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The Manufacture of the Decorated Macehead from Knowth, county Meath.

Joseph Fenwick, Member

This paper addresses the processes employed in the manufacture of 'Maesmawr' type maceheads illustrated through the example from Knowth, county Meath. In addition to recognised contemporary technology, the use of specialised stone-working techniques and the existence of simple machines around the period of transition between theLater Neolithic and Early Bronze Age is explored.

The decorated macehead from Knowth, county Meath (Pl. 2a), is an Irish example of a small group of elaborately decorated 'Maesmore' (Maesmawr) maceheads whose distribution is otherwise diffusely scattered throughout Britain (Simpson 1988, 28-29; Roe 1968, 149-151). This example is arguably the most technically accomplished and aesthetically sophisticated object of its type. It appears to have been deliberately buried as part of a dedicatory or votive offering within the eastern tomb chamber of the largest Passage Grave (Site 1) of the Knowth cemetery (Eogan and Richardson 1982, 123-125). Its context underlines the fact that it was an object of considerable prestige with both a material and symbolic value and is likely to have been used during ceremonial activity.

Though commentators have marvelled at the assured competence of stone-working, the technical finesse and the accomplished surface ornamentation of the Maesmawr group, none have attempted to address fully the technology behind their manufacture. A closer look at the Knowth specimen reveals a superbly crafted object which involved the use of a range of sophisticated stone-working techniques. Its surface ornamentation of interlocking diamond-shaped facets and swirling low relief spirals appears technically flawless and challenges explanation with the known repertoire of contemporary technology.

The Knowth specimen, 79mm in length, is made of flint. A riverine or beach cobble could have constituted the raw material. This would have provided an ideal blank for the manufacture of the macehead, being already close to the required finished shape and, having been thoroughly tested by nature, would have been known to be free of flaws (Fenton 1984, 222, 235, 237). Some initial work may have been required to produce a rough-out of its finished shape using a variety of flaking techniques (Oakley 1972, 25-31). This surface could then be reduced and refined still further by the process of systematic and laborious grinding, made even more labour-intensive given that flint is particularly hard. Alternatively the blank may have been reduced to a finished rough-out by a process of grinding alone. This, though relatively slow, would allow the shape of the finished product to be more easily controlled while imposing negligible mechanical stress on the object and avoiding the possibility of introducing stress fractures.

Grinding is most commonly achieved by rubbing the object against an abrasive stone plaque or rubbing stone (Fig.15a). Friable sandstone varieties are an ideal abrasive agent, being
Fig. 15 The suggested sequence of manufacture and the possible methods, tools and machinery involved in the production of the Knowth macehead.
composed essentially of a matrix of hard quartz or silica particles bound in a clay cement (Semenov 1964, 69). These rubbing stones are effectively self-sharpening and require only water to lubricate and wash away the by-products of the grinding process. A rubbing stone employing an abrasive of loose quartz sand with water was found to be more efficient during practical experiments into the manufacture of battle-axes and axe-hammers undertaken by Fenton (1984, 227). Indeed, if a loose quartz abrasive is employed, then the need for a stone plaque becomes redundant. A wooden block in which the quartz grains could become imbedded may have proved to be an even more effective abrasive surface.

The cylindrical perforation of the Knowth macehead, only 17mm in diameter, also demonstrates extraordinary technical skill. The regularity of the cylindrical perforation is best explained as a result of using a ‘bush’ or hollow cylindrical drill-bit fed with carefully graded silica or quartz grains as an abrasive (Semenov 1964, 80). This form of drilling is effectively another more specialised and controlled type of grinding. Experiments undertaken with a wooden drill in which abrasive granules became imbedded proved to be more effective than its equivalent in flint or bone (Evans 1897, 48; Fenton 1984, 227).

There is no example of this form of drilling tool, recognised as such, from a Neolithic context in Ireland. There is, however, indirect evidence of the use of a hollow cylindrical drill, of unknown material, used during the manufacture of an unfinished pestle macehead from Rathlin Island, county Antrim (Simpson 1989, 116). The perforation through the object has not been completed and the central core still remains attached.

The Knowth example may have been drilled from both ends (Pl. 2b). A similar procedure was clearly used to perforate the Urquhart example (Anderson 1909, 382). This procedure was perhaps preferable to drilling straight through from one side and overcoming problems of flaking and predicting exactly where the drill will emerge at the opposite side. Roe has drawn attention to the internal hollowing of the perforation in a number of examples of the Maesmawr group (Roe 1968, 161). This may be a result of misdirection while drilling from both sides which would require further grinding, giving the appearance of hollowing, if the object required hafting.

The regularity and precision of particularly long and relatively narrow perforations, such as that through the Knowth example, could only have been achieved with the slow and extremely steady rotation of a straight-sided drill (Semenov 1964, 80; Fenton 1984, 227). A simple driving device such as a bow or strap could have been used to provide alternating, back and forth, rotation of the drill (Hodges 1970, 40-41). The task of drilling a precise and regular aperture, however, could have been made easier should the drill-bit have been set on a rigid vertical axis, effectively converting a simple hand drill to a mechanical device (fig.15b). This possibility was briefly considered but effectively dismissed in the past (Semenov 1964, 80).

Certainly the Knowth macehead, among others, demonstrates that technology in the form of a rotary drill, capable of cutting precise and uniform apertures through material as hard as flint, existed in the Irish Neolithic (Eogan and Richardson 1982, 131). It takes no enormous leap of faith, therefore, to speculate that a disc with abrasive cutting edge could have been substituted in place of the drill. This simple adaptation of an already existing tool, though a relatively small technical step, may go some way to explain the apparent technological leap required to produce the distinctive surface decoration of the Maesmawr group of maceheads and, in particular, the refined, precise and fluid surface decoration applied to the Knowth example. This adaptation would, in effect, result in a machine very similar to that used to apply the surface decoration to latter-day prestige objects such as Waterford Crystal (Pl. 3).

Glass grinding and engraving is achieved by applying the object to the cutting edge of a continuously (one-way) rotating wheel set on a fixed horizontal axis. The glass cutter, therefore,
Plate 2a The decorated Knowth macehead.
(National Museum of Ireland)

Plate 2b View of the shafthole of the Knowth decorated macehead.
(National Museum of Ireland)
holds the object against the cutting tool and not vice versa. This allows greater precision in the positioning and application of decoration and affords considerable fluidity of movement in its execution. The wheel or 'lap' can vary considerably in size, shape and the material from which it is made (MacLeod n.d., 124). The modern wheels are diamond-tipped but often the grinding medium is simply carefully graded sand and water fed in a fine stream onto the edge of a rotating iron or hardstone wheel from a hopper above. The shape of the cutting edge reflects the type and shape of cut it will make. Flat cuts are made with the flat edge of a carborundum or sandstone wheel, a rounded or convex edge produces a hollow cut and a V-shaped cutting edge produces a mitred incision. Polishing can be achieved with a wooden wheel of willow in combination with a fine putty abrasive of calcined tin. The fine detail of engraving, however, requires the use of a wide selection of small copper discs, often only centimetres in diameter, in combination with a fine emery abrasive suspended in oil (MacLeod n.d., 126).

If one assumes the surface decoration of the Knowth macehead was produced in a similar way to glass-cutting then the need for a rigid horizontal axis to hold the cutting wheel in a fixed position would be essential (Fig. 15c). Continuous and smooth rotation of the cutting wheel or abrasive disc would also be preferable but perhaps not essential. Prior to the introduction of steam-powered machinery the glass-cutter’s wheel was simply turned by hand by an apprentice (Phelps 1981, 68). Continuous rotation in antiquity could also have been achieved in this simple way with the assistance of a second person. A simple circular wooden block attached to the axis acting as a fly-wheel, for which there are some ethnographic parallels, may have provided the necessary momentum, ensuring the smooth and continuous rotation of the abrasive disc (Semenov 1964, 80) (Fig. 15d). Alternatively, perhaps a strap or bow was adapted to drive the disc in a similar way in which pole-lathes achieve circular motion (Ó Ríordáin 1940, 28-31).

A motif common to all Maesmawr maceheads is a sunken diamond-shaped facet or lozenge which bears a remarkable similarity to the most fundamental of all glass-cut types, the 'leaf cut' or simple incision. When grouped together to form an interlocking lattice-like design this incision would acquire a distinct diamond-shaped appearance which is an inevitable result of the facet edge being slightly eroded by its four adjacent cuts. Indeed, the all-over surface decoration of the eponymous Maesmawr example, made of chalcedony, is composed entirely of diamond-shaped facets (Anderson 1909, 378). In this example the concave facets, which have a distinctive ovoid curvature, are clearly sunken (c.1.6mm) below the surrounding border or margin. It is interesting to note that the facets on the Maesmawr group as a whole are all distinctly concave and, in the case of the Knowth example, the centre hollows to almost 2mm below the outside border (Eogan and Richardson 1982, 134) (Pl. 4b). In addition to this, minute striations invariably running parallel to the long axis of the motif bear witness to the fact that these facets were ground and not produced by carving, flaking or pecking techniques. This suggests that they could have been ground by an abrasive disc, with a convex to mildly V-shaped cutting edge, perhaps only several centimetres in diameter. The disc, like the hollow-drill, may have employed fine quartz grains or other form of abrasive agent applied to the cutting edge. Alternatively perhaps a sandstone or even ceramic disc with an appropriate abrasive filler was used.

The flowing curvilinear decoration comprising groups of parallel lines in shallow relief is unique to the Knowth specimen (Pl. 4a). This style is consistent with O’Sullivan’s (1986, 74-75) developed ‘Plastic Style’ though adapted to a portable object. The balanced and considered compositional layout shows a clear sensitivity and understanding of the form and surface configuration of the object. The design, as with lead crystal, would first be carefully drawn on the surface of the stone before any grinding was attempted. The fluidity of the composition is made possible by the freedom of movement allowed to the artist who can manipulate the position of
Plate 3 A glass engraver at work.
(Waterford Crystal Ltd.)
the object with both hands against the cutting edge of the disc. Perhaps a variety of smaller discs similar to that used for glass engraving were used for this purpose (Fig. 15d).

The final polishing of the Knowth macehead to its glass-like sheen could only have been achieved with an extremely fine abrasive. The slightly raised ornament would prohibit the use of a rubbing stone as may have been employed to polish plain undecorated maceheads and battle axes (Fenton 1984, 228-230). Polishing could have been achieved with an abrasive paste applied to the surface with the use of a soft and flexible leather cloth (Fig. 15e). This would enable even the most inaccessible parts of the surface ornamentation to be polished and achieve the lustre which remains to this day.

**COMMENT**

The possibility of a pre-Beaker metal industry associated with Passage Grave or Wedge Tomb builders has been addressed in the past and is an area which has yet to be fully resolved (Case 1966, 141-177; Herity 1974, 127-129; Harbison 1979, 97-107; Sheridan 1983, 11-19). O’Brien (1995, 39) suggests that the potential for innovation, including the adoption of metallurgy, amongst indigenous Late Neolithic societies should not be underestimated, particularly when seen against a background of long-distance exchange of ideas and movement of peoples along the western seaboard of Europe in addition to a tradition of high-quality ceramic technology. At present, however, the evidence from early mining activity at Ross Island, county Kerry, suggests metallurgy was introduced to Ireland around the mid-third millennium BC and is related to the appearance of Beaker pottery.

The use of ‘soft’ metal tools such as copper in the production of some Maesmawr maceheads and related perforated objects is possible as these objects appear to have been in currency during the transition period between the Later Neolithic and Early Bronze Age. Where contexts are known, maceheads are frequently associated with ‘Grooved Ware’ in Britain (Roe 1968, 153-155). Interestingly, in addition to the Passage Grave activity at Knowth there was also considerable evidence of Late Neolithic (‘Grooved Ware’) and Beaker activity. This may suggest a period of cultural overlap while the Passage Graves continued in use (Eogan 1984, 308-313; Eogan and Roche 1994). Perhaps during this period the Knowth specimen was manufactured, with the assistance of copper tools, before ritual deposition in the tomb.

Roe (1968, 171) suggests the more precise and regular cylindrical apertures through stone required the use of a hollow metal drill. A cylindrical drill, made from copper for instance, in which the abrasive agent could become imbedded, may have been a more effective and efficient alternative to their non-metallic counterparts (Evans 1897, 50; Fenton 1984, 227). Experimental drilling of stone beads using a replica copper tubular drill (of a type in use during the Egyptian New Kingdom Period) was successfully demonstrated by Stocks (1989, 526-31). These were driven by bow and mounted on a hand-held wooden shaft. Quartz mixed with muddy water to form a fluid paste proved to be an ideal abrasive medium.

Evidence for the use of a drill and cutting wheel, possibly driven by a bow, required to work hard stones such as chalcedony was first practised in the Classical world some time before the middle of the sixth century BC. These sophisticated methods of engraving stones and gems, quite similar to that of glass engraving, were first introduced to Greece (from Phoenicia via Cyprus) during the Archaic Period (Boardman 1968, 13). The Elder Pliny, writing in the first century AD, comments on the privileged position achieved by engravers of exceptional talent. He states that Alexander the Great, for instance, decreed that Pyrgoteles alone be allowed to engrave gem-stones bearing his portrait (Eichholz 1962, 169).
Plate 4a Detail of the curvilinear ornament of the Knowth decorated macehead.
(National Museum of Ireland)

Plate 4b Detail of the diamond-shaped facets of the broad end of the Knowth decorated macehead.
(National Museum of Ireland)
THE DECORATED MACEHEAD FROM KNOWTH

It is interesting that copper wheels are used to engrave glass today. Copper has ideal properties for this purpose, as again its relative softness enables the abrasive medium to grip to its surface. The use of metal cutting tools (either drills or discs) should not, however, be considered as essential to the production of maceheads and related objects but the use of copper could have made the task considerably easier especially in the case of the more elaborate examples. Continued experimental research in the area, such as that undertaken by Fenton (1984), will be required to address many of these apparently contradictory issues.

We are left to speculate, as there is no direct evidence found to date, of the existence of the simple machinery or the specialised grinding tools described above during the Irish Neolithic or Early Bronze Age. This technology would predate its Classical counterpart by as much as 2000 years. There exists, however, a wealth of indirect evidence in the form of the elaborately decorated stone maceheads to suggest that a complex and sophisticated technology lay behind their production. The deliberate choice of extraordinarily hard and often the most difficult stone to work is a feature of Maesmawr maceheads. Such blanks may have been deliberately selected to challenge the expertise and resourcefulness of the craftperson. Indeed, the prestige and value of the finished object may have been directly related to the time, labour and ingenuity required in its manufacture.

The technology used in the production of these objects is clearly of a highly specialised nature. It is entirely different to that used to fashion the elaborately decorated carved stone balls principally of Scottish provenance (Marshall 1977, 54-55, 61-62). These too are found in Late Neolithic and Early Bronze Age contexts. In this instance, however, the decoration is clearly incised and not ground. In addition, particularly in the case of the more elaborately decorated examples, relatively soft, more easily carved stone was preferable as the raw material.

The very existence of exquisitely decorated and proportioned objects of such early date illustrates that innovation and creativity were cherished by the society that commissioned such work. The Maesmawr group of maceheads, above all the Knowth example, represent a pinnacle of stone-working achievement, a tradition which perhaps continued in the form of the beautifully proportioned stone Battle Axes of the Early Bronze Age (Simpson 1990). Indeed, the brief flourish in stone-working technology, represented in the Maesmawr maceheads, and perhaps the station of its craftperson in society, may have been overshadowed and ultimately superseded by the new-found allure, value and prestige associated with the manufacture and ownership of objects of gold, copper and soon afterwards bronze.

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