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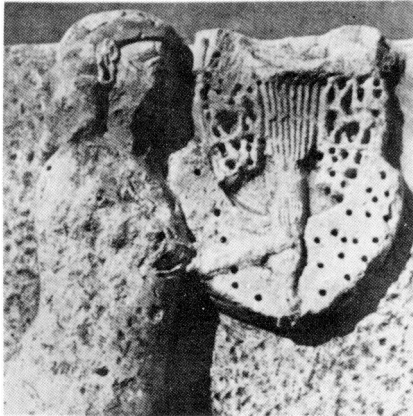


Plate 61 (far left)
Xanthos. Relief. Sixth
century B.C. (Istanbul
Museum)



Plate 62 (left) Assyrian
quartet (oblique and
straight lyres, timbrel
and cymbals). First
millennium B.C.
(Louvre)



Plate 63 (far left) Elamite
lute and small rectangular
lyre, cylinder seal.
Fourteenth century B.C.
(Louvre)



Plate 64 (left) Babylonian
lute. c. 1800 B.C.
terracotta. (Louvre)

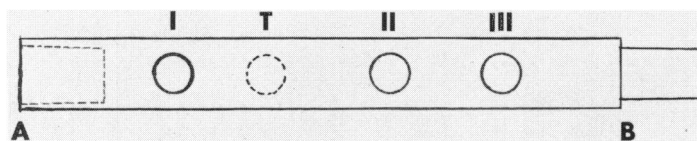


Plate 65 Upper finger-hole section of a
typical *aulos*



Plate 66 Sections of the Reading *aulos*
separated during restoration

The reconstruction of ancient Greek *auloi*

J. G. Landels

Of all the surviving remains of ancient Greek musical instruments, the fragments of *auloi* are the most important and the most informative; though long the subject of study (Howard 1893; Schlesinger 1939; Becker 1966) the difficulties involved in interpreting their evidence, and in any attempt to reconstruct a complete instrument from them, are very severe. The purpose of this article is to survey the main problems and to pinpoint the main difficulties.

Firstly, the surviving instruments and fragments are not a truly representative sample. Most of the important archaeological sites (e.g. Delos, Perachora, Corinth and the Athenian Agora: Landels 1964) have yielded a quota of fragments; but the great majority of them were found among rubbish deposits, and were there precisely because they were damaged and useless. An important exception to this is the Brauron *aulos*, deposited in an underground spring as a votive to Artemis (Landels 1963). This means that the only instruments which we can hope to reconstruct from them will be cheap, simple ones; no professional player would ever be likely to throw away a serviceable instrument, of the elaborate and expensive kind which we know to have been in use from the late fifth century B.C. onwards, with metal keywork and ornamentation. Once again, there are a few exceptions – the four Pompeian *auloi*, which may possibly have been in an instrument-maker's workshop when the eruption occurred (Howard 1893; 47–55; Ward-Perkins and Claridge 1976: (no. 199), and the metal instruments found at Meroë, which may have been funerary offerings (Bodley 1946).

Secondly with very few exceptions these fragments are of bone or ivory, and are listed as such in the excavation reports. But we know from literary evidence that the most common material for the *aulos* was reed (*kalamos*) – a very perishable substance. Because the lengths of reed available to the instrument-maker were much longer than the available pieces of bone (usually from the tibia of a deer or sheep) the finger-hole section of the body would have been made in one piece, whereas that of a bone instrument had at least one join in the middle. Needless to say, apart from very rare exceptions, only one of the bone pieces survives.

Another even more serious problem arises from the fact that the *aulos* was a double pipe, and that the two pipes (this is beyond reasonable doubt) sounded together. This means that in order to gain information on the playing technique from surviving remains,

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we need to find two complete, or almost complete pipes, which can confidently be treated as a matched pair. The only two which come anywhere near to meeting this condition are the Elgin *auloi* in the British Museum, and it is by no means certain that they really belong together.

What, then, can be learned from the typical bone fragment, with four finger-holes? An example *c.* 150 mm. long is shown in plate 65, based on the late Hellenistic Fragment D from the Athenian Agora (Landels 1964: 397–8). This represents part of the simple form of the instrument shown in fifth-century vase-paintings being played by amateurs and *hetaerae*.

From these illustrations it is clear that a section of this type came below the bulb or bulbs normally shown at the mouthpiece end of the instrument. There does not seem to have been any consistency in the choice of upper end for spigot and lower for socket, or vice versa, though almost certainly the sections of any one instrument would be the same in this respect. Hole I is obviously the index-finger hole sounding the highest note, and there is a socket at that end of Fragment D; but Fragment H must be the lower extremity of another instrument, and it has a spigot at its upper end.

Below a section of the Fragment D type there would normally be one or two more sections, the adjoining one containing the last finger-hole (IV, stopped by the little finger) and, usually, a vent-hole which sounded the lowest of the six notes in the scale obtainable. The Brauron *aulos* is the only certain case in which both the sections are preserved; there is another possible example in Corinth (Wegner 1963:32).

Even without the lower section, it is possible to make a guess at the pitch of the upper four notes of the scale. The principal factor in determining this is the length of the air column between the tip of the reed and the nearest open hole. Since it is clear from surviving bulbs that the bore inside them did not expand, but remained straight throughout the instrument, we can posit a hypothetical length x between the top end of the section (A) and the tip of the reed, having the same internal diameter as the surviving piece; this, when added in turn to the distance from A–I, A–T, A–II and A–III, will give a set of four resonant lengths. The frequencies of the notes produced would be inversely proportional to these lengths, and if the four frequencies stand in ratios to each other which make some kind of sense in terms of known ancient Greek intervals, then it is possible that the supposed value for x is approximately right. This value may be arrived at by either of two methods, (a) by making an estimate, based on the length of A–B, of the probable length of two bulbs and the extruding part of the reed, or (b) by positing a given interval between two particular holes, and calculating the length x required to produce that interval. For example, one could posit a fourth (frequency ratio 4 : 3) between holes I and II; x could then be found from the equation

$$\frac{x + (\text{distance A to I})}{x + (\text{distance A to II})} = \frac{3}{4}$$

If it were then found that other intervals were recognizable (e.g. II–III in the ratio 9 : 8, a major tone) then some confidence could be placed in the estimate of x .

This purely mathematical method has been used to make calculations of the scales of some *auloi*; but though it is superficially attractive, it cannot be regarded as anything more than an approximative procedure (Landels 1968). It rests on the assumption that

order to do this she found it necessary to use a single beating reed, for which the ancient evidence is not adequate. Accordingly, the reconstructions of the Meroë *auloi* by N. B. Bodley (1946), based on the Schlesinger principles, cannot be accepted as valid.

So far we have discussed only the pitch of the notes; when it comes to re-creating the tone or timbre of an *aulos*, the problems are still more acute (MacGillivray 1961). There is no modern instrument which combines, as the *aulos* did, a double reed with a cylindrical bore. Any reed designed for a modern instrument has been endowed, by a long process of trial and error, with exactly the right characteristics which will combine with the resonator to produce the right tone. As a result, it will tend to impart to a facsimile of an *aulos* something of that tone quality. A bagpipe drone reed, which is 'wrong' in that it is a single reed, but convenient because its stem is of about the right size, gives an *aulos* replica a single-reed sound like that of a bagpipe drone, and slightly reminiscent of a clarinet. The same facsimile played with a cor anglais reed produced a sound spectrum (analysed from a tape-recording) not unlike that of a cor anglais. When a bassoon reed was used, the tone was harsher and louder – again, not unlike that of a badly-played bassoon. A further disadvantage of the last two reeds was that they were badly mis-matched to the resonator, with the result that the pitch was very unstable, and could be raised or lowered at will by as much as a tone. The *aulos*, in its day, had a special reed of its own, carefully designed and (no doubt) often modified to give subtle effects of tone and dynamics, capable of the great variety of styles needed to match the great variety of musical contexts in which it was played. To re-create such a reed is no easy matter.

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Abstract

Landels, J. G.

The reconstruction of ancient Greek *auloi*

In this article, the four main problems involved in reconstructing ancient Greek *auloi* are discussed, namely (1) the remains are incomplete, damaged, and not a representative sample, (2) theoretical calculations from resonant lengths do not take account of the vagaries of reeds or playing techniques, (3) Schlesinger's theory of equidistant holes is not supported by good evidence, and (4) the tone quality of the instrument cannot be reproduced without accurate knowledge of the reed construction.