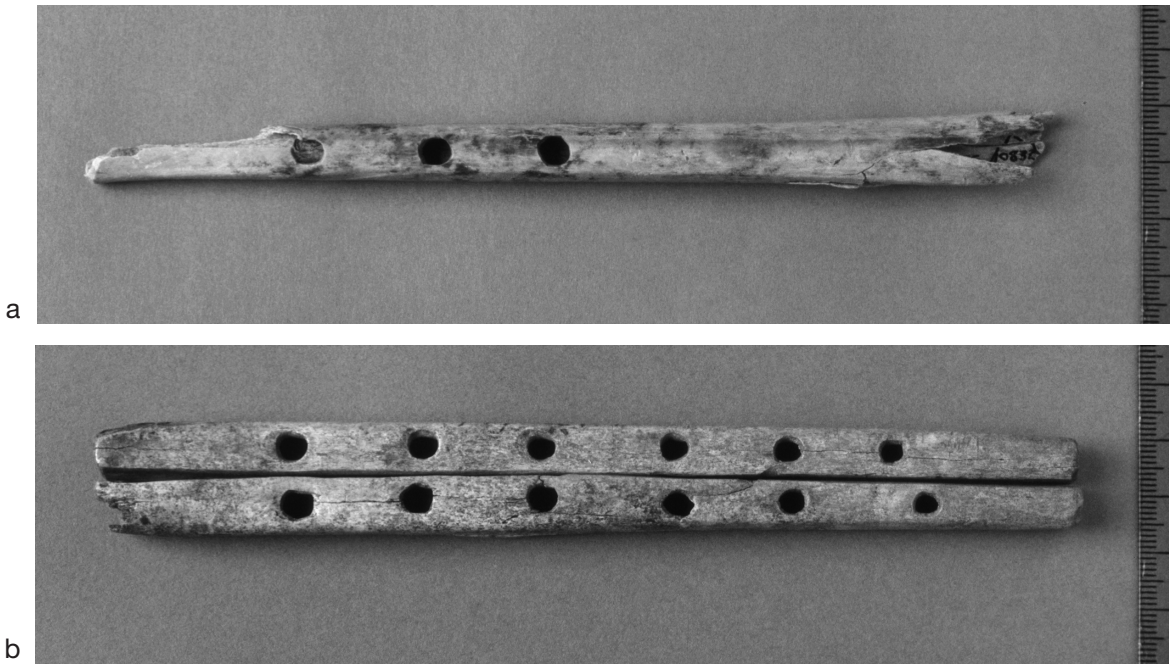


Fig. 2 Reed-pipes of deer metatarsus:
(a) Raunds, Northamptonshire, medieval (Northamptonshire Archaeology, WC85 10832). Length 167 mm. Photograph: G. Lawson, courtesy of Northamptonshire Archaeology.
(b) St Stephen's Lane, Ipswich, Middle Saxon (Suffolk Archaeological Unit, 3104B 183 and 272). Length 170 mm. Photograph: G. Lawson, courtesy of Suffolk County Council Archaeological Unit.

on folio 21 *verso* of the English late twelfth-century manuscript the York Psalter (fig. 3). Remarkably, this already appears to be bellows-driven, like the Northumbrian pipes, not mouth-blown (at any rate a mouth-pipe seems to have been omitted). However, before that date there is no reliable support at all, anywhere in Europe. Finds of wooden reed-pipes from waterlogged deposits in England, the Netherlands and Scandinavia are equally enigmatic, even though some possess tenons at *both* ends (fig. 4). Their reconstruction as bagpipes (for instance in Lund 1991, 63–4, tracks 40–1) is purely conjectural. Suggestions of still earlier, Roman bagpipes, recently revived by enthusiasts and reported widely in the media, rest on controversial readings of ambiguous texts and on highly optimistic reconstructions of enigmatic illustrations and fragments.[2]

The failure of the new finds to inform our dating of the invention of the pipe-bag itself does not, however, mean that we should regard them as unrelated to the chanters of later bagpipe tradition. In fact they exhibit enough points of resemblance in form, and consequently in acoustic and other musical properties, to suggest that there may be a very close relationship. They could even be among the bagpipes' direct precursors. Even in more recent traditions bagpipe chanters and free reed-pipes are clearly related to each other in principle, in a way that flutes, for example, are not. Indeed bagpipes – or rather their individual drones and chanters – *are* reed-pipes.

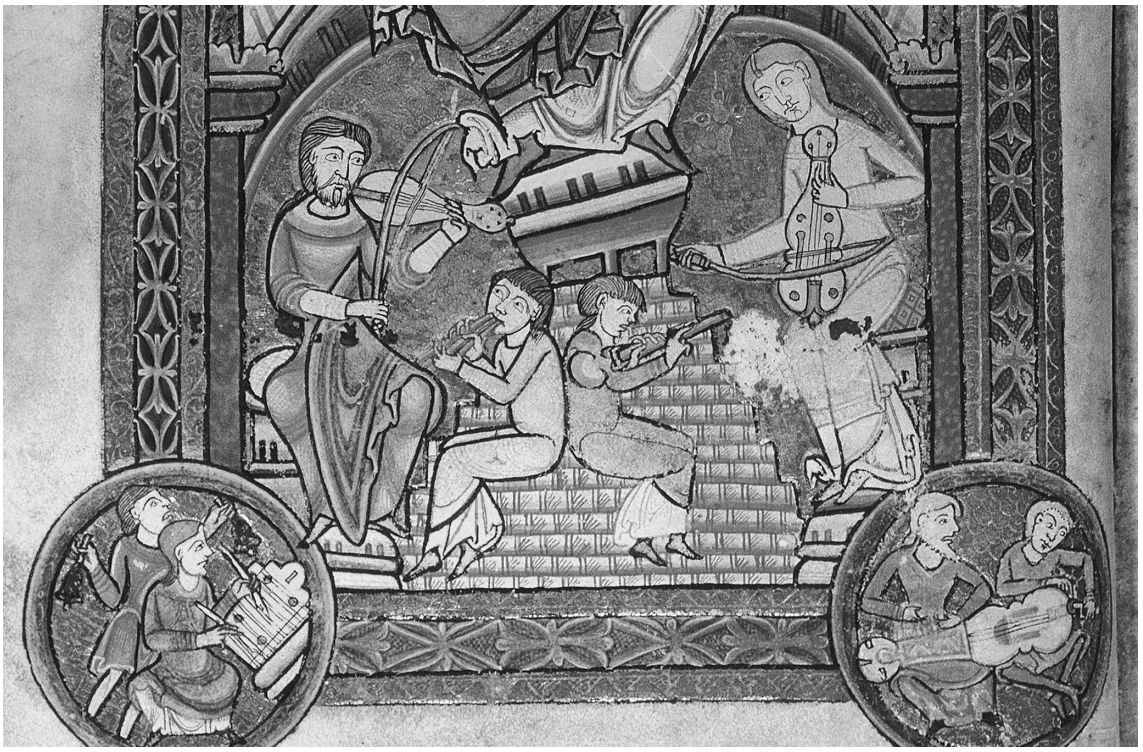


Fig. 3 Musicians accompanying King David, the Psalmist, including bag-pipes being played without a mouth-pipe; from the York Psalter, folio 21 verso; England, circa 1170. Glasgow University Library, MS Hunter 229. Photograph © Glasgow University Library.

They are in several respects closely similar to make, are similar to handle and play, and they make the same characteristic reedy sound.

But it is not just bagpipes *in general* which these early archaeological chanters resemble. Their long, narrow, near-cylindrical (as distinct from conical) bores also lend them some of the distinctive acoustical character of the Northumbrian pipes, including their soft tone quality and their *tessitura* – the average frequency of the range of notes they can play. We must await further archaeological developments before we can safely take this line of argument much further, but already it seems that we might be justified in treating the two traditions at least as analogues, if not actually homologous. It is, to be sure, a direction worth exploring.

NARROW-BORE CHANTERS

The straightness and narrowness of the early reed-pipe finds are most clearly represented in the pair of complete pipes of Middle Saxon date found in 1987–8 during excavations along St Stephen's Lane in Ipswich, Suffolk. By around AD 800, Ipswich, on the Orwell estuary, was developing into an important East Coast trading port, and no doubt musical entertainment would have been an important social activity there. Excavations elsewhere in the town have produced several other items of musical interest from later phases of its occupation. The site lies, of course, less than 9 miles (14 km) as the crow flies from the Anglian Royal burial-place at Sutton Hoo, which in

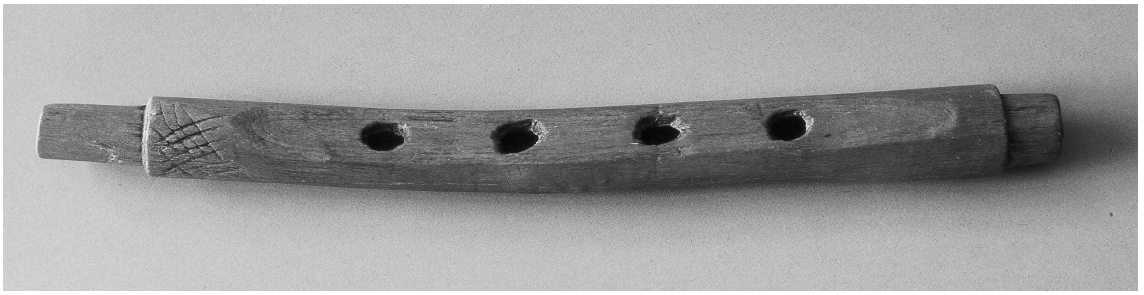


Fig. 4 Reed-pipe of elder (Sambucus sp.) from an 11th-century level at Lund in Skåne, Southern Sweden. The structures into which the tenons originally fitted were not found. Lund, Kulturen, KM62892:3094. Length c. 197 mm after conservation. Photograph: G. Lawson, courtesy of Kulturen, Lund.

1939 produced its famous lyre, and indeed only 3 miles beyond that is Rendlesham, the probable site of the Anglian royal estates which Bede names *Casa Rendili* (Bede, *Historia ecclesiae* III. 22). Even before the Sutton Hoo lyre was buried, around AD 625, there seems to have been a focus of musical and related activity somewhere in the district, judging from the number of other lyre-graves now known from that area of South Norfolk and North Suffolk at the end of the previous century (Lawson 2001). So to come across such an interesting find at Ipswich is by no means a surprise.

The Ipswich pipes, forming a mirror-pair (in fact, shared scratch-marks show that they must have been bound tightly side-by-side when in use), introduce a curious variation which we would now regard as alien to piping in Britain, though it is familiar to us from reed-pipes and bagpipes of Continental and Mediterranean traditions. Blown simultaneously and fingered to produce notes of almost (but inevitably not quite) equal pitch, these generate some very distinctive, additional musical effects.[3] It seems likely that such properties were deliberately engineered, therefore presumably desired, forming a discrete element in the tradition not merely of instrument manufacture but of music-making itself. The principle is, moreover, a very ancient one. A wooden example of the eleventh century, carved in one piece with parallel, very narrow bores, survives waterlogged from an inundated settlement at Charavines, Lac de Paladru, Isère, near Grenoble in eastern France (Homo-Lechner 1993). In Britain we have a single Roman specimen, of potter's clay, from a kiln site at Lydiard Tregoze in Wiltshire. Though simply made, it shares a number of features with Charavines, and also with Ipswich: in particular the positioning of its finger-holes such that each pair is clearly meant to be closed simultaneously by the flat of just one finger. There are obvious family resemblances. But their most interesting shared feature, in the context of our English bone pipes and especially of Northumbrian tradition, must be their very narrow bores. One of the pipes of the Wiltshire pair, the player's right, measures 6.5 mm in diameter (¼ in), the other a mere 3.5 mm (3⁄16 in).

Although pairing, as such, seems not to have been a feature of Northumbrian piping tradition within living memory, it could well have been known in the region in the more distant past. A representation is clearly indicated, for example, in the famous fifteenth-century grotesque at Hexham Abbey (Charlton 1930, plate 32, fig. 2; Bibby-Wilson and Moore 2003, 10). Moreover, these bore-diameters are all surprisingly close to those of the surviving Northumbrian pipes. The Society's chanters examined in this study have bores typically of around 4 mm (0.15 or roughly 5⁄32 in). A single-bore pipe of fruit-wood of 10th-century date from excavations at St Peter Hungate, York in the 1950s, so far the only early medieval wooden pipe from England, had a bore of

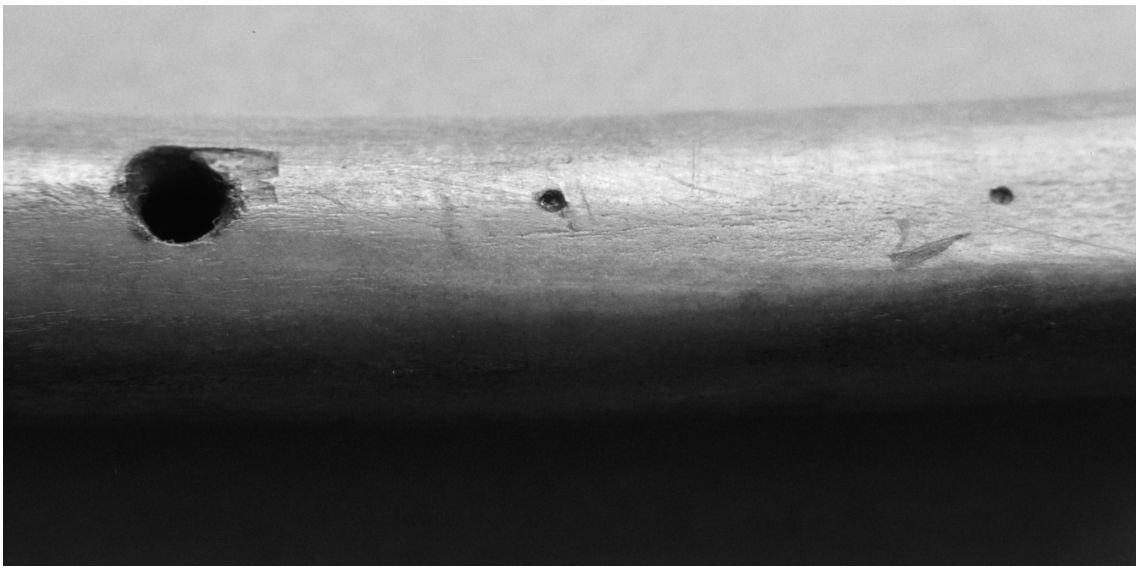
about 4.5 mm when illustrated (Richardson 1958, 63, 84–5). I stress these coincidences because they contrast so markedly with other reed-voiced pipes of what might be termed more 'formal' traditions, and because bore has such a marked influence on tone quality. Elaborate, cylindrical-bore reed-pipes of the Classical Mediterranean world, such as Greek *auloi* or Roman *tibiae*, had bores typically in the region of 8 to 12 mm (⅜ to ½ in), generating a much bigger volume of sound. A find of this sort which was made in the 1980s at the Thames Exchange, London, has a bore of over 7 mm (Lawson and Wardle 1998 and *in preparation*). Later reed-instruments such as late medieval shawms were similarly wide-bored: the tenor instrument from the *Mary Rose*, for example, which was lost in 1545, has a minimum internal diameter (after conservation) of just under 8 mm. So, whether single or double, horn-pipes or bagpipes, these small-bore instruments do seem distinctive.

TUNING PRACTICES

What useful lessons can be drawn from comparisons between any of these medieval small-bore pipes and surviving Northumbrian chanters? One intriguing feature of both groups, which forms the principal subject of the present project, is the way they preserve in their designs and on their surfaces indications that they have been carefully tuned.

After the tuning of the reed itself, the critical elements in the tuning of any pipe are the positioning and shaping of its finger-holes. The location of each finger-hole defines the length of air in the tube between it and the reed (known as the air column), while the hole's diameter, or rather its area, controls the air-column's interaction with the outside air. Depending on the particular characteristics of the reed (such as its length and hardness) these dimensions therefore define the principal pitch (or fundamental) of the note which will sound when the hole is opened and the instrument is blown. The shorter the air column the higher the pitch. Thus a series of finger-holes, opened in sequence, will yield a series (or scale) of different pitches, deriving in very large measure from the way they have been placed and drilled. From such scales melodies can then be formed. However, any variation in either the location or the size of any one hole will alter the pitch which that hole generates, and therefore change the character of the scale. So in making any new instrument it is within the maker's power to control both the tuning it will have and the tonality of the music it will play. For this reason signs in ancient instruments of variation in any of these details are of much historical interest. Indications that such variation may have been deliberate are particularly exciting. In the archaeological record such signs vary in detail from instrument to instrument, from preliminary marking-out scratches to later retouches and enlargements of the holes (fig. 5); but all point repeatedly to the same conclusion: that in shaping their instruments makers must often, perhaps always, have attached great importance to this process (Lawson 1999; 2004).

This seems, at first glance, to be stating the obvious. Why should it surprise us? We might surely take it for granted that people would always have tuned the instruments they made, because they do now – and very precisely too. We might also take it for granted that our familiar musical scales and intervals, especially the tone and semitone, are natural and somehow fixed. Their relative values today are certainly defined very tightly indeed.[4] Many string keyboard players require electronic tuners, or specialist help, to ensure that their instruments play properly in tune throughout their ranges. Many musicians (such as violinists and of course singers) have to make fine adjustments 'in real time', employing great intuition and dexterity, to satisfy accurately their and our clear sense of what sounds 'in tune'. As audiences we are disturbed and alienated by sounds that seem 'out of tune'. And our taught musical frameworks have now come to seem so scientific, and universal, that it can be difficult for us to imagine cultures ever having other preferences. But they do; and we know alarmingly little of their history.



a

b

Fig. 5 Medieval bone flutes: details showing two kinds of markers associated with finger-hole placement: (a) Schleswig, Germany, unfinished instrument of sheep/goat tibia; drill-point markers. External diameter of bone c. 13 mm. Photograph: G. Lawson, courtesy of Schleswig Holsteinisches Landesmuseum, Schleswig. (b) Castle Acre, Norfolk, finished instrument of sheep/goat tibia; single chop-mark. External diameter of bone c. 14 mm. Photograph: G. Lawson, courtesy of Norfolk Museums and Archaeology Service, Gressenhall.

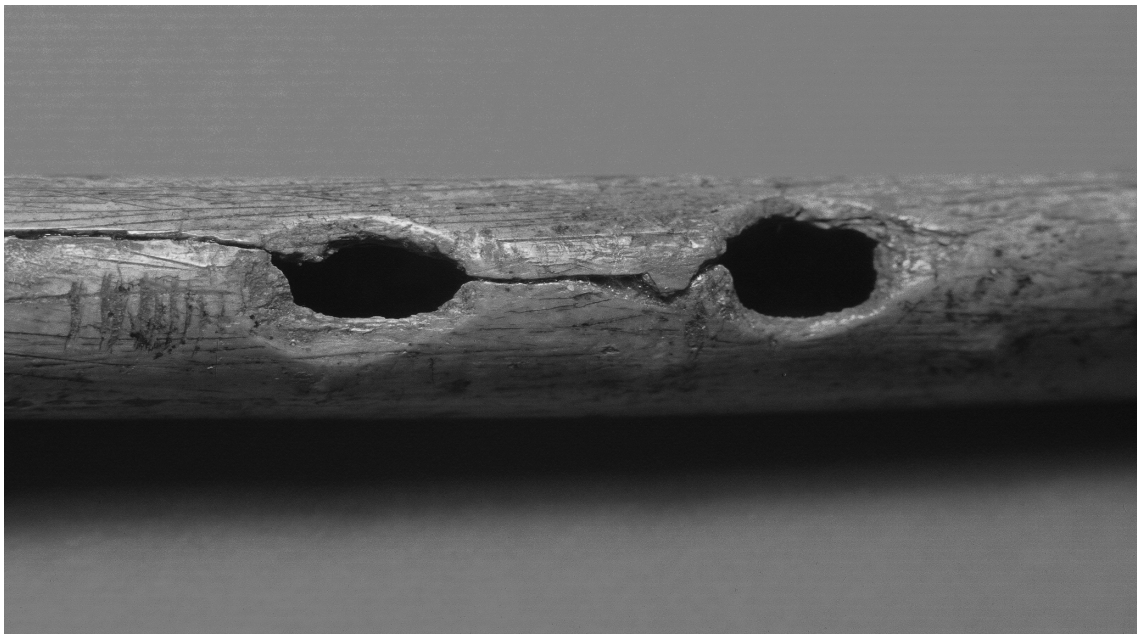


Fig. 6 Musical pipe with finger-holes from the Grotte d'Isturitz, Pyrenées Atlantiques, Aurignacian, approximately 30 to 35,000 years before present. Paris, Saint-Germain-en-Laye, Musée des Antiquités Nationales, 77142a. External diameter of bone c. 13 mm. Photograph: G. Lawson, by kind permission of the Musée des Antiquités Nationales.

In Europe the archaeological evidence, though substantial, has so far made little coherent contribution. It has seemed not only confused but ever more perplexing as more new finds are added to the total. On the one hand we have horns and trumpets which, as early as the Bronze Age, output the familiar, natural scales of trumpets and bugles today, derived directly from the harmonic series.[5] But on the other hand, in excavated instruments where evidence of *engineered* tuning is preserved – such as bone flutes – the actual tuning-schemes achieved seem so variable that we can discern no clear, recurrent pattern in them, anywhere. This has led some commentators to suggest that pipes of such 'simple' sort were indeed probably pitched at random – not tuned at all but merely perforated as it were experimentally or in accordance with schemes quite other than strictly musical ones: perhaps ritual. We might even be tempted to suspect this of some of the earliest Northumbrian chanters. Such arguments can always be supported by selective use of ethnographical parallels from around the world. But are they the only possible reading of the evidence? Not if we take a more critical view.

Studies in European popular musics reveal a history of great tonal diversity, and suggest that it may frequently express strong regional, local or even individual preferences. Not so very long ago, even here on Europe's Atlantic fringes, many folk traditions embodied what today we would think of as 'irregular' tunings. Some have survived. The archaic tuning of the Scottish Highland *piob mór*[6] not only contains some unusual interval values but does so out of preference. Others, like the Norwegian *langeleik*,[7] have lost them in favour of more 'modern', equally-tempered scales, but the original tunings have nevertheless survived, built into the structures of instruments preserved in collections (Reidar Sevåg, *pers. comm.*)

How is it that we came to lose this diversity? How long ago did we acquire our present tonality? These questions are interesting not only from a music-historical point of view but also from a wider archaeological perspective, for they bear upon a range of contemporary issues in this field: for example on ethnicity and communications, and even on our remotest human origins. How long have humans been tonally aware, selecting and manipulating pitches in this way? From prehistoric finds such as the bone pipes of the Upper Palaeolithic (fig. 6) we can see how important it is for us to begin to understand the processes involved, because of the implications they could have for our understanding of the very origins of music – and our species' capacity to organise sound (see for example Lawson and d'Errico 2002; d'Errico *et al*. 2003; also Cross 1999; 2003). If medieval bone pipes provide an analogy for these palaeolithic marvels, and a substantial sample with which to test our methods and ideas, then living traditions like the Northumbrian pipes may in turn offer an opportunity to investigate aspects of medieval practice which may have equivalence in our own culture – irrespective of whether they are, as it were, organically related.

It is thus becoming a key objective of the new 'musical archaeology' to seek out patterns and, if possible, to understand how such variability came about. The first stage in this process has been to show that there was indeed purpose and that – however chaotic the result may seem to us, looking at its detritus – tuning was indeed carried out to a plan or plans, and was executed with precision.

EXAMINATION OF THE W. A. COCKS CHANTERS

When, against this background, we come to look again at the early chanters in the W. A. Cocks Collection we can begin to observe some quite remarkable – and potentially very significant – features. Firstly, although the instruments may appear simple, compared with the modern Northumbrian chanter and all the elaborate keyed mechanisms which operate its additional holes, they are still beautifully and cleverly made. Each of them is made of ivory, delicately turned on a lathe and fitted out with an expanded terminal disc of the same exotic material. The turning is very well controlled, and the bore, which is drilled through solid tissue (unlike the natural cavities of the earlier bone pipes), is impressively straight. Together they give an impression of technical precision and hint at a well-equipped workshop. Moreover, each has its tenon shaped to fit into a standard half-inch (12 mm) stock and each has exactly the same number of finger-holes (seven and one thumb-hole), suggesting a well-established, coherent tradition. But it is the finger-holes themselves which are most astonishing. Even in medieval pipes of animal bone, which evidently were quickly made using only a sheath-knife, we are used to seeing neat, circular holes. These, in contrast, seem extraordinarily crude: some are only slightly larger than the others, but some are quite drastically so, and misshapen (fig. 7).

Such inconsistency suggests that it is very unlikely they were built that way. No self-respecting craftsman, surely, would do such a

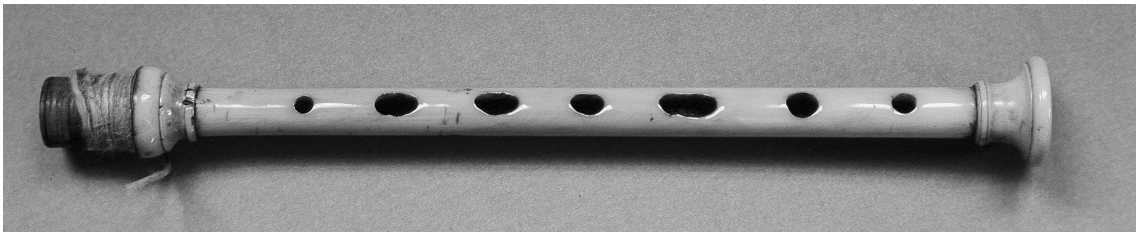


Fig. 7 Northumbrian bagpipe chanter, showing significant modifications to individual finger-holes (see also fig. 1). Morpeth, W. A. Cocks Collection, accession no. 2 WACocks. Ivory, 17th century or earlier. Length 175 mm, bore 3.8 mm (5/32 in). Photograph: G. Lawson, courtesy of the Museum and the Society.

thing so badly: certainly not the lathe-operators who turned the pipes so delicately. They must have been enlarged – in other words retuned – by someone else, at a later date. Close inspection using a low-power binocular microscope (at around 50 magnifications) reveals some of the detail. That retuning was the process at work is confirmed by the observation that the holes are in all cases enlarged upwards, which is to say towards the reed: never downwards. In almost all of them the lower arc of the hole's original circumference is preserved. This is a characteristic of tuning adjustment (downward enlargement having little or no acoustical effect, at any rate on pitch). But it also has the very fortunate consequence that we can establish not only the original position of each hole but also its original diameter. Thus these little chanters provide us, potentially, with two quite distinct sets of tuning data: those of the pipes as they are configured today, adjusted, and, through reconstruction and experimental replication, those of the tunings which their makers (and their original reeds) originally gave them.

CONCLUSIONS

A second, technical report, now in preparation, will discuss and attempt to interpret the outcome of a comparative experimental study of these alternative configurations. But already a number of further questions arise concerning the nature and the occasion of such enlargement. If it was, as seems likely, a later process, can we determine when exactly it could have been done, and by whom? Most importantly, *why* might it have become necessary? Two possible explanations immediately suggest themselves: that adjustment was needed because of some change in reed-making, as a result of which replacement reeds no longer elicited correct tuning-values (in other words the new reeds made them sound 'out-of-tune'); or that it became necessary because preferences in musical tonality itself were somehow undergoing change.

Both of these models find a measure of circumstantial support in the evidence. Change in reed-design, associated perhaps with widespread innovation of larger, keyed chanters, could have demanded adjustment of older, obsolescent forms as old reeds wore out or broke and needed replacement. Players who were unable to make or 'fettle' their own reeds, or could not afford to replace their chanters to suit the new reeds, would have had to 'bodge' or abandon. This is especially likely at a time when numbers of proficient instrument- and reed-makers may have been dwindling. The majority of current makers consulted in the course of this project favoured this model, especially those for whom reed-making is amongst the lost arts being explored experimentally today. Change in musical taste, on the other hand, could find resonances in the gradual standardization of tunings which had been occurring ever since the Middle Ages, and would have received a particular impetus as performers strove (or were pressured) to match their piping to the tunings of other instruments which were becoming increasingly common, especially keyboard types. Could this also offer an explanation?

Tunings of keyboard instruments,with their many strings or pipes, underwent extensive rationalization from the late Middle Ages onwards, culminating in the eighteenth century with the system which we use today, called 'equal temperament'. In equal temperament the intervals of the keyboard scale, already highly standardised,were further adjusted, very slightly, so that all came to have exactly proportional values, each octave comprising 12 identical semitones. In this way a melody could be played 'in tune' from any starting-point on the keyboard. The arrangement was, in reality, a compromise between conflicting interval values, and therefore fractionally 'out-of-tune'; indeed it would have seemed so when first devised. Today we have become so accustomed to the practice that it has lost all sense of 'out-of-tuneness' (showing, incidentally, that tuning really is as much a matter of culture as it is of nature), but for the audience of J. S. Bach (d. Leipzig 1750) it must have been a considerable

novelty. So were the benefits it brought. Under previous rational schemes a melody would have sounded 'out-of-tune' unless its start-tone or tonic ('do') lay on one of only two or three of the 'white notes' of the keyboard. Under equal temperament it would have sounded slightly out-of-tune everywhere – but only very slightly, and uniformly: thus it became a first step in enabling both ensemble playing with other instruments (whatever their tessitura) and harmonic development of the chromatic kind that we now take for granted in modern Western music. This new-found flexibility was celebrated most famously by Bach in his 48 highly chromatic keyboard pieces *Das Wohltemperirte Clavier* ('The Well-tempered Clavier', meaning 'Keyboard') of which the first volume was published in 1722: four preludes and four fugues starting on each of the 12 notes of the octave. It soon achieved universal acceptance amongst composers and performers. But from the point of view of folk traditions it was perhaps its use in tuning the 19th-century parlour piano (rather than the harpsichord or the church organ) that must have had the greatest impact on popular musical perception.

Equal temperament would prove a great asset in the onward development of what in due course became Classical Music as we now know it. For folk musics, however, its influence was not necessarily so benign. The trade-off was the loss not simply of earlier, semi-rational tunings but the abandonment of whole families of older, non-rational, customary tunings. Thus, during the nineteenth and twentieth centuries many European traditions – especially those which were 'well-connected' to elements of the musical mainstream, such as the Norwegian *langeleik* – lost something which had up till then contributed importantly to their uniqueness and individuality. Although it remains to be proven in this particular case, such standardization and such a date could be consistent with what little we know, so far, of these old pipes and their strange adjustments. It will therefore be of considerable importance to determine whether the original tunings they embody could in any way reflect such earlier, indigenous practice.

Whatever model eventually achieves acceptance, there will be important implications for our understanding both of manufacture and music in the Northumbrian tradition and of fine-tuning practices amongst the earlier, archaeological material. In particular, any theoretical model of earlier tuning practices must now explain the absence there of any such drastic adjustment: nowhere in the archaeology can we see any modification so severe or so universal as the Northumbrian pipes exhibit. The event or process through which it came about must have been powerful and very particular. If we can even begin to understand it we will have taken an important ethnohistorical step towards a better understanding of the nature of tuning in pipes preserved in the archaeology of even the remotest periods.

NOTES

[1] I am grateful to Anne Moore, Curator of the Bagpipe Museum, both for access to the pipes and for giving so unstintingly of her time and help. Whilst conducting my studies and the associated field-work I have also benefitted greatly from the hospitality, enthusiasm and wisdom of many others. Of these I should like to extend particular thanks to Kim Bibby-Wilson, David Burleigh, Patricia Jennings, Colin Ross, Dr Ann Sessoms, Dave Shaw and Ray Sloan. The work was supported by a generous research grant from the Society of Antiquaries of Newcastle upon Tyne. This paper comprises the first publication of results; a companion paper, comprising a technical study of the musical data and their cultural implications, is in preparation.

[2] Although a bag may be made out on the figure of the musician shown in the well-known relief from Stanwix, Carlisle (Charlton 1930: Plate 31; Carlisle, Tullie House Museum, OM 362), its initial Roman attribution, proposed by Bruce (1870–5, 484), cannot now be relied upon. Neither is there anything in any of the pieces of turned bone or ivory tubing from Roman Corbridge (Museum of Antiquities, Newcastle upon Tyne, 1956.358.A) to support claims that they are parts of such an instrument. Indeed in the absence of primary diagnostic elements, such as finger-holes, it is difficult to establish

for sure that they are even musical. Museum collections, worldwide, have many tubular objects and components of objects for which some musical function might be postulated – but so equally might other quite different functions. If they lack critical diagnostic elements or confirmed parallels we can only speculate as to what these original purposes could have been.

[3] The simultaneous sounding of two different musical pitches, interacting, generates additional sounds, combination-tones known as overtones or harmonics. Even when two quite pure sounds are pitched very close together the combined result can take on a distinctive skirling or raucous character, even in pipes which, individually, sound sweet. When the original notes themselves are rich in harmonics the effects become extremely complex. Familiar examples include the characteristic sound of school orchestras and recorder bands, where they result from slight mis-tunings. The skirling sound of massed Highland pipes, on the other hand, is an intended part of the effect. Similarly, the *zampogna*-players of Abruzzi shepherding tradition in Italy will often deliberately finger their twin-chanters in such a way as to accentuate their goat-like bleating tones.

[4] The six-note scale *do* – (or *ut* –) *re* – *mi* – *fa* – *sol* – *la* (these names are based on a mnemonic invented in Italy during the early Middle Ages) comprises a sequence of five such intervals: tone – tone – semitone – tone – tone. In modern Western keyboard tuning (known as 'equal temperament') the semitone measures 100 units or 'cents'; there are precisely 12 semitones, or 1200 cents, to one octave, from a given note (whether *do* or any other) to its equivalent in the octave above.

[5] The harmonic series is a universal property of matter – solid, liquid or gas. When a suspended rod of metal, or a stretched wire or cord, is struck and made to vibrate it will do so in ways that vary according to its shape and substance but always according to predictable physical laws. However, different modes of vibration may be induced, producing different effects. In linear vibrating structures like wires and cords, different musical pitches can be obtained by locating different points (called nodes) along their lengths and lightly touching them to damp movement at that point. Damping anywhere else will simply kill all vibration; but when damped at a node the wire or cord will continue to vibrate *in a new pattern*, producing a quite different frequency of vibration. For example, if touched at the mid-point (the first harmonic node) and then plucked it will begin to vibrate in two balanced half-lengths to either side of the node, at twice the frequency, producing a sound one octave higher (12 semitones, from *do* to the *do* above). If touched exactly one-*third* of the way along its length (the second harmonic node) the cord will begin to vibrate in three equal lengths, now three times as fast and thus another fifth higher (7 semitones, *do* to *so*). If touched exactly one-*quarter* of the way along its length (the third harmonic node) the cord will vibrate in four equal lengths, now four times as fast and thus exactly two octaves above the original tone. And so on. When we get down to the very small fractions, from the sixth harmonic upwards, the intervals between pitches become sufficiently small to play tunes, in tones and semitones. Modes of vibration in air columns, though invisible, are no different in principle, and so generate precisely the same series of harmonics.

[6] The Scottish Gaelic term *piob mór* means, literally, 'the great pipes'; although tuned to tone and semitone intervals these are subtly different from the intervals of the modern keyboard, producing to unfamiliar ears some strange dissonances. They nevertheless have precise frequency values and are an essential, intrinsic part of the characteristic sound of that instrument.

[7] The *langeleik* is an elongated rectangular or trapezoidal instrument of box-like construction and lap- or table-top operation, the melody string played with a plectrum and the remaining strings strummed as drones: an arrangement by which its music (if not its sound) resembles that of bag-pipes. In historic survivals the frets are fixed, preserving for us the relative values of all the intervals they played. They differ considerably. I am very grateful to Dr Reidar Sevåg, Oslo, for kindly sharing his thoughts on these errant tunings and on the tuning of the Hardingfele or 'Hardanger fiddle'. For a concise account of Norwegian popular traditions see Sevåg 1973.

BIBLIOGRAPHY

ASKEW, G. 1932 'The origins of the Northumbrian pipes', *AA*[4], 9, 68–83.

BIBBY-WILSON, K. M. and MOORE, A. (eds.) 2003 *Morpeth Chantry Bagpipe Museum, Guide*. Newcastle upon Tyne: Society of Antiquaries and Morpeth Chantry Bagpipe Museum.

BRUCE, J. C. (ed.) 1870–5 *Lapidarium Septentrionale: or a description of the monuments of Roman rule in the north of England*. London and Newcastle upon Tyne.

CHARLTON, G. V. B. 1930 'The Northumbrian Bagpipes', *AA*[4], 7, 131–142.

CLEREVAULX FENWICK, J. 1859 'A few remarks upon bagpipes and pipe music', *AA*[2], 3, 9–19.

COCKS, W. A. 1925 *Tutor for the Northumberland half-long bagpipe*. Oxford.

COCKS, W. A. and BRYAN, J. F. 1967 *The Northumbrian Bag-pipes*. Newcastle upon Tyne.

CROSS, I. R. M. 1999 'Is music the most important thing we ever did? Music, development and evolution', 10–39, in Suk Won Yi (ed.) *Music, Mind and Science*, Seoul.

CROSS, I. R. M. 2003 'Music and evolution: causes and consequences', *Contemporary Music Review*, 22 (3), 79–89.

D'ERRICO, F. *et al*, 2003 'The emergence of language, symbolism and music – an alternative multidisciplinary perspective', *Journal of World Prehistory* 17, no. 2, 1–70, March 2003.

HOMO-LECHNER, C. 1993 'Les instruments de musique', 259–262, in M. Colardelle and Eric Verdel (dir.) *Les habitats du lac de Paladru (Isère) dans leur environnement: la formation d'un terroir au XIe siècle*. Paris.

LAWSON, G. 1982 'Bone flutes', in Coad, J. and Streeten, A., 'Excavations at Castle Acre Castle, Norfolk, 1972–77: country house and castle of the Norman Earls of Surrey.' *AJ*, 139, 252.

LAWSON, G. 1993 'Bone flutes', in Dallas, C. *Excavations in Thetford by B. K. Davison between 1964 and 1970* [East Anglian Archaeology Report 62. Gressenhall], 159–160 and 163.

LAWSON, G. 1999 'Getting to grips with music's prehistory: experimental approaches to function, design and operational wear in excavated musical instruments', in Harding, A. (ed.) *Experiment and Design: Archaeological Studies in Honour of John Coles* (Oxford), 133–138.

LAWSON, G. 2001 'The lyre remains from Grave 32', in Filmer-Sankey, W. and Pestell, T. *Snape Anglo-Saxon Cemetery: excavations and surveys 1884–1992* [East Anglian Archaeology Report 9]. Ipswich, (Grave 32 plans and catalogue entry 77–8 and Fig. 56), 215–223

LAWSON, G. and D'ERRICO, F. 2002 'Microscopic, experimental and theoretical re-assessment of Upper Palaeolithic bird-bone pipes from Isturitz, France: ergonomics of design, systems of notation and the origins of musical traditions (first results)', in Hickmann, E., Kilmer, A. D. and Eichmann, R. (Hrsg.) *Studien zur Musikarchäologie III: Archäologie früher Klangerzeugung und Tonordnungen (The archaeology of early sound: origin and organization)*. Vorträge des 2. Symposiums der Internationalen Studiengruppe Musikarchäologie (Papers from the 2nd Symposium of the International Study Group on Music Archaeology), Kloster Michaelstein, 17–23 September 2000 [Orient-Archäologie Band 10.] (Rahden, Westf.), 119–142.

LAWSON, G. 2004 'Music, Intentionality and Tradition: identifying purpose, and continuity of purpose, in the music-archaeological record', in Hickmann, E. and Eichmann, R. (eds.) *2005 Studien zur Musikarchäologie IV. Vorträge des 3. Symposiums der Internationalen Studiengruppe Musikarchäologie* (Papers from the 3rd Symposium of the International Study Group on Music Archaeology, Kloster Michaelstein, June 2002). (Rahden, Westf.), 61–97.

LAWSON, G. *forthcoming* 'Musical instruments', in Cadman, G. *Excavations at West Cotton, Raunds, Northamptonshire: the Finds*. Northamptonshire Archaeology.

LAWSON, G. and WARDLE, A. 1998 'A Roman pipe from London.' *LAMAS: Transactions of the London & Middlesex Archaeological Society*, 39, 35–36.

LAWSON, G. and WARDLE, A. *in preparation* 'A Roman pipe from excavations at the Thames Exchange, London, and related finds: microscopic and experimental results'.

LUND, C. S. 1991 *Fornnordiska Klanger: the Sounds of Prehistoric Scandinavia*. Stockholm: Kungl. Musikaliska Akademien, Musica Sveciae CD series, MSCD101 (4.5-inch compact disc and 68-page illustrated booklet.) [Re-issue on CD of original publication: Stockholm: EMI Svenska 1984, His Master's Voice HMV 1361031. Musica Sveciae series No. 1 (MS101, 12-inch vinyl LP and 32-page illustrated booklet).]

MEGAW, J. V. S. 1960 'Penny whistles and prehistory', *Antiquity*, 34, 6–13.

MEGAW, J. V. S. 2000 'Whistles', in P. Ellis *Ludgershall Castle, Wiltshire: a report on the excavations by Peter Addyman, 1964–1972* [Wiltshire Archaeological and Natural History Society Monograph Series, 2.], 163–7.

MULLEN, T. C. 1984 'The Northumbrian half-long bagpipes', *AA*[5], 12, 209–221.

RICHARDSON, K. M. 1958 'Excavations in Hungate, York', *AJ*, 116, 51–114.

RYDER, P. 2003 'Medieval cross slab grave covers in Northumberland, 3: North Northumberland', *AA*[5], 32, 91–136.

SEVÅG, R. 1973 *Det Gjallar og det Læt. Frå skremme- og lokkereiskapar til folkelege blåseinstrument*. Oslo: Det Norske Samlaget; Norsk Kultur Arv.