CHAPTER 6

CELTIC INSTRUMENTS[212]

Evidence of Celtic instrumental usage during the later part of the La Tène culture comes from iconographic material (Roman and Celtic), a small quantity of extant fragmentary material and Greek and Roman documentary evidence.

Although the Celts are considered to have utilised only two types of PVA, the evidence gathered in this study suggests the - use of at least five types. However, the evidence for the existence and use of these varies greatly and is outlined below.

1 CARNYX

The name of this instrument is known from Greek and Roman writings and physical evidence existed in the form of a carnyx found in Lincolnshire (since destroyed) and four other fragments found in Europe. A considerable body of iconographic evidence also exists in the form of Roman reliefs and Celtic coins.

[212] It has to be said that I would no longer call these 'Celtic' but refer to them as Pre-Imperial Native Iron Age. It's not nearly as catchy as a simple 'Celtic' but much more accurate.

2. CELTIC Lituus

These have no literary references but four complete specimens exist along with a fragmentary instrument and two previously reported specimens which are now missing. Of the two iconographic references only one is in a clear Celtic context, the other being less clearly assignable.

3. CELTIC Tuba

This is known only from one iconographic reference and two extant specimens.

4. CELTIC CURVED HORN

These also have no literary references but physical evidence exists in the form of three almost complete specimens and two fragments. One iconographic reference occurs on a Roman battle standard and an excellent representation of two instruments exists on a Graeco/Roman statue.

5. WIDE - BELLED INSTRUMENT

This is known only from one iconographic reference, IC78.

6. CLAY HORNS

Known only from Numancia in Spain.

1. CARNYX

Of the six instrument types, the carnyx is most clearly identifiable as Celtic. According to Prof. A.J. Beattie[213], the name is referred to as Karnon "The form is given by Hesychius (DR 3) with the meaning of 'trumpet' and assigned to the Galations." It is also cited by Eustathius (DR2) where he writes of it being blown "upwards and into. "Both describe it as a trumpet with an animal "bell" or mouth, with a leaden tube and assign it to the Celts and the Galatians, Polibius (DR17) in the 2nd century BC describes Celtic war trumpets, using the phrase Bucina and Salpinx, either indicating two types of trumpet or more likely glossing an unfamiliar word by adding "and trumpeters". Diodorus Siculus (DR9) a century later and in a similar context refers to trumpets "peculiar and such as barbarians use" but neither employs the word "carnyx."

[213] quoted in Piggott, 1959,19.

The Carnyx appears on numerous Celtic coins (17 located in this study), generally in the right hand of a Celtic warrior or otherwise generally displayed in a vertical position. It is also displayed on Roman iconographic material (7 references) where it appears as war trophies, and on one N. European cauldron (IC49). Only one complete example has ever been found (SD213) but this was melted down as an archaeological experiment in the 18th century.[214] Four fragments have been found which are generally identified as parts of carnyces; (SD207, 208, 214 and 215).

THE FORM AND USAGE OF THE CARNYX

The general form of the instrument is distinctive and well defined by the evidence as having a parallel to slightly-tapered tube yard with a curved conical bell section which passes through a decorative animals-headed bell termination, boars and stylised bird heads being the commonest terminations. Characteristically seen along the outer radius of the bell, is a mane which runs between two prominent vertical ears and then down the bell yard for almost its entire length. (See Figure 6.1)

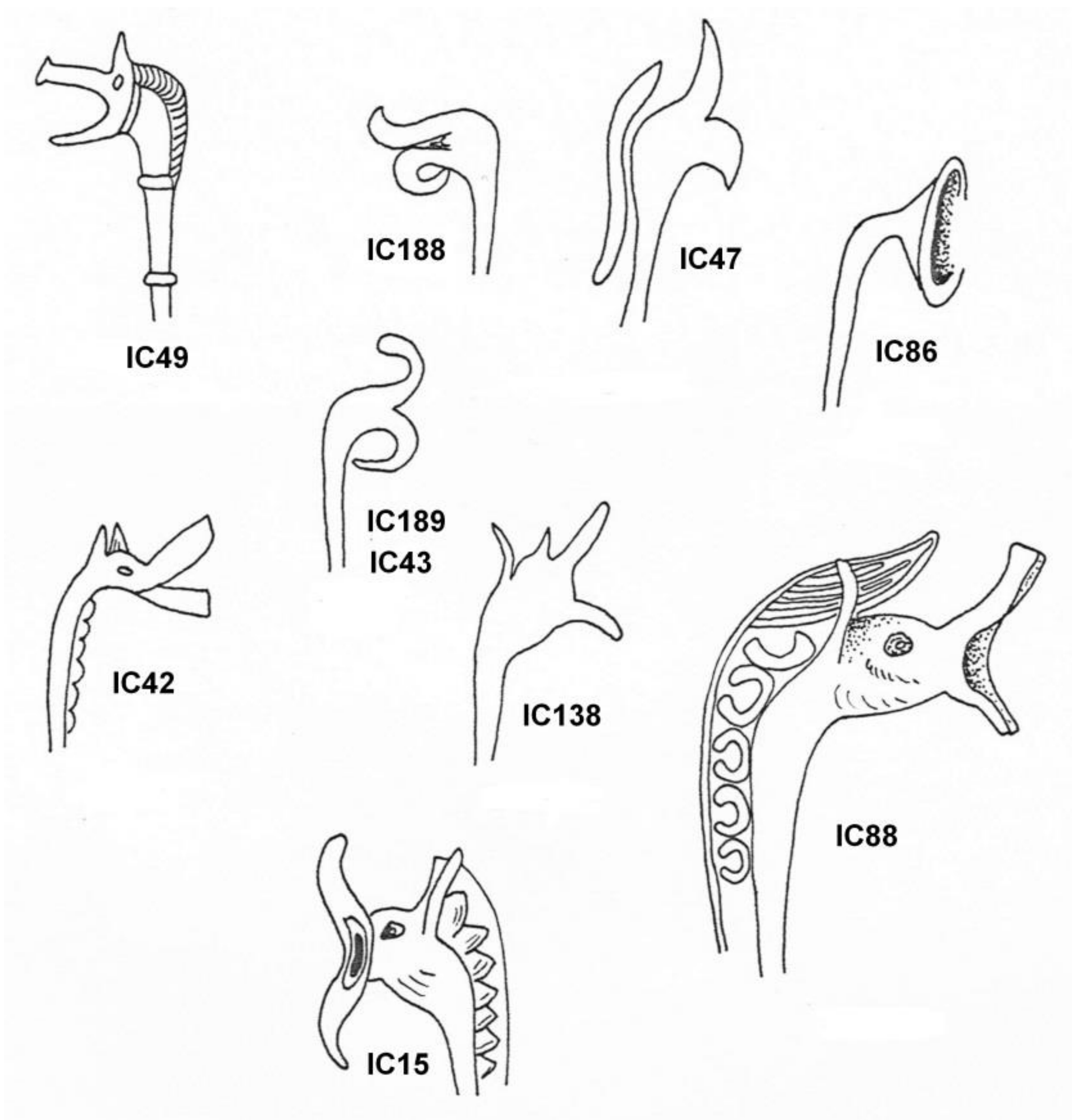


Figure 6.1: Some Designs of Carnyx Heads

[214] Pearson, 1796.

Two illustrations, IC49 and IC109, show the instruments grouped in threes and this may be indicative of a pattern of instrumental use in threes. Were this so, it would show a close parallel with the Roman military instrumental use of the period (see Chapter 3).

Although it has generally been proposed that the carnyx is blown with the tube yard horizontal[215] the evidence for their having been played vertically seems stronger. The Gundestrup cauldron (IC49) depicts three players blowing carnyces in a vertical position as does, probably more conclusively, an illustration of a Gallic soldier on the Triumphal Arch at Orange (IC5).[216] Here the instrument is clearly held at a steep angle pointing upwards but the animal head is pointing to the rear of the player. This may be confirmed as a probable configuration by the termination of the instrument from Trajan's column (IC 88),(Plate, 2.4b, above) which appears to have an oblique termination to the mouthpipe, open in the same direction as the bell mouth. A similar shaped oblique termination was drawn by the illustrator of the Tattersall Ferry carnyx (SD213) in 1796 when this find was published[217]. However, the mouthpipe is disarticulated from the bell yard and no angular relationship can be defined.

The vertical blowing position could be accommodated by an oblique termination of the tube-yard or by provision of an aperture as on the side blown horns or the Roman statuette (SR2). (See Chapter 3) Morphologically, the bell terminations are similar in that their axis is horizontal when the instrument is held vertically as on most depictions. Were the instruments to be held horizontally, then the carefully-made terminations would scarcely be seen and the visual effect lost totally. One Roman iconographic representation (IC109) shows trophies of war with groups of carnyces, there being about one carnyx to each sword suggesting that each warrior would have an instrument. Were this so, then their instruments could hardly have been played facing forward without a considerable spacing between individual players and also a considerable risk of injury to the face and particularly the lips. Also any instruments played vertically would present a waving sea of ferocious bellowing animal heads projecting their sound over the heads of the advancing army towards the enemy. Polibius (DR17) said of the carnyx that, "together with the shouts of the whole army in concert, (they) made a clamour so terrible and loud, that every surrounding echo was awakened, and all the adjacent country seemed to join in the horrible din." As the Celts also carried animal-headed standards into battle the incorporation of an animal head into their instrument would serve a dual role, providing it could be seen.

The provision of attachments on the animal head portion of the instruments is a further indication that their output was not intended to be "musical" in the modern sense of the word. The Deskford boars head, for instance, contained, according to the account of its finding,[218] a moving wooden tongue attached to a spring. No doubt, such a device would add to the intimidating effect when these instruments were used en masse as described by the Romans (DR9 and 17).

If this interpretation of instrumental usage is correct then it seems unlikely that any attempt would be made to co-ordinate the "musical" output of the instruments during a battle. Individual instruments, either carnyces or of the other types may have been used

[215] Behn, 1954, Abb.l88.
[216] Moreau, 1958, Taf. 2.
[217] Phillips, 1934, pl. xxi.
[218] Smith, 1867.

before the onset of mass blowing as a signal instrument but once the main body of instruments had been sounded it is unlikely that any commands could be communicated by sound. The volume of sound might also serve to mask musical commands given to the opponents and thus reduce the efficiency of their organisation.

From the remaining illustration of the only carnyx found, at Tattershall Ferry, some idea of the dimensions of the instrument can be determined although one cannot be sure that this instrument was complete. The remaining part appears to have been approximately 1.27*m* long with an air passage of about 1.31*m* long varying from 14*mm* to 72*mm* diameter at the bell. Iconographic evidence suggests that the instrument was made up of three yards plus the bell yard termination and the longest instrument depicted, (IC189) scales about 1.2*m* in length. This would suggest that SD213 was complete and was about the standard length for a carnyx.

MANUFACTURE OF THE INSTRUMENT

An account of the Tattershall Ferry carnyx (SD213) before its destruction tells that it was made of hammered sheet bronze "about one twentieth of an inch thick, "the seam being made "by means of solder clumsily applied." This solder the author identified as tin. The fragment of carnyx SD215 from the Schwabische Oberland is also of sheet. However, the gauge of this material is much thinner, reportedly 0.2*mm*[219] and the instrument tube is made up of two pieces riveted together. See Figure 6.2 (From Piggott, 1959, Figure 2)

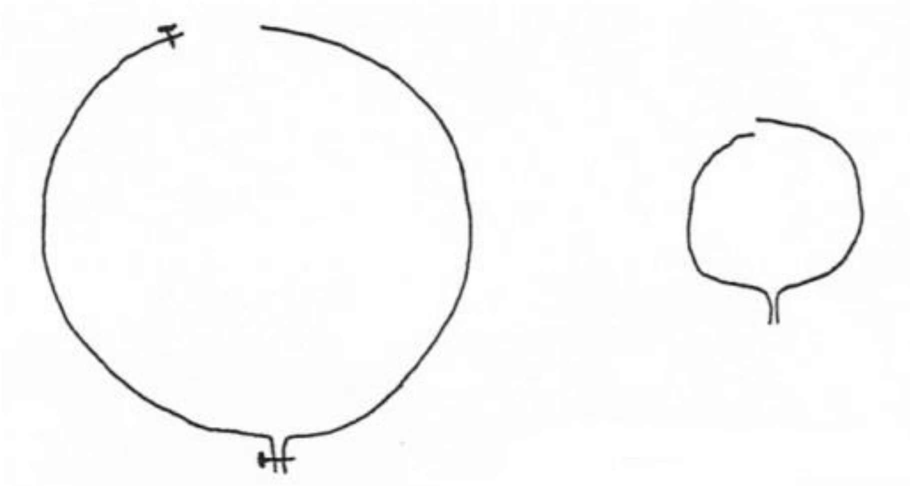


Figure 6,2: Construction Details of the Dürnau Carnyx Fragment

A further example of sheet metal work riveted together is also reported in Piggott's 1959 paper and this he identifies as an animal head termination for a carnyx. This boar's head found at Deskford in Banffshire[220] has a "roughly circular hole" of about 2½ inches (62*mm*) diameter through which a bell yard could pass to mount the head at the bell of the instrument.[221]

[219] Piggott, 1959, 28.
[220] op. cit. pl. VIII.
[221] op. cit. p. 25.

Manufacture from sheet would enable a lighter weight instrument to be produced than would casting, as the sectional thickness produced by casting would probably need to be in the region of three times this thickness in order to obtain satisfactory flow of the metal into the fine mould cavity during pouring. In addition, the wrought material would react to impact by bending rather than fracturing as would a larger-grained (and probably porous) bronze, a feature to be greatly desired in the battle situation. The carnyx appears to have derived its form from an instrument made up of a parallel or near parallel tube-yard with a bell termination turning through approximately 90°. Its ancestral form is thus shared with the Bronze Age Irish Horns, the Etruscan and early Roman Lituus and other instruments such as those from Mari. From where the line of descent branched, it is not possible to say, but it is possible that a familial relationship with the Etruscan and early Roman instruments did exist, (See below) as the Celts did have contacts with both these groups. In addition, the technical processes of manufacture appear similar in that they are both made from wrought material formed into tube and bell and apparently soldered. However, instrumental usage is different in that all iconographic references show the Etruscan and Roman use of the lituus in a horizontal attitude, i.e. pointing forward in front of the player in contrast to the vertical usage of the carnyx, although one reference shows a lituus being used as a side-blown instrument. (Plate 7.1a, below)

Some documentary references are difficult to interpret as the authors tended to use specific instrumental names in a generic sense, frequently applying the name of an instrument present in their culture to a different instrument in another culture. This is seen in the reference by Diodorus Siculus, DR9, to presumably salpinges as being used by the Celtic Gauls. The evidence for use of the salpinx, however, points to a very restricted usage of this instrument both in space and time, and the quotation is usually translated in a general sense as "trumpets," although it most probably refers to carnyces.

THE CELTIC Lituus

This study encompasses instruments of the Roman period and, thus, includes several, previously known Roman Litui.[222] However, as the study of these progressed it became apparent that these were not Roman instruments but, most probably of Celtic origin. These four extant instruments, SD203, 240, 241 and 242 and two fragments SD204 and 248 were examined while two previously reported instruments (SD232 and 244) remain unlocated to date.

EVIDENCE FOR ITS CELTIC ORIGIN

Previously having been described as Roman Litui, these instruments are of somewhat similar form to this instrument in that they are made up from a straight tube-yard with a curving bell. However, the curvature of the bell on the Etruscan/Roman instruments is greater, generally turning through about 180° compared with 90° on the Celtic Lituus. (See Chapter 3, Figure 6.3, below and Plate 6,1, below)

[222] Klar, 1971, 305.

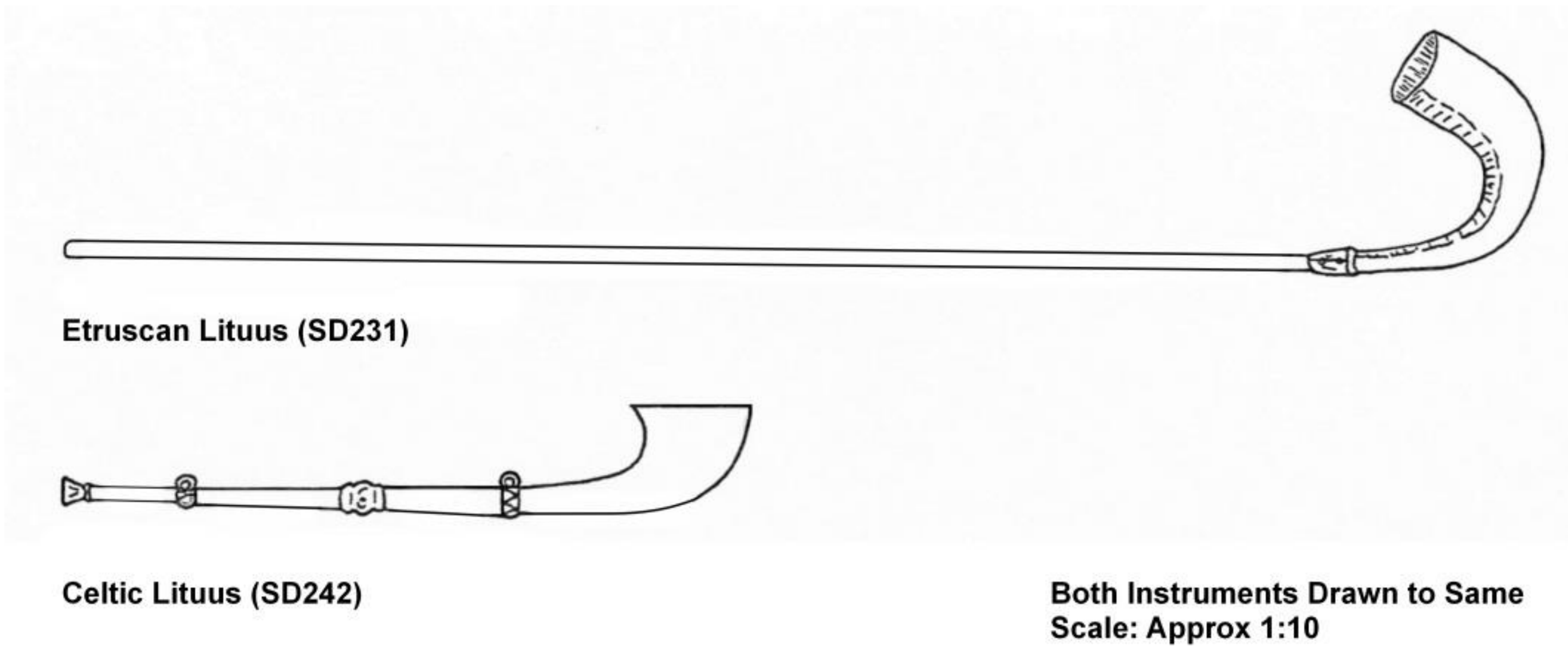
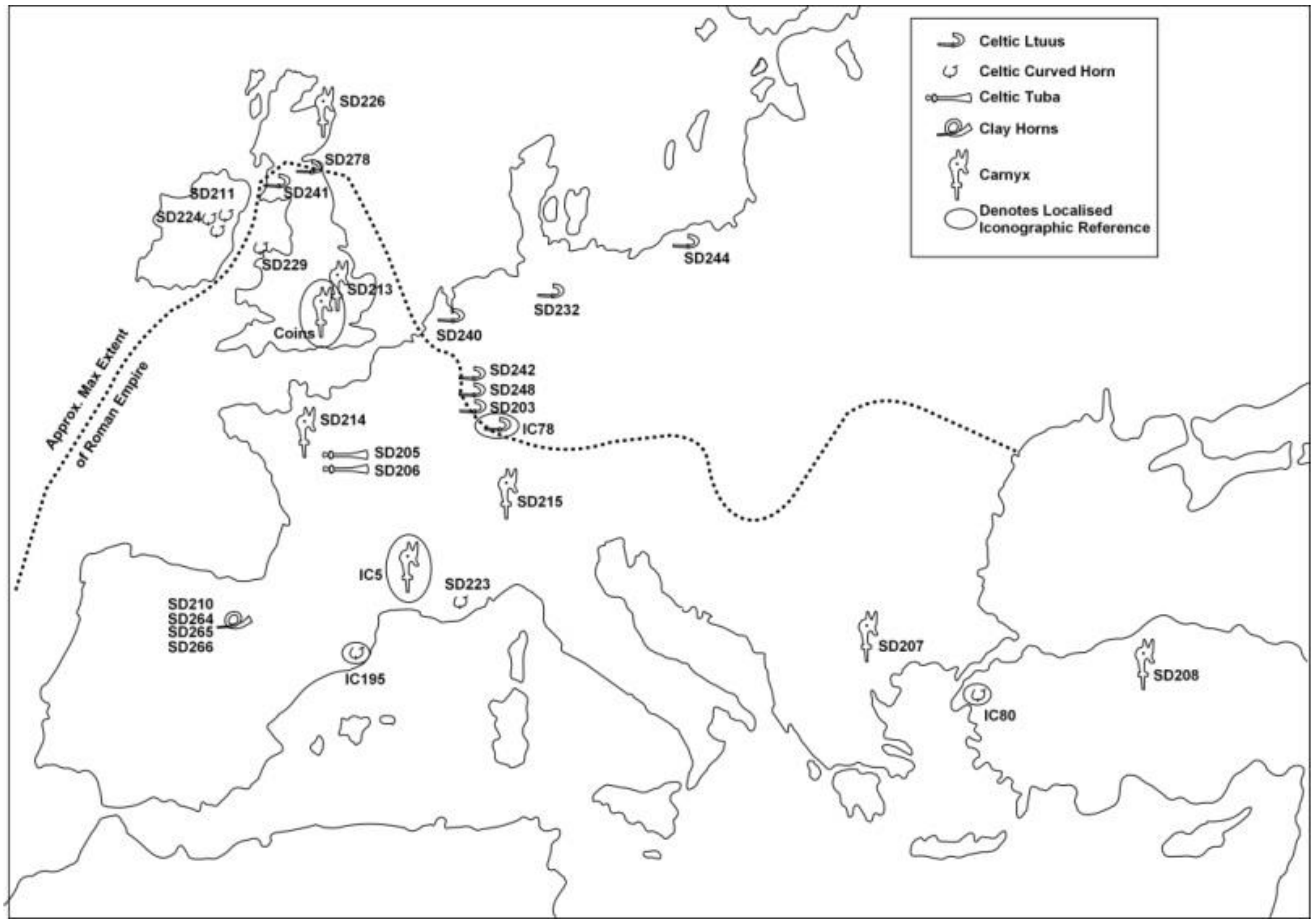


Figure 6.3: The Form of the Etruscan and Celtic Litui

In addition, the Roman instruments are about 1.6*m* long compared with the Celtic instruments' length of 0.68 to 0.70*m*. All the instruments studied are of cast construction, albeit differing in the type of casting used, while the Roman instruments are manufactured from sheet.

The instruments here referred to as Celtic Litui are found only on the periphery of the Roman world or well outside this, in the area occupied, during the Iron Age, by the Celts. See Map 6.1, below. In addition, two instruments and two fragments were found in the Rhine, this deposition in water being typical of the Celtic tradition of depositing votive objects in water. Roman writers frequently mention the use of the lituus prior to about 200 AD but no references to the use of this instrument in the later Imperial period other than those of historians, were found during the course of this study; Similarly with the Etruscan and Roman iconographic references, a decrease in the number of illustrations is seen at the beginning of the Imperial period, the latest illustration of a lituus being in AD 70.



Map 6.1: The Findspots of Celtic Instruments

Most significant of the evidence for the Celtic origin of these instruments is IC78, a Roman silver battle standard found at Kastell Niederbieber in Germany. This standard depicts Caracalla subjugating the lands of the Rhine and displays Celtic and Germanic trophies along with a subjugated personification of the Rhine. Among the trophies are a Celtic lituus and a possible Celtic tube. (Plate 2.5a, above). It is clear that these instruments are among the trophies and are not Roman but belong to the subjugated Celtic tribes.

The only instrument of this form referred to in any Southern European context is IC24 (Plate 3.1a), above) on a Situla from 5/4 century BC Italy. However, the bell form of this instrument is markedly flared and seems to bear more relationship to the eastern instruments, e.g. IC35 (Tak-i-Bostan)[223] than those from the north.

MORPHOLOGY OF THE INSTRUMENTS

All the instruments of this group are of conical form throughout with the bell end of the instrument turning through approximately 90° which, presumably, when played pointed upwards. Those measured vary from 612 to 769*mm* in length, although the two instruments not yet located are reportedly longer than this. Their bell diameters vary from about 109 to 111*mm*, but are by no means as uniform as these figures suggest, SD203 for instance, varying by about 10*mm* in diameter at different azimuths and SD240 having a

[223] Behn 1954, Abb. 107.

bell aperture better described as octagonal than round, the dimension 104*mm* for its bell being the A/F (across-the-flats).

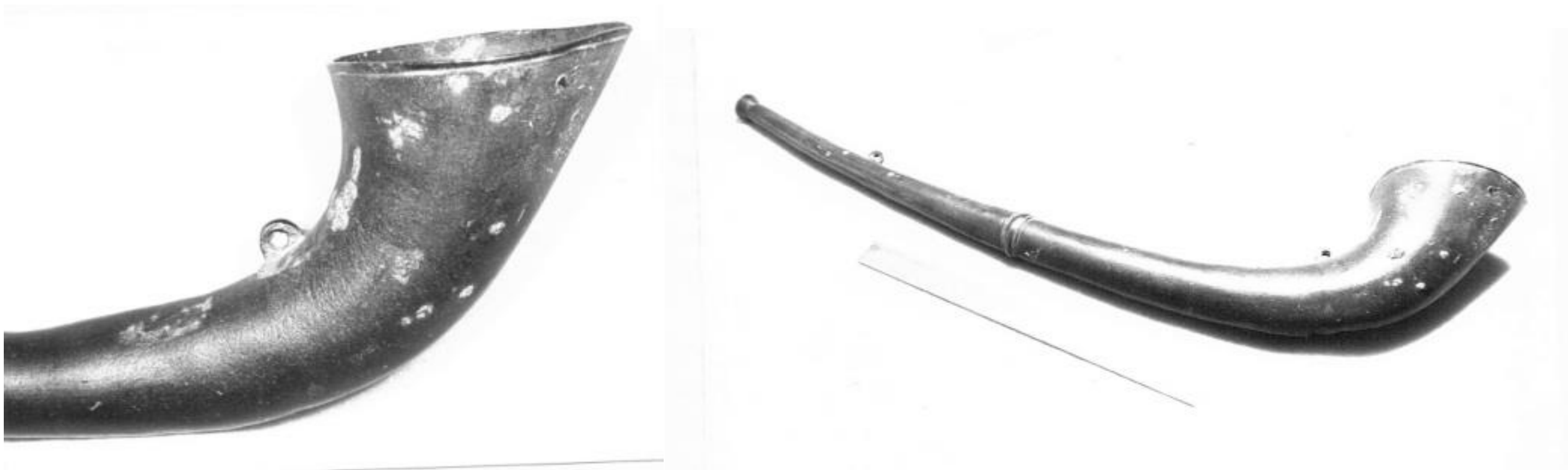


Plate 6.1: Morphology of the Celtic Lituus

Of all the features on instruments of this group, the most characteristic is the mouthpiece with its small throat. (Plate 6·3a lower and (b),·p. 325. (As with many other features, SD240 differs markedly in this respect.)

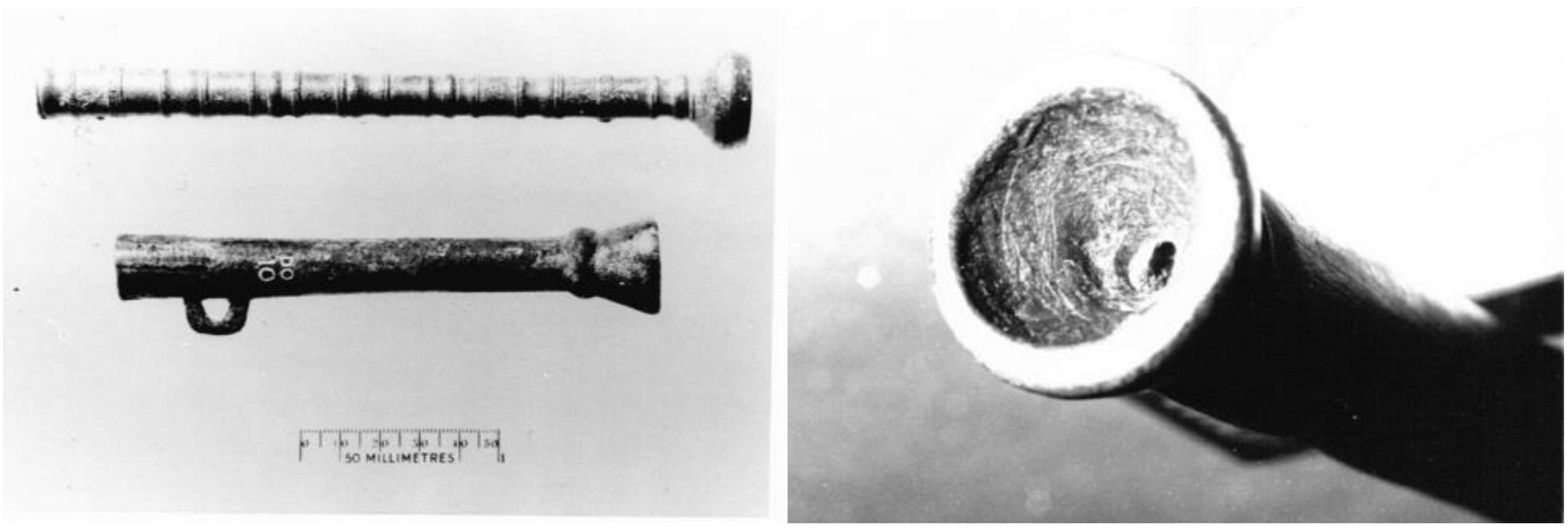


Plate 6.3: Celtic and Roman Mouthpieces

The small diameter of the throats, from 3.5 to 5 mm, does much to improve the blowing characteristics of the instruments as discussed in Chapter 1. Fig.6.4 illustrates the cross-sections of several mouthpieces and also shows the clearly defined rapidly expanding back-bore of these instruments. The good match of the mouth- piece to the bore morphology is particularly noticeable on SD203 which sounds its formants with the greatest of ease.

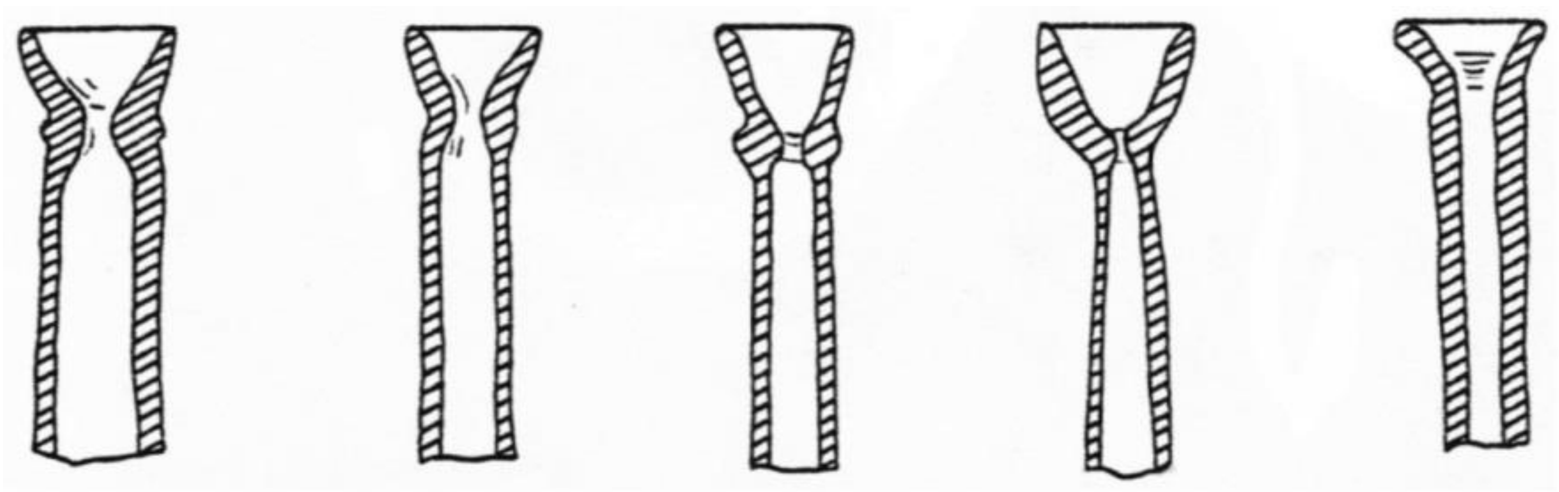


Figure 6.4: Mouthpieces of Celtic Liui

MANUFACTURE OF THE INSTRUMENTS

All the instruments studied are cast, although SD240 has several wrought pieces added and SD241 has a central band which is wrought and probably modern. The major difference in technique is that SD203 and 242 are lost-wax cast, SD204 and 241 are definitely, and SD240 and 248 possibly, cast in a two part mould. Plate 6.1, above, provides an overall view of SD203 and a detailed view of its bell.

This application of different manufacturing techniques to produce to a design seems to be common on Celtic material and is discussed further below. SD242 is lost-wax cast in one single piece. However, the workmanship on the casting is poor and the tube section has failed at one point rendering the instrument unplayable. This is the only instrument integrally cast, however, the others having been made in several pieces. The basic symmetry of these instruments is based on a ring roughly halfway between the mouthpiece and bell. On SD241, this ring appears to have been cast on, presumably joining together the two parts which were cast separately. Subsequently the joint failed as a modern brass ring holds the two parts of the instrument together, this having been soldered in position. SD240 has a similar central feature but this is placed on a 120*mm* (approx.) central tube yard which links the mouthpipe and bell yards.

On instruments SD203 and SD242, the central bands are clearly vestigial and remained to serve an aesthetic function. on these, the bands are 12 and 13*mm* wide with a central raised spherical portion and two circumferential grooves around each end. However, on SD203, this band is integrally cast with the bell yard, whose end forms a socket into which the adjacent yard fits.

When examined, this instrument (SD203) was in one piece and the presence of a joint between the mouthpipe and bell yard had not previously been detected. However, the slope of the tube changed fairly abruptly at two points and close inspection showed the presence of a fine joint gap at one of these. Subsequently, the instrument separated into two parts during examination and the presence of one of the joints was confirmed. The Museum later carried out an X-ray examination of the instrument on my behalf and this confirmed the presence of a second joint. See Plate 6.3, below.

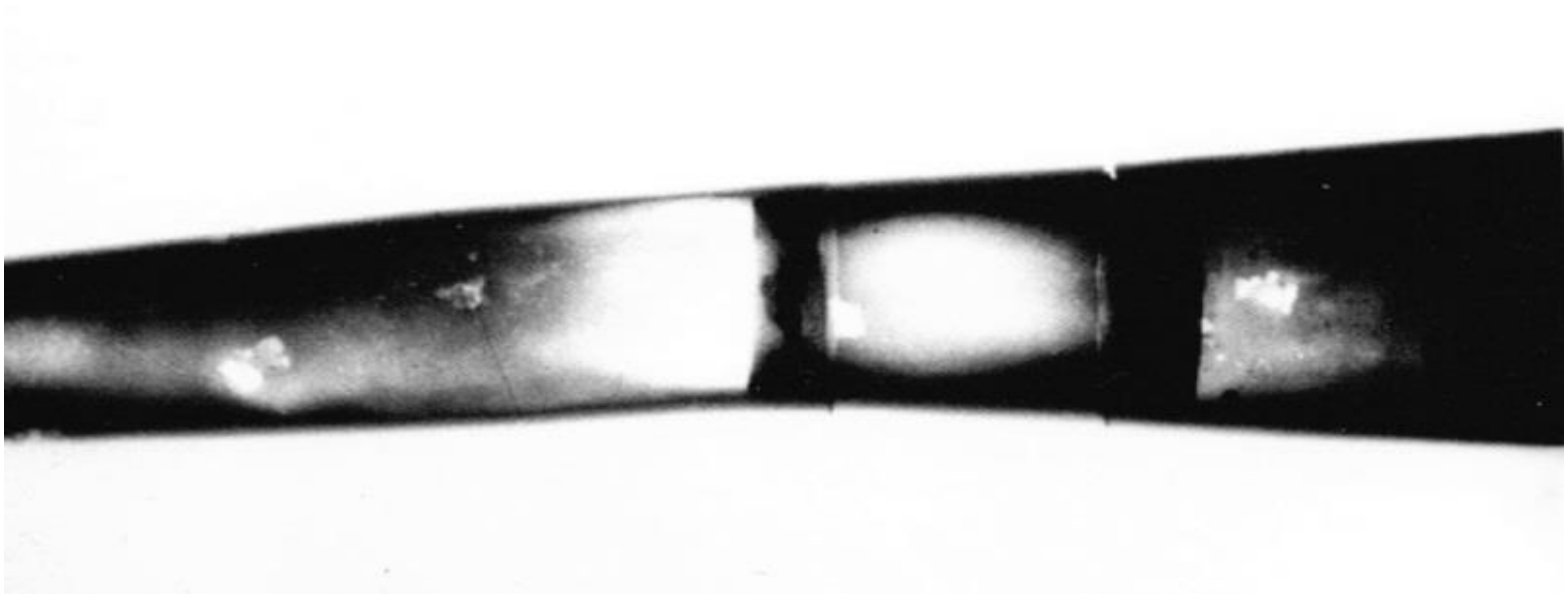


Plate 6.2: The Junction Piece of SD203

Thus, the instrument was made up of mouthpipe and bell yards which were joined by a 25*mm* long central junction piece whose ends fitted into the sockets on these two yards. (See Figure 6.5, below)

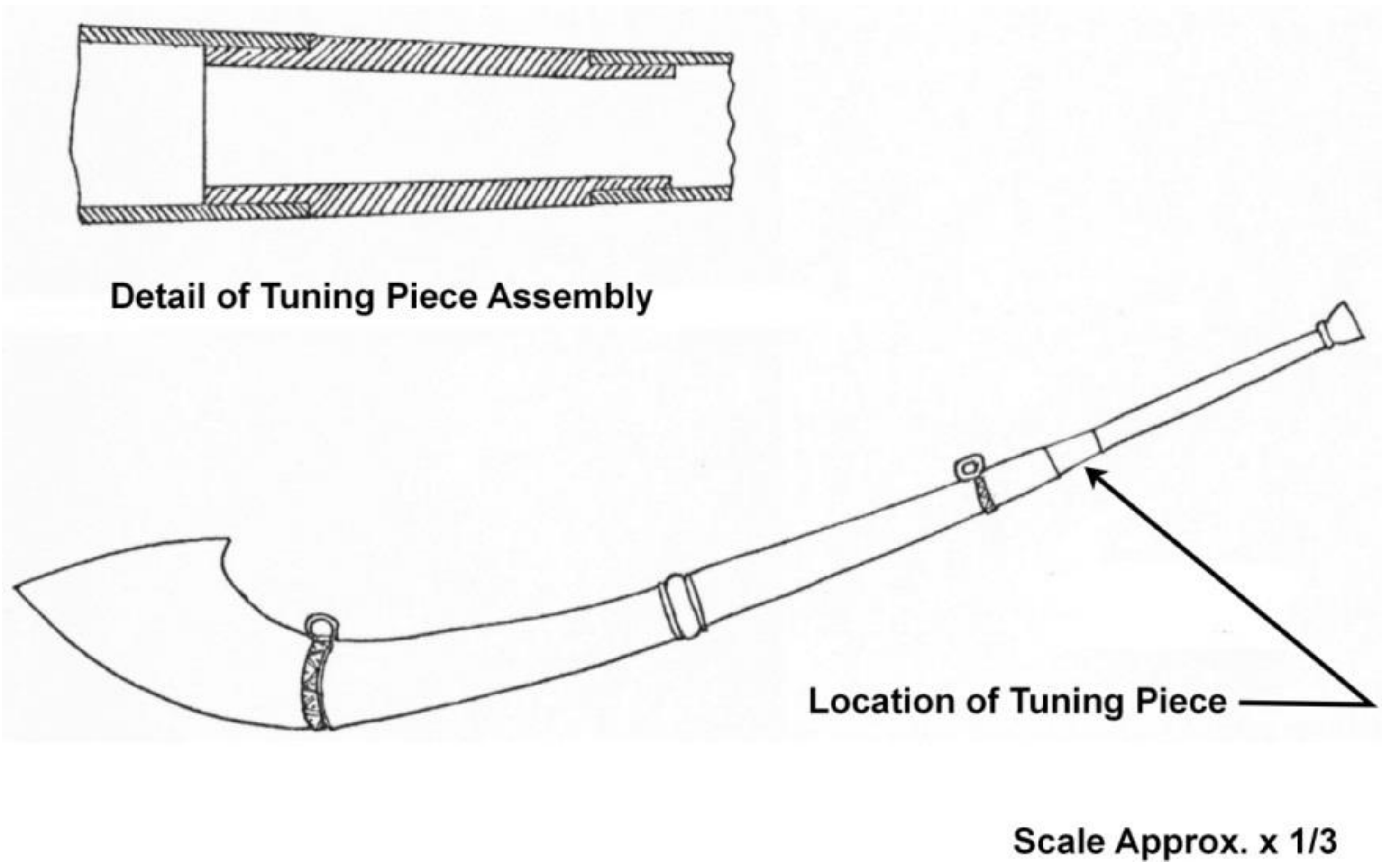


Figure 6.5: The Junction Piece of SD203

On the end of this junction piece which could be examined, its outer form is reduced to a circle of diameter 18.6 ±0.5*mm* over a length of 8*mm*. On this portion of tube is a layer of soft silver-coloured material possibly tin or more complex solder. This material was applied to the joint surfaces prior to assembly as witnessed by the presence of globules in the area between the 18.6 mm diameter and the shoulder which abuts it. On assembly, these were deformed somewhat and they, together with the irregularities in similar material on the shoulder prevent the two pieces of tube from butting perfectly, leaving a slight gap at this joint. The surface of the applied metal showed no signs of having been scored by repeated assembly and it seems probable that this disassembly was the first since original manufacture.

Externally, the profile of the walls of all three adjacent parts of tube which meet blend smoothly one to the other, in spite of their visibly different slopes. In the area where these meet there is no obvious sign of abrasive working to flow one contour into the other and the slopes on each individual piece seem consistent throughout their length.

THE FUNCTION OF THE JUNCTION-PIECE

It is clear from the smooth flow of contours from this junction-piece to the adjacent tubes and of the fit of its ends into the other yards, that it was made deliberately to suit this instrument. It is also clear that the piece was soldered into position, the solder on the mouthpipe/junction-piece joint being visible on the X-ray photograph. (Plate 6.2a, above). Thus, the instrument would be considered complete, and permanently so, following final assembly. The joint did not, therefore, provide a means of detaching the mouthpiece as on many Roman instruments, as the joint had been soldered. This was not an afterthought as, even with the 1.2 to 2.0*mm* thick solder coating the fit of junction piece to bell-yard was still loose and the length of mating diameter too short to provide an adequate support on its own. It is similarly difficult to justify the use of a junction-piece on technical grounds, as the addition of 25 *mm* of tube to either the mouthpipe or bell yard would not appear to have been beyond the maker's ability. Nor would it have been too difficult for him to have provided the male part of the joint on the mouthpipe and avoid the necessity of adding a separate junction piece.

One cannot deny the possibility that the maker was joining together parts from two different instruments i.e. mouthpipe and a bell-yard both of which terminated in sockets, although instruments from one particular industry have been found in this study to retain characteristics such as maleness and femaleness of joints in a very conservative way. Thus, although the two parts from different instruments might not fit, their incompatibility would be one of size only.

The conicity of the junction-piece differs visibly from those of the two adjacent yards (See Figure 6.5), that of the mouthpipe and bell yards being 17.5*mrad* and 20.1*mrad* respectively and that of the junction piece 58.4*mrad*. This difference in slope is much greater than the variation seen on either mouthpipe or bell-yards and the diametral match from junction-piece to adjacent yards is "perfect" from a visual perception point-of-view. Hence, the maker would clearly have been able to produce a nearer match of slope had he so wished.

In order to "correct" the slope of the junction piece to match the adjacent tubes it would need to be made approximately twice as long as it is now is, i.e. with the same end diameters. It would, thus, increase the length of the assembled instrument by about 25*mm* and lower its pitch between one half and a whole tone. Thus, it seems hard to explain the deliberate presence of this junction-piece other than as a fine adjustment to the instrument length to obtain the pitch required. Such a provision would not be unreasonable on a short instrument such as these, where it is the overall form of enclosed air-cavity which determines the precise regime of oscillation and small variations both of length and diameter could give rise to considerable pitch variation. Assuming that a mean value of such tuning pieces has a slope that matches the overall instrument, its length would be about 50*mm*. Hence the "correction" applied by means of these tuning pieces may well have been of the order of ±25*mm*.

THE USE OF THE CELTIC LITUUS

As with most PVAs a first assumption as to their use is almost invariably as a signal instrument and, in the case of these instruments this would seem to be a reasonable assumption. However, the combination of mouthpiece and instrument proper is such that the tube's formants are easily elicited and are harmonically related. If used for signalling, therefore, their usage is likely to have been more sophisticated than simply blasting out one or two simple notes.

The major factor influencing one's view of the instrument's usage is that feature that has here been identified as a tuning-piece. At the very least, this indicates that instruments were designed to be played alongside other similar instruments. A possible usage is, therefore, of instruments in pairs, and, under these conditions, instruments of fixed pitch matched to each other, would be required. No evidence of pairs of instruments has been found although with such a small sample of evidence for these instruments this does not seem surprising.

A further possibility is that the instruments were made to be used with one or other of the Celtic instruments as seen on IC78. If this were so then the maker would require a standard of pitch to which he could make his instruments. He could thus, make the mouthpipe and bell yards to his standard design and then select a tuning-piece to suit, or perhaps make one longer or shorter. Whatever the true case is, the presence of this tuning-piece indicates that the maker possessed an understanding of the problems of tuning and had built a correction into his design.

THE CELTIC TUBA

This instrument has been discussed in Chapter 2.

THE CELTIC CURVED HORN

This instrument is known mainly from the five extant instruments or fragments, three others possibly having been lost, and only one problematical iconographic reference

(IC195) and one representation on a statue (SR16). One possible precursor or related instrument exists, manufactured in wood (SD251).

A group of four instruments were found in a bog at Loughnashade in 1798) Stuart[224] and Wilde[225] 1861 identify the instrument now in the National Museum at Dublin as one of these. This identification (of SD211) has been accepted in this study. The whereabouts of the other three instruments found at this time are no longer known.

A further instrument (SD225) was found in 1809, again in peat, at Ardbrin in County Down, (Bell, 1815) and this is known to be that in the National Museum, Dublin. Two other fragments are known, one from Rosscrea (SD224) (definite findspot not known) and one from Llyn Cerrig in Anglesey (SD229), found in 1943. In the Deutsche Museum in Munich is one other instrument, (SD223) in a moderately poor state of preservation, which was bought by the Museum in 1910 from a dealer, and is said to have been found at Nice. The other major piece of evidence of this instrument is on the statue of the dying Gaul (SR16) where two complete instruments of this type are shown.

MORPHOLOGY OF THE INSTRUMENTS

All these instruments have a large diameter tube yard, 20-30*mm* diameter, curved into a roughly semi-circular form approximately 1.0 to 1.5*m* in length. Their bell-yards then open out to 80-100*mm* diameter at the bell end. These yards are made of wrought material folded to form a tube and then curved to the appropriate shape. On the north-western instruments, the seam on the tube is sealed by riveting in a strip inside the tube while on Munich the seaming strip is on the outside of the tube and is, presumably brazed in position. Unfortunately this instrument is covered with a heavy deposit of resin and copper salts and neither the nature of the fixing technique used nor the roundness of the tube can be determined.

Three instruments, Rosscrea, Llynn Cerrig and Loughnashade, have bosses at the ends of their tube yards, the latter of these being wrought while the other two are cast. No boss was found with Ardbrin or Munich and none can be seen on the two instruments shown on SR16.

These latter instruments, however, do appear to have a rim around their bell end, the only other instrument with any bell-end feature, being Loughnashade. On this, a separate bell-disc was found which although it matched the bell yard exit diameter, retained no traces of the fixing arrangement by which the two were previously joined.

No evidence of the use of mouthpieces was found in this study and none can be seen on either of the two instruments on SR16.

THE MANUFACTURE OF CELTIC LONG HORNS

[224] Stuart 1819.
[225] Wilde 1861.

Being made from sheet, all these instruments, would have required a considerable quantity of this as a basic raw material. That used varied in thickness from 0.85 to 1.4 mm (Ardbrin) and 0.28 to 0.81 mm (Loughnashade). The major variation in sheet thickness is along the _ length of the instrument suggesting that the sheet was made from a long ingot of material by flowing the metal outwards, normal to the axis of the final tube. See Figure 6.6.

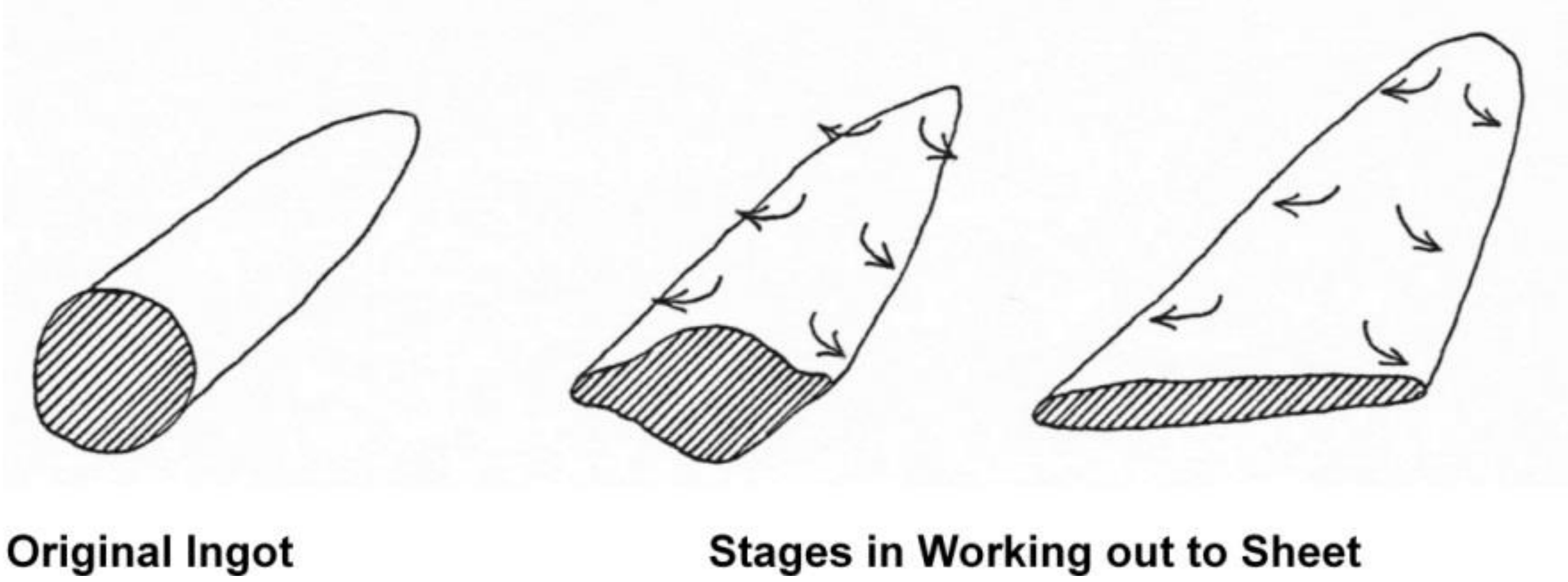


Figure 6.6: Making Sheet to Form an Instrument Tube

Measurements taken on the bell of Loughnashade show the result of this mode of working where the bell end is 0.58±0.10 mm thick whereas 10*mm* upstream of this it is 0.31 ±0.10*mm* thick. Similarly at the tip of this bell yard the end is 0.68 ±0.04*mm* thick and 10 mm downstream. of this 0.74 ±0.07*mm* thick. These latter two figures result from only four measurement stations and thus, are only a guide to the general picture. Figure 6.7 shows the distribution of measurements from which these figures were computed.

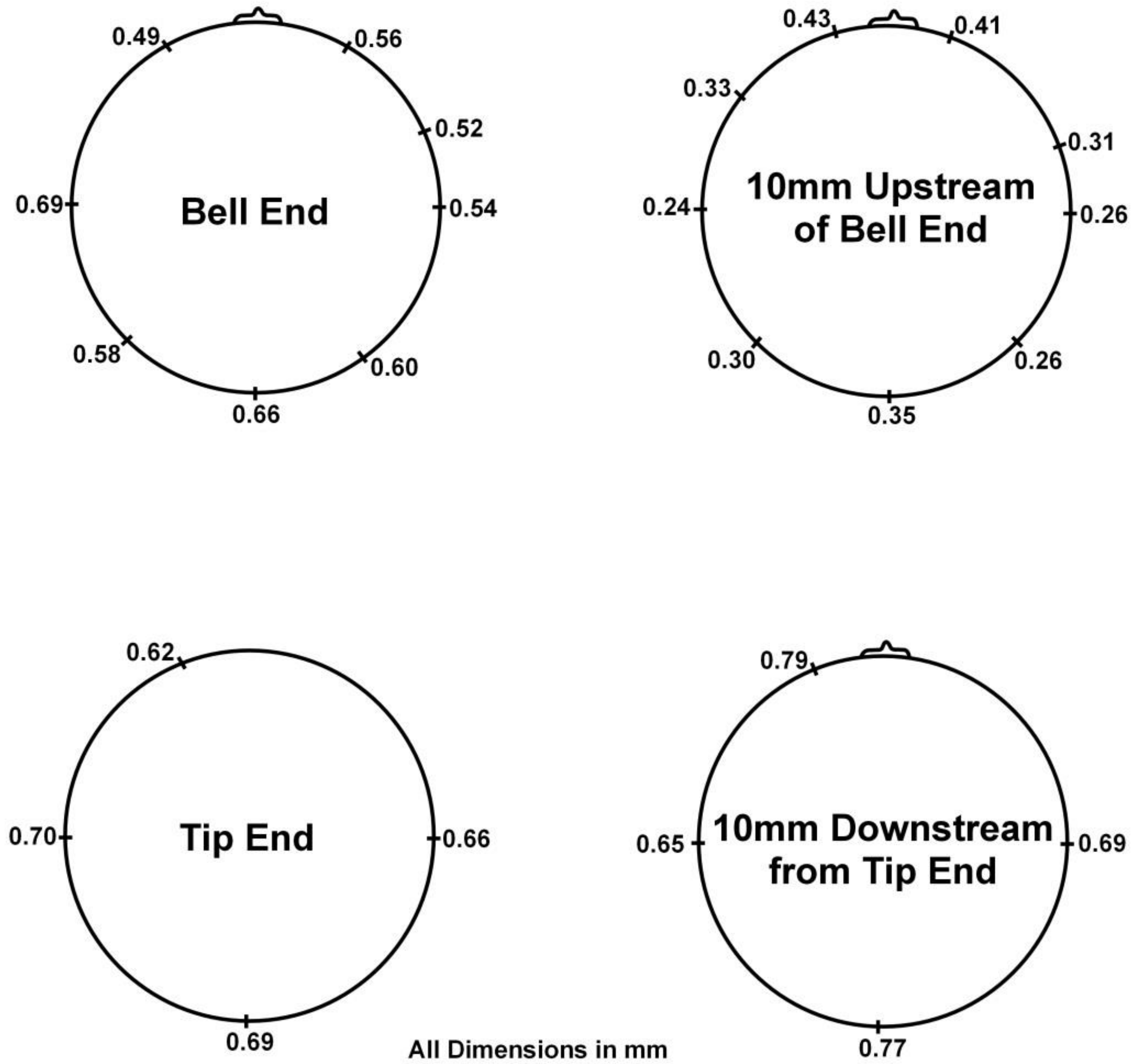


Figure 6.7: Wall Thicknesses of the Loughnashade Horn

It was not possible to measure the material thickness over the whole instrument surface and it is probable that this varies somewhat, away from the edges where measurements could be made.

The largest piece used on any of these instruments was in the construction of the bell yard of Ardbrin, where a piece of sheet 1.49*m* by 0.28*m* was required. Following the cutting out to size, this material would be formed into a tube and sealed. In the case of the riveted instruments, the first operation in providing the seal would be to mark out the axial centre-line for the rivet holes. On the bell-yard of Ardbrin, the scribed line through the centres of the rivet holes is visible over most of the instrument and it seems probable that this would be drawn with the developed sheet flat, i.e. before forming into a tube. The line, which is still clearly visible, was obviously scribed using a straight-edge, the straightness of this being discussed below.

Having defined the centre-line for the rivets the maker then had to space these along the tube, alternating across the seam. (Plate 6.4a/b) Several pitches of these rivets were measured, on Ardbrin, and their spacing of 4.67 mm was found to be consistent to within ±0.25 mm. This limit is clearly tighter than can be attained by simply centre-punching the holes using a visual assessment of spacing and points to the use of some mechanical lay-out technique. No signs are visible, on the riveted seam, of marking out by means of compasses and with this technique anyway, one would tend to get a build-up of errors from both the marking-out and punching operations.

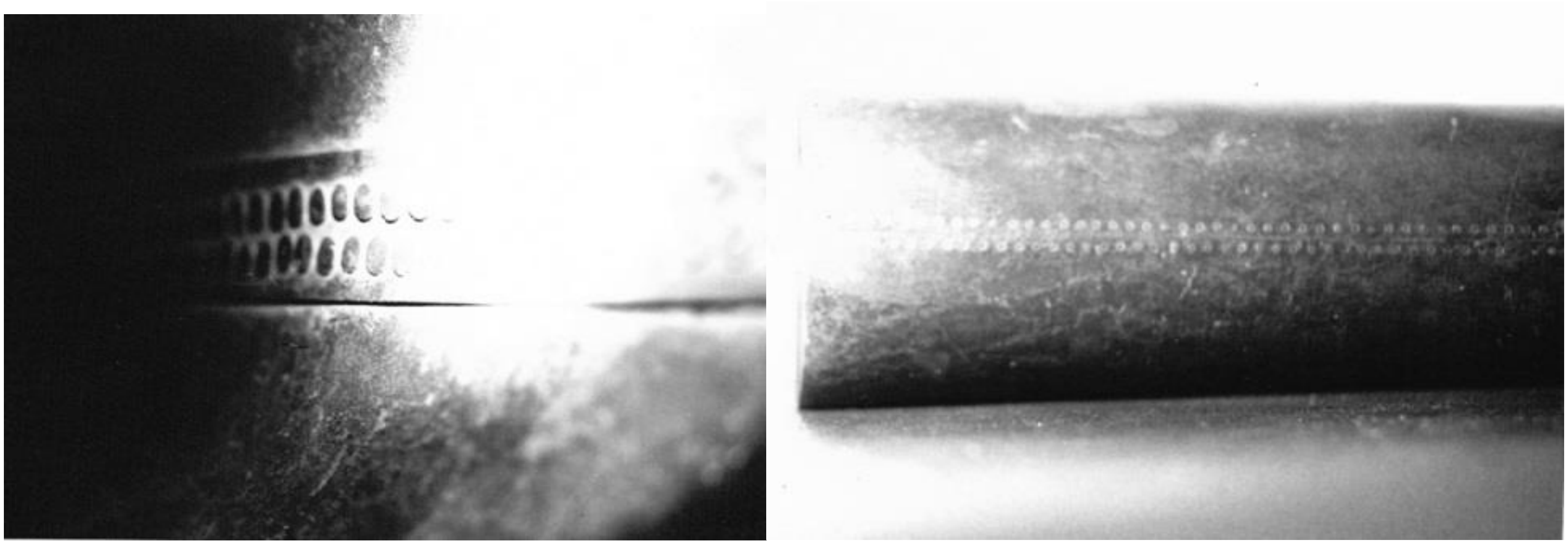


Plate 6.4: The Riveted Seam on The Ardbrin Horn

Thus it is possible that the technique employed by modern craftsmen was used, i.e. the fastening together of two punches one of which located in the previous hole while the other punched the next. Whether or not this was so, very great care was expended in the location of the rivet holes. Drilling of these holes must have been carried out equally carefully to avoid running-off of the marked spot. Only one hole is now vacant and can be inspected, this being on Ardbrin. It is well drilled with a diameter of 1.35*mm* and is countersunk on the outside of the instrument to a diameter of 1.70*mm*. Such a hole form when filled by a rivet formed in situ, and abraded flush to the outer surface of the tube would give a head nip of only 0.175*mm*.

The internal riveting strip (IRS) would also require drilling and it would seem unlikely that this was done before its assembly in the tube. Thus, the first hole could be drilled in the IRS and this riveted in place as the tube is formed round. The next hole could then be drilled, deburred and that section of tube riveted in place. After each such operation, the tube would need to be formed over another rivet pitch and the drilling and riveting carried progressively down the tube. On the inside of the instrument tube the rivet heads are flattened against the tube bore and, being about 4*mm* diameter, these almost touch each other here. These heads would need to have been formed prior to assembly of the seam, as a head of 4 mm diameter could not be formed from 1.3*mm* diameter wire without several stages of annealing between the forming operation. Figure 6.8, drawn to scale, shows the extent to which the metal forming the rivet head on the bore of the instrument is required to flow during manufacture of this rivet. (See Plate 6.4a, above)

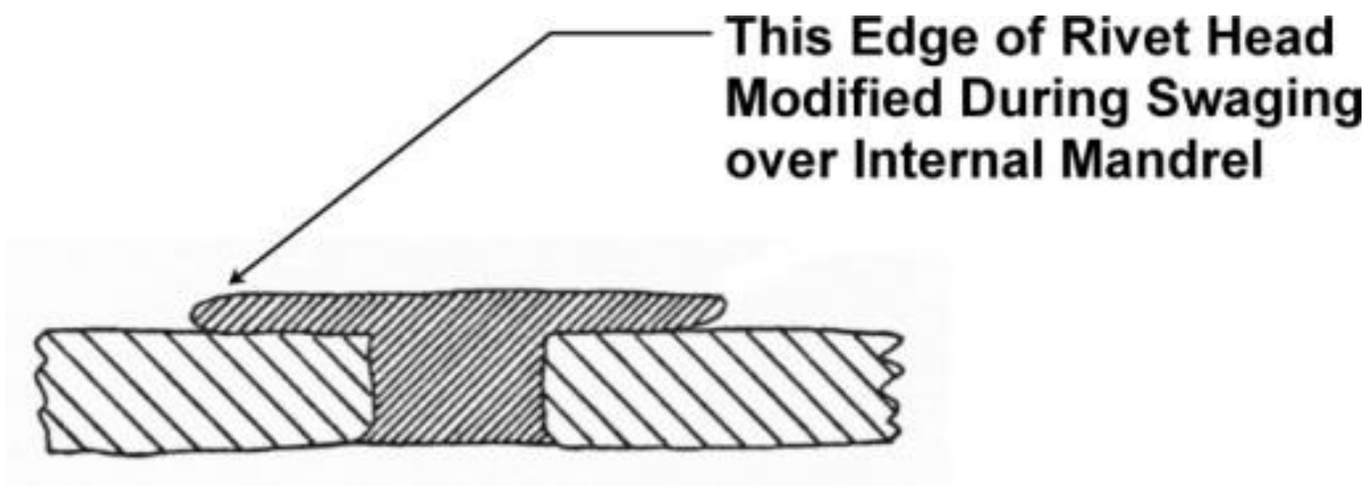


Figure 6.8: Form of Swaged-over Rivet

One key feature when riveting is the close fit between the rivet shank and the sides of the enclosing hole. Where excessive clearance exists, especially with fine rivets such as the ones used on these instruments, the shank tends to bend while the head is being formed. With the advent of wire drawing, the means to produce a uniform wire became available from which rivets could be formed. Whether or not drawn wire was used to form these rivets cannot be stated categorically but draw-plates are known from a late bronze-age hoard from lsleham in Cambridgeshire.[226]

Although each individual rivet is quite small, having used perhaps 3-4*mm* of wire, the rivets together would have consumed some 2.5 m of wire. This is a considerable quantity of 1.5*mm* diameter wire which, judging by the good fit of the rivets in the holes was manufactured to a high degree of roundness. It seems likely, therefore, that the wire to produce these rivets would have been drawn.

While the first few rivets could be fed through the drilled holes reasonably easily, this process would become increasingly difficult as the tube length increased. These later rivets would thus, have to be fed through from the point where the tube is being slowly closed up and, once through the tube wall and IRS, be held hard against the wall with a suitable mandrel.

A more-elaborate technique was used to manufacture the seam on Llyn Cerrig instrument, where the two ends of the tube meet in an interlocking wavy line. See Figure 6.9. Where the edge of the tube material extends over the seam centre-line, the sheet has been thinned by flowing the metal over this, leaving the tube wall thinner at this point. The mating edge of the seam, which had previously been chamfered on its inner edge was then worked down to form a neat seam. See Figure 6.9. A similar technique for producing riveted seams was used on the Cork Horns found in 1909 during excavations in Cork. (See O'Kelly, 1961, 5)

[226] Britton, 1960.

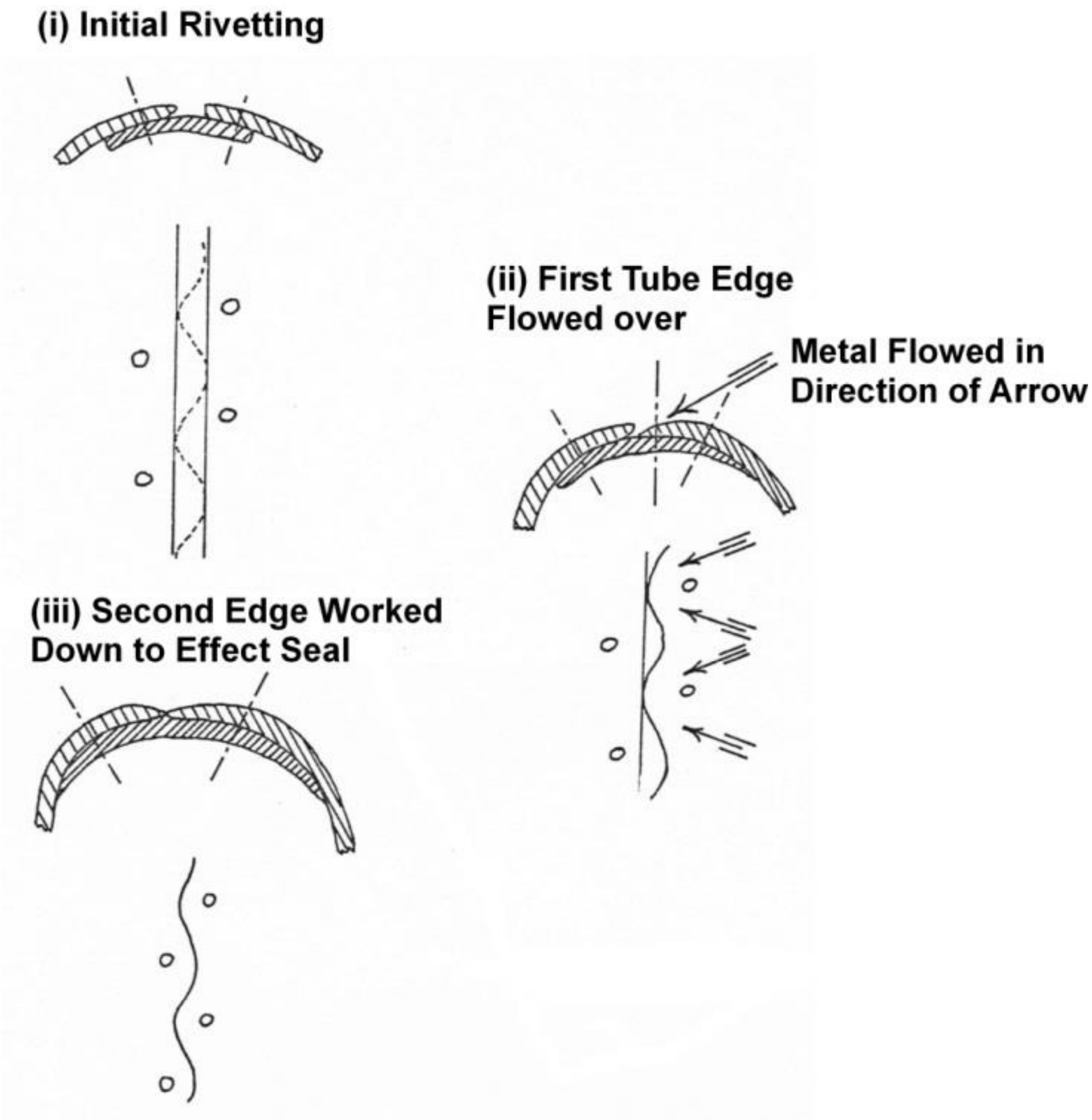


Figure 6.9: Forming the seam on the Llyn Cerrig Instrument

All the Celtic Curved Horns examined have parallel tube yards. In the case of Ardbrin this yard is 22.0*mm* diameter (mean of 52 readings at 8 stations) with a maximum variation of +0.26*mm* and -0.22*mm*. At individual stations, the tube is round to within ±0.29*mm*, in spite of this quality of the tube "roundness" being the first to suffer when the instrument is dropped, banged or otherwise mishandled.

The figures for roundness quoted above are indicative of considerable precision in the forming process both at the stage of cutting out and forming it into a tube. When cutting out the material to form a parallel tube to ±0.24π*mm* (mean error) a rectangular sheet would be required which has parallel sides, themselves uniform to within about 0.24π*mm* (0.75*mm*). This figure of 0.75*mm*, the maximum allowable variation from parallelism is itself the product of the two operations; marking out and cutting to this mark. A relaxation of this tight dimensional requirement is discussed below.

As mentioned above, an accurate straight edge would be needed for the marking-out but no evidence was found as to the mode of shaping the sheet. If parallelism alone is the criterion, then the absolute dimension of the strip width would not be critical and a go/no-go gauge would be suitable for dimensional control.

Having manufactured sheet to the required shape, it then has to be formed into a tube. Although this can be done by folding around a fairly crude mandrel, such a process would not enable a tube to be produced to within ±0.24*mm* roundness. Such a dimensional requirement can only be met by the use of a mandrel of equal or greater roundness. In addition, such a mandrel would need to be of a sufficiently hard material that it can withstand the blow of a hammer used to form the metal. When making hollow objects a hard wood is generally usable for forming metal. However, when the metal itself contains internal projections, such as rivet heads, wood of even the hardest type is no longer suitable. The point pressure from the rivet heads impresses these into the wooden surface of the mandrel and this can then no longer be removed from the formed tube. It seems, therefore, that a metal mandrel was used in the manufacture of these tubes, of a metal that was hard enough to stand the pressure of the rivet heads. Such a metal, however, had to be formed into a circular cross-section with roundness of at least $\pm 0.24\,mm$. Of the methods available for producing such a mandrel, the most likely to have been used seems to be that of generating, probably by turning on a lathe. A further benefit from having a round and hard mandrel, is that, where the tube diameter is slightly less than this mandrel, working of the tube walls over it will stretch the material, producing a tube diameter that conforms closely in size and roundness to that of the mandrel.

A secondary effect which results from this working over a hard mandrel is that the rivet heads themselves, are both curved to suit this mandrel and thin out at their edges to run smoothly into the bore, (Plate 6.5b, p. 340)

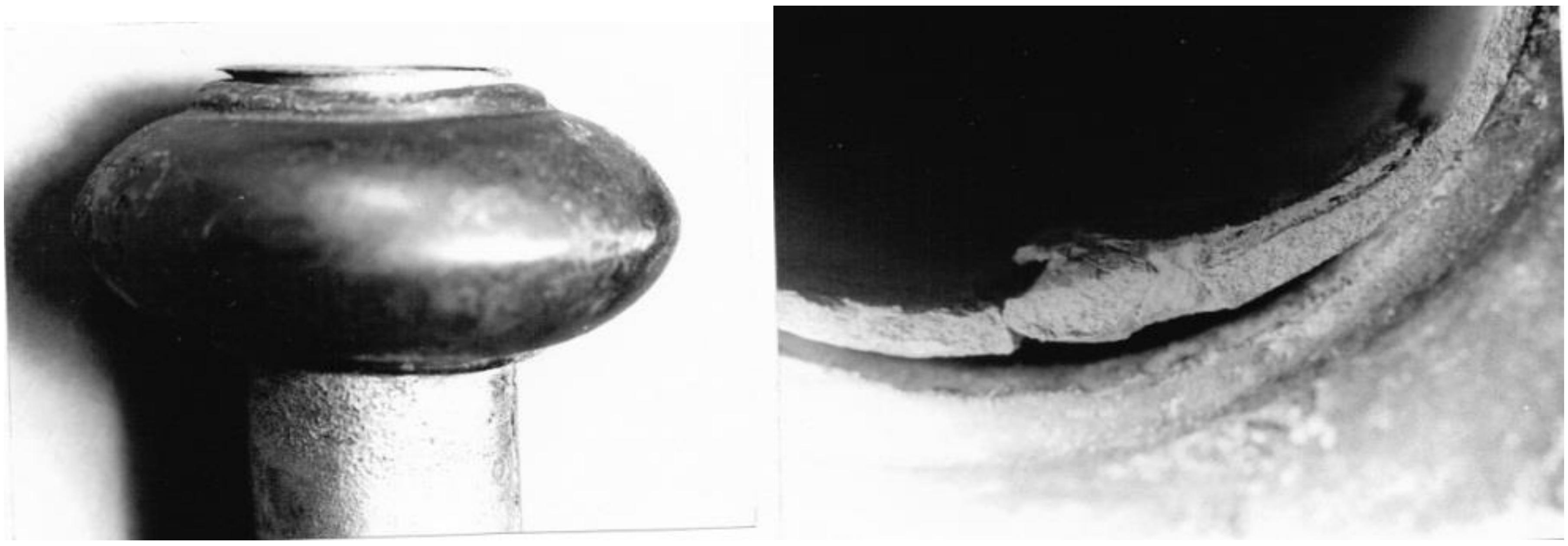


Plate 6.5: A Cross -Section Through a Rivet

There is a bit of a cheat added here in 2012 when I originally scanned in the thesis as the reproduction of Plate 6.5a was not as good as that in the original thesis which was a photograph

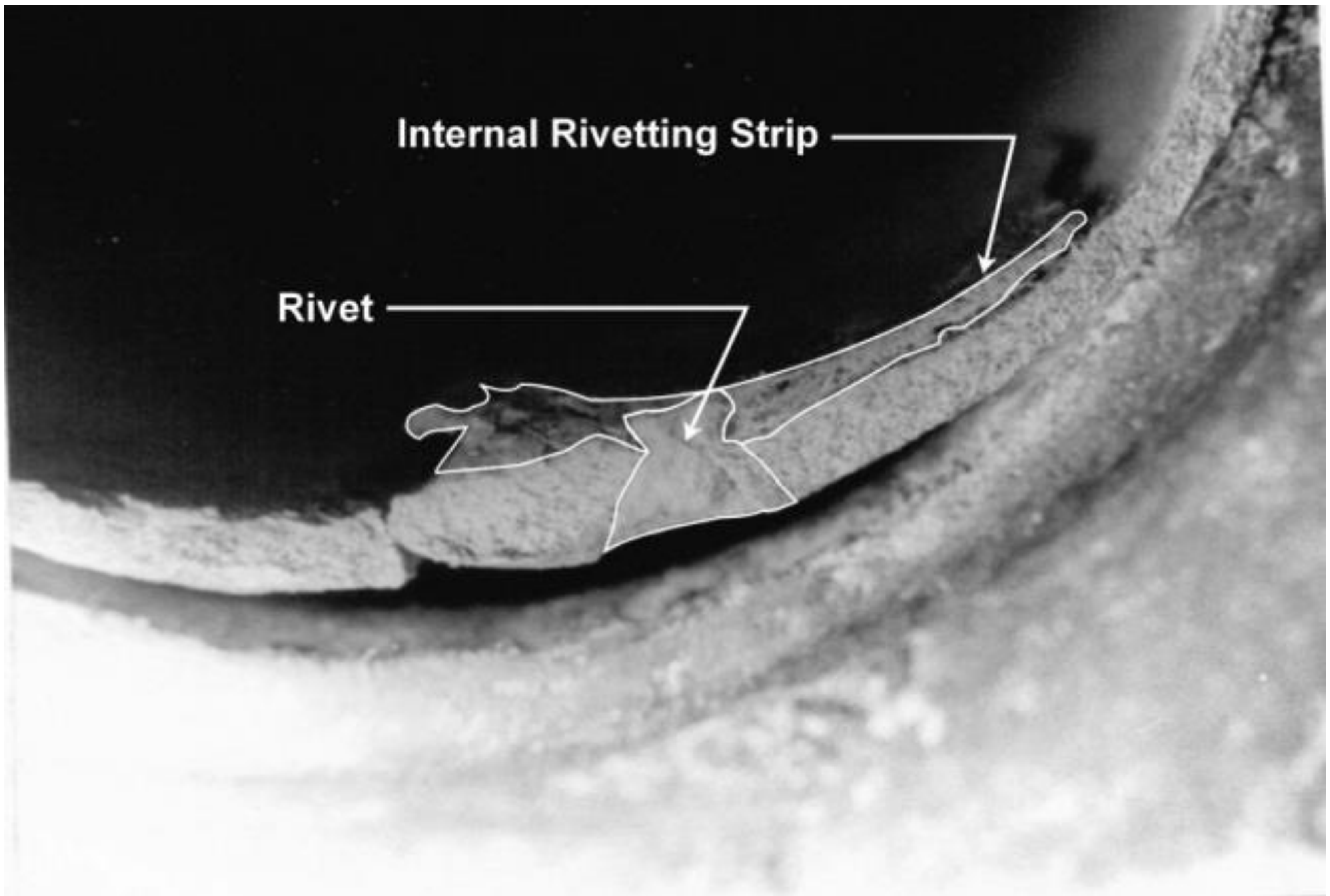


Plate 6.5bb The Rivet Shape Outlined

This effect is very marked on all the instruments examined indicating quite clearly that a hard metal mandrel was used in this operation. (Plate 6.5bb, above.) This photograph show the edge of the tube and it is apparent from the sectioned rivet visible here that this has been abraded back since the tube was originally riveted. The wedge shape of the rivet at this point results from the drilling of the original rivet hole obliquely and not normal to the tube wall. Also visible on this plate is the thinned-down edge of the sheet adjacent to the rivet hole.

MANUFACTURE OF THE BELL YARD

This group of instruments has bell yards which are basically conical in form. Thus, the manufacture of these yards would first involve the production of a sheet of material of the appropriate shape, i.e. the developed surface of the cone. With a long narrow-angled cone such as these bells, the frustrum of a cone would provide a near approximation to this developed surface. The major error would be visible on the bell end of the instrument, where the end face would be inclined at an angle to the normal to its long axis. This excess material could then be removed by abrasive working.

On Ardbrin the bell yard is not truly conical but it is uniformly hollow from the best cone by about 11*mm* over its 1.489*m* length. This variation, however, is not random but reaches a peak at 0.77*mm* from the instrument tip and varies smoothly back to zero either side of this. In order to investigate the nature of this relationship, the values of x (distance from bell yard tip) and y (diameter of bell yard) were tabulated and values of log y calculated.

The values of log x and y were subjected to a straight line regression analysis and yielded a goodness-of-fit correlation (r) = 0.9988. Thus, the analysis was statistically valid and showed that the values of x and y were related by the equation $y = x^{(0.0043)}+19.80$ i.e. the bell yard had an exponential form with a relatively slow rate of flare. Although this form of expansion of the bell yard is more effective both in terms of propagation of the instrument sound output and of producing harmonically related formants it does not seem too likely that this feature of the exponential bell was well understood at this time. On the other hand, whereas the flare on an exponential bell with a more pronounced flare can readily be seen, the degree of flare on this instrument is so small as to be scarcely noticeable.

The forming of this yard would be no less difficult than that of the tube yard as the taper of the bell would require a mandrel of the same shape as the bell to be made were the same technique to if be used. It was not possible to measure the form of the bell yard to the same extent as on the tube but the indication from measurements taken are that this is round to within ±1.0*mm* at its least round point.

Following manufacture of the yards, these would need to be curved to the desired shape. Whatever the technique used on these instruments, it seems to have left behind little surviving evidence. A modern smith faced with this task would fill the tube with a low melting point metal such as lead, or one of the modern commercial alloys, which can flow as the tube is formed. However, on a tube with two rows of rivet heads along the seam, the molten metal being poured in would have wet the tube/rivet interface as these were heated up to the appropriate melting point, and probably flowed into this rivet head/tube interface under capillary action. Such a layer of material would, subsequently, be difficult to remove and would probably remain when the bulk of the infilling material was removed. Inspection of the bore using fibre-optic inspection equipment revealed no such deposit nor traces of the corrosion products of lead in any form.

The other alternative for filling the tube during bending, which is also still used today, is sand or similar granular material. This is also able to flow, taking up the change of shape of the bore, but needs to be packed tightly into the tube during working and to be retained there. With a small diameter tube wooden bungs can be wedged into their ends and can be made to seal better if these ends are given a slight conicity. On both ends of the tube yards and the tip-end of the bell yard are, in fact belled out, the tube yard ends over the first 100*mm* of their length and the bell yard end over the first 40*mm*. This belling out could, thus, have been to facilitate sealing-in of the packing material as well as to accept the adjacent yard or feature. See Figure 6.10.

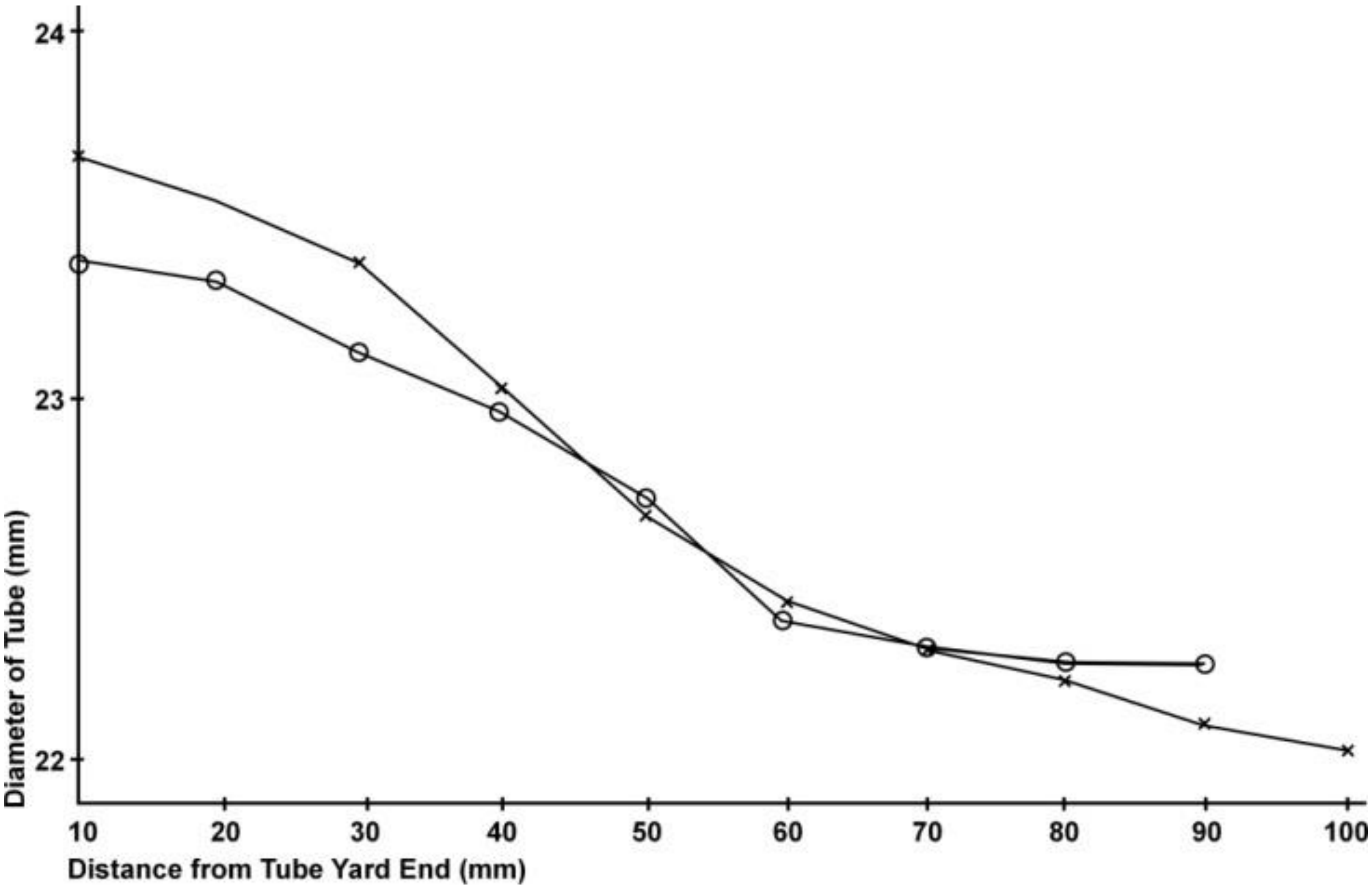


Figure 6.10: Instrument Tube Diameters

No signs of distortion of the bell yard are visible at the instrument bell end, however. Nevertheless, this instrument must have been packed to facilitate bending, and the technical skill called for in this operation was considerable. On the outer curve of the instrument, the tube surface was thinned during this operation but, on the inner surface, where the riveted seam lay, the metal was actually thickened during the process. Had this not been so, then the accommodation to the new form would have been made by rippling of this seam. It is quite clear that the curved surface was produced by subtle flow of the metal rather than by the application of large forces as the integrity of the inner curve seam was maintained by rivet head nip on its outer surface of the order of 0.2*mm*. Such a small nip would have failed with only a minute force and it seems likely that these rivet heads now seen on the instrument were produced after bending of the instrument. In this case, a conventional snap-headed rivet could have been formed when originally manufacturing the tube, only to remove this head, presumably for aesthetic reasons after bending the tube to the required form.

One instrument, Loughnashade, has an external riveting strip in addition to the internal riveting strips seen on all the other instruments. As far as can be seen the IRS was fixed on the seam in the normal way and the rivet heads abraded flush. The external riveting strip was riveted over this seam with the rivets alternating between those already in the tube. Because of the inaccessibility of the tube‘s bore and necessity of inserting the rivets from the outside of the tube, the internal rivet heads could be only poorly formed. This additional strip, unlike the IRS has a central spine running along its length. (See fig, 6.11).

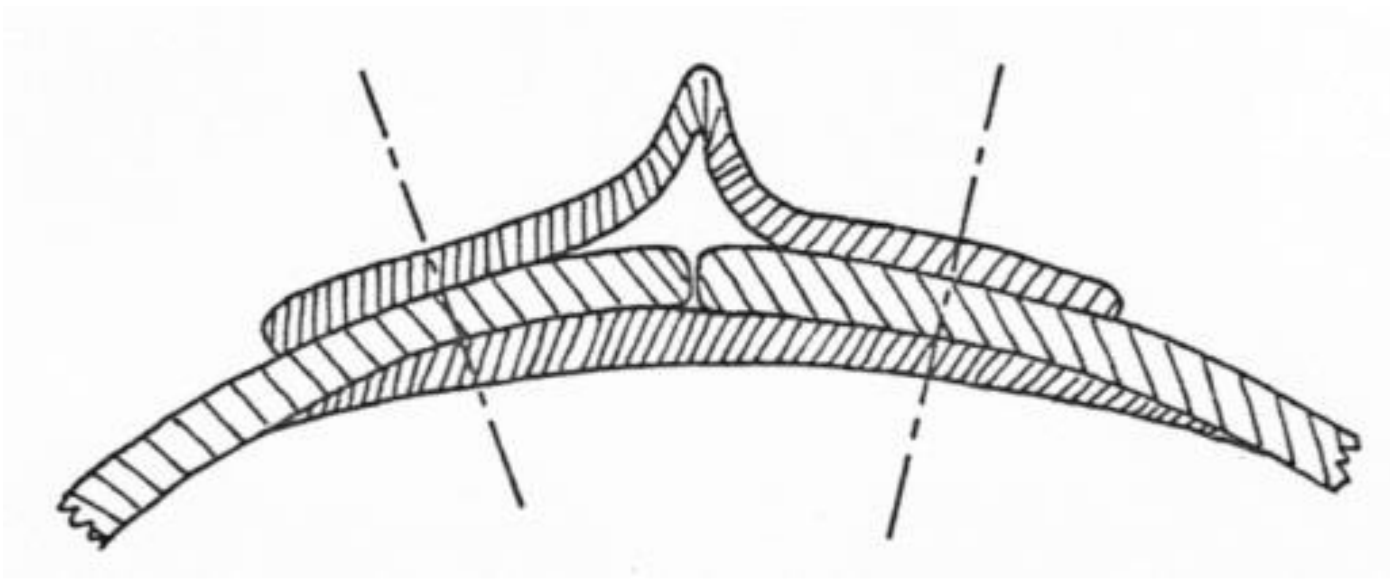


Figure 6.11: The Riveting Strips on the Loughnashade Horn

Were this strip to have been put onto the bell-yard prior to forming it into a curve it would then have been damaged during this operation

With the central spine projecting as it does from the tube surface, it would have been required to thicken considerably along the top of the spine. However, no signs of rippling are visible along this surface and it would seem likely, therefore, that the strip was formed into a curve and applied to the bell after this too had been similarly formed. It could, thus, be that the strip served to cover deficiencies in the earlier riveting operation such as sprung rivets. Many of the rivets on the bell of Ardbrin are pulled below the surface by some 0.37 to 0.50*mm*, this probably having occurred during bending of this yard. However, only one rivet is actually missing and it is not possible to say when this loss occurred.

Clearly the whole process of producing a seam was seen as a functional operation and post-riveting operations carried out for aesthetic reasons, both on this and other material from this area. On the Petrie Crown, for instance, following the riveting, the backing material was tooled away leaving a raised decoration which, as its line cut across a rivet, included part of this raised portion.[227]

A similar riveting technique to that on the horns was also utilised on several spear butts currently seen in the National Museum at Dublin but, unfortunately unlocalised. (See Plate 6.6 (a/b), below)

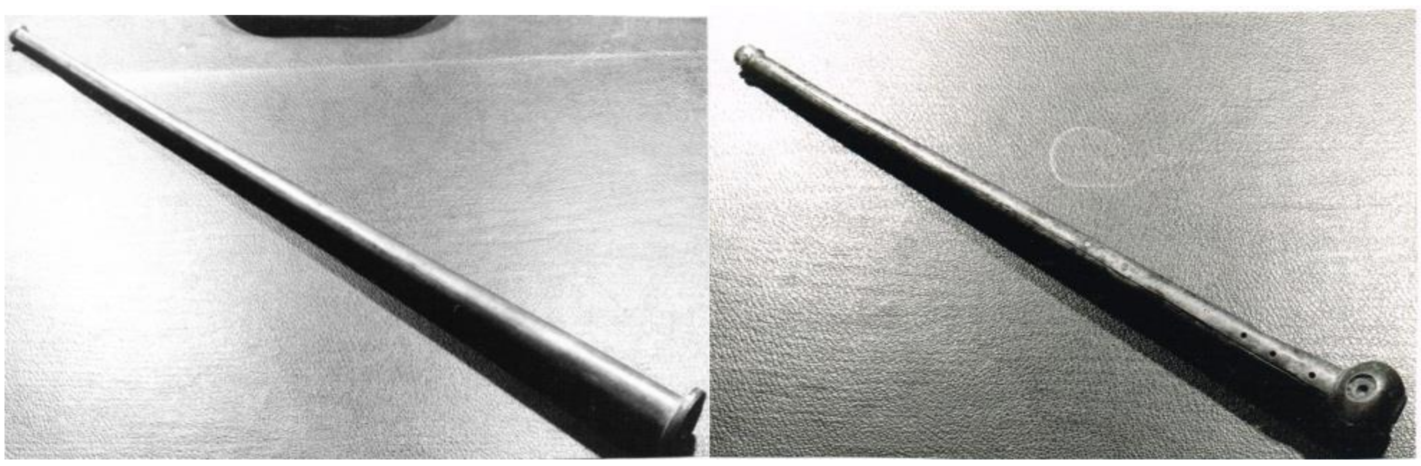


Plate 6.6: Riveting Patterns on Spear Butts

[227] O'Kelly, 1961, 9, pl. v.

However, the elaborately-riveted seam on these seems to be technically in excess of what is required to produce functional items. Also in this collection of spear butts are shorter cast types which, presumably, pre-dated the riveted ones. For some reason, possibly the difficulty in coring out the bore of these to give a reasonably thin section, and possibly because of the availability of bronze sheet, approximately 0.75*mm* thick, these butts were simply wrapped around to form a seam from the butted ends of the sheet. Then, to maintain the seam closed, cast bosses have been fixed over the tube ends. In some cases these seem to be cast-on, in others pressed on and, perhaps brazed. Clearly the key factor in this mode of construction is the integrity of the end fittings and, as most of these seem to have survived, this particular technical problem appears to have been solved.

However, one spear butt has a riveted seam and as the maximum diameter of its tube is 15.8*mm*, the creation of this called for enormous technical skill.(Plate 6.6b, above) One possible explanation of this is that the smith attempted to apply the simple butted seam to other artefacts such as the Cork Horns, etc. and found that, because of their greater cone angle the seam would not remain closed. They thus developed riveting to overcome this problem. Having developed this technique it could then be applied to both horns and spear butts, If this is true then a possible sequence of development of the technique would be:

One of the most complex processes in manufacturing a sheet-metal piece such as the long bells of these instruments is the development of the sheet outline needed to produce a particular curved form. The sequence proposed above would allow for the problem of developing surfaces shapes to be solved on the simpler shapes of spear butts and, then to progress to the more complex forms of horn bells. Even with the instruments studied, which were presumably towards the end of the evolutionary sequence, problems of defining the horn form were experienced.

THE JOINING OF ADJACENT YARDS

In the case of Loughnashade, the tube yard end slides into the bell yard tip to a depth of 48*mm* but as this tube has been subjected to such a degree of repair and reworking it is not possible to say if this inter-relationship was part of the original design. However, the end 20*mm* or so of the external riveting strip is omitted from the bell yard tip and its spine abraded back by 7-8*mm*. This would allow the boss found with this instrument to fit onto the bell yard tip and, when pushed hard up to the external riveting strip, would be half on the bell yard and half on the tube yard. It would, thus, cover the actual joint of the two yards, hiding whatever attempts had been made here to effect a seal.

No other features exist which would serve to join together the yards of these instruments in a satisfactory way. Such features would need to be mechanically stable enough for one yard to be held rigidly when the instrument is supported by the other, and, in view of the fact that two people are required to handle Ardbrin, if this is to be done without damaging it, the requirement of this mechanical fixing can be seen to be an exacting one. In addition, a moderately air-tight seal would be required to enable them to be blown satisfactorily as musical instruments. As discussed above, the ends of the yards of Ardbrin are slightly belled out and the tube and bell yards do not fit together. A separate junction-piece must have been used on these instruments and, presumably, this fitted inside the two yards.

It is at the junction of individual yards where the requirement for accurate diameters is at its greatest. The surface development of a tip diameter is not simply defined by π times tip diameter on a cone unlike on a length of parallel sided tube. Hence, the Smith must have either developed a technique for laying-out surface developments or stored the dimensional information in some way between making one instrument and the next.

Clearly, difficulties were experienced with bell yards, as is seen on Loughnashade. On this, the bell yard is extended at its tip by 99*mm* and by continuing the slope of the bell by this amount its tip diameter is reduced. Presumably the bell and tube yards were made with internal riveting strips only and, on offering up together found not to fit. The small 99*mm* portion of sheet was then formed into a tube and carefully riveted onto the short band previously riveted to the bell tip. (Figure 6.12, below, Plate 6.7a, below).

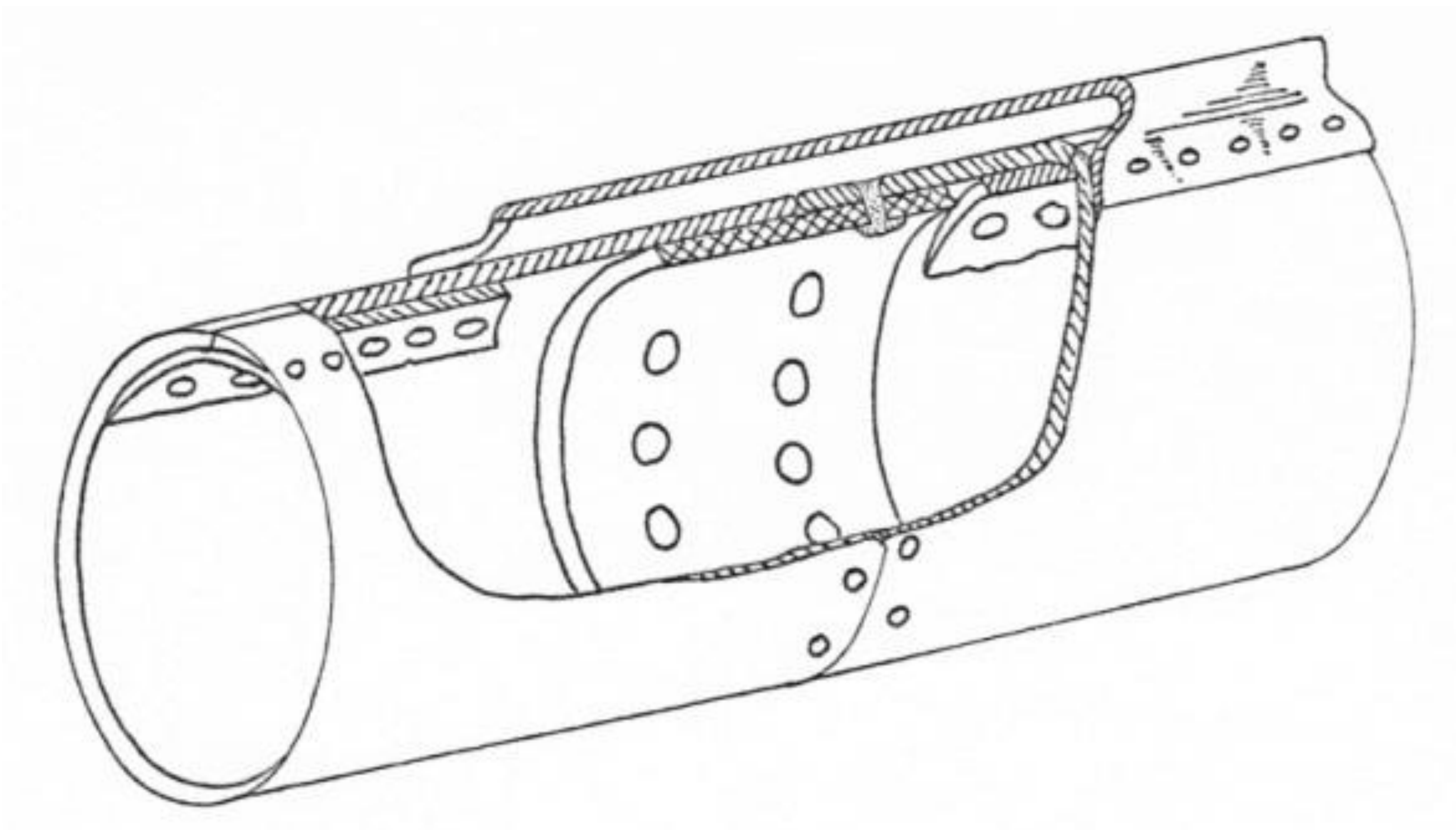


Figure 6.12: The Tip End of the Loughnashade Tube Yard

The tip of this additional tube was provided with an internal riveting strip only where no external riveting strip was to be provided. This external riveting strip was then riveted in position along the whole length of the bell, overlapping the junction of the tube extension, and stopping about 20*mm* short of the bell tip, presumably to allow the boss to slide over the tube at this point.

Three instruments, Loughnashade, Rosscrea and Llyn Cerrig, have bosses which were probably originally used at the junction of yards but are not in a form which could effect a seal at this point. None of these bosses that have survived would be much use in this respect and seem only to serve an aesthetic function, perhaps as skeuomorphs of some earlier device. On Rosscraea and Llyn Cerrig these bosses are cast and retained by the edge of the tube which has been peened over to form a retaining rim. (Plate.6.5b) above) Thus, on these instruments the boss would not cover the actual joint between adjacent yards but would be to one side of this.

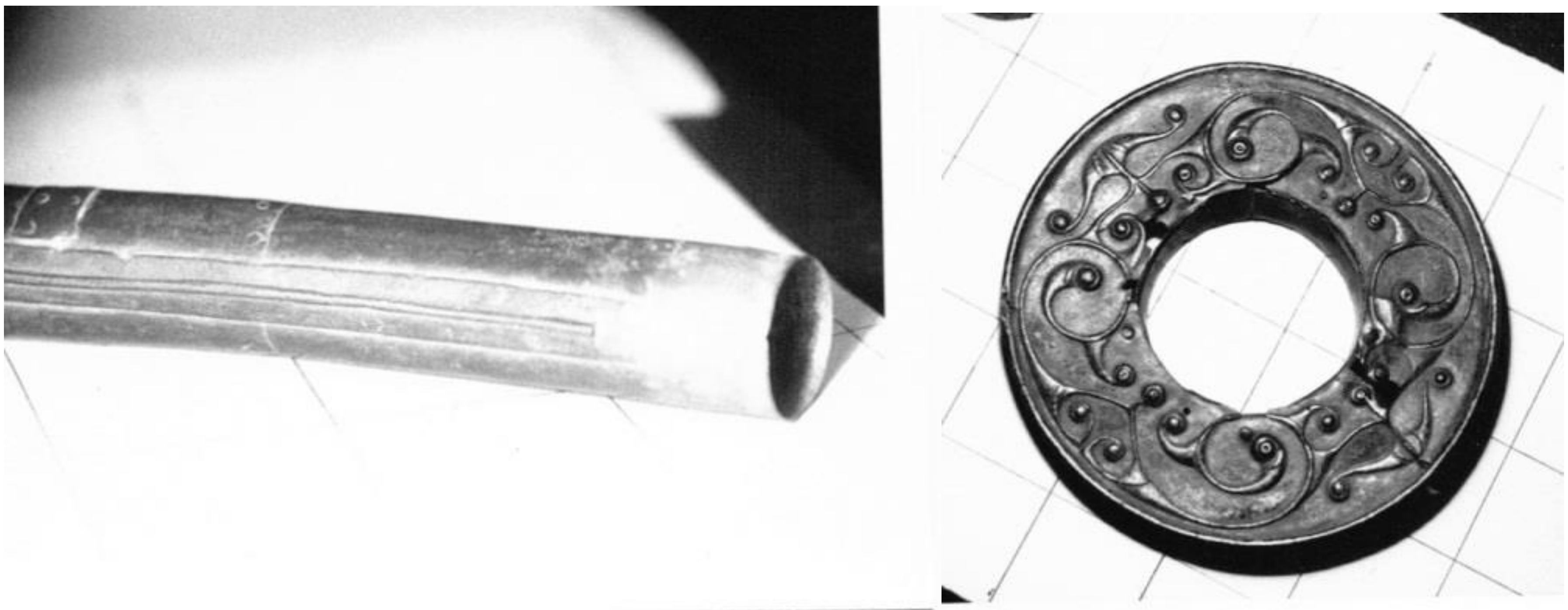


Plate 6.7: Details of the Loughnashade Instrument

The importance attached to the provision of this feature is perhaps illustrated by the wrought boss provided on Loughnashade. To a practicing silversmith, this is probably the most satisfying piece of craftsmanship seen in the present study. Its form is shown on Fig, 6.13 where it can be seen to consist of two pieces. Each of these would need to be cut out from sheet, and worked as shown on this figure. The modern smith would use a variety of tools to produce such pieces and would need to work systematically to develop the various features that this boss has. It is hard to imagine how such a piece as this could have been made without both a wide variety of tools and a considerable tradition of metalworking.

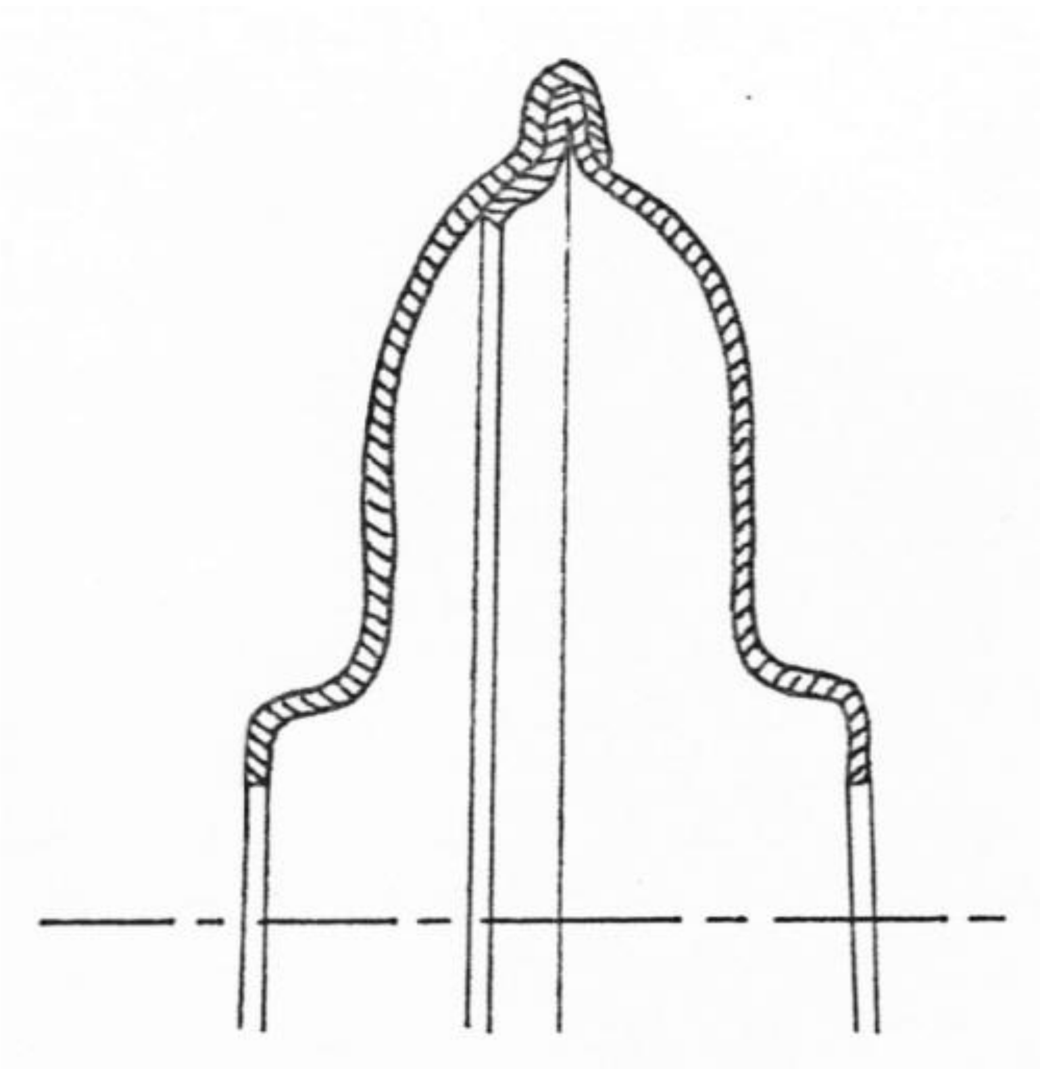


Figure 6.13: The Loughnashade Boss

TERMINATION OF THE BELL-YARD

Only one instrument still possesses an annular bell disc which seems designed to fit around the bell exit diameter. This too is a carefully made piece worked from sheet and decorated by repousse work. The elements in this decoration are dated by Dr. Joseph Raftery to the La Tène period, probably about 100BC[228] See Plate 6.7b, above).

THE KILLYFADDY FIND

This find,[229] was of pieces of wood curved in form and hollowed out into semi-circular cross-sections. The eight pieces can be matched together in pairs to form four curved tubes each roughly 0.74*m* long along their outer curve, with outside diameters of approximately 37*mm* and bores of 24*mm*. Three of the yards have both male and female ends and the fourth two male ends. They thus appear to be a single set of material and not two pairs. On the external surfaces of the tubes are numerous square bronze pegs with traces of corrosion products around these. From the shape of these traces and indentations on the tube surface, the tubes appear to have been held together by means of a bronze strip approximately 13*mm* wide wrapped spirally around the tube and nailed into position.

When re-assembled in what appears to be a reasonable reconstruction, the four pieces appear to be the four yards of PVA with a cylindrical bore and curved in a semicircle. In

[228] Fox, 1946.
[229] Wilde, 1857, 244.

this form, the overall length is about 2.6*m* and, combined with their bore of 24*mm*, these pieces form an instrument very similar in morphology to the other Celtic curved horns.

THE ORGANOLOGY OF THE INSTRUMENTS

These instruments consisted of two or three yards of large bore (c. 25*mm*) tubing some 2*metres* long. From the evidence of SR16 they appear to have had little or no mouthpiece or mouthsupport and, thus must have been very similar, acoustically, to Ardbrin as it now exists. (The two yards of this are now held together with a modern junction piece that allows the instrument to be blown). When blown, this instrument sounds its first two or three formants readily but becomes progressively more difficult to play as higher pitches are attempted. However, during blowing tests for this study it was found to be playable up to its eighth harmonic. Undoubtedly, with only a small measure of support for the lips these higher harmonics would come within the range of feasibility for use as they could be played with moderate success using the tube end alone. In view of the tradition in this area of PVAs with large diameter tubes and simple mouthsupports, i.e. no developed throat, there seems to be no justification for proposing that these instruments had any form of mouthpiece. Thus, the increase in lengths of instruments in this area was probably brought about by the desire for deep bass notes rather than the increase in playable harmonics that came with this longer tube. In any case, regardless of the number of attainable notes, the performer could never sound these with any agility. The lack of mouthpiece throat makes a rapid alternation between notes almost impossible to achieve.

When complete, the Celtic curved horns are anything but portable. Their physical size alone is such that two persons are required to handle them if they are not to be damaged in the process. The presence of an elaborate bell disc on Loughnashade gives rise to further difficulties in the handling of this and leads one to propose that these instruments would almost certainly be used in a stationary position.

The tradition of large bore PVAs in Ireland has been mentioned previously in this study and the question of their usage discussed in Chapter 3. In this chapter it was proposed that the Bronze-Age horns of Ireland were blown as variable tone-colour instruments with a complex usage pattern. With the iron-age horns under discussion here, however, the ratio of tube length to tube diameter is much greater than on the bronze-age instruments and does not appear to allow their use in this way. One must enter a caveat here, of course in that the author while being able to play the didjeridu and, hence the Irish bronze-age horns moderately well, may lack the technique to make these iron-age instruments speak in the appropriate way.

The uniformity of morphology between the Irish instruments, that from Nice (Munich) and the eastern Meditteranean (SR16) would suggest that a stable technique of blowing these instruments had been developed and was widely utilised. In addition, this wide spread points to their being effective as musical instruments and not simply the product of technology and aesthetic taste.

THE USAGE OF THE CELTIC CURVED HORNS

Earlier discussion has mentioned the size of these instruments and their use in a stationary way. Such use may have been in a social group and, it seems quite likely, as a part of some ritual activity. Close technological affinities can be seen between the Irish horns the so-called Cork Horns and the Petrie Crown[230] and they were probably produced by the same school of craftsmen. These other items are clearly designed for use in a ritual, quite probably the same one where the horns too were utilised.

In the case of Loughnashade this instrument was used over a long period of time and was much repaired. Some of these repairs are of a quality comparable with the original work on the horns but many are very poorly carried out and of a quality grossly inferior to the general standard of workmanship on the instrument. It is hard to express in this brief chapter just how high the quality of workmanship is on these instruments and what this means in terms of control of the manufacturing processes used in their construction. Indeed, a second stage of investigation to carry out a precise metrological examination, possibly utilising photogrammetric methods might well reveal much more of value about the school of smiths making these items. It may well be in the case of the Irish material, that only a very small number of manufacturing centres ever existed, having developed this technology·over several generations. Such a situation would be vulnerable to social disruption and relatively easily destroyed. Perhaps the successively poorer stages of repair on Loughnashade chronicle the decline of the smith over the period of its use. Perhaps too, Killyfaddy, the wooden instrument, is a further example of this decline in metalsmithing. While maintaining the morphology of the Celtic Curved Horns, this instrument is restricted in its use of metal to bronze strip for wrapping around the tube and pins or nails for holding this in place.

CLAY HORNS

These instruments are known only from Spain, having been excavated in Numancia, which was destroyed by the Romans in 135AD. They are now fragmentary but portions of tubes, mouthpieces and instrument bells have been recovered. In their original form they were probably made up of several yards which were made to fit into each other, yielding a spiral instrument of about 40*mm* cross-section 140-200*mm* diameter and possibly about 0.8*m* long. (Figure 6.14; Plate 6.8 (a))

[230] see O'Kelly, 1961.

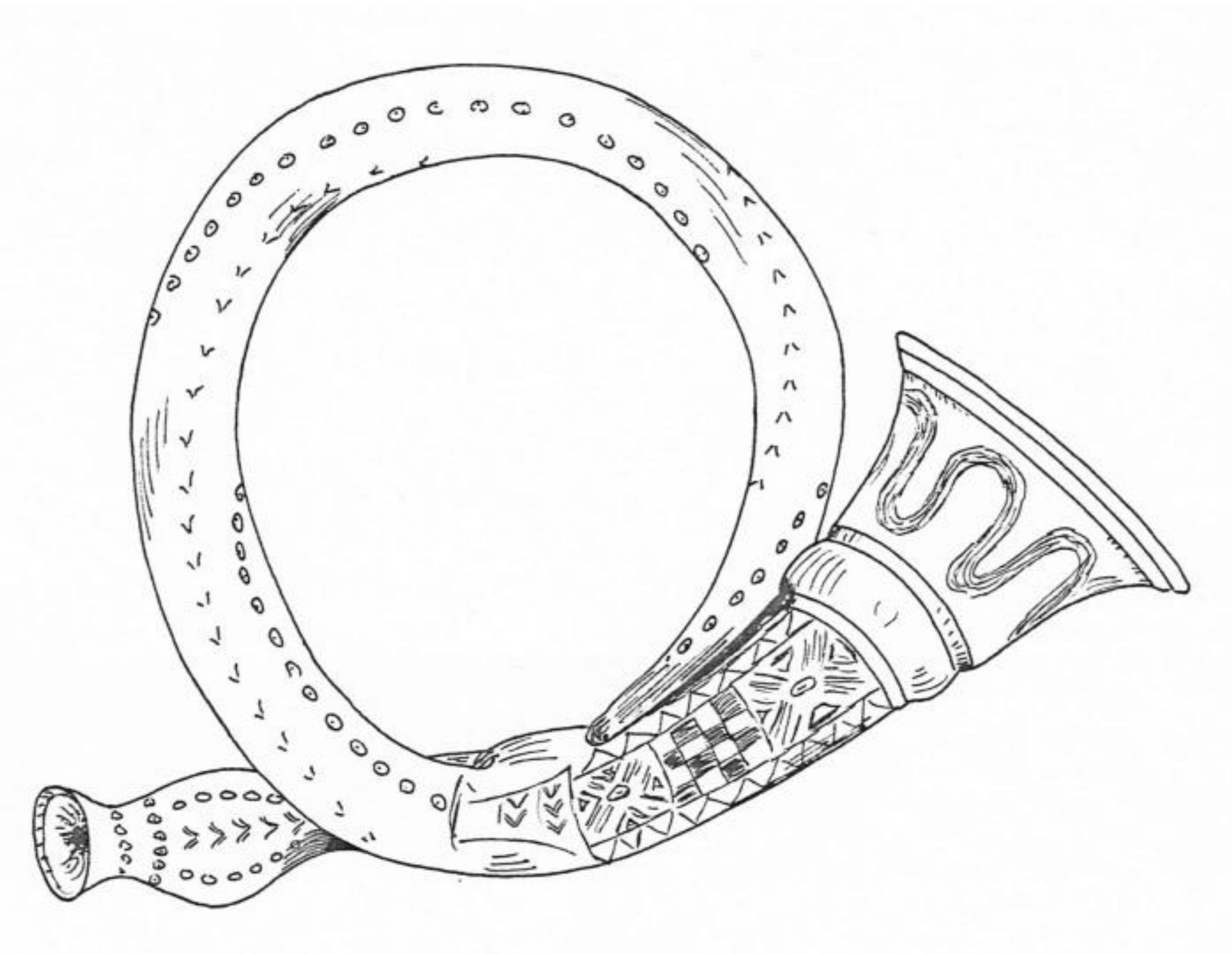


Figure 6.14: An Impression of a Complete Clay Horn from Numancia, Spain

The bell form is conical with a slight flare and on SD266 is richly decorated with geometric shapes and patterns. From the information available nothing can be said about the bore of these instruments but from the illustration of the mouthpiece[231] it seems reasonable to assume that these are conical. The mouthpieces illustrated have a well formed cup and rim with throats of 5*mm* and less.

Plate 6.8: The Mouthpiece of one of the Numancia Clay Horns

It is obvious that the makers of these instruments had mastery over their medium, fired clay, and were, thus able to concentrate on the production of their designs in this.

[231] Comision Ejecutiva, 1912, Lam. (plate) LV.

Numancia itself dates from Neolithic times and the local clay industry may well have developed over a period of several thousand years. While the manufacturing material, clay, no doubt gave rise to problems in the formation of a bore, it did provide opportunities lacking in other media. For instance, in the forming of the mouthpieces seen here, the clay has been carefully worked to provide what appear to be very modern looking mouthpieces with a considerable constriction at the throat. It may well have been the plastic quality of the medium that gave rise to what appears to be the indigenous development of the mouthpiece in this area. Certainly, the horns themselves are unique in the Celtic world, the only other roughly contemporaneous material being reported from Cyprus (SD269), the Fayum (SD209) and the Po Valley (SD259). Whether or not the development of the mouthpiece spread from here to the rest of the Celtic world is hard to say but it may be that the development in this area, being related to clay working did not spread to the artisans working in metal.

Clay instruments do appear in Ethnographic material and, interestingly this is concentrated in South America where instruments very similar in form to the Numancia ones can be seen.[232]

These particular instruments are well made and meticulously decorated in a local style and would, thus, be used for either social or some form of ritual or cult use. Whatever they were designed for, they were effective and, no doubt, eminently playable instruments capable of producing up to about five notes, which if the bore is conical, should be harmonically related.

CELTIC INSTRUMENTAL USAGE

The Celts utilised a wide variety of player-voiced aerophones and each would have had its place in the day-to-day running of their society. This range of instruments, at the same time, expresses both the uniformity and the diversity of the Celtic peoples, in that instruments such as the Carnyx are ubiquitous through most of the Celtic world while other instruments are of very local distribution.

Represented as it is on coins in the hands of horsemen, the Carnyx is, par excellence, the instrument of the cavalry. Its spread throughout and beyond the Celtic world, therefore, symbolises the mobility of the warrior class at this time. Unlike earlier instruments of the north, however, the Carnyx is of wrought construction.

Its source from the Celtic point of view could well be northern Anatolia, one instrument having been found in Paplagonia (SD208) See Map 6.1. However, as well as spreading to the Celtic world, two instruments of this type (admittedly earless!) are clearly depicted on a relief of an "orchestra" playing at Sanchi, central India. (IC27).[233] This would suggest that its origin could be to the east of Anatolia, perhaps having developed there from the lituus and spread both to the east and west. Celts (Galatae) are known from this general

[232] Collaer, 1973.
[233] Dubois 1937, 38; Sachs 1940, 156/7.

area from Greek authors around the 4th century BC and were frequently involved in military actions against the populations of Greece, Rome and Asia Minor.[234] In addition to this:

> *"Celtic mercenaries were frequently found in Hellenistic armies in the third century (BC). It was originally by the invitation of the king of Bythinia that some 20,000 Galatae (Celts) were invited into Asia Minor, about half of them as warriors, and in 270 (BC) were permanently settled in something of a native 'state' in the area still known as Galatia."*

(Quote: Chadwick, 1970, 52).

Thus, a Celtic "nation" occupied this area with its record of instrumental use and connections with the eastern Mediterranean world. They had every opportunity to absorb the instruments of that area and to spread them to the rest of the Celtic world.

If the lituus already existed in an early form in this area, the new "nation" was in a position to take it over and embellish it to suit their own customs. However, this does not explain its passage to the east (IC27, Sanchi) as the Celtic connections were to the north and west and it may be that the lituus developed in Anatolia and thence spread north and east, perhaps during the campaigns of Alexander c. 323BC. During this spread, its conversion to a vertical instrument could well have taken place and, along with this the elaboration of its bell mouth. The subsequent collapse of this Empire and the return of Alexander's men would bring the modified instruments back to Anatolia and leave its form behind in what became the Maurya Empire in India.

A further possibility is that the Carnyx developed in India and was subsequently brought back to the Anatolia area where it was adopted by the Celts. Certainly, the name Karna survives in India for a straight trumpet (Karana in Persian) and is also found in Sanskrit records. If such a name was brought back to the Greek world and suitably hellenised, Karnon would result, i.e. the name that the Greeks did apply to the Celtic instrument. It also seems likely that the Greeks met this instrument ready-developed and with a name as their proclivity for the use of the term "salpinx" for all PVAs that they met, would have given rise to the use of this term all the time had the instrument not already been equipped with a name.

Undoubtedly, about 500BC in Northern ltaly great experimentation in instrument design was taking place. The Etruscans had developed numerous forms of PVAs and further south, a type of side-blown salpinx had been produced. (SR2) (See Chapter 3) It was with this society that the Celts had frequent contacts, albeit not always friendly ones. They could, from these contacts, have adopted a form of sheet-metal lituus which subsequently developed into the carnyx. This instrument could then have spread around the Celtic world and account for the location of SD207 in Dacia. However, Galatia was finally

[234] Chadwick, 1970.

absorbed into the Roman Empire in 25BC, having been isolated from the rest of the Celtic world since about 75BC by the Romans and, prior to that essentially isolated by the Greek and other Empires except for the brief period around 270BC (see above).

Thus the instrument must have been developed prior to 270BC whichever argument one follows, i.e. accepting a southern origin. Its distribution around the Celtic world is little more than one would expect from an instrument carried by a mobile force and universally used as both a standard and a musical instrument.

THE CELTIC TUBA

The development and spread of this instrument is discussed in Chapter 2 along with other forms of the tuba. As discussed there this instrument seems to have come from contacts with the Etruscans.

THE CELTIC LITUUS

With its northern distribution (see Map 6.1) this instrument is clearly a development of a north-west European industry. Its mouthpiece has a typical cup form that seems designed to achieve a particular tone-colour. This contrasts with the Roman and most southern mouthpieces whose cups are relatively simple hemispheres. It seems unnecessary to look further than the North German/Scandinavian experience with mouthpiece design to seek a source for the inspiration in these mouthpieces and the technology of the area was clearly adequate for their production. In the Scandinavian area at this time the technological base of casting practice clearly declined since the heyday of lur production and the only manufactured instrument of this period is SD249. (Stenstugan) This is of wrought construction, on an animal horn base and lacks a developed mouthpiece, having only a mouthsupport. The Celtic lituus, therefore, was probably the heir to the tradition of lur making in this area and, being utilised by a Celtic people spread throughout the Northern Celtic world.

THE CELTIC CURVED HORN

As discussed above, the origins of this instrument seem to be firmly in Ireland, its organological ancestors being the Irish Horns. What may be indicative of coastal trading with the Mediterranean World is the presence of SD223 (Nice) and IC148 (Narbonne) which would also account for SR16 at Pergamon, the sculptor having seen the instrument brought in by this trade.

Within the range of instruments used by the local Celtic "nations" a variety of technological processes are seen. Indeed, particular instrument types are made in different ways, in different areas, presumably each area applying that technology appropriate to its own technological infrastructure. For example, in the case of the Celtic lituus, three examples are cast by use of lost-wax, while two are cast in two-piece moulds. (The remaining two not found). In the case of one of Caprington (SD241), for instance, the technology is applied in a very similar way to that of the Irish horns, which were made only 150*km* away across the Irish sea, admittedly sometime earlier. Thus, the Celts were using a design to which they applied the appropriate manufacturing technology, i.e. an example of design diffusion.

A similar pattern is seen on the Celtic curved horn where the seams on the Irish instruments are riveted in a variety of ways while that from Nice (SD225) appears to have a soldered or brazed seam. Similarly in the case of the Carnyx the tube seems to have been soldered or riveted as suited the particular manufacturer. In addition, in the case of the Carnyx, the bell termination was also modified to suit local demand. This does not mean, however, that any particular area utilised only one form of bell, as can be seen on the coins minted at Verulam. A wide variety of terminations is seen on these coins, all of which circulated in the same area at roughly the same time.

This complex picture points to a complex pattern of usage of instruments in the Celtic world. Only the carnyx has a documented military usage with the other instruments, most probably being used in religious or cult practice.