From Europeanization to Africanization

The Complexities of the Technological Encounter in the Colonial Era

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"The single story creates stereotypes, and the problem with stereotypes is not that they are untrue, but that they are incomplete. They make one story become the only story."
Chimamanda Ngozi Adichie

Abstract

Through an examination of three case studies, this paper reviews the complexities of the technological encounter in various settings in Africa in the colonial era. Technology played a role in fostering many colonial conflicts, but also enabled many connections, collaborations and opportunities. Together with its destructive role, it was also constructively transformed by local African populations to serve needs that had not been initially anticipated by the colonial administration and agents. In discussing the case studies of guns, railways and bicycles, the paper shows how technology became a site of struggle and negotiation between colonial and local needs, with local populations ultimately investing their own meaning into various technologies. Guns became a valued commodity for trade and livelihood as well as taking on cultural symbolisms; railways presented an opportunity for development, enhanced urbanization and supported new elites; and bicycles were turned into a mark of prestige and social status as well as enablers of entrepreneurship. Thus, while all technologies embody meanings and predetermined usages by those who introduced them to various settings in colonial Africa, once on the ground, these technologies took on range of new meanings and usages that were both functional and conceptual. It will be seen that technologies initially intended to further the colonial agenda ultimately became viable objects for serving local needs and aspirations.[2]

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Introduction

The colonial period was a time of multiple and significant changes, including the establishment of new political borders, occupation by foreign sovereigns, religious conversion, and the introduction of new languages and customs; nonetheless, one of the most profound inducers of change was the massive introduction of new technology. Formally, the colonial period began with the 1884 Berlin Conference and ended for many colonies around 1960 – the year by which most African countries received their independence. Although not a long one, the period left an indelible impression on the continent that is still clearly evident today.

Colonialism was largely enabled by European technologies as both an instrument and a symbol of European power (Headrick 1981; 2012; Diamond 1997). Colonial technologies had a great physical and sociocultural impact on the African population. The history and role of technology in colonial Africa, like the history of colonialism itself, is complex and controversial (Cooper 2005). Technologies played a role in many colonial conflicts, but were also an enabler of local opportunities, innovation and entrepreneurship. The history of technology in the colonial period is an additional dimension in the complex nature of the colonial encounter.

Several scholars (e.g. Ajayi 1968; Dupré 1982; Mazrui 1980; Rodney 1972) argue that colonialism had a destructive influence on the continent. Others, however, argue that colonialism was just a phase in history. They tend to stress a resilience within the African population and more powerful aspects such as significant resistance to hegemony rather than being completely transformed by it, as suggested by A. Adu Boahen (1985), Fredrick Cooper and Ann Laura Stoler (1997) or William Beinart (2000), showing the complexities of the encounter and the collaborations together with the conflict. Undeniably, devastation occurred, but colonialism was also unquestionably a time in which new ideas were introduced, changes were made, and technology was key. The colonial encounter between Europeans and Africans was an arena of “bargaining and strife, translation and mixtures” (Hunt 1999, p.11) personal interests and agendas as well as collective ones, agreement and rejection, acceptance and resistance. Each single new idea or technology met with diverse reactions and was shaped by specific and changing local circumstances.

There was glaring discrepancy, however, between the vision of the European ‘civilizing mission’, on the one hand, and what happened on the ground on the other: the colonial administrations’ preconceived plans and grandiose ideas met with constraints and

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budget restrictions, as well as unanticipated physical and human challenges. While these were received with compliance in some places, there was resistance in others. In practice, more often than not, the colonialist ideology of change and modernization was implemented through exploitation grounded in brute racism; but the converse was also true: colonialists, imperialist politicians, and entrepreneurs justified their shady practices in retrospect with the high-minded ideology of the civilizing mission.

This discrepancy, however, was not the Europeans' alone. Technology introduced to Africans was interpreted, appropriated, and given meaning far beyond any European expectation. Compliance or resistance, as such, are not a sufficient account of the local reaction to the introduction of technology but more important was how Africans complied or resisted and to what extent and the differences between one group to another. Furthermore, although virtually the entire continent was under formal European rule and hegemony, not all regions and peoples were directly colonized or affected and many customs and traditions were protected and maintained.

Much of the literature on technology in the colonial period has been written from the European perspective, but African populations had their own responses and interpretations to the introduction of European technologies in their local settings, as will be exhibited in this paper. Moreover, following its introduction in Africa, every new technology continuously developed. Technologies first introduced in the 16th century were significantly transformed by the 18th or 19th, not to mention the 20th century. The continent was both a source of inspiration for new technologies and an arena of adaptation for new climates, regions and usages. In addition, much of the literature tends to focus too narrowly on the functionality of technology. Inspired by Giacomo Macola (2016) and Nancy R. Hunt (1999), in this chapter, I focus on both the functionality and the symbolic characteristics of technologies, as well as on their profound local appropriation, distinctly different from the original intention and unanticipated by its European introducers.

Accordingly, some of the questions and issues that arise from the encounters between European technology and its African users have to do with the ideology and rationale behind its introduction: How were technologies introduced? What changes did they induce? What role was played by local cultures? What symbolic/traditional properties were attached to new technologies? How did the local population accept or reject these technologies? To what extent was their impact deliberate? These and related questions are explored in this paper.

The paper starts with a definition of technology, continuing with a historical review of some key pre-colonial African technologies and related themes. This will bring us to a discussion of the tensions of technology within the colonial encounter, the complexities of

technological transfer, and the impact of culture and local technical ability and adaptability as illustrated by three case studies: guns, railways and bicycles.

Technology Perspectives

In order to understand the impact of technology, it is important to discuss how technology was perceived by different cultures. While acknowledging the immense diversities in cultures both among European colonizers and local African populations, it will be seen that there were significant, inherent differences between "European" and "African" perceptions of technology. In order to argue this point, it is first necessary to define 'technology'. Moreover, although "technology has no single universally agreed upon meaning" (Mawere 2014, p.82), I shall first suggest some broad definitions of the term. Oxford English Dictionary defines technology as "The application of scientific knowledge for practical purposes, especially in industry" (2015). Daniel Headrick, a longtime researcher on the global history of technology, offers the following definition: "all the ways in which humans use the materials and energy in the environment for their own end, beyond what they can do with their bodies" (2010, p.3), including skills and systems. Importantly, he adds, "Technology is power." It is the power wielding over the natural world, the defense against the hostile elements, the means of using the forces of nature to do one's bidding and improve one's condition" (Headrick 1981, p.83). The issue of power over nature is crucial for our discussion and sheds some light on cultural differences on technology. Another very important dimension is added to the definition: technology is power over people (Kass 1971, Headrick 2010). Power over people, together with the ability to subdue nature and using technology for industrial purposes are all valid connotations of the term, but are not necessarily accepted by, relevant to or representative of all cultures. Thus, we shall see how technology transcends its functionalities and is symbolically interpreted and culturally appropriated, leading to impacts unintended by its inventors and introducers, with far-reaching effects.

Pre-Colonial African Technology

Historically, technology was not new to Africa as Europeans presumed at the time. Africans had their own history of technology, evolving and changing over time and across regions. According to Ralph Austen and Daniel Headrick, three technological periods can be defined. The first is the classical period until around the 13th century, in which "Africans had built up a pool of knowledge and technology which they used to sustain agriculture, human and animal health, industrial production involving food processing, metallurgy, leather tanning, timber seasoning, fermentation of beverages, making of dyes, mining and architectural engineering" (Mawere 2014, p.32). The second, precolonial period 13th -19th centuries in which new

European and Asian technologies were introduced, such as the loom, the spindle-whorl, but also the wheel, the plow and writing, which for various reasons were not adopted (Austen & Headrick 1983). The third period, the focus under study here, is associated with the Industrial Revolution and its uneven impact on Africa on the one hand and local cultural appropriation on the other. L. H. Gann and Peter Duignan (1975) add the post-WWII period characterized by schemes to introduce large expensive machinery such as tractors, which largely failed due to high costs.

Five key sectors of pre-colonial indigenous technology and economy will be discussed in this section: agriculture; textiles; mining; iron tools and weapons; and waterway transportation. Precolonial African economies were based on subsistence agriculture. There were extensive trading networks across the continent, between and among groups in each region, but the arrival of Europeans in the 15th and 16th centuries led to the significant reorganization and expansion of some of these pre-colonial networks. Jean and John Comaroff (1997) show how local farmers in South Africa were affected by this expansion: “Agricultural surpluses were also important, especially among the middle and upper peasantry... these surpluses were sold, in steadily increasing quantities, to merchants and settlers, permitting the purchase of cattle, farming implements, wagons, and other commodities” (p.195). The grassland people in West Africa traded in cattle and skins and forest people cultivated kola nuts for trade.

Precolonial trade led to the spread of technological innovations. Basil Davidson (1977) provides examples of local technical transfer. The Yoruba, for example, “shared the skills of their neighbors in forest farming, iron-smelting, brass work, cotton-weaving and other valuable handicrafts” (p.120). He describes the adaptation of foreign varieties such as maize and pineapple that had been brought from South America to West Africa by the Portuguese after 1500. “These new crops were eagerly accepted, and they spread rapidly” (p.147). Furthermore he shows that without European scientific knowledge, locals in West Africa were able to solve complicated problems such as identifying medicinal herbs, how to extract their ingredients and how to use them; how to overcome dry weather in cattle raising; and how to grow food in forests. “Of all their material skills, tropical farming and mining were most important. In both these fields, West Africans were so far advanced indeed, that it was Africans (even though working as slaves) who later pioneered the development of tropical farming and mining in South America” (Davidson 1977, p.147). It is clearly laid out here that pre-colonial West Africans developed local agricultural technologies and skill sets and had a high learning and adaptability capacity.

Cotton was also cultivated in West Africa since before 1000 AD. People such as the Yoruba in Southern Nigeria or Akan in Ghana were experts in spinning and dying cotton.

Since 1450, Europeans found that some African cloth was better than that made in Europe. This technology of spinning, dying and cloth making was transferred from the South to the North of Nigeria, to Tripoli in Libya, to Timbuktu and Mauritania, as noted by German traveler Henry Barth (Davidson 1977). Its quality was outstanding – particularly the high quality cloth from Central Africa whose production process involved the use of tree bark. As Portuguese traveler Pacheco Pereira wrote, "In this kingdom of Congo they make some cloths of palms, with a surface like velvet, and those with fancy work like velvetized satin, so beautiful that there is no better work done in Italy" (Thornton 1998, p.49)[3]. Mandinga cloth from the North Gold Coast was also considered very expensive; as stated by Olaudah Equiano (1789/2001), an Igbo from the 18th century states, "This is usually dyed blue, which is our favourite colour. It is extracted from a berry, and is brighter and richer than any I have seen in Europe" (p.15).

Europe bought many African items, such as Senegambian mats, which were often used in Europe as bedcovers. In the early 18th century, "an English factor at Sierra Leone was instructed to acquire no less than one million of them" (Thornton 1998, p.53). There are also many accounts of substantial bilateral trade in cloth since before 1650, such as annual purchase of 100,000 meters of cloth by the Portuguese from East Kongo. Contrary to popular misconception, Africans produced most of their cloth intake and it is estimated that only 2% of the cloth they consumed was imported from outside Africa (Thornton 1998). This goes to show that cloth was important from Europe not because it was scarce or of lesser quality in Africa, but rather that European cloth purchase was intended to satisfy a local desire for different designs and colors (Thornton 1998).

Like textiles, mining was a major precolonial industry, which also involved significant local expertise. "They had found out how to recognize minerals in rocks, how to sink mines, how to get the ore and smelt and work it. They had developed a wide range of hand-manufacture in many materials" (Davidson 1977, p.147). Mining metals such as gold, iron and copper dated back to the African Iron Age (3rd century BC-10th century AD; Hilson 2002). Gold was found in West Sudan, and especially in the territories of the Asante in Ghana, who specialized in sophisticated weighing equipment such as scales. Much of the gold was mined but some was extracted from rivers by panning. An estimated nine tons per year was extracted in West Africa in the 16th century (Davidson 1977).

Smelting techniques were developed and used to produce jewelry and tools, albeit on a small scale, serving the needs of the local chiefdoms with limited trading. As European demand grew, Africans were able to trade more and acquire as many foreign products as

[3] Quoted from Pacheco Pereira, Esmeraldo, bk. 3, chap. 2 (ed. Silva Dias), p.134·

they needed or wanted, including many luxury goods, such as Asian silks. “As trade grew with European sea-merchants, especially after 1600, they bought guns and gunpowder, bars of iron, rings of copper, jewelry, hats and a host of other items” (Davidson 1977, p.153).

Iron was used by the Nok culture in Nigeria around 300 BC. “Iron-pointed spears were more useful than sharp sticks or stones. Iron-headed hoes, probably invented sometime after iron-pointed spears, were better than stone or wooden ones. Iron-headed axes could fell trees and shape wood much better than stone axes” (Davidson 1977, p.15). This enabled communities to produce more and better food, leading to a population increase; it also allowed safer travel, thus facilitating migration and expansion; finally, it was also a new source of military power: “Stronger peoples began to rule weaker peoples” (Davidson 1977, p.16) devising new sociopolitical structures.

Africans produced many metal goods from iron and copper, including spears, knives, copper basins, and axes, all needing a source of heat. Since they lacked fuel generators, fuel conservation methods were invented such as “devising a system to preheat the air blast that entered the furnace, which prefigured techniques used in Europe only in the nineteenth century” (Thornton 1998, p.46), which also improved the quality of the metal, perhaps to a standard higher than the European one. This innovativeness and the resulting quantity and quality of goods produced also enabled consumerism and indulgence.

> Africa’s trade with Europe was largely moved by prestige, fancy, changing taste, and a desire for variety… The Atlantic trade of Africa was not simply motivated by the filling of basic needs, and the propensity to import on the part of Africans was not simply a measure of their need or inefficiency, but instead, it was a measure of the extent of their domestic market. (Thornton 1998, p.45)

John Thornton (1998) shows this clearly for both the cloth and iron trade. He concludes that only between 10-15% of cloth and iron consumed in Africa were imported from Europe. Dutch exports to the Gold Coast show a demand for 150 different commodities and 40 different types of cloth. Hundreds of other commodities were rejected, however, showing very clearly that the locals developed their own taste (Thornton 1998). This also suggests that European iron played a more complex role, with Africans buying steel swords as prestigious objects. As discussed in the case study of guns below, swords were also used for burial purposes, as seen in excavations of 12th-13th century sites in Rao, Senegal, showing a very sophisticated, fashionable and consumer oriented market (Thornton 1998).

The final economic sector to be discussed is waterway transportation. Africans had very sturdy watercrafts suited for coastal navigation and rivers. Since the shoreline had strong currents and were difficult to bypass, West Africans concentrated their building talents on these areas rather than on ocean navigation. Their watercrafts were usually carved from singletree logs, and they tended to be long, very low in the water and fast, powered by oars

and paddles independently of the winds. They were designed to carry between 50-100 soldiers and merchandise (Thornton 1998). They enabled West Africans to protect the coastline, unlike native populations in South America for example.

Several European travelers and traders tell about the West Africans' diligence in protecting themselves when besieged by European raiders. After being attacked, locals often displayed effective resistance. In 1446, for example, Nuno Tristao, Captain of a Portuguese ship, wanted to land in the Senegambian region, but was attacked, and almost all the raiders were killed (Thornton 1998). Soon enough, although Africans could not storm European ships, the Europeans ended their unproductive raids and were satisfied with peaceful trading. This balance of power allowed local African leaders to determine their trading role under their own terms as well as to collect duties and taxes. To protect their commercial interests, many European traders did their best to deter other traders from violent practices; this status quo was maintained at least until the mid-18th century.

This account of the five major economic sectors in Africa indicates that Africans were highly skilled and that contrary to European racist misconceptions, there was much technical ability and transfer. We also see that at least until about the 1800s there was a balance of power and knowledge between Africans and Europeans (Thornton 1998; Storey 2008).

African Cultural Values and Perspectives on Technology

"Let the west have its technology and Asia its mysticism! Africa's gift to world culture must be in the realm of human relationships." (Kaunda 1966, p.22)

Munyaradzi Mawere argues that indigenous knowledges transmitted across the generations enabled innovations designed to meet the problem at hand: "While in many instances, problems and challenges in the community were perceived as a curse from the ancestors or works of witchcraft, they were also perceived as calls for new innovations, solutions and even critical thinking" (2014, p.25). He goes on to say that, these innovations always had a cultural connection and were perceived very differently than by Europeans:

> Africans had a pragmatic epistemology as well as practical metaphysics with which they used to judge the worthiness of an idea, belief or explanation.... This is why in many African societies, a belief, idea or explanation could pass as knowledge, and hence acceptable as long as it can solve the problems at hand. This is different from the Western understanding of reality which is totally based on objectivity and empirical validation. (Mawere 2014, p.26)

As in pre-industrial Europe, African societies did not live in isolation of each other: indigenous knowledge, culture and technology were shared and exchanged. While it is

impossible to offer a monolithic 'African' perception of technology, or challenge the general agreement with Sidney W. Mintz and Richard Price's (1976) emphasis on the significant differences among African cultures, a review of the literature does suggest some commonalities in African values and thus might explain local reactions to European technology informed by those values. David Ndegwah and Otto Kroesen (2012) suggest three core cross-African values: (1) respect for elders, (2) belief in the supernatural and (3) communitarianism (community-centered life). In an attempt to explain and reinforce African tributes and contributions, Zambia's first president Kenneth Kaunda (1966) suggests additional elements (although thought upon beforehand) to what may be called the African Philosophy of Man: traditional or tribal society, which is an extension to the above-mentioned communitarianism and (4), living with nature.

Respect for elders, part of the tribal society described by Kaunda (1966), is expressed by the traditional acceptance of the authority of elders, whereby the elder's life experience, calm and wisdom are respected based on religious beliefs. As seen below, the age group system is also based on this value. In terms of technology, there is a debate whether this value is detrimental to development as it may cause a lack of opposition and opposing thoughts, to elders and leaders – who are thought upon as father figures as well, forming a lack of open dialogue (Ndegwah & Kroesen 2012). Obviously, there are also many examples of deviation from absolute obedience to elders.

As for the second core value, belief in the supernatural, it is often said that religion is a way of life in Africa, with "no distinction between the secular and the sacred" (Ndegwah & Kroesen 2012, p.8). Although this claim is frequently contested, it seems that belief in the supernatural has a significant impact on African culture as a whole. One of the problems in colonial times was the explicit denigration of African innovations and knowledge by missionaries and colonial governments that deemed rituals and customs as superstitious (one example is the 1899 Witchcraft Suppression Act designed to criminalize traditional healers in Zimbabwe; Mawere 2014). In the context of local acceptance of new technology, the notion of man's ability to make changes might be discouraged, as interference with the supernatural.

Thirdly, Ndegwah & Kroesen (2012) define communitarianism as "living together as an organic group" (p.9). Kaunda (1966) argues through his concept of traditional or tribal society that it represents an element of African humanism because it cultivates social harmony. He claims that the activities in the bush are a matter of teamwork for survival: "this means that there must be fundamental agreement upon goals and all must act together" (p.25). Relatedly, individuals are accepted in the community as they are, not based on their achievement but rather on their presence in the community. Lastly, inclusive society is another key element of communalism, involving mutual responsibility towards parents,

elders, children and siblings regardless of their actual immediate family connection. Both tribal society and communitarianism promote patience, forgiveness, optimism and a general sense of happiness inspired by gratefulness for life rather than taking it for granted. Despite its obvious merits, the value of communalism clashes with European individualism, widely deemed a necessary attribute for innovation.

Living with nature – the fourth core value – is commended by Kaunda since "Those people who are dependent upon and live in closest relationship with Nature are most conscious of the operation of those forces: the pulse of their lives beats in harmony with the pulse of the Universe" (1966, p.23). Whereas a key Western motivation, as we have seen, was to gain power over nature through technology, clearly, in many precolonial African societies nature was not seen as something to be dominated, but to harmonize with. Nature was revered; there was a spiritual connection between the Gods and nature (Akiwumi 2006; Gordon 2006), that was associated with political and religious roles. A good example which also enforces the superstition element is the 'Owners of the Lagoons', earth priests or guardians in the Mweru lake area in Northern Zambia, who are engaged with "control of nature through correct management of society" (Gordon 2006, p.80). Through different fishing regulations, they ensure the spawning of fish and their conservation. There were also sacred forests, which raised a spiritual conflict when they were cut down for wood or to make way for plantations (Beinart & Hughes 2007). Anything deemed as threatening to nature, such as modern technology or European systems of law and order, was looked upon with suspicion and conservatism. Control of nature through technology was resisted as unacceptable, even blasphemous (see also Austen & Headrick 1983; Boahen 1985). Kaunda (1966) goes on to say:

> …to be exposed to nature and to have to live your life at its rhythm develops humility as a human characteristic rather than arrogance. Men are more companionable and take the trouble to live harmoniously together because they know that only by acting together can they reap the benefits and try to overcome the hardships of nature. (p.24)

Another, related value is the idea of 'commons'. Most African societies tended to view natural resources as common (Guelke & Shell 1992; Beinart 2000; Gordon 2006; Anderson 2002). "Individual Khoikhoi owned their own stock, but the land and water that sustained them were the common property of the group" (Guelke & Shell 1992, p. 803). For nomadic groups, in particular, to leave their lands and water sites unattended was a matter of customary practice, without any damaging consequences for hundreds of years. This never meant that these were not valuable to them. Moreover, customs and religious ideas were often designed to prevent exploitation of common resources and reserve them for future usage.

In conclusion, as Mawere (2014) argues, Kaunda (1966) believes "that there is a distinctively African way of looking at things, of problem-solving and indeed of thinking – we have our own logic-system which makes sense to us however confusing it might be to the westerner" (p.29). One very important question that he posed which Ndegwah and Kroesen (2012) echoed subsequently was whether Africans could enjoy the benefits of technology "without being eaten away by materialism and losing the spirituality dimension from their lives"? His answer was "that however intensely we industrialize, the fast majority of the peoples of Africa will still live in close contact with nature..." (Kaunda 1966, p.24). The relationship of local populations to technological innovations coming from the West mirrors the ways local populations continually attempt to adopt selected elements of colonial history and culture and still maintain their integrity. From colonial times to this very day, many Africans across the continent desire technology and its benefits but are also very concerned with its transformative and negative impact on their value system. As succinctly put by Ndegwah & Kroesen (2012), "How can the African soul remain loyal to its heritage and nevertheless innovate?" (p.1).

The Tensions of Technology in the History of Colonialism

As discussed above, technology can mean many things and has to do with all walks of life. Technology was a distinct characteristic of colonialism, without which it would have been impossible to conquer the continent. Technology affected many of the features of colonialism, facilitated its power and was crucial to the colonialist ideology in that it was consistent with the desires for efficient economic exploitation of raw materials, law and order, trusteeship and betterment of colonies through modernization – all subsumed under the civilizing mission ideology.

However, what may be an essential technology for one society or worldview, may be irrelevant or distracting for another. More than just worldviews, however, in conjunction with social construction of technology (SCOT) theorists who attribute agency to users in shaping technological innovation and endowing it with unforeseen functions (Macola, 2016), the following sections reveal that not only functions were unforeseen, but also the symbolism attached to technology.

As a way of addressing the complexity of the introduction of European technology in Africa, the ensuing discussion is divided into three main sets of technologies, each with a different initial ideology, agenda or designated usage. Note the word initial, since very rarely did the technology exclusively serve its initial purpose and most often found new avenues of progress exceeding boundaries of space, populations, race and use. The sets of technology to be examined below are divided based upon three main agendas of the European powers:

(1) Conquering the continent and installing colonial hegemony; (2) Exploiting local raw materials such as mining, land for agriculture and very low cost labor; and (3) Europeanization and the civilizing mission.

Within each set of technologies, I will focus on a specific technology in a specific region: (1) guns in South Africa, (2) railways in Ghana, and (3) bicycles in Congo. Each technology had a distinctive way in which it was accepted by the local population and its unique effects. While all technologies affected the continent, contingent on their specific degree of penetration in society, some caused far-reaching changes, all were appropriated and Africanized, with some integrated into existing social infrastructures and others creating new ones. In all cases, it will be seen that local interpretations subject to local values were uniquely inspired by the supernatural beliefs in African society.

In discussing these three technological areas, I will show how they were introduced by Europeans, highlighting their initial agendas, how they were affected by the civilizing mission and how they played out in reality. I will examine how local societies interpreted these technologies through their own cultural prism. I will also review how local populations made these technologies their own both physically, conceptually and symbolically. Lastly, I will discuss who ultimately benefited from the newly introduced technology and who did not.

Guns: From Hegemonic Mechanism to Multifaceted Appropriation

Several technologies were employed by Europeans to facilitate the colonial conquest of the continent and later facilitated to maintain and reinforce the European hegemony. These were weapons such as the breechloader and Maxim machine gun (Headrick 2010), combined with well-developed military tactics and organizational skills, but steamships and aircrafts also contributed to the effective penetration of the continent in some regions (Headrick 1981; Diamond 1997). Conquering and establishing hegemony required force, as the African population was significantly stronger in numbers. Europeans thus needed technology, and this technology had to be efficient, quick and economical due to funding constraints. Steamships, for example, started as trade tools to enable traders to navigate the different waterways across the continent but soon became a quick and useful conquering tool for easy penetration of the inner land. Tropical medicines, another example, might be considered auxiliary weapons and forms of “technology as power” over the hostile elements. Quinine prophylaxis was proven effective in malaria prevention, and was given to the European soldiers and significantly decreased their death toll, thereby enabling them, together with missionaries and settlers to live almost free of malaria.

This section reviews how these technologies, specifically firearms, served European goals of conquest and hegemony but also turned into trading commodities: guns were transformed from an instrument of colonial dominance into one of protection and livelihood. Yet, the adoption process was not limited to the technology's functionality aspect but also involved distinct symbolic attributions and effects on existing social infrastructures, including the acceleration of new social forms such as warlords. Guns became an important marker of status and power that far exceeded their functionality.

In order to understand the true scope of the transformation that this technology caused and was part of, we need to start this analysis prior to colonial times. Guns were introduced to South Africa by early Dutch traders and to Western Africa by the Portuguese, around the 16th century. In Europe, they were mainly used for military purposes and they were initially brought by the merchants to Africa as a means of protection from the unknown and for the purposes of invasions and raids. As discussed earlier, with the rise of consumerism in the 18th century, locals purchased large quantities of commodities. Soon enough, guns became an important commodity sought by the locals – as was European cloth – not because it was needed for subsistence, but rather to satisfy a desire for the new and diverse, displaying sophistication (Thornton 1998).

Among the Europeans, there was not one single agenda or belief regarding firearms, but rather several conflicting and mixed approaches. In some cases, merchants and missionaries encouraged sale of firearms to Africans. Merchants such as Henry F. Fynn, John Dunn and Nathaniel Isaacs wanted to profit from the sale of muskets and guns coveted by the locals. Missionaries such as David Livingston and Robert Moffat also encouraged their use because they saw guns as civilized progress, although this was not the initial rational for bringing guns to the continent, which was instead linked to the desire to hunt animals more efficiently, and promote productive agriculture and free trade. Van de Kemp of the London Missionary Society, for example, advocated for the KhoiKhoi's ("Khoi") the indigenous inhabitants of the Cape of Good Hope ("Cape"), right to own firearms as symbolic of their equality before the law (Storey: 2008). On the other hand, the VOC, which were in control of the Cape area since 1640, saw the selling of guns to indigenous Africans as a threat, especially if they were sold to "disloyal" natives such as the Xhosa. The Boer settlers also objected to the selling of guns to Africans, as they wanted to keep its symbolic power to themselves. By the early 19th century, however, the arms trade became an important economic activity for the settlers because of the great local demand, which will be elaborated on below.

From 1806, the British annexed the Cape and colonial administrators imposed gun control for order and hegemonic purposes. In the 1820s, the sale of arms and ammunition

was forbidden throughout the colony. Illegal trade continued on a massive scale, however, and practically anyone who wanted and could afford a firearm found the way to obtain it. African chiefs were willing to buy them at very high prices – as much as 30 cattle per gun. As modern weapons were introduced, the old obsolete guns were dumped and their prices dropped, but the trade continued to be lucrative. At first many, colonial officials ignored the illegal trade, because they "maintained that there was no risk from the trade, because Africans were technically incompetent, even though it was relatively easy to learn how to shoot a musket" (Storey: 2008, p.68). Later, the British government decreed a firearm registration law (1859) and a disarmament law (1878), due to the perceived threat of excess firearms among the indigenous Africans.

Colonial authorities also used the sale of guns as a divide-and-conquer mechanism. "Friendly" locals, such as part of the Khoi or the Mfengu, were given guns at different times and became military auxiliaries to the British troops in the Boer Wars (1880 and 1899-1902). Cecil Rhodes – a leading opponent to African armament – gave the Ndebele who were considered aggressive but necessary for the diamond field concessions, 1,000 Martini-Henry rifles and 100,000 rounds of ammunition in order to obtain the Rudd concession in 1888 (Atmore et al. 1971). The Xhosa, on the other hand, were deemed rebellious and thus denied access to guns. This reinforced the ownership of guns as a symbol of power and influence. These examples reveal the links between political interests and the history of uneven technological transfer.

By the second half of the 19th century, guns were popular and prevalent throughout the continent. In addition to South Africa, they were used in British Northern Rhodesia (present-day Zambia), the Zambezi region and Western Africa in trading, farming and hunting and turned into a household item, posing a threat to colonial authorities. It is estimated that probably more than one half of the male population both white and black had a gun (Storey, 2008).[4]

Disarmament laws and regulations in preparation for European expansion plans served "to symbolize the curtailment of African citizenship rights on which the edifice of European domination was predicated. They thus spelled the end of the gun-centered systems of social relationships" (Macola, 2016, p.570). Due to the initial weakness of the British administration in colonial North-Western Rhodesia, however, the popularity of the gun among locals did not diminish before the 1920s, when the "unregulated right to possess and exchange guns was taken away " (Macola 2016, p.1518).

[4] This number does not include illegal sales, guns arriving through other borders, or older models previously in circulation.

The disarmament law was specifically for Africans and was enforced by the growth of settler racism and fear. At first, there was little racism toward the local Africans, comparable to the 'equal power' between African and Europeans described by Thornton (1998) and Robin Law and Kristin Mann (1999) in the section above. In the 17th century when the VOC entered the Cape, there was a situation of mutual interests, because the VOC needed to buy supplies from the Khoi for their ongoing journeys to Asia; so the VOC were tolerant of the Khoi, this tolerance did not include recognition of indigenous land rights, however (Guelke & Shell: 1992). When the Khoi became increasingly reluctant to cooperate with the VOC mainly due to land issues; mutual dependence and respect turned to fear and distrust, rationalized by scientific racism. With disarmament and growing racism, guns turned into a symbol of those who had power. Denying access to firearms also had an economic benefit for the colonizers, as it served their growing demand for local labor in the mines and fields and land for settlement, as without guns, Africans were forced to work for the colonizers and forfeit their land to others because they could not protect it, either from the settlers or other threats.

Once again, technology is seen as manipulated for the benefit of the colonial regime, in enforcing hegemony using divide-and-conquer methods or the weakening of local resistance with the restrictions on gun sales, while at the same time encouraging work or collaboration in gun sales.

By the time of the 1884 Scramble, although many Africans had guns and were proficient in their use, these were usually of obsolete brands inferior to the breech-loaded or Maxim machine-gun. Combined with superior European tactics, this meant that conquering the continent was fairly straightforward, with only small numbers of troops required. These technologies did not only facilitate penetration, but also kept the European takeover highly cost-effective. The reduction of sickness and death by new medicines ensured a reliable supply of troops. The steamboats reduced the time it took to enter certain areas and once entered, the guns and machine guns achieved the takeover quite rapidly enabling the use of only a few soldiers to take over massive territories, with the added advantage of keeping locals at bay due to their fear of the sophisticated weapons. France needed only 4,000 men led to conquer Western Sudan, and even less (2,000) to conquer Dahomey as for Ijebu, Nigeria, the British only used 1,000 men (Headrick 2010). This cost-effectiveness assisted not only governments but also the large trading companies whose interests they promoted, reducing their costs and maximizing their gains.

African perceptions and sentiments regarding the introduction of European technologies were multifaceted from the very start of the colonial encounter. On the one hand, David Arnold argued: "technological intervention was characterized by violence – a physical and epistemological violence directed against past practices and outmoded

technics [sic]; but also a current violence expressed through technologies of warfare and policing, of rapacious land appropriation and mineral extraction, of intrusive medicine and coercive public health" (2005, p.87). However, other views were also prevalent. Different rulers saw benefits in the new ideas and technologies, albeit not at the expense of their sovereignty. Chief Makombe Hanga in Central Mozambique, for one, said in 1895: "My country will also have to take up these reforms and I am quite prepared to open it up . . . I should also like to have good roads and railways . . . But I will remain the Makombe my fathers have been" (Boahen 1985, p.49).

The tensions that evolved between these divergent views can be seen in the history of the introduction of firearms in southern Africa. The first encounters between Europeans and Africans in South Africa were between the Khoi and Dutch East India Company (VOC) merchants in 1640. The Khoi were herders who migrated according to seasonal rainfall and traded livestock and agricultural produce with the Europeans in return for tobacco, copper and iron. At first, they feared firearms, as documented by Donald Moodie[5]: "They often asked our people if they had fire-arms with them, sitting by our men with the greatest fear, shaking and trembling" (Storey 2008, p.27)[6]. By the 18th century, however, they overcame this fear and became skilled shooters. They recognized that firearms could help them defend against predators, guard their crops against grazing, and hunt – a growing source of revenue (Storey 2008). Many groups, including the mighty Zulu fighters who first encountered them around the 1820s, as documented by the British traveler Nathaniel Isaacs (Guy 1971), shared the fear of firearms. In 1839, this fear was confirmed in the four aggressive expeditions by the Boers against the Zulu who clung to conventional weapons and tactics – as a result, approximately 3000 Zulu fighters died with no loss to the Boers (Guy 1971).

Thus, while firearms initially induced fear, the Khoi, Xhosa and Zulu also recognized the technical limitations of the early guns, such as the matchlock's[7] vulnerability to humidity, short range, inaccuracy and the inefficiency of the reloading process (Shineberg 1971; Storey 2008). Several local populations, such as the Zulu of South Africa and the Ngoni of Eastern Zambia and Malawi, had developed a military culture over many centuries, with ritual significance reserved to the prestige of the stabbing spear and shedding the

[5] Commander royal navy and colonial secretary in Natal who compiled the Cape Record, containing documents and translations dated from the 1640s.
[6] Quoted from Donald Moodie in *The Record,* December, 11, 1653 I:41
[7] Matchlock muskets were the most common firearms employed by Western European armies in the early 17th century, and were introduced to the Cape at that time (Storey 2008).

opponent's blood in close combat attesting to bravery and honor (Laband 2014; Macola 2016). Thus, the gun became a "handicap to valor" (Macola 2016)[8].

Eventually, many locals came to appreciate the power of guns through hunting demonstrations by the European traders and lost battles. Nevertheless, the first impression of inefficiency, the importance of local military cultures as well as conservatism similar to that described by Austen and Headrick (1983) above, stalled its use in later military engagements. In the 1879 Anglo-Zulu War, for example, the Zulu continued to depend on numerical strength and traditional practices and the rifle remained secondary to the spear (Guy 1971; Storey 2008; Laband 2014). Even more than the Zulu, the Ngoni "objected to fighting with firearms because they appraised this particular technological import in pejorative terms, viewing it as posing a threat to dominant notions of masculinity and honor constructed around close combat" (Macola 2016, p.2419).

Thus, the rejection of a given technology as militarily efficient was not due to failed adoption of modernity, but was rather motivated by sociocultural values and beliefs. This, Macola argues, "was a deliberate choice, rather than the enforced consequence of economic insularity or the technical deficiencies of the imported hardware of violence available to them" (2016, p.2413).

This complexity is further highlighted by the Ngoni's appreciation of various European artifacts such as European attire collected by the king. Despite ambivalence regarding their military value, guns were also collected and appreciated for their novelty, modern workmanship and finesse: "These guns, however, were deployed solely as symbols of royal wealth" (Macola 2016, p.2697)[9]. Despite the technological superiority of guns, this technology was often rejected for normative considerations. In many cases, this conservative approach to warfare eventually led to defeat and loss of independence.

Relatedly, guns were instrumental to the balance of power between different ethnic groups in South Africa and other parts of Southern Africa and had a similar effect on the precolonial weapons of stronger groups ruling, raiding or controlling weaker groups. As we have seen, some groups did not embrace guns for military purposes. Most, however, did adopt them, including the Khoi and Xhosa; the Luvale, for whom firearms were a natural extension of a preexisting hunting tradition; the Lozi who recognized that centralizing gun trade would be politically advantageous; or the Chokwe, who embraced the gun as a tool "for

[8] Quoted from Eva Sebestyen and Jan Vansina, ed. and trans., "Angola's Eastern Hinterland in the 1750s: A Text Edition and Translation of Manoel Correia Leitão's 'Voyage' (1755– 1756)," *History in Africa* 26 (1999): 347.
[9] Ibid, p195

the production of human and animal capital" (Macola 2016, p.451), and used it to exert their rule over weaker groups, becoming among the most important suppliers of slaves to Angola.

This differentiation between groups, together with the subsequent disarmament described above, fluctuations in availability, and prices affecting the ability to possess guns, created new inequalities and alliances. This was true not only in economic terms, such as the ability to hunt and trade in ivory as did the Tswana people (Atmore et al. 1971), but also militarily, as in the example of the Ndebele people who used guns to attack the Shona in the 1860s. Groups in the Zambezi area that adopted guns, such as the Yeke in Southern Katanga, had an advantage over others enabling them to conquer other groups. Temporary shortage of firearms in the disarmament periods led to unexpected alliances such as between the Tlhaping and the Girqua in the 1820s; this alliance lasted up to five years until the Tlhaping finally obtained access to illegal firearms (Storey 2008). Other bizarre alliances were made between the Shona and the Afrikaner settles in Zoutpansberg since 1850, against the Ndebele raids, and between the Shona and the Portuguese in Eastern Mashonaland, until, by 1890, raids became unprofitable for the Ndebele (Atmore et al. 1971).

In the first period after their introduction, guns were used mainly for protection, livelihood, and status symbols as seen with the Khoi and San. Later local chiefdoms and ethnic groups needed guns to fight off rival groups and increasingly also Boer settlers who built farms and took over more and more of their grazing land, and finally in the wars over sovereignty with the British. Other than the importance of their functionality, guns assisted to keep in place the hierarchical structures in the 18th century. As foreign as it was, the gun was incorporated within the existing political and social systems of the local population, for example by Zulu groups or the Northern Nguni which formed the *Amabutho*, age-grade regiments which acted as an ad-hoc militia of young men called in by the chief as required, similar to the settlers' militia (Laband 2000). However, this was more than a military system coinciding with communalism: "The system also helped them organize labor for cattle herding, farming and hunting" (Storey 2008, p.58), and the gun played a role in non-military functions as well – to keep animals from attacking livestock and protect lands against human incursions. Thus, by the 19th century in South Africa, "States and chiefdoms came to depend extensively on the use of guns to generate income and maintain security" (Storey 2008, p.78).

The Makolo system of the Lozi of the upper Zambezi floodplain is an additional example, made up of military and labor units to which people belonged since birth. Guns enabled the king, chief or bureaucratic aristocracy to strengthen their supporters by providing or denying guns. Royal centralization was maintained by inward gun control and

"elevated social status depended solely on its alliance with, and loyalty to, the kingship" (Macola 2016, p.778)[10]. Guns were incorporated into and reinforced the traditional political and social structure, without causing structural change; as in gold or ivory, chiefs or kings had the exclusive right to trade in guns. Hence, we see how easily guns were incorporated in political systems and even sustained royal power.

However, guns also created new social statuses, such as Warlord polities. These were groups of men following a powerful leader, outside of the traditional political and social structures, usually commercially driven, enhanced by the availability of firearms and leveraging violence. This was enabled by the erosion and fragmentation of royal monopolies, caused in some cases by foreign commercial conflicts and the distribution of imported commodities. These resulted in increased violence and high levels of slave exploitation, facilitating the power of the warlords. However, these did not have a long lifecycle, because technological superiority was an insufficient basis for a system of government which eventually died out due to lack of grounded legitimacy (Macola 2016). A good example is Msiri, the Yeke warlord, who accumulated much power and wealth through guns, but not enough to overcome the Sanga rebellion against him of 1891(Macola 2016). The emergence of warlords and the growing slave trade in the West African coast, had a great impact on the gun trade – growing demand for firearms on the part of the African leaders fed a vicious slave-gun cycle.

In addition to military and political applications, guns had multiple commercial and economic purposes. They were used for protecting the fields from predators in farming and also became crucial in areas such as hunting, which developed into a very lucrative business and an industry in itself by the 19th century, and continued to be an important cultural activity related to masculine expression of both indigenous and settler populations. Income was generated by trading hides, skins, ivories and feathers – items much in demand in the colonial metropoles. Eventually this activity contributed to the depletion of animal populations, changing the local ecological system, and causing an unanticipated detrimental impact of the gun.

In the mid-19th century, the capitalist revolution began in South Africa, with growing prosperity following the discovery of diamonds in Kimberly and the thriving agricultural farms. The high demand for guns was exploited by the colonialists as in the example provided by Comaroff & Comaroff of a Tswana ruler who "sent a regiment of young men to the mines so that their earnings might be spent on weaponry" (1997, p.201). Africans emigrated there

[10] Quoted from Mutumba Mainga, *Bulozi under the Luyana Kings: Political Evolution and State Formation in Pre-Colonial Zambia* (London: Longman, 1973), 34-35; Eugene L. Hermitte, "An Economic History of Barotseland, 1800– 1940" (PhD diss., Northwestern University, 1974), p.39.

from areas as far as Tanzania in the hope of obtaining money to buy guns, farming tools and cattle.

The new reliable guns were also desirable as a trading commodity far easier to exchange than cattle – a form of currency. This created a strong link between the capitalist and the breechloader revolutions: "as more Africans were drawn to migrant labor, they often spent their money on weapons" (Storey 2008, p.133). Gradually, "all transactions regarding wives, inheritance, succession, compensation, illness, deaths, burials, and initiation ceremonies" came to entail "the loaning or passing of guns and powder" (Macola 2016, p.1492).[11]

Curiously, as opposed to the "technology as a developer of skills" notion, there was also a second relation between the two revolutions. Storey (2008) brings to our attention the 'deskilling factor'. The capitalist revolution turned many multi-skilled African men, in farming, hunting, cattle herding and many other professions into unskilled laborers for settlers or mining companies, and "it took fewer skills to fire a breechloader than a muzzle-loader" (p.133). This deskilling was related not only to shooting but also to the industry surrounding the older versions, that of repairs, modifications, and bullet production, but far worst, "All shooters came to depend on highly skilled city gunsmiths, as well as European ammunition factories" (Storey 2008, p.133). This highlights the role played by technology as a political tool that could be manipulated for colonial purposes and thereby transforming social structures, local skills and sources of livelihood.

Some historians (e.g. Bailey & Nie 1978; Storey 2008) argue that the bulk of the gun trade between 1650 and 1900 was bound for indigenous buyers throughout the British Empire, from Native Americans to Indian and Africans. Although exact numbers are unknown, from 1857-1881, 308,512 firearms for legal private consumption entered the Cape (Storey 2008) alone; about 100,000 guns passed from Zanzibar to the mainland each year in the 1880s (Macola 2016); and "From England alone, at the height of the eighteenth-century Guinea trade, the gunsmiths of Birmingham were providing more than 100,000 a year" (Davidson 1977, p.213).

These staggering statistics are also a mark of how a foreign technology introduced in the 17th century became a household commodity by the 19th century, causing many scholars to define many groups on the continent as gun societies. As Macola (2016) states, however, the phrase 'gun society' may be appropriate in the limited sense of quantity and coverage, but does not coincide with the concepts other Western and Marxist connotations. Thus, local

[11] Quoted from C. S. Parsons to P. Hall, *Solwezi*, 23 January 1923, NAZ, BSAC/ NR/ B1/ 2/ 368.

populations demonstrated their ability to identify the utility of new technologies but also to integrate them into local ways of living. Similar

The Khoi demonstrated an impressive ability to develop and integrate technologies. They and other groups such as the San proved to be skilled shooters. As guns were very popular but also expensive, an entire industry of gunsmiths and blacksmiths evolved around guns repairs and spare parts. Apart from shooting, a range of local technical skills emerged and developed: producing gun powder formulations for different effects and distances, cleaning and fixing rifles, developing original bullet designs for greater effectiveness, etc. (Storey: 2008). Other groups such as the Chokwe and the Mbwela, both from the upper Zambezi, were documented as highly proficient in manufacturing gun parts by foreign travelers impressed by their technological knowhow (Macola 2016).

Once the breechloader became popular around the 1860s, however, Africa became a dumping ground for the older obsolete weapons (Pilossof 2010). On the one hand, many of those technical skills became obsolete and the local gunsmiths could no longer compete with their European counterparts, since the technologically sophisticated breechloader was a much more expensive weapon and was difficult to maintain it was mostly used by Europeans. On the other hand, Africans stuck to the cheaper and older versions muskets and muzzle rifles, so that the local gunsmith industry continued to thrive. The Lozi were extremely competent in repair work and learned “to overcome some of the new technology’s limitations by honing preexisting ironworking skills” (Macola 201, p.1394). The need to hunt large animals such as elephants also required alternations such as the development of the double-barreled gun, not to mention developing ivory extraction techniques that became highly sought after by the Europeans. Thus, “African ironworkers possessed the specialized skills and knowhow necessary to overcome or minimize the inherent deficiencies of the new technology” (Macola 201, p.1157). Here we see African practicality, technical skills as well as adoptability and the ability to accept given circumstances and make the best of them.

Guns were associated with different cultural beliefs, and were used for marriages and funerals as ceremonial expressions of power (Pilossof 2010). To the Sotho people of Southern Africa, guns connoted “death by human hands” rather than by God. The Kaonde hunters of Solwezi Zambia were accustomed to appease their ancestors before and during the hunt, and guns were incorporated in this tradition “to invoke the same spirits whose blessing was being sought” (Macola 2016, p.1503). Both are typical examples for African mysticism associated with colonial artefacts rather than accepting European values (Storey 2008).

In the late 19th century, in other parts of Africa, such as Central Sudan, firearms were not necessarily used for warfare, but to bolster the feudal system: “rulers bought guns and trained slave-soldiers to fight with them as a way of rendering vassals more dependent” (Storey 2008, p.8). The Lozi kings adopted firearms as a symbol of royal strength and as artifacts, which expressed hegemonic power much like western attire. These examples show that “the value of guns was as much symbolic as it was practical” (Comaroff & Comaroff 1991, p.345). The African chiefs and kingdoms appropriated this technology on a cultural basis also coinciding with their belief of the supernatural and gave meanings and usage to the technology based on their culture, customs and traditions.

With the disarmament regulations, once again local political structures and social systems were disrupted. Rulers lost their might and advantage as well as their royal symbolism, and became hostages of the colonial administration. “Losing their earlier significance as centrally monopolized means of military and economic domination, guns were now recast as individually owned tools of production and emblems of male identity” (Macola 2016, p.2374). Since most local males had a gun, enforcing ownership permits caused turmoil, not to mention the economic impact since guns were used as a form of currency, as seen above. This marked the end of local independence in many ways, both military and economic.

Having said that, it did not happen overnight. Even in the 1920s, some of the more militant groups such as the Yeke, for whom the gun was a strong symbol of masculinity, volunteered as policemen and soldiers in the colonialist administration. Paradoxically, the Ngoni, who had rejected firearms in the past, had a radical change of understanding of guns; in colonial times, they accepted them as a symbol of masculinity and were recruited into the colonial police forces (Macola 2016).

To conclude this section, the history of guns in colonial Africa highlights the complexity of technology introduction. There is little doubt that there were far-reaching and multifaceted consequences to the introduction of firearms to local societies, as described in the many examples above. As Africans did not pose a threat in the 17th and 18th centuries, the gun was transformed from the weapon of the European invaders into a trading commodity, hunting tool and fashion item. It was also used in the trans-Atlantic slave trade. Africans developed the skills to repair guns, turning obsolete technology into a thriving industry. Appropriation was not only technical but also involved unexpected symbolic connotations. For different local cultures, guns became a symbol of the royal class, markers of masculinity, or a threat to manhood and honor. Thanks to their multiple practical and symbolic uses, guns spread throughout the continent and became a household item. By the time of the Scramble, they completed their circle of development and were converted back to

their original function of invasion and conquest. In some cases, they backfired as a tool of local resistance, but with limited success owed to exclusive European access to the most advanced models.

Railways: From Facilitating Exploitation and Profit to Reordering Geographical and Socioeconomic Spaces

The second set of technologies to be examined, are those that contributed to the colonial goals of economic exploitation and profit, including agricultural innovations, cash crops, mining developments and transportation. Africa offered colonialists and settlers huge areas of underexploited arable lands suitable for massive cultivation; it also offered abundant raw materials deposits for mining. In order to exploit Africa's natural resources, Europeans introduced a range of new technologies. In Europe, such technologies had raised standards of living and facilitated modernization; but what were their effects in Africa?

Of particular significance were railways. Railways were built throughout colonial Africa to facilitate transportation of raw materials and agricultural produce but also to enhance the colonial economy. This certainly succeeded in some places, whereas others fared poorly. The extent to which railways transformed local economies was dependent upon a wide range of relations between Europeans and Africans, but also between the colony and metropole, and government and private interests, all of which added to the complexities and controversies that characterized the introduction of this new technology to Africa. With a focus on the evolution of railways in colonial Gold Coast (present-day Ghana), we shall see how local Africans viewed this technology, what impact it had on the local population, and its detrimental effects. At the same time, we will see how railways were appropriated by local societies, and how they became instrumental in facilitating the remaking of African society in the form of new economies, new cities and new elites.

The growing mining and cash crop industries of the mid-19th century required transportation and communication infrastructures and railways, roads, harbors and telegraph lines were built across the African landscape. "The railway was seen as a necessary component in the colonial objective of amassing natural resources from colonial territories for transmission to the metropolitan country" (Njoh 2007, p.16). Railways were first introduced to Africa in 1852, in Alexandria; by the 1930s, over 32,000 miles of railroad were built around the continent (Gann & Duignan 1975). Railways were introduced in Ghana by the British in 1896 and were the single largest item on the budget. According to Remi Jedwab and Alexander Moradi (2012), it amounted to "31.4% of total public expenditure in 1898-1931" (p.2) in Ghana. This was true of other colonies as well: "in Kenya in 1896-1930

the share of railway expenditure in total public expenditure was 19.3%. In French West Africa in 1910-1956, this share amounted to 30.0%" (Jedwab & Moradi 2012, p.2). More generally, Jedwab and Moradi (2013) found that 88.3% of sub-Saharan African railroad lines were built before independence.

Colonizers had many grandiose visions of how the railway was to change and improve Africa. Cecil Rhodes' vision was to eventually link Egypt to the Cape, to unify the British colonies and enhance trading – a plan that didn't materialize due to high costs, geographical constraints and lack of immediate return on investments. The French had a similar vision of linking Senegal to Sudan, which also made little headway.

Due to budget constraints, the colonial administration in Ghana had to choose between a Western, Central or Eastern route. Eventually two lines were built: the Western line, linking Sekondi on the coast to the gold mining areas of Tarkwa and further North to Obuasi, completed in 1903. In addition to the physical difficulties involved, building the railway involved political difficulties. On the British side, the railway involved a conflict between the gold mining companies and the palm oil lobby. Governor William Maxwell (1895-1897) supported the 'mining first' concept and thus the die was cast in favor of the mining interests. There were also military reasons for building the railway: the Ashanti Kingdom was annexed to the colony in 1896 after several wars and it was now deemed important to create this link to the Ashanti capital Kumasi, further North of Obuasi. Governor John Rodger (1904-1910) promoted the Eastern line, connecting Kumasi to the capital Accra, against the opinion of former governors who supported a Central line. Construction began in 1909 but was completed only in 1923, due to wartime constraints. Eventually the line supported the export of palm oil, rubber and cocoa as well as the new gold mines in Kibi. Evidently, different motivations caused friction between interest groups and this huge endeavor was not conflict-free.

There is a unanimous agreement that colonial railroads boosted exports in Africa, and were a major enhancement to the economy in general, with a transformative effect on the entire continent (Gann & Duignan 1975; Robinson 1999; Njoh 2007; Jedwab & Moradi 2013). Jedwab and Moradi (2013) uncovered that, commercial agriculture reasons were suggested as a motivation for railway construction in 42.4% of the cases in Ghana, mining was suggested in 36% and military in 35.5%. Ambe J. Njoh (2007) shows productivity and trade enhancement in the continent due to the railroads. In Nigeria, groundnut exports to Europe increased significantly from 1911 when the Kano line opened, and in South Africa, the Kimberly mines became lucrative only after the line was complete in 1885.

Mines required heavy machinery, and the main means of transportation before the railway, had been head-loading by porters or slaves, making the production process very expensive. "While the freight rate per ton mile was 5 shillings (s) for head-loading, 3.2s for canoe, 2.5s for lorries (1910, against 1s from 1925), 1.9s for cask rolling,[12] and 1s for steam launch, it was only 0.4-0.6s for railroads" (Jedwab & Moradi 2013, p.7). This does well to illustrate the argument that "The impact of a new technology depends on the previously used technologies… The less efficient the old technology is relative to the new one, the larger this impact will be" (Jedwab & Moradi 2013, p.4). In this case, the transition from head-loading to railways was a phenomenal technological leap, with remarkable consequences. Railways were much more than just cost-effective, however – they were more efficient than other forms of transportation. Trucks were expensive and required quality roads, which were scarce; draft animals were not used due to the Tsetse fly; and waterways were few. Thus, at least until the late 1920s, railways were by far the best transportation technology.

In the Ghana case, the decrease in production costs due to the new transportation system caused an increase of production and exports, making colonial Ghana the world's largest cocoa exporter by 1911. The Western line saw an increase in cocoa freight from 0 tons in 1904 to 19,191 tons in 1915 and the Eastern line saw a hundredfold increase from about 1,000 tons in 1901 to 100,000 tons in 1925 (Jedwab & Moradi 2013). Gold production and export similarly increased. Most of the pre-rail gold operations (from 1892-1901) had virtually failed due to transportation and safety problems (Hilson 2002). Since 1902, however, gold production increased from about 25,000oz to about 200,000oz in 1910 (Hilson 2002). This example is quite consistent with many more accounts from around the continent (e.g. Robinson 1999, in Senegal; and Storey 2008, in South Africa).

However, this economic growth was not always mirrored in other colonies. Leroy Vail (1975), for example, describes how railways became a hindrance on the economy of Nyasaland (present-day Malawi). Vail claims that unlike the Cape region or Kenya, Nyasaland was of secondary importance to the British government. Government decisions with regard to railway expansion were motivated by power retention vis-a-vis the Portuguese presence, the perceived American commercial threats, and the alliances with the Mozambique Company – the British proxy in the area – with little attention paid to the protectorate's wellbeing. From the very beginning, Nyasaland suffered from a labor shortage, deeply impeding the success of the agricultural farms. The government undertook commitments to private companies to build the railway with other interests in mind, culminating in the frivolously unnecessary and costly Zambezi Bridge. By 1935, this conduct caused massive debt of 5,100,000 pounds, as well as great poverty due to the high taxes

[12] Rolling barrels of cocoa on tracks cleared in the forest.

charged in order to repay the debt, which "rose three times faster than that of any other territory in British Africa" (Vail 1975, p.89). Vail summarizes the failed endeavor in retrospect: "Too late were they realizing that the wrong railways had been built in the wrong places for the wrong reasons" (1975, p.111).

This conclusion flies in the face of the perception that the colonial administrations and European metropoles' agendas were matched, and that the realization of this agenda was an unbridled process. Railways did not facilitate economic expansion in all contexts, especially when contradictory agendas were competing with each other. The colonial administration's agenda might have included the achievement of some economic prosperity for the colony and its people, while officials in the metropole often had an eye to broader geo-political dynamics, which focused on efforts of expansion alliance-building, even if this came at the expense of the colony and its people.

In the Nyasaland case and in others, one major controversy that bedeviled colonial railway construction in Africa was the debate whether the government or private enterprises should be financially responsible for funding railway expansion. Colonial governments normally believed that Africa should be developed by private enterprise as had been done in Britain. One example in which the colonial administration was able to engage a private company to undertake the costly endeavor was in Northern Rhodesia and Southern Rhodesia (present-day Zimbabwe), where the British South Africa Company (BSA Co.) was responsible for constructing railways (Njoh 2007).

Eventually, however, due to the massive cost of railway construction (estimated at around a third of colonial budgets) and doubts as to the return on private capital investments, governments ultimately undertook the great majority of railway construction, as private companies refused to finance the costly ventures. The Kenya-Uganda railway – whose construction began in 1896 and which reached Lake Victoria in 1902 – exceeded the cost of 5.5 million pounds, an amount paid off by an interest-free grant (Gann & Duignan 1975). In the Congo, the 1920s saw massive infrastructure construction: "Of the total spent, 75% went to railway and river transport" (Gann & Duignan 1975, p.200). In the 1950s, more than half the budget was spent on transportation, about half that amount devoted to railways and river transportation and 40% to roads and airports (Gann & Duignan 1975). Most private companies could not afford such expenses owing to their risky nature – mainly because hazardous environmental conditions and a highly instable workforce to begin with.

Government thus funded the endeavors, but it is important to understand the full range of underlying motives behind these projects. In Sierra Leone, for example, railways were designed to help the British to win over the local leadership in order to satisfy their

territorial ambitions. As a goodwill gesture to the king of Falaba, they "proposed to link Freetown by rail to the Northeastern part of the country… the British colonial authorities saw such a railway as a necessary component in British efforts to establish sovereignty over the entire protectorate of Sierra Leone" (Njoh 2007, p.71). Indeed, railways were not only tools for economic exploitation, but also played a role in sustaining the colonial hegemony over the population.

Irrespective of the economic and political benefits involved, the very construction of these new transportation networks often had severe consequences for local African laborers. Colonial governments as well as private corporations exploited forced or low-cost labor to realize these grandiose schemes. In some countries they even imposed labor quotas, commissioned labor from chiefs or recruited local workers for obligatory workdays (for example, 12 days per year in French West Africa or 15 in French East Africa; Boahen 1985; Loomba 2015).

In Ghana, railway construction and increased cocoa production produced an acute lack of laborers. The colonial government did not want to admit to using forced labor, so they called it 'communal obligations' and used manipulation, threats or bribery to persuade local chiefs to find laborers by any means. In March 1921, the Commissioner for the Southern Province told the chiefs "that the men who supplied most labour would be attended to first in the matter of wells in their villages… the Chiefs [decided to] look upon it as an order and tell their people to come forward and volunteer for work" (Thomas 1973, p.98).

When the 'volunteers' arrived at work, they found labor conditions to be very poor, even deadly. The Brazzaville–Pointe Noire railway line completed in 1934, for example, cost the lives of as many as 20,000 forced laborers (Njoh 2007) and in 1939 on the Sudanese railway which was the largest employer of industrial labor in the country, harsh work conditions, little facilities and medical services, employer brutality, poor wages took their toll in African lives. Although no specific number was found, some accounts discuss up to 30% of the 20,000 workforce (McCulloch 2004; Wolmar 2011). While this is typical of most railway construction worldwide, in Africa, colonial economic and ideological hierarchies ensured that the loss of life and harsh discrimination of workers went on with little accountability.

Komla Tseya and Stephanie D. Short (1995) examined the health issues of railway workers in Ghana in 1898-1929. Three groups were affected: expatriate workers, African workers and the African communities living near the railways. The expatriates suffered harsh conditions, tropical diseases and hazards, as well as malnutrition and intestinal illnesses caused by poor sanitation, not to mention a range of stress related illnesses such as alcoholism, 'melancholia' and schizophrenia. On the Sekondi-Kumasi line built between

1898 and 1902, morbidity rates were estimated at 33%, and at least one death per month (Tsey & Short 1995). The health of expatriate workers became a colonial concern and was dealt with through segregated living areas and later towns, provision of fresh foods, better equipped clinics and a leave of absence after two years of work (Hogbin 1985; Tsey & Short 1995). Hogbin claimed that these efforts were not simply humanitarian, and the investment in these services was necessary to ensure the continued supply of labor. As he wrote: "The Railway's motives were not solely altruistic…, since the capital outlay associated with anti-malarial work was redeemed by a decline in lost working hours due to sickness" (1985, p.934).

The Ghanaian railway workers, who in 1902 numbered around 16,000 on the Western line alone, were even worse off. Malnutrition, water shortage, inadequate shelter, and physical exhaustion were very common, not to mention outbreaks of smallpox, diarrhea, and yellow fever. Workers also died of construction accidents. The situation caused many to flee and protest, as in the 1900 'Tarkwa food riots'. The high turnover and absenteeism was explained in racist rhetoric: the workers were described as 'lazy' and 'slow', and were blamed for their illness. Draconian measures were taken: "flogging and the withholding of wages were some of the extreme measures adopted to increase labour discipline... railway work got a bad name amongst the natives'" (Tsey & Short 1995, p.618)[13]. While expatriate workers' health issues were addressed to a certain degree, African workers were not as lucky. Nevertheless, over the years the health issue could not be ignored and medical response improved, as did working conditions and shelter for essential workers. By 1920, hospitals were established in railway towns, but only less than 1% of Africans had access to these services (Tsey & Short 1995).

The communities living near the railways were also affected, in the form of rail accidents, for which no compensation was paid, bad sanitation conditions due to accelerated urbanization and the spread of disease facilitated by the railway. In 1918, it was believed that the railways facilitated the spread of the deadly influenza in Nigeria and Ghana causing the death of at least 100,000 people (Hogbin 1985; Patterson 1995; Ayoola 2013). "The fact that in these countries the first inland towns affected by influenza were those connected to the main ports by rail, is proof of the greater speed at which railways allowed the virus to be diffused" (Hogbin 1985, p.935). Syphilis, introduced by the Europeans, also plagued the population along the railways. According to Tsey and Short, "the iron horse which the British promised would catapult the nineteenth-century Gold Coast society into the modern civilization of the twentieth century, soon became a nightmare" (1995, p.619).

[13] Quoted from, Tsey C. E. (1986), *Gold Coast Railways: The Making of a Colonial Economy*. Unpublished Ph.D. thesis, University of Glasgow.

As we have seen, it was not only cost savings that made the railway a leading cause of death in colonial Africa. The underlying racist view that Africans were seen as not worthy of healthcare also played a key role. Thus, although railway development had an overall positive economic effect on some colonies, those working for it were on the low end of the benefits (Tsey & Short 1995). We see that with all the good intentions of prosperity and progress the first immediate impact of the railway technology on locals was death and misery to thousands of people.

In some places, Africans refused to be recruited for railway construction and Indian workers were brought in (Mwanzi 1985). In Senegal, for example, the French Governor, Brière de l'Isle, devised to build a railway between Dakar and Saint-Louis in 1879, under the guise that he was only building a road. When realizing his true intentions, Lat Dior Diop, the indigenous ruler of the Cayor region saw this act as the end of his independence and resisted the construction by imposing sanctions on collaborators and prohibiting the cultivation of groundnuts to make the area unattractive to the French. This was the second time, that he opposed railway construction: the first had been when it was first suggested in 1865. Not everyone cooperated with the resistance against the French and the railway issue became a point of inter-African political conflict. Eventually, Diop was left with 300 men and lost his war against the French in 1886 when he died (Boahen 1985; Robinson 1999). Local dignitaries who had opposed him were rewarded with the position of colonial chiefs, such as Demba War Sall, who recognized the inevitability of the railway construction. As in the case of guns, the colonialists used technology as a tool in their divide-and-conquer strategy to retain hegemony over their colonies.

Despite the widespread ill effects described above, many Africans considered the train a great modern marvel, and called it the iron snake, or iron horse (Tsey & Short 1995; Reichart-Burikukiye 2013). In Kenya, on the other hand, many locals attributed famine and lack of rainfall to the railway. Another key motive for resisting railroad construction was fear of land expropriation. In Kenya, Senegal, South Africa, Zambia and many more countries, significant amounts of land were expropriated for that purpose (Gann & Duignan 1975).

Africans were also a minority among railway users. In Tanganyika in 1913, less than 10% of train travelers were Africans. A racist segregation system was installed whereby the fourth class was assigned to Africans, where they sat on the floor; the third class, with benches, was reserved for Indians, Arabs and other non-whites; and the second and first classes were exclusive to Europeans. Racism was certainly expressed in the railways. Still, Africans used the railways for their benefit as well. According to Christine Reichart-Burikukiye (2013), the train offered African people a new independence, such as for women wanting to flee unwanted marriage, or skilled laborers migrating in search for work. Some

locals enjoyed vocational training (Headrick 1988). However, the scale of these efforts was negligible: with the start of railroad construction in Senegal in1878, for example, only eight Senegalese were trained in Saint-Louis, and seven others were sent to France, so that the colony continued to rely mainly on imported professionals (Headrick 1988). In general, vocational training in the colonies was mostly agricultural (White 1996) and very few resources were distributed for technical vocational training.

In Nigeria, for example, railway construction revived the dying blacksmithing industry, which had suffered from raw material shortage for many years prior (Gewald et al. 2012). Railway construction brought large amounts of scrap metal into the country, and led to a surge of metal theft in the rural areas. Together with a ban on imported manufactured metal products during WWII, this brought about a swell in local blacksmith innovation and imitation. They developed the coldsmithing, a new process for imitation, using less tools and technical process of the initial smithing, demonstrating once more how the locals were innovative and practical with the introduction of new technologies and related circumstances.

Some Africans even benefitted financially from the railways. As transportation investments increased, cocoa exports soared, generating significant boosts in income, which led to the emergence of new economic elites within the local population in Ghana. These were mainly cocoa brokers, lawyers, and merchant and mining clerks but also civil servants, teachers and other highly educated Ghanaians (Newell 2006). According to Jedwab & Moradi, in 1901-1931 railway connectivity had a strong effect on urban growth, with farmers exporting cocoa to the rest of the world and importing foreign consumption goods – all thanks to the reduced transportation costs. In economic terms, “railways have caused around 30% of cocoa production in 1927, which represents 4.5% of GDP implying a social return of around 20-30% on capital outlay. We find that half of the surplus went to Ghanaians while the other half was captured by the colonizer (2012, p.3)

The surge of income and production expansion caused the development of new economic centers along the rail tracks and these formed into new cities. Thus, urbanization became another unintended byproduct of the railways, but with a long term impact. Towns emerged around train stations and urban population increased, already before the turn of the 20th century. “Ghana’s urbanization rate increased from 23.5% in 1901 to 48.6% in 1931, 52.6% in 1960” (Jedwab & Moradi 2013, p.9). Accra grew from a population of 18,000 in 1901 to around 135,000 fifty years later (Parker 2000). These towns had a far-reaching impact on African society as whole, highlighting the complexity of the colonial encounter within the realm of technology.

To conclude, railways were first introduced as a technology for the facilitation of exploitation and profit and an additional means of enforcing hegemony. They had some devastating effects on Africans: land was expropriated and Africans were forced to work on the railways in terrible and lethal conditions, with only few enjoying the benefits of the railways. However, the railways had unexpected far-reaching consequences in that they increased overall economic activity, affecting incomes and labor migration, and facilitating the emergence of new economic elites within the African communities. These are extreme changes which demonstrate the extensive ways in which technology reshaped local societies, and actually became a truly revolutionary technology.

Bicycles: From Europeanization to Africanization

The third set of technologies includes those that influenced daily life. Many of these innovations were introduced into Africa by and for Europeans seeking to maintain a European lifestyle in Africa. They offered the "comforts" of Europe to Europeans overseas, and they sought to Europeanize Africa in the image of the civilizing mission and 'development'. Yet, soon enough many of the technologies were appropriated and Africanized. These technologies included amenities such as sewing machines, bicycles, cameras, typewriters, a range of healthcare solutions and water pumps, as well as large-scale infrastructures such as water, sewage and electricity systems. In this section, I show how Europeanizing technologies such as bicycles were Africanized by cultural and physical appropriation. It will be seen that local populations used their technical abilities and skills to appropriate the technologies to meet local needs. In time, these objects also took on local cultural and social meaning as they emerged as objects of social status and prestige. As new forms of entrepreneurship and innovation emerged in the process, some Africans derived new forms of empowerment, and Europeans were once again confronted with the unintended consequences of the colonial encounter.

Bicycles were introduced to Africa close to the time of their introduction in Europe, in the first decade of the 20th century. Europeans in Africa immediately imported and adopted bicycles and they were seen as a marvel that quickly transformed their lifestyle and comfortability. Travelers in West Africa, such as Hans Schomburgk in 1911-12, "chose the bicycle for the ease of mobility and communication" (Hahn 2012, p.35). Much of what is known to us about bicycles in Africa is based on reports and travel logs of missionaries, doctors and nurses. In 1909-10, for example, missionary physician Rudolf Fisch traveled over 2,000km on bicycle through the colonial Gold Coast and Togo (Hahn 2012). Nancy R. Hunt (1999) quotes two letters from travel journals written in the 1930s by male nurses in the

Belgian Congo, in which they describe a 78km bicycle ride; these were probably the first cyclists in the country.

Access to bicycles for Europeans was not always unburdened, particularly in the case of colonial administrators on limited budgets. As Lynn Schler (2008), notes, in 1919, when the police commissioner of Douala requested bicycles for policing duties, the frugal and underfunded administration rejected the request at first. Later, they authorized the purchase of one bicycle for the commissionaire himself, which hardly satisfied the needs of the police force. Thus, as in the railways case, we see that the introduction of technologies revealed some of the underlying tensions of colonialism. Essential resources were not always readily available to enable the smooth functioning of the colony, and colonial administrations had to compete for limited resources from officials back in the metropole who had little understanding of their needs.

As we have seen in the railway section, transportation was never an easy task in Africa. Railways were few and expensive, as were steamships. If a European needed to travel far, he would use local porters, and if he were African, he would walk the distance regardless of how many hours or days were required. As expected, when Africans first saw the bicycles they looked at them with awe and curiosity (Hunt 1999). But very quickly long-distance traveling by bicycle became a new form of mobility. The bicycle was quite a revelation because it enabled people who could afford it, initially Europeans such as missionaries, merchants and explorers and later African professionals, to maintain direct contact and communication with the population that they served, to decrease travel time and provide far more efficient services to many more people.

In *A Colonial Lexicon* – a book about the medicalization of colonial Belgian Congo – Hunt (1999) demonstrates the vital role played by bicycles in everyday life through the specific context of maternity healthcare. Massive deployment of dispensaries around the country required (male) nurses to travel from village to village. Although bicycles cost a small fortune in local terms, it was much cheaper than motorized vehicles that hardly existed at the time. Other circumstances also contributed to the popularity of bicycles among nurses. The roads on which the evangelical Yakusu nurses cycled were those that opened the BaMbole forest for the rubber and coffee plantations. When the plantations opened, there was demand for many laborers, so porters who used to carry doctors were no longer available, and doctors started using motorbikes. As there were new dispensaries managed by the evangelicals of Yakusu city, the nurses too needed a means of transportation. The use of bicycles by nurses was also prompted by restrictions on local travel and recruitment of forced labor which also prevented Africans from traveling, thus requiring the nurses to come

to them. The import, introduction and use of bicycles initially had a very specific practical initial purpose of facilitating and decreasing travel time and enhancing work efficiency.

The bicycle was recognized quite quickly by locals in Congo as a very useful and practical technology and naturalized by naming it *kinga,* a Swahili term (Hunt 1999). This did not happen with less accessible technologies such as trucks, for which local populations maintained the foreign name, *camion*. Hunt (1999) builds upon Claude Levi Strauss and Michel de Certeau when describing the evolution of the appropriation of objects, arguing that objects take meaning from a 'living practice' or 'procedures of everyday creativity' together with local psychological and historical processes.

Bicycles were not only about practicality and functionality, they were seen as objects of social status, prestige, and epitomized the dream of a good life: "a symbolic marker of middle status, a marvelous technology, and a manner of dress" (Hunt 1999, p.176). They were also used for entertainment and sports. As early as 1911, African photographer Alex Acolatse captured a bicycle race in Lomé (Hahn 2012). To return to the Congo nurses, bicycles afforded them not only with mobility but also with autonomy and leisure time: "the mobile style of nursing may have been a significant part of what made the vocation attractive" (Hunt 1999, p.179). Both Schler (2008) and Hunt (1999) also illustrate how bicycles became markers of social class, of 'middle figures' as coined by Hunt (1999), those interpreting and moderating between the Europeans and locals such as midwifes, nurses, and administrators: "Yenga's dream suggests that his kinga impressed social and vocational identities on him" (p.176). According to Schler, "Status was deeply tied to a certain 'look'" (2008, p.66). Indeed, part of the Yakusu nurses' prestige lay in their riding a bicycle and their white dress: people would look in awe and children would cheer at the riders (Hunt 1999; Schler 2008). Bicycles on the one hand retained their original purpose as "helpers for the feet" (1999, p.175) as described by Yenga Mboli ya Tengai in 1931, and as a tool that became an ability. Yenga even goes so far as to equate his surgical ability to his bicycle as a tool used for the greater good. On the other hand, they became among the locals, a symbol of status and success.

As with other technologies, local populations invested their own meaning and symbolism into bicycles, changing both their function and design. Modification were made both in the physicality of the bicycle as well as in its meaning and implications. Hans P. Hahn (2012) describes cultural appropriation as a process of local interpretation and creation of new usages. In the case of the bicycle, creative modifications were made in each region to suit specific usage and changed it to what is still known today as the 'African bicycle' in each country with its modifications, showing great creativity and technical ability at the grassroots level.

Specifically, the bicycle was reinforced by Africans to survive the difficult terrain in rural areas and ensure prolonged usage, thereby protecting the costly investment. In Nigeria, for example, bicycles were imported from England but were assembled locally from 1930, with local mechanics adding, “sturdier baggage carriers, appropriate for the transport of the heavy oil drums” (Hahn 2012, p.36). To make the bicycle even more affordable and to break the European monopoly, Nigerian traders traveled to Shanghai to import bicycles and parts in 1946. These and other modifications served multiple uses and functions. Nurses in the Congo used bicycles for transportation, as mentioned, but it was also typical to see scales on their bicycles for weighing babies (Hunt 1999).

Bicycles not only engendered innovations, but also entrepreneurship and economic growth. Retail bicycles became popular as was the case in colonial India where the bicycle was locally adopted as an empowering object economically and socially (Arnold & DeWald 2011). As seen in the case of railways, the infiltration of bicycles into local economies coincided with the emergence of new elites or middle status that Hunt refers to, and this gave rise to unexpected entrepreneurs and empowerment of people who forged new economic opportunities and employment around the technology. In Cameroon, for example, merchandise was transported by bicycles and chickens received the name *poulet de bicyclette* by virtue of their mode of transportation until this very day, as I have encountered in my journeys to Cameroon. In Uganda and Kenya taxi bikes became a business and were called *boda boda*, and in Nigeria cyclists founded bicycle clubs, “including repair shops and credit circles” (Hahn 2012, 35). In 1934, this even became a threat to the motorized transport that became popular at the time, since there were over 20,000 cyclists in the country. In other West African colonies, the bicycle was used as a trading facilitator, empowering mine workers who could afford imported goods, and in South Africa, some miners were even given free bicycles for easy transport (Hahn 2012). Through these examples we see that bicycles were popular both in rural and urban areas. Thus we see how the bicycles were appropriated for local circumstances: reinforcements for cost saving and adaptability to the local terrain, modifications for local employment and livelihood purposes. They certainly exceeded the initial intention of brining comforts of Europe or Europeanization, and the Africanization of the technology brought about a rise of entrepreneur spirit, new economic opportunities and employment.

Their affordable cost, although still very expensive for the average African, their mobility, being opportunity promoters and easy technical maintenance, enabled bicycles to become very popular and significant around the continent, and sometimes there were even two to three bicycles per household. “The 1920s and 1930s were the major decades for the multiplication of bicycles in the colony, and this swell in cycling directly paralleled the

addition of roads" (Hunt 1999, p.174). In 1925, there were only 947 bicycles in colonial Belgian Congo, but by 1939, there were no less than 52,206 (Hunt 1999).

However, the enthusiasm shown for the object by local Africans was not to the liking of all colonialists. The French colonial administration in Douala, for example, was not pleased with the growing consumption ability of the locals, and was even threatened by it as it crossed some unseen racial boundaries. "Once the purchasing power of Africans approached that of Europeans in the colony, the latter feared that their civilizing mission had perhaps gone too far" (Schler 2008, p.65). Similarly, the colonial administrators of Zambia scorned Africans' use of bicycles (Gewald 2009). Some colonial administrators, as in Mali, even charged bicycle owners with a special tax (Hahn 2012). This once again demonstrates the complexity of the introduction of new technology, and how colonialists felt it went dangerously out of their control triggering a threatening effect due to perceived local independence, certainly showing once again the limits of colonial rule.

When compared to large-scale infrastructural technologies introduced by the colonialists such as railways or sewage works, it is important to recall that products such as bicycles, sewing machines, and cameras were within Africans' reach: accessible, practical and effective (Arnold 2005). It is debatable which had a more profound impact on the local population: the latter had a day-to-day and immediate impact on the population's well-being, while the former technologies had a more long-term, and broader-reaching impact. Another difference is that the former technologies are large-scale infrastructures which were introduced and owned by the government and administrators, while the affordable products, although similarly introduced at first by Europeans, were part of the private sector and quickly appropriated as part of a thriving and innovative local market.

To summarize this section, the bicycle was introduced by Europeans for its functional practicality and for Europeanizing daily life. Soon enough, the bicycle was appropriated and Africanized. As David Arnold and Eric DeWald summarize in their article on bicycles in colonial India, "Apart from the material benefits they brought to foreign manufactures from which they were imported, they helped open up a range of opportunities within the colony for employment and entrepreneurship, for collective sociability and individual self-expression" (2011 p.995). Africanization also occurred on the conceptual level, with the bicycle being naturalized in language but also translated into social status, as well as a mystical interpretation of a tool used for the greater good.

Conclusion

Technology was a distinct characteristic of colonialism, without which it would have been impossible to conquer the continent, facilitate colonial hegemony, exploit raw materials, and install practices of European modernization – all subsumed under the civilizing mission ideology. As described in this paper in the particular context of technology introduction, this vision, however, did not always work out as planned and local circumstances led to different outcomes. In all cases, technological transfer involved considerable debate between and within each side. On the European side, we can see the struggle between interest groups, economic or military, between industries and between different moral positions. On the African side, the scarce research available indicates that Africans had a thriving history of technological development and invention. At least until the 18th century, there was a stable balance of power between Europeans and Africans. African leaders knew how to protect their communities and thus were able to dictate trading terms, recognizing that what they had to offer was in much demand in Europe.

This balance of power changed with the accelerated technological developments in Europe, and the introduction of new technologies was pivotal in promoting European hegemony in the heyday of colonialism around the turn of the 20th century. These left a mark on the African continent that remains visible long after decolonization. Technology became a site of struggle and negotiations between colonial and local needs, with local populations ultimately investing their own meaning into various technologies. Different interest groups with different visions supported a range of views towards technology, from rejection to appropriation to resistance. Despite the suffering technology often caused, Africans adopted the technologies that suited them without making do with what was presented to them. Guns became a valued commodity for trade and livelihood as well as taking on cultural symbolisms; railways presented an opportunity for development, enhanced urbanization and supported new elites; and bicycles were turned into a mark of prestige and social status as well as enablers of entrepreneurship.

Using these examples, this paper also refutes two colonial misconceptions about technology in Africa. The notion of Africa's inability to receive technical skills is proven false across the three sets of technology discussed transcending specific technology or local conditions. Africans also showed grassroots ingenuity in appropriating, modifying and repairing firearms and bicycles as well as giving them new usages and meanings – refuting the second misconception of acceptance without modification. These misconceptions still bedevil many researchers, developmental experts and laypersons. As a researcher of water issues in Africa, I am constantly asked why Africa fails to develop, why 'they' seem unable to master 'our' technologies even when provided to them. I hope to have demonstrated here that these

questions are irrelevant because Africa has always been on a development path – but on her own terms, with those technologies that were appropriate for her, with her own cultural contexts and local ingenuity.

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