

‘VOYAGE IRON’: AN ATLANTIC SLAVE TRADE CURRENCY, ITS EUROPEAN ORIGINS, AND WEST AFRICAN IMPACT*

In West Africa, as in other parts of the Atlantic world, the eighteenth century was an age of exuberant consumerism. The West African coast was a burgeoning marketplace to which goods from all points of the compass were rushed: Indian cottons, Brazilian tobacco, brassware from Aachen, New England rum, glass from Venice and Bohemia, and much else besides. Trashy gewgaws would not do. Traders from Europe and the Americas knew that African consumers were discerning; only articles that matched African tastes and met local quality standards would find a market. African buyers, much like their prosperous counterparts in Paris or Philadelphia, were ‘moved by prestige, fancy, changing taste, and a desire for variety’.¹ Consumer demand in West Africa was therefore dynamic. Sub-Saharan consumption patterns varied from place to place and changed markedly over time.²

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¹ John Thornton, *Africa and Africans in the Making of the Atlantic World, 1400–1800* (Cambridge, 1998), 45.

² David Richardson, ‘West African Consumption Patterns and their Influence on the Eighteenth-Century Slave Trade’, in Henry A. Gemery and Jan. S. Hogendorn (eds.), *The Uncommon Market: Essays in the Economic History of the Atlantic Slave Trade* (New York, 1979); Stephen D. Behrendt, ‘Markets, Transaction Cycles, and Profits: Merchant Decision Making in the British Slave Trade’, *William and Mary Quarterly*, lviii (2001).

It was the transatlantic slave trade, of course, that supplied the propulsive force behind West African consumerism. It had not always been so. The first two centuries of Euro-African exchange, from the late 1400s to the mid 1600s, were characterized by a more limited and less flamboyant range of imported goods. Early European traders were interested in acquiring gold, ivory, pepper, precious woods, and other high-value commodities. These were purchased with imported currencies, most notably cowries, or metals that could act both as currency and producer good. Joseph Inikori identifies this early phase of exchange as essentially benign. Quickening international trade brought benefits to West Africa. It was a period of agricultural commercialization, urban growth, and flourishing manufactures. From the late seventeenth century, however, Atlantic trade took a destructive turn. European traders were no longer focused on precious things for Old World markets; they required captives who could labour on New World plantations. The consequences were catastrophic. The rapid escalation in slave-trading stimulated warlordism, a contraction of market activity, de-urbanization and de-population. The composition of European imports, Inikori argues, shifted to reflect this. Currencies and capital goods were now overshadowed by consumer goods and weaponry, imports that signalled the relentless spread of slave-raiding and the erosion of West Africa's own manufacturing capacity.³

This is a powerful vision of change but it needs to be qualified. It should not be taken to mean that the trade in producer goods or commodity currencies stopped. Bars of malleable iron ('voyage iron' in contemporary parlance) and copper ('Guinea Rods') were a persistent feature of Euro-African exchange throughout the precolonial era. The boom in consumer goods in the eighteenth century meant that metals declined in relative terms and in visibility, but they did not disappear from coastal marts. The *Africa*, a slave ship that departed from Bristol for the Bight of Biafra in 1774, may be taken as emblematic. The *Africa*'s cargo

³ Joseph E. Inikori, 'Transatlantic Slavery and Economic Development in the Atlantic World: West Africa, 1450–1850', in David Eltis and Stanley L. Engerman (eds.), *The Cambridge World History of Slavery*, iii, AD 1420–AD 1804 (Cambridge, 2011).

was dominated by textiles, mostly expensive Indian fabrics, as was standard at that time, but there were also more mundane items: 1,530 bars of iron, close on thirteen tons, as well as four thousand copper rods.⁴ This was not at all unusual. Iron, the particular focus of this article, was a staple of Euro-African trade in the eighteenth century, as we will demonstrate using the records of both chartered companies (London’s Royal African Company and Copenhagen’s Vestindisk-Guineisk Kompagni) and private traders, chiefly those sailing from Liverpool. The archival record shows that the consignments could be substantial. The Liverpool merchant William Davenport supplied voyage iron to eighteen slaving ventures to the Bight of Biafra in the 1760s.⁵ The average consignment was 11.6 tons. If the vessels supplied by Davenport were representative, the 367 slaving voyages known to have left Europe for the Bight between 1760 and 1769 would have landed more than 420 tons annually. As a proportion of north European iron production this was inconsequential. In a local African context, however, it was hugely significant. Indeed, our contention is that European iron had a profound impact on West Africa in the age of the transatlantic slave trade. Voyage iron underpinned an agro-environmental transformation of coastal Africa from Senegambia to Biafra. It cleared the way for the introduction of New World crops and provided the nutritional wherewithal for population growth. In that sense, voyage iron helped sustain the export of enslaved people. The continuing, indeed growing, influx of European iron in the eighteenth century suggests that Inikori’s contrast between a phase of commercial uplift in West Africa between 1450 and 1650 and a phase of dislocation in the century and a half that followed is too strongly drawn. The presence of voyage iron implies a spread of

⁴ Bristol Archives, 45039; Stanley B. Alpern, ‘What Africans Got for their Slaves: A Master List of European Trade Goods’, *History in Africa*, xxii (1995); Colleen E. Kriger, ‘“Guinea Cloth”: Production and Consumption of Cotton Textiles in West Africa before and during the Atlantic Slave Trade’, in Giorgio Riello and Prasannan Parthasarathi (eds.), *The Spinning World: A Global History of Cotton Textiles, 1200–1850* (Oxford, 2009).

⁵ Merseyside Maritime Museum (hereafter MMM), Davenport MSS, D/DAV/2/4; Nicholas Radburn, ‘William Davenport, the Slave Trade, and Merchant Enterprise in Eighteenth-Century Liverpool’, (Victoria Univ. of Wellington M.A. thesis, 2009), 97–9.

commercialized agriculture and the development of metalware manufacturing even in the midst of the mayhem brought on by slave-raiding.

The arrival of European iron on the West African coast — in volumes that have not hitherto been appreciated — also raises questions about the relationship between European materials and African practices. The metal forged in northern Europe had quite different properties to iron smelted in sub-Saharan Africa. A smith could not arbitrarily substitute one for the other. Because of that, voyage iron did more than add to the stock of iron circulating in precolonial West Africa; it posed a challenge for African artisans. They were confronted with ferrous matter that was alien: it lacked the physical attributes and ritual associations of locally produced iron. The incorporation of European iron into West African production networks therefore required creative adjustment on the part of African artisans. Voyage iron, for all its apparent banality, initiated a process of African–European technological interaction.

I

European traders carried two metals in their unmanufactured form to early modern West African markets: iron and copper. The copper is relatively easy to account for. Copper is not an abundant element. It was therefore routinely used in past times as specie, as a recognised bearer of value in its own right. Copper is also easily worked and has a natural lustre. It was a common part of material culture in most parts of the pre-modern world, not least in Africa where copper and brass (a copper-zinc alloy) vessels were put to a wide variety of domestic and industrial purposes. When alloyed with tin to make bronze, copper also played a conspicuous role in African expressive culture.⁶ Copper and cupreous wares were therefore traded to Africa from the very earliest expeditions of the Portuguese, and they continued to be an important part of Euro-African exchange throughout the era of the Atlantic slave trade. Given its ready malleability, its reflective sheen, and the ease with which it could act as a store of value, copper presents few interpretive

⁶ Eugenia W. Herbert, *Red Gold of Africa: Copper in Precolonial History and Culture*, new edn (Madison, 2003).

difficulties. The export of large volumes of iron to Africa in the era of the slave trade is less readily accounted for. Iron is 900 times more abundant than copper in the earth’s crust; its intrinsic value is correspondingly less. Why, then, carry iron to Africa? In so far as scholars have considered the matter, they have concluded that the inflow of voyage iron was limited in scale and peripheral to African needs. We take a different view. The importation of iron was both substantial and significant.

It is certainly not the case that Africa wanted for iron in any existential sense, for the continent was home to a venerable metallurgical tradition.⁷ Metalworking was deeply embedded in ancient African culture and cosmology.⁸ Smelters were liminal creatures, gatekeepers at the boundary between nature (metalliferous rock) and culture (the metal they conjured from it). They exercised transformative powers which were thought to depend on ritualized performance for their success. In numerous African cultures, it is clear, the working of iron was far more than a set of technical procedures; it was a stylized activity in which beliefs about age, gender, and authority were acted out. Iron often featured in creation myths and smithing was sometimes seen as an attribute of kingship. Exalted status in the kingdom of the Kongo, for example, was closely associated with ironmaking and coronation ceremonies featured iron regalia and the drumming of ritual hammers.⁹ For the Kongolese, the foundation of their kingdom and the coming of iron technology were one and the same.

In fact, the onset of the sub-Saharan Iron Age predicated the Kingdom of the Kongo (established in the 1300s) by many centuries. The first signs of West African smelting came in the early first millennium BCE, coeval with the equivalent

⁷ David Killick and Thomas Fenn, ‘Archaeometallurgy: The Study of Preindustrial Mining and Metallurgy’, *Annual Review of Anthropology*, xli (2012); Joseph O. Vogel (ed.), *Ancient African Metallurgy: The Socio-Cultural Context* (Walnut Creek, Calif., 2000); François J. Kense and John Ako Okoro, ‘Changing Perspectives on Traditional Iron Production in West Africa’, in Thurstan Shaw *et al.* (eds.), *The Archaeology of Africa: Food, Metals and Towns* (London, 1993).

⁸ S. Terry Childs and David Killick, ‘Indigenous African Metallurgy: Nature and Culture’, *Annual Review of Anthropology*, xxii (1993); Eugenia W. Herbert, *Iron, Gender, and Power: Rituals of Transformation in African Societies* (Bloomington, 1993); Shadreck Chirikure, *Metals in Past Societies: A Global Perspective on Indigenous African Metallurgy* (Heidelberg, 2015), 87–92.

⁹ Cécile Fromont, *The Art of Conversion: Christian Visual Culture in the Kingdom of the Kongo* (Chapel Hill, 2014), 34–44.

development in Western Europe. Archaeometallurgists are sharply divided on the question of whether knowledge of smelting diffused into sub-Saharan Africa from the Mediterranean world or arose independently, but all are agreed on the variety and sophistication of African iron-working.¹⁰ Smelters were imaginative in furnace design, inventive in their use of ores and fluxes, and acute in their assessment of the calorific value of the different tree species they exploited for fuel.¹¹ They came to excel in making carbon-tinged material of steely hardness, a feature much admired by European travellers: 'Their iron is much harder', an agent of Denmark's Vestindisk-Guineisk Kompagni observed after examining the spears carried by warriors on the Gold Coast.¹²

West African smelting was buoyant in the seventeenth and eighteenth centuries. Claims that precolonial ironmaking was hampered by energy shortages seem wide of the mark.¹³ The over-exploitation of forest resources may have led to localized fuel shortfalls but there was no systemic difficulty.¹⁴ The geography of precolonial smelting certainly shifted over time but there is no *prima facie* reason to attribute this to deforestation, still less, as we shall see,

¹⁰ Hamady Bocoum, 'Iron Metallurgy in Africa: A Heritage and a Resource for Development', in Hamady Bocoum (ed.), *The Origins of Iron Metallurgy in Africa. New Light on its Antiquity: West and Central Africa* (Paris, 2004) stands as a manifesto for those who argue for the endogenous character of African smelting. Stanley B. Alpern, 'Did They or Didn't They Invent It? Iron in Sub-Saharan Africa', *History in Africa*, xxxii (2005) and D. J. Killick, 'What Do We Know about African Iron Working?', *Journal of African Archaeology*, ii (2004), offer critical reviews. Chirikure, *Metals in Past Societies*, 19–28, is the most up-to-date overview of the debate.

¹¹ Nicholas David *et al.*, 'Between Bloomery and Blast Furnace: Mafa Iron-Smelting Technology in North Cameroon', *The African Archaeological Review*, vii (1989); Louise Iles, 'The Development of Iron Technology in Precolonial Western Uganda', *Azania: Archaeological Research in Africa*, xlviii (2013); Gill Thompson and Ruth Young, 'Fuels for the Furnace: Recent and Prehistoric Ironworking in Uganda and Beyond', in Marijke van der Veen (ed.), *The Exploitation of Plant Resources in Ancient Africa* (New York, 1999).

¹² Ludewig Ferdinand Romer, *A Reliable Account of the Coast of Guinea* (1760), trans. and ed. Selena Axelrod Winsnes (New York, 2013), 24.

¹³ Compare Louise Iles, 'The Role of Metallurgy in Transforming Global Forests', *Journal of Archaeological Method and Theory*, xxiii (2016) and Candice L. Goucher, 'Iron is Iron 'Til it is Rust: Trade and Ecology in the Decline of West African Iron-Smelting', *Journal of African History*, xxii (1981).

¹⁴ Randi Håland, 'Man's Role in the Changing Habitat of Mema during the Old Kingdom of Ghana', *Norwegian Archaeological Review*, xiii (1980); Barbara Eichhorn *et al.*, 'Fuel for Iron: Wood Exploitation for Metallurgy on the Dogon Plateau, Mali', in Jane Humphris and Thilo Rehren (eds.), *The World of Iron* (London, 2013).

to the competitive pressure of European imports. Warfare, slave-raiding, and conceivably climate change were more powerful disruptive forces. The abandonment of old-established smelting sites in some parts of eighteenth-century West Africa, for example, was a response to intensified slave-raiding. But the smelters affected did not abandon their trade; they just relocated to more defensible hilltop locations.¹⁵ Indeed, it is the durability of ironmaking in African societies in the age of Atlantic slavery that is striking. Quantitative studies are few in number and their method is necessarily inexact; they depend upon surveying and dating furnace debris left behind by smelting communities. Even so, the evidence they provide is unequivocal. It is of growth, often considerable growth. A study of Bassar (modern Togo), described as an ironmaking centre of ‘continental importance . . . among the most important iron producers in African history’, suggests a massive rise in output (‘approximately 300–450 per cent’) between the mid sixteenth and the late eighteenth century, and continuing growth in the nineteenth.¹⁶ The Babungo chiefdom (modern Cameroon) was another specialized smelting zone that continued to flourish, with a notable climb in output between 1780 and 1880.¹⁷ Indeed, the Ndop plateau in southwest Cameroon, in the view of those who have investigated its iron industry most closely, should be seen as the ‘Ruhr’ of central Africa.¹⁸ There is, in other words, little indication that European metals drove precolonial African metallurgy to the wall.¹⁹ That did not happen until the twentieth century when the availability of European scrap, harvested from colonial railways and imported machinery, heralded the end of traditional smelting.

On the basis of this literature many contemporary Africanists have concluded that imported European iron had at best a

¹⁵ Philip Lynton de Barros, ‘The Effect of the Slave Trade on the Bassar Ironworking Society, Togo’, in Christopher DeCorse (ed.), *West Africa during the Atlantic Slave Trade: Archaeological Perspectives* (London, 2001).

¹⁶ Philip de Barros, ‘Bassar: A Quantified, Chronologically Controlled, Regional Approach to a Traditional Iron Production Centre in West Africa’, *Africa*, lvi (1986), 164.

¹⁷ Ian Fowler, ‘Babungo: A Study of Iron Production, Trade and Power in a Nineteenth Century Ndop Plain Chiefdom (Cameroons)’ (Univ. of London Ph.D. thesis, 1990), 168–9.

¹⁸ Jean-Pierre Warnier and Ian Fowler, ‘A Nineteenth-Century Ruhr in Central Africa’, *Africa*, xl ix (1979).

¹⁹ L. M. Pole, ‘Decline or Survival? Iron Production in West Africa from the Seventeenth to the Twentieth Centuries’, *Journal of African History*, xxiii (1982).

marginal role. John Thornton, for example, has maintained that Africa was producing iron enough for its own needs; supplements from Europe added little to the overall volume in circulation. In Thornton's view, European iron was not meeting an unfulfilled need in Africa; nor were Europeans offering a product that was qualitatively superior. Indeed, if there was a quality differential the advantage lay with 'steelier' African irons. Voyage iron was not necessary, nor was it capable of suborning African consumers from their traditional loyalties.²⁰

II

And yet Europeans persisted in bringing iron to African markets. It helped, of course, that the metal did not perish. Textiles were vulnerable to mould and insect infestation but bars that were unsold on one voyage could be used on another or warehoused on the coast.²¹ Voyage iron was a low-risk commodity. Far more important, however, was the profit to be earned, which was considerable. Voyage iron was a highly rewarding trade good because of the productivity gap between north European and African ironmaking. This disparity was of relatively recent vintage. At the end of the first millennium CE smelters in Europe and West Africa operated under a common technological regime. They both made iron by the direct method. Modestly sized furnaces, so-called bloomeries, could reach temperatures high enough to isolate iron from the other elements to which it was bonded in the ore. The outcome was a mass of spongy iron and slag: the bloom. Battering away the slag yielded a lump of malleable iron that a smith could work into the desired end product. This was batch production; each bloom was the result of a separate smelt. It was also small-scale; each smelt produced only a few kilos of metal.

Productivity at bloomeries was governed by the strength of the air draught introduced to the furnace. For as long as the draught

²⁰ Thornton, *Africa and Africans in the Making of the Atlantic World*, 45–7. See also Philip D. Curtin, *Economic Change in Precolonial Africa: Senegambia in the Era of the Slave Trade* (Madison, 1975), 207–11.

²¹ Keele University Library, Special Collections and Archives, Raymond Richards Collection (hereafter Richards Collection), William Davenport & Co. trading invoices and accounts, letter of instruction to William Hindle, commander of the *Tyrell*, 7 Feb. 1761; Rigsarkivet, Copenhagen, Det vestindisk-guineiske Kompagni, Bogholderen på Christiansborg, Vol. 909 and 927S, Negotiehovedbog and Negotiejournal 1749.

was supplied by hand-operated bellows, production levels remained low. In the first half of the second millennium CE that began to change as smelters in both Europe and West Africa explored new technological solutions. European iron workers looked to harness water power.²² Water-driven bellows allowed for an enlargement of the bloomery. Stumpy furnaces now grew taller. This did more than extend the scale of production; it started to change the nature of the product. The stronger draught generated hotter temperatures and a gaseous atmosphere capable of liquefying parts of the bloom. Droplets of metal made their way to the foot of furnace where they cooled into a crystalline deposit — cast iron — which was initially discarded as a waste product. Soon though, ironworkers learned how to refine cast iron into a malleable substance suitable for smithing. As a result, bloomeries were deliberately heightened and the air blast intensified to yield cast iron as a primary product. They evolved into blast furnaces, the first archaeological evidence for which dates from the twelfth century.²³ With this, the *direct method* gave way to the *indirect method*: the production of iron in a two-part operation involving the blast furnace and a finery forge. The first produced cast iron; the second converted it to malleable bar iron.

Water power was an essential component of this new production system; it was what distinguished European metallurgy from the African. It was not and could not be a technology of the Sahel, one of the heartlands of West African iron production. This was an environment that was both arid and labour-short, which militated against using either water or human muscle tissue as a store of energy. A strengthening of the air flow in a furnace could, however, be induced by heightening (but not widening) the structure. Furnaces grew taller, just as in Europe, making the Sahel the Manhattan of African metallurgy, with natural draught furnaces that might be four metres high. (Forced draught furnaces were often no more than shoulder

²² Adam Lucas, *Wind, Water, Work: Ancient and Medieval Milling Technology*, pbk edn (Leiden, 2011), 216, 251–5, 393–4.

²³ Nils Björkenstam, ‘The Blast Furnace in Europe during Medieval Times: Part of a New System for Producing Wrought Iron’, in Gert Magnusson (ed.), *The Importance of Ironmaking: Technical Innovation and Social Change* (Stockholm, 1995).

height.) Individual smelts took an extraordinarily long time — perhaps eight times longer than forced-draught bloomeries — but labour costs were lowered.²⁴ Just as in Europe, technological change resulted in a new product. The slower smelt allowed carbon to diffuse evenly into the bloom resulting in a high-quality steel rather than the more mixed results obtained from smaller, bellows-driven furnaces.

Between the eleventh and the sixteenth centuries, then, new patterns of iron production emerged in both West Africa and Europe. In Africa, a long-established ironmaking landscape began to break up. Small-scale production for local consumption had been pervasive and continued to be so, but areas that were blessed with unusually rich ores started to develop smelting capacity above and beyond local needs. This was still smelting on a batch basis but specialization enabled districts such as Bassar to produce surpluses for inter-regional trade from the sixteenth century onwards.²⁵ Even larger export surpluses were built up in northern Europe as new high-volume production systems came on stream. In the fifteenth century, just as Iberian navigators were beginning to trade slaves along the Guinea coast, the blast furnace/finery pairing became the standard method of iron production across the Rhine–Meuse basin and adjacent regions of northern France. It was a striking piece of synchronicity. When a transatlantic slave trade took root in the sixteenth century European traders had every incentive to include iron in the cargoes they shipped south because north European bars, produced at blast furnaces and water-powered forges with throughput speeds that African smelters were quite unable to match, could be hugely profitable. Voyage iron exchanged at far above its prime cost, allowing European traders a massive mark-up — that on iron carried to Senegambia on the Portuguese slave ship *Nuestra Señora del Vincimiento* in 1617 amounted to 1,200 per cent.²⁶ The margins calculated by

²⁴ David Killick, 'Invention and Innovation in African Iron-Smelting Technologies', *Cambridge Archaeological Journal*, xxv (2015), 313–14; Bruno Martinelli, 'On the Threshold of Intensive Metallurgy: The Choice of Slow Combustion in the Niger River Bend (Burkina Faso and Mali)', in Bocoum, *Origins of Iron Metallurgy in Africa*.

²⁵ De Barros, 'Bassar', 160.

²⁶ Linda A. Newson and Susie Minchin, *From Capture to Sale: The Portuguese Slave Trade to Spanish South America in the Early Seventeenth Century* (Leiden, 2007), 43–5.

Danish custom officials between 1757 and 1764 were not quite so sensational; they were substantial nonetheless. The returns on iron ranged from 141 to 262 per cent, making it the most lucrative commodity the Danes dealt in. There were other goods, such as tobacco pipes, which could bring in profits at over 200 per cent, but they were only sold in very small quantities. Textiles, which made up the bulk of what was taken to Africa, realized much lower returns, ranging from the 70 per cent to be had for Indian fabrics such as *romals* and *niccanees* to a meagre 14 per cent on long ells, a coarse English woollen.²⁷

Sourcing iron to trade in Africa was no simple matter though, for Europe’s major slaving powers were seldom leading iron producers. Most of Europe’s slave-trading economies were in fact net importers of iron. Perhaps only France was self-sufficient in the metal; Jean Barbot spoke of the ‘Province of Brittany’ as the source of the iron exported by the Compagnie du Sénégal in the 1690s.²⁸ But the Portuguese had no iron industry to speak of; nor did the Dutch. Both had to rely on imported iron. The Dutch were fortunate in that the Rhine and Meuse rivers gave them ready access to iron-producing districts in Wallonia, the Ardennes, and the Rhineland.²⁹ ‘Regarding the voyage iron for Genoa [Guinea]’, Amsterdam merchant Louis Trip reported in 1679, ‘we get it made inland, from Luxemburg and Germany’.³⁰ The English also resorted to imported iron, even though the British Isles did have a substantial iron industry, one that had grown rapidly in the sixteenth century. In the seventeenth century, however, English ironmasters encountered fuel shortages that put a ceiling on production. The consumption of iron in Britain could only continue to grow if domestic supplies were augmented by imports. Augmented they were, largely by bar iron from Sweden,

²⁷ Rigsarkivet, Copenhagen, Generaltoldkammeret — Aeldre del Vestindisk-guineisk renteskriverkontor, 1775–1803 Guineiske uafgjorte journalsager, vol 1037.

²⁸ Awnsham Churchill, *A Collection of Voyages and Travels*, 6 vols. (London, 1732), v, 44–5.

²⁹ Riksarkivet Stockholm, Bergskollegium Huvudarkivet, Relationer m.m. ang. utländska bergverk, E 3:27 och 28, vol. 2, ‘Om Jernverken på begge sidor om Rhenströmmen af R. Angerstein 1758’.

³⁰ Louis Trip to Jacob David, 12 Dec. 1679, in *Markets and Merchants of the Late Seventeenth Century: The Marescoe–David Letters, 1668–1680*, ed. Henry Roseveare (Oxford, 1991), 556.

baroque Europe's leading exporter.³¹ Indeed, by the end of the seventeenth century imported iron outweighed the local on the British market, and imports remained dominant until the very end of the eighteenth century.³² The voyage iron despatched to African markets from British quaysides was not a product of Britain's Industrial Revolution (which did not affect bar iron production in British forges until the 1790s); it was almost invariably a re-export.³³

The Royal African Company (RAC), which exercised a legal monopoly over English slave-trading in the late seventeenth century, purchased its iron from London's leading Baltic merchants.³⁴ The contractors were few in number and enjoyed long-lasting relations with the Company, not least because many of the men concerned were also directors of the Company.³⁵ A reliance on Swedish iron was to be a feature of the British slave trade until its legal extinction in 1807. Should Swedish supplies be insufficient, they could be supplemented by purchases made on the Dutch market. The London slave merchant Humphry Morice, for example, had his ship the *Portugal* call at Rotterdam to take on 'German bars' in 1724. Another of Morice's fleet, the *Anne*, loaded 'Liege bars' at the same port in 1730.³⁶ By contrast, and for reasons that will become clear below, very little voyage iron originated in Russia, even though Russian iron overhauled Swedish in the 1760s and 1770s to become the most widely traded in Europe.

Voyage iron had to be made to precise specifications: Africans demanded iron of the correct dimensions, iron of the correct weight, iron with the proper finish, and iron that bore

³¹ Karl-Gustaf Hildebrand, *Swedish Iron in the Seventeenth and Eighteenth Centuries: Export Industry before Industrialization*, trans. Paul Britten Austin (Stockholm, 1992), 25–42; Chris Evans and Göran Rydén, *Baltic Iron in the Atlantic World in the Eighteenth Century* (Leiden, 2007). The contribution of Europe's northern flank to the Atlantic slave system is rarely explored, but a recent addition to the literature is Felix Brahm and Eve Rosenhaft (eds.), *Slavery Hinterland: Transatlantic Slavery and Continental Europe, 1680–1850* (Woodbridge, 2016).

³² Peter King, 'The Production and Consumption of Bar Iron in Early Modern England and Wales', *Economic History Review*, lviii (2005), table 2 at 23.

³³ David Northrup, *Africa's Discovery of Europe 1450–1850*, pbk edn (Oxford, 2014), 61, 90–1, errs in linking voyage iron exports to the Industrial Revolution.

³⁴ The National Archives, London (hereafter TNA), T70/129 and 130, Royal African Company, minutes of the Committee of Goods, 1695–1703 and 1703–1720.

³⁵ K. G. Davies, *The Royal African Company* (London, 1957), 171–2.

³⁶ Bank of England Archive, London, M7/10 and M7/13.

recognisable stamps ('marks') attesting to its provenance. Voyage iron that did not meet the exacting requirements of African buyers would find no sale. 'These people begin to aske for iron barrs', one of the RAC's agents on the Gold Coast wrote in 1683, 'and I have a great many but they do not like them, for they must all be marked and no flaw's in them'.³⁷ Indeed, 'iron for the Guinea coast' had not only to be 'entirely smooth and soundly forged', a Dutch supplier of the 1660s explained, it had to be 'made according to the measurements which the blacks there demand'.³⁸ A Swedish observer of the 1670s elaborated:

The correct length of voyage iron or Guinea iron is about 11 feet, and of such weight that 18, 19 or 20 bars of it make 5 cwt or 76 to 80 bars in a cask of 20 cwt. It must be smooth and well forged. There is much discussion when there are cracks along the edge of the bars . . . The buyers in England take great offence at this.³⁹

Traders who arrived with iron of the wrong dimensions would be at a competitive disadvantage. The difficulty for European slavers was that the desired measurements shifted over time and timely notice of such shifts was required if they were to furnish what was needed. Writing in 1707, the RAC agent at Ouidah on the Bight of Benin advised 'that ye Iron bars you send may be 75 & 80 to ye Tun'.⁴⁰ Six years later, however, the Company was told to order voyage iron that was lighter at '84 barrs to the Tun'.⁴¹ The constant changes meant that voyage iron was a bespoke product. Its manufacture was therefore a specialized business. Voyage iron, a Gothenburg merchant told English clients in 1672, was 'rather troublesome to make and that not so many places can make it'.⁴² Hammermen with out-of-the-ordinary proficiency were needed.

³⁷ Robin Law (ed.), *The English in West Africa, 1681–1683: The Local Correspondence of the Royal African Company of England, 1681–1699: Part 1* (Oxford, 1997), 137.

³⁸ Louis Trip to Charles Maresco, 1 Feb. 1669, in *Markets and Merchants*, ed. Roseveare, 267.

³⁹ The Historical Metallurgy Group of the Swedish Ironmasters' Association, *Iron and Steel on the European Market in the 17th Century: A Contemporary Swedish Account of Production Forms and Marketing* (Stockholm, 1982), 197.

⁴⁰ TNA, T70/22, fo. 14: 'Schemes of Goods wanted And Abstracts of Letters from the Coast of Africa'.

⁴¹ TNA, T70/130, 25 Sept. 1713.

⁴² Jan van Savelant to Leonora Maresco & Peter Joye, 9 [?] Jan. 1672, in *Markets and Merchants*, ed. Roseveare, 341.

As one Swedish ironmaster admitted, 'not all my forges are suitable'.⁴³

The supply of voyage iron to English traders was confined to Sweden and the territories drained by the Meuse and the Rhine because ironmasters there were able to respond smartly to market signals in ways that their Russian counterparts could not. To be more accurate, Swedish ironmasters were able to respond to information brokered by iron merchants who catered for the slave trade, men such as Graffin Prankard (d. 1756), a Bristol ironmonger whose dealings in the 1730s are exceptionally well documented. Every winter Prankard would quiz returning slave captains about the state of the market along the African coast. Once he was satisfied about the dimensions currently favoured for voyage iron and had formed some idea of the volume required for the coming year, he issued instructions to his agent in Stockholm. This was in February. Prankard's man would then bargain with the Stockholm representative of the ironworks at Gammelbo, a place that regularly produced voyage iron to Prankard's order. Instructions from Bristol were thus conveyed to Gammelbo, deep in Sweden's wintry interior. The workers at Gammelbo's four forges, who had spent the year's darkest months making iron in generic forms, now turned their attention to making bars designed expressly for the African market.⁴⁴ Apprised of what was needed, the Gammelbo forgemen could accumulate a stock of correctly sized voyage iron, one ready for shipment once the ice in the Baltic began to break up and Stockholm's quays reopened for international trade. If everything went well, voyage iron from Sweden could be in Bristol and ready for dispatch between June and October, the peak months for ships clearing for African destinations.

This was not an arrangement that worked without hitch. Graffin Prankard's letter books are laced with complaints about bars that were under-sized ('I know not what to do with it . . . its length not above 10 foott long wch rendered it unsalable') or so heavy that he had to offer his clients rebates.⁴⁵ Yet communication with Stockholm was sufficiently slick to make it a workable arrangement. The same

⁴³ Henrik Cletcher to Leonora Maresco, 19 Feb. 1675, in *Markets and Merchants*, ed. Roseveare, 373.

⁴⁴ See the forge accounts from the 1730s at Gammelbo bruksarkivet.

⁴⁵ Somerset Archives, Taunton (hereafter SA), DD/DN 427, Prankard to Francis Jennings, 27 Sept. 1736, and DD/DN 439, Prankard waste book 1735–9, 22 June 1738.

arrangement could not be made to work with Russia. The time that would elapse between iron being forged on the Ural frontier of the Russian Empire and its arrival on British markets was too great.⁴⁶ As it took a full year for Siberian iron just to reach St Petersburg, voyage iron from Russia would inevitably conform to market information that had long ceased to be current. The bars would therefore have to be re-sized at an English rolling mill. Not only did this in itself bear a cost, but the iron thereby became a British manufactured article in the eyes of revenue officials and lost the customs drawback available to simple re-exports.⁴⁷

III

Voyage iron had to be of the correct size and weight because it acted as specie. The Scottish explorer Mungo Park reflected on this upon his arrival in Senegambia in the 1790s. Africans, he realized, appreciated iron for its use value but it was also used to embody exchange value.

In their early intercourse with Europeans, the article that attracted most notice was iron. Its utility, in forming the instruments of war and husbandry, made it preferable to all others; and iron soon became the measure by which the value of all other commodities was ascertained. Thus, a certain quantity of goods, of whatever denomination, appearing to be equal in value to a bar of iron, constituted, in the trader's phraseology, a bar of that particular merchandise. Twenty leaves of tobacco, for instance, were considered as a bar of tobacco; and a gallon of spirits (or rather half spirits and half water), as a bar of rum; a bar of one commodity being equal in value to a bar of another commodity.⁴⁸

Indeed, the ‘bar’ was the medium in which most of the commerce between Africans and Europeans was transacted. As such, the bar had a dual nature. On the one hand, it was an index of abstract value, as was made plain in the invoices of British slave ships which priced their cargo both in sterling and bars.⁴⁹ On the

⁴⁶ Maria Ågren, ‘Introduction: Swedish and Russian Iron-Making as Forms of Early Industry’, in Maria Ågren (ed.), *Iron-Making Societies: Early Industrial Development in Sweden and Russia, 1600–1900* (Oxford, 1998), 26–7.

⁴⁷ David Richardson and M. M. Schofield, ‘Whitehaven and the Eighteenth-Century British Slave Trade’, *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society*, xcii (1992), 18.

⁴⁸ Mungo Park, *Travels in the Interior of Africa* (Folio Society edn, London, 1984), 14.

⁴⁹ Examples include the Liverpool snow *Molly* (National Maritime Museum, London, Caird Library, MSS 76/027), which sailed in 1758, and the *Swift* of Bristol in 1759 (Bristol Archives, 39654/2).

other hand, the bar had tangible utility as a slab of metal. This dualism — the bar's capacity to embody both use value and exchange value — gave voyage iron its strange character. It was in steady demand as a store of wealth. It was also in demand as a material from which agricultural implements or weapons could be fashioned. European travellers commented on the skill with which African blacksmiths did so. Along the Sanaga river in present-day Cameroon local artisans used European iron to 'make their own Utensils, such as Spades, Hooks, Hatchets, &c. at which they are very dexterous'. At Barraku, on the Windward Coast, African smiths were observed hammering out iron delivered by the Dutch; they knew 'how to work [it] well, and make all Kinds of Arms or Weapons for themselves'.⁵⁰

Our knowledge of African consumption is imperfect but some broad patterns are clearly discernible.⁵¹ There was a sharp contrast between the coastal rainforests of West Africa, where high humidity and abundant rainfall inhibited smelting, and the drier savannah woodlands to be found further inland. The interior was well supplied with iron; the forested coast was not. Coastal people suffered from a historic 'iron hunger' that voyage iron could assuage.⁵² The impact that European iron had on the societies to which it was introduced has yet to be mapped systematically but the work of Walter Hawthorne on Guinea-Bissau (Senegambia) offers important pointers.⁵³ Portuguese traders were landing iron there by the 1490s, with the slave trade still in its infancy.⁵⁴ Not only was there a basic local demand for iron but that demand was extended and deepened by the slave trade itself. Voyage iron was taken up avidly in coastal communities, such as those of the Balanta, which needed weaponry to resist predatory neighbours in an age of intensifying slave-raiding. Indeed, to pay for iron, the Balanta

⁵⁰ John Green (ed.), *A New General Collection of Voyages and Travels: Consisting of the Most Esteemed Relations, which have been hitherto Published in any Language*, 4 vols. (London, 1745), ii, 459, 614.

⁵¹ Richardson, 'West African Consumption Patterns and their Influence on the Eighteenth-Century Slave Trade', table 12.2 at 312–15, and David Eltis, *The Rise of African Slavery in the Americas* (Cambridge, 2000), table 7.2 at 168.

⁵² A. F. C. Ryder, *Benin and the Europeans, 1485–1897* (London, 1969), 98.

⁵³ Walter Hawthorne, *Planting Rice and Harvesting Slaves: Transformations along the Guinea-Bissau Coast, 1400–1900* (Portsmouth, NH, 2003).

⁵⁴ Toby Green, *The Rise of the Trans-Atlantic Slave Trade in Western Africa, 1300–1589* (Cambridge, 2012), 116, 118.

resorted to slaving themselves. This leads Hawthorne to speak of an ‘iron-slave cycle’.⁵⁵ Moreover, as a defensive measure, Balanta people began to resettle in low-lying littoral zones whose mangrove swamps impeded the movement of raiding parties. In adapting to this new habitat, they turned to the cultivation of rice.⁵⁶ Paddies multiplied along the coastal creeks, allowing rice to be grown not just as a provision crop but as a marketable commodity. Iron was essential here too. Traditional tools made of fire-hardened wood could not cope with tangled mangrove roots; metal-tipped implements could. The effect of voyage iron on Guinea-Bissau was therefore twofold. It ratcheted up the seizure of captives while generating food surpluses that European slavers could use to sustain those captives during their transatlantic ordeal.

Rice was an ancient African grain, but voyage iron was also of profound importance for the New World cultigen that were introduced to coastal West Africa in the early modern era. The plant species that the Colombian Exchange brought to the Guinean forests — cassava, beans and maize — were transformative. They supplied bulk carbohydrates to a region that had previously known shortage, allowing for a sharp rise in the coastal population, a more complex social division of labour, the emergence of royal bureaucracies, and the formation of standing armies. Maize was of particular significance. Yielding two crops a year and requiring relatively little labour, it spread rapidly through the forest zone. But the success of maize depended upon piercing the forest canopy, for it is a species that demands abundant sunlight if it is to thrive. The ‘agricultural carbohydrate revolution’ that advanced through the coastal forests from the sixteenth to the eighteenth century therefore required the clearance of timber on a grand scale, which required in turn a ready supply of iron tools.⁵⁷ Moreover, this was not a one-off event, a single pulse of demand. Because of the very

⁵⁵ Hawthorne, *Planting Rice and Harvesting Slaves*, 96–8.

⁵⁶ Toby Green, ‘The Export of Rice and Millet from Upper Guinea into the Sixteenth-Century Atlantic Trade’, in Robin Law, Suzanne Schwarz and Silke Strickrodt (eds.), *Commercial Agriculture, the Slave Trade and Slavery in Atlantic Africa* (Woodbridge, 2013).

⁵⁷ James McCann, ‘Maize and Grace: History, Corn, and Africa’s New Landscapes, 1500–1999’, *Comparative Studies in Society and History*, xlvi (2001), 258.

long fallow periods favoured by forest agriculturists trees were able to re-establish themselves. As a result, programmes of clearance had to be re-enacted, again and again.⁵⁸ Voyage iron, fashioned into axes and hoes by African smiths, was therefore an essential element of the Colombian Exchange in West Africa.⁵⁹ Repeated sales of iron, humdrum in themselves, thus contributed to an epochal re-orientation of West African societies and economies. There was a shift in the centre of social gravity, away from the city states and empires of the interior, and away from the trans-Saharan caravan trade that had for centuries linked them to the Mediterranean world. The Atlantic now exerted a gravitational pull it had previously lacked.

IV

The extent of voyage iron imports is difficult to assess, but there is evidence enough to suggest that they represented a major addition to the stock of iron in West Africa. 'I have before now delivered 20,000 to 25,000 bars in one year', Louis Trip of Amsterdam told a London customer in 1679. That was equivalent to between 268 and 335 tons.⁶⁰ The archive of the Royal African Company provides a further snapshot, this time for 1707. With the transatlantic slave trade on the increase, the Company asked its agents in the field for an up-to-date assessment of the quantities to be held at each of the Company's forts and trading posts. The answer from Upper Guinea (Senegambia and Sierra Leone) was that 13,600 bars or about 176 tons should always be in stock.⁶¹ The Gold Coast, with

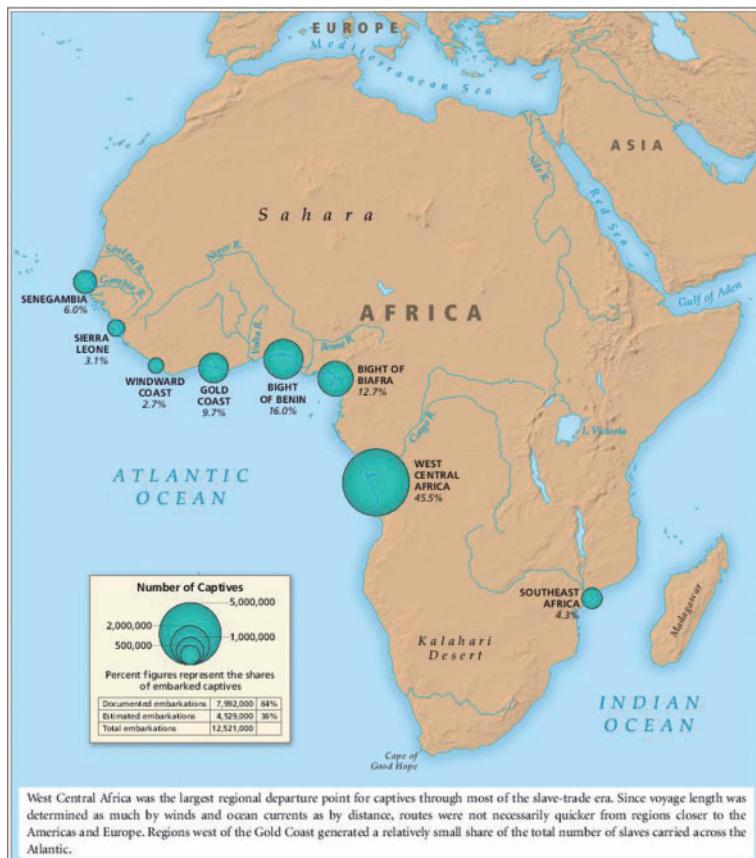
⁵⁸ Ivor Wilks, 'Land, Labor, Gold, and the Forest Kingdom of Asante: A Model of Early Change', in his *Forests of Gold: Essays on the Akan and the Kingdom of Asante* (Athens, Ga., 1993).

⁵⁹ Christopher R. DeCorse, *An Archaeology of Elmina: Africans and Europeans on the Gold Coast, 1400–1900* (Washington, DC, 2001), 111–13; A. G. Hopkins, *An Economic History of West Africa* (London, 1973), 29; Robin Law, *The Slave Coast of West Africa 1550–1750: The Impact of the Atlantic Slave Trade on an African Society* (Oxford, 1991), 43–4; Randy J. Sparks, *Where the Negroes Are Masters: An African Port in the Era of the Slave Trade* (Cambridge, Mass., 2014), 12–13.

⁶⁰ Louis Trip to Jacob David, 12 Dec. 1679, in *Markets and Merchants*, ed. Roseveare, 556. Trip wrote at a time when the standard weight for a bar was between 28 and 30 English pounds.

⁶¹ TNA, T70/22, fo. 28A, 'Memorial of Merchandise proper for the Trade of this River & to be dispatched by January 1708', a report from Jon Snow, Fort James, 23 June 1707.

MAP



West Central Africa was the largest regional departure point for captives through most of the slave-trade era. Since voyage length was determined as much by winds and ocean currents as by distance, routes were not necessarily quicker from regions closer to the Americas and Europe. Regions west of the Gold Coast generated a relatively small share of the total number of slaves carried across the Atlantic.

THE SLAVE-EXPORTING COASTAL REGIONS OF AFRICA, 1501–1867

Source: David Eltis and David Richardson, *Atlas of the Transatlantic Slave Trade* (New Haven, 2010). By permission of the publishers. Copyright © 2010 Yale University. All rights reserved.

nine Company factories along its length, took far more: 52,900 bars were requested, equivalent to 865 tons.⁶² A clear answer did not emerge from the Slave Coast (Bight of Benin). The Company's agent at Ouidah restricted himself to noting that sales of iron were concentrated in the first two months of the year when local agriculturalists prepared their fields for planting.⁶³ Overall, the Royal African Company committed itself to keeping a minimum of 1000 tons of iron on the West African coast in 1707–8.

Stocks are not the same as sales, but they are indicative. And to the volume warehoused by the English must be added the stocks held by the Dutch at their forts, and the contributions made by other nations, not least the French, whose slave trade was on the verge of explosive growth. Actual sales could be erratic, of course, as erratic as the slave trade itself. In 1738, his best year in the trade, Graffin Prankard of Bristol sold 616 tons of voyage iron to the slave merchants of his city. Five years earlier, however, with 'our Guinea Trade . . . wholly at a stand', he had managed just 148 tons.⁶⁴ Even so, the volume of iron being landed in West Africa surely rose during the eighteenth century. Not only was the trade in captives expanding but the areas of greatest growth, such as the Bight of Biafra, had a marked appetite for European metals.⁶⁵ There is no comprehensive body of evidence with which to document the inflow of iron, but it must have been considerable. That, at least, is the message of what little hard data survives. Some 954 tons of voyage iron was shipped from Stockholm in 1739, mostly for English ports.⁶⁶ Allowing for a parallel export from Gothenburg, perhaps 1,350 tons of voyage iron left Sweden that year.⁶⁷

⁶² TNA, T70/22, fos. 37–38, 'An Indent or List of ye Sorts and Quantitys of Goods that ought always to be for Stock in each and every Castle fort & factory on ye Gold Coast' [1708].

⁶³ TNA, T70/22, fo. 8, Richard Willis to the Committee of Goods, 9 May 1706.

⁶⁴ SA, DD/DN 438–9, Prankard waste books, 1732–5 and 1735–9; SA, DD/DN 425, Prankard to Francis Jennings, 28 Apr. 1733.

⁶⁵ Richardson, 'West African Consumption Patterns and their Influence on the Eighteenth-Century Slave Trade', table 12.2 at 312.

⁶⁶ Riksarkivet, Stockholm, Manufakturkontorets arkiv, Handlanden Peter Westmans utskeppningsböcker 1729–45, vol. 490.

⁶⁷ Staffan Högberg, *Utrikeshandel och sjöfart på 1700-talet: Stapelvaror i svensk export och import 1738–1808* (Lund, 1969), 62, suggests that Stockholm routinely accounted for about 60 per cent of Sweden's iron exports in the eighteenth century and Gothenburg 25 per cent. If this ratio held true for voyage iron, 390 to 400 tons would have departed Gothenburg in 1739.

This was a formidable quantity, one that eclipsed the productive capacity of any specialist smelting zone in sub-Saharan Africa. African smelters were unquestionably skilled and numerous but they were restricted to small batch production and could not match the productivity of northern European ironmakers. Bassar, the West African production complex hailed as being of ‘continental importance’, for example, produced an annual maximum of just eighty tons in the eighteenth century.⁶⁸ The smelting district of Fiko in present-day Mali appears to have exported a large surplus to the interior delta of the Niger but the best estimates of its annual output are in the tens not the hundreds of tons.⁶⁹ The Babungo chiefdom, another specialized smelting district, might have achieved an output of 100 tons annually in the nineteenth century (a figure that ‘may sound unbelievable’ in the view of its investigators) but rather less than that in the eighteenth.⁷⁰ Seen in this context, voyage iron can hardly be dismissed as marginal. Indeed, the indications are that African demand for voyage iron was on an upward path. Tellingly, the size of the standard bar was shrinking over the course of the eighteenth century. Bars made for the African market in the seventeenth century were between twenty-eight and thirty English pounds apiece. By the time of the American Revolution the standard weight had slipped below twenty pounds; by the first decade of the nineteenth century voyage iron was consistently below fifteen pounds per bar (see Figure 1). This phenomenon is best explained by a growing appetite for iron in West Africa, which pushed prices higher. The quantity of metal that European traders had to offer to obtain a ‘bar’ of value in African slave marts shrank accordingly. The terms of trade were turning in favour of

⁶⁸ Barros, ‘Bassar’, 164, 168.

⁶⁹ Smelting at Fiko extended over an extraordinarily long period, from the sixth century CE to c.1900. The slag remains imply a yearly production (assuming uninterrupted production over those centuries) of 12 tons. See Sébastien Perret and Vincent Serneels, ‘Technological Characterization and Quantification of a Large Scale Iron Smelting Site in Fiko (Dogon Plateau, Mali)’, paper given at the 36th International Symposium on Archaeometry (Quebec City, 2006); Caroline Robion-Brunner *et al.*, ‘A Thousand Years of Metallurgy on the Dogon plateau (Mali)’, paper given at the 18th Biennial Meeting of Africanist Archaeologists (Calgary, 2006). Both papers are available at <https://www.researchgate.net/profile/Vincent_Serneels/publications>.

⁷⁰ Warnier and Fowler, ‘Nineteenth-Century Ruhr in Central Africa’, 338; Fowler, ‘Babungo’, 169–70.

Europe. This makes the case of iron highly unusual. In almost every other regard, the terms of trade were moving Africa's way, as David Northrup explains:

The sharply increased demand for African slaves, the rising competition among Europeans, and the growing centralization of African ties to the Atlantic trade all served to strengthen African trading positions. As the terms of trade shifted steadily in their favor, African traders received goods for each slave worth three or four times as much in 1800 as a century earlier.⁷¹

V

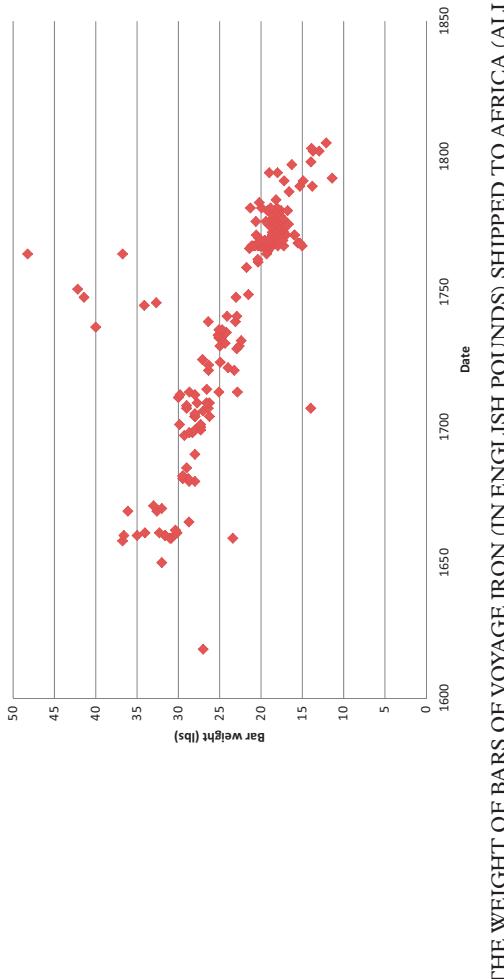
We are now in a position to address some basic questions about the overarching ferrous relationship between Africa and Europe in the era of Atlantic slavery. Africa was not, it must be said, a major market for north European exporters. If 1,350 tons of voyage iron was shipped from Stockholm and Gothenburg in 1739 it amounted to less than four per cent of Sweden's total export at that time.⁷² There is no reason to suppose that the African market loomed any larger for ironmasters in the Rhine–Meuse basin or in western France. European iron made its way to Africa in other ways, of course. It was embodied in many of the manufactured goods that played a key role in the Atlantic slave trade, most notoriously in musket barrels. Nevertheless, we can be tolerably confident that Africa absorbed only a small proportion of European iron output.

But what of the importance of voyage iron for African consumers? This is a far more complex issue. Iron was rarely a major component of a slave ship's cargo, not in terms of value. It was a dependable, indeed indispensable, staple but, like many other workaday commodities, it is easily overlooked. Indigenous African irons have proved far more beguiling to scholars because they raise such profound questions about technological creativity and cultural transmission. The issue of whether ferrous smelting diffused into sub-Saharan Africa or was an autochthonous development carries — for some at least — a political charge. The tenacity of sub-Saharan smelting traditions,

⁷¹ Northrup, *Africa's Discovery of Europe*, 61; David Eltis and Lawrence C. Jennings, 'Trade between Western Africa and the Atlantic World in the Pre-Colonial Era', *American Historical Review*, xciii (1988), 942–4.

⁷² Hildebrand, *Swedish Iron*, 25–6.

FIGURE 1



THE WEIGHT OF BARS OF VOYAGE IRON (IN ENGLISH POUNDS) SHIPPED TO AFRICA (ALL REGIONS), 1600–1850

Figure 1 shows the weight of individual iron bars traded to Africa. The data are mostly from the invoices of English vessels, which conventionally recorded the number of bars in a consignment and their overall weight. We have 230 data points between 1617 and 1810. That for 1617 is an outlier; it is not until 1658 that our data begin in earnest. Thereafter the data are reasonably continuous, albeit with gaps in the 1670s, between the mid 1680s and mid 1690s, the late 1710s, and the mid 1750s. The downward trend over the course of the eighteenth century is clear, despite some anomalously high observations in the mid-eighteenth century. The iron loaded on the *Sisters* in 1764 was designated as 'Large Bars', each of 36 lbs, rather than voyage iron, suggesting that it was not intended as a trade article. The bars carried on the *Little Britain* in the same year are described as voyage iron but they are so off-trend — 48 lbs at a time when the standard bar was about 20 lbs — that there is no ready explanation. Iron carried to the Gold Coast by the Danes in the 1740s and 1750s divides into two quite distinct types. Some parcels conform closely to the overall trend; others are markedly heavier. It may be that the heavier bars were intended for use by smiths at the Danish fort of Christiansborg.

Principal sources: Margaret Makepeace, 'English Traders on the Guinea Coast, 1657–1668: An Analysis of the East India Company Archive', *History in Africa*, xvi (1989); *Markers and Merchants*, ed. Rosevere; TNA, T70/129–130; Bank of England Archive, Monice MSS; Somerset Archives, Dickinson MSS; Rigsarkivet, Copenhagen, MSS 209, 300–01; Richards Collection, Davenport & Co. MSS; MMM, Davenport MSS; Liverpool Record Office, Tuohy MSS; University of Michigan, Clement Library, Leyland MSS; HSBC Archive, Leyland MSS; Liverpool Record Office, Leyland MSS.

which endured into the twentieth century, bears political freight too. It demonstrates the resilience of indigenous knowledge in the face of colonial science. This reversal of colonial-era assumptions about Africa's technological poverty is refreshing, but the contribution of voyage iron to sub-Saharan life should not thereby be dismissed. The evidence provided above suggests that European bar iron played a vital role.

The coastal forests of West Africa were deeply affected, as the experience of Guinea-Bissau and the Gold Coast suggests. The arrival of European metal along coastlines that had traditionally been short of iron facilitated an assault on the forest and an agricultural revolution based upon New World crops. Voyage iron thereby introduced a commercial and social dynamism to stretches of the Atlantic littoral that had hitherto been quiescent. The intensification of the slave trade in the eighteenth century deepened the demand for voyage iron (as suggested by Figure 1). Iron was needed for arming aggressive slave-exporting states such as Asante. The use made of European muskets by slave-raiders is well-attested, but locally manufactured spears, blades and arrowheads were also necessary if the cycle of seizure and sale was to continue. Weaponry, of course, was also sought after by groups who were vulnerable to enslavement. Voyage iron, it might be said, helped to create its own demand.⁷³ That demand was not evenly distributed, however. European iron was always wanted in Guinea-Bissau, the seat of Hawthorne's 'iron-slave cycle', and it was a major item of trade to the Bight of Biafra, but it found strikingly few takers in West Central Africa. Indeed, the lack of interest in imported iron south of the equator demands fuller investigation.⁷⁴ So too does the chronology of the trade in voyage iron. The Portuguese were shipping iron to Guinea before the fifteenth century was out, but the volumes traded from Portuguese forts on the Gold Coast do not appear to have been significant before the 1550s, and it was only in the second quarter of the seventeenth century that voyage iron became an important

⁷³ Killick, 'Invention and Innovation in African Iron-Smelting Technologies', 316.

⁷⁴ Richardson, 'West African Consumption Patterns and their Influence on the Eighteenth-Century Slave Trade', table 12.2 at 315; Joseph C. Miller, 'Imports at Luanda, Angola: 1785–1823', in Gerhard Liesegang, Helma Pasch and Adam Jones (eds.), *Figuring African Trade: Proceedings of the Symposium on the Quantification and Structure of the Import and Export and Long-Distance Trade in Africa, 1800–1913* (Berlin, 1986), 193.

feature of Luso-African exchange.⁷⁵ Indeed, the period from the 1620s to the 1640s seems to mark a turning point on the Gold Coast when first the Portuguese and then the Dutch began to land iron in large quantities. A similar chronology is evident along the Bight of Benin. The importation of iron, which can first be documented in the 1580s, underwent an upswing in the 1630s and 1640s when iron 'won a permanent and prominent place in the Benin trade'.⁷⁶ Similar step-changes in the eighteenth century are harder to detect but aggregate growth seems likely because those parts of the coast that saw the biggest increases in the export of captives were also those most disposed to accept payment in iron.

It seems reasonable to assume that per capita consumption of iron rose in West Africa in the age of Atlantic slavery, especially if population growth was damped or reversed by the shipment of people across the ocean. Archival evidence and the archaeological record are in accord. The former suggests that European iron imports were on an upward trajectory; the latter points to a substantial growth of indigenous smelting. The volume of iron circulating through West Africa in the eighteenth century must have greatly exceeded that available three centuries earlier when Euro-African trade got underway. The full implications of this await exploration but some preliminary propositions can be advanced. One is that metalworking crafts in West Africa must have undergone extensive growth during the era of Atlantic slavery. Certainly, they cannot have been held back by a shortage of material. This suggests the possibility of greater specialization, increased labour productivity, and 'industriousness' in the seventeenth and eighteenth centuries — a possibility that invites further investigation.⁷⁷

There is something else that requires further study: the relationship between imported iron and the native product. This remains obscure. That there was an underlying geographical complementarity is plain enough; voyage iron flooded the forest zones whilst indigenous smelting was practised most successfully

⁷⁵ John Vogt, *Portuguese Rule on the Gold Coast 1469–1682* (Athens, Ga., 1979), 69, 74.

⁷⁶ Ryder, *Benin and the Europeans*, 98.

⁷⁷ Gareth Austin, 'Labour-Intensity and Manufacturing in West Africa, c.1450–c.2000', in Gareth Austin and Kaoru Sugihara (eds.), *Labour-Intensive Industrialization in Global History* (London, 2013).

in the semi-arid interior. In that sense, the role of voyage iron was simply to make good a historic deficit in the tropical forests of West Africa. But European iron and African irons were not exact substitutes. Voyage iron was a malleable material from which every particle of carbon had been expunged. Its malleability meant that voyage iron was not suitable for the manufacture of tools that needed a cutting edge — things that could bite into wood or flesh — for it was too easily deformed. Historically, European manufacturers overcame that difficulty by welding a thin edge of steel onto a body of malleable iron. Such composite tools, combining hard but expensive steel with softer but cheap iron, were standard across Eurasia. In Africa they were unknown, no doubt because West African smiths worked up blooms which, being heavy with carbon, could be made into effective sharp-edged implements without the addition of welded steel. In European iron, therefore, artisans in coastal West Africa encountered a material that was quite unsuited for making bladed tools in the traditional African manner. Why then did voyage iron continue to find a market?

Three possibilities suggest themselves. The first is that voyage iron was not sought out as an industrial input; its purpose was to act as a store of wealth. Iron certainly served as a currency, as we have seen. Like many commodities circulating in West Africa, it had an amphibious character: sometimes a producer good, sometimes a currency, sometimes even a consumer good (when worn as adornment).⁷⁸ But if voyage iron was primarily a currency we would expect it to depreciate over time as the volume entering West Africa mounted. That did not happen. On the contrary, as Figure 1 makes plain, the value of voyage iron vis-à-vis the 'bar' appreciated over the course of the eighteenth century. There is a second possibility — that voyage iron was recognised as an inferior material and accepted as such. It may have made unsatisfactory tools that wore out quickly but a ready supply of iron did at least allow African smiths to make implements that were morphologically respectful of local traditions. An officer of the RAC pointed to this when he requested that iron be sent to Winneba on the Gold Coast to be

⁷⁸ Jane I. Guyer, *Marginal Gains: Monetary Transactions in Atlantic Africa* (Chicago, 2004).

made into ‘cuntrey hatchets’, which wood-cutters in the Company’s service preferred to steel-edged European axes.⁷⁹

Yet there is a third, intriguing possibility: that voyage iron was combined with the obdurate high-carbon irons made by African smelters. If this was the case, voyage iron did more than occupy a hitherto vacant space in West Africa’s productive landscape; it precipitated new, hybridized forms of metalworking. Direct evidence for this is scant, admittedly. Smithing, as opposed to smelting, has received little attention from archaeometallurgists, not least because its residues are so exiguous and difficult to interpret.⁸⁰ Even so, metallographic examination of precolonial iron artefacts has yet to reveal a single example of composite tool manufacture.⁸¹ There is some suggestive indirect evidence, however. As noted above, metalworking by African smiths, both free and enslaved, was a feature of the forts that Europeans established on the Gold Coast. Those working at Cape Coast Castle developed hybrid working practices, using English tools but without conforming to English craft traditions. The enslaved workers also departed from local custom; necessarily so, because they were often shipped in from more distant parts of West Africa, some from the Gambia.⁸² The coastal forts were small and atypical places, of course, but there are hints in the archival record that African labour and European materials were cross-pollinating at other points along the coast. English ships carried anvils as trade goods to the rivers of Cameroon (Bight of Biafra) in the 1760s and 1770s, for example. This can only mean that African smiths had begun to use European equipment in the place of traditional stone anvils, for this was a region where there were no European shore installations.⁸³

⁷⁹ Robin Law (ed.), *The English in West Africa, 1685–1688: Local Correspondence of the Royal African Company of England, 1681–1699: Part 3* (Oxford, 2006), 432.

⁸⁰ Duncan E. Miller and Nikolaas J. Van Der Merwe, ‘Early Metal Working in Sub-Saharan Africa: A Review of Recent Research’, *Journal of African History*, xxxv (1994), 28; Chirikure, *Metals in Past Societies*, 105–8.

⁸¹ David Killick, ‘A Global Perspective on the Pyrotechnologies of Sub-Saharan Africa’, *Azania: Archaeological Research in Africa*, li (2016), 73.

⁸² Simon P. Newman, *A New World of Labor: The Development of Plantation Slavery in the British Atlantic* (Philadelphia, 2013), 129–30; William St Clair, *The Grand Slave Emporium: Cape Coast Castle and the British Slave Trade* (London, 2006), 132–6.

⁸³ Richards Collection, William Davenport & Co. trading invoices and accounts 1761–73 (for ten anvils carried on the *King of Prussia* in 1767) and 1772–85 (for twenty-four anvils on the *Badger* in 1775).

At this point conclusions based upon the documentary record must give way to conjecture. Some degree of hypothesizing is permissible, however. There was, after all, nothing odd about hybrid Euro-African products. The famous *kente* cloth of Asante, to name just one, was reliant upon unravelling imported textiles for yarn.⁸⁴ And creolized technological systems were a feature of the African Diaspora in the Americas. The contribution of African expertise to the development of rice cultivation in South Carolina and Maranhão is now well known, although the exact nature of that contribution is controversial.⁸⁵ The activities of diasporic blacksmiths in the Caribbean have also attracted some attention, although hybridized techniques have been more readily deduced than demonstrated.⁸⁶

Taking a broad Atlantic view will help if the ferrous relationship between Europe and sub-Saharan Africa is to be unravelled. In broad-brush terms, Europe exported huge quantities of agricultural hardware to the Americas but relatively little raw metal.⁸⁷ In Africa, the reverse applied: European traders landed large volumes of bar iron but the trade in agricultural implements was far more modest. The contrast is very visible in the archive of the Vestindisk-Guineisk Kompagni. The *Laarburg Galleij*, which sailed for the Caribbean in 1735, carried 3,000 hoes, 500 axes, and 180,000 examples of that indispensable ingredient in European building systems, the nail.⁸⁸ Danish ships headed for Africa without hoes and without nails. This contrast reflected the historic absence of ferrous metallurgy in the Americas. Pre-Colombian civilisations were essentially lithic. West Africa, by

⁸⁴ Kriger, ‘‘Guinea Cloth’’, 124–5.

⁸⁵ Judith A. Carney, *Black Rice: The African Origins of Rice Cultivation in the Americas* (Cambridge, Mass., 2001); S. Max Edelson, *Plantation Enterprise in Colonial South Carolina* (Cambridge, Mass., 2006); David Eltis, Philip D. Morgan and David Richardson, ‘Agency and Diaspora in Atlantic History: Reassessing the African Contribution to Rice Cultivation in the Americas’, *American Historical Review*, cxii (2007); and the forum in *American Historical Review*, cxv (2010).

⁸⁶ Candice L. Goucher, ‘African Metallurgy in the Atlantic World’, *The African Archaeological Review*, xi (1993); Candice L. Goucher, ‘Iron Sails the Seas: A Maritime History of African Diaspora Iron Technology’, *Canadian Journal of Latin American and Caribbean Studies/Revue canadienne des études latino-américaines et caraïbes*, xxxviii (2013).

⁸⁷ Chris Evans, ‘The Plantation Hoe: The Rise and Fall of an Atlantic Commodity’, *The William and Mary Quarterly*, lxix (2012).

⁸⁸ Rigsarkivet, Copenhagen, Det vestindisk-guineiske kompagnie, Bogholder og kasserer, Fagturabog, vol 300.

contrast, could boast a long tradition of metalworking. That meant a taste for European metals rather than hardware.

Is it too much to think of Europe on the eve of the industrial era and West Africa in the age of the Atlantic slave trade as interlinked parts of a single Iron Age landscape? To think of Hanoverian London or Gustavian Stockholm as Late Iron Age settlements may strain credulity. To be sure, the notion of an Iron Age can be a conceptually blunt instrument; it certainly is for a good many Africanists. And yet, thinking of a common Iron Age may be helpful in dissolving the conceptual cordon that separates Africa from Europe. In metallurgical terms, the boundary separating Europe and Africa did not respect the continental frontier marked by the Mediterranean. In fact, the real division is not between continents; it is within Europe. The indirect process — the high-volume procedure that paired blast furnaces and forges — was largely restricted to a zone north of the Alps. Southern Europe in the eighteenth century was ‘African’ (or Africa was ‘south European’) in that iron was made in a single-step procedure at a bloomery. To distinguish between advanced European and primitive African technologies is therefore to introduce a false division. It is better to conceive of a single ferrous universe in the eastern Atlantic through which iron of various types circulated, but circulated in ways that disrupt our expectations. Iron, a basic producer good, did not flow from an African periphery to a north European core. Quite the contrary, the ostensible core exported to the ‘periphery’.

It would be preferable, in fact, to jettison that core-periphery polarity and to think instead of networked smelting zones and manufacturing districts that traded raw metals, semi-manufactured articles, and consumer goods in ways that were multidirectional. Hanoverian England, for example, was a place at which a great number of metallic commodity chains intersected. All manner of ferrous material could be had on English quays: pig iron from the Chesapeake; bar iron fetched from Sweden and Russia; and steel imported from Germany. Britain’s manufacturing success stemmed from the number and variety of metals that were at the disposal of its artisans. Metallic abundance allowed workers to select materials with precisely the hardness, or ductility, or tensile strength they required. A wealth of different metals also allowed materials to be combined in cost-effective ways.

Might West Africa be usefully thought of in the same way—as a part of the world that benefitted from an increase in the supply of iron from both local and overseas sources? Just such a reliance on imported bar iron had been a feature of the English economy in the century before 1750. Heavy imports of Swedish iron had allowed per capita consumption to double and the metal trades of Hanoverian England to flourish.⁸⁹ Could developments in West Africa be an equatorial echo of this earlier process, despite the disabling loss of population to the Atlantic slave system? West Africa's seaborne connections to Europe began in the fifteenth century with an outflow of gold but, with regard to African agriculture and handicrafts in the precolonial period, the inflow of a base metal may have been more consequential.

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⁸⁹ King, 'The Production and Consumption of Bar Iron', table 2 at 23.