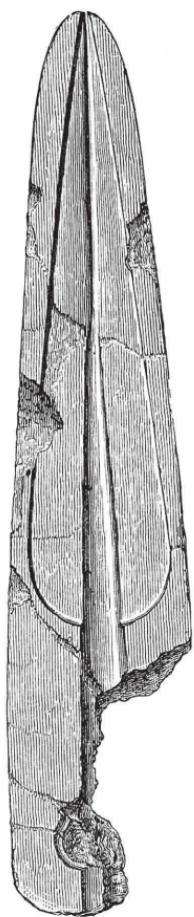
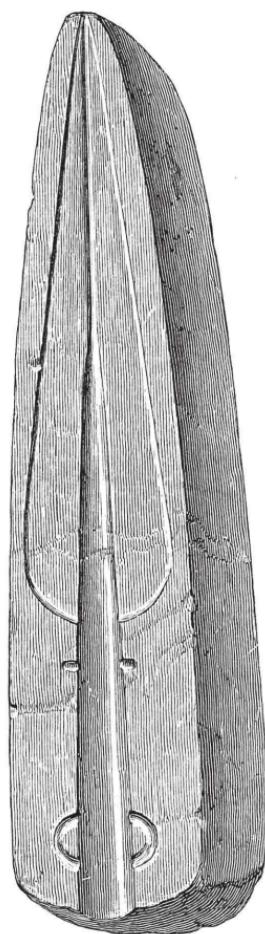


A a



B a

SCALE  $\frac{1}{4}$  SIZE



A b

THE DOUBLE STONE MOULDS  
FOR CASTING SPEAR HEADS AND CORES,  
FROM CROGLIN, CUMBERLAND.

ART. XXIII.—*On the Discovery of Stone Moulds for Spear-heads at Croglin, Cumberland, and on the Process of Casting in Bronze.* By MICHAEL W. TAYLOR, M.D., F.S.A., Scot.

*Communicated at Caldbeck, August 22, 1883.*

THE implements and weapons of the later bronze period exhibit a variety of form, a frequent elegance of design, and an excellence of workmanship, which evince, on the part of the artificers, consummate skill, and a thorough knowledge of the metallurgical qualities of the alloy.

The earliest metal-workers probably availed themselves of the malleable and ductile properties of copper, by massing bits of the native metal, and by beating the lump, they fashioned it into an axe-head, after the type of the flat stone celt of their predecessors of the Neolithic age.

But in time the knowledge came that the admixture with copper of a decimal portion of the softer metal tin readily gave a compound, which, though less malleable, had acquired the desirable recommendations of hardness and capacity of maintaining a durable edge, and, above all, which furnished a material much more fusible and more tractable to the process of casting than pure copper. There is no doubt that the use of the melting-pot, and casting in moulds, became the plan exclusively pursued in dealing with the material in fabricating implements of true bronze. The acquired skill of the workers would enable them to furnish an admixture of the metals in such proportions as would produce an alloy, tough and hard, though not too brittle, and capable of being drawn out to a cutting edge by hammering in the finishing process. Such serviceable bronze would approximate in quality and glitter to the gun-metal used by machinists at the present day, which, when

when burnished, would merit the epithets of red, bright, and gleaming, bestowed by the ancient heroic poets on the furniture of war. “Æratæque micant peltæ, micat æreus ensis.”\*

The production of the manufacture was, doubtless, very considerable; the area of its distribution extended over the country from the rocky islets of the north Hebrides to the southern shores of the channel, and over the whole of Ireland; and the duration of the age of bronze possibly embraced many centuries. Though it is probable that, on account of the value of the metal, old implements as they became worn out and effete would be recast; the same material might have been used over and over again in reproducing newer forms, leading to the greater proportionate survival of the latest types. Nevertheless, the profusion of the relics of bronze, still preserved, bear witness to a copious manufacture. But, though the discovery of the implements themselves is frequent, the discovery of the utensils, tools, and apparatus employed in their fabrication is of comparatively rare occurrence. Hence, any discovery tending to throw light on the details of the craft of the bronze-workers, such as is the subject of the present enquiry, must be deemed important.

The melting-pots and crucibles in use for the molten metal have perished utterly in this country, at least I know of no specimens being extant in the public museums of the capitals; crucibles of burnt clay, however, have been discovered in the lake-dwellings of Switzerland, at †Robenhausen, and in the Ueberlinger See.‡

Some of the methods of casting were probably similar to those followed in brass-founding at the present day; for instance, a pattern or model of the object to be produced, or the weapon itself, might have been pressed into

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\* “Æneid.” vii. 743.

† Keller “Lake-Dwellings,” p. 54.

‡ *Oþ. cit*; p. 118.

damp sand, and for a flat object, such as a simple celt, a single mould giving one-half or two-thirds of the object might suffice. There is no reason to believe that the old metal-workers were unacquainted even with the process of working with double moulds of loose sand in boxes, as is now usually practised. But such moulds, of course, would be sacrificed after the first time of using. There is no evidence that the bronze people ever have had any knowledge of the burning of gypsum or alabaster, or of its properties for forming plaster moulds. Instead, they used a mixture of clay, loam, and sand for obtaining the lateral halves of the pattern, which were afterwards baked. These double moulds constituted part of the stock of a foundry, and were capable of being used over and over again. Moulds in two pieces, made of burnt clay and loam for pal-staves, socketed celts, spear-heads, &c., have been found in the north of France and in the lake-dwellings of Switzerland, particularly on the lake of Bienne.\* None, however, exist in the museums of this country. It has been suggested that moulds might have been made by working the plastic clay and loam on a model consisting of wood or wax, which might afterwards be burnt out, leaving behind the solid casing, with the form of the object in the interior. If such a device were pursued, each mould of course must have been destroyed in getting out the casting. It may, however, be stated broadly that all the moulds in use by the artificers in bronze, which have been preserved to the present day in the United Kingdom, are composed either of stone or of the metal bronze itself. Stone moulds only concern us at present. Dr. Evans, in his valuable work on "Ancient Bronze Implements of Great Britain," has made a thorough investigation of all varieties of stone moulds, and has collated the known examples existing in this country, which I have tabulated as follows:—

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\* "Keller, 7ter Bericht."

Celts	Pal-staves	Socketed Celts	Daggers	Sword Blades	Spear-heads	Rings, &c. Pins	Total
8	7	5	2	2	10	2	36

Mr. MacEniry, Major Curator of the R.I.A. Museum, has kindly transmitted to me a list of nine stone moulds for casting bronze weapons existing in that collection, but of these there are only three intended for spear or arrow-heads. In the Edinburgh Museum there are two stone moulds for casting spear-heads; and in the British Museum there are two stone moulds for bronze swords, found in Devonshire.

I have appended a tabular list, with references, of all the stone moulds for bladed or laminated weapons which are known to exist in this country.

The rarity of the occurrence constitutes one point of interest in the recent discovery in Cumberland of two stone blocks for casting spear-heads; besides which, the moulds themselves are of singular size and elegance, and have been recovered in an almost perfect condition.

The village of Croglin is one of a line of villages which lie at the base of the western slope of the Pennine range; it is one of the fell-side villages of the Eden side. It is situated about 800 feet above the level of the sea, and it stands about fourteen miles to the north-east of Penrith, and five miles to the north of the Stone Circle of "Long Meg and her Daughters" at Little Salkeld. Besides this famous megalithic monument, the country round affords traces of British occupancy, as indicated by the remains of tumuli on Cumrew Fell and Carlattan, and of sepulchral circles on King Harry Common. I may state parenthetically that at this spot we are rather out of the line of march of the Roman roads of the country, and the place is fourteen or fifteen miles distant from the nearest station on the wall of Hadrian, which is Amboglanna or Birdoswald, which lies directly to the north.

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In close proximity to the village of Croglin there is some waste land, near what has always been the public quarry. On the 14th of June, 1883, two workmen were engaged in removing some soil from this waste ground, and at a depth of about three feet they found the two engraved stones which attracted their attention, and which, though broken in several pieces, they very judiciously and carefully removed and recovered.

Not anywhere in the environs of the place where the stones were found were there any evidences of tumuli or cairn-structure, nor were there any fragments of bone, flint, pottery, or metal noticed.

The stones were shortly after placed in my possession. For the sake of distinction I will call them A and B, as indicated in the engraving. The block A was in three pieces, recently fractured, but admitting of ready adaptation, and a perfect restoration was made by dowelling and cementing. The other block B was rather more mutilated, and some fragments were wanting to complete the lower end of it. I have succeeded in restoring it as far as possible.

The stones are composed of a sandstone of the carboniferous series, of an exceedingly fine grain and soft consistency, so as to be capable of being cut or pared with a knife, and of a pale fawn colour. It is a kind of sandstone, which occurs in the strata of the Eden valley.

The two blocks are a pair, in their size, shape, and configuration; they are exact counterparts of each other, so that the description about to be given applies to both.

Each stone is 18-in. in length; breadth  $3\frac{5}{8}$ -in. at base, narrowing to 1-in. at the top; thickness  $2\frac{1}{2}$ -in., and uniform throughout. The stones are of a prismatic form, quadrangular in section, with a narrow lanceolate leaf-shaped outline. The sides are rectangular, flat, smooth, and polished. The narrow end is levelled downwards, so that the inferior face is  $1\frac{1}{2}$ -in. shorter than the upper. That which we call the superior face, as shewn in *A.b* and *B.a*,

is

is that on which has been carved out the mould of the spear-head. The form of the object has been worked out of the material with wonderful smoothness and accuracy, so that, when the two blocks *A.b* and *B.a* are put together, they furnish a double mould, which would give a casting of the implement in solid metal.

The form and dimensions of the weapon are delineated by the drawing of the *intaglio*. The blade is leaf-shaped, 12-in. long, and 3-in. broad at the base, tapering to a point. The socket is 6-in. long, and 1-in. in diameter at the shaft end, and it is continued as a tapering half-round midrib along the blade to the point. There are two semicircular loops attached to the socket 1-in. from the shaft.

This example is one of the very latest types of spear-heads of the bronze age, and belongs to the second variety in the classification adopted by Sir W. Wilde\*—viz., those with loops on each side of the socket, below and on the same plane with the blade. These loops were of course for the passage of a thong for attachment to the haft.

Dr. Evans remarks that there are usually no rivet-holes in the spear-heads of this class,† nor do they appear in any he has chosen for illustration of this variety, except in one from the collection of Canon Greenwell, F.R.S.,‡ found at Knockans, co. Antrim. But I think I shall be able to shew that, in the example before us, arrangements have been made in the mould for providing rivet-holes.

It has been accepted also, as a rule, that the cores of sockets were always made of loam or sand. This, doubtless, is true in regard to the short thick cores of socketed celts and palstaves, as unfinished weapons have been found from time to time with burnt cores still in them;§ but I expect to be able to prove, from these stones, that in these long slender-

\* Catalogue Mus. Roy. Irish Acad.

† Ancient Bronze Implements, p. 321.

‡ Ancient Bronze Implements, p. 331.

§ Ancient Bronze Implements, p. 445.

fashioned spear-heads, *metal* cores were used for coring the socket and long midrib. This custom was probably followed on account of the difficulty in steadyng a long slender core of loam, and possibly from a knowledge that a metal core toughens or hardens, or, as foundry-men say, chills the casting.\*

I conceive the conical-shaped objects, the moulds for which are graven on the reverse faces of the two stones, were for the metal cores. It has been suggested that it may have been for a javelin, or even a ferrule, to tip the lower end of the shaft of a spear or lance. However, a consideration of their details indicate that these moulds were contrived for casting solid pieces of metal for coring the socket and forming the rivet-holes. Each of the two faces presents a half-round hollow, one inch in diameter at the base, tapering to a point 11-in. along the length of the stone, terminating in a fine V-shaped gutter, which was simply the vent for the escape of air. The presence of this vent proves that the mould was for a metal casting, and that it was not a core-box for clay or loam.

In both moulds, one inch from the base, there are two transverse nicks in the stone, half an inch long, which would give two trunnion-like stops in the casting. On the reverse of the stone *B*, there are two similar but smaller notches situated  $5\frac{1}{4}$ -in. distant from the former; these are about a quarter of an inch long and a quarter of an inch in diameter, and conical in form. The result of the casting, after cutting off the jet and runner, would be a solid conical rod 11-in. long, with these two sets of cross-stops upon it, that near the base, shewing a full round; the other a half round. Now, if we examine the obverse of the stone *A*, we shall find notches exactly at corresponding points in the socket, and just of a size to accommodate these nipple-like

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\* Metal or chill cores are constantly used with this object in casting plough shares, the tines of cultivators, &c.

projections.

projections. These, however, do not appear on the same face of the stone *B*. For the sake of testing critically, I took a cast of this conical object in modelling wax, and suspended it within the double mould for the spear-head, with its end stops resting in the mouth of the socket, and it was seen that the second set of stops fitted the notches in the stone *A*, and so supported the rod in its place.

Dr. Evans remarks, "it is difficult to understand the manner in which the cores for forming the sockets of the spear-heads were supported in the moulds. Possibly small pieces of bronze were attached to the clay core, which kept it in position, but which, during the casting process, got burnt into the molten metal. I have, however, found no actual traces of such contrivance."\*

These stones demonstrate the contrivance designed to support a metal core within the mould, and also the method of producing the rivet-holes. Besides this example, I have found two others amongst the stone moulds for spear-heads existing in the country, which present the same arrangement.† These trunnion-like projections, however, within the socket must have been moveable, otherwise it would have been impossible to have withdrawn the core after the metal had cooled. The following, I conceive, must have been the procedure:—The two cross-stops were chiselled off from the metal core and laid in their appropriate notches, after having been rubbed over with black lead, or some simple means to prevent the adhesion of the hot metal. The pointed spiked object would be similarly treated, and then be wedged between the two loose cross-stops, which would steady it in its place, and act as *chaplets*, as they are called in the language of the foundry. The inside of the moulds would then probably be smoked, as is done with plaster moulds at the present day. A little fine damp sand

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\* Ancient Bronze Implements, p. 435.

† One in British Mus. from Lochgur, Co. Limerick, Archæol. Journ., vol. xx., p. 170, and one from Anglesea, Archæol. Journ., vol. iii., p. 257.

would

would be sprinkled between the opposing surfaces of the stones to secure a fine joint ; the two blocks would then be firmly bound together and placed upright in sand ; the molten bronze would then be poured in from the crucible. After the cooling of the casting, the metal core would be easily withdrawn, and the two little wedges punched through the rivet-holes and extracted from the interior of the socket. A moderate amount of heat suffices to the proper temper of bronze for hammering. The semi-circular loops would be slightly flattened, and the edge of the blade would be drawn fine by beating, and finally sharpened on the whetting-stone. The end of the tough ash-shaft would be pared to fit the socket and fill the mid-rib, which was made hollow half-way up the blade, both to lighten the weight of the weapon, and to improve its poise and balance. A peg of horn would be used as a rivet, and a thong of deer hide or split sinew would be passed through the loops and lapped round the haft ; and thus would the weapon be furnished for service in the field.

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## STONE MOULDS OF SPEAR-HEADS AND LAMINATED WEAPONS, FOUND IN GREAT BRITAIN AND IRELAND.

IMPLEMENT.	REMARKS.	REFERENCES.
1 Small leaf-shaped Spear-head with loops ... ... ..	Indented on three faces, 6-in. by 1½-in., Sandstone, Lough Ramer, County Cavan ... ... .. .. .. .. ..	Wilde, Catal. Mus. R.I.A., p. 93.
2 Rapier Blade ... ... ..	Upper and lower Moulds, 1-ft. 8½-in. by 2½-in., Sandstone ... .. .. ..	Mus. R.I.A.
3 Arrow-heads ... ... ..	Soft Chloride Slate, length 2½-in., Dundalk .. .. ..	Mus. R.I.A.
4 Spear-head ... ... ..	Double Stone Mould, Bell Collection .. .. ..	Mus. Soc. Ant. Scot.
5 Spear-head, Socket & Rings... ..	Two pairs of Stone Moulds, 6½-in. by 2-in. and 5-in. by 1½-in., Serpentine, Campbellton, Argyleshire .. .. ..	Proc. Soc. Ant. Scot. vi., p. 48, pl. vi.
6 Dagger Blade ... ... ..	Half Mould, 12-in. by 3-in., mica slate, Broughshane, County Antrim ; on other face mould for flat chisel, 2½ long, rock-side stops .. ..	Fig. 519, Evans.
7 Tanged Blade ... ... ..	Half Mould, midrib along blade, Sandstone, Ballymoney, Co. Antrim .. ..	Fig. 518, Evans.
8 Sword Blade ... ... ..	Two Moulds, 24½-in. by 3-in. and 21½-in. by 3-in., green mica schist, Chudleigh, Devon .. .. .. .. ..	Arch. Journ., vol. ix., p. 185.
9 Spear-head, Loops & Socket... ..	One Mould, 7-in. by 2-in., mica schist, Greenwell Coll., Maghera, County Derry .. .. .. .. ..	Fig. 522, Evans.
10 Spear-head ... ... ..	Half Mould, 7½-in., Greenwell Coll., Armoy, County Antrim .. ..	Evans, p. 435.
11 Spear-head ... ... ..	Half Mould, square sides, North of Ireland, Evans Coll. .. ..	Evans, p. 435.
12 Long Spear-head ... ..	Mould, with pin-holes at base, Claran Bridge, Dunkellin, Co. Galway .. ..	Arch. vol. xv., p. 349, pl. xxxvi.
13 Spear-head, Loops & Socket, and pointed conical object... ..	Half Mould, 6½-in. by 2½-in., 4-sided transverse notches in socket ; same in mould for pointed object (the metal core?), Loch Gur, Limerick, Brit. Mus. .. .. .. .. ..	Arch. Journ., vol. xx., p. 170.
14 Spear-head, looped, of 2 sizes, and a pointed conical object	One Quadrangular Mould on four faces, 9½-in., tapering from 2-in. to 1½-in., spiked object (a core?). Anglesea .. .. .. .. ..	Arch. Journ., vol. iii., p. 257, and vol. vi., p. 385.
15 Spear-head with Socket and Loops, and a pointed conical object... ..	Double Moulds, quadrangular section, with two faces, 18-in. by 3½-in., sandstone ; spiked object a core; Croglin, Cumberland. Dr. M. W. Taylor Coll. .. .. .. .. ..	Cumberland & Westmorland Archaeol. Soc. Transactions vol. 7.