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Pictures by Jerry Mason

Who taught the smiths of Igbo Ukwu?

Casting and smithing in Nigeria reached a standard from the 10th century onwards that has been compared to the art of Benvenuto Cellini. It is a mystery where the West Africans found their materials and learned their skills

Frank Willett

IN 1897 the Royal Navy conducted a punitive expedition against Benin (in what is now Nigeria) and brought back to Britain a large number of bronze castings which were sold to pay for the raid. They had been found in the royal palace, where most had served as altar furnishings. The rectangular plaques, showing battle scenes and officials in court dress, were made to decorate the wooden columns of the palace. They were found by the expedition in a store where they served as a rather cumbersome "card index" of courtly precedents.

The study of these remarkable objects began at once. One of the very first accounts, published in 1897, was an analysis of the metal used. Other important casting centres have since come to light in Nigeria and some hundreds of castings have been analysed. It was hoped originally to discover the source of the metals. This would explain more about the history of local trade and perhaps show how knowledge of bronze-casting reached West Africa. Yet, so many variables are involved that precise sources may never be identified.

The composition of the ores varies substantially at any one site, and the method of preparing the ore affects the amounts of impurities in the metal. Also, metal from various sources may be melted together to make new castings. The composition of any casting is not homogeneous due to variations in the specific gravity and solidifying temperature of different elements, so one sample cannot be representative of the

whole casting. In addition, when a sample is analysed by different techniques the results sometimes show substantial variations, while no technique is more precise than about 5 or 10 per cent of the measurement indicated.

The oldest artistic castings so far known in Nigeria were excavated around the beginning of 1960, on behalf of the Nigerian Department of Antiquities, by Thurstan Shaw at Igbo Ukwu in the south-east. They have been radiocarbon dated to about the 9th or 10th centuries AD and seem to have been intended for use in ceremonies associated with an important priest. Their compositions fall into two major groups: copper, usually with no more than traces of other elements; and alloys, either tin-bronze or leaded tin-bronze.

Shaw observed that the pieces made from copper had been manufactured by smithing techniques alone—by twisting, hammering and chasing the metal. The twisted snakes that acted as ferrules on ceremonial staffs are amongst the less elaborate objects fashioned in this way.

The alloys were cast into complicated forms. The surfaces were usually richly decorated with patterns made from thin threads, spirals and pellets of wax often superimposed by stylised representations of crickets, mantids, spiders, birds, snakes, frogs, snails and scaly anteaters. Some of the castings were intended to be worn as pendants, some were decorations for staffs, while others were vessels. Many had strings of beads attached to their already encrusted surfaces.



The beads probably came from the Islamic world.

The artists had unlimited patience not only in modelling but also in casting, for some pieces were made in stages. There is, for example, a vessel on a stand surrounded by ropework. The body and the upper stand seem to have been made in a single casting. The neck, the lower stand, the loose ornament on the ropework cage and then the ropework, with the exception of the lower loops, were cast separately.

The ropework was passed over the pot from above and bent to fit. Next, the rim was attached to the body of the pot by casting-on more metal. The two parts of the base were joined in the same way, the lower loops of the ropework being added at the same time. These castings-on involved the whole lost-wax process, the missing parts being first modelled in position in wax, the whole enveloped in clay and metal run in to replace the wax. One can only suppose that the smiths at Igbo Ukwu enjoyed demonstrating their virtuosity.

These smiths, towards the end of the first millennium AD, clearly knew how their metals would behave. Molten copper oxidises in air and so does not flow well in enclosed moulds.

Spiral snake smithed from copper to ornament a staff. Igbo Ukwu, 9th/10th century, 16.3 cm



It has to be worked by smithing techniques. The addition of tin and lead makes the metal flow more easily so that an alloy of copper with these elements is more suitable for casting.

Paul Craddock of the British Museum Research Laboratory has pointed out that the silver in metals used at Igbo Ukwu would almost certainly have been recovered by European and Arab smiths of the period, while the unusually low iron content suggests the copper was made by a very primitive technology. It is thus unlikely that the metals used at Igbo Ukwu were prepared north of the Sahara. Indeed there are West African sites, where copper was mined or refined,



Pot (left) made in parts joined (above and below) by casting on extra metal. Igbo Ukwu, 9th/10th century, 32.3 cm, leaded bronze



which date from the first millennium BC and perhaps even the second.

Marandet in Niger, 1200 kilometres due north of Igbo Ukwu, has been dated by radiocarbon to between the 6th and the 10th centuries AD. A range of copper alloys has been found there and evidence suggests that lead was extracted from the copper by causing it to fuse with the silica and alumina in the clay crucible to form a lead-glass. The only castings found were ingots, so this seems to have been a metal refinery.

Ife, a city to the west of the River Niger and, according to Yoruba tradition, the centre where the world was created, was occupied at the time of Igbo Ukwu. Casting was practised here from the 13th to perhaps the mid-16th century AD, though terracotta sculpture was practised earlier. Artistically, the Ife sculptures are remarkable for the portrait-like naturalism with which kings, queens and courtiers are represented. The castings are mainly life-size heads. They are thought to have been attached to wooden figures to carry a dead king's crown in ceremonies expressing the continuity of royal office. There is also a life-size mask of similar appearance, together with some sculptures of royal figures and some staffs with human heads.

Most of these castings are of an alloy of lead zinc-brass which runs well in enclosed moulds. Some parts of the castings are extremely thin. A sculpture representing a king and queen was broken by the builder's labourer who found it, revealing that the metal of the faces was only about a millimetre thick. The Ife smiths were so self-confident that they seem always to have allowed a casting to cool slowly inside the mould, instead of splashing cold water over it so

it could be opened and checked quickly, which is the usual modern African practice. The slow cooling allowed the metal crystals to grow, in this case to the thickness of the face. The sieving of 80 tonnes of earth failed to recover even a scrap of the missing face, which must have shattered into individual crystals.

Surprisingly, some of the Ife castings are of unalloyed copper and they are more successful than similar castings in leaded zinc-brass. The average number of casting faults which had to be repaired is well over twice as high in the alloy heads as in the copper ones.

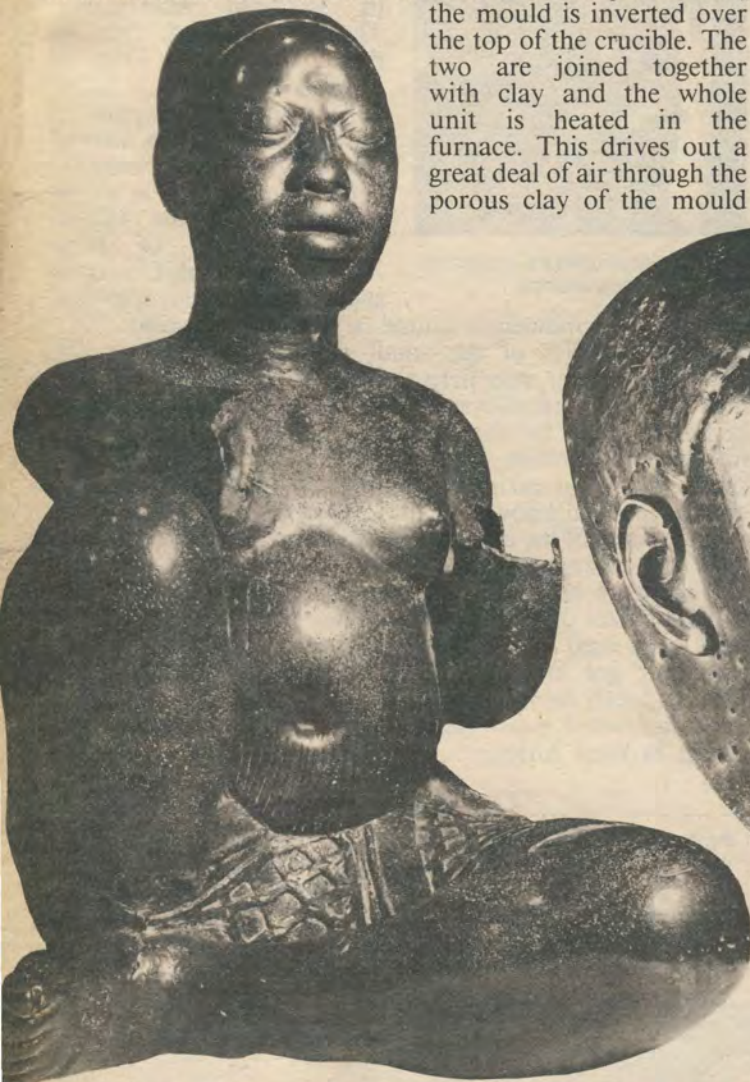
The Ife smiths must have known the only technique by which air can be largely excluded to permit copper to be cast in an enclosed mould. After the wax has been poured out,

the mould is inverted over the top of the crucible. The two are joined together with clay and the whole unit is heated in the furnace. This drives out a great deal of air through the porous clay of the mould

Although the combined crucible technique works well with copper, it was not appropriate for casting the other heads since their alloys are rich in both zinc and lead which are very volatile. Their vapours would not have been able to escape, thus causing holes in the castings. That the metal was poured from separate crucibles is shown very clearly in one of the heads where the mould had to be topped up. The metal cooled slightly before the additional pouring and this left a crack most of the way round the top of the head.

These two techniques of casting are regarded as distinct and having different geographical distributions. They have been labelled the "Egyptian" (joined crucible) and the "Renaissance" or "Cinquecento" (separate crucible) techniques. These names however are misleading for the earliest castings known were made by the "Renaissance" technique. Both methods seem to have been used at Ife, depending on the metal to be cast.

According to traditions in Benin, casting was introduced there from Ife at a date estimated to be towards the end of the 14th century, about a century before the first European contact with Benin was made by sea. Some of the castings, like the head of a Queen Mother, show that the metal



Mask cast (above) in copper by joining mould and crucible. Ife, 12th/15th century, life-size. Figure (left) cast from several crucibles of copper. Tada 13th/14th century, 53.7 cm

producing a partial vacuum which helps to suck the metal quickly into place when the arrangement is inverted.

Max Frölich, a Swiss silver- and goldsmith, studied the technique in Cameroon in 1977. He says that the maximum weight of casting that can be made in this way is about 6 kg. The heaviest copper head from Ife weighs almost 7 kg so the Ife smiths seem to have been working at the limits of this technique. No one knows whether they discovered the technique for themselves, or learnt it from others.

The seated figure found at Tada, on the River Niger 200 km north of Ife, is generally considered one of the master-pieces of Ife sculpture. It too was cast in copper but at 18 kg it was too heavy to cast by inverting a joined mould and crucible. It had to be cast by the unsuitable technique of melting the metal in separate crucibles. As a result it shows evidence of a score of repairs, some of them very extensive. Perhaps copper was the only metal available at the time.



Queen Mother head (top right) cast upside down causing (above) a flaw in the base as the bronze cooled between pourings. Benin, 16th century, 51 cm

was poured in from separate crucibles. The initial pouring had partly cooled before another crucible was added, leaving a crack around the base. The position of the crack shows also that the head was cast upside-down. This seems to have been the usual practice in Benin in contrast to Ife. The tops of the Ife heads, where they would be hidden by the crown, carry the marks of the sprues—the passages in the mould formed from rods of wax, through which the metal runs. The Benin heads are represented with crowns or have the hair modelled and no traces of sprues can be seen on their tops. Sprues can however sometimes be detected at the bottom.

The most accomplished of the Benin castings are the high relief plaques of around the 17th century. These often have projecting parts like spears and swords supported by metal, which has been fed from the rear by fine ducts, hidden when the plaque is seen from the front. A modern founder would probably use a centrifuge for such a complicated casting.

Graham Connah's excavations in 1964, for the Department of Antiquities, revealed that tin-bronze was available in 13th-century Benin where it was cast into ingots in open moulds before being smithed into bracelets. When lost-wax casting came in, tin-bronze was used but it was gradually replaced by zinc-brass. Otto Werner, formerly of the Bundesanstalt für Materialprüfung, Berlin, published analyses in 1970 which showed that in very general terms the amount of zinc in the brass increased with time until it reached a natural maximum of about 28 per cent. He has demonstrated in the laboratory that this is the highest obtainable by heating zinc ore with copper.

Zinc metal needs to be added to the copper to get beyond this barrier. There is no evidence that zinc metal was ever prepared in Africa—it has to be made by condensation since it volatilises before it can be reduced from the ore. The technique was known in Europe in classical times but was forgotten. It had to be rediscovered in the 18th century. Brass made from metallic zinc was patented in England in



Detail of warrior on plaque (left). Metal supports (right) for projecting weapons. Benin, 17th century, 53.5 cm, bronze

1781, so Benin alloys exceeding 30 per cent of zinc must be later than this date.

There is plenty of documentary evidence that brass objects were imported into Benin from Europe by sea and no one doubts that this was the main source of the metal from the 16th century onwards. In earlier periods, some metal was traded across the Sahara Desert. In 1964 at Ma'aden Ijafen, in southern Mauretania, Theodore Monod, then of the Institut Français d'Afrique Novre, found 2085 brass bars abandoned by a camel caravan around the 12th or 13th century. Their composition is so far unmatched in the known casting centres of West Africa, but Paul Craddock suggests that their zinc and

iron contents indicate a source in the Islamic world.

Isotope studies of the small amounts of lead in the unalloyed copper may help to identify the source, but it is only too likely that alloys will contain lead from different ore bodies and thus be unidentifiable. Whether or not we ever find out the precise source of the metals, analyses have shown that these early casters in West Africa had a considerable technical knowledge and expertise.

The source of the expertise is still a matter for speculation. Lost-wax casting was known in the Middle East in antiquity and seems to have diffused from there. Bronze moulds for elaborate axes of the late Bronze Age in Britain could only have been used in the lost-wax process. By what route the technique got into West Africa—or even whether it was independently devised there—cannot be ascertained until we have discovered more sites of the first millennium AD, and earlier in West Africa. □

Professor Frank Willett, formerly government archaeologist in Nigeria, is director of The Hunterian Museum and Art Gallery, Glasgow University. The objects are part of an exhibition "Treasures of Ancient Nigeria", currently in Stockholm. Future venues are: Copenhagen May-July, Hildesheim August-October, Leningrad October-November, Moscow December 1983-January 1984, Sofia February-March, Paris April-July.

Metal cast by lost-wax

LOST-WAX casting is so called because the object to be cast is first modelled in wax (over a clay core if the casting is to be hollow). The wax is enveloped in clay, baked in a fire and poured off. Molten metal is then poured into the space left by the wax. Provision has to be made for the wax to escape and the metal to enter. This is done by applying wax rods at appropriate points which form ducts in the mould when the wax has been melted out. The core is secured in position by metal pins and if possible by joining the core and mould together. The diagram shows how one Ife head was made.

There is a crack around most of the head in what must have been a horizontal line at the time of casting. □

