Chapter 19
Cairo to Cape: The Spread of Metallurgy through Eastern and Southern Africa

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Introduction

This review is structured differently from the other contributions to this volume. My assigned task is to review the evidence for the social contexts of the earliest metallurgy in the eastern half of the African continent. This presents two practical problems. The first of these is that the target (the earliest metallurgy) keeps moving through time and space. The earliest metallurgy in Egypt dates to the fifth millennium cal BCE; in the Great Lakes region of Central Africa it dates somewhere in the first millennium cal BCE, while at the southernmost terminus before European colonization—at the Great Fish River in the Eastern Cape province of South Africa—metals were not used before about 300 cal CE. My review of the earliest metallurgy must therefore span a linear distance of some 11,000 km and nearly five millennia. I have chosen to expand it to six millennia so that I can discuss the first use of gold and bronze in southern Africa, which on present evidence was more than a thousand years after the first production of iron and copper in this region.

The sheer size of the area assigned also makes it impossible for me to discuss the social contexts of metallurgy in each of these areas, as there are gross disparities in our knowledge of the early history and archaeology of these various regions. Egypt has 5,000 years of written records; Nubia at least 3,000; Ethiopia a little less than 2,000; and parts of the Sahel and the East African Coast 1,000 years (though most of these are not eyewitness accounts). In the rest of Africa the historical record extends back barely 200 years, and in some regions less. Similar caveats apply to the archaeological record. Egypt and Nubia have attracted the attention of large numbers of European and American archaeologists over the last two centuries, but their attention has been focussed almost entirely upon tomb and temple. Oddly, we actually know much less about the history of metallurgy in Egypt than in sub-Saharan Africa, in which (as David O'Connor once said, with pardonable exaggeration) a teaspoon of soil has been excavated for every ton on the Nile. Paleolithic archaeology

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has been undertaken over most of the African continent for a century, as have attempts to locate the towns in the Sahel mentioned by Muslim travelers in the first and second millennia CE. But until the late 1960s the total number of archaeologists working in all of sub-Saharan Africa were never more than 30, and often much smaller (Robertshaw 1990). Even this overstates the extent of research, for there was no satisfactory means of dating prehistoric sites in sub-Saharan Africa until the advent of radiocarbon dating, which did not become widely used until the late 1960s. Even today there are fewer archaeologists (both resident and foreign) working in the whole of sub-Saharan Africa than in my home state of Arizona. There are only three radiocarbon laboratories on the entire African continent (in Cairo, Dakar and Pretoria), and only one laboratory for archaeometallurgy (at the University of Cape Town). Most archaeology in sub-Saharan Africa has been on a small scale, focussed on the excavation of test pits, trenches or near-surface features (e.g., furnaces) rather than lateral decoupage, so at present it is rarely possible to situate metallurgical practices in their spatial contexts. Given these constraints, it is hardly surprising that the history of technology in sub-Saharan Africa has barely begun to be written. There have been only two review articles on the topic (Austen and Headrick 1983; Killick 2005) and these are necessarily brief.

Under these circumstances, it is impossible to address many of the questions posed by the organizers. We simply do not have the primary data that we would need to address questions about the social contexts of metal production and use in Africa, about transmission of technical knowledge between generations or about the varying uses of metals by elites and commoners. What little we do know about the prehistory of metallurgy in Africa is however so interesting, and so different from the course of early metallurgy in other regions of the world, that some account of it must be given in this volume.

On the Use of Ethnographic Analogy

My statement that we can say little about the social contexts of early metallurgy in Africa will undoubtedly raise some eyebrows. Most students of archaeometallurgy know that in the late nineteenth and twentieth centuries, iron smelting in many areas of sub-Saharan Africa was viewed by its practitioners as exactly equivalent to human gestation and childbirth. More broadly, iron workers in many areas were recognized as masters of the transformation of both substances and persons. Thus, in some West African societies, ironworkers were also entrusted with circumcision and burial, while their spouses were potters and midwives. Both might be feared (and shunned) as sorcerers. In some central African kingdoms royal investiture involved symbolic appropriation of the occult powers of the ironworker, with kings being symbolically "forged" into their new roles (Childs and Killick 1993; Herbert 1993). These are perhaps the best-known examples of the social construction of technology, and obviously they must have had prehistoric antecedents. Many African archaeologists in the southern half of the continent still assume that these same beliefs can be inferred for any prehistoric iron-smelting site (e.g., Huffman 2007). So why am I so reluctant to allow these ethnographic analogies in the interpretation of early African metallurgy?

It is by no means illegitimate to use analogy in the interpretation of prehistoric archaeological remains; indeed it would be impossible to function as an archaeologist without analogy (David and Kramer 2001; Wylie 2002). For example, we employ analogy every time that we identify an archaeological feature as a smelting furnace. The act of identifying a prehistoric furnace involves—or should involve—a systematic comparison of attributes noted in excavation with attributes that we (or others) have recorded on modern or historic smelting furnaces. It is however much more difficult to make secure inferences about the beliefs of prehistoric metalworkers because these rarely have material correlates. Such inferences are most secure where there is good reason to argue for an unbroken line of descent from a particular prehistoric society. For example, it seems quite likely that the isolated human finger bones buried beneath prehistoric furnace bases in the Lowveld of eastern South Africa were put there to harness occult powers to ensure a successful smelt, as the same practice is recorded in an early twentieth-century ethnography of this same region (Miller et al. 2003). But we cannot make a secure argument that smelters thought of a furnace as a woman unless the furnace is so marked, whether explicitly (with molded breasts, etc.) or with symbols that are unambiguously linked in other contexts with sexually mature women (on which see Childs 1991). Unmarked prehistoric furnaces may well have been seen as female, but to claim this is just speculation.

Nor is it appropriate to export this analogy to a distant context where there is no direct link to historically recorded beliefs. Structuralists like Eliade and Delcourt did so in the late 1950s and 1960s by claiming a conceptual link between metallurgy and procreation for pre-industrial societies in Europe and Greece. Sandra Blakely's comprehensive restudy of Greek *daimones* finds absolutely no support for this claim (Blakely 2006). She shows that the surviving myths are fragments of several distinct regional traditions, only some of which can be identified with metallurgy, and that there is no clear conceptual link in any of these between metallurgy and procreation. In this case, as so often in structuralist analyses, the urge to identify the "deep structures" of human thought has led its proponents to grossly misrepresent the underlying data. The lesson that we should draw from Blakely's reassessment is that interpretations of the social context of early metallurgy should be grounded in the soil of the region under consideration, rather than in analogies to other times and places.

Copper, Silver and Gold in Early Egypt and Nubia

The extent of excavation and publication of archaeological sites in Egypt and Nubia dwarfs that for the rest of continent. It is therefore a curious fact that we know more about the development of extractive metallurgy in sub-Saharan Africa than in Egypt, where archaeometallurgy has barely begun. Most of what we currently know about

Egyptian metallurgy derives from historical inscriptions, finds of metal objects in graves and field studies of mines (mostly Dynastic); there has been very little study indeed of smelting or alloying (Ogden 2000).

There are no sources of copper, lead, silver or gold near the lower Nile Valley (Fig. 19.1). Copper objects first appeared in the Maadi culture near the Nile delta between 4000 and 3200 BCE, and in the later part of this period partially replaced flint for many tool forms. Midant-Reynes (2000, p. 59) notes that the same transition occurred in the southern Levant at about the same time, though there is no parallel in Egypt for the elaborate lost-wax castings in copper–arsenic–antimony alloys, such as those in the Nahal Mishmar hoard, in the Levant (see Golden, this volume). The sources of copper ore may have been the same for both for both regions—namely those of the Sinai peninsula and/or Feinan in southern Jordan—but this has yet to be tested by lead isotope analysis. The green copper carbonate malachite is also quite common in Maadi culture sites, but was not necessarily imported for metallurgical purposes, as no evidence of reduction of the ore has yet been reported from Lower Egypt. The possibility that copper was imported as already-smelted metal must therefore be kept in mind. The well-known obsession of Dynastic Egypt with bright colors has its origin in Predynastic times, and copper and malachite were just parts of a whole spectrum of desirable color and lusters that also included turquoise (from Sinai?), lapis lazuli (from Afghanistan?) and amazonite (Aston et al. 2000).

On the middle Nile, malachite has been recovered graves of the Badarian period (ca. 4400–4000 cal BCE), which is the period when agriculture was first practiced in Egypt. It was ground to powder (for eye shadow?) and possibly derived from the copper deposits of the Eastern Desert, which begins at the longitude of Luxor and continues south into Nubia (Aston et al. 2000). Badarian tools were made of flint, but rare ornaments and implements of copper metal have been recovered. It is not known whether these were made from native or smelted copper.

Copper oxides were a necessary component of the blue and green glazes used on carved stone objects found in Naqada I cemeteries (4000–3500 cal BCE), which developed into faience. By the Naqada II phase (3500–3200 cal BCE) larger copper objects—axes, blades bracelets—were used in the middle Nile, though flint tools were still dominant. Gold and silver also appear at low frequency appearance in Naqada II graves (Midant-Renes 2000). The nearest gold deposits to the middle Nile are in the eastern desert, but the major sources lie to the south-east in Nubia (Fig. 19.1). The uncertainties regarding the sources of copper for the middle and lower Nile may potentially be resolvable by lead isotope analysis, which has been little used so far in Egypt and Nubia.

Copper and gold items first appeared in lower Nubia (the region between the First and Second Cataracts) in graves of the Middle A-Group, which are dated from ca. 3600–3300 cal BCE. These occur with Naqada pottery and other imports of Egyptian origin, so it seems probable that the copper was also imported. By 3000 cal BCE copper beads, awls and pins were reaching as far south as the Third Cataract. Almost all cutting implements were however still made of stone. Edwards (2004, pp. 68–74) suggests that the A-Group settlements were collecting products from the savannah

Fig. 19.1 Locations of sites in Egypt and Nubia, and potential sources of metals and other materials (Shaw 2000, p. 319. Reprinted by permission of Oxford University Press)

margins, such as ivory and ostrich feathers, and trading them north to present Egypt. The earliest evidence of the production of metals in Nubia is from Old Kingdom context (ca. 2600 BCE) at Buhen (Emery 1963) and within the temple precinct further upstream at Kerma, in contexts dated by radiocarbon to 2200–2000 cal BCE

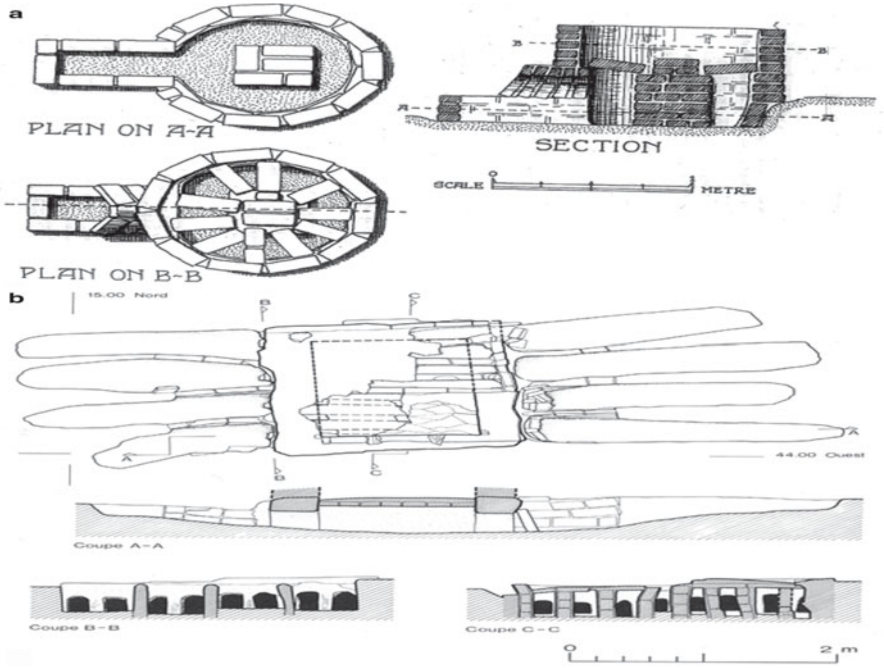

Fig. 19.2 **a** Furnace excavated at Buhen, ca. 2600 BCE (Emery 1963, Fig. 19.1); **b** furnace excavated at Kerma, 2200–2000 cal BCE. (Bonnet 1986, Fig. 19.1)

(Bonnet 1986). The Buhen finds (which long predate the famous Middle Kingdom fortress at that site) relate to the reduction of malachite ore to copper metal. There is some uncertainty about the nature of the smelting process; the supposed crucible-smelting furnace (Fig. 19.2a) is identical to the usual Nubian pottery kilns (Bonnet 1986), but a study of pieces of furnace lining (El Gayar and Jones 1989) suggests the use of a conventional smelting furnace with iron oxide flux. The later Kerma furnace (Fig. 19.2b) is a rectangular platform, originally covered by a vault, and heated from below. This was used for melting bronze in crucibles. No evidence of smelting has yet been found at Kerma, and the sources of the copper and tin used are unknown. Both sites require more substantial archaeometallurgical study, and it can be expected that evidence of even earlier metalworking will emerge in due course (Edwards 2004, p. 86).

Although the major sources of gold lie within present Sudan, in the eastern desert between the First and Second Cataracts, there is no evidence that Nubians attempted to contest Egyptian control of these deposits—not even during the Second Intermediate Period (1650–1550 BCE), when the Kerma state drove the Egyptians back past the First Cataract. Edwards (2004, pp. 96 and 137–138) suggests that the Kerman and later Napatan elites much preferred copper to gold, and that the highly polished red-slipped pottery of the Classic Kerma period is meant to evoke the redness of polished copper. Here he is extending the argument of Eugenia Herbert, in *Red Gold of Africa* (1984), that there was a strong cultural preference for the redness of copper over the yellow of gold throughout sub-Saharan Africa before the Islamic era.

Taking a wider view, it is clear that the adoption of metal in Egypt and Nubia was a very slow process. Knowledge of metals seems to have diffused to Egypt from the Levant, with groups along the middle and lower Nile adopting the high valuation placed by contemporary Near Eastern groups on gold and brightly colored stones. The adoption of metals in Egypt had little effect on agricultural production; peasant farmers were still using flint for cutting tools well into the first millennium BCE. Metal objects were traded into Nubia within 500 years of their first appearance on the Middle Nile, but even after a century of large-scale excavation we still do not know when metallurgy was first practiced in Nubia.

What is certain, however, is that copper metallurgy was not transmitted along the upper Nile to the Great Lakes area during the third millennium BCE, as pottery and domestic animals had been a millennium before (Edwards 2004, pp. 38–65). This long hiatus in the southwards movement of metallurgy has attracted curiously little comment. I suggest that it is probably related to climatic constraints upon agriculture based on wheat and barley. These crops formed the basis of the first agriculture in the middle and lower Nile, and appear from stable isotope ratios of human bone collagen (summarized in Thompson et al. 2008) to have been the staple cereals at Kerma. But wheat and barley are winter-rainfall domesticates from the Near East, and cannot be grown under in the lowland summer-rainfall regimes of the upper Nile and the Great Lakes. Since the earliest metallurgy on the middle and lower Nile was in the context of agricultural societies, I suggest that its southern expansion halted at the southern limit for wheat and barley agriculture. The most recent synthesis of research on the domestication of the African summer-rainfall cereals (sorghum, finger millet and bulrush millet) suggests that these were domesticated no earlier than the third millennium BCE (Neumann 2005), but there is no evidence for their cultivation in the southern half of present Sudan at this time. The Nile headwaters south of present Khartoum appear to have populated in the third millennium by highly mobile cattle pastoralists who also fished and gathered wild grains (Edwards 2004, pp. 60–64). These mobile populations evidently had little inclination to adopt the practice of metallurgy from the sedentary farmers further downstream.

Holl (2009) argues that in sub-Saharan West Africa the earliest evidence of metallurgy was among mobile pastoralists. It is too early to be sure about this, as almost none of the sites containing early metallurgy in West Africa have also received the attention of an archaeobotanist, though certainly the earliest metallurgical sites in Mauretania and Niger lie north of the probable limit of rainfed agriculture at that time. In the Nile Valley, only agricultural societies produced metals between the fifth and second millennia BCE.

As is well known, Egyptian vessels sailed down the Red Sea to the land of Punt (modern Eritrea?) to trade for ebony, animal skins and incense. The earliest voyages were during the Middle Kingdom, but they became more frequent in New Kingdom times (after 1500 BCE), as recorded in the famous panels on the temple of Queen Hatshepsut (Kitchen 1993). But the Egyptians never established any colonies there, and do not appear to have given the inhabitants of that region the gift of metallurgy. As noted below, metallurgy was probably not practiced in Eritrea until the first millennium BCE.

Fig. 19.3 East Africa, showing location of the Great Lakes

The Origins of Ironworking in East-Central Africa

In sharp contrast to the Nile Valley, the Great Lakes area of East Africa (modern Uganda, Tanzania, Rwanda and Burundi) has provided us with a wealth of evidence for the first smelting of metal in the region, backed by some first-rate archaeometallurgical investigation (Fig. 19.3). Unfortunately, the age of many of these smelting sites is very uncertain, and few are connected to habitation sites that might allow some inference about the social context.

All of these early smelting sites relate to the smelting of iron. No early copper smelting sites have been found, but then there are very few sources of copper in the Great Lakes region. The origin of iron smelting in sub-Saharan Africa has been the subject of intense controversy over the last 60 years, with proponents of independent invention battling with those who favor diffusion of the technology from various other regions (Egypt, Phoenician North Africa, Arabia or all of these). This literature has been comprehensively reviewed by Alpern (2005).

No evidence for the antiquity of metallurgy in this region was available until the 1960s, when radiocarbon dating first began to be widely applied in Africa. Prior to this time most scholars had assumed that iron working technology had diffused into the Great Lakes region from the Meroitic state on the upper Nile (ca. 300 BCE–ca. 350 CE). There are massive mounds of iron slag at the capital city of Meroe (Fig. 19.1) itself, representing, by a rough calculation, the production of about 5000 tons of iron bloom (Rehren 2001). In the late 1960s, however, a number of surprisingly early radiocarbon dates (between 2500 and 3600 BP) were announced for ironworking sites in Buhaya, north-western Tanzania (by Peter Schmidt) and in Rwanda and Burundi (by Jean Hiernaux and Francis van Noten). Although the field evidence was not yet published, these dates were immediately accepted by many Africanists. Bruce Trigger (who was at this point still a specialist in Nubian archaeology) wrote a highly influential review entitled “The Myth of Meroe and the African Iron Age” (Trigger 1969). He concluded that iron working in central Africa was earlier than that at Meroe, and must therefore have been independently invented. This fuelled a debate that is still without resolution.

The evidence for early ironworking in the Great Lakes region was greatly expanded during the 1970s and 1980s through archaeological fieldwork in Buhaya (directed by Schmidt), Rwanda and Burundi (by Van Noten and by Marie-Claude van Grunderbeek). The cumulative result of all of these projects is a corpus of about 30 iron-smelting furnaces, dated by radiocarbon to between ca. 1500 BP and 3600 BP (van Grunderbeek et al. 1982, 2001; Schmidt and Childs 1985; Schmidt 1997). All of these are slag-pit furnaces with truncated conical shafts made of clay (Fig. 19.4), the deliberately broken remains of which are often found within the slag pit, sometimes with tuyères. These furnaces certainly used multiple tuyères, but it is difficult to say how many. The slag pits vary in diameter from ca. 80 to ca. 130 cm; in the rare cases where the original shaft height can be estimated from fragments, it appears to have been between 78 and 130 cm from the top of the slag pits, which were between 20 and 77 cm deep. In both Buhaya and Rwanda/Burundi the slag pits were often stuffed with reeds or grass before charging, as impressions of these are preserved in the slags (van Grunderbeek et al. 1982, 2001; Schmidt and Childs 1985).

Exemplary archaeometallurgical studies (by Donald Avery and Terry Childs) of the Buhaya materials dating to the early first millennium cal CE show that they were capable of producing steel blooms and highly fluid slags that drained efficiently from the iron, producing clean blooms (Childs 1996). A recent study of the slags from

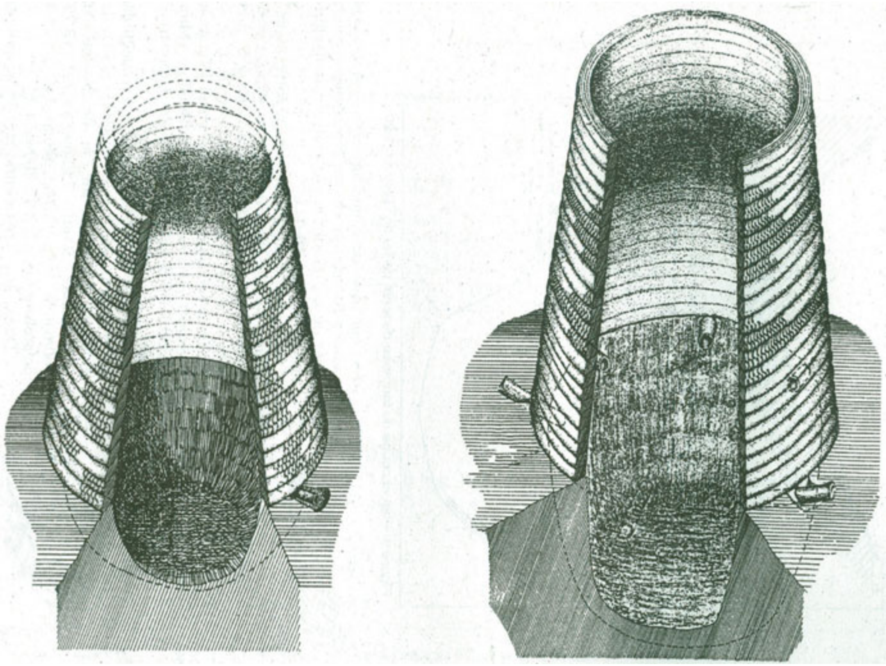

Fig. 19.4 Reconstruction of an early slag-pit iron-smelting furnace from Rwanda. (van Grunderbeeck et al. 2001, Figure 7)

van Grunderbeek's Rwanda and Burundi furnaces (Craddock et al. 2007) shows that they are very similar to those from Buhaya and were capable of reaching at least 1,250 °C.

How do these compare with iron-smelting technology at Meroe? The earliest radiocarbon date associated with iron slag at Meroe is 2514 ± 73 BP (Shinnie 1985), but only fragments of the bases of shallow bowl bases were found in deposits of the first millennium BCE. It is not clear whether these are from forging or smelting. Five complete furnaces were excavated and dated by radiocarbon in the interval 0–600 cal CE. These are slag-tapping furnaces built of fired brick with a shaft 100 cm tall, lined with a sandy clay; in one case four pot-bellows were found still in place (Shinnie 1985). Since most of the huge slag heaps at Meroe are of tapped slag (Rehren 2001), this type of furnace seems to have been responsible for the bulk of iron production there. Obviously these furnaces are of completely different design than contemporary slag-pit furnaces from the Great Lakes region; Shinnie considers them to be derived from Roman prototypes. It is frustrating that we do not have any firm evidence for smelting furnace construction from the first millennium BCE at Meroe.

Paul Craddock's wealth of comparative knowledge has brought some much-needed external perspective to the overheated debate about the origins of African iron smelting. A decade ago he noted that it is difficult to derive these large, efficient

African furnaces of the first millennium BCE from anything in the Near East (Craddock 1997, pp. 261–264). It is true that almost no iron-smelting furnaces of any kind are known from the Levant or Mesopotamia but, as Craddock points out, slag pits are highly distinctive and preserve very well, so it is hard to imagine that they would not have been noted had they ever been employed in these areas. The only remaining candidate for an extra-continental source for Great Lakes iron metallurgy is South Arabia, via the pre-Axumite culture of present Eritrea and lowland Ethiopia. There is a hint of a north-eastern origin for Great Lakes iron in historical linguistics; Ehret (1998) and Schoenbrun (1998) both derive the words for iron working in Eastern Bantu languages from Central Sudanic languages. But there is no published work at all on ancient iron metallurgy in south Arabia, and the director of a large archaeological survey project in Yemen informs me that she has never even seen an iron-smelting site in that nation (Joy McCorriston, personal communication, March 2008).

Could iron smelting have been independently invented in the Great Lakes region? The many supporters of an independent invention of metallurgy continue to cite the published radiocarbon dates of 2800–3600 BP in the Great Lakes region, but ignore the fact that the archaeologists who are most familiar with these dates no longer have confidence in them. Schmidt (1997, p. 14) has disavowed the three oldest dates (> 3000 BP) from Buhaya, while van Grunderbeek et al. (2001) have backed away from the dates > 2800 BP from Rwanda and Burundi. One cannot prove that these dates are not contemporary with the furnaces, but the most likely explanation for these dates is that they are on old charcoal from forest fires, which were present in the soils into which the slag pits were dug.

There remain, however, at least four radiocarbon dates between ca. 2350 BP and ca. 2650 BP, each in good association with furnaces and on charcoal of small diameter, which should eliminate the possibility of an "old wood" error (Marie-Claude van Grunderbeek, personal communication, February 2006). Unfortunately these all fall within a well-known "black hole" in the radiocarbon calibration curve, and thus all calibrate at two sigma to a calendar range of approximately 800–400 cal BCE. This is exactly the same range of calibrated age as for the earliest radiocarbon dates for iron slag at Meroe (Shinnie 1985; Rehren 2001)— and indeed almost all of the earliest dates for iron smelting in West Africa also fall in this range (Alpern 2005; Holl 2009). Clearly we cannot progress as long as we rely solely upon radiocarbon dating for chronology. For more than 25 years I have urged African archaeologists to use thermoluminescence dating to date potentially early furnaces (Killlick 1987, 2004) and it is currently being used to date slag heaps around Meroe (Dana Drake Rosenstein, personal communication, 2012).

I have gone into the evidence in some depth to make it clear that the origins and timing of the first metallurgy of the Great Lakes area are still quite unclear. If we accept, for the sake of argument, that ironworking began here somewhere in the interval 800–400 cal BCE, let us see what else was happening in the Great Lakes region in this interval. Pollen cores show little evidence for widespread forest clearance during the first millennium cal BCE (Taylor and Marchant 1995; Schmidt 1997, pp. 268–280; Lejju et al. 2006), but there are nevertheless hints of agricultural activity. The domesticated cereal *Eleusine coracana* (finger millet), whose wild ancestors are in the Great Lakes region, has been found in secure archaeological contexts at the end of the second millennium BCE in South Asia (Fuller 2003). It must therefore have been cultivated in the Great Lakes area for some time before this. Conversely, phytoliths of banana (*Musa* spp.), which is an Indonesian domesticate, have been reported in a swamp core from Uganda in levels below a radiocarbon date of 4560 ± 40 BP (Lejju et al. 2006), and also from charred residue in a pot from Nkang, Cameroon, dated in the range 850–350 cal BCE (Mbida et al. 2000). So there is good reason to believe that when ironworking began in the Great Lakes area, it was in an agricultural context, though there do not appear to have been very many people on the landscape. This is not much to go on, but at present it is all that we have.

There is some contextual evidence from Buhaya for iron smelting in the first few centuries cal CE. Clusters of several slag-pit furnaces at this time were situated between and within village sites around small bays and swamps within a few kilometers of the western shore of Lake Victoria (Schmidt and Childs 1985). Little faunal or botanical evidence has yet been recovered, and the scale of iron production appears to have been small. Charcoal analysis implies that in the initial centuries cal CE mature gallery forest was still close to the lake, but by ca. 1100 CE much of this appears to have been cleared, and the region was abandoned for several centuries (Schmidt 1997).

Ironworking spread south from the forested regions of the Great Lakes into the savannas of present Kenya and Tanzania, and had reached the coast in the region of present Dar-es-Salaam by the first century BCE. The near-coastal site of Limbo, dated in the first centuries CE, is of interest because it contains at least 3 t of iron slag (Chami 1992). This is the earliest known evidence of the production of metals on a substantial scale in regions south of the Meroitic and Axumite states.

Iron- and Copper-Working in Southern Africa

The southwards expansion of iron-producing agricultural peoples brought them, by the second century BCE, to the northern edge of the vast belt of *miombo* woodlands that covers Angola, southern Tanzania, Zambia, Malawi and northern Mozambique. These woodlands, dominated by the genera *Brachystegia* and *Julbenardia*, evolved on an old stable continental craton covered with deeply leached, very infertile soils. Before the advent of chemical fertilizers, agriculture within the *miombo* was only possible because of the invention of a number of truly ingenious crop rotations, employed for a few years on fields temporarily fertilized by the felling, stacking and burning of large volumes of wood, and subsequently abandoned to long periods of fallow (Allan 1965). These systems of agriculture would not be possible without a constant supply of metal axes. I have suggested (Killick 2005) that there may have been a hiatus in the expansion of agricultural populations at the northern margin of the *miombo* while these swidden systems were invented, but there are as yet too few radiocarbon dates to confirm this.

In the Great Lakes region it appears that agriculture, ironworking, cattle keeping and Bantu languages have different time depths (Schoenbrun 1998). There can however be little doubt that all of these came into southern Africa as a package, together with the first evidence for settled village life. The immigrants settled among hunter-gatherers, but did not wholly displace them. Excavations in rock shelters in many parts of east-central Africa have shown that microlithic technologies persisted in many areas until at least the middle of the second millennium CE. Two separate "streams" of migrants can be traced archaeologically—a western stream from Angola into Namibia and Botswana, and an eastern stream from Tanzania south through Mozambique, Zambia and Zimbabwe (Phillipson 2005; Huffman 2007). Expansion of the eastern stream continued down the fertile eastern coastal plain of South Africa, reaching the Fish River by the fourth century cal CE. South of this lies the winter rainfall region, in which the African cereals (millets and sorghum) cannot be grown. For the next 1,000 years, metals were traded in small quantities from the agricultural communities to the pastoralist and hunter-gatherers of the eastern and southern Cape; after 1500 CE this supply was supplemented by metals scavenged from European shipwrecks. But there was never enough metal circulating to replace microlithic stone tool technologies, which were still being used in these regions in the mid-nineteenth century CE (Mitchell 2002).

On the drier western side of the continent agriculture was similarly restricted, and hunter-gatherers, pastoralists and agriculturalists were linked in complex webs of exchange at the margins of the arable regions. The complexity of these relationships is well illustrated at the Tsodilo hills, deep in the Kalahari Desert at the north-west corner of Botswana (Fig. 19.5). Archaeological research has shown that between ca. 550 and ca. 1100 CE these hills were occupied by both stone-tool makers (presumably hunter-gathers) and later arrivals (presumably agro-pastoralists) who smelted iron and copper (Denbow and Wilmsen 1986; Miller 1996; Reid 2005). Both groups were attracted to the hills by specularite, a glittering form of the iron ore haematite. This had been mined at Tsodilo—and at many other locations in southern Africa—for many thousands of years before metallurgists entered the area, and was used as a pigment in rock art and as a cosmetic. Metal-using populations appear to have adopted the latter practice, and the glittering powder (known in Tswana as *sebilo*) was still widely traded and used by hunter-gatherers, pastoralists and agriculturalists alike in the early twentieth century CE. The image of the isolated Kalahari hunter-gatherer, painstakingly constructed by social anthropologists from the 1950s to the 1980s, has been exposed by archaeologists as a romantic fiction. In fact, agriculturalists, pastoralists and hunter-gatherers have been sharing spaces and exchanging metals, *sebilo*, pottery, hunted products and imported materials (glass beads) in the northern Kalahari since the first millennium cal CE (Denbow and Wilmsen 1986; Wilmsen 1989; Reid 2005).

Iron and unalloyed copper were the only two metals used in southern Africa before ca. 1100 cal CE. Unalloyed copper was employed exclusively for items of personal adornment, in the form of pendants, rings, bangles and wire. Iron was also used for jewelry, but its main inferred use was in hunting and agriculture, as spears, axes, knives and hoes. (Large iron items have rarely been found in archaeological

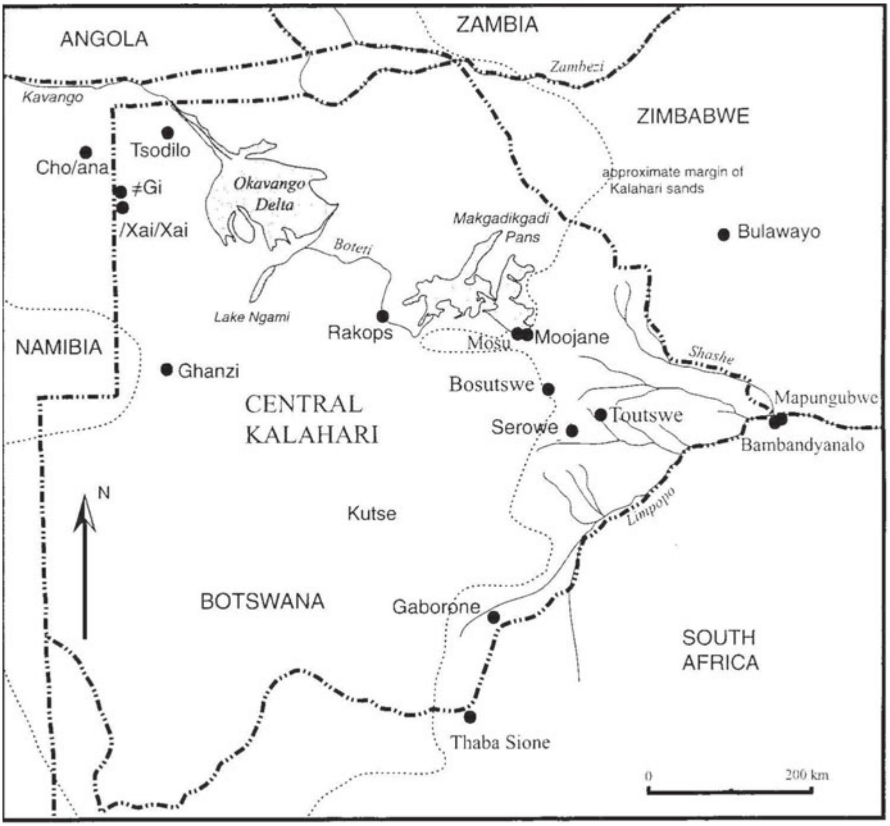

Fig. 19.5 The Kalahari Desert and adjacent regions, showing archaeological sites mentioned in the text. (Reid 2005, Figure 14.1. Reproduced by permission of Blackwell Publishing)

excavations and are presumed to have been intensively recycled). Little evidence for the smelting, casting or forging of copper has been reported for this early period (Miller 2002), but there is abundant evidence of iron smelting. There has been recent controversy in southern African archaeology over the location of early iron-smelting sites. As I noted above, historical and ethnographic accounts of African iron smelting show that in many regions of Africa the formation of the iron bloom was understood through the metaphor of pregnancy and childbirth (Herbert 1993; Schmidt 1997). In smelting iron, men were symbolically appropriating the reproductive powers of women, who were excluded from the vicinity of the furnace while the smelt was under way. The archaeologically visible correlate of this social construction of technology is that smelting furnaces were usually situated well outside villages, beyond the gaze of women. Forges were generally not assigned a gender, and thus forging was often done within the confines of the village.

There has been much argument over the time depth of this distinctive practice. In the Great Lakes area, there is no doubt that smelting was carried out within villages during the early first millennium cal CE (Schmidt and Childs 1985; Schmidt 1997), but southern African archaeologists have tended to interpret early ironworking through the ethnographic model of smelting as reproduction. This position has recently been challenged by archaeologists working in Zimbabwe, who have produced evidence of iron smelting within villages of the first millennium cal CE (Chirikure and Rehren 2006; Swan 2007). This debate can only be resolved with further evidence, but it serves as a reminder of the potential dangers of uncritical application of ethnographic analogy.

Gold, Silver, Lead and Tin in Eastern and Southern Africa

Perhaps the most striking feature of the early metallurgy of the vast region from the Great Lakes to the southern Cape is the absolute lack of evidence for metals other than copper and iron until maritime trade with the Islamic world commenced in the eighth or ninth century CE. On present evidence there was no tin or bronze, no silver, no gold and no lead in southern Africa before then. Yet all of these metals are present in archaeological sites of the last centuries BCE and early centuries CE in Nubia and Ethiopia. Their absence in contemporary sites in the Great Lakes region and Kenya must surely be telling us that there was essentially no interaction between these regions and the contemporary Meroitic and Axumite states to the north.

Silver deposits are very rare in Africa, but there is abundant tin (as cassiterite) in the pegmatites of southwest Uganda, Rwanda, eastern Congo and Zimbabwe (von Knorring and Condliffe 1987). Tin deposits are also found in many locations around and within the Upper Granite of the enormous Bushveld Igneous Complex in northern South Africa. Yet there is no evidence at all that any of these deposits were exploited in the first millennium CE. There is not even much evidence of arsenical copper in artifacts analyzed to date, though admittedly the available data are geographically skewed—almost all chemical analyses for copper alloys of the first millennium CE have been generated in South Africa by Duncan Miller (e.g., Miller 1996, 2002). The scarcity of arsenical copper presumably means that only the surficial copper carbonate ores were smelted by early metallurgists in southern Africa. Lead is also quite common (as galena) in the subcontinent south of the Great Lakes region, but neither lead metal nor leaded copper has been noted in archaeological contexts of the first millennium BCE and the first millennium CE.

One might argue that it is not obvious that cassiterite, which is a heavy dark brown or black mineral, contains a metal, but this argument will not hold for galena, which has a metallic luster. It is not even very convincing for cassiterite—magnetite, which is also dull, heavy and black, was certainly smelted to iron in Zimbabwe during the first millennium CE (Swan 2007), so there is no good reason why alluvial cassiterite should have been ignored. The temperatures and furnace atmospheres needed to reduce cassiterite to tin are comparable to those for reducing iron oxide to iron metal (Killick 2001, Fig. 39.1) so early African ironworkers would have no difficulty in producing metallic tin. It is even harder to account for the absence of

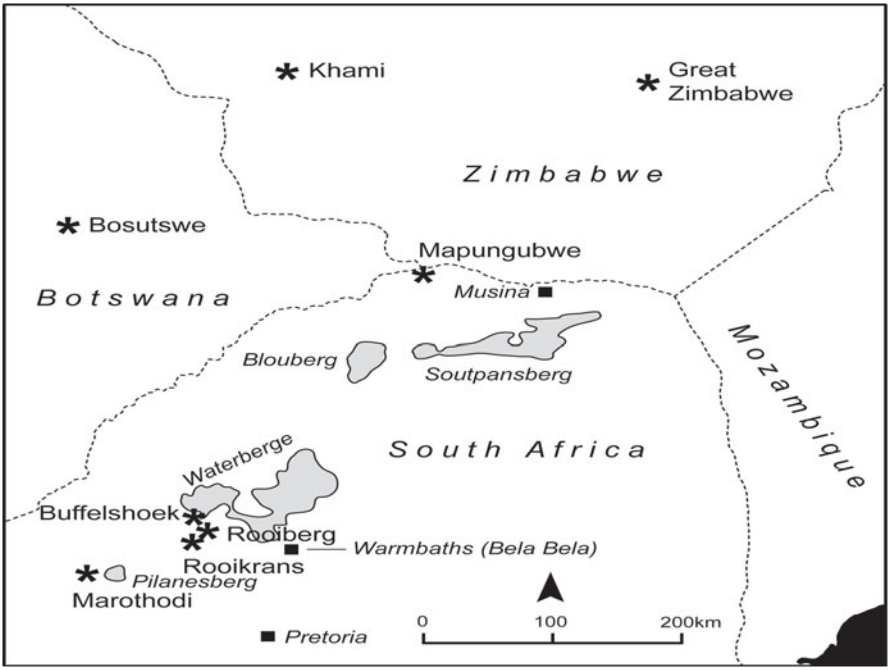

Fig. 19.6 Archaeological finds of tin and bronze in southern Africa (*stars*) modern towns (*squares*) and major mountain ranges (irregular *grey areas*). *Dotted lines* are modern national boundaries. (Figure supplied by Simon Hall)

gold, which only occurs as the bright shiny metal. Gold deposits of Africa are mostly in Precambrian rocks on the old stable continental cratons of west and southern Africa, which between them supplied most of the gold circulating in the western half of Eurasia from the tenth through the fifteenth centuries. Alluvial gold could be found in the streams draining these cratons, and it is simply impossible to believe that the inhabitants of the regions between the Great Lakes and the Cape of Good Hope were not aware of its presence.

The only satisfactory solution to these paradoxes is that proposed by Eugenia Herbert (1984). She argued that prior to trade contacts with the Muslim world, the populations of sub-Saharan Africa valued the redness of unalloyed copper much more than the yellow of gold or bronze. A quarter of a century later, with much more archaeological and archaeometallurgical data in hand, her argument looks even stronger. The most telling evidence in support of her thesis is the change that occurred when the external trade with the Muslim world became established (Miller 2002; Killick 2009). Before the eighth or ninth century cal CE there was no external trade, and unalloyed red copper was the metal of choice for personal adornment (Miller 1996, 2002). In the ninth century imported glass beads first appear in the Limpopo river valley, the present border between South Africa, Zimbabwe and Botswana (Fig. 19.6). Beads, and probably Indian cotton cloth, were traded for ivory, and the struggle for local control of this trade led to political centralization in the Limpopo valley, leading to formation of the first state in southern Africa at Mapungubwe in the thirteenth century cal CE (Leslie and Maggs 2000).

The impetus behind state formation in the Limpopo valley was in large part the trade in alluvial gold (Huffman 2007; Killick 2009). The earliest mention in Arabic documents of trade in gold from southern Africa is in the eleventh century, but it is not yet known when the alluvial gold of the middle Limpopo valley began to be exported. By the thirteenth century cal CE, the high cultural value of gold in the Muslim world had evidently been adopted by the emerging African elites of the region, as the royal burials on Mapungubwe Hill contained gold jewelry and other objects—the earliest objects of gold yet found in southern Africa. It is definitely not a coincidence that the earliest bronze objects known from southern Africa also come from twelfth- and thirteenth-century Mapungubwe (Miller 2002). What we are seeing in this sequence is the adoption by the new southern African elites of an alien value system, in which the golden color of gold and bronze supplanted the red of copper for personal ornamentation among an emerging elite. In Bourdieu's terms, this is a new form of distinction created to differentiate the new royal stratum from lower strata of the elite.

There is an interesting coda to this story. The Mapungubwe bronzes are assumed to have been imported, as no tin or evidence for bronze working has been found in sites of this period. A further two centuries pass before there is actual evidence of manufacture of tin and bronze in southern Africa. At the site of Bosutswe in eastern Botswana, a lead–tin object and a spill from bronze casting are dated in the range 1450–1550 cal CE (Denbow and Miller 2007), while at Great Zimbabwe a tin ingot and a lead-tin object are dated in the same range (Thomas Huffman, personal communication, 2006). My collaborators Lisa Molofsky and John Chesley have established by lead isotope ratio analysis that both the lead-tin objects and the Zimbabwe tin ingot derive from the Rooiberg tin mines in north-western South Africa, where hard-rock mining of cassiterite is implied at roughly the same time by dates of 1436–1650 cal CE on charcoal embedded in a tin ingot and 1426–1633 cal CE on a wooden pit prop from a prehistoric mine (Grant 1990; Chirikure et al. 2007; Molofsky et al. in prep.).

What these findings suggest is that a tin mining industry began at Rooiberg in the fifteenth or sixteenth century to supply an indigenous bronze industry over a wide area of southern Africa (Chirikure et al. 2007). This is contemporary with the late Zimbabwe state, which by this time was centered at Khami. Sites with Khami pottery are found in northern Botswana at this time, and Reid (2005) suggests that these are connected with the procurement of distant resources (particularly salt) for the state. Though no Khami pottery has yet been found at Rooiberg, it is conceivable that the start of tin mining here was also the result of a widening network of resource exploitation by the late Zimbabwe state. Although there is no mention of tin from southern Africa in Islamic sources, we should also be aware of the possibility that Rooiberg tin was exported through Swahili intermediaries into the Indian Ocean trading network. This may explain some very puzzling passages in Portuguese documents from the early 1500s. Portuguese sailors reported that some inhabitants of coastal Mozambique were wearing silver, and that some captured Swahili vessels were also bearing it (Axelson 1973, passim). The Portuguese spent another two centuries desperately searching for silver mines in present Mozambique and Zimbabwe, but the fact is that there are no sources of silver in southern Africa that would have been exploitable by pre-industrial miners. My guess is that what the first Portuguese sailors actually saw was Rooiberg tin.

Conclusion

I make no apology for stretching out my examination of "early" metallurgy over six millennia. As I noted in the introduction to this paper, Africa is a very large continent indeed. The earliest metallurgy in Egypt, in the fifth millennium BCE, was clearly acquired from adjacent regions of the Levant, as is seen by the parallelism in the value accorded to copper, gold and particular colored stones in both regions. It is not yet clear when metals were first smelted in Nubia (as opposed to imported from Egypt) but bronze metallurgy was definitely well established at Kerma towards the end of the third millennium BCE. It appears, on present evidence, that there was then a long hiatus in the further expansion of metallurgy. Copper, bronze and iron technology probably first appeared in Ethiopia and Eritrea in the early first millennium BCE, but we must await publication of ongoing archeometallurgical work from that region. The origins of iron smelting in the Great Lakes region are still a complete mystery. If we accept for the moment that iron smelting began here somewhere in the range 800–400 cal BCE, then it took between 800 and 1,200 years for the technique to be transported to its southernmost terminus at the Fish River. To put this whole process in perspective, the earliest metallurgy in Africa is contemporary with the first agriculture in Egypt; by time that metallurgy reached present South Africa, Egypt was a province of the late Roman Empire.

We can as yet say very little about the social contexts of early African metallurgy. The main conclusion to be drawn from my very brief review is that the relative social valuation of metals in early Egypt (gold > silver > bronze > copper) did not necessarily apply in Nubia, and was most certainly not shared by the inhabitants of Africa south of present Sudan. The only metals used—and thus valued—in the long trek of metallurgy from the Great Lakes region to southern Africa were copper and iron. Gold, lead and tin ores are quite common in eastern and southern Africa, but appear to have been completely ignored until the early second millennium CE. At that time Muslim traders, sailing south along the east African coast, and penetrating up its major rivers, noted alluvial gold and induced African societies to pan and mine it for exchange against imported beads and cloth (Leslie and Maggs 2000; Huffman 2007; Killick 2009). The struggle to control the African end of this trade produced southern Africa's first state, the rulers of which chose to mark their distinction from their subjects by wearing gold.

In conclusion, it must be noted that the interpretations offered here are made on the basic of data that are clearly inadequate. Indeed, it has been difficult to find any relevant data on the social contexts of metallurgy for regions north of southern Africa, which was the last region of the continent to acquire the capacity to make metal. Given the slow pace at which archaeological research proceeds in sub-Saharan Africa—a consequence of the low level of funding and the dearth of specialist technical expertise—it will be many years before Africanists can address the very detailed questions posed by the editors of this volume.

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