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"Guinea Rods" and "Voyage Iron": metals in the Atlantic slave trade, their European origins and African impacts[1]

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The merest glance at the invoice of a slave ship – the detailed listing of the articles that were to be bartered for captives on the Guinea coast – puts paid to the notion that European traders were able to obtain slaves by offering a few trashy gewgaws to their African counterparts. The typical invoice, which extended over many pages, itemised an enormous variety of goods, few of them cheap. Indeed, slave merchants in European ports took great pains to source goods that would command a high price on the African coast. They knew that African consumers were discerning; only articles that matched African tastes and met local quality standards would find a market. Europeans also knew that African demand was dynamic. As David Richardson's research reveals, African consumption patterns varied from place to place along the coast and changed markedly over time.[2]

Most imports into West Africa were consumer goods, very often articles that allowed for personal display or ceremonial splendour.[3] Overwhelmingly, these were textiles: at first, woollens and linens from Europe; later, cottons from India. By the middle of the eighteenth century Indian fabrics were of paramount importance: *allejars*, *niccanees*, *romals*, and the rest.[4] The 1600s and 1700s have been labelled Europe's Asian Centuries, an age in which objects from the East became embedded in the material culture of the West. They might equally be labelled Africa's Asian Centuries, for articles from the Indian Ocean, whether cowrie shells or cottons from Bengal, were indispensable in the

[1] This paper is based upon research carried out in conjunction with Göran Rydén (Uppsala University) with the support of Riksbankens Jubileumsfond.

[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: Academic Press, 1979), pp. 303-330.

[3] Stanley B. Alpern, 'What Africans got for their slaves: a master list of European trade goods', *History in Africa*, 22 (1995), 5-43.

[4] 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: Oxford University Press for the Pasold Research Fund, 2009), pp. 105-26.

Atlantic slave trade.[5] Textiles often accounted for the greater part of the value of a ship's cargo but they were never the sole component. African merchants insisted on a basket of goods. Typically, bolts of cloth would be sold in conjunction with cowrie shells and glass beads; guns, gunpowder, and shot; ceramic wares; alcohol and tobacco; and articles of clothing. Then there were metal wares. The *Fly*, for example, which sailed from Bristol in 1787, carried several hundred brass pans, dozens of pewter basins, and a wide selection of smaller metal consumables (razors, padlocks, penknives, mirrors, scissors, and gilt earrings).[6] Such things were well calculated to appeal to African consumers whose choices were, in the words of one leading Africanist, 'moved by prestige, fancy, changing taste, and a desire for variety'.[7]

But what of metals that were not consumer articles, copper and iron in their raw unmanufactured form? These were among the staples of European-African trade, as the invoice of another slave ship, the *Africa*, which cleared Bristol for the Bight of Biafra in 1774, suggests. The *Africa* loaded 1,530 bars of iron – close on 13 tons – and 4000 copper rods.[8] 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, making it a common part of material culture in all parts of the premodern world. Copper and brass (a copper-zinc alloy) were accordingly traded to Africa from the very earliest expeditions of the Portuguese. This material was sourced in northern Europe, from well-established smelting and processing centres like Liège and Aachen, and, from the seventeenth century, from Sweden. In other words, the export of cupreous material to Africa in the baroque era was in the hands of the Dutch, who controlled the marketing of copper and brass from Scandinavia.

That network dissolved in the early eighteenth century in the face of an abrupt reconfiguration of European (and global) copper production, one brought about by the introduction of coal-fuelled smelting processes in the British Isles. The key breakthrough came in the 1680s in the Bristol region when the reverberatory furnace was successfully adapted to the smelting of copper ores. This was to introduce a technological schism into European (and global) copper making for a century and half to come. Copper was henceforth made in one of two ways: it was *either* smelted according to an age-

[5] http://www2.warwick.ac.uk/fac/arts/history/ghcc/eac/.
[6] The National Archives [TNA], C 107/1, 'Fly's Insett from Africa & Antigua', 28 June 1787.
[7] John Thornton, *Africa and Africans in the Making of the Atlantic World, 1400-1800* (Cambridge: Cambridge University Press, 1998), p. 45.
[8] Bristol Record Office, 45039.

old Eurasian and African norm by means of a charcoal-fired blast furnace *or* it was made by the coal-fuelled methods taken up in Britain, what became known as the 'Welsh process'.[9]

The coal-fuelled method was identified with Wales for good reason. After the initial success in the Bristol region, coal-smelting begin to slip westwards to the Swansea-Neath district, where the South Wales coal measures outcropped close to the coast and to which seaborne ores from Cornwall could be freighted at low cost. It was a spectacularly successful formula. British smelters (in effect, Welsh smelters) started to make their mark in the middle decades of the eighteenth century. In 1690 the Welsh contribution to the world copper output stood at zero (and the overall contribution from Britain barely registered besides the major European centres in Sweden, Saxony or Slovakia), but by 1740 Welsh copper works were smelting nearly one quarter of the world's copper. By 1770 they were producing one half.

That a British copper industry should emerge at the tail end of the seventeenth century, just as the English made their first serious inroads into slave trafficking, was more than coincidence. The slave Atlantic constituted an important source of external demand for the fledgling industry. The close relationship between copper and slaving was soon evident in investment patterns and product design. Investors in copper were very often investors in slaving. That so much of the entrepreneurial impetus behind Britain's copper industry originated in Bristol proved to be telling. Slavers were apt to take shares in copper works because they thereby gained privileged access to the supplies they needed for trading on the Guinea coast; copper masters were likely to take shares in slaving ventures because they thereby secured a market for their metal. This much is evident in the earliest copper works to be established in the Swansea valley, those at Llangyfelach (1727) and White Rock (1739). The partnerships that established them were led respectively by Richard Lockwood, a director of the Royal African Company, and Thomas Coster, MP for Bristol, and a merchant who was deeply involved in shipping captives to South Carolina.[10]

These works were specifically equipped for the production of articles used in slaving. One of the earliest engraved views of the White Rock works shows a structure clearly labelled as the 'Manilla House'. Llangyfelach experimented from the word go with the copper rods that served as one of the essential currencies in many African slave marts. 'Guinea rods' were manufactured in the dimensions and with the finish that would satisfy customers in West Africa. If, wrote the Llangyfelach works manager, 'Negroes like the bars [better] for the print of the hammer' then so be

[9] Chris Evans and Olivia Saunders, 'A World of Copper: Globalizing the Industrial Revolution, 1830-1870', *Journal of Global History*, 10 (2015), 3-26, especially 6-8.

[10] Chris Evans, 'Slavery and Welsh industry before and after emancipation', in Catherine Hall, Keith McCelland and Nick Draper (eds), *Emancipation and the Remaking of the British Imperial World* (Manchester: Manchester University Press, 2014), pp. 60-73, especially pp. 65-67.

it: the bars would be formed under a trip-hammer rather than drawn out in the manner of wire.[11] The same concern for satisfying African consumers was shown in Flintshire, another major centre of copper and brass manufacture. The Swedish traveller Reinhold Angerstein, who stopped at the Greenfield works on Deeside in the early 1750s, watched copper rods being prepared. As in South Wales, the rods were drawn out under a trip hammer. Angerstein was a little surprised to see the work done in this way. 'The production would take much less time', he wrote, 'if the rods were drawn through holes in an iron plate, as is done with heavy brass wire, but I was told that this way of processing would not give the copper the same degree of ductility'. And ductility was an essential quality because, Angerstein added, the 'Negroes in Guinea use the rods as ornaments and wind them around arms and legs'. Indeed, these lengths of copper had a simple and expressive trade name: 'Negroes'.[12]

The orientation on African markets was quite explicit: when the lease on the Greenfield factory was renewed in 1755 it was specified that the premises would be 'kept at work in… the making and finishing of copper rods such as are usually sold to Guinea merchants'.[13] Thomas Williams, the Anglesey copper magnate who monopolised British ore production in the 1780s, was to claim that the British copper sector was wholly dependent on African demand. Petitioning the House of Lords in 1788, when the first moves to regulate the slave trade were afoot, the 'Copper King' claimed that it had been the demand for copper in Africa that had induced him to lay out £70,000 on facilities at Holywell, Penclawdd and Temple Mills. The articles they manufactured were 'entirely for the African market and not saleable for any other'.[14]

This was a considerable exaggeration. The British copper industry was unusually export-orientated, it is true, but exports did not outweigh domestic sales. Moreover, when Thomas Williams made his tendentious claim to Parliament, Africa was no longer the principal export market. From the 1760s the East India Company's exports of copper to Asia assumed greater importance.[15] Nevertheless, for the first two-thirds of the eighteenth century the relationship between African enslavement and British copper had been intimate and profound. Indeed, the connections between copper and Atlantic servitude become even closer if the place of copper in fitting out the plantation world is

[11] Louise Miskell (ed.), *The Origins of an Industrial Region: Robert Morris and the First Swansea Copper Works, c.1727-1730* (Newport: South Wales Record Society, 2010), p. 61.
[12] Torsten Berg and Peter Berg (eds), *R. R. Angerstein's Illustrated Travel Diary, 1753-1755: Industry in England and Wales from a Swedish Perspective* (London, 2001), p.324; Joan Day, *Bristol Brass: A History of the Industry* (Newton Abbot, 1973), p.199.
[13] Flintshire Record Office, MS D/MT/1016, quoted in Ken Davies, 'The Greenfield valley and the slave trade' (forthcoming in the *Transactions of the Flintshire Historical Society*).
[14] Parliamentary Archives, 10/7/788, petition dated 9 July 1788.
[15] H.V. Bowen, 'Sinews of trade and empire: the supply of commodity exports to the East India Company during the late eighteenth century', *Economic History Review*, 55: 3 (2002), 466-86, at 479.

considered. The Caribbean sugar sector absorbed considerable quantities of copper. The giant vessels in which the sap from crushed cane was transformed into sugar were, after all, 'coppers'. And copper was also indispensable in the distilling of rum. The plantation complex, in other words, absorbed considerable volumes of copper. Some attempt has recently been made to quantify this. The embodied copper needed for sugar production in the British islands has been estimated at 191 tons in 1650, rising to 1,456 tons in 1700, and then 5,539 tons in 1770.[16]

Eric Williams made no mention of copper and brass in *Capitalism and Slavery* (1944). He might usefully have done so, for the case of copper was congruent with his over-arching thesis. Slave traders integrated vertically into the copper industry and the demand from the Guinea trade for the red metal was an important stimulus to production in Britain. It was part of a wider process in which the centre of gravity of European copper making shifted from central Europe to the British Isles. Much more could be said about this trade, about the uses to which copper was put in Africa, about the various functions – domestic, industrial, and votive – that 'Guinea Kettles' or 'Neptunes' fulfilled. Yet copper presents relatively few interpretive difficulties. It was of high value. It acted naturally as a medium of exchange, and it was, by virtue of its workability, readily incorporated into African material culture. Indeed, copper enjoyed enormous prestige in many African cultures, more prestige than gold, in fact.[17]

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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. It is certainly not the case that Africa wanted for iron in any existential sense, for ferrous metallurgy was very well established in the continent. Indeed, the onset of the sub-Saharan Iron Age coincided with the equivalent development in Western Europe. Both date to the early first millennium BCE. Nor can it be said that the export of iron from Europe to Africa represented a transfer of material from a metal-rich zone to a region poor in metals. Although European smelting capacity outstripped that of Africa in general terms, most of Europe's major slave

[16] Nuala Zahedieh, 'Colonies, copper and the market for inventive activity in England and Wales, 1680-1730', *Economic History Review*, 66 (2013), 805-825. In the second half of the eighteenth century the sheathing of ships' hulls, especially those of vessels sailing to tropical waters, was a major new use of copper. In 1780 Matthew Boulton estimated that Britain's merchant fleet consumed 1000 tons of sheet copper annually, quite apart from that used by the Royal Navy: Birmingham Archives, MS 3782/12/108/27, 'Copper 1780', p. 70.

[17] David Killick and Thomas Fenn, 'Archaeometallurgy: the study of preindustrial mining and metallurgy', *Annual Review of Anthropology*, 41 (2012), 559-75, especially 568.

trading economies were net importers of iron. Perhaps only France was self-sufficient in the metal.[18] Traders at Nantes were able to source iron from forges in Brittany or, via the Loire, Burgundy. The Dutch were not so fortunate. The Republic had no smelting industry of its own. Nevertheless, the Rhine and Meuse waterways gave the Dutch ready access to iron-producing districts in Wallonia, the Ardennes, and western Germany. Things were more difficult for the Portuguese and the British, who had to contend with far longer supply chains.

The problem was acute for the British, the eighteenth century's leading slavers. The British Isles did have a substantial iron industry, one that had grown rapidly in the sixteenth century. In the seventeenth century, however, 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, Baroque Europe's leading exporter. Indeed, by the end of the seventeenth century imported iron outweighed the local on the British market.[19] The 'voyage iron' despatched to African markets from British quaysides was therefore more likely to be of overseas origins than not. In fact, voyage iron was almost invariably sourced overseas.[20]

The Royal African Company, which exercised a legal monopoly over English slave trading in the late seventeenth century, purchased its iron from London's leading Baltic merchants.[21] The contractors were few in number and enjoyed long-lasting relations with the Company, not least because many of the men concerned, such as Peter Joye (1636-1721), were also directors of the Company.[22] A reliance on Swedish iron was to be a feature of the British slave trade until its legal extinction in 1807. The Swedes appear to have been equally reliant on British buyers. In 1739, when some 954 tons of voyage iron was shipped from Stockholm, well over 90 per cent of it was directed to English ports.[23] 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 200 bars of 'German bars' in 1724. Another of Morice's fleet,

[18] The Danes could claim self-sufficiency too, being able to access iron from Norway, an integral part of the joint Danish-Norwegian monarchy. The Danes were minor players though, often sending just one ship a year to the Gold Coast.

[19] Peter King, 'The production and consumption of bar iron in early modern England and Wales', *Economic History Review*, 58: 1 (2005), 1-33, especially table 2.

[20] If domestically forged iron had to be substituted it was worthy of special note. When Liverpool slave trader William Davenport fitted out the *King of Prussia* in 1767 he had 2,600 bars of iron carried on board, 100 bars of which were singled out as 'English Iron'. Keele University Library, Special Collections and Archives, Raymond Richards Collection, William Davenport & Co. trading invoices and accounts 1764-1779.

[21] TNA, T70/129 and 130, Royal African Company, minutes of the Committee of Goods, 1695-1703 and 1703-1720.

[22] K.G. Davies, *The Royal African Company* (London: Longmans, Green & Co., 1957), pp. 171-72.

[23] Riksarkivet (Stockholm), Manufakturkontorets arkiv, Handlanden Peter Westmans utskeppningsböcker 1729-45, vol. 490.

the *Anne*, loaded 'Liege bars' at the same port in 1730.[24] In the 1760s and 1770s, William Davenport of Liverpool, who was both a slave merchant and a wholesaler of iron, followed a similar pattern. He supplied his customers with a mix of 'London' (i.e. Swedish) iron and bars shipped in from Rotterdam. Thus, the *Swift*, in which Davenport was an investor, departed Liverpool for the Bight of Biafra in 1775 with 600 iron bars in its hold: 191 of them Swedish, the rest German.[25]

By contrast, very little voyage iron originated in Russia, even though Russian iron overhauled the Swedish in the 1760s and 1770s to become the most widely traded in Europe.[26] That was because voyage iron had to be made to precise specifications: Africans required iron of the correct dimensions, iron of the correct weight, iron with the proper finish, and iron that bore 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 Royal African Company's agents on the Gold Coast reported in 1683, 'and I have a great many but they do not like them, for they must all be marked and no flau's in them.'[27] Indeed, 'iron for the Guinea coast' had not only to be 'entirely smooth and soundly forged', as a Dutch supplier of the 1660s explained; it had to be 'made according to the measurements which the blacks there demand'.[28] The difficulty for European slavers was that the desired measurements shifted over time and they required timely notice of such shifts if they were to furnish what was needed. The Royal African Company had salaried officers at its forts to do just that. Richard Wallis, writing from Ouidah in 1707, advised 'that ye Iron bars you send may be 75 & 80 to ye Tun'.[29] Six years later, however, the Company was ordering voyage iron that was lighter at '84 barrs to the Tun'.[30] Change was constant. In 1731 the Bristol merchant Graffin Prankard learned that bars 'that run neare about 92 to ye ton' were now standard and altered his instructions to his suppliers accordingly.[31]

The supply of voyage iron was confined to Sweden and the territories drained by the Meuse and lower 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 north European iron merchants who catered for the slave trade, men such as Graffin Prankard of Bristol. During the winter Prankard would quiz returning slave

[24] Bank of England Archive, M7/10 and M7/13.
[25] Merseyside Maritime Museum, D/DAV/2/4.
[26] Chris Evans and Göran Rydén, *Baltic Iron in the Atlantic World in the Eighteenth Century* (Leiden: Brill, 207), pp. 178-85.
[27] Robin Law (ed.), *The English in West Africa 1681-1683: Local Correspondence of the Royal African Company of England 1681-1699. Part 1.* (Oxford: Oxford University Press for the British Academy, 1997), p. 137.
[28] Henry Roseveare, *Markets and Merchants of the Late Seventeenth Century: The Marescoe-David Letters, 1668-1680* (Oxford: Oxford University Press for the British Academy, 1991), p. 69.
[29] TNA, T70/22, fo. 14: 'Schemes of Goods wanted And Abstracts of Letters from the Coast of Africa'.
[30] TNA, T70/130, 25 September 1713.
[31] Somerset Archives, DD/DN 424, Graffin Prankard to Francis Jennings, 1 December 1731.

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 that would be required for the coming year, he issued instructions to his agent in Stockholm. This was in February. Prankard's man would then confer with Jacob Feiff, the merchant who handled the sale of Gammelbo iron in the Swedish capital – Gammelbo being the ironworks estate that regularly produced voyage iron to Prankard's order. Feiff would transmit the instructions from Bristol 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. Since Prankard had made an advance payment on the iron he could dictate the form it took: 'press hard on Feoffe [Feiff]', he told his agent in February 1733, 'for Striking the Voyage of [Gammelbo] much wider & to run about 90 to ye Ton'.[32] Forewarned in this way, the Gammelbo forgemen could accumulate a stock of correctly sized voyage iron, one ready for shipment to Bristol 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.[33]

Russian iron could not fulfil the same role. 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. 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.[34]

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 realised, 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.

[32] Somerset Archives, DD/DN 425, Graffin Prankard to Francis Jennings, 28 February 1733.
[33] Evans and Rydén, *Baltic Iron in the Atlantic World*, pp. 164-72.
[34] For an example of this problem see David Richardson & M.M. Schofield, 'Whitehaven and the eighteenth-century British slave trade', *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society*, 92 (1992), 183-204 [at 18].

> 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 or rum; a bar of one commodity being equal in value to a bar of another commodity.[35]

Indeed, the 'bar' served as the unit of account in most African slave marts. Along the Gold Coast, naturally enough, the 'ounce' of gold took that role, and there were zones where the 'copper' (the rods manufactured in northern Europe) prevailed, but 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 1759 invoice of the *Swift* of Bristol, which priced the cargo both in sterling and bars.[36] On the 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 could be fashioned. This second source of demand was far more volatile than the first, with sudden spikes that followed the tempo of the agricultural year. Iron as a raw material was always in high demand just ahead of the planting season, when land had to be cleared and soil dressed, and when agricultural implements were at a premium. An ample supply of iron should be on hand in the months of January and February, the Royal African Company was advised by its agent at Ouidah in 1706; 'wch two months I have known large quantities to be sold it being their Rowsawing time for small Corne'.[37]

Yet despite the attention that eighteenth-century European traders accorded to voyage iron some contemporary Africanists have denied that imported iron had anything other than a marginal role in West African societies in the era of Atlantic slavery. 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 or capable of suborning African consumers from their traditional loyalties. Indeed, if there was a quality differential the advantage lay with African irons, which were high-carbon and therefore 'steelier'.[38] It is indisputable that the African continent was home to a rich metallurgical tradition, one that was every bit as old as its counterpart in northern Europe.[39] Archaeometallurgists are sharply divided on

[35] Mungo Park, *Travels in the Interior of Africa* ([1799] London: The Folio Society, 1984), p. 14.
[36] Bristol Record Office, 39654/2.
[37] TNA, T70/22, fo. 9: abstract of a letter from Richard Willis, 9 May 1706.
[38] Thornton, *Africa and Africans*, pp. 45-47. See also Philip D. Curtin, *Economic Change in Precolonial Africa: Senegambia in the Era of the Slave Trade* (Madison: University of Wisconsin Press, 1975), pp. 207-11.
[39] Killick and Fenn, 'Archaeometallurgy'; Joseph O. Vogel (ed.), *Ancient African Metallurgy: The Socio-Cultural Context* (Walnut Creek CA: Altamira Press, 2000); François J. Kense and John Ako Okoro, 'Changing perspectives on traditional iron production in west Africa', in Thurstan Shaw, Paul Sinclair, Bassey Andah and

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.[40] Smelters were imaginative in furnace design and inventive in their use of ores and fluxes.[41] There is little indication that the availability of European metals drove the African to the wall. That waited until the twentieth century when the availability of European scrap, harvested from colonial railways and imported machinery, heralded the end of traditional smelting. The geography of pre-colonial iron making shifted over time but there is no prima facie reason to attribute this to the competitive pressure of voyage iron. African production networks were certainly disrupted by the over-exploitation of forest resources.[42] And it is likely that intensified slave-raiding in some parts of West Africa in the eighteenth century led to the abandonment of old- established smelting sites and the relocation of furnaces in more defensible positions.[43] It may even be the case that desiccating climate change thinned out the tree cover along the fringes of West Africa's savannah belt, thereby shrinking the energy base for West African smelting quite independently of human action.[44]

None of this implies that African ironmaking was decaying. Indeed, it has been argued that growing aridity was a stimulus to technological change, with fuel shortages prompting the introduction of energy-efficient methods that were far in advance of those practised in contemporary Europe.[45] This is another contentious area among African archaeometallurgists. What is less contentious is the extent of ironmaking in African societies in the age of Atlantic slavery. 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

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Alex Okpoko (eds), *The Archaeology of Africa: Food, Metals and Towns* (London and New York: Routledge, 1993), 449-58.

[40] Augustin F.C. Holl, 'Metals and precolonial African society', in Vogel (ed.), *Ancient African Metallurgy*, pp. 1-81.

[41] Nicholas David, Robert Heimann, David Killick and Michael Wayman, 'Between bloomery and blast furnace: Mafa iron-smelting technology in North Cameroon', *The African Archaeological Review*, 7 (1989), 183-208; Louise Iles, 'The development of iron technology in precolonial western Uganda', *Azania: Archaeological Research in Africa*, 48: 1 (2013), 65-90.

[42] Randi Håland, 'Man's role in the changing habitat of Mema during the Old Kingdom of Ghana', *Norwegian Archaeological Review*, 13 (1980), 31–46.

[43] Philip Lynton de Barros, 'The effect of the slave trade on the Bassar ironworking society, Togo', in Christopher R. DeCorse (ed.), *West Africa during the Atlantic Slave Trade: Archaeological Perspectives* (London and New York: Leicester University Press, 2001), pp. 59-80.

[44] Candice L. Goucher, 'Iron is iron 'til it rust: trade and ecology in the decline of West African iron-smelting', *Journal of African History*, 22 (1981), 179-89.

[45] Peter R. Schmidt and D.H. Avery, 'Complex iron smelting and prehistoric culture in Tanzania', *Science*, 201: 4361 (22 September 1978), 1085-1089; Nikolaas J. Van der Merwe and Donald H. Avery, 'Pathways to steel', *American Scientist*, 70 (1982), 146-55; Peter R. Schmidt and D.H. Avery, 'More evidence for an advanced prehistoric iron technology in Africa', *Journal of Field Archaeology*, 10: 4 (1983), 421-34; David Killick, 'On claims for "advanced" ironworking technology in precolonial Africa', in Peter R. Schmidt (ed.), *The Culture and Technology of African Iron Production* (Gainesville FL: University Press of Florida, 1996), pp. 247-66.

of growth, often considerable growth, during the eighteenth and nineteenth centuries. A study of Bassar (modern Togo), described as an iron-making 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.[46] The Babungo chiefdom (modern Cameroon) was another specialised smelting zone that continued to flourish, with a notable climb in output between 1780 and 1880.[47] Indeed, the Ndop plain 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.[48]

All of this would suggest that European iron was indeed of little overall significance. Yet European traders imported it regardless. They had every incentive to do so because northern European irons, 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 *Nuestra Señora del Vincimiento* in 1617 amounted to 1,200 per cent.[49] Even so, there had to be demand on the African side. How that demand was constituted remains in many ways mysterious, but there are local studies that do much to reveal the attractiveness of imported iron. Inevitably, some coastal regions knew a relative shortage of iron and were eager for what Europeans could offer. Guinea-Bissau was one of these. There is clear evidence that Portuguese traders were landing iron there by the 1490s, with the slave trade still in its infancy.[50] Not only was there a basic local demand for iron – one that was inadequately met by producers in the African interior – but that demand was extended and deepened by the slave trade itself. Voyage iron was taken up avidly in coastal communities, such as that of the Balanta, which needed weaponry to resist predatory neighbours in an age of intensifying slave raiding. Indeed, to pay for iron, Balanta resorted to slaving themselves. This leads Walter Hawthorne to speak of an 'iron-slave cycle'.[51] Moreover, as a defensive measure, Balanta people began to resettle in low-lying littoral zones whose mangrove swamps impeded the movement of heavily armed raiding parties. They also began to cultivate a

[46] Philip de Barros, 'Bassar: a quantified, chronologically controlled, regional approach to a traditional iron production centre in West Africa', *Africa*, 56: 2 (1986), 148-74 [at 164].
[47] Ian Fowler, 'Babungo: A Study of Iron Production, Trade and Power in a Nineteenth Century Ndop Plain Chiefdom (Cameroons)', Ph.D. thesis, University of London, 1990, pp. 168-69.
[48] Jean-Pierre Warnier and Ian Fowler, 'A nineteenth-century Ruhr in central Africa', *Africa*, 49: 4 (1979), 329-51.
[49] Linda A. Newsom and Susie Minchin, *From Capture to Sale: The Portuguese Slave Trade to Spanish South America in the Early Seventeenth Century* (Leiden: Brill, 2007), pp. 43-45.
[50] Toby Green, *The Rise of the Trans-Atlantic Slave Trade in Western Africa, 1300-1589* (Cambridge: Cambridge University Press, 2012), pp. 116, 118.
[51] Walter Hawthorne, *Planting Rice and Harvesting Slaves: Transformations along the Guinea-Bissau Coast, 1400-1900* (Heinemann: Portsmouth NH, 2003), pp. 96-98.

new, high-yield crop: rice. 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 was therefore two-fold: it ratcheted up the seizure of captives whilst generating food surpluses that European slavers could use to sustain those captives during their transatlantic ordeal.

The example of Guinea-Bissau demonstrates the need for analyses that are sensitive to variations in terrain and social organisation. As broader comparative work by Richardson and Eltis reveals, the role of voyage iron varied from place to place (as was the case with almost every European trading good) and from time to time.[52] Quite how variations in demand reflected demographic shifts, cycles of violence, episodes of state-building, or the spread of commercial agriculture remains yet in the realm of conjecture. What is certain is that considerable quantities of voyage iron were delivered to coastal West Africa. The Royal African Company kept over 50,000 bars in stock on the Gold Coast in the first decade of the eighteenth-century, approximately 685 tons.[53] The volumes that were actually traded may have been rather smaller, but this was still a formidable quantity. African smelters were unquestionably skilled and numerous but they were restricted to small batch production and could not match the productivity of northern European iron makers. Bassar, the West African production complex hailed as being of 'continental importance', for example, produced an annual maximum of 80 tons in the eighteenth century.[54] The Babungo chiefdom, another specialised smelting district, could have achieved an output of 100 tons annually in the nineteenth-century (a figure that 'may sound unbelievable') but rather less than that in the eighteenth.[55] By way of contrast, the British regularly exported over 900 tons of bar iron to Africa during years of international peace in the middle decades of the eighteenth century.[56] Seen in this context, voyage iron can hardly be dismissed as marginal.

What is curious, however, is that there is no automatic correlation between high levels of importation and low levels of indigenous production. Sometimes there was a clear alignment between the two. In Guinea-Bissau the typical products of the coastal zone (salt and dried fish) gave the Balanta little purchasing power in their dealings with the Mandinka smiths of the interior; hence the welcome extended to iron-rich Europeans.[57] Yet West Central Africa, where 'the production levels of nineteenth-century smelters were... generally low in relation to potential demand', was

[52] Richardson, 'West African consumption patterns'; David Eltis, *The Rise of African Slavery in the Americas* (Cambridge: Cambridge University Press, 2000).
[53] TNA, T70/22, fo.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]
[54] Barros, 'Bassar: a quantified, chronologically controlled, regional approach', pp. 164, 168.
[55] Warnier and Fowler, 'A nineteenth-century Ruhr', quote at p. 338; Fowler, 'Babungo', pp. 169-70.
[56] TNA, BT6/241. This is to leave out of account the iron incorporated into muskets and other articles that were staples of the Guinea trade.
[57] Hawthorne, *Planting Rice*, pp. 40-46.

never much of a market for voyage iron.[58] Conversely, the Bight of Biafra, which was fringed by regions with strong smelting traditions, such as the Ndop plateau (the 'African Ruhr'), exhibited a persistent appetite for European metals. The Liverpool merchant William Davenport supplied voyage iron to eighteen slaving ventures to the Bight in the 1760s.[59] 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 4,257 tons over the course of that decade, or more than 420 tons annually. Voyages fitted out by Davenport in the 1770s suggest an even higher influx. The average consignment then was 16.1 tons.

This was a formidable quantity of iron, suggesting that smiths around the Bight of Biafra were increasingly dependent on imported iron. Indeed, there are indications that African demand as a whole was on an upward path. It is telling, in this respect, that 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 28 and 30 English pounds apiece. By the time of the American Revolution the standard weight had slipped below 20 pounds; by the first decade of the nineteenth century voyage iron was consistently below 15 pounds per bar. In other words, the volume of metal that Europeans traders had to offer to obtain a 'bar' of value in African slave marts had halved. How is this to be understood? It could be that the fall in the weight of bars reflected a widening technological gulf between African and European smelters – that the shrinkage tracked improvements in the efficiency of European ironmaking. That seems unlikely, however. The productivity gap between north European and African smelters had opened up in the later Middle Ages with the application of water power to bellows and forge hammers.[60] (Indeed, for early modern Europeans, ironmaking without water was unthinkable. A Dane who was 'somewhat acquainted with the true iron ore in Norway', was convinced that the Gold Coast abounded in rich ore that could be smelted to great advantage, but only 'if there could be found the necessary supplies of water with which to work it'.[61]) In the eighteenth century that productivity gap remained, but it was not widening, not until the 1780s at least. Only then did radically new coal-dependent technologies,

[58] Colleen E. Kriger, *Pride of Men: Ironworking in Nineteenth-Century West Central Africa* (Oxford: James Currey, 1999), p. 4; Richardson, 'West African consumption patterns', table 12.2.
[59] Merseyside Maritime Museum, D/DAV/2/4.
[60] Note Joseph C. Miller's suggestion that Africans, 'rather than emphasizing technologies of appropriating nonhuman sources of energy, sought productivity (and power) by controlling the efforts of people around them, through multiple distinctions of age, gender, rank, among other means of differentiation – increasingly, after 1700 or so, including slavery...': Joseph C. Miller, 'Beyond Blacks, bondage and blame: why a multicentric world history needs Africa', in Donald A. Yerxa (ed.), *Recent Themes in the History of Africa and the Atlantic World: Historians in Conversation* (Columbia SC: The University of South Carolina Press, 2008), pp. 7-18 [here at 10].
[61] Johannes Rask, *A Brief and Truthful Description of a Journey to and from Guinea. Two Views from Christiansborg Castle. Vol. 1, translated by Selena Winsnes Axelrod* (Accra: Sub-Saharan Publishers, 2009), p. 84..

most notably puddling and rolling, have an impact on British ironmaking.[62] And voyage iron, it will be remembered, was usually sourced in parts of Europe that were unaffected by the changes sweeping the British iron industry. If the decline in bar weight cannot be made to correlate with downward shifts in the cost of producing iron in northern Europe, it may be that it is better understood as an index of European slavers' increasing commercial efficiency. Yet this too appears unlikely; the drop in weight seems too dramatic to be explained by a lowering of transactions costs. The explanation may be simpler: it is that African demand for imported iron was growing, pushing prices upwards and thereby causing a drop in the quantity of iron needed to constitute a 'bar'.

It is striking that very large shipments of voyage iron went to the Cameroons, the most easterly part of the Bight of Biafra. This was a region that was, on the face of things, very adequately supplied with iron from the interior, for it is thought that iron from the Ndop plateau circulated as far as Douala on the coast.[63] The Cameroons, in other words, benefitted from an increase in the supply of iron from both local and overseas sources. Indigenous production and imports marched upwards together. Given this relative surfeit, is it too much to suggest that voyage iron was sustaining an African 'industrious revolution', one characterised by a rise in the per capita consumption of iron? 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.[64] Could developments in the Cameroons be an equatorial echo of this earlier process?

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That European and African iron circulated through the same markets in the Bight of Biafra poses questions about the over-arching relationship between Europe and Africa. Africanists have been keen to stress the tenacity of sub-Saharan smelting traditions. Many have also insisted upon the 'superiority' of African iron, arguing that African smelters pioneered a 'direct steel process' that yielded an exceptionally obdurate metal. Reversing colonial-era assumptions about Africa's technological poverty, Africanist scholars are able to dismiss the contribution of voyage iron to sub-Saharan life. Yet the evidence provided above suggests that European bar iron played a very significant role along some, although not all stretches of the West African coast. In Guinea-Bissau voyage iron was a trading *sine qua non*; it contributed to a profound reshaping of local society. In the

[62] In 1791 Richard Crawshay, the leading British ironmaster of the day, drew a distinction between English voyage iron and Swedish. The former, presumably made at Crawshay's own puddling works in Wales, weighed 14.9 lbs per bar; Swedish bar iron was markedly heavier at 17.2 lbs. Gwent Archives, D2.162, Richard Crawshay to Miles Barber, 2 September 1791.

[63] Augustin F.C. Holl, 'Metals and Precolonial African Society', in Joseph O. Vogel (ed.), *Ancient African Metallurgy: The Socio-Cultural Context* (Walnut Creek CA: Altamira Press, 2000), pp. 1-81, especially pp. 59-70.

[64] King, 'The production and consumption of bar iron', table 2.

Cameroons, the arrival of British slavers in the second half of the eighteenth century brought with it a massive influx of iron.

The presence of northern Europe iron should not be taken as a sign of African weakness. It could be a sign of vitality, of a burgeoning 'industriousness'. Indeed, it would be well to dispense with the notion that European and African irons were competitors engaged in a zero-sum struggle. Rather than seeing voyage iron and African bloomery iron as the embodiments of radically different productive systems it would be better to consider Europe and Africa as interlinked parts of a single Iron Age landscape. Africa in the eighteenth century is conventionally classified as Late Iron Age; there may be merit in applying the same designation to Europe of the eighteenth century. To think of Georgian London or Gustavian Stockholm as Late Iron Age settlements may strain credulity. And the notion of an Iron Age may be a conceptually blunt instrument, to be sure; 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 off 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.[65] Southern Europe in the eighteenth century was disarmingly 'African'. Iron was made by the direct method: a single-step procedure at a bloomery. The Basque Country, for example, one of Europe's major iron-producing zones, practised direct reduction. To distinguish between advanced European and primitive African technologies is therefore to introduce a false division. Equally, to make claims about the superiority of African 'steel' is over-hasty. Direct reduction methods that could be controlled to yield steel were a feature of the Austrian Alps as well as parts of Africa.[66] 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 crude raw material, did not flow from an African periphery to a north European core. Quite the contrary, the ostensible core exported to the periphery.

[65] 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: Jernkontoret, 1995), pp. 143-53; B.G. Awty, 'The blast furnace in the Renaissance period: *haut fourneau* or *fonderie*?', *Transactions of the Newcomen Society*, 61: 1 (1989), 65-78.

[66] Philippe Braunstein and Erich Landsteiner, 'The production and trade of steel and steel tools in the early modern semi-periphery: a commodity chain approach to the Innerberg district (Austria) in the 16th and 17th centuries', in , in Philippe Dillman, Liliane Pérez and Catherine Verna (eds), *L'acier en Europe avant Bessemer* (Toulouse: CNRS – Université Toulouse-Le Marail), pp. 405-446, especially pp. 412, 416-17; Killick, 'On claims for "advanced" ironworking technology', pp. 256-60.