NOTES ON TRADITIONAL SMELTING IN NORTHERN RHODESIA

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The general practice of smelting came to an end in Northern Rhodesia some forty years ago, and while there was a revival during the Second World War the craft again lapsed when normal importing was resumed.[1] The Rhodes-Livingstone Museum has recently sponsored demonstrations and the following accounts refer to processes observed at those times.

I. LUNGU IRON SMELTING

Introduction

The first smelting took place at Chibote Mission which lies some fifty kilometres north-west of Luwingu in the Northern Province. Damiano Maipembe, the smelter who demonstrated his craft, is about 75 years old. He learned the work from his father, who had learned it from his father. Although living all his life amid the Chishinga people, he still considers himself a Lungu. Until a few years ago there were several other men smelting in the district, as the industry had been restarted during 1940 to offset the reduction in imports because of the war. One by one his companions left to work on the copper-mines, as native smelting provides an inadequate return for the labour involved. Old kilns are to be found a few miles away, much closer to the source of iron ore. This is on a hill, Akamana mpango, named after the stream at its foot. The meaning is 'the stream of the bride price', a reference to the function of many of the hoes made near the spot.

The Kiln

The kiln that was used for the smelting had been erected some three years ago; a new lip had been built and the whole furnace replastered inside and out with ant-hill clay. The type of furnace used may be seen from the illustration (Plate 1B). Its over-all height was 2·3 m.; the internal diameter narrowed from 100 cm. at the base to 45 cm. at the top. The walls were some 16–18 cm. thick.

An interesting point is that different names are given to the holes at the foot of the kiln, into which the ventilating pipes are set. Table I gives details of these names; the relative positions of the holes being shown in figure 1.

Making the charcoal

The charcoal site was at least a mile from the kiln, in land bordering a *mushitu*; three large piles of logs were burnt. The wood used was from selected trees.[2] Half-burned logs from one fire would be added to another, and the charred wood crushed with a long solid rake before being carried in baskets back to the kiln.

Making of Tewels[3]

Earth was taken from small, grey ant-hills and pounded with water in a mortar made from a hollow log. At the same time, in a smaller mortar, the roots of the nTombolyo[4] tree were pounded and worked to a creamy consistency with water. The ant-hill clay was made into balls, which were kept moist under a cover of branches; the maker then took a ball, dipped it in sifted ashes and kneaded it a little with his hand. The ball was flattened slightly on two sides and with the thumb a hole made that was filled with

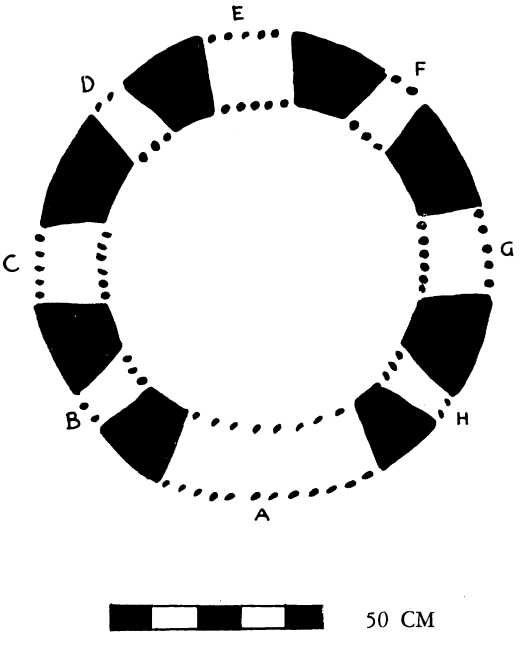

FIG. 1

ashes. Next, a peeled, slightly tapering, stick was inserted through the hole. The further end of this stick was set into a forked branch set in the ground, while the free end rested on a convenient block. The impaled clay was worked with the hands to about a third of its final length and then smeared with root-paste before being smoothed forwards and along the stick, being rotated at the same time. When the tube was of correct length (40–45 cm.) the thick end was cut clean with a bark string tensed by a withy bow, and the cut end carefully plastered with more paste (Plate 1A).

A small sloping screen of grass had been set up, and in front of it a layer of millet chaff was scattered; the clay pipe was turned on to this bed with a twisting and withdrawing movement. After a short time (in this instance in batches of six) the tewels were set up on their wider end against the grass screen. In all, forty-two were made, which were left drying in the sun for some three days, being turned occasionally; the bark paste deepened in colour as it hardened.

Stacking the Kiln

Before the work began an old man led his helpers, children from the Mission School and other onlookers in prayer. The work that followed took four hours, there being one main assistant and many helpers to fetch and carry. The ground inside the kiln was cleaned and hollowed a little before a thick layer of charcoal was spread over it. The operator then entered the kiln and the tewels were set into the openings around the bottom of the kiln, being luted with clay so that only about an inch of the narrow end of each protruded. Next, the lower part of the kiln was completely filled with about forty logs of firewood, the operator remaining inside to do the stacking for as long as possible. The charcoal was then brought in basketloads, poured in and firmly tamped down to an initial level some 60 cm. below the lip of the kiln. Using thick logs (24 cm. long) a hollow chamber was built and charcoal poured around it. At this point a thick lump of ant clay was set against the side above the largest opening, and kept in place with a tensed pole, this was to provide extra strength in case cracks developed during firing. Burning charcoal was then spread over the bottom of the small chamber and the crushed iron ore hastily packed in. The pile of ore surrounded by charcoal finally reached 30 cm. above the top of the kiln, and was surrounded by further small logs and charcoal. The smelter was the last worker to leave, saying a prayer as he did so.

The kiln burnt well; a few cracks appeared but were patched with wet clay. The outer surface was hardly warm, but the light from the molten mass within glowed through the tewels (Plate I B), and a constant sizzling noise accompanied the soft roar of the furnace as it burnt through the day, the night and into the following day.

When some 26 hours had passed, a hole was made at ground level in the mud wall of the front and largest hole; molten slag poured out of this, the iron itself remaining inside the hollow at the bottom of the kiln.[5] After a further 18 hours the kiln had cooled, and the block of iron could be removed. The refining process was not observed, but it is said to take place in a small open furnace. A ceremonial hoe, prepared from some of the resulting iron, is shown in figure 2.

Discussion

Apart from the description of smelting methods used by the Kaonde, which follows this account, there exist records of the processes used by the Aushi to the south-west of the area now being described,[6] the Fipa of Tanganyika, who are adjacent to the Lungu,[7] and the Bemba, who occupy much of the country's Northern Province.[8] The most noticeable difference between these methods and that of the Lungu is the amount of ritual and medicine employed, but as the demonstration was taking place at a mission, prayers were substituted. As will be seen the Kaonde kiln had to face east; among the Fipa, the reverse was the case and the furnace faced west. As far as the Lungu are concerned the eastern position was certainly chosen in the demonstration described, but I am not sure that the same applies to other ruined kilns seen around the country.

Another major difference is in the way in which the kiln is filled. In both the Bemba and Fipa methods,

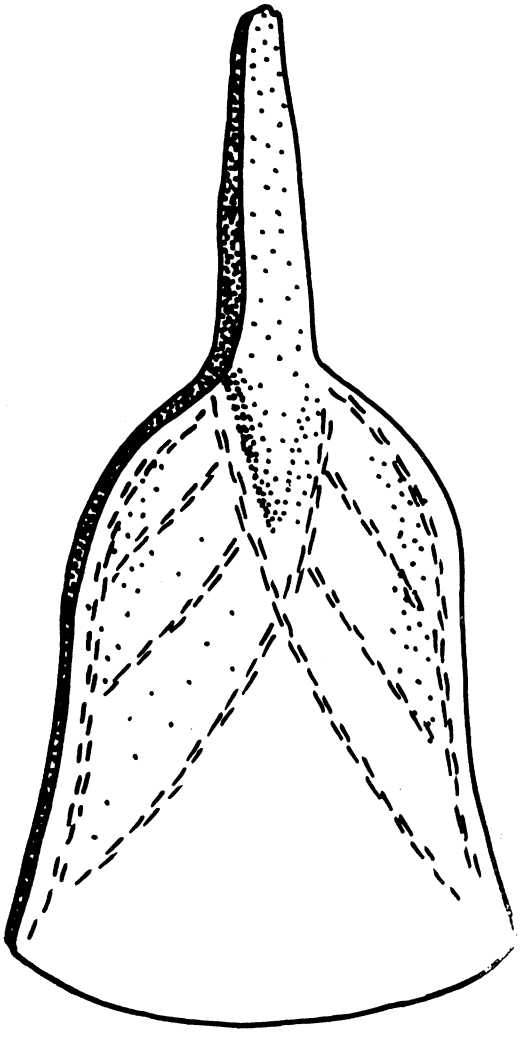

FIG. 2

alternate layers of charcoal and iron ore are packed in, though in the former these layers are not continued to the top of the kiln, but only a little over half-way, then logs of firewood are put in place. The Aushi follow the Lungu in having only a small nest of ore at the top of the kiln.

TABLE I

Notes on Ventilating Holes

Hole	Width (at base)	Height (to top of arch)	Number of Tewels	Name	Translation
A	55 cm.	51 cm.	12	*Chabwilo*	Place from which liquids are removed. (*-kwabula:* to take something out of water, or fire.)
B	10	15	3	*Kambo*	It is possible that this is a corruption of *Kambone:* a witness, if not, then no translation can be given.
C	18	20	5	*Chimbusa*	Midwife (*Nachimbusa*).
D	10	15	3	*Mukowanganga*	-In-Law of the Doctor (*Muko:* any in-law, *Wanganga:* doctor). This seems the most probable meaning but *Mukowa nganga* could mean, 'the clan of the guinea fowl'.
E	25·5	23	6	*Ning'anga*	Doctor.
F	10	13	3	*Mukowanganga*	As above.
G	18	20	5	*Chimbusa*	As above.
H	10	15	3	*Kambo*	As above.

The process of making the tewels is closely similar in all these methods. In Ufipa the front hole of the furnace is called *Mama ilungu* (the wife of the kiln); the Aushi call the main entrance, *chabwilo*; the back one, *nana*; the smaller openings around the sides, *kamba*: words closely similar to those given in Table I. The Bemba furnace appears to differ from the others; the tewels are set individually into the walls, while around the top is a series of openings *intolokoso*) to assist the draught.

Taken all in all, none of these differences appear to be more than a local variation of a uniform process, where perhaps individuals have taken, here a little, there a little, from other smelters. The real difference lies in the use of natural, as opposed to forced, draught, which is found further to the west. The large furnace with its greater production for much less labour would seem to be geared to a wide export trade, while the smaller furnaces probably served a more local market.

Vocabulary

Bwiko The small log chamber containing the iron ore.
Chala Shelf around the lip of the furnace.
Fing'andu Logs of firewood heaped on end.
Fumbwe Ashes used during the making of tewels.
Inkwanda Solid-ended rake for breaking charcoal.
Kantelentenshya A thin piece of bark string tensed by a withy loop and used to cut the ends of clay tubes.
Kashama Small droplets of iron found amidst the ashes of the kiln and used as gun-shot.
Lubwe Iron ore (modern Bemba word).
Lukoba Hook-ended stick for pulling charred logs.
Mafito Charcoal (old Bemba word).
Makaka Small logs used to build up chamber in which the ore is set.
Malasha Charcoal (modern Bemba word).
Mambala Slag.
Misungu Millet chaff.
Mucelo Smelting kiln.
Mushitu A dense thicket of trees and undergrowth bordering a stream.
Mutanda. Mass of iron and slag at the bottom of a kiln when smelting is complete.
Mutoto Ant-hill block bound to front of kiln to hold back pressure, (Lit.: umbilicus).
Ncelo Tewels.
Shishili Partly burnt logs.
Umutapo Iron ore (old Chishinga word).

NOTES AND REFERENCES

[1] Brelsford, W. V. Man, 1949, Art. 27. In his paper only the rituals were described, the author feeling the methods to be too well known to justify description. However the intervening decade has seen such a great loss of skills as to warrant a full record being made.

[2] Kyimbi *Erythrophleum africanum.*
Ndale *Swartzia madagascarienses.*
Kapanga *Burbea africana.*
Cibobo *Terminalia trichopoda.*
Mufinsa *Syzygium huillense.*
Only this wood has to be dried before burning.

[3] I have taken this opportunity to restore an English word that has fallen into disuse, but which provides a useful distinction in meaning. Strictly speaking the word *tuyere*, commonly used for these tubes, should

only refer to a pipe through which air is *forced* by bellows into a furnace. A *tewel* is an air-vent or pipe and as such applicable to the present type of furnace where no bellows are used. (See Webster's *New International Dictionary*.)

[4] NTOMBOLYO *Ficus* sp.

[5] I am grateful to the Geological Survey Department, Lusaka, for an analysis by Mr. W. G. Hesom (No. 1397) of the ore and slag from both this site and the Solwezi smelting to be described.

	si02 %	Fe^2O^3 %	Fe %	CaO+MgO %
Chibote Ore	0·6	96·2	67·3	—
Chibote Slag	28·5	70·3	49·2	1·1
Solwezi Ore	0·4	96·5	67·5	—
Solwezi Slag	15·2	86·3	60·3	0·4

It would seem from this that the Chibote smelting was more efficient than that at Solwezi.

[6] Barnes, H. B. Iron smelting among the Ba-ushi. *J.R.A.I.*, LVI, 1926, pp. 189–94.

[7] Wise, R. Iron smelting in Ufipa, Tanganyika. *Notes Records*, No. 50, June, 1958, pp. 106–11.

[8] Kasonde, E. Imilimo ya Bena-kale. London. 1952, pp. 18–20.

II. KAONDE COPPER SMELTING

Introduction

Solwezi lies to the west of the main Copper Belt of Northern Rhodesia. Some 16 km. away is Kansanshi, a mine operated by the Bantu inhabitants long before European occupation and only recently closed down as a modern mining concern. It was from Kansanshi that the ore used in this smelting was obtained. Small pieces of weathered rock rich in malachite were hoed from the outcrops and on being brought to the smelting site were carefully broken down so as to remove as much rock as possible, leaving the green carbonate in pieces approximately a cubic centimetre in size.

The Kaonde tribe of the area have a tradition of copper smelting which appears to have died out around 1914. It was fortunately possible to find a group of old men who had taken part in smelting with their fathers and so could demonstrate the traditional methods of copper production. All but one were over 70 years old and their conservatism was illustrated in their persistent wearing of an ankle-length dark blue waist-cloth, rather than the more general shorts or trousers. Three were of the lion totem, one of the goat and one of the ant. This disparity may have been the reason for various differences of opinion as to small details of method, but the general principles were well remembered.

Preparing the kiln

A convenient area was cleared close to a large ant-hill, and a hole was dug some 20 cm. wide and 5 cm. deep. This was thickly spread with ashes. The top 15 cm. of a small ant-hill had a hole pierced through it by careful gouging with a spear, to form a tuyere. This was set on its side pointing slightly downwards, being kept in place by clay. Other small ant-hills had been cut in half and these were set round the excavated hole to form a wall in which any gaps were filled with puddled clay. The resulting furnace was some 40 cm. high with approximately the same diameter (Plate II B).

The bellows (described more fully in the section on iron-smelting that follows) were kept anchored either by the loops at the end being stepped on, or by inserting the toes into them. The nozzles were inserted right into the vent-pipe and kept in position by having small stakes pushed firmly into the ground on either side, which were then bound together with bark rope. For further security a heavy stone was set on top of the nozzles.

Firing the Kiln

A layer of ashes filled the hollow at the bottom of the kiln and charcoal was added until it was above the opening of the tuyere. Fire-brands were added and the bellows were worked. When the charcoals began to glow a few handfuls of the ore were placed on to them on the side of the furnace directly above the vent, and further charcoal added to cover it. The appearance of a green-blue flame was said to indicate that the copper had been smelted. In this instance after three hours there was a careful turning-over of fragments of copper amid the charcoal, and a stick, inserted into the ventilating hole, came out with a globule of molten copper at its end. The kiln was then broken down with a long pole and the charcoal scattered. A glowing pool of liquid copper was seen just below the vent. This rapidly ran into streams and solidified, in some cases enclosing slag and charcoal.

Refining the Copper

A similar kiln was prepared, except that a clay pot almost filled with ashes was fixed into place in the hole in the ground, and the tuyere was directed at the top of this. It seemed very important to keep this ash layer clean as at one time leaves were laid over it to prevent dirt from entering. The furnace was heated as before and the crude copper placed carefully in the centre of the glowing pile, this time no charcoal being set on top of it. After two hours (or less on a second attempt) the kiln was swiftly broken down. The pot had a pool of molten copper on the ash layer, but as the sides of the pot glowed red, efforts to tip the metal into a mould (cut in the side of a small detached ant-hill) were unsuccessful. The metal cooled too quickly and nothing the men had at hand would give protection from the heat. Eventually thick cloths were brought and on a further attempt a little of the metal was poured. It seems not unlikely that in earlier times a pair of tongs would be used. The

final product would be stored and traded either in ingots or the well-known cross shapes.

Ritual seemed much less important in connexion with copper than with iron. No medicines were used, and orientation of the kiln was not significant. The only prohibition was for ritually 'impure' people to refrain from touching the ore, or crude copper.

Discussion

Reading through the summaries of copper smelting methods in other parts of southern Africa[1] one is struck by their difference from the method just described. The Yeke of the Katanga piled 50 kg. of malachite (broken to the size of a small hen's egg), on to a furnace 75 cm. high and 40 cm. wide already filled with charcoal. After two and a half hours, roasting by natural draught, bellows were used to complete the reduction in a further half an hour to give some 12 to 15 kg. of copper, the furnace being broken down to obtain it. The Sanga (neighbours of common stock with the Kaonde) had a permanent furnace more than twice as high, worked by four pairs of bellows. The Luba, from further south also employed a permanent kiln with channels leading to cross-shaped moulds.

The other area of southern Africa where copper was smelted lies south of the Limpopo River in Venda country.[2] It is said of these people that they appeared from the east and consisted of only two inter-related clans, their totems being the lion and the hearth-stone. They were distinguished from their neighbours by being uncircumcised and wearing a black cloth around their hips rather than the loin-skin passed between the legs as was Sotho custom. It may be noted in passing that the Kaonde smelters differed from the near-by Lunda in both these ways. The method employed by these Messina smelters, who used both carbonates and sulphides, was to break down the ore, winnow out the rock dust, and then heat the remainder in crucibles.

By contrast, the Kaonde smelting seems the simplest method of all; although Melland[3] reports that a limestone flux was used, this was not the case in the recent demonstration. For the initial smelting, the copper furnace was identical with that used for refining iron, and it may well be that the use of this smaller, labour-saving kiln has replaced an earlier method, though if this is the case, the old men we spoke to knew nothing of it.

Vocabulary

-bumbwa	To model with clay.
Jibwe ja mukuba	Copper ore (lit.: stone of copper).
Jikokwa	Small ant hill.
Kafulo	A bar-shaped copper ingot.
Kampote	Small kiln used for copper smelting and the refining of iron.
Kimbo	Any hole, in this instance applied to a trench mined for ore.
Kyela	Any metal, either copper or iron.
Kyusu	Nozzles of bellows; usually made from bamboo.
Mfubya	Copper ore (related to its colour).
Mukuba	Copper.
Mulobwe	Puddled clay.
Mwaba	A mould for casting metal.
Mwambo	A cross-shaped copper ingot.
Myuba	Bellows.
-pañanya	To break down a kiln.
-poya	To mine (lit.: to dig a hole).
-sanda	To break down a kiln.
-tobwela	To puddle clay.
-vukuta	To pump with bellows.

REFERENCES

[1] Cline, W. Mining and Metallurgy in Negro Africa. Menasha Wisconsin, 1937, pp. 67–73. See also: Clark, J. D. Pre-European Copper Working in South Central Africa, Roan Antelope, May 1957.

[2] Van Warmelo, N. J. (editor). *The Copper Miners of Messina . . . Pretoria.* 1940, pp. 81–2.

[3] Melland, F. H. *In Witchbound Africa.* London. 1923. p. 159.

III. KAONDE IRON SMELTING

Preparing the kiln

A site was chosen by the side of an ant-hill which was then cleared of undergrowth and a hole dug back into the side facing east (this orientation was deliberate). A trench was cut from this to the lower level of the cleared ground. Four medicine pegs[1] were placed at the back edge of the hole and then a ring of thin sticks set to surround the hole with two rather stronger stakes inserted into the bottom of the trench in front. Some metres to one side of the excavation, earth was dug up and trampled to a puddled clay, which was then slapped into position around the framework. At 25 cm. intervals creepers of *mudundu*,[2] which had been softened in hot water, were looped around the twigs to give support.

When the wall stood some 60 cm. above the ground, two logs were set on either side of the front opening to support the weight of clay. The building continued until the kiln rose to a total height of 1·20 m. becoming generally oval in form. Inside, the walls sloped from a wide mouth to a narrow hole, which in turn gave way to the larger cavity beneath. The inner slope of the western part of the upper chamber was much steeper than that of the front. A hole was pierced through the back of the kiln at ground level, entering just below the constriction between the upper and lower chambers. The clay was then smoothed by hand. The four logs were also covered with clay and where they met the ground the clay was shaped to resemble feet; at the same time a narrow curb of clay was built around the base and the two stakes across the trench were plastered.

Allowing for a false start when the walls sagged very badly, this activity took about seven hours. The shape of the completed kiln can be seen in Plate II A.

Firing the kiln

Before the kiln was filled certain leaves[3] were burnt in the lower chamber. Charcoal[4] was then burnt and while still glowing was shovelled, by means of a bark tray, into the mouth of the kiln until it reached the constriction. Previously prepared charcoal was then added and at the same time the iron ore (broken to walnut-sized pieces) was carefully placed into the furnace so that it filled the front quarter of the top opening, lying against the steeper slope down which it was supposed to slip gradually as smelting progressed.

The bag-bellows were prepared from the leg skin of a situtunga,[5] the hair being left inside; when not in use they were stuffed with straw. Nozzles came from a variety of materials: metal, bamboo or bark from certain trees[6] were used to make pipes that were bound into the narrow end of the bag. They lay on a bed of straw and each was tethered to a peg on its outer side. The nozzles were kept in place by a lump of clay and were directed at the hole at the back of the furnace, but they did not project into it, there being a gap of about 5 cm. Each side of the open end of the bellows had a loop under which the thumb or the fingers were inserted; alternately the wide mouth was allowed to open and was then snapped shut and pressed down to expel the contained air. A fairly constant pace was maintained but this was sometimes interrupted by a more vigorous and complex rhythm reminiscent of drum-beats, usually at times when the operator had burst into song.[7]

Each of the men would have a spell of about twenty minutes at the bellows. For the rest of the time attention was paid to the beer provided. Charcoal and ore would be added and admonitions shouted to keep away any 'unclean' people. Continence was demanded of all who even looked at the operations at close hand, and most men and youths were considered potentially dangerous to the success of the smelting. No women were allowed to approach at all. When the site began to be crowded with onlookers, certain plants[8] were brought to offset the influence of the impure, but not before certain failures had occurred that were attributed to this cause.

Before any beer was drunk from a new gourd a little was poured over the front lip of the furnace, then into each of the foot-like projections (in an anti-clockwise direction beginning at the east) and finally over the back lip. This was in honour of the ancestral spirits that they might bless the work of the smelters.

After seven hours the result was investigated, the two bars at the main opening were broken down with a long pole employed as a poker, and the charcoal, mingled with the slag, raked into the trench. The contents of the upper chamber were prevented from falling through by the insertion of a small ant-hill into the hole between the two chambers. Amid the embers was a glowing mass of iron and slag that was worked into the trench. Sufficient iron for a hoe had been obtained.

Refining the Iron

A small kiln was built of ant-hills and clay in the same way as that used to smelt copper. The mass of iron and slag from the preliminary smelting had been broken into small pieces and these were slowly added to the charcoal as it heated. After some four hours, the kiln was broken down and a secondary lump of iron was seen which was considered suitable for the making of tools.

Discussion

The Solwezi district, from which the smelters come, lies close to the northern limit of the Kaonde people, while at no considerable distance to the west are to be found the southern Lunda. Melland,[9] in his reference to Kaonde smelting, describes the kilns as cone-shaped and contrasts them with the Lunda types which are 'of fantastic shapes generally representing the human figure, with certain members thereof unnecessarily enlarged'. As will have been noted, the kiln described above has certain human features, viz. arms, legs, a throat, but there was no attempt to represent genitalia. The taller cone-shaped furnace was known to the old men and they said that a battery of three or more pairs of bellows would be used with it, but they claimed that the type built for us was the more common. They were emphatic that the bag-bellows were the only ones used, though they knew of drum-bellows as a Lunda custom.[10] In this connexion it may be worth mentioning the remains of a small kiln found beyond Mwinilunga (some 260 km. north-west of Solwezi). According to the son of its builder, this, when new, was about a metre high and was worked by drum-bellows.

While it is clear from the above that the Kaonde knew of other smelting methods similar to their own, it is also true that they appear to have no knowledge of a smelting method not using bellows; my description of the Lungu smelting (dealt with in the first section of this paper) was received with interest. The Aushi, who are of the same stock as the Kaonde, used the natural draught method in their tall kilns, and it would seem that they were prepared to give up their traditional ways when they saw the superior method of the north-eastern tribes.

The sole reason for the ending of the craft of smelting was the cheapness of the industrially produced hoe and other tools. It is true that one encounters all over the country a belief that, 'many years ago the Government stopped us to make hoes', but, even though I have heard this same tale from missionaries long resident in their areas, it has no backing in fact.[11] Some idea of the value of a hoe may be gained from the fact that ten were needed for a female slave, seven for a male.

An interesting point is the value of a hammer. One hammer with two hoes could purchase a female slave; the reason given for this high value (quite out of proportion to the amounts of metal involved) was that with a hammer one could make many other

things, so its potential was taken into account. A possible underlying factor may be that. when the Supreme Being (Lesa) showed the Kaonde how to make iron, He used a stone hammer, but as soon as the first hoe and the first axe were completed a second smelting resulted in the first iron hammer.[12] This hammer is conical in shape and the type has a long history as an identical one may be seen in illustrations of smithing in Angola and the Congo three hundred years ago.[13]

In an account intended for archaeologists one other aspect of this industry may be worth mentioning. As far as I am aware there is no depiction of any smelting process in southern African rock-art. Despite the fact that the domestic and other scenes from which we draw our knowledge of the life of the artists date predominantly from the Late Stone Age this did not prevent these people from showing us aspects of the life of other groups with whom they were in contact. Metal weapons are shown in the rock-paintings[14] (and there are engravings of metal axes near Lusaka, N.R.), which suggests contact with the metal workers. Did these latter keep their metallurgical skills hidden from the artists, or did the artists, while knowing the secrets, decline to show them in their art for some magical reason? As the most intimate and mystical events have been portrayed, it seems that secrecy on the part of the smelters is the more likely explanation.

Vocabulary

(Several words given in Part II also apply to the iron smelting.)

Jibalula Lunda word for iron.
Kapasa Axe.
Kamina ñandu Hole between top and bottom chambers. (Lit.: 'crocodiles' gullet', but only used in connexion with the kiln and the valve in certain types of fishing-nets—*Muvuba.*)
Kapotwe Iron.
Kibelo Opening at front of the kiln (lit.: doorway).
Kimbo Bottom chamber (lit.: main hole).
Kintengwa The tall type of kiln with up to four pairs of bellows; it was sometimes also used for copper.
Kyula Any piece of utilized bark, in this instance that used as a tray.
Kyulu Large ant-hill.
Lubwe Iron-ore.
Lukasu Hoe.
Lupopo A marking peg; in this instance a medicinal one.
Luputa *Psychotria* spp. A pliant twig of this plant was worn around the waist of one of the smelters, to give him strength and offset 'the power of the kiln'.
Lutengo Lunda word for *Kintengwa.*
Maboko Upper form of supports (lit.: arms).
Maulu Lower form of supports (lit.: legs).
Mokolo Stick used as poker and rake.
Mukachi Top chamber of kiln (lit.: inside).
Musense Conical shaped hammer.
Nkela Air vent in the side of the kiln, sometimes made from *jikokwa* (the small ant-hill).
Nyanshima Slag.

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NOTES AND REFERENCES

[1] Made from MUPUNDU *Parinari curatellifolia* and MUKOSO *Erythrophleum africanum* trees.
[2] MUDUNDU is a wild rubber *Landolphia buchananii.*
[3] The leaves were taken from: MUKOSO (see above).
MULUNDU (?)
KANKONA *Ziziphus* sp.
[4] Prepared only from MUKOSO (see above).
[5] The SITATUNGA is *Limnostragus* sp.
[6] The following trees are used for bark objects:
MUBOMBO *Brachystegia boehmii.*
MUSAMBA ,, *longifolia.*
MANGA ,, *spiciformis.*
[7] A selection of the songs is as follows:
Luomba o yoyo luomba tenga pañoma bwakya
Drummer o yoyo drummer get on the drum it's now morning.
Naji kuya nakwenda mama ndubulayi naiya naiya
I went hunting mother welcome me back I have come I have come
Baleke balale tukebasa lukelo banyama
Let them sleep we shall shoot them in the early morning animals

Obewa waluba kunukuta yaya wo ukavukuta na mukazhobe
You who do not know how to pump, brother you will pump with your wife
Obe wajanga lukelo, obe wajanga lukelo, kita mpitampi ku myevu iya unkwachile myuba
You who always eat in the morning; you who always eat in the morning; you who get food around your whiskers come and get on our bellows.

[8] The flowers of the following shrubs are laid close to the furnace:

MUFUTU *Vitex* sp.
KANKONA See above.
KINTEU (?)

[9] Melland, F. H. *In Witchbound Africa.* London, 1923, p. 138.

[10] An illustration of a Lunda kiln from Angola, is given by J. Redinha, in *Campanha Etnografica ao Tchiboco.* Lisbon, 1953, figs. 70 and 73. In this, two pairs of drum-bellows lead into the tuyere; the front rim protrudes so far as to need buttressing with logs (though these are not covered with clay); breasts and a protruding navel are shown; a bark tray is used for the charcoal.

[11] I am indebted to Mr. G. C. R. Clay for the suggestion that it was not so much a ban on smelting, but a ban on the custom of preparing the bellows from the skin of a goat that had been flayed alive. If the suppression of this cruelty led to a cessation in the making of bellows, it would certainly account for an ending of smelting. But, unless the smiths' bellows were similarly made, it would not account for cessation of smelting in those areas where bellows were not used with the furnaces.

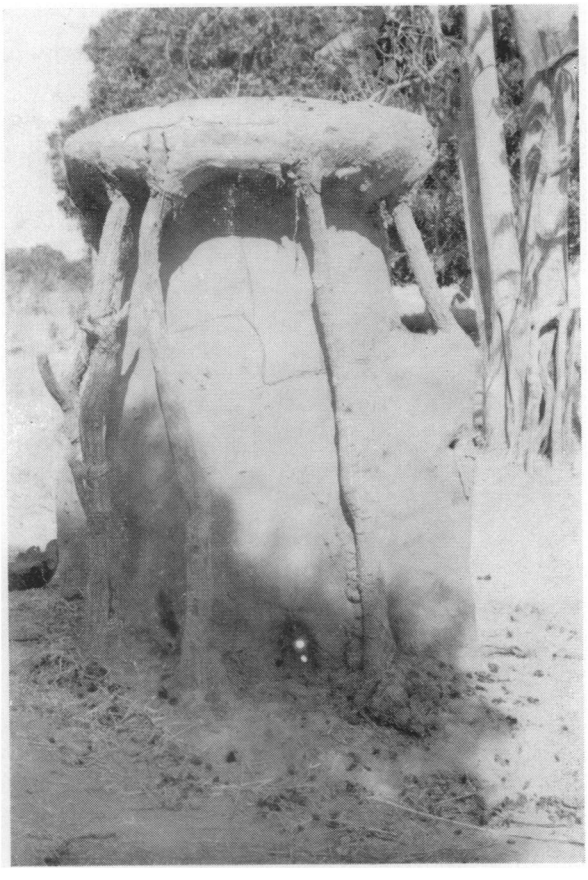
[12] Melland. Op. cit., p. 159.

[13] Cavazzi, P. G. A., *Istoria descrizione de' tre regni Congo Matamba, e Angola* . . . Munich 1694. The plate opposite p. 198 in this German edition shows such conical hammers.

[14] Cooke, C. K., *Occ. Paper, Nat. Museum of S.R.*, 3, No. 22A, pp. 120–140. A study of weapons in rock-art.

1

PLATE I



↑

A. Making tewels.

← B. Lungu iron-smelting furnace in operation.

PLATE II

A

B

Kaonde iron- (A) and copper- (B) smelting furnaces.