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# The Tools of Imperialism: Technology and the Expansion of European Colonial Empires in the Nineteenth Century\*

Daniel R. Headrick

Brethren! Oh! be not afraid  
Heaven your Christian work will aid;  
Banish all your doubts and tears,  
Rifles cannot fail 'gainst spears.  
Take your banner! Onward go!  
Christian soldiers, seek your foe,  
And the devil to refute,  
Do not hesitate to shoot.<sup>1</sup>

One of the liveliest debates in modern history has revolved around the causes of the “new imperialism” of the nineteenth century. Historians have offered a wealth of explanations for this dramatic expansion of European control over much of the eastern hemisphere. Some have emphasized political motives, such as international rivalries, naval strategy, the instability of imperial frontiers, the diversion of popular attention from domestic problems, or the influence of pressure groups on political decision makers. Others, following in Hobson’s footsteps, have stressed economic motives: the need for raw materials, secure markets, or investment opportunities.<sup>2</sup> The debate has grown to include so many works that it has even begun producing anthologies and historiographies.<sup>3</sup>

\* For their helpful and incisive comments on earlier versions of this paper, I wish to thank Ralph Austen, Zohar Ben Asher, Arthur Donovan, Virginia Fry, Rita Headrick, David Northrup, Carol Williams, and Steven Zelman.

<sup>1</sup> Satirical “hymn” in *Truth* (April 16, 1891), quoted in John Galbraith, *Mackinnon and East Africa 1878–1895: A Study in the ‘New Imperialism’* (Cambridge, 1972), p. 15.

<sup>2</sup> J. A. Hobson, *Imperialism: A Study* (London, 1902).

<sup>3</sup> For a sample of the debate on the causes of nineteenth-century imperialism, see such anthologies as Harrison M. Wright, ed., *The ‘New Imperialism’: Analysis of Late Nineteenth Century Expansion*, 2d ed. (Lexington, Mass., 1976); George H. Nadel and Perry Curtis, ed., *Imperialism and Colonialism* (New York, 1964); or Ralph Austen, ed., *Modern Imperialism: Western Overseas Expansion and Its Aftermath, 1776–1965* (Lexington, Mass., 1969). More analytical studies of the debate will be found in E. M. Winslow, *The Pattern of Imperialism* (London, 1948); George Lichtheim, *Imperialism* (New York and Washington, 1971); Roger Owen and Bob Sutcliffe, *Studies in the Theory of Imperialism* (London, 1972); and Benjamin Cohen, *The Question of Imperialism: The Political Economy of Dominance and Dependence*

Yet vast and fruitful as the debate is, it deals almost exclusively with the motives and policies of the imperialists and very little with the means they used to achieve their ends. True, there are a few case studies of the impact of particular technological changes on certain frontiers of empire at certain times; such are, for example, the works of Philip Curtin and Michael Gelfand on quinine prophylaxis and the articles on firearms that appeared in the *Journal of African History* and in Michael Crowder's *West African Resistance*.<sup>4</sup> None, however, has drawn any general conclusions about the relationship of technology and imperialism.

On the other hand, there are historians who categorically deny that technological changes made any significant difference in the history of nineteenth-century European imperialism. Two examples will suffice. In an article entitled "Imperialism and Technology," which appeared in a general history of technology, Rondo Cameron argued: "It is sometimes asserted that the rapid progress of Western technology in the 19th century was a major determinant of the imperialist drive. . . . Western superiority in ships, navigational techniques, and firearms was a fact of long standing, however. It cannot be used to explain the burst of expansion at the end of the 19th century, after almost a century during which Europeans showed little interest in overseas expansion."<sup>5</sup> In a similar vein, Hans-Ulrich Wehler has written: "If one points to technological progress as the main factor of expansion, thereby defining imperialism as a sort of unavoidable 'natural' consequence of technological innovations, one is led astray too. There is no direct causal relationship between those innovations and imperialism."<sup>6</sup>

Most historians of European expansion, however, have avoided taking a definitive position on the impact of technological change. Almost every work on nineteenth-century imperialism contains a

(New York, 1973), among others. A detailed bibliography of imperialism will be found in John P. Halstead and Serafino Porcari, *Modern European Imperialism: A Bibliography*, 2 vols. (Boston, 1974); see vol. 1, pp. 32–37, on the historiography of imperialism.

<sup>4</sup> Philip Curtin, "The White Man's Grave: Image and Reality, 1780–1850," *Journal of British Studies* 1 (1961): 94–110, and *Image of Africa: British Ideas and Actions 1780–1850* (Madison, 1964); Michael Gelfand, *Rivers of Death in Africa* (London, 1964); *Journal of African History*, vol. 12 (1971) and vol. 13 (1972); Michael Crowder, ed., *West African Resistance: The Military Response to Colonial Occupation* (London, 1971). See n. 65 below.

<sup>5</sup> Rondo Cameron, "Imperialism and Technology," in *Technology and Western Civilization*, ed. Melvin Kranzberg and Carroll Pursell, Jr., 2 vols. (New York, 1967), 1:693.

<sup>6</sup> Hans-Ulrich Wehler, "Industrial Growth and Early German Imperialism" in Owen and Sutcliffe, pp. 72–73.

sentence or paragraph recognizing that technological change facilitated the penetration and conquest of non-Western areas by Europeans. The rest of the work will then go on to concentrate on the motives and actions of the participants.<sup>7</sup> The conclusion is inescapable: At the present stage in the debate, historians place technological factors very low in their order of importance among the causes of the new imperialism. Such a curt dismissal of the role of technology in nineteenth-century imperialism stands in striking contrast to the central role assigned to technological change—better known as the Industrial Revolution—in the histories of European societies and economies in that very same period. It contrasts even more with the careful attention that historians of the early modern period have devoted to the technological aspects of the oceanic discoveries and of the exploration and conquest of the Americas.<sup>8</sup>

One reason for the disregard of technological factors lies in the leading-sectors model of the Industrial Revolution. This widely accepted explanation concentrates on the role of the most innovative and fastest expanding industries—textile mills, railroads, foundries, steamships, and telegraph—which exerted strong multiplier effects on the rest of the economy. It is quite reasonable for someone to consider these leading sectors and conclude that they became important in the non-West only in the colonial period but not in the earlier age of penetration and conquest.

To say that these dramatic aspects of the Industrial Revolution had only a marginal impact on imperialism is not to show, however, that technology in general was unimportant. To discover which innovations were important we must look at Africa and Asia as well as Europe, and at indigenous technologies and natural obstacles as well as at the technology of the imperialists. What mattered on the frontiers of European expansion was often, as we shall see, of minor impact in Europe itself.

A more fundamental reason for the misunderstanding of technol-

<sup>7</sup> See, e.g., David Landes, "The Nature of Economic Imperialism" (*Journal of Economic History* 21 [1961]: 511), where he recognizes the importance of technological factors but does not explain or elaborate.

<sup>8</sup> See, e.g., Samuel Eliot Morison, *The European Discovery of America: The Northern Voyages* (New York, 1971), chap. 5, "English Ships and Seamen 1490–1600"; Joseph R. Levenson, ed., *European Expansion and the Counter-Example of Asia, 1300–1600* (Englewood Cliffs, N.J., 1967), chap. 1, "Technology"; Eugene F. Rice, *The Foundations of Early Modern Europe, 1460–1559* (New York, 1970), chap. 1, "Science, Technology and Discovery"; J. H. Parry, *The Establishment of the European Hegemony 1415–1715: Trade and Exploration in the Age of the Renaissance* (New York, 1961), chap. 1, "The Tools of the Explorers: (i) Charts (ii) Ships (iii) Guns"; and Carlo Cipolla, *Guns and Sails in the Early Phase of European Expansion 1400–1700* (London and New York, 1965).

ogy's role lies in the very concept of causality used by historians. Few historians nowadays would explain imperialism with a single cause. Most see it as resulting from the sum of many causes, and each historian's interpretation determines the weights to be assigned to each cause or its position on the list. The problem with this model is that any attempt to enhance the role of one factor automatically reduces the importance of others and thereby conflicts with other interpretations. This dilemma is much relieved if we divide causes into motives and means. A complex process like imperialism is the result of both appropriate motives and adequate means. If the motives are too weak (as they were in the case of the Chinese expeditions to the Indian Ocean in the 1430s) or if the means are inadequate (as in the Italian invasion of Ethiopia in the 1890s) then the imperialist venture aborts. Both types of causes are indispensable, and focusing on one in no way reduces the importance of the other.

For a wave of imperialism to come about requires one of three possible scenarios: Adequate means are at hand and an increase in the motives triggers the event; sufficient motives exist and new means come into play which bring about the event; or, finally, both the motives and the means change, and both lead to the event. The first scenario—which Cameron sums up with the words “Western superiority . . . was a fact of long standing”—has formed the basis of the debate until now. It is the purpose of this paper to challenge this view by arguing that technological changes were indispensable to the expansion of Europe in the nineteenth century and profoundly affected its timing and location. Thus the third scenario becomes historically the more accurate one.

A model of causality in which the technical means are as indispensable as the motives does not imply that the two are unrelated. On the contrary, the appearance of a new technology can reinforce or trigger a motive by making the desired end possible or acceptably cheap. Conversely, a motive can provoke a search for appropriate means. So we must steer between two dangerous determinisms: the technological (“what can be done will be done”) and the psychological (“where there’s a will there’s a way”). What this paper proposes, then, is not to combat any of the positions already taken in the great debate over the causes of the new imperialism but to add a new dimension to it.

Of the many devices and processes that Europeans used to penetrate and conquer their Asian and African empires in the nineteenth century, the earliest to appear was the steamboat. From the days of Vasco da Gama until the Russo-Japanese War, the Europeans pos-

sessed control of the seas, but their power only extended as far as the shore line. The great sailing men-of-war off the coasts of China, Japan, or Africa may have insulted or annoyed the inhabitants but could not conquer their lands. In the harbors and on the rivers that led to inland cities, European warships were difficult to maneuver, subject to grounding, and vulnerable to coastal cannon fire. The limits of naval power determined the relations between Britain and China before the Opium War. While English ships could fire upon the Chinese forts at the mouth of the Pearl River—and did so as early as 1637—they could not threaten Canton nor any other important city. It was therefore easy for the Chinese to consider the English “barbarians from the sea” and refuse to take seriously the entreaties of such distinguished ambassadors as Lord Macartney in 1793 or Lord Amherst in 1816.<sup>9</sup>

It was steam that opened up the rivers and shallow waters of the world to the Europeans. Early attempts to propel a boat by steam power—that of the Marquis de Jouffroy d’Abans on the Rhone in 1783, of John Fitch on the Delaware in 1786, of William Symington and Patrick Miller on the Clyde in 1788—had all failed for lack of an engine both small and powerful enough. In the first decade of the nineteenth century improvements in the steam engine removed this handicap. In 1807 Robert Fulton’s *Clermont* proved that a steamboat could be a commercial success. This demonstration quickened the pace of development. In the second decade of the century steamboats of various kinds were built in America, Britain, and France, culminating in the establishment of regular steamer service between England and Ireland in 1816 and in the first transatlantic crossing by the *Savannah* under steam and sail in 1819.<sup>10</sup>

Soon thereafter steamers appeared in Asian waters. The first was

<sup>9</sup> On British-Chinese relations before the Opium War, see Louis Dermigny, *La Chine et l’Occident: Le commerce à Canton au XVIII<sup>e</sup> siècle 1719–1833*, 4 vols. (Paris, 1964); Michael Greenberg, *British Trade and the Opening of China, 1800–24* (Cambridge, 1951); and John K. Fairbank, *Trade and Diplomacy on the China Coast: The Opening of the Treaty Ports, 1842–1853*, 2 vols. (Cambridge, Mass., 1953).

<sup>10</sup> On the early history of steamboats, see Ambroise Victor Charles Colin, *La Navigation commerciale au XIX<sup>e</sup> siècle* (Paris, 1901), pp. 37–38; T. K. Derry and Trevor I. Williams, *A Short History of Technology from the Earliest Times to A.D. 1900* (Oxford, 1961), p. 370; Eugene Ferguson, “Steam Transportation” in Kranzberg and Pursell, 1:286–89; F. J. C. Hearnshaw, *Sea-Power and Empire* (London, 1940), pp. 190–91; George Henry Preble, *A Chronological History of the Origin and Development of Steam Navigation*, 2d ed. (Philadelphia, 1895), pp. 119–25; Joannès Tramond and André Reussner, *Éléments d’histoire maritime et coloniale (1815–1914)* (Paris, 1924), p. 50; and David B. Tyler, *Steam Conquers the Atlantic* (New York, 1939), p. 112. It is interesting that each of the authors cited above emphasizes the early attempts in his own country; the Marquis de Jouffroy d’Abans is mentioned only in French books, for example.

the little *Diana*, built at Kidderpore near Calcutta in 1823. Another craft, the steam dredge *Pluto*, was launched a year earlier but its engine was not attached to paddlewheels until 1824. The next year, the first steamer to reach Asia from Europe, the *Enterprize*, arrived after a voyage of 103 days, sixty-three of which were under steam.<sup>11</sup>

These three craft soon became pioneers in imperialism. For in 1824 the Honorable East India Company had launched the first large-scale river war in modern history, against the Kingdom of Burma. The three steamers were requisitioned for war duties. The *Enterprize* served as a transport, ferrying troops and supplies from Calcutta to Burma. The *Pluto*, equipped with two cannon and four carronades, served as a floating battery during the attack on the Arakan coast. The *Diana* became the star of the war. She reconnoitered the Irrawaddy, chased and captured Burmese war boats, ferried troops, towed sailing ships, bombarded enemy positions with her Congreve rockets, and steamed up the river to Amarapura, 500 miles from the sea. The Burmese called her the "Fire Devil." The East India Company would have won the war without her, but she hastened the victory. With her help, Britain acquired Arakan, Pegu, and Tenasserim.<sup>12</sup> The age of gunboat imperialism had begun.

Despite these successes, the early steamers were beset with problems. Their hulls suffered not only the usual indignities of all wooden vessels—dry rot, vermin, water seepage—but they also had problems which sailing ships avoided. The pounding of the machinery was hard on their wooden structure.<sup>13</sup> The engines and fuel stole precious space from the crew, the stores, and the magazine.<sup>14</sup> There was danger in a wooden ship with roaring fires on board and sparks flying out the chimney. Finally, due to the weakness of wood, a wooden ship large enough to carry engines and guns could not be

<sup>11</sup> On the early steamers in Asian waters, see H. A. Gibson-Hill, "The Steamers Employed in Asian Waters, 1819–39," *Journal of the Malayan Branch of the Royal Asiatic Society*, 27, pt. 1 (May, 1954): 122–31; and Henry T. Bernstein, *Steamboats on the Ganges: An Exploration in the History of India's Modernization through Science and Technology* (Bombay, 1960), pp. 28–32. Preble is quite unreliable on this subject, as Gibson-Hill demonstrates.

<sup>12</sup> On the steamers in the First Anglo-Burmese War, see Col. W. F. B. Laurie, *Our Burmese Wars and Relations with Burma: Being an Abstract of Military and Political Operations, 1824–25–26, and 1852–53* (London, 1880), pp. 46 and 71–72; Preble, pp. 76–77; Bernstein, pp. 31–32; and Gibson-Hill, pp. 129–30.

<sup>13</sup> Cammell Laird & Co. (Shipbuilders & Engineers) Ltd., *Builders of Great Ships* (Birkenhead, 1959), p. 12.

<sup>14</sup> This was aggravated by attempts to maintain the steamers' sailing capabilities in order to save fuel; the masts, the sail, and the crew took up room which could have been used for fuel. In the end, hybrid ships lost out to the ever-increasing efficiency of pure steamers, and ships became progressively more specialized rather than more adaptable.

made both shallow enough for river travel and strong enough to withstand the longitudinal stresses of ocean waves.<sup>15</sup>

The solution was to build boats of iron. As early as 1787 the great iron founder and gunmaker John Wilkinson had experimented with an iron barge on the Severn. Further experimentation, however, was delayed three decades by the conservative mentality of British shipbuilders. Since iron does not float, they said, wouldn't an iron ship sink? Wouldn't it rust away, or attract lightning, or shatter on the high seas, or become burning hot in the sun? As a result of these compunctions, no sea-worthy iron boat was built until 1815, and not until 1820 did an iron steamboat, the *Aaron Manby*, prove it could steam across the Channel and up the Seine. For an iron boat not only floated, it was actually lighter and of greater capacity than a wooden one of equal displacement, since a two-and-a-half-inch iron beam could do the work of an oak girder two feet thick. Iron also proved to be more resilient than wood, less easily damaged by grounding, and easier to repair. An iron boat could be built with watertight bulkheads, greatly diminishing the dangers of shipwreck.<sup>16</sup> And best of all, iron boats could be built in new shapes and dimensions difficult to achieve in wood: large but shallow-draft river boats or huge ocean liners. It is to iron that later ships owed their incredible diversity and specialization.

The idea of an iron steamer was not persuasive in itself but required visionary innovators. In one direction it led to the ocean liner, culminating in Isambard Kingdom Brunel's gigantic *Great Eastern*. In another, less grandiose but just as consequential, were the river steamers. In this field the pioneers were the Lairds of Birkenhead.<sup>17</sup> In 1829 William Laird and his son John founded the firm of William Laird and Son and built their first iron boat, a sixty-ton lighter for use on Irish lakes. Two years later, news arrived

<sup>15</sup> The Royal Navy, it is true, ordered hundreds of small wooden steam-powered gunboats and gun vessels during and after the Crimean War. These were essentially coastal vessels, not particularly shallow for their size and not intended for river service (e.g., gun vessels 150–200 ft. long drew 10–12 ft. of water; gunboats 100–150 ft. long drew 5–8 ft.). By the 1850s steam engines had become much smaller and more fuel efficient. In the late sixties the Royal Navy replaced these boats with iron-framed or all-iron gunboats and gun vessels (see Antony Preston and John Major, *Send a Gunboat! A Study of the Gunboat and Its Role in British Policy, 1854–1904* [London, 1967], chaps. 2 and 7 and pp. 191–233).

<sup>16</sup> The development of iron boats is treated in James P. Baxter III, *The Introduction of the Ironclad Warship* (Cambridge, Mass., 1933), p. 33; Colin, pp. 53–54; Derry and Williams, p. 370; Preble, pp. 119–35; and Tyler, pp. 112–13.

<sup>17</sup> On the early days of the Laird firm, see Cammell Laird, chap. 1; Tyler, pp. 112 and 169; Preble, pp. 132 and 142; and *Dictionary of National Biography*, s.v. "Laird, John" (hereafter cited as *DNB*).

that Richard Lander had traced the course of the River Niger by canoe from the Bussa Rapids to the Delta, thus completing the journey begun by Mungo Park three decades before. Macgregor Laird, William's younger son and the adventurous one in the family, decided to steam up the Niger from the sea and open up the interior of Africa to British trade and influence.<sup>18</sup> His self-proclaimed motives were the mixture of philanthropy, Christianity, and profit hunger one often finds in explorers' narratives of the time: ". . . to create new and extensive markets for our manufactured goods, and fresh sources whence to draw our supplies; . . . to raise their fellow creatures from their present degraded, denationalized and demoralized state nearer to Him in whose image they were created."<sup>19</sup>

Yet this son of a shipbuilder was as much an enthusiast for technical progress as for business and religion:

We have the power in our hands, moral, physical and mechanical; the first, based on the Bible; the second, upon the wonderful adaptation of the Anglo-Saxon race to all climates, situations, and circumstances . . . the third, bequeathed to us by the immortal Watt. By his invention every river is laid open to us, time and distance are shortened. If his spirit is allowed to witness the success of his invention here on earth, I can conceive no application of it that would receive his approbation more than seeing the mighty streams of the Mississippi and the Amazon, the Niger and the Nile, the Indus and the Ganges, stemmed by hundreds of steam-vessels, carrying the glad tidings of "peace and good will toward men" into the dark places of the earth which are now filled with cruelty.<sup>20</sup>

With other Liverpool businessmen Laird founded the African Inland Commercial Company "for the commercial development of the recent discoveries of the brothers Lander on the River Niger." They had two boats built. One, the *Quorra*, was a wooden steamer of 145 tons, 112 feet long and eight deep, with a forty horsepower engine. The other, the 55-ton *Alburkah*, measured seventy feet long by six-and-a-half feet deep, had a sixteen horsepower engine, and was built of iron. Both ships were heavily armed: In addition to handguns, the *Quorra* carried a four-pound swivel gun, an eighteen-pound

<sup>18</sup> On the Niger expedition of 1832–34, see K. Onwuka Dike, *Trade and Politics in the Niger Delta 1830–1885: An Introduction to the Economic and Political History of Nigeria* (Oxford, 1956), pp. 61–63; in *DNB.*, s.v. "Laird, Macgregor" and "Lander, Richard Lemon"; Curtin, *The Image of Africa*, p. 296; Christopher Lloyd, *The Search for the Niger* (London, 1973), chap. 7; and esp. Macgregor Laird and R. A. K. Oldfield, *Narrative of an Expedition into the Interior of Africa, by the River Niger, in the Steam-Vessels Quorra and Alburkah, in 1832, 1833, and 1834*, 2 vols. (London, 1837).

<sup>19</sup> Laird and Oldfield, 1:vi.

<sup>20</sup> *Ibid.*, 2:397–98.

carronade, and eight four-pound carriage guns; the *Alburkah* carried a nine-pound and six one-pound swivel guns.

In 1832 Macgregor Laird, Richard Lander, and their two steamers, accompanied by a sailing ship with supplies, headed for the Niger delta. The little *Alburkah* was the first iron steamer ever to venture out onto an ocean. The fleet arrived safely at the Bight of Benin, and from there the steamers successfully navigated through the delta and up the Niger as far as its confluence with the Benue. As a demonstration of the power of steam to penetrate Africa, the expedition was a great success. As a venture in commerce and religion, however, it failed completely. Technological advances, in overcoming one obstacle of nature, often bring to light another. In this case it was malaria: Of the forty-nine whites on the expedition, forty died, and Laird himself returned home in 1834, having lost his fortune and his health in Africa. The motives were all there, but the means were not. The European penetration of Africa had to wait another twenty years.

Though tropical Africa was still closed to European penetration, the Lairds had proven the value of iron steamers. The firm began to build a great number of them for distant destinations. Their *John Randolph*, sent to Savannah in 1834, was the first iron steamer to operate in American waters. In 1836 Francis Rawdon Cherney explored the Euphrates River on the Laird-built iron steamer *Euphrates*. And in 1837 Mehemet Ali purchased the *Egyptien* to navigate the Nile.<sup>21</sup> But their greatest success was to be in the Far East, where their boats contributed a great deal to the growth of British power.

The first steamship to reach China was the *Forbes*, which arrived there from Calcutta in 1829 or 1830.<sup>22</sup> The English merchant colony in China quickly recognized the potential value of steam for river transportation. In 1835 they petitioned their Chinese counterparts for permission to send the little steamer *Jardine* up the Pearl River from Macao to Canton.<sup>23</sup>

Anglo-Chinese relations were tense. Several British diplomatic

<sup>21</sup> Gibson-Hill, p. 123.

<sup>22</sup> The *Forbes* was built in Calcutta in 1829 (see Gibson-Hill, p.122); Preble (pp. 142–43) says she reached China in 1830. However, according to Peter Ward Fay, it was 1829 (see *The Opium War, 1840–1842: Barbarians in the Celestial Empire in the Early Part of the Nineteenth Century and the War by Which They Forced Her Gates Ajar* [Chapel Hill, N.C., 1975], p. 51).

<sup>23</sup> The *Jardine*, a 115-ton dispatch boat, was built in Aberdeen in 1835 and shipped in pieces to China (see Gibson-Hill, pp. 122 and 153–56; and Preble, p. 148).

missions had failed to persuade the Chinese government to permit more trade. Meanwhile the English thirst for tea and the Chinese craving for opium were growing apace. When in 1834 the East India Company lost its monopoly on the Chinese trade, merchant adventurers began crowding in, sensing huge profits in the tea and opium business. What the British traders called free enterprise was smuggling and piracy to the Chinese officials, and what was law enforcement to them the traders saw as unjustified and whimsical interference.

So the Chinese were not pleased at the thought of a “fire ship” steaming up to Canton. The acting governor ordered it to stay away: “. . . if [the captain] presumes obstinately to disobey, I, the acting governor, have already issued orders to all the forts that when the steamship arrives they are to open a thundering fire and attack her. On the whole, since he has arrived within the boundaries of the Celestial Dynasty, it is right that he should obey the laws of the Celestial Dynasty. I order the said foreigner to ponder this well and act in trembling obedience thereto.”<sup>24</sup> But the foreigners were not reduced to trembling obedience by threats of thundering fire from the forts along the river. As William Jardine, one of the richest of the traders, said in 1834: “Nor indeed should our valuable commerce and revenue both in India and Great Britain be permitted to remain subject to a caprice, which a few gunboats alongside this city would overrule by the discharge of a few mortars.”<sup>25</sup>

These tensions finally led to the Opium War. Behind the British willingness to attack one of their best trading partners lay the knowledge that they now had the “few gunboats” they needed to make a mockery of the “thundering fire” of the Chinese forts. In 1836 John Laird had offered to build an iron frigate for the Royal Navy, but the Admiralty rejected his idea. The East India Company, fortified by its experience in Burma, was not nearly so conservative.<sup>26</sup> In 1839 the Secret Committee of the Court of Directors of the Company commissioned him to build a most unusual ship, to be called the *Nemesis*. She was the biggest iron ship to be built up to

<sup>24</sup> Preble, pp. 144–45.

<sup>25</sup> K. M. Panikkar, *Asia and Western Dominance* (New York, 1969), p. 97.

<sup>26</sup> The Admiralty and other navies had good reason not to accept the latest bit of technological progress. Paddle-wheel steamers were quite unsuited for naval warfare between Western navies because the wheels were inefficient in rough seas, very vulnerable to artillery, and took up too much of the space needed for cannon. Furthermore, steamers were slow and too dependent on coal supplies for the tastes of European admiralties. It is only after the perfection of the propeller in the 1840s and especially after the Crimean War that naval officers began to think of their wooden ships of the line as obsolete (on this, see Tramond and Reussner, pp. 52–54).

that time: 184 feet long, displacing 630 tons, and propelled by two steam engines of sixty horsepower each. She was armed with two pivot-mounted thirty-two-pound guns, five six-pounders, ten small swivel guns, and a rocket launcher, and she could carry a crew of up to ninety men.<sup>27</sup> Despite her size, she only drew six feet of water fully loaded, less when ready for battle. This was not just another steamboat but a weapon of imperialist warfare, "peculiarly adapted for that particular service," said her captain, William Hall.<sup>28</sup>

On March 28, 1840 the *Nemesis* left England bound for Odessa, "much to the astonishment of everyone; but those who gave themselves time to reflect, hardly believe it possible that such could be her real destination."<sup>29</sup> Once at sea, Captain Hall announced to the crew that she was headed for Ceylon instead; she was thus the first iron steamer to pass the Cape of Good Hope. In Ceylon, Hall received orders to proceed to Malacca, and there he was finally told his real destination: China. He arrived off Macao on November 25, 1840.

The *Nemesis* was not the only steamer to see action in the Opium War. A number of wooden steamers from the Bay of Bengal—the *Atalanta*, the *Madagascar*, the *Queen*, even the old *Enterprize*—came to lend their support. A year later the new frigate *Sesostris* arrived, and so did the *Phlegethon*, another Laird-built iron river steamboat. By the end of the war, eighteen steamers saw action in China, of which fifteen belonged to the East India Company.<sup>30</sup> With the arrival of the steamers, especially the *Nemesis*, Sino-European relations acquired a whole new character. No longer was it the classic futile confrontation of the whale and the elephant. The steamers brought modern warfare into the heart of China.

China was well equipped for seventeenth-century warfare. Against Western attack her main defense was a line of forts on the Bogue below Canton, at Taku on the approaches to Peking, and at several other points along the coast. These forts were heavily armed, but their cannon, some of which were two centuries old, were charged with weak and unreliable powder and embedded in the masonry so they could not be aimed. In 1840 the forts of the Bogue were easily silenced by broadsides from the British ships of the line, then taken

<sup>27</sup> For a description of the *Nemesis*, see Fay, p. 261; Baxter, pp. 33–34; Tyler, p. 113; and esp. Capt. William H. Hall (R.N.) and W. D. Bernard, *The Nemesis in China, Comprising a History of the Late War in That Country, with a Complete Account of the Colony of Hong Kong*, 3d ed. (London, 1846), pp. 1–6.

<sup>28</sup> Hall and Bernard, p. 1.

<sup>29</sup> *Ibid.*, p. 6.

<sup>30</sup> Gibson-Hill, pp. 160–61.

by marines. On water the Chinese were similarly outgunned, for their war junks were large unwieldy affairs armed with two to six pieces of artillery lashed to blocks of wood and impossible to aim. Their crews carried swords, spears, and gingals.<sup>31</sup> Attempts to remedy this situation proved futile. Before the war began, Commissioner Lin had bought the British warship *Cambridge*, but he lacked both the guns to arm her and sailors skilled in handling a European ship. Against the ordnance of the British ships, the coasts of China were almost defenseless. And to the problem that navies had always faced against coastal defenses, the British now had a solution: steamers.<sup>32</sup>

In some instances—as in the attack on the Bogue forts or on the city of Tinghai—steamers were used as tugboats to pull the big ships of the line into position to fire their broadsides at the enemy.<sup>33</sup> At other times they pulled boats full of marines to the site of amphibious attacks; shallow-draft steamers like the *Nemesis* were especially suited to such operations. With their quick maneuvers and Congreve rockets, river steamers could sink the best Chinese war junks with no trouble.<sup>34</sup> They were also very effective against another favorite Chinese river tactic: fireboats filled with oily cotton set ablaze and cast adrift to smash against the British men-of-war. The steamers simply grappled them with hooks and pulled them out of reach of the warships.

Perhaps the most spectacular feat of the *Nemesis* was the attack on Canton from the rear in February 1842. While the sailing fleet slowly worked its way up the Pearl River, the *Nemesis* made her way through narrow inland channels which no warship had ever dared enter, destroying junks, bombarding forts, and terrorizing the population.

That the war did not end sooner only shows how long it took the Chinese government to realize what it was faced with. The loss of Canton was a defeat, but not yet a disaster. A year later, however, the British launched a major offensive up the Yangtze: eight ships of

<sup>31</sup> G. R. G. Worcester, "The Chinese War-Junk," *Mariner's Mirror* 34 (January 1948): 22.

<sup>32</sup> This description of steamers in the Opium War is taken from Fay, and from G. R. G. Worcester, "The First Naval Expedition on the Yangtze River," *Mariner's Mirror* 36, no. 1 (January 1950): 2–8.

<sup>33</sup> This was the familiar tactic used by the French against Veracruz in 1838 and by the British, Austrians, and Turks against St. Jean d'Acre in 1839 (see Preble, pp. 132 and 192; and Baxter, p. 11).

<sup>34</sup> Congreve rockets are perhaps best known to Americans for the verses they inspired: "And the rockets' red glare, the bombs bursting in air/Gave proof through the night that our flag was still there."

the line, ten steamers, and a host of lesser craft took part in it. The Chinese countered with paddle-wheel gunboats of their own, but without steam-engines to move them, they were an easy prey to the British steamers.<sup>35</sup> At Chinkiang the fleet seized the junction of the Yangtze River with the Grand Canal. At this point the Chinese government realized that the British could cut Peking off from its rice supplies, and so it capitulated.<sup>36</sup> Britain had found the means to impose her will on China.

The Opium War is no doubt the most striking case of the use of steamers in an imperialist venture, but it was far from the last. When in 1852 the British again attacked Burma, steamers were quite common in Indian waters, both as riverboats and as oceangoing ships. The East India Company had steam service on the major rivers of India,<sup>37</sup> and the Peninsular and Oriental Steam Navigation Company was serving the Far East on a regular schedule. It was a simple matter to requisition a few of both kinds of steamers, in addition to the specialized gunboats *Rattler*, *Sesostris*, and *Phlegethon*, to make the success of this attack a forgone conclusion.<sup>38</sup>

The story of Commodore Perry's visit to Japan in 1853–54 is too well known to warrant repeating here. It is worth pointing out, however, that this event does not belong only in histories of Japan and America but in the history of technology as well. At the very time that Perry was steaming into Tokyo Bay, a Russian fleet under Admiral Putiakin, which also included steamers, had appeared off the coasts of Japan.<sup>39</sup> It was steam, not any individual or nation, which broke down the walls of Tokugawa Japan.

Other imperialist wars in Asia at that time followed much the same pattern. The Second Opium War (1856–60) was a repetition of the first, in weapons as in other ways. The Royal Navy used over twenty-five gunboats and other small steamers in its attack on

<sup>35</sup> Worcester, "The Chinese War-Junk," pp. 23–24. China offered \$50,000 for the *Nemesis* but her offer was rejected; see Cammell Laird, p. 20.

<sup>36</sup> Worcester, "The First Naval Expedition," pp. 6–8.

<sup>37</sup> Bernstein's *Steamboats on the Ganges* (n. 11 above) is excellent both as an introduction to nineteenth-century India and as a case study of technological diffusion under colonial circumstances.

<sup>38</sup> See Laurie (n. 12 above), pp. 86–109.

<sup>39</sup> Commodore Perry's expedition is described in Hugh Borton, *Japan's Modern Century* (New York, 1955), pp. 11–39; Sir George Sansom, *The Western World and Japan* (London, 1950), pp. 275–80; and esp. Arthur C. Walworth, *Black Ships Off Japan: The Story of Commodore Perry's Expedition* (New York, 1946).

Canton, on the Chinese fleet, and on the Taku forts near Peking.<sup>40</sup> Gunboats also figured prominently in the French conquest of Tonkin in 1873–74 and of Annam in 1883, and in the Third Anglo-Burmese War of 1885.<sup>41</sup> By the end of the century, the steamship and the river gunboat had become not just the instruments but the very symbols of European power in Far Eastern nations that had coastlines and navigable rivers. One of the protagonists of the colonial conquests of that time, Colonel W. F. B. Laurie, put it succinctly. Steamers, he pointed out, were “a ‘political persuader,’ with fearful instruments of speech, in an age of progress!”<sup>42</sup>

In Africa, as Macgregor Laird discovered in 1832, the steamboat was not sufficient to carry the European presence into the interior. Here the obstacle was malaria, and only after it had been overcome could other technological advances become effective. There have been a number of scholarly studies by Philip Curtin, Michael Gelfand, and others on the influence of malaria on European-African relations.<sup>43</sup> A brief summary of their findings will, therefore, suffice.

Although malaria was prevalent in many parts of the world, the variety caused by the *Plasmodium falciparum*, found only in Africa, was by far the deadliest. The death rates for newcomers to West Africa reflect this fact. In the 1790s among first-year European military personnel stationed in West Africa, the death rates ranged from 46 to 72 percent; for those who survived their first year, the death rate in subsequent years fell to about 10 percent. One study for the years 1817–36 found the death rates per annum of British soldiers in Britain to be 1.53 percent; in Sierra Leone it was 48.3 percent; and in the Gold Coast, 66.83 percent. While yellow fever, dysentery, and other ills played a part in these deaths, malaria was certainly the principal culprit.<sup>44</sup> For good reason the British govern-

<sup>40</sup> On the use of gunboats in the Second Opium War, see Preston and Major (n. 15 above), chap. 4.

<sup>41</sup> See, e.g., Tramond and Reussner (n. 10 above), pp. 344–49; and Frédéric Nolte, *L'Europe militaire et diplomatique au dix-neuvième siècle, 1815–1884*, 3 vols. (Paris, 1884), 3:521.

<sup>42</sup> Laurie, p. 109.

<sup>43</sup> Philip Curtin, “‘The White Man’s Grave’” and *The Image of Africa* (n. 4 above); Michael Gelfand, *Rivers of Death, and Livingstone the Doctor: His Life and Travels* (Oxford, 1957); Michael Colbourne, *Malaria in Africa* (London, 1966); René-Jules Cornet, *Médecine et exploration: Premiers contacts de quelques explorateurs de l’Afrique centrale avec les maladies tropicales* (Brussels, 1970); and sections of Jaime Jaramillo-Arango, *The Conquest of Malaria* (London, 1950); and Paul F. Russell, *Man’s Mastery of Malaria* (London, 1955).

<sup>44</sup> Philip Curtin, “Epidemiology and the Slave Trade” in *Political Science Quarterly* 83, no. 2 (June 1968): 203, “‘White Man’s Grave,’” pp. 95 and 109–11, and *Image of Africa*, p. 177.

ment withdrew almost all white military personnel from West Africa, replacing them with African or West Indian soldiers, whose death rates were lower.

Malaria was also the cause of disasters that befell countless expeditions into the interior of Africa. Early Portuguese missions up the Congo (1485) and into the interior of Mozambique (1569) suffered great losses.<sup>45</sup> British explorers of the late eighteenth and early nineteenth centuries fared no better. William Bolt's expedition at Delagoa Bay in 1777–79 lost 132 out of 152 European members; Mungo Park's into the upper Niger in 1805 lost all Europeans; Captain James Tuckey's up the Congo in 1816 lost nineteen out of fifty-four; and the Lander-Laird expedition up the Niger in 1832–34 lost forty out of forty-nine, including Lander. In 1841–42 the British government sent a major expedition under Captain Trotter up the Niger on board three iron-hulled steamers, the *Albert*, *Wilberforce*, and *Soudan*; again tragedy struck as fifty-five out of 152 Europeans succumbed, much to the embarrassment of the government.<sup>46</sup>

Despite these failures, the lure of Africa continued unabated. Part of this pressure was economic and philanthropic, but a large part was due to the ever enthusiastic Macgregor Laird. In 1852 he and some fellow businessmen set up the African Steamship Company, the first shipping line to offer a regular monthly service between England and Africa. This shipping line was to engage in the usual trade with the coastal middlemen. Laird knew, however, that even greater profits would await those who could overcome the disease barrier of the African interior and thus bypass the middlemen, and so he persisted in urging more expeditions.

The solution to malaria was a triumph not of science but of experimental technology. The plasmodium of malaria was not isolated until 1880, and the role of the anopheles mosquito as its vector was only discovered in 1898.<sup>47</sup> By then a practical preventive, quinine prophylaxis, had been in use for many decades. Europeans had been familiar with the antimalarial properties of cinchona bark since the seventeenth century. Unfortunately its effectiveness was hampered by a number of drawbacks: It had to be imported from South America and was subject to deterioration, adulteration and price gouging; its use ebbed and flowed with medical fashions; it was used as a remedy rather than a preventive; and worst of all, it tasted awful. After a period of popularity in the eighteenth century, British

<sup>45</sup> Cornet, p. 7; Gelfand, *Rivers of Death*, p. 17.

<sup>46</sup> Curtin, *Image of Africa*, pp. 181, 289–308, and 483–87, and “‘White Man’s Grave,’” pp. 104–5; Gelfand, *Rivers of Death*, pp. 18 and 49; Lloyd, chap. 8.

<sup>47</sup> Colbourne, p. 6; Jaramillo-Arango, pp. 5–8.

doctors lost faith in the bark, for it did little to cure falciparum malaria and had no effect at all against yellow fever and all the other fevers which were then confused. Instead they prescribed bloodletting, blisters, mercury to cause salivation, and calomel for purgation. These treatments only served to kill a few more who might have survived without them.<sup>48</sup>

Then in 1820 two French chemists, Joseph Bienaimé Caventou and Pierre Joseph Pelletier, isolated the quinine alkaloid of cinchona. Beginning about 1826 many experiments were carried out, mainly by British naval physicians stationed on the West African coast who were most concerned with tropical diseases. Their evidence began to show that quinine could be an effective prophylactic against malaria. By the 1830s quinine was being produced at a price low enough for general use. The practice of bleeding was falling into disfavor, and in the 1840s mercury and calomel treatments also began to decline. By 1848 Europeans along the Gold Coast started keeping quinine pills by their bedside, ready to be taken at the least sign of fever. Authoritative works appeared on the subject, including Dr. T. R. H. Thomson's "On the Value of Quinine in African Remittent Fever" and Dr. Alexander Bryson's *Report on the Climate and Principal Diseases of the African Station* and "On the Prophylactic Influence of Quinine."<sup>49</sup>

In 1854 came the conclusive demonstration. Macgregor Laird received a contract from the Admiralty to build yet another steamer at his brother John's shipyard: the *Pleiad*. This was an iron-hulled schooner of 260 tons, with a steam engine of sixty horsepower turning a screw propeller. The captain, Dr. William Balfour Baikie, was a physician who saw to it that all Europeans on board religiously took their daily quinine. The ship sailed up the Niger and back, and no one died.<sup>50</sup>

The discovery of quinine prophylaxis opened the gates to the European invasion of Africa. The *Pleiad* was quickly followed by other steamers that began regular journeys up and down the Niger,

<sup>48</sup> Curtin, *Image of Africa*, pp. 82 and 192–93, and "White Man's Grave," pp. 100–102; Russell, pp. 92–99.

<sup>49</sup> T. R. H. Thomson, "On the Value of Quinine in African Remittent Fever," *Lancet* (February 28, 1846); Alexander Bryson, *Report on the Climate and Principal Diseases of the African Station* (London, 1847), and "On the Prophylactic Influence of Quinine," *Medical Times and Gazette* (January 7, 1854).

<sup>50</sup> William Balfour Baikie, *Narrative of an Exploring Voyage up the Rivers Kwo'ra and Bi'nue (Commonly Known as the Niger and the Tsádda) in 1854* (London, 1856), pp. 5 and 389–400. See also Curtin, *Image of Africa*, pp. 195 and 344–57, and "White Man's Grave," pp. 106–10; Jaramillo-Arango, p. 87; Russell, pp. 105 and 133; Gelfand, *Rivers of Death*, pp. 57–59; and Lloyd, chap. 10.

bypassing the delta middlemen and bringing British trade and eventually British domination into the Nigerian hinterland.<sup>51</sup> Explorers like Richard Burton, John Speke, Gustav Rohlfs, Verney Cameron, and Henry Stanley carried with them supplies of quinine; all came down with malaria, but recovered and continued their travels.<sup>52</sup> David Livingstone had his own "Livingstone pills" composed of quinine, calomel, rhubarb, and resin of julep, which he gave to the whites who accompanied him; many suffered from malaria, but few died.<sup>53</sup> When his drugs were stolen during his last expedition, he wrote in his journal: "I felt as if I had received the sentence of death," and not long after he died.<sup>54</sup>

Explorers like Livingstone and Stanley and conquerors like de Brazza on the Congo, Dodds in Dahomey, and Gentil in Chad also made use of steamboats whenever they could.<sup>55</sup> Given the difficult topography and flora of much of Africa, it is doubtful that Europeans could have penetrated the continent so fast or dominated it so thoroughly if they had had to do so on foot. And it is certain that they could never have done so without an antimalarial drug. Such was the demand for quinine that the cinchona forests of Peru could not keep up with it. In 1854, the year of the *Pleiad* expedition, the

<sup>51</sup> A. C. G. Hastings, *The Voyage of the Dayspring: Being the Journal of the Late Sir John Hawley Glover, R.N., G.C.M.G., Together with Some Accounts of the Expedition up the River Niger in 1857* (London, 1926); D. K. Fieldhouse, *Economics and Empire, 1830-1914* (Ithaca, N.Y., 1973), p. 132; K. O. Dike, *Trade and Politics in the Niger Delta*, pp. 204-12; *DNB*, s.v. "Laird, Macgregor"; Lloyd, p. 199; Obaro Ikime, "Nigeria—Ebrohimi" and D. J. M. Muffett, "Nigeria—Sokoto Caliphate" in Crowder (n. 4 above), pp. 105-15 and 284-85, respectively; Robert Smith, "The Canoe in West African History," *Journal of African History* 11 (1970): 526-27; and Preston and Major, pp. 115-26 and 152-55.

<sup>52</sup> Robert I. Rotberg, ed., *Africa and Its Explorers: Motives, Methods and Impact* (Cambridge, Mass. 1970), pp. 76, 175-81 and 261; and Cornet, chap. 3.

<sup>53</sup> Gelfand, *Livingstone the Doctor*, pp. 3, 12-13, 65, 122-30, 180, 221-23, 297, and 304-21, and *Rivers of Death*, pp. 63-67.

<sup>54</sup> Horace Waller, ed., *The Last Journals of David Livingstone* (London, 1874), 1:177, quoted in Rotberg, p. 47.

<sup>55</sup> On Livingstone's steamers, see Gelfand, *Livingstone the Doctor*, pp. 126, 176, 181 and 233; and Richard Thornton, *The Zambezi Papers of Richard Thornton, Geologist in Livingstone's Zambezi Expedition*, ed. Edward C. Tabler (London, 1963), 2:243-44. On the use of steamers on the Congo, see Henri Brunenschwig, *French Colonialism, 1871-1914: Myths and Realities* (London, 1966), p. 45; Roland Oliver and Anthony Atmore, *Africa since 1800* (Cambridge, 1967), p. 109; and Fieldhouse, pp. 343-44. On the situation in Dahomey, see David Ross, "Dahomey" in Crowder, p. 158; and Col. Charles E. Callwell, *Small Wars: Their Principle and Practice*, 3d ed. (London, 1906), pp. 63-64. On the Ubangi, Shari, and Chad, see Pierre Gentil, *La Conquête du Tchad (1894-1916)*, 2 vols. (Vincennes, 1971), 1:51-63. In some instances, Africans also used steamers; e.g., Prince Muhammed Abd al-Halim of Egypt kept a steamer on the White Nile in the Sudan in the 1860s for trading purposes (see Richard Hill, *Egypt in the Sudan 1820-1881* [London, 1959], pp. 99-101).

Dutch started cinchona plantations in Java with seeds smuggled out of Bolivia; six years later they were followed by British plantations near Madras. By the early twentieth century almost all the world's quinine came from these two areas.<sup>56</sup> Thus European colonialism in Asia furnished the *sine qua non* of the scramble for Africa.

Both steamers and quinine prophylaxis represent the kind of technology that overcomes the obstacles of nature. But in venturing into new places Europeans also encountered the resistance of the inhabitants, a resistance which called forth the power of weapons and tactics. The history of imperialism is intertwined with developments in the art of war.

European superiority in land warfare was of long standing. Yet in distant parts of the world where indigenous peoples had the advantages of numbers and knowledge of the land, imperialism required not simply a one-to-one advantage but a crushing superiority, a disparity in power so great that small military units, even on occasion private exploring and trading parties, could overcome native resistance. This degree of superiority did not appear until the mid-nineteenth century and was the result of the revolution in firearms.

No period in history produced so dramatic a development of infantry weapons as the nineteenth century. In terms of effective firepower the distance between the rifle of World War I and the Napoleonic musket was greater than between the latter and the bow and arrow. Unlike quinine prophylaxis and river steamers, the modern gun was developed almost entirely for use among Europeans and Americans, and its application to colonial warfare was a fortuitous side effect. Yet ironically this new technology changed the balance of power in the non-Western world far more than it did in the West itself.

The development of the modern gun was the result of a complex series of minor advances from many different sources, some of them centuries old.<sup>57</sup> Among them we can distinguish two stages. In the first stage percussion caps, rifling, cylindro-conoidal bullets, and paper cartridges brought the muzzle-loader to its peak of perfection.

<sup>56</sup> Russell, pp. 96–97; Jaramillo-Arango, pp. 83–84; William H. McNeill, *Plagues and Peoples* (Garden City, N.Y., 1976), pp. 279–80.

<sup>57</sup> The development of firearms in the nineteenth century is described in William Wellington Greener, *The Gun and Its Development: With Notes on Shooting*, 9th ed. (London, 1910); H. Ommundsen and Ernest H. Robinson, *Rifles and Ammunition* (London, 1915); J. F. C. Fuller, *Armament and History* (New York, 1933); William Young Carman, *A History of Firearms from the Earliest Times to 1914* (London, 1955); Edward L. Katzenbach, Jr., "Military Technology" in Kranzberg and Pursell (n. 5 above), 1:489–502; and Thomas A. Palmer, "The Mechanization of War, 1880–1919" in *ibid.*, pp. 548–61.

The second stage began with the breechloading Prussian needle gun and culminated in the Maxim gun. The shift from muzzle-loaders to breechloaders in the 1860s was no ordinary technical improvement. It dramatically widened the power gap between Europeans and non-Western peoples and led directly to the outburst of imperialism at the end of the century. To understand this momentous change, we must consider European and non-Western weapons and tactics and the resulting disparity of power, both before and after the 1860s.

At the beginning of the nineteenth century the standard weapon of the European infantryman was the muzzle-loading smoothbore musket with a bayonet. The Brown Bess, which British soldiers used up to 1852, was much the same weapon their forefathers had used at Blenheim in 1704. This gun had an official range of 200 yards, but even at half that distance it was so inaccurate that soldiers were advised to withhold their fire until they saw the whites of their enemies' eyes. Even so, said the gunmaker W. W. Greener, they commonly shot away their weight in lead for every enemy they killed. Since muzzle-loaders took a minute or more to reload, they were more useful as pikes than as guns.<sup>58</sup>

The earliest change introduced into infantry guns was rifling. This caused the bullet to spin on its axis and fly straighter. The idea had long been used in experimental and sporting guns. In the War of Independence some American soldiers used hunting rifles with an effective range of 200 yards, roughly twice that of the Brown Bess. Likewise some French soldiers of the Revolution were armed with rifles, as were a few elite rifle corps in the British army. Yet the rifles of the early nineteenth century had drawbacks which made them unsuited to mass warfare. Bullets large enough to spin properly were difficult to ram home, and the barrels fouled very fast, making them even harder to load. Sportsmen could afford the care and attention that rifles required, but ordinary soldiers could not be expected to show such skills in the heat of battle. That is why the mass armies that fought in the Napoleonic Wars eschewed rifles. Nonetheless experiments with rifling continued, and special units such as the British Rifle Brigade or the Chasseurs d'Orléans, who went off to Algeria in 1830, were armed with rifles.<sup>59</sup>

Another important advance was the percussion cap. Until the early nineteenth century, gunpowder had been ignited with a flintlock, a method which worked only in dry weather. In 1807 Alexander Forsyth introduced the use of fulminates as priming powders,

<sup>58</sup> Greener, p. 624.

<sup>59</sup> Ommundsen and Robinson, p. 18; Greener, pp. 623–27.

and in 1816 Thomas Shaw patented the copper percussion cap. In tests by the Woolwich Board of the British army the new Brunswick percussion-cap rifle misfired only 4.5 times per thousand rounds, as compared with 411 times per thousand for flintlocks. As a result of these tests a few select British units were equipped in 1836 with Brunswick rifles.<sup>60</sup> The impact of these guns can be judged from this account of a battle near Canton in 1841: "A company of sepoys, armed with flintlock muskets, which would not go off in a heavy rain, were surrounded by some thousand Chinese, and were in eminent peril when two companies of marines, armed with percussion-cap muskets, were ordered up, and soon dispersed the enemy with great loss."<sup>61</sup>

The third important advance was the cylindro-conoidal bullet, developed to overcome the inaccuracy of the muzzle-loader. Ideally a bullet should be small enough to slip down the barrel easily, yet large enough to grip the rifling on the way out. Early efforts concentrated on making the bullet swell at the moment of firing. Of these, the most successful was that of Minié, whose bullet was long and pointed, with a plug at the back to make it expand. Not only did the Minié bullet take the rifling and spin well, but its streamlined shape helped give it a flat trajectory. The results were amazing. At 100 yards the Minié rifle hit the target 94.5 percent of the time, compared to 74.5 percent for the Brunswick; at 400 yards the figures were 52.5 and 4.5 percent, respectively. In 1849 Minié rifles were issued to units of the French army and two years later to some British troops. Since Europe was then at peace, the new weapons had to be tried out elsewhere. The French sent their *Chasseurs d'Afrique* (formerly *Chasseurs d'Orléans*) to fight the Algerians with new long-bullet rifles, while the British tested their Minié rifles against Africans in the Kaffir War of 1852.<sup>62</sup> This stage in the evolution of the gun reached its peak in 1852–53 when the British army replaced the Brown Bess with the Enfield rifle which fired the new bullets. This was the first European military gun to be made on the "American system" of interchangeable parts. Its great advantage, like that of the French Minié, was its accuracy; it had an official range of 1200 yards and an effective one of 500 yards, five or six times greater than the Brown Bess.<sup>63</sup> In the end it achieved its

<sup>60</sup> Carman, pp. 104 and 178; Palmer, pp. 492–93; Fuller, p. 110; Greener, pp. 112, 117, and 624.

<sup>61</sup> Fuller, p. 128, n. 20; see also Fay, pp. 214 and 301.

<sup>62</sup> Fuller, p. 110; Ommundsen and Robinson, pp. 46–48.

<sup>63</sup> Ommundsen and Robinson, pp. 46–49 and 54–65; Fuller, pp. 110 and 128–29, n. 23; Greener, pp. 625, 631 and 727; Palmer, pp. 492–93; Carman, p. 113. The

most lasting fame by appearing in the wrong place at the wrong time: It was its paper cartridge greased with tallow that provided the excuse for the Indian Mutiny of 1857.<sup>64</sup>

Despite their astonishing range, these new rifles were slow and awkward to use. Soldiers needed a minute to reload, standing up in full view of the enemy. The guns emitted tell-tale puffs of smoke. They fouled badly. Their paper cartridges were delicate and vulnerable to moisture. And they could not be fired and reloaded on the run or on horseback. In their impact on Europe's imperial ventures, they were soon overshadowed by their successors, the breechloaders.

In Africa the gun revolution completed what quinine prophylaxis had begun. Its impact has been well documented in the *Journal of African History* and in Michael Crowder's *West African Resistance*.<sup>65</sup> Guns were no novelty to most of Africa. North Africans had possessed firearms since the Renaissance. Before 1830 the people of Algeria made their own guns, sometimes with European barrels and locks; the cheaper, more common weapons were entirely homemade.<sup>66</sup> South of the Sahara firearms had been introduced by

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"American system," introduced by Eli Whitney in 1797, took fifty years to cross the Atlantic. In Europe, old-world craftsmanship and the relative cheapness of labor still held sway in the gun trade (see Greener, chap. 10).

<sup>64</sup> Ommundsen and Robinson, pp. 78-79; Carman, p. 112.

<sup>65</sup> A number of articles have appeared recently on the subject of weapons and warfare in nineteenth-century Africa. Among them are the following in Crowder (n. 4 above): J. K. Fynn, "Ghana—Asante (Ashanti)," pp. 19-79; B. Olatunji Oloruntimehin, "Senegambia—Mahmadou Lamine," pp. 80-110; Yves Person, "Guinea—Samori," pp. 111-43; Ross, pp. 144-69; Robert Smith, "Nigeria—Ijebu," pp. 170-204; Ikime, pp. 205-67; and Muffett, pp. 268-307. See also the following in the *Journal of African History*: M. Legassick, "Firearms, Horses and Samorian Army Organization 1870-1898," 7 (1966): 95-115; Smith, "The Canoe in West African History," 11 (1970): 515-33; Gavin White, "Firearms in Africa: An Introduction," 12 (1971): 173-84; R. A. Kea, "Firearms and Warfare in the Gold and Slave Coasts from the Sixteenth to the Nineteenth Centuries," *ibid.*, pp. 185-213; Humphrey J. Fisher and Virginia Rowland, "Firearms in the Central Sudan," *ibid.*, pp. 215-39; Myron J. Echenberg, "Late Nineteenth Century Military Technology in Upper Volta," *ibid.*, pp. 241-54; Shula Marks and Anthony Atmore, "Firearms in Southern Africa: A Survey," *ibid.*, pp. 517-30; Anthony Atmore and Peter Sanders, "Sotho Arms and Ammunition in the Nineteenth Century," *ibid.*, pp. 535-44; Anthony Atmore, J. M. Chirinje, and S. I. Mudenge, "Firearms in South Central Africa," *ibid.*, pp. 545-56; J. J. Guy, "A Note on Firearms in the Zulu Kingdom with Special Reference to the Anglo-Zulu War, 1879," *ibid.*, pp. 557-70; Sue Miers, "Notes on the Arms Trade and Government Policy in Southern Africa between 1870 and 1890," *ibid.*, pp. 571-77; Joseph P. Smaldone, "Firearms in the Central Sudan: A Revaluation," 13 (1972): 591-607; and R. A. Caulk, "Firearms and Princely Power in Ethiopia in the Nineteenth Century," *ibid.*, pp. 609-30. Finally, see Robin Law, "Horses, Firearms and Political Power," *Past and Present* 72 (1976): 113-32.

<sup>66</sup> Pierre Boyer, *La Vie quotidienne à Alger à la veille de l'intervention française* (Paris, 1963), p. 140.

the Portuguese and the Arabs. Here Africans seldom manufactured their own guns; lacking waterwheels to drive bellows, they could not achieve temperatures high enough to make good barrels.<sup>67</sup> Yet those who lived near the coasts had no trouble obtaining guns and ammunition from European traders.<sup>68</sup> These “Dane guns” were cheap, poorly made, and apt to burst. Yet they were most suited to the prevailing technology, since village blacksmiths could easily repair them if they broke, and since African gunpowder, being uncorncorned, was just weak enough for them.<sup>69</sup> Bad as these weapons were, they were better than those of the Chinese who fought in the Opium War with matchlocks, spears, bows and arrows, and gingals.<sup>70</sup>

Since Africans imported all their firearms, guns were progressively rarer as one got further from the coast. From a military point of view the interior of Africa was then divided into two zones. In the states of the savanna region, there was little sleeping sickness to kill off horses. There the mainstay of armies was the cavalry dressed in quilted cloth or leather and armed with shields, swords, and spears. Infantry troops carried bows and arrows, battle-axes, clubs, and javelins. Cities were protected by walls and moats. Firearms were few and costly, and ammunition and powder were too precious to be used in target practice. Some rulers dared not entrust their soldiers with guns until the day of battle. Despite a centuries-long acquaintance with firearms, the Sudanese states were just entering the age of guns when the Europeans interrupted them.

<sup>67</sup> This is the explanation given by Jack Goody in *Technology, Tradition and the State in Africa* (London, 1971), pp. 28–29. There is certainly evidence that African iron was of poor quality, since the main import item during the age of the slave trade was iron bars. Nonetheless, there were attempts to manufacture guns, but these were sporadic and inconsequential (see Thomas R. DeGregori, *Technology and the Economic Development of the Tropical African Frontier* [Cleveland and London, 1969], p. 121).

<sup>68</sup> In 1844 Britain exported 83,721 muskets to Africa (80,530 to West Africa alone) or 49 percent of her total exports. The muskets exported to Africa were worth half a pound sterling on the average, compared with one pound sterling for the average of all British export muskets, and over two pounds sterling for muskets destined for India. Most shotguns and pistols, on the other hand, went to India, and very few to Africa (see Russell I. Fries, “British Response to the American System: The Case of the Small-Arms Industry after 1850” in *Technology and Culture* 16 [July 1975]: 377–403). By the 1860s Birmingham was producing 100,000–150,000 guns for the African trade, in competition with Spain, Belgium, and other exporting countries (see Kea, pp. 200–201; White, pp. 176–83; and Muffett, p. 277).

<sup>69</sup> Law, pp. 122–23; Atmore and Sanders, p. 537; Miers, p. 572; Legassick, p. 100; White, pp. 174–81; Echenberg, pp. 251–53; Kea, pp. 203–5; and Jean Suret-Canale, *Afrique Noire Occidentale et Centrale: L’Ere coloniale, 1900–1945* (Paris, 1964), p. 12, n. 3.

<sup>70</sup> On Chinese weapons in the Opium War, see Fay, pp. 123–24, 209, 218, 272–73, 289, and 344–50; and Jack Beeching, *The Chinese Opium Wars* (New York, 1975), pp. 51–52. Greener (pp. 123–24) has a description of Chinese gun making.

In the forest regions and in eastern and southern Africa, cavalry was rare and states were more loosely organized. Here large areas existed where the only firearms belonged to occasional Arab or European travelers and traders. Among the Africans the spear, the bow, poisoned arrow, and the assegai or throwing-spear were the favored weapons.<sup>71</sup>

Before the 1860s the regions of Africa with the most backward weaponry were protected from European invasion by disease and remoteness. Only in a few places did Europeans venture beyond the coasts. In the Ashanti War of 1826, as in the First Anglo-Burmese War or the Opium War, British victories were the result of artillery and Congreve rockets and were heavily dependent on water transportation.<sup>72</sup> The history of South Africa in the early nineteenth century is that of a long stalemate between a small number of whites armed with muskets and a larger number of Africans with assegais, axes, and a few guns. This stalemate was not broken until the whites obtained breechloading rifles and field artillery after the mid-century.<sup>73</sup>

When the French attacked Algeria in 1830, they found the Algerian and Turkish troops armed with muskets and rifles equal to their own and often more accurate at long ranges.<sup>74</sup> Soon the people of the hinterland arose under the direction of the brilliant guerrilla chief Abd el-Kader. To conquer Algeria, France poured in more and more troops. By 1846 there were 108,000 French soldiers, or one-third the French army, fighting an enemy of half that number. While these soldiers were equipped with the latest in guns, so were those of Abd el-Kader; at one point his army had 8,000 rifles, of which 2,000 were English guns smuggled in through Morocco.<sup>75</sup> It took France two decades of bitter and pitiless warfare to impose her rule on that recalcitrant colony. The conquest of Algeria may well serve as an example of imperialism without the benefits of technological superiority. The motivation was there, as was the willingness to sacrifice treasure and manpower. What was lacking was the advantage which technological innovation gave the Europeans in their later imperial conquests.

That innovation was breechloading. The idea was simple: If a gun

<sup>71</sup> Marks and Atmore, p. 519; Gentil, 1:55; Rotberg, p. 275.

<sup>72</sup> Laurie, p. 72; Fynn, p. 32.

<sup>73</sup> Marks and Atmore, pp. 519-28; Guy, p. 558; Crowder, p. 8.

<sup>74</sup> Charles André Julien, *Histoire de l'Algérie contemporaine: La Conquête et les débuts de la colonisation (1827-1871)* (Paris, 1964), pp. 53 and 279.

<sup>75</sup> *Ibid.*, pp. 178 and 182.

could be opened at the breech then it could be reloaded quickly and from a prone position. Furthermore a tighter and harder bullet could be used, making the rifling much more effective and increasing the range and accuracy. Breechloading is another of those inventions that recurred over many centuries until finally it worked. It, in turn, opened the door to other, more complex developments.

The earliest military breechloaders were the Sharp carbine used in the Mexican-American War of 1848 and the Dreyse needle-gun adopted by the Prussian army in the forties and fifties. Other nations still considered these weapons curiosities, as the British choice of the muzzle-loading Enfield in 1853 testifies. But in the war with Denmark in 1864 and again in the war with Austria in 1866, the needle-gun gave the Prussians two great advantages: Not only could Prussian soldiers fire three times faster than their enemies, but they could do so lying down or kneeling. No sooner had breechloading proven itself in battle than the French proceeded to rearm with the Chassepot, an even better weapon than the needle-gun. The British, somewhat more conservative, converted their Enfields to breechloading by fitting them with the Snider breech mechanism. After a final demonstration in the Franco-Prussian War, every European army switched to breechloaders.<sup>76</sup>

Early military breechloaders fouled quickly and leaked hot gases out the breech; and the more they fouled the more they leaked, until soldiers had to hold them at arm's length to fire. This practice greatly impaired their effectiveness. The Royal Laboratory at Woolwich, which conducted extensive tests on breechloaders, realized that their weakness was the paper cartridge. A metal cartridge would solve these problems. In 1866–67 Colonel Boxer of the laboratory developed a brass cartridge that held the bullet, powder, and cap together, that was sturdy and waterproof and, best of all, sealed the breech during the explosion, allowing accurate aim. The Snider-Enfield of 1867 was the first military rifle of this new generation. Its range was extraordinary: While the needle-gun was accurate at 350 yards and the Chassepot at 650, the Snider-Enfield had a range of 1,000 yards. All major European armies scrambled to develop new weapons that could use the new metal cartridges. In the 1870s British soldiers were armed with the Martini-Henry, the French with the Gras, and the Germans with the Mauser.<sup>77</sup>

<sup>76</sup> On the introduction of military breechloaders, see Ommundsen and Robinson, pp. 65–86; Greener, pp. 631 and 701–11; Carman, p. 121; Fuller, p. 116; and Palmer, pp. 493–94.

<sup>77</sup> On cartridges, see Carman, pp. 112–18 and 178; Ommundsen and Robinson, pp. 78–90; Fuller, p. 111; and Greener, pp. 590 and 703–11.

In the eighties two more developments completed the gun revolution. One was the invention of smokeless explosives in 1885. These powders, based on nitrocellulose or nitroglycerine, were nonfouling, impervious to dampness, and more powerful than gunpowder. They propelled smaller bullets faster, hence further in a flat trajectory. Soldiers could now fire undetected and unhindered by clouds of smoke. Between 1886 and 1891 all European armies abandoned the old gunpowder. The British even developed a specially stable explosive, Cordite, for use in the more extreme climates of the colonies.<sup>78</sup>

The second invention was the magazine and the repeating mechanism. Repeating rifles existed at the time of the American Civil War, but were prone to explode when one bullet touched another. In 1877 the Scottish watchmaker James Lee patented a safe box-magazine. It was quickly adopted by every major army. In 1880 the French converted their Gras to Gras-Kropatchek repeaters, and in 1886 they replaced them with the newer Lebel; both weapons were tested in the Sudan. In 1884 the German army converted its Mausers to magazine loading, while the British did the same to a variety of rifles: Lee-Enfields, Lee-Burtons, Lee-Metfords. By the nineties military single-shot rifles were obsolete everywhere in Europe.<sup>79</sup>

The repeating rifle carried to its logical extreme became the machine gun. The first machine gun, the Gatling, appeared in the American Civil War. Just before the Franco-Prussian War the French developed the Montigny mitrailleuse. Both of these weapons were multibarreled and hand cranked, and as unwieldy as field artillery without anywhere near the range. Furthermore they frequently jammed in the midst of battle. The British bought a dozen Gatlings in 1869 and by the eighties were using Gatlings on small boats and in the colonies. Then in 1884 Hiram Maxim developed the first truly automatic repeating rifle. It was light enough for infantry soldiers to carry, it could be set up inconspicuously, and it spat out eleven bullets per second. The next year Lord Wolseley, conqueror of the Ashanti, paid Maxim a visit and "exhibited the most lively interest in the gun and its innovator; and, thinking of the practical purposes to which the gun might be put, especially in colonial warfare, made several suggestions to Mr. Maxim." The Maxim gun was to prove as decisive in the colonial wars of the turn of the century as the rapid-fire rifle had been in the seventies and eighties.<sup>80</sup>

<sup>78</sup> On smokeless powders, see Greener, chap. 22; Ommundsen and Robinson, pp. 111-12; and Fuller, p. 120.

<sup>79</sup> On repeaters, see Carman, p. 112; Greener, pp. 716-17 and 731; and Ommundsen and Robinson, pp. 93-101.

<sup>80</sup> On early machine guns and their use in colonial wars, see Carman, pp. 83-85;

The last bit of “progress” in the evolution of the gun arose in response to the special needs of empire. In the words of the historians of guns, Ommundsen and Robinson; “. . . savage tribes, with whom we were always conducting wars, refused to be sufficiently impressed by the Mark II bullet; in fact, they often ignored it altogether, and, having been hit in four or five places, came on to unpleasantly close quarters.”<sup>81</sup> The solution to this unpleasantness was patented in 1897 by one Captain Bertie-Clay of the Indian ammunition works at Dum-Dum: the mushrooming or “dum-dum” bullet.<sup>82</sup> This particular invention was so vicious, for it tore great holes in the flesh, that Europeans thought it too cruel to inflict upon one another, and used it only against Asians and Africans.

By the 1890s the gun revolution was complete. Most European infantrymen could now fire fifteen rounds of ammunition in as many seconds, lying down undetected, in any weather, with an effective range of up to half a mile. Machine gunners had even more power. Though the generals were not to realize it for many decades, the age of raw courage and cold steel had ended, and the era of arms races and industrial slaughter had begun.

The gun revolution, like any other technological change, could not be confined to its creators. But the spread of the new guns and tactics was a most difficult and uneven process and may thus serve as a case study of technological diffusion under pressure. In China the defeat in two wars against European powers and the difficult struggle against the Taiping revolutionaries led many to reconsider the myth of Chinese superiority, at least in technical and military matters. In the sixties and after, a “self-strengthening movement” persuaded the government to purchase Western guns and warships and set up shipyards and arsenals. Yet these efforts were hampered by low budgets. In 1885, upon witnessing a demonstration of the Maxim gun, the Chinese emissary to London, Li Huang Chang, declared that China could not afford a gun that used up five British pounds worth of cartridges a minute.<sup>83</sup> At that time, half the Chinese soldiers carried matchlocks, one quarter had percussion flintlocks,

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Fuller, p. 120; Lt. Col. Graham Seton Hutchison, *Machine-Guns: Their History and Tactical Employment (Being Also a History of the Machine Gun Corps, 1916–1922)* (London, 1938), pp. 31–50; and John Ellis, *The Social History of the Machine Gun* (New York, 1975), chap. 4.

<sup>81</sup> Ommundsen and Robinson, p. 118.

<sup>82</sup> *Ibid.*, p. 118.

<sup>83</sup> Hutchison, pp. 54–55.

and only a quarter were armed with breechloaders; auxiliary troops had no firearms at all but carried spears and bows and arrows.<sup>84</sup> As late as the Boxer Rebellion of 1900 a Russian force was able to assault Peking with two machine guns and four cannon, against thousands of Chinese soldiers armed with muskets.<sup>85</sup> In the end, the failure of the self-strengthening movement was a result of the decay of Manchu leadership and the conservative nature of Chinese society.<sup>86</sup>

The gun revolution penetrated Africa in a number of ways. As the Europeans rearmed with breechloaders in the sixties and seventies, and with repeating rifles in the eighties, they discarded vast quantities of surplus weapons. Many of these found their way to Africa by the coastal or trans-Saharan trade.<sup>87</sup> In regions where Europeans needed African laborers, as in South Africa from the 1850s on, they often could only purchase these services for guns. And wherever white settlers had modern weapons, their black neighbors found ways to obtain them also.<sup>88</sup> Yet the whites, whether settlers, military men, or missionaries, had reason to fear the acquisition of guns by Africans and tried to restrict their sale. Like many regulations of the time, the Brussels Act of 1892 made a clear connection between European interests and the gun revolution: It restricted the sale of flintlocks to Africans living between the twentieth parallel north and the twentieth south and prohibited the sale of breechloaders completely.<sup>89</sup> Yet these restrictions were more symbolic than real. What mattered in the end was the more advanced technology and purchasing power of the Europeans.

<sup>84</sup> Nolte, 3:571–72; Carman pp. 53, 85.

<sup>85</sup> G. A. Lensen, ed., *Russia's Eastward Expansion* (Englewood Cliffs, N.J., 1964), pp. 115–23.

<sup>86</sup> On China's attempt and failure to modernize militarily in the nineteenth century, see John L. Rawlinson, *China's Struggle for Naval Development 1839–1885* (Cambridge, Mass., 1967); Albert Feuerwerker, *China's Early Industrialization: Sheng Hsuan-huai (1844–1916) and Mandarin Enterprise* (Cambridge, Mass., 1958); and Barton C. Hacker, "The Weapons of the West: Military Technology and Modernization in 19th-Century China and Japan," *Technology and Culture* 18 (January 1977): 43–55.

<sup>87</sup> Kea, p. 213, lists some of the weapons of the Fon in the late nineteenth century: Chassepots, needle-guns, 1871 model Mausers, Enfield-Sniders, and mitrailleuses, not to mention Dane guns and other muzzle-loaders. An example of the diffusion of weapons into the interior of Africa can be found in Fisher and Rowland (p. 223, n. 60): in 1836–58 the Sultan of Wadai in the Central Sudan had 300 muskets; in 1859–74 his successor had 4,000 muskets; and the Sultan who ruled Wadai from 1902 to 1909 had 10,000 guns, of which 2,500 were breechloaders.

<sup>88</sup> Atmore, Chirenje, and Mudenge, pp. 546–53.

<sup>89</sup> Miers, pp. 571–72 and 577. See also Marks and Atmore, pp. 517, 524, and 528; Atmore and Sanders, pp. 537–39; and Fries, pp. 392–93. One is reminded of more recent well-intentioned efforts to curb arms sales to Third World nations.

The new weapons of the sixties and after were so powerful that those who owned them often got their way by demonstration alone. Among the European explorers of Africa, some, like Heinrich Barth, David Livingstone, and René Caillé, made their way unarmed by befriending the people they visited. Others, however, mounted quasi-military expeditions: Samuel White Baker searched for the source of the Nile with 1,000 men and enough arms and ammunition to last him years;<sup>90</sup> Stanley explored the Congo with hundreds of men and did not hesitate to fire elephant guns and explosive bullets at Africans who had never seen firearms before.<sup>91</sup> Between these extremes, most explorers carried a few guns, both to hunt game and to impress their hosts. Malamine, a Senegalese associate of Savorngnan de Brazza, became the sole representative of France on the Congo thanks to a repeating Winchester with which he made himself the most successful and popular hunter in the region.<sup>92</sup> Gustav Rohlfs, traveling through Bornu, occasionally intimidated the local inhabitants with his rifles.<sup>93</sup> And Hauptmann Kling explored central Ghana with a machine gun to knock down walls and inspire awe.<sup>94</sup> At no time in history has the distinction between tourists and conquerors been so blurred as it was in late nineteenth-century Africa.

Colonial battles in Africa became increasingly lopsided as the century drew to a close, both because the weapons of the Europeans were constantly improved and because the last African areas to be conquered were often the furthest from the coasts, hence had the most difficulty obtaining those very weapons. In the wars of the sixties, as between the British and the Ethiopians or between the Orange Free State and the Sotho, the Europeans had breechloaders and field artillery, while the Africans had muskets and spears. The Europeans won the battles, but not decisively enough to take over the land.<sup>95</sup> In the seventies and eighties the statesmen of Europe, in a display of arrogant certainty unprecedented in the annals of conquerors, drew lines on the map of Africa to indicate where their future conquests would lie. They were only reflecting their faith in the absolute power of European weapons to overcome any native resistance. In the Ashanti War of 1873–74 and in the Zulu War of 1879 the victories of small European or European-led units over African armies of tens of thousands showed just how powerful

<sup>90</sup> Rotberg, pp. 141–71.

<sup>91</sup> *Ibid.*, pp. 242–45.

<sup>92</sup> Brunschwig, p. 17.

<sup>93</sup> Rotberg, p. 208.

<sup>94</sup> Goody, p. 62.

<sup>95</sup> Atmore and Sanders, pp. 540–41; Caulk, pp. 610–13.

Gatlings and breechloaders were.<sup>96</sup> In 1887 a French army of 1,400 men armed with Gras-Kropatchek repeating rifles defeated Mahmadou Lamine.<sup>97</sup> Gardner and Nordenfeldt machine guns (improved versions of the Gatling) figured in the British takeover of Egypt in 1882–84.<sup>98</sup>

In the nineties the high commands, which stoutly resisted the introduction of Maxim guns into their European armies, consented to send a few to the colonies.<sup>99</sup> These guns, along with field artillery and repeating rifles, turned battles into one-sided massacres. In 1891 near Porto Novo a French unit of 300 men defeated the entire Fon army in a two-and-a-half hour battle by firing 25,000 rounds of ammunition.<sup>100</sup> In 1897 the Royal Niger Company conquered the Caliphate of Sokoto with a force of thirty-one Europeans and 507 African troops armed with seven small cannon and six Maxims.<sup>101</sup> In Chad in 1899 a French force of 320 mostly Sudanese soldiers defeated Rabah's 12,000 warriors with their 2,500 guns.<sup>102</sup>

Probably the best known of these colonial wars was Lord Kitchener's conquest of the Sudan in 1898. He brought with him six heavily armed steamers and four other boats. His army had forty-four pieces of artillery and twenty Maxims. On September 2, 1898 the expedition encountered the main Dervish army of 40,000 men at Omdurman. Winston Churchill left this description of the battle:

The infantry fired steadily and stolidly, without hurry or excitement, for the enemy were far away and the officers careful. Besides, the soldiers were interested in the work and took great pains. But presently the mere physical act became tedious. . . . And all the time out on the plain on the other side bullets were shearing through flesh, smashing and splintering bone; blood spouted from terrible wounds; valiant men were struggling on through a hell of whistling metal, exploding shells, and spurting dust—suffering, despairing, dying.<sup>103</sup>

The battle was over within a few hours; 11,000 Dervishes and forty-eight British soldiers lay dead.<sup>104</sup> Churchill commented; "Thus ended the battle of Omdurman—the most signal triumph ever gained

<sup>96</sup> Hutchison, pp. 38–39; Carman, p. 81; Ellis, p. 82; Fynn, p. 40.

<sup>97</sup> Oloruntimehin, pp. 93–105; Legassick, p. 102; Callwell, p. 378.

<sup>98</sup> Hutchison, p. 43; Carman, p. 83.

<sup>99</sup> Callwell, pp. 440–42. Hutchison mentions their use by the British on the North-west Frontier of India (pp. 64–65), by the Russians in Central Asia (p. 32), and by the Germans in Africa (p. 55).

<sup>100</sup> Callwell, p. 260; see also Ross, p. 158.

<sup>101</sup> Muffett, pp. 284–85.

<sup>102</sup> Gentil, 1:99.

<sup>103</sup> Winston Churchill, *The River War: An Account of the Reconquest of the Soudan* (New York, 1933), p. 274.

<sup>104</sup> Hutchison, pp. 64–69; Derry and Williams, p. 305; Callwell, pp. 389, 438–39; Cyril Falls, *A Hundred Years of War* (London, 1953), pp. 119–20.

by the arms of science over barbarians. Within the space of five hours the strongest and best-armed savage army yet arrayed against a modern European Power had been destroyed and dispersed, with hardly any difficulty, comparatively small risk, and insignificant loss to the victors."<sup>105</sup> As Churchill noted, the significant, indeed the indispensable factor was "the arms of science" which produced the great disparity in firepower between Europeans and Africans.<sup>106</sup>

The strategy and tactics of the new imperialism deserve a special mention because of what they reveal about the culture of war.<sup>107</sup> Colonial armies seldom encountered guerrilla tactics. Instead they were time and again attacked in frontal assaults by great masses of warriors on open battlefields. This was true of the Chinese, the Zulu, the Ndebele, the Dervishes, the Fon, and so many others. These troops often displayed the highest discipline and courage, and the tactics most suited to the kind of warfare to which they were accustomed. But against European guns these tactics were obsolete. Firing on the run, reloading standing up, or running to get close enough to hurl a javelin were, under the circumstances, suicidal.

Against the open assault of masses of warriors, the imperialist forces resurrected the square of Napoleonic times, a human fortress surrounded by an impenetrable wall of bullets. It was a near-invincible defense against attacking forces armed with inferior weapons, no matter how numerous.<sup>108</sup> A battle of this kind took place in October 1893 near Zimbabwe in Southern Africa. A column of fifty British South African Police had encountered the 5,000 Ndebele warriors of King Lobengula. The Ndebele carried assegais and shields. The whites had four Maxims, a Nordenfeldt, and a

<sup>105</sup> Churchill, p. 300.

<sup>106</sup> On the role of machine guns in the conquest of Africa, see Oliver and Atmore, p. 115; Crowder, p. 8; and Hopkins, p. 115. Further examples of the lopsidedness of colonial battles at the turn of the century can be found in Ellis, chap. 4; Fisher and Rowland, pp. 230-31; Smith, pp. 178, 187; and Hutchison, p. 63.

<sup>107</sup> In an article entitled "Western Imperialist Armies in Asia" (*Comparative Studies in Society and History* 19 [January 1977]: 2-29), Gayl D. Ness and William Stahl have argued that the decisive superiority of Western armies over Asian ones was not due to better weapons but to superior organization, discipline and tactics, themselves reflections of a more modern society. Their evidence, however, comes mainly from the British campaigns in India between 1740 and 1840. Because they ignored steamers and rifles, their statements about technology are simply not applicable to the later period of the "new imperialism." Their "attempt to link the microprocesses of battlefield organization to the macroprocesses of a broad historical movement" is nonetheless fruitful as a model for later periods as well as their own.

<sup>108</sup> On the tactic of the square in colonial warfare, see Muffett, p. 290; Crowder, p. 9; Callwell, pp. 30-31; Falls, pp. 118-19; and Ross, pp. 160-61.

Gardner. Lt. Col. Graham Hutchison, a British writer of the purple-prose school of imperial history, described the confrontation:

Fierce tribesmen, inflamed with racial fanaticism, armed with the assegais, formed their impis, and in great force went forth to battle; while a thousand war-drums, in wild crescendo, beat their primitive tattoo of vengeance amid the scattered kraals. The B.S.A.P., though hurriedly reinforced by volunteer Rhodesians, were from the outset greatly outnumbered. . . . They stood on the defensive, forming a wagon laager, within which had been concentrated women, children and provisions, and provoked the Matabele to charge. Maxim guns were placed at the angles of the laager: and it is recorded how again and again hordes of Matabele bit the dust far beyond the thrust of the deadly assegai.<sup>109</sup>

Not everywhere did the Europeans encounter peoples with such obsolete armaments and tactics, for some Africans and Asians had learned that to fight an enemy armed with modern weapons one needed either equally modern weapons, or guerrilla tactics, or both. There were many such cases, from the Japanese to the Afghans and from the Sotho to the Riffi. Two examples will suffice.

In the Western Sudan the French encountered Samori Touré, an upstart state builder, religious leader, and military innovator. Starting with 500 soldiers and thirty-six repeating rifles in 1887, his army accumulated 4,000 repeaters by 1898. With skillful guerrilla tactics he held the French at bay for a decade, but was finally doomed when his supplies of fresh weapons and cartridges were cut off by an Anglo-French agreement.<sup>110</sup>

Emperor Menelik of Ethiopia was luckier. Starting with a larger base and more of the latest weapons, he confronted a weaker enemy. The battle of Adua in 1896, in which he defeated the Italians, was both a proof of Ethiopian valor and an omen of a time to come in which non-Western peoples would command the deadly firepower of the Europeans and close the power gap.<sup>111</sup>

The European imperial forces of the late nineteenth century, engaged in the largest strategic offensive since the days of Genghis Khan, won most of their battles by such defensive tactics as the square and the wagon laager. Col. Charles Callwell, author of *Small Wars*, the classic study of colonial warfare, recognized this curious juxtaposition of offensive strategy and defensive tactics but did not

<sup>109</sup> Hutchison, p. 63; see also Atmore, Chirenje, and Mudenge, p. 554; and Katzenbach, p. 551.

<sup>110</sup> Alexander S. Kanya-Forstner, *The Conquest of the Western Sudan: A Study in French Military Imperialism* (Cambridge, 1969). On the weapons used, see also Legassick and Person.

<sup>111</sup> Caulk, pp. 614–26.

pursue its implications.<sup>112</sup> He took the weapons superiority for granted, hardly commenting on it. Instead, throughout his book he stressed the superiority of European and European-trained soldiers over peoples he called hordes, fanatics, barbarians, savages, or, at best, semicivilized. He attributed the victories of the Western forces to zeal, resolution, daring, courage, initiative, vigor, boldness, and other such moral virtues.

If Callwell's interpretation is typical of his caste and time—and I believe it is—then it helps to explain what happened in World War I. For over forty years European armies had fought only colonial wars, and mostly with great success. Their colonial conquests reinforced the Napoleonic theory that a bold offensive strategy coupled with overwhelming firepower would surely lead to victory. What they overlooked was that the new guns were defensive weapons, and that it was defensive tactics that had won them their empires. The soldier in the trench in Flanders with his machine gun or his rifle was as invulnerable as his counterpart in the square at Omdurman or the wagon laager in Ndebeleland. The string of racist epithets that the Callwells of the turn of the century applied to non-Western peoples hid from them a most unpalatable fact: Against the hail of steel from the new weapons, vigor and *élan vital* were of no use, for the European soldier going over the top on the Western Front was as helpless and vulnerable as any Dervish or Ndebele. Hence the effect of modern guns on the battlefields of Europe was the exact opposite of what it had been in the colonies. Instead of bringing the quick and cheap success that everyone expected, they made victory impossible.

This paper began with an argument and an observation. The argument was that means and motives were not rival but congruent causes of the new imperialism, and that a model that accounted for changes in the means as well as the motives was more realistic than the conventional one which emphasized one aspect and ignored the other. The observation was that means and motives were interrelated, but not in a one-directional determinist way.

A paper of this length can only hope to open the question of

<sup>112</sup> Callwell (n. 55 above) pp. 75–76. Cyril Falls, taking after Callwell, also noted this fact; see chap. 8. Amazingly, several other military historians ignore the colonial wars and consider the period 1871–1914 (or at least 1871–1904) as one of “peace” (see, e.g., Theodore Ropp, *War in the Modern World*, rev. ed. [New York, 1962]; and Maj. Gen. J. F. C. Fuller, *War and Western Civilization 1832–1932* [London, 1939]). They miss the connection between colonial warfare and the attitudes that led to the “Great War.”

technology and imperialism and give a few examples to illustrate the argument and the observation. Through a constant flow of information between the industrial core and the imperial frontiers of Europe, imperialist motives helped stimulate such technical innovations as the *Alburkah* and the *Nemesis*, quinine prophylaxis, Cordite, and the dum-dum. These and other technical innovations in turn permitted the expansion of Europe and guided its timing and location. But what of all the motivations that historians have been arguing over for years: Ferry and Disraeli, the depression of the eighties, the missionary movement, the German industrial bourgeoisie, the investment bankers, the popular press, and so many others? These are so diverse, profuse, and contradictory that they cannot easily be harmonized: hence the great debate. But they all appeared in the late nineteenth century. Could it be that the innovations which suddenly made it easy and cheap to conquer whole nations had in fact stimulated these motivations? This is certainly a hypothesis worthy of further investigation.