

Cornell Studies in Comparative History

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Empires, by Michael W. Doyle

Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance, by Michael Adas

MICHAEL ADAS

MACHINES AS THE MEASURE OF MEN

*Science, Technology, and Ideologies
of Western Dominance*

CORNELL UNIVERSITY PRESS

ITHACA AND LONDON

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First published 1989 by Cornell University Press

First printing, Cornell Paperbacks, 1990

Printed in the United States of America

Library of Congress Cataloging-in-Publication Data

Adas, Michael, 1943-

Machines as the measure of men: science, technology, and ideologies of Western dominance/Michael Adas.

p. cm.—(Cornell studies in comparative history)

Includes bibliographical references and index.

ISBN 978-0-8014-9760-5 (pbk.: alk. paper)

1. Technology—History. 2. Technology—Philosophy. I. Title. II. Series.

T15.A33 1989

609—dc19

89-000845

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Paperback printing 10 9

For John Smail

*As teacher and scholar,
a model for us all*

They are landing with rulers, squares, compasses,
Sextants
White skin fair eyes, naked word and thin lips
Thunder on their ships.

Léopold Sédar Senghor, "Ethiopiiques"

INTRODUCTION

IN THE 1740S while the ship on which he was traveling was at anchor off the mouth of the Gambia River, William Smith went ashore to instruct one of the ship's mates in the use of surveying instruments. On a stretch of beach near a small town, Smith had begun to demonstrate how one could measure distances with his theodolite and hodometer when he noticed a sizable band of armed Africans gathering nearby. Troubled by their hostile gestures, Smith questioned the ship's slave, who had come along to help him operate the instruments, as to why they were so vexed by activities that Smith regarded as entirely peaceful and nonthreatening. The slave explained that the "foolish natives" were alarmed by Smith's strange devices, which they believed he would use to bewitch them. The Africans had driven off their cattle, sent the women and children from the town to hide in a nearby forest, and marched out to confront the dangerous strangers who had appeared so suddenly in their midst. Concluding that attempts to reason with "ignorant savages" would be futile, and observing that the Africans were afraid to approach the surveying party, Smith continued with his instruction—though he cautioned the mate to keep his blunderbuss ready. As the slave measured the distance along the beach with the hodometer, the frightened warriors tried to stop him by running in his path—but they were careful not to touch the wheel. The slave amused himself by trying to run into them. Smith and his companions found the Africans' fear of the wheel and their scrambling to avoid it a source of merriment which they wished the "other gentlemen" on board had been present to enjoy. But when Smith stopped to rest in the shade and sent the mate and slave off to make punch, the townsmen grew more and

more threatening. Alone and surrounded by the angry and well-armed warriors, Smith began to fear that he might be attacked. Just as it occurred to him that he could be "cruelly torn asunder," the mate returned, and together they chased away the band of warriors by making threatening gestures and discharging the weapons that the terrified Africans had left behind on the beach. The mate pleaded to be allowed to pursue them, but Smith insisted on returning to the safety of the ship.¹

Though in itself a relatively insignificant encounter, this incident reveals much about European attitudes toward and interaction with non-Western peoples in the centuries since the fifteenth-century voyages of exploration. It was the Europeans who went out to the peoples of Africa, Asia, and the Americas, and never the reverse—though at times Africans and Amerindians were carried back to Europe to be exhibited and studied. For the Africans the ship from which Smith and his small party disembarked was a marvel of design and workmanship. It represented an area of technology in which the Europeans had few rivals by the fifteenth century and in which they reigned supreme by the seventeenth. Sailing ships with superior maneuverability and armament permitted the Europeans to explore, trade, and conquer all around the world. Smith's instruments and his reason for taking them ashore convey both a sense of the curiosity that provided a major motivation for the Europeans' overseas expansion and their compulsion to measure and catalogue the worlds they were "discovering." With little thought for the reaction of the people who lived there, Smith set out to measure a tiny portion of the vast continent he was exploring. Much more than his physical appearance and dress, it was Smith's unknown instruments and what the Africans perceived as strange behavior in employing these devices that became the focus of their concern. He delighted in dazzling and terrifying the townspeople with his strange machines and continued his activities despite their obvious hostility to his intrusion. When threatened, he relied on the Africans' fear of his technology to drive them off. As he informs the reader, the guns that the warriors dropped and he and the ship's mate fired into the air were of European manufacture.

Our only source of information about this encounter is what we are told by Smith. It is the European observer who describes the Africans' reactions, interprets their motives, and even speculates about their underlying belief systems—in this case, with the assistance of a black slave whose views are filtered through Smith's own perceptions and memo-

ry. The explorer stresses that the awe and fear evoked by his innocuous surveying equipment is the main source of the power he is able to exert over the African townspeople. He suggests that they are too backward to have any comprehension of the use of these devices and too ignorant for him to attempt an explanation. He concurs with the slave's assumption that because the Africans have no natural frame of reference from which to comprehend these wondrous devices and cannot imagine humans creating them, they resort to superstitious notions rooted in witchcraft to explain them. The black slave, who is depicted as a loyal servant, has nothing but contempt for the Africans. The surveying instruments both tie him to his white masters and set him off from the African townspeople. Though he is supervised by Smith, his ability to use the hodometer places him above the "ignorant Savages," and he readily joins in the merriment caused by what he regards as their unfounded fear of the surveying equipment. It is implicit in Smith's account that the slave himself could not conduct sophisticated surveying operations, much less devise the instruments that make them possible. But he has been instructed in their use and understands that they are human fabrications, not the products of magic or witchcraft.

As Smith relates this encounter, it is superior technology—the surveying instruments and firearms—that set the European traveler and his companions off from the Africans and give them the upper hand in the confrontation that ensues. Taken in isolation, the incident overstates the importance of technology in an age when religion was still the chief source of western Europeans' sense of superiority. But it indicates how influential achievements in material culture had become, especially those relating to technology and science, in shaping European perceptions of non-Western peoples even before the Industrial Revolution. From the very first decades of overseas expansion in the fifteenth century, European explorers and missionaries displayed a great interest in the ships, tools, weapons, and engineering techniques of the societies they encountered. They often compared these with their own and increasingly regarded technological and scientific accomplishments as significant measures of the overall level of development attained by non-Western cultures. By the mid-eighteenth century, scientific and technological gauges were playing a major and at times dominant role in European thinking about such civilizations as those of India and China and had begun to shape European policies on issues as critical as the fate of the African slave trade. In the industrial era, scientific and technological measures of human worth and potential dominated European thinking on issues ranging from racism to colonial education. They also provided

¹William Smith, *A New Voyage to Guinea* (London, 1744), pp. 15–20.

key components of the civilizing-mission ideology that both justified Europe's global hegemony and vitally influenced the ways in which European power was exercised.

In view of their importance, it is remarkable that scientific and technological accomplishments as measures of European superiority and as gauges of the abilities of non-Western peoples have been so little studied. Most authors who have dealt with European attitudes toward African and Asian peoples in the industrial era acknowledge that Europe's transformation and the power differential that it created had much to do with the hardening of European assumptions of racial supremacy in the late nineteenth century.² But few writers have examined these complex connections in any detail, and in all cases consideration of them has been subordinated to discussion of racist issues. The rare works that deal in any depth with the pervasive effects of the scientific and industrial revolutions on European perceptions of non-Western peoples are focused on Africa, the geographical area that elicited the most extreme responses.³ Because these studies cover a wide range of topics beyond the impact of European advances in science and technology, even for Africa we have only a partial view of one of the most critical dimensions of European interaction with non-Western peoples in the modern era. For China, India, the Islamic empires, and the Amerindian civilizations of the New World, we have little more than chance comments on the superiority of European weapons, tools, and mathematical techniques. The accounts that deal with these observations often give little sense of the material conditions and the cultural and ideological milieus that shaped them or their place in the broader, ongoing process of European exchange with non-Western peoples which has spanned the last half-millennium.

This book examines the ways in which Europeans' perceptions of the material superiority of their own cultures, particularly as manifested in scientific thought and technological innovation, shaped their attitudes toward and interaction with peoples they encountered overseas. It is not a work in the history of science or technology as those fields are usually defined. The processes of invention and of scientific investigation which have traditionally occupied scholars in these fields and the patterns of

²See, e.g., Ronald Hyam, *Britain's Imperial Century, 1815–1914* (New York, 1976), pp. 47–50; Christine Bolt, *Victorian Attitudes towards Race* (London, 1971), pp. 27–28, 111–12, 211; Gérard Leclerc, *Anthropologie et colonialisme: Essai sur l'histoire de l'africanisme* (Paris, 1972), pp. 26–28; and Francis G. Hutchins, *The Illusion of Permanence: British Imperialism in India* (Princeton, N.J., 1967), pp. 121–24.

³The best of these include Philip Curtin, *The Image of Africa* (Madison, Wis., 1964); H. A. C. Cairns, *Prelude to Imperialism: British Reactions to Central African Society, 1840–1890* (London, 1965); and William B. Cohen, *The French Encounter with Africans: White Response to Blacks, 1530–1880* (Bloomington, Ind., 1980).

institutional and disciplinary development which have more recently come into favor are crucial to the themes I explore. But for my purposes, these discoveries and developments are important only insofar as they influenced the ways in which Europeans viewed non-Western peoples and cultures and as these perceptions affected European policies toward the African and Asian societies they came to dominate in the industrial era. Though varying forms of interaction—including trade, proselytization, and colonial conquest—often resulted in the diffusion of European tools and scientific learning to overseas areas, my main concerns are the attitudes and ideologies that either promoted or impeded these transfers rather than the actual processes of diffusion. Because the spread of European science and technology has been central to the global transformations that Western expansion set in motion, the assumptions and policies that determined which and how many discoveries, machines, and techniques would be shared with which non-Western peoples have been critical determinants of the contemporary world order.

As I stress in the early chapters on the growing impact of material achievement on European perceptions of non-Western peoples and societies, the meanings of "science" and "technology" changed considerably over the centuries covered in this book. It is therefore necessary to indicate at the outset how I define these terms for the purposes of the study as a whole. Though contemporary scholars continue to debate how they ought to be understood and struggle to delineate the boundaries between them,⁴ I have adopted broad definitions combining elements suggested by A. R. Hall and Edwin Layton. Hall terms scientific those endeavors that are aimed at gaining a knowledge of the natural environment, while he views technology as efforts to exercise a "working control" over that environment. Layton elaborates upon similar definitions: he sees the search for the understanding of fundamental entities as the essence of science, whereas technology seeks to solve more practical and immediate problems. Science may be theoretical or applied, but it is oriented toward systematic experimentation and the discovery of underlying principles. The primary objective of technology,

⁴As well as those between "pure" and "applied" science. For an introduction to many of the issues contested, see Robert Multhauf, "The Scientist as an 'Improver' of Technology," *Technology and Culture* 1/1 (1959), 38–47; the essays by Peter Drucker and James Feibleman in *ibid.* 2/4 (1961); the contributions by A. R. Hall and Peter Mathias in Mathias, ed., *Science and Society, 1600–1900* (Cambridge, Eng., 1972); A. R. Hall, *The Historical Relations of Science and Technology* (London, 1963); and Charles C. Gillispie, "The Natural History of Industry," in A. E. Musson, ed., *Science, Technology, and Economic Growth in the Eighteenth Century* (London, 1972).

though it may often involve theory and experimentation, is design, the application of rules to human artifice.⁵

I had originally intended to focus this study exclusively on the industrial age, when scientific and technological measures of human capacity peaked in importance. It soon became clear, however, that the impact of these standards in the industrial period could not be understood without some sense of their influence in the preceding centuries of European overseas expansion. European observers did not suddenly begin in the industrial era to distinguish their cultures from all others on the basis of material achievement; they had stressed the uniqueness of the extent and quality of their scientific knowledge and mechanical contrivances for centuries. In the early phase of overseas expansion, European travelers and missionaries took pride in the superiority of their technology and their understanding of the natural world. Their evaluations of the tools and scientific learning of the peoples they encountered shaped their general estimates of the relative abilities of these peoples.

Still, throughout most of the preindustrial period, scientific and technological accomplishments remained subordinate among the standards by which Europeans judged and compared non-Western cultures. Religion, physical appearance, and social patterns dominate accounts of the areas explored and colonized. When discussed, science and technology are generally treated as part of a larger configuration of material culture. Within this configuration, monumental architecture, sailing vessels, and even housing were often more critical than tools or astronomical concepts in determining European attitudes toward different non-Western peoples.

Throughout the centuries covered by this study, European judgments about the level of development attained by non-Western peoples were grounded in the presuppositions that there are transcendent truths and an underlying physical reality which exist independent of humans, and that both are equally valid for all peoples. Further, most of the travelers, social theorists, and colonial officials who wrote about non-Western societies assumed that Europeans better understood these truths or had probed more deeply into the patterns of the natural world which manifested the underlying reality. In the early centuries of overseas expansion, considered in Chapter 1, the Europeans' sense of superiority was anchored in the conviction that because they were Christian, they best understood the transcendent truths. Thus, right thinking on religious

⁵A. R. Hall, "Science, Technology, and Utopia in the Seventeenth Century," in Mathias, *Science and Society*, pp. 33–53; and Edwin Layton, "Mirror-Image Twins: The Communities of Science and Technology in 19th-Century America," *Technology and Culture* 12/4 (1971), 562–80.

questions took precedence over mastery of the mundane world in setting the standards by which human cultures were viewed and compared. The Scientific Revolution did not end the reliance on Christian standards. In fact, to the present day they remain paramount for certain groups and individuals, most obviously Christian missionaries. But as I suggest in Chapter 2, religious measures of the attainments of overseas peoples diminished in importance for many European observers beginning in the eighteenth century, while scientific and technological criteria became increasingly decisive.

The rise to predominance of scientific and technological measures of human capacity during the industrial era, which is discussed in Chapter 3, owed much to the fact that they could be empirically demonstrated. In the late eighteenth and nineteenth centuries, most European thinkers concluded that the unprecedented control over nature made possible by Western science and technology proved that European modes of thought and social organization corresponded much more closely to the underlying realities of the universe than did those of any other people or society, past or present. In Chapter 4 I examine the ways in which this assumption shaped ideologies of European imperialism. Chapter 5 focuses on two closely related themes: the impact of European scientific and technological superiority on arguments of white racial supremacy, and the ways in which European advantages in these fields influenced the educational policies by which European colonizers proposed to refashion non-Western societies.

In Chapter 6 I explore the reasons why the trench slaughter on the Western Front in World War I caused many European thinkers to challenge the assumption that better machines and equations demonstrated privileged access to physical as well as transcendent truths. In the Epilogue, I suggest some of the reasons why doubts about scientific and technological measures of human accomplishment were less pronounced in American intellectual circles after the war. I then consider the longstanding and increasing American addiction to technological innovation and the ways in which it contributed to the rise of modernization theory. This paradigm, resting on an assumed dichotomy between traditional and modern societies, represented a reassertion of scientific and technological standards. Its popularity in the post–World War II era reflected a restored confidence in the premise that there was close correspondence between Western thinking and external reality.

As these patterns suggest, European responses to non-Western peoples and cultures over the past five centuries have been strongly influenced by advances in Western understanding of and control over the material world. But the links between material advance and shifts in

perception or judgment were not always clear or direct. Both the conflicting views held by different thinkers or groups during the same "phase" of development, and the lag between changes in European material conditions and shifts in European ideas about non-Western peoples caution against attempts to periodize rigidly or to treat prevailing views as the consensus of a given age.⁶ Though I have identified general phases, I have tried to show that the boundaries between them are blurred. Ideas that were dominant in one era persisted but played lesser roles in the next, and various authors writing in the same period could draw widely varying conclusions from the same evidence. Thus, for example, reports of African material backwardness were cited in the eighteenth century both by writers who sought to prove the racial inferiority of Africans—and thereby justify their enslavement—and by abolitionists who argued that the Africans' vulnerability, reflected in their low level of development, made it morally imperative for Europeans to protect rather than exploit them. Some centuries later, European intellectuals proposed a range of often contradictory solutions to the crisis of Western civilization brought on by World War I. These included, on the one hand, assaults on science and industry, which were blamed for the horrific magnitude of the war, and, on the other, visions of Americanized technocracies of the future.

In each of the phases considered, I have attempted to examine these conflicting responses and to weigh their impact on European views of and interaction with non-Western peoples. I have also sought to avoid reducing the factors that shaped European attitudes to those involving material accomplishment by comparing the influence of these gauges in each period with the major alternatives to them, including physical appearance, religious beliefs, and social customs. Finally, I have had to take into account the fact that the impact of European scientific and technological breakthroughs on shifts in European responses to non-Western peoples was often not felt until decades later. The failure of sixteenth-century European explorers and missionaries to appreciate fully the advantages that the mechanical innovations of medieval artisans had bequeathed to them provides a major example of this lag. Another is illustrated by the fact that the eighteenth-century rage for *chinoiserie* peaked in the very decades when a number of French and British authors, who were attuned to the latest European advances in the sciences and familiar with the writings of the Jesuit missionaries on

⁶My thinking on these issues has been strongly influenced by John Greene's superb essays on approaches to the history of science; see esp. "Objectives and Methods in Intellectual History" and "The Kuhnian Paradigm," both reprinted in *Science, Ideology, and World View* (Berkeley, Calif., 1981).

China, had begun to dismiss the "Middle Kingdom" as despotic, superstition-ridden, stagnant, and hopelessly behind Europe in civilized attainments. For all these reasons, the phases and patterns I identify arise not from the delusion that the "messy realities" of history can be reduced to a rigid hierarchy of factors and precise categories but from an effort to give analytical coherence to the large and complex questions I address.

My central concerns are the attitudes toward non-Western peoples and cultures which were held by literate members of the upper and middle classes of western European societies, and the ways in which these attitudes shaped ideologies of Western dominance and informed colonial policy-making. Though these ideas often influenced the actual social interaction of all classes of Europeans with Africans and Asians, I deal only indirectly and peripherally with what George Frederickson has termed the "societal" dimensions of contacts between European and non-Western peoples.⁷ This approach reflects my agreement with Theda Skocpol that ideologies ought to be distinguished from cultural idioms. Arguments for or against the abolition of the slave trade, appeals to the "civilizing mission," and competing approaches to modernization theory were (or are) all "idea systems deployed as self-conscious political arguments by identifiable political actors."⁸ These ideologies tended to be less temporally specific and at times more oriented to intellectual and moral disputes than Skocpol's exclusively political definition would allow, but I strongly concur with her contention that they must be distinguished from the less consciously fashioned and more anonymous ideas and values that are constants in all cultural systems. Therefore, when I write of "European" views and responses, I am (unless I indicate otherwise) referring collectively to the ideas and arguments of those members of the "articulate classes"⁹ of western Europe who concerned themselves with issues relating to European involvement overseas. Most of the authors who dealt with these issues can at best be characterized as middle-level intellectuals, and some were little more than polemicists or popularizers in the worst sense of the term; only a handful—including Voltaire, John Stuart Mill, and René Guenon—were major thinkers.

As I seek to demonstrate in the book's early chapters, both the class

⁷George Frederickson, "Toward a Social Interpretation of the Development of American Racism," in Nathan I. Huggins, Martin Kilson, and Daniel M. Fox, *Key Issues in the Afro-American Experience* (New York, 1971), pp. 240–54.

⁸See the stimulating exchange on these issues between Theda Skocpol and William H. Sewell, Jr., in *Journal of Modern History* 57/1 (1985), 57–96 (quoted portion, p. 91).

⁹As G. M. Young has so aptly labeled them in *Victorian England: Portrait of an Age* (Oxford, 1964), p. 6.

and occupational background of those who wrote about overseas areas shifted considerably during the centuries covered. The bourgeoisie steadily increased in numbers and influence in the mix of aristocratic and middle-class observers. Explorers, traders, missionaries, and writers of fiction dominated the discourse on African and Asian lands in the early decades of expansion. Though they remained important, from the late eighteenth century on, natural scientists, colonial administrators, social theorists, and anthropologists became the leading experts on matters relating to the non-Western world. As the occupational backgrounds of these writers suggest, both thinkers within Europe itself and Europeans engaged in diverse enterprises overseas played critical roles in shaping responses to non-European peoples and cultures. From the first decades of expansion the two were constantly interacting. Medieval accounts of the fabled Orient and the African empire of Prester John aroused the expectations of early explorers, missionaries, and conquistadores. Their accounts of the worlds they had "discovered" provided the basis for the works of authors in Europe, from the philosophical tracts of Montesquieu and Voltaire to the disquisitions of naturalists such as Julien Virey and Johann Blumenbach. These works, and those by such later authors as James Mill and John Barrow, in turn shaped the attitudes of Westerners who went out to colonize or Christianize African and Asian lands in the nineteenth century, and who described them in unprecedented detail for the rapidly growing readership back home.

Because the British and French were prominent among the European nations involved in overseas expansion in each of the phases I consider, and because they were the foremost imperialist powers of the nineteenth century, the travelers and administrators and social theorists of these two nations have been by far the most important sources of information and opinion about the non-Western world. Both countries were also leading centers of scientific investigation and technological innovation throughout the centuries in question. Even though France was slower to industrialize than Great Britain, the French were as sensitive as the English to the profound differences, created by the scientific and industrial revolutions, between western Europe and the rest of the world. For these reasons, I concentrate on British and French writings in all but the earliest period and the latter half of the twentieth century. In dealing with the sixteenth and seventeenth centuries, I also make use of Iberian and Dutch and to a lesser extent Italian and German descriptions of overseas lands and cultures because accounts by explorers and travelers from these areas were among the most influential in this era. In the Epilogue I compare nineteenth-century European ideas with those of twentieth-century American social scientists, who have dominated

post-World War II thinking on the relevance of Western science and technology for the Third World.

Comparison of shared and divergent British and French responses throughout all the different phases discussed serves to identify both the assumptions that writers from the more advanced nations of western Europe held in common, and areas where perceptions and policies differed by nationality. A comparative approach applied also to the areas to which European observers were responding makes possible the identification of generalized patterns of European perception and policy as well as variations in European responses to specific cultures and the sources of those differences.

Among the many culture areas with which the Europeans interacted, I have concentrated on three: sub-Saharan Africa, India, and China. Not only have my teaching and previous research given me some familiarity with these areas, but each has proved ideal for testing the themes I am examining. Though their interaction with the agents of an expansive European civilization differed considerably, they were all major targets of early European exploration and remained primary centers of European overseas trade, proselytization, and conquest or informal domination. European observers saw in these three culture areas major examples of the differing levels of social development that eighteenth- and nineteenth-century writers sought to locate on a variety of evaluative scales. European thinkers also judged that the peoples of each had reached a different level of scientific understanding and technological mastery. Careful examination of these areas soon impresses one with the great diversity within each one, but in European thinking they were often treated as single civilizations or their achievements regarded as those of a single "race" or people. Thus, although I have noted important variations in cases where these differences were vital to the issues under consideration, I have generally followed my sources in comparing each with the others as a single and discrete entity.

Other culture areas, particularly Japan and various centers of Islamic and Amerindian civilization, have great potential for comparison and might well warrant examination in subsequent studies, but none proved as suitable for the present work as the three I have chosen. Some, such as Japan and Polynesia, were not at all or only marginally in contact with the Europeans during key phases of the centuries considered and thus were not consistently major objects of European intellectual inquiry. Others—the Middle Eastern centers of Islamic civilization, for example—not only shared the Mediterranean heritage of western Europe but had long been rivals of the Europeans and had maintained significant contacts for centuries through trade, war, and cultural ex-

change. As a result, the Muslims were never "discovered" like the Indians and Chinese, and the Semitic origins of the Arabs tended to muddy discussions of "racial" characteristics. This and the fact that they had bequeathed to the Europeans, whether as originators or as go-betweens, some of the technology and a good deal of the basic mathematical and scientific learning vital to the West's transformation from backward outlyer to global hegemon make it difficult to distinguish clearly between the achievements of the two civilizations. The early phases of European interaction with the peoples of the New World produced patterns of response comparable to those discussed in Chapter 1, and I have been strongly tempted to include one of the Amerindian civilizations as a fourth case study. But the early conquest of the New World societies and the demographic catastrophes that followed, coupled with the early and relatively large migration of Europeans to the Americas, gave the patterns of thought and domination that I examine very different meanings in New World contexts. A consideration of these contrasts would have greatly extended the scope and length of the present work.

In view of the issues that have preoccupied writers on related subjects, it is vital that I indicate a number of things that this book does not attempt to do. It is not a study of racism or racial prejudice per se, even though the patterns I explore converge with racist ideologies in each phase. But the impact of racism in the only sense in which it has been a meaningful concept at the level of intellectual discourse—the belief that there are innate, biologically based differences in abilities between rather arbitrarily delineated human groups—varied greatly from one time period to another. Terms such as ethnocentrism, cultural chauvinism, and physical narcissism more aptly characterize European responses in the early centuries of overseas contact, and they remain more important than racism in much of the literature on two of the three culture areas considered. Though scientific and technological measures of human potential were used to support racist ideologies, particularly in the nineteenth century, these gauges were widely applied long before racist ideas were first systematically expounded by such writers as Edward Long and S. T. Soemmering in the late 1700s. Even in the nineteenth century, when racist theories relating to non-Western peoples won their widest acceptance among the articulate classes of Europe, many thinkers gave credence to scientific and technological proofs of Western superiority while rejecting those based on racist arguments. These patterns underscore one of the major findings of my research: racism should be viewed as a subordinate rather than the dominant theme in European intellectual discourse on non-Western peoples.

In this work I do not attempt to determine the accuracy of either

individual or collective European assessments of African and Asian technology and scientific thought at different points in time. Rather, my aims are to trace the history of these assessments, to give some sense of the conditions in Europe and overseas that influenced the choice of items selected for comment and how these were regarded, to explore how both objects of interest and evaluations changed over time, and to examine the impact of these changes on broader European attitudes toward non-Western peoples and on the formulation of ideologies of Western dominance. A determination of the validity of European commentary in different periods on the quality of African tools or the accuracy of Chinese astronomical calculations would entail a very different sort of inquiry.¹⁰ It would require extensive comparisons of European accounts with whatever contemporary writings are available from each culture area, and with the findings of research carried out in the past three or four decades by scholars working on the history of science and technology in China, Africa, and India.¹¹ Therefore, unless correctives were provided by contemporaries, I have refrained from specific commentary on the accuracy of European assessments of differing non-Western peoples' conceptions of the natural world and their level of material culture. However, in my more general discussions of European interaction with African and Asian peoples at different points in time, I have tried to indicate where statements and impressions unduly distort the actual relationship between the Europeans and the culture area in question.

As "the measure of men" in the title is intended to suggest, scientific and technological standards have been, with rare exceptions, applied by males to activities presumed to be dominated by males. The Marquise

¹⁰Some sense of the size of such a task can be gained from the detailed notes that J. L. Cranmer-Byng has appended as editor to Lord Macartney's journal of his visit to China in the 1790s; see *An Embassy to China* (London, 1962), pp. 355–98.

¹¹The most important work to appear thus far on non-Western science and technology is the monumental, multivolume study by Joseph Needham (assisted by Wang Ling); *Science and Civilization in China* (Cambridge, Eng., 1954–).

On China, see also the useful essays in Nathan Sivin, ed., *Technology in East Asia* (New York, 1977); and Sivin and Shigeru Nakayama, eds., *Chinese Science: Explorations of an Ancient Tradition* (Cambridge, Mass., 1973). For an overview of scientific investigation in India, see the contributions in D. M. Bose, S. N. Sen, and B. V. Subarayappa, *A Concise History of Science in India* (New Delhi, 1971). David Pingree's *Census of the Exact Sciences in Sanskrit* (Philadelphia, 1970–81) conveys a sense of the depth and range of Indian scientific learning, while Shiv Visvanathan's monograph *Organizing for Science* (New Delhi, 1985) provides numerous insights into the nature and organization of industrial research in modern India. Robin Horton's essay "African Traditional Thought and Western Science," *Africa* 37/1–2 (1967), 51–71, 155–87, is a good place to begin an inquiry into African approaches to the natural world. Jack Goody's *Technology, Tradition, and the State in Africa* (London, 1971) provides a provocative interpretation of the role of technology in African history. See also Ralph A. Austin and Daniel Headrick, "The Role of Technology in the African Past," *African Studies Review* 26/3–4 (1983), 163–84.

du Chatelet and Marie Curie notwithstanding, European and North American thinkers have assumed that the unprecedented achievements in experiment and invention which they invoked to demonstrate Western superiority, as well as the African and Asian scientific learning and tools with which these accomplishments were compared, were the products of male ingenuity and male artifice. Colonial proposals to train physicians and railway engineers were drawn up with male students in mind, just as colonial development schemes and post-independence modernization proposals (both capitalist- and socialist-inspired) have been for the most part male-oriented.¹² Throughout the five centuries surveyed here, male attainments and male potential were being measured; better machines and equations were being invoked to demonstrate that men of one type were superior to those of another.

The phrase “ideologies of dominance” in the subtitle indicates that assessments of African tools, Chinese timepieces, and the Indians’ capacity to run steam locomotives were not simply academic exercises. They were expressions of power relationships. Especially in the industrial era, science and technology were sources of both Western dominance over African and Asian peoples, male and female, and of males over females in European and American societies. As I note in Chapter 5, at times the parallels between European women and non-Western “races” in this regard were explicitly stated. But usually it was simply assumed that women knew and cared to know little about mathematics and engineering and that the power derived from superiority in these fields should be monopolized by white males.

Machines as the Measure of Men is not intended to be an exercise in anti-scientific or antiindustrial polemic. In fact, it has occurred to me as I work at my personal computer—surely one of the more remarkable products of Western (and increasingly Japanese) inquiry and innovation—that it would be hypocritical to engage in such an exercise. I have no utopian system to propose as a replacement for the scientific-industrial order, nor do I believe that the non-Western rivals it has come to domi-

¹²Ester Boserup's *Woman's Role in Economic Development* (New York, 1970) pioneered the study of the impact of colonial development and postcolonial “modernization” schemes on the women of Africa and Asia. For a recent appraisal of Boserup's work which takes into account the considerable research conducted since *Woman's Role* first appeared, see Lourdes Beneria and Gita Sen, “Accumulation, Reproduction, and Women's Role in Economic Development: Boserup Revisited,” *Signs* 7/2 (1981), 279–98. For additional studies on these issues, see esp. Barbara Rogers, *The Domestication of Women: Discrimination in Developing Societies* (London, 1980); Maxine Molyneux, “Women in Socialist Societies: Problems of Theory and Practice,” in Kate Young, Carol Wolowitz, and Roslyn McCullagh, *Of Marriage and the Market* (London, 1981), pp. 167–202; the essays in the symposium published in *Signs* 7/2 (1981); and the earlier collection, “Women and National Development,” in *Signs* 3/1 (1977).

nate were intrinsically better. For all the problems associated with scientific and technological innovations, they remain the only way we have yet discovered to provide a decent standard of living for a high proportion of the populations of human societies. That all societies or all groups within industrialized societies have not equally enjoyed these benefits is a matter for continued reform efforts but not in itself cause to conclude that science and technology have led humankind down the wrong path.

Nevertheless, as I seek to demonstrate, evidence of scientific and technological superiority has often been put to questionable use by Europeans and North Americans interested in non-Western peoples and cultures. It has prompted disdain for African and Asian accomplishments, buttressed critiques of non-Western value systems and modes of organization, and legitimized efforts to demonstrate the innate superiority of the white “race” over the black, red, brown, and yellow. The application of technological and scientific gauges of human potential has also vitally affected Western policies regarding education and technological diffusion which go far to explain the varying levels of underdevelopment in the Third World today.

The misuse of these standards has not only impeded and selectively channeled the spread of Western knowledge, skills, and machines; it has also undermined techniques of production and ways of thinking about the natural world indigenous to African and Asian societies. Concern for the decline of these alternatives is not simply a matter of relativistic affirmation of the need to preserve difference and heterogeneity. Their demise means the neglect or loss of values, understandings, and methods that might have enriched and modified the course of development dominated by Western science and technology. The possibilities of alternative systems are suggested, for example, by the recent Western recognition of the efficacy of Chinese acupuncture, as well as Indian, African, and Amerindian healing techniques. As we better understand the attitudes toward the environment and material acquisition that were fostered by non-Western philosophical and religious systems, we also begin to appreciate how they might have tempered the Western obsession with material mastery and its consequences: pollution, the squandering of finite resources, and the potential for global destruction. It is, I think, significant that a passage from the *Bhagavad-Gita* “floated through the mind” of the “father” of the atomic bomb, Robert Oppenheimer, as he witnessed the detonation of the first of these weapons: “I am become death, the shatterer of worlds.”¹³

¹³Quoted in Peter Goodchild, *J. Robert Oppenheimer: The Shatterer of Worlds* (Boston, 1981), p. 162.

Less arrogance and greater sensitivity to African and Asian thought systems, techniques of production, and patterns of social organization would also have enhanced the possibility of working out alternative approaches to development in non-Western areas, approaches that might have proved better suited to Third World societies than the scientific-industrial model in either its Western or its Soviet guise. At the very least, the first generations of Western-educated leaders in the newly independent states of Africa and Asia would have been more aware of the possibilities offered by their own cultures and less committed to full-scale industrialization, which most of them viewed as essential for social and economic reconstruction. The reappraisal in recent decades of Gandhian social and economic philosophy, which was long a favorite target for the sarcastic barbs of development specialists, reflects a growing recognition that the paths followed by western Europeans, North Americans, and the Soviets are not the only possible routes to national solvency and material well-being.¹⁴

¹⁴For an early defense of Gandhi's economic thinking, see Shiva Nand Jha, *A Critical Study of Gandhian Economic Thought* (Agra, 1955), esp. chap. 4. For later reappraisals, see A. K. N. Reddy, "Alternative Technology: A View from India," *Social Studies of Science* 5/3 (1975), 331–42; and Abdul Aziz, "Gandhian Economic System: Its Relevance to Contemporary India," in J. T. Patel, ed., *Studies on Gandhi* (New Delhi, 1983).



A Little Tea Party, a mid-nineteenth-century cartoon from the satirical magazine *Punch*, rather smugly expresses British pride in the most obvious manifestation of their technological superiority over the once mighty Chinese empire. (Reproduced by courtesy of the Trustees of the British Museum)

Global Hegemony and the Rise of Technology as the Main Measure of Human Achievement

THE RISE of the industrial order in western Europe was a good deal more gradual and cumulative than the standard combination of the terms “industrial” and “revolution” would suggest. In some sectors the forces that made steam-powered factory production possible had been building for centuries, and even in England traditional handicraft manufacturing predominated in most industries until the second half of the nineteenth century.¹ Nonetheless, from the 1780s in Britain there was an acceleration in the pace of invention and, perhaps even more critically, an increasing application of new inventions and earlier advances in engineering to mineral extraction, manufacturing, and transportation. This shift was noted before the end of the decade by such perceptive contemporary observers as Arthur Young, who, after witnessing the spread of steam-driven machines from the cotton to the woolen textile industry, declared that a “revolution was in the making” which would transform the “appearance of the civilized world.”² R. H.

¹For recent studies stressing the gradual and incremental development of industrial technology, see A. E. Musson, *The Growth of British Industry* (London, 1978), and G. N. von Tunzelmann, *Steam Power and British Industrialization* (Oxford, 1978), for England; see Clive Trebilcock, *The Industrialization of the Continental Powers, 1780–1914* (London, 1981), for continental Europe. This view was, of course, advanced decades ago by such authors as J. H. Clapham, Paul Mantoux, T. S. Ashton, and esp. J. U. Nef. Nef's extreme arguments for pushing back the beginnings of industrialization as far as the sixteenth century have received rough treatment at the hands of subsequent scholars. On the persistence of handicraft production, see Musson, *British Industry*, and the references in Chapter 2, n 22.

²Quoted in H. Heaton, “Industrial Revolution,” in R. M. Hartwell, ed., *The Causes of the Industrial Revolution* (London, 1967), p. 35.

Tawney's estimate that the early decades of industrialization brought about the most profound reshaping of the "material appearance" of England since the last geological upheavals rather dramatically underscores the degree to which Young's predictions were fulfilled.³

As industrialization spread both within England and to Belgium, the Rhineland, Saxony, and parts of France in the early decades of the nineteenth century, European travelers, missionaries, and colonial policymakers grew more and more sensitive to the fundamental differences that set their societies off from all others. They increasingly stressed Europe's uniqueness and invariably proclaimed its superiority to even the most advanced of its civilized rivals. Though by no means eschewing the sense of religious righteousness or the physical narcissism that had been the preeminent standards by which Europeans compared themselves with overseas peoples in the first centuries of expansion, European observers came to view science and especially technology as the most objective and unassailable measures of their own civilization's past achievement and present worth. In science and technology their superiority was readily demonstrable, and their advantages over other peoples grew at an ever increasing pace. This was particularly true after Europe and its North American progeny entered a new phase of industrial development based on steel, electrification, and chemical production in the last decades of the nineteenth century. Prominent social theorists and policymakers drew varying, often conflicting, conclusions from the undeniable fact of Europe's material mastery and its concomitant global hegemony, but few disputed that machines were the most reliable measure of humankind.

In the last two decades of the eighteenth century more patents were issued in Great Britain than had been granted for new inventions in all the preceding years of the century combined.⁴ The successful application of Watt's rotative steam engine to the spinning of yarn on rollers in 1785 and to Crompton's spinning "mule" in 1790 greatly facilitated the concentration of cotton textile production in factories and urban areas and vastly increased British output. Between 1782 and 1800, British

³Quoted in *ibid.*

⁴This overview of the first Industrial Revolution is based primarily on T. S. Ashton, *The Industrial Revolution, 1760–1830* (Oxford, 1948), and *An Economic History of England: The 18th Century* (London, 1966); Samuel Lilley, "Technological Progress and the Industrial Revolution, 1700–1914," in Carlo Cipolla, ed., *The Fontana Economic History of Europe* (Glasgow, 1974), vol. 3, pp. 187–255; Musson, *British Industry*; D. S. L. Cardwell, *Steampower in the Eighteenth Century* (London, 1963); Peter Mathias, *The First Industrial Nation* (New York, 1969); Phyllis Deane, *The First Industrial Revolution* (Cambridge, Eng., 1965); and David Landes, *The Unbound Prometheus* (Cambridge, Mass., 1969), chap. 2. Only additional sources or specific statistics are cited below.

broad cloth production grew by three-fourths, its printed cloth by four-fifths, and its cotton piece goods by nine-tenths. Between 1785 and 1822, overall British cotton textile production increased ten times. In 1783–84 Henry Cort developed the "puddling" and rolling process of iron production that allowed the substitution of coke, which Britain possessed in abundance, for charcoal, which centuries of deforestation for shipbuilding and manufacture had rendered a scarce resource. Cort's innovations also made it possible for the British to use their own lower grade of iron ore, rather than importing higher quality ore from the Baltic, and led to a dramatic increase in British iron production from an estimated 61,000 tons in 1788 to over 227,000 tons in 1806. In the decades following Cort's breakthrough, iron steadily replaced wood, leather, and stone in virtually all fields of technical endeavor from ship- and bridgebuilding to the manufacture of machines and farm implements. These substitutions made possible great increases in the scale of building and machine design. In the 1790s, for example, the first five- and six-story buildings, supported by iron frames, were constructed both in England and on the Continent.⁵

In this same period steampower was also applied to a wide range of industries from brewing and distilling to corn milling and papermaking. The multiplication of Watt's rotative engines alone provides a striking index of the quickening pace of change. The first engine was in operation by 1784; a decade later 150 were employed in a variety of industries; and just five years after that, more than 500 Watt engines were in use.⁶ In the last decades of the century in Britain and France, as well as across the Atlantic in the fledgling American republic, efforts were under way to harness the power generated by the increasingly efficient steam engine to transportation. After several failures the Marquis Jouffroy d'Abban's steam-driven vessel successfully navigated a short stretch of the river Saone near Lyons in 1783. Just over two decades later the American painter-turned-inventor Robert Fulton proved that paddle-driven steamboats could be commercially viable. Steamboats would not dominate oceanic shipping until decades later, but their potential to do so was established at the outset of the nineteenth century. In the same period attempts were made in France and England to apply steam power to land transport. Wooden rails had been in use in German and British mining and iron manufacturing areas since the sixteenth century, providing a more or less regular running surface for horse-drawn wagons, but the earliest experiments with steam-driven land transport were per-

⁵Carl W. Condit, "Building and Construction," in M. Kranzberg and C. Pursell, eds., *Technology in Western Civilization* (London, 1967), vol. 1, p. 368.

⁶Mathias, *First Industrial Nation*, p. 135; Ashton, *Industrial Revolution*, p. 70.

formed on ordinary streets and roadways. As early as 1769, a steam carriage trundled—briefly—through the streets of Paris. In the first years of the nineteenth century, Richard Trevithick achieved much greater success in a series of road trials in Cornwall and London which led to the introduction of the smokestack and a steam gauge. Trevithick's subsequent experiments with locomotives on cast-iron tramways inspired George Stephenson's "Rocket," which launched the railway age with its victory in the 1829 competition on the newly constructed Liverpool to Manchester tracks.

The coal- and steam-powered revolution in production, transportation, and extraction had been compressed into a remarkably brief span of three or four decades. These transformations were so rapid and fundamental relative to change in all preceding eras that only the most myopic or isolated of George III's subjects could remain unaware or unaffected. "The people of the day were not deceived by the pristine air of much of Britain's landscape," David Landes has observed. "They knew they had passed through a revolution."⁷ An 1808 article in *The Times*, for example, assumed that "the extraordinary effect of mechanical power" was "already known to the world" and that "the novelty, singularity and powerful application [of machines] against time and speed" had "created admiration in the minds of every scientific man." In 1815 Sir Richard Philips recounted how a walk through London had left him with vivid impressions of the "triumphs of mechanics" and "the precision and grandeur of action that was really sublime," a source of astonishment to every onlooker.⁸

In the mid-1830s the great essayist Thomas Babington Macaulay celebrated the uniqueness of this revolution and Britain's distinction in having initiated it. He confidently judged that the English were the "greatest and most highly civilized people that ever the world saw." In support of this sweeping assertion, Macaulay drew attention to Britain's vast empire and its powerful maritime fleet, which, he argued, could "annihilate in a quarter of an hour the [preindustrial] navies of Tyre, Athens, Carthage, Venice and Genoa together." He also stressed as proof of Britain's greatness the great advances that had been achieved in medicine, transportation, and "every mechanical art, every manufacture . . . to a perfection that our ancestors would have thought magical." In

⁷Landes, *Prometheus*, p. 122. For a fuller discussion of contemporary awareness of these changes, see Maxine Berg, *The Machinery Question and the Making of Political Economy, 1815–1848* (Cambridge, Eng., 1980), esp. pp. 9, 20.

⁸These reactions are recorded in the excerpts included in Humphrey Jennings, *Pandemonium, 1660–1886: The Coming of the Machine Age as Seen by Contemporary Observers* (New York, 1985), p. 128. For workers' and farmers' reactions, see pp. 235, 238.

an earlier essay he had boasted that the British were better fed and clothed than any people who had previously existed because of the great gains in wealth that industrialization had made possible.⁹ Though less exuberant than Macaulay and more sensitive to the adverse effects and potential dangers of industrialization, John Stuart Mill best expressed the sense of a large majority of the English middle class that machines had provided the means for the progressive improvement of humanity. In his *Principles of Political Economy*, first published in 1848, Mill also stressed the convergence of science and technology, which was of increasing importance as industrialization advanced and spread abroad:

Our knowledge of the properties and laws of physical objects shows no sign of approaching its ultimate boundaries: it is advancing more rapidly, and in a greater number of directions at once, than in any previous age or generation, and affording such frequent glimpses of unexplored fields beyond, as to justify the belief that our acquaintance with nature is still almost in infancy. This increasing physical knowledge is now, too, more rapidly than at any former period, converted, by practical ingenuity, into physical power. The most marvellous of modern inventions, one which realizes the imaginary feats of the magician, not metaphorically but literally—the electro-magnetic telegraph—sprang into existence but a few years after the establishment of the scientific theory which it realizes and exemplifies. Lastly, the manual part of these scientific operations is now never wanting to the intellectual: there is no difficulty in finding or forming, in a sufficient number of the working hands of the community, the skill requisite for executing the most delicate processes of the application of science to practical uses. From this union of conditions, it is impossible not to look forward to a vast multiplication and long succession of contrivances for economizing labour and increasing its produce; and to an ever wider diffusion of the use and benefit of these contrivances.¹⁰

Some Britons, of course, were a good deal less enthusiastic about the effects of industrialization. Critics as diverse as Robert Owen and William Blake, Charles Dickens and Elizabeth Gaskell drew attention to the pollution of the factory towns and the miserable condition of the workers whose ranks, particularly in textile mills, included a high proportion of women and children in the early industrial era.¹¹ Though

⁹Quoted in Walter E. Houghton, *The Victorian Frame of Mind* (New Haven, Conn., 1957), pp. 39–40.

¹⁰John Stuart Mill, *Principles of Political Economy* (London, 1909), pp. 696–97.
¹¹For a useful survey of literary responses to industrialization (which, however, ne-

some critics, particularly among the Tories, condemned machines themselves for blighting the English countryside and supplanting paternal ties with class hostility, many Tory intellectuals and radical reformers made a distinction between technological accomplishments and abuses caused by defects in the political and social systems into which machines were introduced. As Maxine Berg has shown, working-class spokesmen and radical intellectuals could both deplore the dislocations and suffering brought on by the "iron monster[s] with a pulse of steam" and promote machines "adapted to the needs of co-operative production" as essential elements in the workers' utopias they aspired to create. Even Owen and his disciples stressed the many ways in which mechanization could relieve workers, both male and female, from the drudgery of routine tasks, from sawing and grinding to cooking and washing clothes.¹²

Thomas Carlyle, one of the most influential Tory critics of industrialization, displayed a similar ambivalence. He decried the degradation of the industrial laboring classes and the filth of the mining and industrial towns without abandoning faith in the potential of the new machines that had produced them. He despised the factory organization that reduced workers from skilled artisans to appendages of machines, but he eschewed "criticism of industry as such." Carlyle delighted in Britain's "industrial animation," which he believed could, with proper supervision and a different form of organization, give rise to a society in which labor was vastly more productive and fulfilling than in any that had preceded it. His impulses to retreat into the Middle Ages or the seventeenth century were balanced by an "equally idealistic and often imperialistic faith in British industrialism, progress and labor."¹³ Carlyle chided those who could see only "smoke and dust," "tumult and contentious squalor," in the great industrial centers such as Manchester. In his 1839 essay "Chartism" he urged his numerous readers to look beneath the surface ugliness of the industrial landscape in order to exult with him in the awesome precision and power, the triumph of man over

glects the fine novels of Elizabeth Gaskell), see Herbert Sussman, *The Victorians and the Machine: The Literary Response to Technology* (Cambridge, Mass., 1968). For early debates over the effects of industrialization, see Gertrude Himmelfarb, *The Idea of Poverty: England in the Early Industrial Age* (New York, 1984); and Berg, *Machinery Question*. For sample contemporary criticisms of industrialization, see Jennings, *Pandæmonium*, pp. 145–46, 165–66, 171–72, 233–35, 273, 319.

¹²Berg, *Machinery Question*, pp. 271–74, 279–81 (quoted portions, pp. 270, 271).

¹³Albert J. LaValley, *Carlyle and the Idea of the Modern* (New York, 1968), pp. 185, 203–8 (quoted portions pp. 203, 205). For an earlier and more typical handling of Carlyle's views on industry, which nonetheless concedes his faith in the potential of the new technology, see Frederick W. Roe, *The Social Philosophy of Carlyle and Ruskin* (New York, 1921), esp. pp. 48–70, 88–89, 107, 118–19.

nature, that the factories represented. He insisted that "a precious substance, beautiful as magic dreams, and yet no dream but a reality, lies hidden in that noisome wrappage; a wrappage struggling indeed . . . to cast itself off, and leave the beauty free and visible there."¹⁴

A decade later the popular novelist Charles Kingsley gave a teleological twist to the British celebration of their industrial achievements. The hearts of his middle-class readers must have swelled with pride as they read the passage in which Lancelot Smith, the spirited protagonist of Kingsley's best-selling novel *Yeast*, dismisses his Catholic cousin's "Romish Sanctity" and extolls the virtues of his own English "Civilization." Deriding the meager achievements of centuries dominated by saints and Jesuits, Smith champions "the political economist, the sanitary reformer [and] the engineer," who invented, repair, and run the machines—"spinning jenny and the railroad, Cunard's liners and the electric telegraph"—which he sees as the surest signs of Britain's power and greatness. His impromptu discourse builds to a remarkable rhetorical finale that expresses sentiments shared by Britons at all social levels in this era. Smith informs his abject cousin that the technological advances of the British are "signs that we are, on some points at least, in harmony with the universe; that there is a mighty spirit working among us, who cannot be your anarchic and destroying Devil, and therefore must be the Ordering and Creating God."¹⁵ Kingsley's novel proved a fitting prelude to the Great Exhibition in Hyde Park two years later, which provided an occasion for the British to congratulate themselves on their truly remarkable material accomplishments and to impress their European and American rivals, as well as their colonial subjects, with the commanding lead they enjoyed in most aspects of technological development.

Although widespread industrialization in France occurred at a later date than in England, French thinkers and inventors had for centuries played leading roles in Europe's scientific and technological advance.¹⁶ In the late seventeenth century the Académie des Sciences had commit-

¹⁴Thomas Carlyle, "Chartism," in *English and Other Critical Essays* (London, 1925), p. 219.

¹⁵Charles Kingsley, *Yeast* (London, 1849), pp. 77–78. Another clergyman, John Cumming, in *The Great Tribulation* (London, 1859), pp. 295–96, dubbed the scientific and industrial revolutions "a grand regenesis."

¹⁶Trebilcock's *Industrialization of the Continental Powers* includes an excellent synthesis of recent work on French industrialization. In numerous essays F. Crouzet has explored the formulative decades of French mechanization from a variety of perspectives. His work can be supplemented by the more general works of Rondo Cameron, C. Fohlen, and Charles Ballot.

ted itself by statute to the search for practical applications of its scientific investigations. The French led all other peoples in the systemization and institutionalization of the study of science. They were the first to establish government agencies to oversee civil engineering projects, an advanced school of engineering (*l'Ecole des Ponts et Chaussées*, founded in 1747), and a technical college (*l'Ecole Polytechnique*, founded in 1794).¹⁷ French artisan-engineers such as J. M. Jacquard, who devised major improvements in the draw loom, and Jacques de Vaucanson, who made major contributions to machine development from lathes to looms, belie the stereotype of the French as theoreticians rather than inventors. As we have seen, the French pioneered efforts to apply steam power to land and water transport. French scientists such as Nicolas Leblanc, who founded the soda industry, and Claude Louis Berthollet, who developed chlorine for bleaching and thereby broke one of the main bottlenecks in textile manufacture, also advanced the process of industrialization.

However wide of the mark Louis Jaucourt's predictions, in his articles on manufacturing in the *Encyclopédie*, that factory production could never withstand competition from handicraft producers,¹⁸ many French intellectuals displayed an avid interest in new inventions and a strong awareness of the changes they were setting in motion. Denis Diderot, editor of the *Encyclopédie*, prided himself on frequent visits to the "ablest craftsmen" in France.¹⁹ And though some of the plates in the supplementary volumes to the *Encyclopédie* were dated or lifted from previous publications,²⁰ the production of eleven volumes of exquisitely rendered and expensive illustrations of tools and techniques is itself ample testimony to the great interest in technology among the educated classes in late eighteenth-century France.

The works of such writers as Condorcet and Julien Virey indicate an early and acute sensitivity to the roles of science and technology in long-term historical transformations. Characteristically, they continued to stress the importance of science, perhaps more than their British counterparts did, but to a much greater degree than writers earlier in the century they linked science and technology as historical forces. In the successive editions of his *Histoire naturelle de genre humaine*, Virey extolled discoveries in the sciences as the "true lever of power for man" and argued that experiment and invention were the true source of Eu-

¹⁷For discussions of these developments, see Rondo Cameron, *France and the Economic Development of Europe, 1800–1914* (Princeton, N.J., 1961), pp. 34–43; and G. Pinet, *Histoire de l'Ecole Polytechnique* (Paris, 1887).

¹⁸John Lough, *The Encyclopédie* (New York, 1971), pp. 360–62.

¹⁹Peter Gay, *The Enlightenment* (London, 1979), vol. 2, pp. 252–53.

²⁰Lough, *Encyclopédie*, pp. 85–91.

rope's recently won dominance over nature and all other peoples. In a characteristic passage he marveled at the way in which so simple a device as a compass ("une petite aiguille aimantée, placée sur un pivot") had made possible the discovery of unknown worlds, which in turn had brought Europe vastly greater wealth than all of the "Romans' pillaging." Likewise, he argued, the elementary chemical mixture that produced gunpowder made possible Europe's emergence as a global power able to draw tribute from "the most opulent nations."²¹ Virey's contemporary B. G. E. Delaville Lacépède included a lengthy paean to European discoveries in science and technology in his continuation of Buffon's monumental *Histoire naturelle de l'homme*. Lacépède saw these achievements as clear proof of his claim that the civilizations fringing the Mediterranean, and especially those that had arisen in Europe, represented the height of human accomplishment and the most nearly perfect episodes in human history.²²

By the middle decades of the nineteenth century, the industrializing nations of western Europe and North America had greatly enhanced the advantages in the mastery of the material world which they had gained centuries earlier over all other societies. In the last decades of the century a new "cluster of innovations" launched a second wave of industrialization which increased Europe's superiority exponentially in virtually all fields of science and technology. Henry Bessemer's experiments in the 1850s with new ways of firing pig iron and the improvements made by Frederick Siemens and the Martin brothers in the following years made possible the manufacture of cheap and abundant steel. With the opening of the Suez Canal in 1869, oceangoing steamships soon eclipsed sailing vessels in global commerce and travel. The development of internal combustion engines in the last decades of the century led to the substitution of oil for coal as a source of energy, particularly for transportation. In the decades before the Great War, diesel and petrol engines enabled Europeans to travel at even greater speeds on land and sea. Electricity supplied yet another new source of power for the second Industrial Revolution. Innovations in production design and factory organization, increases in plant scale and both vertical and horizontal integration within and between industries, and remarkable advances in precision instrumentation and machine-tooling were also hallmarks of the new era. The new wave of inventions and improvements in the organization of production spawned in turn a rapid proliferation of durable consumer

²¹Julien Virey, *Histoire naturelle de genre humaine* (Paris, 1826), pp. xxii–xxiv.

²²B. G. E. Delaville Lacépède, *Histoire naturelle de l'homme* (Paris, 1827), pp. 294–96, 304–20.

goods in the last decades of the century.²³ Perhaps even more than steel mills or power plants, machine-made draperies and carpets and vacuum cleaners (introduced in the 1850s and 1860s), telephones, cash registers, and typewriters (first marketed in the 1870s), and sewing machines and bicycles made the average citizen of western European and North American societies aware of the extent of the transformations that were under way.

The greatest gains from the second Industrial Revolution were achieved in emerging rather than established industrial centers. The entrepreneurs and engineers of Germany and the United States were less committed to obsolescent techniques and physical plants than those of Great Britain and thus better positioned to exploit new power sources and modes of production. Both follower nations had surpassed Great Britain in electrification, steel production, and machine-tooling well before the Great War. Both nations, but especially Germany, made extensive use of scientific expertise in industrial development. By the last decades of the century, large staffs of scientists and advanced laboratories were integral parts of major industrial firms. The knowledge and experimental techniques of chemists and other scientists were essential to the growth of the synthetic dye industry, which the Germans pioneered in the late nineteenth century. The Germans and French also solidified the links between science and industrial production through the establishment of a network of state-supported polytechnical schools—a pattern that the British adopted only belatedly and for the most part grudgingly.²⁴ The connections between science and technology—which had significantly increased but remained sporadic, individualistic, and informal during the first Industrial Revolution, were institutionalized and professionalized in the second. By century's end, science and technology had become “mirror-image twins”: one oriented to experiment, theory, and knowing; the other to application, design, and doing; but both joined in a systematic endeavor to uncover the secrets and harness the energies of the natural world.²⁵

²³The fullest study of the consumer side of the Industrial Revolution remains Siegfried Giedeon, *Mechanization Takes Command* (Oxford, 1948). See also Carroll J. Pursell, Jr., “Machines and Machine Tools, 1830–1880,” in Kranzberg and Pursell, *Technology*, pp. 396–404; and Stephen Kern, *The Culture of Time and Space* (Cambridge, Mass., 1983), esp. chap. 5.

²⁴The most detailed study of technical education, focusing on England but making frequent comparisons with continental Europe, is D. S. L. Cardwell, *The Organisation of Science in England* (London, 1972).

²⁵Lilley, “Technological Progress,” pp. 235–42; Peter Mathias, *The Transformation of England* (London, 1979), pp. 79–86; Cardwell, *Organisation of Science*, pp. 13–18, 22–28; D. S. L. Cardwell, *Technology, Science, and History* (London, 1972), pp. 215–18; Edwin Layton, “Mirror-Image Twins: The Communities of Science and Technology in 19th-Century America,” *Technology and Culture* 12/4 (1971), 562–80.

As industry spread, locomotives increased in speed and comfort, inventions multiplied, and European scientists probed ever more deeply into the workings of nature, Europeans translated their material superiority into global hegemony. Industrialized nations—first Great Britain and later France, Germany, and the United States—flooded African and Asian markets with cheap machine-made consumer goods, ranging from cotton textiles to kerosene lamps. The great advances in weapons design and production that accompanied the process of industrialization permitted the Europeans to subdue forcibly any overseas peoples who resisted their efforts to trade, convert, or explore. When combined with military forces which, well before the Industrial Revolution, had achieved clear superiority in discipline and organization, mass-produced weapons, railway and telegraph lines, and iron-clad steamships made it possible for the Europeans to conquer and rule directly—or defeat and control through indigenous surrogates—virtually all African and Asian peoples.²⁶ Each year between 1871 and 1914 the European imperialist powers added an area the size of France to their empires.

But it was not the conquests themselves that most impressed European observers (victory had become rather routine, despite temporary reverses such as those the French suffered in the 1880s in Vietnam); it was the relatively low cost and the growing ease of colonial conquest. Though only small forces and not always the most advanced weapons were committed to colonial wars, conflict with the Europeans meant that African warriors or the banner armies of China were subjected, as D. A. Low points out, to “vastly greater, more lethal demonstrations of force than any which [they] had experienced from any quarter in the past.”²⁷ An operation such as the destruction of large flotillas of Chinese war junks by small squadrons of British men-of-war or the annihilation of thousands of determined Mahdist warriors at Omdurman served to bolster the consensus among European thinkers, politicians, and colonial administrators that they had earned the right (and duty) to be the “lords of humankind.”

As the evidence of their material achievement multiplied and per-

²⁶The military dimensions of European technological superiority have received more attention than any other. The best cross-cultural analysis can be found in William H. McNeill, *The Pursuit of Power* (Chicago, 1982). For Europe’s “splendid little wars” in the nineteenth century, see William McElwee, *The Art of War: Waterloo to Mons* (Bloomington, Ind., 1974), esp. chaps. 3 and 7. On the broader technological and scientific dimensions of European global conquest in the nineteenth century, see Daniel R. Headrick, *The Tools of Empire* (New York, 1981), and *The Tentacles of Progress* (New York, 1988); and William Woodruff’s *Impact of Western Man* (New York, 1967), esp. chaps. 5 and 6.

²⁷Quoted in Terrence Ranger, “Connections between ‘Primary Resistance’ Movements and Modern Mass Nationalism in East and Central Africa,” *Journal of African History* 9/4, pt. 1 (1968), 440.

vaded all aspects of life in industrializing societies, Europeans and (increasingly) Americans grew more and more conscious of the uniqueness and, they believed, the superiority of Western civilization. Those involved in the colonies and intellectuals who dealt with colonial issues came to view scientific and technological achievements not only as the key attributes that set Europe off from all other civilizations, past and present, but as the most meaningful gauges by which non-Western societies might be evaluated, classified, and ranked. Science and technology were often conflated as criteria for comparison, rather than treated as distinct endeavors, as they had tended to be in earlier centuries. In addition, generalized assertions of superiority or inferiority supplanted the detailed descriptions of individual tools or particular ideas which had been characteristic of earlier accounts of overseas cultures. This shift reflected a growing sense on the part of overseas observers that African and Asian peoples had little to offer Europe in techniques of production and extraction or in insights into the workings of the natural world. Increasingly industrialized European (and North American) cultures as a whole were seen to be a separate class, distinct from all others. The polarities were numerous and obvious: metal versus wood; machine versus human or animal power; science versus superstition and myth; synthetic versus organic; progressive versus stagnant. All aspects of culture could be linked to these polarities, to the fundamental dichotomy between industrial and preindustrial societies. Beggars, for example, who had once wandered in great bands throughout France and England and whose sparse numbers in China and Africa had once been noted with approbation by European observers, now scandalized visitors to the "Orient" and the "Dark Continent." As numerous travelers recounted on arriving in a non-Western port (which increasingly meant a colonized area), the very tempo of speech and motion slowed noticeably, and even the spatial arrangement of the material environment altered disconcertingly.

Most nineteenth-century observers mixed nontechnological or non-scientific gauges—systems of government, ethical codes, treatment of women, religious practices, and so on—with assessments of African and Asian material mastery. As the century passed, however, colonial administrators and missionaries, travelers and social commentators increasingly stressed technological and scientific standards as the most reliable basis for comparisons between societies and civilizations. In an age when what were held to be "scientific" proofs were increasingly demanded of those engaged in the study of natural history and social development, material achievement and anatomical measurements proved irresistible gauges of human capacity and worth. Mechanical

principles and mathematical propositions could be tested; bridges, machines, and head sizes could be measured and rated for efficiency. Thus, unlike earlier gauges by which the Europeans compared societies, those favored in the nineteenth century were believed to be amenable to empirical verification and were especially suited to the late Victorian penchant for "statistical reductiveness."²⁸

Improved and cheaper techniques for mass printing, advances in graphics and statistical enumeration, and (from the middle of the century) developments in photography all reinforced the preference for evaluative criteria that were tangible and testable. Empirical observation and "objective" evaluation appeared to elevate comparisons between Europeans and African and Asian peoples to the realm of "demonstrated truths," which John Seeley—one of the great champions of late nineteenth-century British imperial expansion—viewed as the main source of the greatness of Western civilization. Contrary to widely accepted contemporary assumptions, Seeley suggested that British superiority over Indians and other subject peoples did not arise from larger brains or cleverer ideas. British dominance, Seeley argued, was based on ideas that were "better tested and sounder."²⁹ Some decades earlier an aside by Gustave d'Eichthal, a disciple of the famed French sociologist August Comte, had provided an even more striking example of the degree to which nineteenth-century thinkers were convinced that empirical testing had advanced the reliability of the standards by which they ranked humankind. D'Eichthal observed that even if one disregarded the physical appearance of blacks—in itself enough to indicate that they were a "different sort of humanity" from whites—the division between the two races could not be contested, because it had been "scientifically demonstrated" since the end of the eighteenth century.³⁰ The belief that European views of non-Western peoples were grounded in scientific investigation was popularized in the last decades of the nineteenth century by such writers as Winwood Reade. In his suitably lurid *Savage Africa*, Reade admitted that he found it difficult to resist those who argued for African inferiority because it was futile to "struggle against the sacred facts of science."³¹

Because nineteenth-century Europeans believed that machines, skull size, or ideas about the configuration of the solar system were culturally

²⁸On this propensity, see Richard D. Altick, *Victorian Peoples and Ideas* (New York, 1973), pp. 244–45.

²⁹John Seeley, *The Expansion of England* (Chicago, 1971), p. 193.

³⁰Gustave d'Eichthal and Ismail Urbain, *Lettres sur la race noire et la race blanche* (Paris, 1839), p. 2.

³¹Winwood Reade, *Savage Africa* (London, 1863), pp. 508–9.

neutral facts, evaluative criteria based on science and technology appeared to be the least tainted by subjective bias. Blatantly narcissistic gauges of the worth of non-European peoples—skin color, fashions in or lack of clothing—receded in importance; measurements of cranial capacity, estimates of railway mileage, and the capacity for work, discipline, and marking time became the decisive criteria by which Europeans judged other cultures and celebrated the superiority of their own. The fact that these criteria were as culturebound as earlier gauges and even more loaded in favor of the industrializing West was grasped by only a handful of intellectuals, who continued to value the achievements of non-Western peoples and lament the erosion or utter disappearance of African and Asian ideas, customs, and institutions in an age of European global dominance.

As Martin Weiner has demonstrated, more than a handful of British intellectuals regretted the passing of an idealized rural England.³² Tory and radical critiques of the filthy factory districts and miserable workers' slums—familiar features of industrialization in what Lewis Mumford has termed the paleotechnic phase—grew into a broad-based anticapitalist and anti-industrial backlash in the late nineteenth and early twentieth centuries. A gentlemanly, aristocratic amateur ideal was championed in a struggle against the ascendancy of a profit- and productivity-obsessed elite of industrialists, financiers, and technicians. But this assault on William Blake's "dark Satanic Mills" and the values of the capitalist entrepreneur was for the most part a domestic campaign. Weiner's contention that "Imperialists and 'patriotic' writers [in the late nineteenth century] rarely saw industrial progress as an appropriate source of inspiration"³³ is at odds with the frequent invocation in this period of technological and scientific proofs of British superiority. These were used to explain how Britain had gained its place of world dominance and to justify the manner in which it ruled vast populations of non-European peoples around the globe. The tensions of "Janus-faced" industrial Britain longing for its village, artisan past were intensified by a clear recognition, even on the part of those of aristocratic birth who found refuge in imperial administration in the late nineteenth century,³⁴

³²Martin Weiner, *English Culture and the Decline of the Industrial Spirit* (Cambridge, Eng., 1981). Some of the authors and themes discussed by Weiner are also considered in Raymond Williams, *The Country and the City* (New York, 1973); and Sussman, *Victorians and the Machine*.

³³Weiner, *English Culture*, p. 55.

³⁴Francis Hutchins, *The Illusion of Permanence: British Imperialism in India* (Princeton, N.J., 1967), esp. pp. 124–36 and chap. 9.

that the advantages the British had gained as a result of the scientific and industrial revolutions were essential to the growth and maintenance of Britain's imperial order.

Perhaps no more striking illustration of the importance of technological superiority as a justification for imperial dominance can be found than in Mary Kingsley's recollection of the sense of pride and reassurance that Britain's industrial technology gave her as she explored the rainforests and savannas of west Africa. Kingsley was one of the most intrepid and independent-minded of nineteenth-century travelers, and her works are studied today mainly because of her sincere and, at the time, rather rare admiration for African beliefs and customs. Yet however strong her defense of African peoples and cultures, she made no secret of her conviction that the British were superior and that technological accomplishment was the best test of their superiority:

All I can say is, that when I come back from a spell in Africa, the thing that makes me proud of being one of the English is not the manners or customs up here, certainly not the houses or the climate; but it is the thing embodied in a great railway engine. I once came home on a ship with an Englishman who had been in South West Africa for seven unbroken years; he was sane, and in his right mind. But no sooner did we get ashore at Liverpool, than he rushed at and threw his arms round a postman, to that official's embarrassment and surprise. Well, that is just how I feel about the first magnificent bit of machinery I come across: it is the manifestation of the superiority of my race.³⁵

The apparent contradiction between Weiner's vision of a rising tide of anti-industrial criticism in the late nineteenth century and the predominance of scientific and technological standards as gauges of levels of human achievement in this era can in part be resolved by distinguishing between technology per se and industrialization in its capitalist guise. Much of the hostility to industrialism which Weiner so ably explores was aimed at excessive commercialism, unbridled competition, and change as an end in itself. Few of the critics of industrialization sought to deny that the British had displayed a remarkable capacity for invention and scientific investigation. The traditions of the gentleman scientist and inventor as part-time tinkerer were quite consistent with a "gentrified," intellectual, and entrepreneurial elite. In giving the world both the Newtonian and industrial revolutions, the British demonstrated beyond all doubt that they could excel in scientific inquiry and invention. Even

³⁵Mary Kingsley, *West African Studies* (London, 1901), pp. 329–30.

the craft techniques and tools that such implacable critics of industrialization as William Morris and John Ruskin worked to preserve or restore had been used in earlier centuries as a gauge of European superiority in the "arts" over non-Western peoples. In the anticapitalist, anti-industrial utopia that Morris created in his 1891 *News from Nowhere*, all manner of machines were available, but his utopians used only those they found "handy" and ignored those that seemed unnecessary.³⁶ Thus, despite recurring depressions, England's eclipse as the leading industrial power by Germany and the United States, and a growing sense of the perils of unlimited mechanization, numerous late-Victorian authors exulted in Britain's scientific acumen and inventive genius.

Many of those who saw scientific and industrial achievements as the best proof of British "racial" or national superiority had little use for the aesthetic misgivings of Ruskin or for Morris's socialist critiques. As Weiner points out, few Englishmen fought the antiscientific, antitechnical trend among the public school elite more fiercely than Frederic Farrar, headmaster at Harrow and later at Marlborough.³⁷ But Farrar not only berated those who thought that scientific learning was not essential for the education of a gentleman; he viewed invention and scientific discovery as the best tests of the "aptitudes of races." In his 1867 essay of that title, he systematically dismissed all claims of non-European contributions in these areas. He argued that the Semites and the Aryans were the only races that had created "true" civilizations and that they had been responsible for "every noble discovery, every thought and influence that has enabled and purified the white race."³⁸ Farrar contrasted the vigor and progressive advance of European civilization with the savagery of Africa and the "stolid unprogressiveness of the Mongol." Though he attributed all civilized development to the Aryans and Semites, he gave particular stress to advances in science and technology as irrefutable proof of the superiority of these races over all others. Thus, though he may have had a difficult time convincing other headmasters to include more science in their curricula, Dean Farrar did much to propagate these gauges of human worth among several generations of public school boys who went on to dominate English politics and run the overseas empire.

Alfred Russel Wallace, who shared with Darwin the distinction of originating the theory of evolution by natural selection, outdid even Farrar in his unqualified praise for the blessings of industrialization. In

³⁶William Morris, *News from Nowhere* (London, 1970), p. 146.

³⁷Weiner, *English Culture*, p. 19.

³⁸Frederic Farrar, "Aptitudes of the Races," *Transactions of the Ethnological Society of London* (hereafter T.E.S.L.) 5 (1867), 125.

his 1899 postmortem on the Victorian era, fittingly entitled *The Wonderful Century*, Wallace calculated that there had been only seven inventions of the "first rank" in all the centuries before 1800. The great minds of the nineteenth century he reckoned had produced thirteen, and he sought to capture his countrymen's unqualified pride in these accomplishments: "We men of the nineteenth century have not been slow to praise it. The wise and the foolish, the learned and the unlearned, the poet and the pressman, the rich and the poor, alike swell the chorus of admiration for the marvelous inventions and discoveries of our own age, and especially for those innumerable applications of science which now form part of our daily life, and which remind us every hour of our immense superiority over our comparatively ignorant forefathers."³⁹ In Wallace's view, the anti-industrial barbs of the Ruskins and Morrises had had little influence on most of their countrymen.

Even those who expressed doubts about the effects of industrialization and capitalism on British society tended to set Britain and Europe more generally apart from non-Western cultures on the basis of the unparalleled advances the former had made in material culture. Walter Bagehot, for example, might deplore the "rough and vulgar structure of English commerce,"⁴⁰ but in his best known work, *Physics and Politics*, he set Europe off from the rest of the globe as a sort of industrialized Middle Kingdom: "The miscellaneous races of the world [can] be justly described as being upon the various edges of industrial civilization, approaching it from various sides, and falling short of it in various particulars."⁴¹ Bagehot contrasted Europe—where "habitual instructors," "ordinary conversation," and "inevitable and ineradicable prejudices" joined forces to make progress a "normal fact in human society"—to Oriental and "savage" societies that had no conception of progressive change. He reasoned that the inability of the Indians to appreciate fully the "blessings" conferred by British rule arose from their rigid adherence to custom and an "old feeling" of "fixity" which clashed sharply with the Englishman's "modern feeling," rooted in a commitment to social improvement and economic growth.⁴²

Benjamin Kidd, whose best-selling *Social Evolution* disseminated his

³⁹Alfred Russel Wallace, *The Wonderful Century* (New York, 1899), p. 1.

⁴⁰Walter Bagehot, quoted in Weiner, *English Culture*, p. 137.

⁴¹Walter Bagehot, *Physics and Politics* (London, 1872), p. 16.

⁴²Ibid., pp. 156–57; and Bagehot, "Physics and Politics," pt. 2, *Fortnightly Review*, n.s. 3 (1868), 433, 452. Similar views were shared by Henry Maine and John Crawfurd. See John Burrow, *Evolution and Society: A Study in Victorian Social Theory* (Cambridge, Eng., 1966), p. 159 (on Maine), and Crawfurd, "On the Physical and Mental Characteristics of the European and Asiatic Races of Man," *T.E.S.L.* 5 (1867), 73.

ideas even more widely than Bagehot's had spread, shared the fears for Britain of many late Victorians in a world of growing competition for markets and resources. Nonetheless, Kidd began his work with a eulogy to the scientific and mechanical advances of the industrial age. Following a fairly standard catalogue of inventions and discoveries, he proclaimed that the best was yet to come. Even the tremendous achievements of the past, he declared, were "destined to be eclipsed at no distant date" by the efforts of the "vigorous and virile" Anglo-Saxons who had been responsible for the Industrial Revolution. Even though Kidd believed that Europe's distinctiveness as a civilization was rooted in its Christian foundations, he repeatedly fell back on evidence of material accomplishment to illustrate the great differences separating Europeans from all contemporary peoples, as well as those who had built civilizations in the past. He concluded that the contrasts between Europeans and the rest of humankind were most readily apparent "in the great advances which have been made in the arts of life, in trade, in manufactures, and commerce, in the practical appliances of science, and the means of communication."⁴³

Although his arguments were a good deal more defensive than Kidd's, A. H. Keane displayed the same concern to affirm the superiority of the Anglo-Saxon or English "race" in scientific exploration and technological innovation. After a series of pithy caricatures of the other peoples of the globe, he launched into an effusive tribute to England's accomplishments. Beginning with allusions to Shakespeare and other English "greats" in the literary and artistic realm, Keane moved quickly to an extensive listing of English discoveries in chemistry, physics, mechanics, engineering, and the natural sciences. He indignantly rebutted the notion (perhaps suggested by an envious Frenchman?) that the English were "dull" by again supplying a long list of scientific and inventive geniuses from Newton and Priestly to Faraday and Edison. (His inclusion of Edison reflected his view that Americans could be classified as Anglo-Saxon, though he apparently excluded the other main rival of the English, the Germans, from this select category—or at least the German peasants, whom he characterized as "heavy, dull and superstitious.") Keane concluded that the Anglo-Saxons were the best strain of the best race, the Caucasian, and vehemently rejected the contention that the main English contribution to scientific and technological advance had consisted of their improvements on French inventions. He dismissed the French as a people of inferior racial stock. "For one Frenchman," he declared, "it would be easy to produce ten or a dozen English and American inventors."⁴⁴

⁴³Benjamin Kidd, *Social Evolution* (London, 1894), pp. 6–7, 45, 120–21.

⁴⁴A. H. Keane, *The World's Peoples* (London, 1908), esp. pp. 341, 379–80.

Even those who questioned the validity of science and technology as gauges of human worth admitted that they had dominated British attitudes toward colonized peoples. Though Rudyard Kipling retreated late in life into a rural refuge free of telephones and other modern contrivances, for decades his stories and poems had celebrated the technical skills, assertiveness, and commitment to hard work that had made the British rulers of more than a quarter of the globe. However much he might deplore the fact, C. F. G. Masterman could not deny that British imperialists had long equated physical power and sheer size with greatness and had "neglected and despised the ancient pieties of an older England."⁴⁵ Even Dean William Inge, who emerged as one of the leading critics of England's industrial order in the first decades of the twentieth century,⁴⁶ readily acknowledged that nineteenth-century Englishmen routinely equated material achievement with civilized advance. Writing in the shambles that the Great War had made of European societies, Inge mused on the Victorians' reasoning that if they could travel sixty miles per hour by train, they must be five times more civilized than non-Europeans who could do at best twelve miles per hour by nonmechanized transport.⁴⁷

The current of hostility to industry and capitalist values was stronger in France than in England, so much so that some economic historians have seen these attitudes and the French attachment to handicraft production as major reasons for France's late industrialization relative to its cross-Channel rival.⁴⁸ France's slower and less extensive industrialization may also account for the fact that most French writers adhered more than the invention-conscious British to the eighteenth-century preference for scientific rather than technological gauges of human worth, though the two were often blended. Gustave Le Bon and Arthur de Gobineau, for example, who did much to shape nineteenth-century thinking on racism and attitudes toward non-Western cultures, found much to criticize in industrial Europe. But both viewed peoples of European stock as racially superior to all others and cited the white or Aryan race's achievements in science and, to a lesser extent, technology as clear proof of the high level of civilization it had attained. Gobineau

⁴⁵For Kipling's and Masterman's anti-industrial sentiments, see Weiner, *English Culture*, pp. 59–60. For Kipling's celebration of capitalist and industrial values as the key to Europe's "civilizing mission," see below, Chapter 4.

⁴⁶Weiner, *English Culture*, pp. 111–13.

⁴⁷William Inge, *Outspoken Essays* (London, 1922), p. 162.

⁴⁸For a general discussion of these currents in revolutionary and postrevolutionary France, see Trebilcock, *Industrialization of the Continental Powers*, pp. 136–39. For a critical appraisal of this line of argument, at least for the prerevolutionary era, see François Crouzet, "England and France in the Eighteenth Century: A Comparative Analysis," in R. M. Hartwell, ed., *The Causes of the Industrial Revolution* (London, 1967), pp. 139–74, esp. 157–70.

found the Europe of his day clearly inferior to ancient Greece and Egypt and even India in artistic production but argued that Europe had been responsible for virtually all important breakthroughs in the sciences. Though he acknowledged Europe's technological advances and advantages, he believed that the Europeans' capacity for discerning underlying principles and developing general theories was more critical than the inventions themselves. Like Farrar, he contended that Europeans had been responsible for all civilized development. Even India and China, which Gobineau included in his list of ten "true" civilizations, had advanced to that level because of the ideas and skills transmitted by Aryan invaders.⁴⁹ Le Bon also doubted that the "age of steam and electricity" was one in which the arts had peaked, but he was firmly convinced that the racial genius and superiority of Western peoples had been indisputably demonstrated by their scientific discoveries and unmatched inventiveness.⁵⁰

By no means all late nineteenth-century writers felt the need to qualify their praise for France's industrial growth. The novelist and essayist Edmond About, for example, contrasted the slow pace of change and resistance to new technology in earlier civilizations with the recognition accorded to scientists and inventors in European society. He believed that the status and material rewards gained by achievers in these fields, as well as the competition and interaction between scientists of different nations, were the keys to the progress that he felt set Europe off from all other civilizations.⁵¹ Decades later the journalist Pierre Mille wryly summed up the importance that generations of Frenchmen had ascribed to material advance as the standard by which to judge a society's level of development. He observed that his countrymen generally accepted the notion that the indisputable superiority of European mental capacity over that of all other races had been clearly demonstrated by European scientific discoveries and their application to production, war, and communications.⁵²

In the late eighteenth century and the first decades of the nineteenth, an awareness of European material mastery was confined to small numbers of educated travelers, colonial administrators, social theorists, and missionaries. As the pace of scientific discovery and technological innova-

⁴⁹ Arthur de Gobineau, *Essai sur l'inégalité des races humaines* (Paris, 1853), vol. 1, pp. 172, 264–65, 360ff; vol. 2, pp. 11, 349–52.

⁵⁰ Gustave Le Bon, *Les civilisations de l'Inde* (Paris, 1887), esp. pp. 550–52. See also Robert Nye, *The Origins of Crowd Psychology: Gustave Le Bon and the Crisis of Mass Democracy in the Third Republic* (Beverly Hills, Calif., 1975), pp. 43–45.

⁵¹ Edward About, *Le progrès* (Paris, 1864), pp. 34–38.

⁵² Pierre Mille, "La race supérieure," *Revue de Paris* 1 (1905), 820–21.

vation quickened in Europe and North America, while societies in other areas appeared to stagnate or break down, growing numbers of writers sought to determine the causes of Europe's unique transformation and the meaning of what they viewed as the failure of non-European peoples to initiate their own scientific and industrial revolutions. Through romantic novels or adventure stories, and especially in the popular press, the conclusions of phrenologists, social theorists, ethnographers, and storytellers such as Rudyard Kipling and Pierre Loti were disseminated widely among the middle and literate working classes.⁵³ Often corrupted and vulgarized, invariably oversimplified and sensationalized, these ideas have played a major role from the nineteenth century to the present in shaping popular attitudes in Europe and North America toward African and Asian peoples and cultures. Notions of white supremacy and racial superiority, jingoistic slogans for imperialist expansion, and the vision of a dichotomous world divided between the progressive and the backward have all been rooted in the conclusions drawn by nineteenth-century thinkers from the fact that only peoples of European stock had initiated and carried through the scientific and industrial revolutions.

Africa: Primitive Tools and the Savage Mind

In contrast to the civilizations of India, China, and Islam, which most writers conceded had made significant contributions to scientific inquiry and technological development early in their histories, African cultures were considered by almost all nineteenth-century European observers to be devoid of scientific thinking and all but the most primitive technology. This assessment became more and more central to efforts to demonstrate the validity of the long-standing view of the Africans as backward and inferior peoples. Johann Blumenbach's spirited defense of "Negro" mathematical and scientific aptitudes was forgotten or ignored. Echoing, often unknowingly, an argument that Edward Long had advanced in the 1770s, numerous nineteenth-century authors asserted that the Africans had not been responsible for a single scientific discovery or any mechanical invention. Julien Virey developed this

⁵³ For surveys of the popular literature on Africa and "the Orient" in this era, see Léon Fanoudh-Siefer, *Le Mythe du nègre et de l'Afrique noire dans la littérature française* (Paris, 1968); E. F. Oaten, *A Sketch of Anglo-Indian Literature* (London, 1908); Susanne Howe, *Novels of Empire* (New York, 1949); and William Schwartz, *The Imaginative Interpretation of the Far East in Modern French Literature* (Paris, 1927). For a more analytical treatment of the processes by which these ideas were popularized in the late nineteenth century, see William Schneider, *An Empire for the Masses: The French Popular Image of Africa, 1870–1900* (Westport, Conn., 1982).

theme at some length. Unlike the Egyptians, he asserted, the Africans had never built great cities or monuments but were content to live in "primitive" huts. In contrast to the Indians, they were incapable of manufacturing textiles. They had produced no art worth the name and no inventions. In fact, Virey argued, the Africans had never even displayed the sort of ingenuity that the Indians had evinced in devising the game of chess or that the Arabs had revealed in their delightful stories, especially the *One Thousand and One Nights*.⁵⁴ The American writer Josiah Nott was equally sweeping in his assertion that in their entire history the Africans had produced no cities, no monumental architecture, no "relic" of science or literature, and not even a "rude" alphabet. Similarly, James Hunt, the first president of the Anthropological Society of London, challenged those who argued for African equality with whites to name one "Negro" who had distinguished himself in any field. In listing careers in which evidence of African achievement might be sought (but never found), Hunt ranked "man of science" above all others.⁵⁵

In the view of most nineteenth-century authors of works on Africa, these categorical dismissals of black material achievement appeared to be confirmed by the accounts of European explorers, missionaries, and colonial officials. Though some authors made exceptions for particular peoples, Richard Burton, one of the most wide-ranging and frequently quoted of British explorers, captured the sentiments of the great majority of the on-the-spot observers when he declared that technology in Africa was limited to weaving, cutting canoes, making "rude" weapons, and "practising a rough metallurgy."⁵⁶ Less hostile and better-informed observers than Burton made distinctions between different African peoples in terms of their level of technological development. In general, there was a strong correspondence between praise for a particular people's tools and weapons and favorable judgments about its society as a whole. The German explorer Karl Peters, for example, had little good to say about most of the peoples whom he encountered during his travels in East Africa. His stereotypes—from the "thieving" and "impudent" Kikuyu to the "proud but savage" Masai—were standard fare for late nineteenth-century readers of explorers' accounts. Relative to his undisguised disdain for most African peoples, however, Peters had high

⁵⁴Virey, *Histoire naturelle*, pp. 48–49.

⁵⁵Josiah Nott, "The Negro Race," *Popular Magazine of Anthropology* 3 (1866), 107–9; James Hunt, *On The Negro's Place in Nature* (London, 1863), p. 37. See also Charles Smith, *The Natural History of the Human Species* (Edinburgh, 1848), p. 196.

⁵⁶Richard Burton, *A Mission to Galele, King of Dahomey* (London, 1864), vol. 2, p. 202. For a similar summary, see Edmond Ferry, *La France en Afrique* (Paris, 1905), pp. 221–22, 229.

praise for the powerful Ganda, whom he considered extremely skillful builders. Yet he qualified even this rare praise by his supposition that the Ganda's engineering feats had been stimulated by Egyptian and European influences.⁵⁷

As H. A. C. Cairns has shown, the Ganda's skill at roadbuilding and their capacity for metalworking were vital in winning very favorable assessments of their level of social development from a number of British travelers and missionaries in this period.⁵⁸ The British were particularly impressed by the complexity of Ganda political organization, engineering and architectural skills, and proclivity for experiment and innovation. These were seen as evidence that they shared many of the traits the British considered central to their own superiority. The fact that the Ganda were eager to learn and imitate British techniques, specifically those related to metalworking, only served to reinforce the impression that they were a cut above the rest of the Africans in social development and potential for improvement.

Another of the great experts on colonial affairs of the day, Sir Harry Johnston, distinguished the "Bayansi" from the other "savages" of the Congo as a people who had developed a "decided indigenous civilization of their own." He based the distinction solely on the Bayansi's superior engineering skills, which were evinced in their large houses with swinging doors, sophisticated handicraft industries, and skill in the working of metals.⁵⁹ In response to a lecture on Africa delivered some years later by Johnston, a missionary named Milum vehemently rejected Johnston's sweeping assertion that before colonization all Africans were savages. But in his defense of the Yoruba and claims for the high level of development they had achieved, Milum relied on the standards invoked earlier by Johnston, standards that were overwhelmingly technological: "What were they [the Yoruba] before they came into contact with Europeans? Certainly not savages. They had smelting furnaces, and they made iron and excellent steel. They were dyers, and to this day their dyes are the envy of European countries. They made their own cloth. They were by no means naked savages, for they dressed in the most decent manner, and I should like to commend the native dress of the

⁵⁷Karl Peters, *New Light on Dark Africa* (London, 1891), pp. 417–18.

⁵⁸H. A. C. Cairns, *Prelude to Imperialism: British Reactions to Central African Society, 1840–1880* (London, 1965), pp. 109, 112.

⁵⁹Harry Johnston, "On the Races of the Congo and the Portuguese Colonies in West Africa," *Journal of the Anthropological Institute* 13 (1884), 475. For other examples of this pattern, see David and Charles Livingstone, *Narrative of an Expedition to the Zambesi and Its Tributaries, 1858–1864* (New York, 1866), pp. 122–25; William Allen and T. R. H. Thompson, *A Narrative of the [Trotter] Expedition to the River Niger in 1841* (London, 1848), vol. 1, p. 324; and Louis Figuier, *The Human Race* (London, 1872), p. 495.

Yorubas as the most fit and proper costume, and as being superior to the European style."⁶⁰

Yet, however much travelers or colonial officials may have been impressed with the technical skills of particular peoples, their praise was always qualified by the underlying assumption that a vast gap existed between the capacities of Africans as a whole and those of the Europeans. The French-born explorer Paul Du Chaillu captured this ambivalence in noting that the "cannibal" Fon of the Congo region refused to barter for European or American iron for their knives and arrowheads, preferring metal forged on their own "ingenious bellows." Nevertheless, Du Chaillu saw Fon material culture as woefully primitive: they had not invented, he observed, "a thing so simple as a handle for a hammer."⁶¹

Perhaps the most striking manifestation of the assumption that the African peoples lacked either technological development or the capacity for invention can be found in works on the riddle of Zimbabwe, which preoccupied so many travelers to southern Africa in this period. The massive and skillfully constructed stone edifices found in what was to become the British colony of Southern Rhodesia appeared to contradict the widespread belief that Africans were utterly lacking in engineering skills and had produced little or no monumental architecture. The ruins of Zimbabwe had to be explained or these assumptions reassessed. The former approach was much more congenial to nineteenth-century authors. The mystery of Zimbabwe's origins was conceded by all who wrote about the impressive ruins, whose impact was considerably enhanced by the paucity of comparable stone buildings in the rest of sub-Saharan Africa. The absence of written records relating to the ruins and the infant state of archeological and anthropological work in the Zimbabwe region left much room for speculation. But one thing was clear to most observers: black Africans were incapable of the architectural, engineering, and stoneworking feats that those who built the great walls and towers of Zimbabwe had obviously possessed.⁶²

⁶⁰ Recorded in *Proceedings of the Royal Colonial Institute* 20 (1888–89), p. 118. Similarly, Richard Freeman ranked the Muslim peoples of the Sudan above the pagan peoples of the forest almost wholly on the former's superiority as toolmakers and textile producers; see *Travels and Life in Ashanti and Jaman* (Westminster, Eng., 1898), pp. 201, 417–18.

⁶¹ Paul Du Chaillu, *Explorations and Adventures in Equatorial Africa* (London, 1861), pp. 90–92. See also the Livingstones' *Expedition to the Zambesi*, p. 562.

⁶² The following discussion of the Zimbabwe riddle is based on Lionel Decle, *Three Years in Savage Africa* (London, 1898), vol. 1, p. 191; Robert M. Swan, "Some Notes on Ruined Temples in Mashonaland," *Journal of the Anthropological Society of Great Britain and Ireland* 27 (1897), 2–13 (quoted portions, pp. 9–10); Frederick C. Selous, *Travel and Adventure in Southeast Africa* (London, 1893), pp. 331–41; J. T. Bent, "Origins of the Mashonaland Ruins," *Nineteenth Century* 34 (1893), 991–97 (quoted portion, p. 996). For variations on these arguments, see James Bryce, *The Relations of the Advanced and Back-*

The British explorer Lionel Decle summarized the general consensus of nineteenth-century writers when he concluded that the construction of buildings as grand as those suggested by the "magnificent ruins" of Zimbabwe was simply beyond the capacity of *any* African people; the structures in "their extent, their gigantic proportions, and their general plan indicate a loftiness of conception very far superior to the present ability of the Negro race." Decle's contemporary Robert Swan agreed. He cautioned readers of the prestigious journal of the Royal Anthropological Society against assuming that the "Kaffirs" had constructed the edifices simply because Africans then living in the vicinity often built their homes on top of the ruins. Swan declared emphatically that none of the tribes "now living anywhere near Mashonaland" could ever have had "even the small knowledge of geometry and astrology [sic] that was necessary in planning these temples." Frederick Selous, a big-game hunter in the 1890s with strong opinions on all manner of African affairs, was among the tiny minority who believed that the Bantu peoples might have played a role in the construction of Zimbabwe. But his conviction arose from a low opinion of the ruins rather than a maverick respect for African abilities. He called Zimbabwe a "rude structure" and surmised that its architects could have achieved only the low state of development which he associated with Africans.

Though most writers dismissed the Africans as candidates, there was some disagreement over who had in fact built Zimbabwe. The dominant view was advanced by J. T. Bent, who wrote a detailed essay on the origins of the structures in 1893. Drawing on the work of German and Austrian archeologists in addition to the standard British sources, Bent speculated that the great edifices had been constructed centuries earlier by Arabs who had migrated inland from the Swahili coast. He surmised that if Africans had played any role in the construction, it had been as slave laborers. He found this conclusion inescapable, given "the well accepted fact that the negroid brain never could be capable of taking the initiative in work of such intricate nature." Until recent years, similar views were espoused by the white settlers who dominated Rhodesia. In official publications and textbooks the African role in the construction of Zimbabwe was vigorously denied.⁶³ That the name Zimbabwe

ward Races of Mankind (Oxford, 1902), pp. 93–97; and R. N. Hall, *Great Zimbabwe* (London, 1905), pp. xxvi–xxviii, 18, 80.

⁶³ Perhaps the earliest expression of this view at the popular level was included in John Buchan's adventure for schoolboys, *Prester John*, originally published in 1910. In the novel an English schoolteacher named Wardlaw summarily dismisses the notion that Zimbabwe was erected by the "natives," insisting that "the men who could erect piles like that . . . were something more than petty chiefs" (New York, n.d.), p. 65.

was chosen by the new nation which emerged from the struggle for black majority rule in Rhodesia indicates the importance that the discovery of the Bantu origins of the great complex has played in the efforts of Africans to rebut centuries of misinformation about their historic achievements.

Attempts to deny the African contribution to the technological or architectural accomplishments of ancient civilizations had been made, of course, long before European explorers prowled the ruins of Zimbabwe in the late nineteenth century. In the 1850s the American authors Josiah Nott and George Gliddon, who were widely considered authorities on the "Negro question," had declared that the civilization of Meroe, long noted for the high level of ironworking it had attained, was the product of Egyptian and not "Negro" genius. They also rejected the suggestion that black Africans had played a role in the development of Egyptian civilization and its wondrous architectural feats, other than perhaps the provision of brute labor. Confronted with evidence that the Mandingos and Fulani had historically displayed considerable technical skill and achieved a high level of civilization, Nott and Gliddon countered that these peoples were "less black" ("mahogany") than other Africans and had been highly influenced by Arab migrants and Islamic civilization.⁶⁴ A decade later Frederic Farrar conceded that the Africans had made some contributions to Egyptian civilization but asserted that these had been highly inflated by defenders of the "Negro race." Farrar concluded that the achievements of Egypt were largely the product of Aryan and Asiatic efforts and that black Africans had supplied mainly "strains of cruelty and Fetishism."⁶⁵ William Clark, who in the 1850s wrote a highly favorable account of the Yoruba of present-day Nigeria, inexplicably traced the origins of what he regarded as an exceptional people to the Canaanites of ancient Palestine.⁶⁶ These claims do much to explain why authors of African descent, from Antenor Firmin in the late nineteenth century to Cheikh Anta Diop in the twentieth, have been so concerned to demonstrate the importance of black African contributions to ancient Egyptian civilization.⁶⁷

⁶⁴Josiah Nott and George Giddon, *Types of Mankind* (London, 1854), pp. 52, 186–88.

⁶⁵Farrar, "Aptitudes of Races," pp. 119–20.

⁶⁶William Clark, *Travels and Explorations in Yorubaland, 1854–8* (London, 1872), pp. 287–92.

⁶⁷Antenor Firmin, *De l'égalité des races humaines* (Paris, 1883), esp. pp. 333–77; Cheikh Anta Diop, *The African Origins of Civilization* (New York, 1974); Anthony Noguera, *How African Was Egypt?* (New York, 1976). A surprising number of late nineteenth-century European writers conceded important African influences on Egyptian civilization; see, e.g., Marius-Ary LeBlond, "La race inférieure," *Revue de Paris* 4 (1906), 109–113.

Nowhere was the technological gap that grew ever wider between nineteenth-century Europeans and Africans more graphically depicted than in the hundreds of incidents in which travelers, settlers, and missionaries reported the awestruck responses of Africans to even the simplest mechanical devices. Paul Du Chaillu recalled how the "natives" regarded his clock as an "object of wonder" and believed it to be his guardian spirit. On a later journey, Du Chaillu delighted in the Africans' awe (and fear) of his "galvanic battery," magnet, and photographic equipment; even his black-tinted beer bottles were "held in very high estimation by the chiefs."⁶⁸ Anna Hinderer, the wife of a missionary in Yoruba country, told of crowds of Africans with "eyes and mouths wide open" gathering around her bungalow to listen to her play the harmonium. A visiting African leader insisted on seeing and attempting to play the instrument. When he could not, he remarked, according to Hinderer, that "only white people can do anything great like make wood and ivory 'speak.'"⁶⁹ Lovett Cameron, a British explorer, recorded an even more exuberant response. Having inspected the watches, guns, compasses, and other instruments that Cameron's party carried, the uncle of another African "chief" exclaimed: "Oh, these white men! They make all these wonderful things and know how to use them! Surely men who know so much ought never to die; they must be clever enough to make a medicine to keep them always young and strong, so that they will never die."⁷⁰ The old man, Cameron claimed, believed that the Europeans were thousands of years old and able to conjure up these devices from their inner consciousness.

The English traveler Richard Freeman "astonished and delighted" his African bearers by allowing them to view the moon through his telescope. Freeman derived even greater pleasure from African wonderment at the flame that engulfed his Christmas pudding (he reported that the "native" onlookers burst into applause) and his use of a fork.⁷¹ The Scottish explorer Henry Drummond, reminding his readers that he was without books or newspapers, reported that he amused himself and was able to "entertain the savages" by lighting matches, buttoning his coat, "snapping" his revolver, or using his mirror to set fire to their clothing. He added that he found such pleasure in the Africans' awestruck response to these diversions that he sometimes indulged in them three or

⁶⁸Du Chaillu, *Explorations and Adventures*, pp. 412, 417.

⁶⁹Richard B. Hone, ed., *Seventeen Years in the Yoruba Country: Memorials of Anna Hinderer* (London, 1872), pp. 34–38, 44. See also William Junker, *Travels in Africa during the Years 1875–1878* (London, 1890–92), vol. 2, p. 173.

⁷⁰Lovett Cameron, *Across Africa* (London, 1876), p. 100.

⁷¹Freeman, *Travels and Life*, pp. 109, 159.

four times a day.⁷² As late as the decade before the Great War, the young Elspeth Huxley described similar African reactions to such commonplace objects as matches, wheels, and oil lamps. She puzzled over the fact that these devices made a much greater impression on the "ignorant" and "backward" peoples of Kenya than did such modern marvels as airplanes and radios.⁷³

Perhaps no inventions elicited as much astonishment and respect from Africans as European firearms. As early as the 1820s, G. Mollien, a French traveler with considerable sensitivity to the Africans, reported that when he fired his double-barreled gun, the Bahene people cried out in astonishment, "We are only beasts."⁷⁴ Some decades and great advances in firearms manufacture later, Du Chaillu told of the Ashira's praise for his revolver. Even though they had muskets, he wrote, they could not even begin to comprehend the workings of a gun that "fired time after time without stopping."⁷⁵ Du Chaillu's contemporary, the French explorer M. E. Mage, noted a similar "avid interest" in his Colt revolver on the part of the ruler Ahmadou. Mage recalled with amusement the obvious amazement of the proud leader, who sought to maintain an air of indifference in all situations. The gun's performance, however, prompted Ahmadou to lose his composure and openly marvel at the "small copper cartridges" that could carry so far.⁷⁶ Though the superiority of European firearms to the weapons wielded by Africans was readily apparent, some travelers were not above resorting to ruses to amuse themselves and dazzle the "natives" further. William Devereux recounted how he and his companions told a group of "fine strapping natives" who had boarded his steamship to look it over that the funnel was a large cannon. The visitors were understandably "awe-stricken" by what they believed to be a monstrous gun, but they were even more impressed—Devereux confided—by the white women on board.⁷⁷ Ironically, it was the great missionary-explorer David Livingstone who most accurately and succinctly summarized the advantages for Europeans in Africa of vastly superior firearms: "Without any bullying, fire-

⁷²Henry Drummond, *Tropical Africa* (London, 1888), pp. 103–4.

⁷³Elspeth Huxley, *The Flame Trees of Thika* (Harmondsworth, Eng., 1983), p. 31. Decades earlier, David Livingstone had recorded similar responses (*Expedition to the Zambesi*, p. 242).

⁷⁴G. Mollien, *Travels in the Interior of Africa to the Sources of the Senegal and Gambia* (London, 1820), p. 64.

⁷⁵Du Chaillu, *Explorations and Adventures*, p. 412.

⁷⁶M. E. Mage, *Voyage dans le Soudan Occidental (Sénégambie-Niger)* (Paris, 1868), p. 229.

⁷⁷William Devereux, *A Cruise in the "Gorgon"* (London, 1869), p. 193. For a similar account of African confusion about naval artillery, see Paul Du Chaillu, *A Journey to Ashango-Land* (New York, 1867), pp. 61–62.

arms command respect, and lead [African] men to be reasonable who might otherwise feel disposed to be troublesome."⁷⁸

The apparently overwhelming impression that firearms and mechanical devices made on peoples throughout sub-Saharan Africa led many explorers and envoys to the courts of African rulers to recommend guns and machines as gifts for African "chiefs" and kings. In the account of his 1817 mission to the ruler of Ashanti, Edward Bowdich described at great length the king's great interest in British medicines and botanical books and his obvious delight in the many mechanical devices that Bowdich had brought along as presents. Bowdich advised that "ingenious novelties"—including, in this instance, telescopes, pistols, kaleidoscopes, watches, a microscope, a pocket compass, matches, and a camera obscura—had played a critical role in winning the favor of the powerful African ruler.⁷⁹ Perhaps acting on Bowdich's instructions, Joseph Dupuis, who led a similar mission to the Ashanti capital at Kumasi three years later, selected "mainly mechanical contrivances" as gifts for the African ruler. Unfortunately, some of the items he had chosen met with a decidedly less favorable reception than Bowdich's presents had enjoyed. The Ashantehene, Dupuis reported, was frightened by a small organ, which had been hauled through the rain forest with great effort, and he was disappointed by a lathe, which Dupuis conceded was "too mechanical for a royal present." Even a watch and a music box failed to win favor. Rather than admit his own failings as a purveyor of royal presents, Dupuis blamed the vast distance separating European and African in technological mastery: "The task of winding up the watch or the musical box required a degree of care foreign to the comprehension of the king; it was requisite, therefore, to put the mechanism in motion each time."⁸⁰

Despite occasional setbacks, mechanical devices were favored as gifts by most travelers and explorers throughout the nineteenth century. In the 1870s Wilhelm Junker assured his readers that African leaders took "childish delight in the merest mechanical trifles." He recommended knife blades, mirrors, photographs, and even empty candy boxes as presents that were sure to please the "natives."⁸¹ John Hanning Speke,

⁷⁸Livingstone and Livingstone, *Expedition to the Zambesi*, pp. 213, 310. See also Decle, *Savage Africa*, p. 111; Cameron, *Across Africa*, pp. 125, 161; Francis Galton, *The Narrative of an Explorer in Tropical South Africa* (London, 1853), p. 201; and Cairns, *Prelude to Imperialism*, pp. 43–47, 76, 119, 162.

⁷⁹Edward Bowdich, *Mission from Cape Castle to Ashanti* (London, 1819), 44, 97–98, 455–57.

⁸⁰Joseph Dupuis, *Journal of a Residence in Ashanti* (London, 1820), pp. 93–94, 100.

⁸¹Junker, *Travels in Africa*, vol. 3, p. 2. See also Allen and Thompson, *Expedition to the River Niger*, vol. 1, pp. 315–18.

one of the most lionized explorers of the late nineteenth century, related numerous incidents in which mechanical presents or demonstrations of technological prowess won his expedition the protection or at least grudging acceptance of local "chiefs." A box of "lucifers," the accuracy and rapid fire of his revolvers, and even the opening and shutting of his umbrella (which Speke apparently carried throughout his travels) proved sufficient to overawe hostile warriors or mollify the suspicions of African leaders, from the powerful ruler of the Ganda to a local headman who, Speke reported, literally begged him for a box of matches.⁸²

As Speke's experience suggests, innocuous, nonmilitary contraptions could sometimes be as effective for compelling cooperation or dispelling hostility as the advanced weapons that have all but monopolized the attention of historians of colonialism. Henry Drummond observed that even a piece of glass used to set fire to some dry grass could become a source of wonder and terror.⁸³ An equally striking example of reliance on the simplest of devices is provided in Hermann von Wissman's 1891 account of his travels in equatorial Africa. Von Wissman told of how the captain of the steamship on which he was traveling sounded the whistle to frighten off a crowd of African merchants who were quarreling with members of Von Wissman's party. He noted that this tactic had also been used on an earlier journey with much the same impact. On the second occasion, "the impression was again so overpowering that all of the natives took to their heels in wild fear, disappearing in the thickets and rushing towards the village. Only one old white-haired Herculean chief, who was standing close to the river, felt ashamed to run, but was terrified to such a degree that he staggered backward."⁸⁴

Though as far as I am aware no direct connection has been established, this incident could have been the inspiration for two encounters that occur in Joseph Conrad's novella *Heart of Darkness*. In Conrad's story the protagonist Marlowe also uses the steam whistle of his ramshackle riverboat to scare away hostile "natives" on two occasions. In the first instance the sound of the whistle brings an abrupt end to an

⁸²John Hanning Speke, *Journal of the Discovery of the Source of the Nile* (London, 1868), pp. 131, 186-87, 228, 291, 295, 298. For another account of the use of an umbrella to scare away "threatening natives," see Joseph Thompson, *To the Central Lakes and Back* (London, 1881), vol. 1, pp. 53-54. Speke's onetime traveling companion Richard Burton ignored Speke's advice on gifts and came to grief when the king of Dahomey spurned his "fancy clothes" and chided Burton for not having brought him a fine carriage; see Burton, *Mission to Galele*, vol. 1, pp. 321-22.

⁸³Drummond, *Tropical Africa*, p. 104. David Livingstone (*Expedition to Zambesi*, p. 242) also noted the "magical aura" that the colonizers' vast technological superiority gave them in the eyes of the "natives."

⁸⁴Hermann von Wissman, *My Second Journey through Equatorial Africa* (London, 1891), pp. 19-20.

attack by the forest dwellers who have killed Marlowe's helmsman. Marlowe recalls the awesome effect that the shriek of the whistle has on the attackers: "The tumult of angry and warlike yells was checked instantly, and then from the depths of the woods went out such a tremulous and prolonged wail of mournful fear and utter despair as may be imagined to follow the flight of the last hope from the earth."⁸⁵ On the second occasion Marlowe uses the whistle to drive off the African followers of Kurtz (the trading company's agent) and prevent them from being slain as a "jolly lark" by the "pilgrims" aboard the steamship. Again the impact of the simple device is overwhelming:

At the sudden screech there was a movement of abject terror through the wedged mass of bodies. "Don't! don't you frighten them away," cried some one on deck disconsolately. I pulled the string time after time. They broke and ran, they leaped, they crouched, they swerved, they dodged the flying terror of the sound. The three red [clay-caked] chaps had fallen flat, face down on the shore, as though they had been shot dead. Only the barbarous and superb woman did not so much as flinch, and stretched tragically her bare arms after us over the sombre and glittering river.⁸⁶

A comparison of Von Wissman's and Conrad's accounts not only enhances Conrad's reputation as a skillful writer but also reveals his remarkable empathy, rare for a European in this period, with the African and Asian peoples who were being beaten into submission by the European imperial juggernaut.

In addition to the vital role they accorded technological superiority in subduing the peoples of Africa, European writers viewed it as a major determinant of the nature of social and economic interaction between Europeans and colonized Africans. As the builders of railways, seaports, and mine shafts and the suppliers of finance and machine capital, the Europeans thought it fitting that the Africans, whom they regarded as technologically backward, be relegated to the position of laborers. As the following incident related by H. L. Duff demonstrates, most Europeans were also convinced that all but the most truculent Africans accepted this allocation of roles in deference to the Europeans' manifest scientific and technical mastery. Duff, who was Chief Secretary in the British administration in Nyasaland, had decided to take his "boy" back to England with him. As the two were approaching the steamship on

⁸⁵Joseph Conrad, *Heart of Darkness* (New York, 1950) p. 118.

⁸⁶Ibid., p. 145.

which Duff had booked passage to Europe, the servant was dazzled by the lights gleaming in the darkness from the portholes and asked Duff why the flames did not consume the vessel. After patiently explaining the workings of electric lamps and pointing out other technological marvels on the ship, Duff teasingly asked his servant why the Africans had not invented such "wonders." The African protested that his people lacked the white man's magic and that the Europeans were favored by God, who helped them to understand many things that were kept hidden from other others. When asked whether God had not made the Africans as well as the Europeans, the African, according to Duff, replied: "Perhaps, but I think he made us to be your *tenga-tenga* (bearers)."⁸⁷

For many Europeans the differences between their own highly developed, technologically and scientifically oriented societies and what they perceived to be backward and superstitious African cultures were merely manifestations of the vast gap in evolutionary development that separated "civilized" Europe from "savage" Africa. Richard Freeman's association of the "rude and primitive" tools of the Africans he encountered in his travels with the peoples of the Stone Age was rooted in the widely accepted idea of recapitulation which Stephen Gould has argued was one of "the most influential ideas of late nineteenth century science."⁸⁸ Ethnologists and natural scientists who adhered to the idea of recapitulation believed that primitive cultures represented an ancestral stage in the evolutionary development of more advanced cultures. It followed that contemporary African societies, which were widely held to be primitive or savage, provided living examples of a level of material culture, organization, and thought which European peoples had passed through millennia earlier. Those who lived and worked among African peoples, Harry Johnston observed, felt as if they were going "thousands of years into the past" to ages of savagery and brutishness.⁸⁹ That such a journey back in time offered opportunities for the study of the earliest stages of human development was, according to Henry Drummond, one of the most important reasons for African exploration. "Ignorant eyes," he

⁸⁷H. L. Duff, *British Administration in Central Africa* (London, 1903), pp. 265–66. For a similar exchange, see Ferry, *France en Afrique*, p. 243. Some observers averred that the Africans were indifferent to technological marvels because the ingenuity that went into them was simply beyond their comprehension—"ça c'est affaire pour Blanc" (A. Cureau, *Les sociétés primitives de l'Afrique équatoriale* [Paris, 1912], pp. 80–81).

⁸⁸Freeman, *Travels and Life*, pp. 417–18; Stephen Gould, *The Mismeasure of Man* (New York, 1981), p. 114. As Peter Marshall and Glyndwr Williams point out, the idea had originally been suggested by a number of eighteenth-century authors; see *The Great Map of Mankind* (London, 1982), pp. 215, 274.

⁸⁹Quoted in Keane, *The World's Peoples*, p. 73.

noted, saw only savages, but the informed observer realized that "they are what we were once; possibly they may become what we are now." Drummond confessed that however edifying, the journey back to the dawn of civilization was a profoundly disturbing one: the juxtaposition of civilization as represented by "a steel ship; London built, steaming six knots ahead" and African savagery in the form of "grass huts, nude natives, and a hippopotamus" was so unsettling that "the ideas refused to assort themselves."⁹⁰

No writer captured better than Joseph Conrad the sense of adventure and unease that late nineteenth-century European explorers and missionaries felt as they traveled into the African interior—and back in time:

We penetrated deeper and deeper into the heart of darkness. It was very quiet there. At night sometimes the roll of the drums behind the curtain of trees would run up the river and remain sustained faintly, as if hovering in the air high over our heads, till the first break of day. Whether it means war, peace, or prayer we could not tell. The dawns were heralded by a chill stillness; the wood-cutters slept, their fires burned low; the snapping of a twig would make you start. We were wanderers on a prehistoric planet. We could have fancied ourselves the first men taking possession of an accursed inheritance, to be subdued at the cost of profound anguish and of excessive toil. But suddenly, as we struggled round a bend, there would be a glimpse of rush walls, of peaked grass-roof, a burst of yells, a whirl of black limbs, a mass of hands clapping, of feet stamping, of bodies swaying, of eyes rolling, under the droops of heavy and motionless foliage. The steamer toiled along slowly on the edge of a black and incomprehensible frenzy. The prehistoric man was cursing us, praying to us, welcoming us—who could tell? We were cut off from the comprehension of our surroundings; we glided past like phantoms, wondering and secretly appalled, as sane men would be before an enthusiastic outbreak in a madhouse. We could not understand because we were too far and could not remember because we were travelling in the night of first ages, of those ages that are gone, leaving hardly a sign—and no memories.⁹¹

⁹⁰Drummond, *Tropical Africa*, pp. 3, 40, 60. For other contemporary examples, see Livingstone and Livingstone, *Journey to the Zambezi*, pp. 492–93; Decle, *Savage Africa*, vol. 1, pp. 509–10; and Duff, *British Administration*, pp. 187–88. For more general discussions of these themes in the colonial literature, see Cairns, *Prelude to Imperialism*, pp. 88–91; and Fanoudh-Siefer, *Le mythe du Nègre*, pp. 63, 104–5. Some writers saw the Africans as examples of a prehuman or pre-Adamite stage of development; see Samuel Baker, *The Albert N'yanza, Great Basin of the Nile* (London, 1866), vol. 2, pp. 316–17.

⁹¹Conrad, *Heart of Darkness*, p. 105.

India: The Retreat of Orientalism

In contrast to the generally accepted European views of Africa, which were shaped and then fixed in stereotypes through the cumulative impact of numerous writers and observers—from natural scientists and explorers to novelists and missionaries—a single author and work exerted a decisive influence on nineteenth-century European attitudes toward India. Begun in 1806 but not finally published until the end of 1817, James Mill's *History of British India* captured many of the philosophical currents and much of the common prejudice and ethnocentrism of his day in its relentless critique of Indian tradition and culture. In his blanket dismissal of Indian achievements and in the general standards he enunciated for judging the worth of any society past or present, Mill provides a striking illustration of just how important scientific thinking and technological skills had become as gauges of human worth.

Although Mill had no firsthand experience of India—a fact he noted proudly because he believed that it heightened his capacity for objectivity—as preparation for the writing of his six-volume magnum opus he had spent many years reading whatever works on the subcontinent were available.⁹² Mill, the self-made son of a shoemaker, did not come to these materials as a neophyte seeking knowledge. He was a mature thinker who had long before completed his university education in Greek history and philosophy and who had already formed very definite opinions about a wide range of questions from ethics to the proper role of government in “advanced societies.” Working from a rather rigidly held set of philosophical assumptions rooted in Benthamite Utilitarianism and ideas about progress set forth by the thinkers of the Scottish Enlightenment,⁹³ Mill sifted through massive amounts of information. He selectively gathered evidence to support his critiques of Indian beliefs and customs and to demonstrate Utilitarian positions on various aspects of political economy. He vehemently rejected the generally favorable view of Indian civilization advanced by Sir William Jones and other Orientalists. He drew heavily on parliamentary papers and such critical accounts of India as those by Robert Orme and the Abbé Dubois. Mill

⁹²The biographical background for James Mill's *History* has been taken primarily from Duncan Forbes, “James Mill and India,” *Cambridge Journal* 5 (1951–52), 19–33; Alexander Bain, *James Mill: A Biography* (London, 1882); Leslie Stephen, “James Mill,” in *The English Utilitarians*, vol. 2 (London, 1900); William Thomas's useful introduction to the 1975 edition of Mill's *History of British India*; and Eric Stokes, *The English Utilitarians and India* (Oxford, 1959).

⁹³See esp. Gladys Bryson, *Man and Society: The Scottish Inquiry of the Eighteenth Century* (Princeton, N.J., 1945), pp. 36, 42–43, 76; and Sidney Pollard, *The Idea of Progress: History and Society* (Harmondsworth, Eng., 1971), pp. 59–78.

sought to propound definitive judgments about the worth of Indian ideas and institutions in particular and of “Oriental” societies more generally.

The views of his fellow Scotsman Charles Grant set the tone for Mill's massive *History*.⁹⁴ As a member of the Board of Trade in India, Grant had worked closely with Lord Cornwallis in the latter's efforts to reform the notoriously corrupt East India Company administration in the 1780s and early 1790s. Grant suffered the loss of two children and severe financial setbacks during his early years as an aspiring financier in Bengal. These experiences shaped his appraisal of Indians and Indian civilization, which differed substantially from that shared by prominent officials like Warren Hastings and the members of the Orientalist clique. Driven by a religious zeal that was first manifested during the period of his successive personal crises, Grant drafted in 1792 his “Observations on the State of Society among the Asiatic Subjects of Great Britain,” which anticipated many of the main arguments James Mill would make in far greater detail and more vehemently two and a half decades later.

Grant found the Indians dishonest, servile, indolent, and morally stunted. Though he focused his criticisms on the Hindu religion, which he pictured as an ancient repository of degrading social customs, rituals, and superstitions, he implicitly questioned the worth of Indian society and civilization as a whole. He commented explicitly on deficiencies in Indian science and technology, which he linked to overall defects in Hindu civilization. He conceded that the Indians had made advances in a variety of forms of handicraft manufacture, but like Sonnerat he argued that these had been achieved in an age long past and that there had been little improvement in Indian techniques in thousands of years. Grant contrasted the Hindus' superstition and lack of curiosity with the “great use” that the British and other Europeans had made of reason “in all subjects” and the manner in which European scientific discoveries complemented, rather than competed with, Christian beliefs.⁹⁵ He argued that the Indians were ignorant of the natural sciences and that “invention seems wholly torpid among them.” He boasted that the superiority of

⁹⁴The best biography of Grant remains Ainslee Embree, *Charles Grant and British Rule in India* (London, 1962). See also Stokes, *English Utilitarians*, esp. chap. 1; and George D. Bearce, *British Attitudes towards India, 1784–1858* (Oxford, 1961), esp. pp. 51–64. The following discussion of Grant's views is based upon his “Observations on the State of Society among the Asiatic Subjects of Great Britain, Particularly with Respect to Morals; and on the Means of Improving It—Written Chiefly in the Year 1792,” *Parliamentary Papers*, 1832, East India Company (8) “Report from Committee,” vol. 1, app. 1, pp. 3–92.

⁹⁵This argument was made by numerous nineteenth-century authors. See, e.g., J. M. Mitchell, *Hinduism Past and Present* (London, 1897), p. 271.

Europeans' understanding of the natural world could readily be demonstrated by the "sight of their machines."

Grant's "observations" were published in the *Parliamentary Papers* of 1813 and reprinted in 1832, in each instance at a point when important policy decisions regarding India were being debated. The considerable influence of Grant's opinions is perhaps best attested by the admission of Warren Hastings that the insistence of men like Grant that Indian civilization was decadent and mired in superstition, and thus much in the need of conversion to Christianity, had prevailed over his own advocacy of tolerance toward Indian beliefs and customs.⁹⁶

Although Mill rarely cited his sources, many of his arguments also correspond to those advanced by two writers who published works highly critical of India in the years just before Mill's own study appeared. In 1811, William Ward, the head of the Serampore Mission College in Bengal, produced a formidable four-volume *Account of the Writings, Religion, and Manners of the Hindus*. Ward's main purpose was to expose the deficiencies of Indian religious beliefs and practices, but he managed to summarize most of the major criticisms of Indian science that had been raised by earlier writers. Ward declared categorically that the Hindus knew "nothing" of anatomy, surgery, chemistry, pharmacy, physics, and botany; that their geography was "wholly false"; and that they were "very imperfectly acquainted" with mathematics. He conceded that the Hindus had once made discoveries in astronomy and had some medical knowledge, but even in these fields, he added, their knowledge had long since stagnated, and they were centuries behind the Europeans. In general, he concluded, the sacred books of the Hindus contained "little if any real knowledge" and were full of the "grossest absurdities, the greatest exaggerations, and the most puerile conceits."⁹⁷ Ward's dismissal of the worth of most of Indian science was complemented by the less comprehensive but nonetheless telling critique of Indian technology published three years later by Benjamin Heyne, a surgeon in the service of the East India Company and a self-styled naturalist and amateur geologist. Heyne's criticisms were focused on Indian mining techniques, which he found "desultory and destructive, wasteful and negligent," and ironworking, which he characterized as "rude, imperfect and small-scale."⁹⁸ Taken together, these accounts by men with years of service in India belittled Indian achievements in sci-

⁹⁶Penderel Moon, *Warren Hastings and British India* (New York, 1949), pp. 348–50.

⁹⁷William Ward, *Account of the Writings, Religion, and Manners of the Hindus* (Serampore, 1811), vol. 1, pp. v, x, 191–93; vol. 2, pp. 333–37.

⁹⁸Benjamin Heyne, *Tracts Historical and Statistical on India* (London, 1814), pp. 104–10, 219, 222–24.

ence and technology as a whole and provided abundant ammunition for Mill's all-out assault on the Orientalists' image of India as a great civilization.

James Mill's critique of virtually all things Indian was more comprehensive than Grant's or Ward's and largely devoid of the qualifications with which these earlier writers had hedged many of their pronouncements. Driven by the Utilitarian belief that general principles could be found on which all human polities and societies could be effectively organized and run, Mill employed what he had learned about India to illustrate how societies should *not* be structured and administered. Often using Indian beliefs and institutions as surrogates for those in England itself which he found offensive and wished to attack, he criticized Indian civilization with a lack of restraint made possible by the paucity of its defenders and the utter ignorance of the British reading public beyond a small circle of Orientalists and retired East India Company officials.

Mill found virtually nothing to praise in Indian society, past or present. Indian religion was "gross and disgusting" and Indian law "impossibly backward"; all manner of Indian creations from art and architecture to historical records were summarily dismissed as "rude."⁹⁹ Though he had met few and knew none well, Mill confidently characterized the Indians as dirty, dishonest, lacking in muscular development, and (befitting a people of the tropics) highly sensuous. He exhibited a remarkable penchant for finding fault with anything Indian. Even the game of chess, which earlier writers had cited as proof of the Indians' ingenuity, was mentioned by the dour and workaholic Mill only to demonstrate their indolent nature. According to his vision of India, Brahmins sat on rocks chanting meaningless mantras, and Indian princes played chess and hunted tigers while cities fell into ruin, bandits marauded in the countryside, and the peasants starved. Much of this vision was little more than extravagant fiction. Unfortunately, some of it was grounded in the reality of the chaos and suffering that had spread across the subcontinent in the eighteenth century following the collapse of the Mughal empire.

In Mill's view, the Indians had advanced beyond the first and lowest stage of social development but had never been "truly" civilized—a level of refinement that he believed had been attained only by the ancient Greeks and the Europeans since the Renaissance. He thought India

⁹⁹"Rude" was apparently a favorite epithet of writers of the Scottish Enlightenment, such as Adam Ferguson. See Bryson, *Man and Society*, p. 42. This summary of Mill's general views is based on the relevant portions of the *History of British India*, vol. 1 (London, 1826).

roughly comparable to medieval Europe, though inferior to the latter in agriculture, the arts and intellectual attainments. Central to his low estimate of both Indian and medieval European achievements was his conviction that they had contributed little to scientific thought and technological advancement. Though Mill was a scholar and administrator, like many Utilitarians he showed a keen interest in scientific discoveries, particularly those that might be applied to inventions that would improve the condition of humankind. Along with other luminaries from Edinburgh, in the early 1820s Mill became actively involved in the campaign to establish mechanics' institutes to spread scientific knowledge among the artisan classes.¹⁰⁰ These interests were reflected in the considerable attention that he gave to science and technology in the *History of British India* and his underlying contention that material backwardness was a clear sign of a low level of social development. Mill could not deny that the Indians had long excelled in the production of cotton textiles, but he pointed out that Indian looms and tools in general were "rude," thus demonstrating that Indian "ingenuity" was only in its infancy. He conceded that India had monumental buildings in abundance but averred that they were not necessarily signs of advanced civilization. He felt, on the other hand, that good roads and lead pipes were clearly associated with civilized development, but India, he declared, had neither. He asserted that the Indians "knew nothing" about the use of glass for windows or improved sight and that their furnaces for working both glass and iron were of poor quality. The fact that "all Europeans" who had visited India had been struck by the "rudeness" of Indian tools, he concluded, was one of the surest proofs of his contention that Indians had never been truly civilized.¹⁰¹

James Mill also argued that the irrational and superstitious nature of Indian thought and the backward state of the sciences in India provided further evidence of the "low state" of the subcontinent's development. Like William Ward, he opposed the view of many earlier writers that India had made great contributions to scientific thinking in ancient times. Selectively citing the works of H. T. Colebrooke and the French scholar Pierre Laplace, Mill sought to show that discoveries attributed to the Indians in astronomy, algebra, and numerical notation were in fact the work of "bolder and more inventive peoples." Even if the Indians had invented "Arabic" numerals, he declared, that would not prove that they were civilized. If, of course, they themselves had devel-

¹⁰⁰Cardwell, *Organization of Science*, pp. 36–43.

¹⁰¹For Mill's criticisms of Indian technology, see his *History*, vol. 2, pp. 1, 3, 9, 14–19, 21–22, 30–31, 42–43.

oped the algebra they possessed when the Europeans first arrived, that would "indicate a high level of civilization"; needless to say, Mill thought they had not. He considered Indian medicine backward, Indian botany "superficial," and Indian trigonometry nonexistent. Even in areas where the Indians had attained some knowledge, Mill found the ends to which they directed their inquiry unworthy of a civilized people. The Indians' cultivation of mathematics and astronomy exclusively for "wasteful and mischievous" and "irrational" pursuits such as astrology, he argued, rather than ends that would serve utility, "infallibly denotes a barbarous nation."¹⁰²

It is difficult to overstate the impact of Mill's polemic. His *History of British India* helped him earn a position with the East India Company, where he eventually rose to the post of Examiner of India Correspondence and where his son John Stuart was also gainfully employed. The *History* firmly established James Mill as Jeremy Bentham's most prominent disciple. It was widely regarded as a major attempt to apply to specific societies a broad range of Utilitarian tenets from those stressing education and legal reform to those advocating free trade. Mill's views on Indian society and history strongly influenced the pivotal policy decisions of reformist British administrators in India such as Lord William Bentinck and Thomas B. Macaulay. The latter declared Mill's *History* to be the "greatest historical work in English" since Gibbon's *Decline and Fall of the Roman Empire*.¹⁰³ The *History* became required reading for British youths preparing to rule, conduct trade, or win Christians in India. Numerous authors have pictured Mill's six volumes piled on the nightstands of the portside cabins of Company servants on the voyage out to India—though how many youths were dutiful enough actually to read Mill's turgid tomes is uncertain. Presumably most future administrators had some acquaintance with Mill's views, because the *History* was long used as a textbook for training candidates for the Indian Civil Service. Eric Stokes has seen the work as the chief source of the British sense of superiority over the Indians.¹⁰⁴ Even though more knowledgeable and balanced accounts of India appeared soon afterward, Mill's extreme opinions and blatant biases came in time to be regarded as facts and reasoned judgments. Perhaps more than any other writer, he was responsible for the image of India that prevailed in the middle and late nineteenth century in British circles, from the Viceroy's council chamber to the infamous clubs where Anglo-Indians gath-

¹⁰²Ibid., pp. 67–70, 86–101, 125–34.

¹⁰³Quoted in Forbes, "Mill and India," p. 33.

¹⁰⁴Stokes, *English Utilitarians*, p. 313. John Burrow notes the highly detrimental effect that Mill's polemic had on Oriental studies in England; see *Evolution and Society*, p. 52.

ered to drink, gossip, and above all shut themselves away from the decadent, irrational, and bewildering peoples and customs that Mill had conjured up in his *History of British India*.

Contrary to the impression left by many of the authors who have discussed Mill's ideas and their impact, his specific assertions and even his overall assessment of Indian culture were often challenged by better-informed observers. Writers as varied in background and general approach as the East India Company official John Howiston and the famed French sociologist Gustave Le Bon readily acknowledged India's claims to a "vast and indisputable" antiquity as a civilized nation.¹⁰⁵ Many writers concurred with the view of the distinguished jurist Henry Maine that earlier in its history India had achieved a level of civilization roughly comparable to that of medieval Europe. Like his contemporaries who wrote on Africa, Maine believed that the study of Indian institutions and ideas was valuable not because these posed viable alternatives for Europe but because they provided valuable insights into Europe's own past. For Maine, however, the stage of development that India exemplified was well above that which most observers accorded "savage" Africa.¹⁰⁶

Well-researched and carefully argued works like Maine's could not compete with Mill's. The vision propounded in the *History of British India* of a barbarous and superstition-encrusted India that carried one back into "the deepest recesses of antiquity," rather than Maine's medieval *gemeinschaft*, was the one that prevailed in nineteenth-century popular literature and ideas. It pervaded Anglo-Indian fiction in hackneyed descriptions of moonlit temples crowded with grotesque statuary; filthy, half-naked fakirs both repelling and fascinating innocent English maidens; and lewd and boisterous festival celebrations.¹⁰⁷ In scenes reminiscent of Conrad and other authors who pictured their travels in Africa as journeys back in time, William Arnold captured the nineteenth-century British colonizer's sense of the gulf that had opened between Europe and India. In his 1850 novel *Oakfield; or, Fellowship in the East*, Arnold's protagonist Edward Oakfield, a young East India Company cadet, remarks on the contrast between the "mud hovels of the swarm-

¹⁰⁵John Howiston, *European Colonies in Various Parts of the World* (London, 1834), vol. 2, p. 210; and Le Bon, *Les civilisations de l'Inde*. Mill's assertions about Indian science and technology were often at odds with contemporary assessments by on-the-spot observers. See, e.g., Edward Strachey, "On the Early History of Algebra," *Asiatick Researches* 12 (1816), 158–59, 161–64, 183–84; the essays by Alexander Walker and Thomas Halcott included in Dharampal, *Indian Science and Technology in the Eighteenth Century* (Delhi, 1971); and the discussion of the views of Lancelot Wilkinson in Chapter 5, below.

¹⁰⁶Burrow, *Evolution and Society*, pp. 77, 87.

¹⁰⁷For a detailed study of these themes across a wide selection of Anglo-Indian literature, see Benita Parry, *Delusions and Discoveries: Studies on India in the British Imagination, 1880–1930* (Berkeley, Calif., 1972), esp. chaps. 2 and 3.

ing natives" and the swiftly moving steamship on which he is traveling up the Ganges to Calcutta. Oakfield reflects on the differences between the dynamic British, engaged in trading and empire-building on a global scale, and the languid, unchanging Indians passively spending their pre-destined lives beneath "the same scorching sky, the same rich vegetation,—the same funeral river; while the primeval Brahmins, sitting in primeval groves, asked 'Where shall wisdom be found?'" On a later journey, a fellow voyager named Middleton comments on the incongruity between the Europeans on the swiftly moving steamer and the Indian "multitudes engaged in their harsh-sounding, unpleasing, but animated devotion." Both men agree that the juxtaposition provides clear confirmation of the "inconceivable separation there apparently and actually is between us few English, silently making a servant of the Ganges with our steam-engine and paddle-boats and those Asiatics, with shouts and screams worshipping the same river."¹⁰⁸

Like the eighteenth-century Orientalists, those writers who disagreed with Mill's contention that India had failed to rise above barbarism to civilization invariably stressed India's past achievements and contrasted them with its current backwardness relative to advanced European states. In this view, India had produced flourishing civilizations in the distant past, but, for reasons that varied by author—including climate, "racial inertia," and despotic governments—these once great cultures had stagnated and fallen into the decadent condition in which the Europeans found them in the eighteenth and nineteenth centuries.¹⁰⁹ Also like the Orientalists, many writers in the early nineteenth century singled out the stagnation of Indian scientific learning and the backwardness of its technical instruments as indicative of the experience of the civilization as a whole. From Bishop Heber's often quoted dismissal of Indian astronomy as "rubbish" to the French traveler Victor Jacquemont's characterization of Indian science as "triple nonsense for the makers and consumers," the fallen state of Indian learning was impressed upon European readers.¹¹⁰ The decline in Indian mechanical and

¹⁰⁸William Arnold, *Oakfield; or, Fellowship in the East* (London, 1854), vol. 1, pp. 13–14, 128. For a discussion of additional meanings in the Oakfield-Middleton exchange, see Hutchins, *Illusion of Permanence*, p. 122.

¹⁰⁹For examples of these arguments, see Figuer, *The Human Race*, p. 336; Kidd, *Social Evolution*, pp. 142–43; J. S. Mill, *Political Economy*, pp. 12–14, 113–14; and George Campbell, *Modern India* (London, 1852), p. 6.

¹¹⁰Reginald Heber, *Narrative of a Journey through the Upper Provinces of India* (London, 1828), vol. 1, pp. 291, 295–97; Victor Jacquemont, *Letters from India* (London, 1835), p. 343. See also Howiston, *European Colonies*, vol. 2, pp. 49, 71; James T. Wheeler, *Adventures of a Tourist from Calcutta to Delhi* (n.p., 1868), p. 26; and the examples in R. C. Majumdar, "Social Relations between Englishmen and Indians," in Majumdar, ed., *British Paramountcy and Indian Renaissance*, vol. 10, pt. 2, of *History and Culture of the Indian People* (Bombay, 1965), pp. 337–38.

engineering skills was also cited by numerous authors. Robert Knox drew attention to the fact that the Indians of his day looked with "awe and wonder" at the "splendid structures" found throughout the subcontinent which they no longer possessed the capacity to build or even the energy to repair. John Crawfurd, citing the want of mechanical and mathematical skills among the Indians, doubted that such a people could have made the ancient discoveries and edifices that earlier writers had attributed to them. He speculated that they might have imported their learning and skills from classical Greece.¹¹¹

As in Africa, superiority in military technology and organization was one of the more obvious manifestations of the differences that Europeans believed distinguished their level of social development from that of the Indians. In contrast to their behavior in Africa, however, the Europeans made no attempt to employ rifles and revolvers or music boxes and cameras to dazzle or entertain the "natives." Extensive involvement in the internal affairs and political struggles of the subcontinent, extending back to the early decades of the eighteenth century, had left the British with no illusions about their ability to overawe the Marattas, Sikhs, or Rajputs with mere displays of the accuracy and firepower of their latest weapons. In land weaponry, the Europeans had begun their rise to power in India in a state of rough parity with their Indian rivals. Through much of the eighteenth century the advantages the British and French enjoyed in warfare were primarily due to superb leadership, exemplified in such men as Robert Clive and Joseph Du-Plessix, plus superior discipline and organization. In applying the latter to struggles in the subcontinent, first the French and soon after them the British recruited Indian troops, called sepoys, into the European-led armies that vied for control with the larger but more unruly and poorly trained armies of Indian princes. In addition, Indian leaders—most successfully those of the Sikhs in the northwest—adopted European modes of training and organization and purchased large quantities of European arms in what eventually proved to be futile efforts to block the rise of British hegemony.¹¹² Thus, the Indians had been exposed to British military technology long before the Industrial Revolution. They felt little or none of the shock of African peoples who were drawn—often quite abruptly—into conflict with European forces in a later era when Western military advantages had been greatly enhanced by the process

¹¹¹Robert Knox, *The Races of Men* (London, 1862), pp. 451–52; Crawfurd, "Physical and Mental Characteristics," p. 68.

¹¹²The best discussions of these patterns can be found in Philip Mason, *A Matter of Honour: An Account of the Indian Army, Its Officers and Men* (Harmondsworth, Eng., 1976); and Stephen P. Cohen, *The Indian Army* (Berkeley, Calif., 1971), esp. chaps. 1–3.

of industrialization. In addition to large-scale sepoy recruitment, the extensive employment of Indians in the imperial bureaucracy, British mercantile and manufacturing concerns, and later in the railway, telegraph, and postal services meant that they had a greater familiarity with the latest advances in European applied science and European technology than any other non-Western people.

Military technology more often brought together than distanced the British and Indians on a day-to-day basis, but most nineteenth-century writers were quick to point out the ways in which the superiority of the Europeans was demonstrated by the fact that they were the inventors and manufacturers of modern weaponry. From James Mill early in the century to Fitzjames Stephen in the 1880s, British observers tended to subsume military technology within a broader category of military prowess that was seen as the key to the conquest and rule of the vast Indian subcontinent by a handful of intrepid Europeans.¹¹³ This myth of the stalwart few dominating the many hundreds of millions, which pointedly ignored the essential Indian military, administrative, and economic roles in the rise of British dominance, buttressed the claim of numerous writers that Britain had earned the right to rule India by virtue of conquest and martial excellence. In the 1860s John Crawfurd explored the links between better weapons and overall British superiority in some detail. Noting the Asians' failure to fully develop their early innovations in military organization and firearms, Crawfurd asserted that "the art of war is that which proclaims the loudest the incomparable superiority, both physical and intellectual, of the European over the Asiatic races." He contrasted the stagnation of Indian military technology since the early eighteenth century with the Europeans' development in the same period of artillery that made Clive's cannons at the battle of Plassey in 1857 seem like "poppguns." He noted that the sepoys were useless without British officers to train and command them. Echoing the sentiments of numerous nineteenth-century authors, Crawfurd declared that the technology and military skills that had allowed the British to conquer and rule the hundreds of millions of Indians provided "the most signal example of the superiority of the European races over the Asiatic."¹¹⁴

Perhaps no writer better illustrates the great impact of scientific and

¹¹³For examples, see James Mill, "East Indian Monopoly," *Edinburgh Review* 20 (1812), 485; Fitzjames Stephen, "Foundations of Government in India," *Nineteenth Century* 80 (1883), 545; Thomas B. Macaulay, "Minute on the Black Act" (1836), in C. D. Dharker, *Lord Macaulay's Legislative Minutes* (London, 1846), p. 196; and Pearce, *British Attitudes*, pp. 47, 181.

¹¹⁴Crawfurd, "Physical and Mental Characteristics," pp. 69–70.

technological standards on the nineteenth-century decline in European esteem for India than the French sociologist Gustave Le Bon. A physician by profession, Le Bon is now remembered chiefly for his works on crowd psychology and revolution, but he was also an avid traveler who visited both the Middle East and India in the last decades of the nineteenth century. His personal impressions and inquiries were published in two large volumes, one on the Arabs in 1884 and a second, *Les civilisations de l'Inde*, in 1887. Though these works are now largely forgotten (Edward Said, for example, does not mention Le Bon's account of the Arabs in his indictment against Western Orientalists), both are in fact substantial works that capture in revealing detail many of the intellectual preoccupations and assumptions of bourgeois Europe in *la belle époque*. With regard to India in particular, Le Bon offered fresh impressions at a time when British assumptions about the Indians had reached a high degree of consensus.¹¹⁵ His views were also a good deal more generous and often more sensitive to Indian values and aesthetics than those of Mill and many earlier writers. Le Bon left little doubt that civilizations had developed in India and that these were mainly the creations of the Indians themselves. He had high praise for Indian art and architecture, religion, philosophy, and some artisan skills, such as weaving, fine metalworking, and woodcarving. Moreover, he expressed strong misgivings about the level of artistic accomplishment in industrial Europe; he even had the audacity to assert that in the fine arts and philosophy, Indian civilization had once reached higher levels of achievement than Europe exhibited in the age of "steam and electricity."

Nevertheless, Le Bon's praise for Indian civilization was fundamentally qualified by his conviction that the Indians were greatly inferior to the Europeans in the fields of science and technology. Judging that Indian scientific thinking had not advanced beyond "vulgar mediocrity," he found it far inferior to the pioneering work of the Arabs and too crude to be compared with that of the Europeans. Unlike most of his contemporaries, Le Bon recognized the high level of craftsmanship that Indian artisans had attained in numerous fields, but he agreed with those who argued that such technology and scientific understanding as the Indians possessed had been borrowed long before from the Arabs and especially the Greeks. He also concurred with the widely held view that the Indians had progressed to a level of development on a par with medieval Europe and then stagnated and fallen far behind progressive Western societies. Thus, even though Le Bon's estimates of Indian cul-

¹¹⁵This overview of Le Bon's arguments is based primarily on *Les civilisations de l'Inde* (Paris, 1887). For his views on the sciences and handicrafts in India, see esp. pp. 189–94, 244–46, 547–52, 562–64.

ture and history displayed a much greater appreciation for Indian contributions than most nineteenth-century European observers allowed, his evaluations of Indian science and capacity for invention were as disparaging and categorical as those of Mill and earlier writers and virtually all his contemporaries. These perceived flaws in turn strongly detracted, in Le Bon's eyes, from the overall accomplishments of the Indian peoples. He concluded that an inherent incapacity for scientific inquiry and original invention had stranded them at a far lower level of social development than that of the western Europeans and led to their conquest and domination by peoples more proficient in these critical areas of human endeavor.

China: Despotism and Decline

As the French essayist and novelist Pierre Mille observed in the early 1900s, when merchants, scientists, and technicians replaced missionaries and philosophers as arbiters of European opinion, beginning in the late eighteenth century, European awe of and desire to emulate China shifted to hostility, contempt, and an urge to remake the country in accord with Western designs. Mille mused, not without sarcasm, that because China lacked railroads, spinning jennies, and leaders like the German General Helmuth von Moltke, it could no longer hide its scientific and technological shortcomings and general backwardness from the progressive and aggressive Western powers.¹¹⁶ The Qing dynasty found its ability to resist the demands of the Western powers that they be able to trade and proselytize at will steadily diminished as overpopulation, natural calamities, and spiraling official corruption gave rise to widespread social unrest and a series of major rebellions, which sapped China's strength from within. Thus, long before the Opium War of 1839–42, which so brutally revealed the great military and technological advantages the Europeans had gained as a result of the Industrial Revolution, European assessments of Chinese civilization had turned decidedly negative. As we have seen, eighteenth-century merchants and naval commanders such as Lange and Anson were the first to broach many of the criticisms that would be directed against China in the era of industrialization. From the early decades of the nineteenth century these critiques were elaborated and intensified by travelers, missionaries, and members of the embassies that periodically visited the court at Beijing. No single writer played as pivotal a role in articulating shifting European attitudes toward China as James Mill did with regard to India, but

¹¹⁶Mille, "La race supérieure," p. 821.

John Barrow, a member of the Macartney embassy in 1793, published in 1804 an account of his experiences in China that set the tone for most later writers.

Formulated in the midst of a mission that is largely remembered for the ominous differences it underscored between British and Chinese approaches to foreign trade and diplomatic relations, Barrow's *Travels in China*, reflects the indignation and growing frustration felt by the members of Lord Macartney's retinue, who numbered nearly a hundred. In earlier centuries China's wealth, size, and unified power had permitted its rulers to display a good deal of arrogance in their dealings with European traders and missionaries. By the last decades of the eighteenth century, this posture was anachronistic, but the Chinese, oblivious to the transformations that were occurring in the West, persisted in regarding British and Dutch presents to the emperor as tribute from barbarian supplicants. They insisted that Macartney and other plenipotentiaries "kowtow" to the emperor. His refusal precipitated a major crisis for the protocol-conscious courtiers. In addition, the Qian-long emperor issued an imperious edict informing George III that Britain had nothing of importance to offer China in trade. The emperor also threatened that if the British continued to be troublesome, he would forbid the export of rhubarb and thereby cause overseas peoples the untold suffering of constipation.¹¹⁷ Thus, at one level Barrow's account, as well as a similar reminiscence published by George Staunton and Macartney's own journal, can be seen as responses to the supercilious behavior of the Chinese. Given China's much diminished position relative to the industrializing nation-states of Europe, the English and other Europeans increasingly found this behavior intolerable.

Barrow's reactions were also shaped by his own experiences and personal prejudices. Like Mill, Barrow was a self-made man. Reared in a modest Lancashire household and lacking the financial support and encouragement Mill had received from his mother, Barrow was forced to end his formal schooling after completing grammar school. But, as he proudly informs the reader of his *Auto-Biographical Memoir*, he strove with some success to continue to educate himself after becoming a clerk in a Liverpool foundry at the age of fourteen.¹¹⁸ Though William Proudfoot, who in the 1860s published a somewhat petty critique of *Travels in China*, heaped scorn on Barrow's pretensions to scientific

¹¹⁷An excellent introduction to the background of the mission is included in J. L. Cranmer-Bing, ed., *An Embassy to China* (London, 1962). For a discussion of the imperial edict and a translation of the original version, see Arthur Waley, *The Opium War through Chinese Eyes* (Stanford, Calif., 1958), pp. 28–31.

¹¹⁸John Barrow, *Auto-Biographical Memoir* (London, 1847), pp. 6–7, 14–16. Biographical details on Barrow are based on this memoir.

learning,¹¹⁹ Barrow had in fact received considerable practical instruction in applied science in the years during which he rose from clerk to overseer of the iron foundry. He also claims that at various points he had received instruction in or taught himself additional mathematics and astronomy. He left the foundry for a chance to travel to Greenland on a whaling ship and, after returning to England, won a position as a teacher of mathematics at a boys' academy in Greenwich. Barrow's part-time work as a tutor for the son of Sir George Staunton, who served as secretary to the Macartney mission, led to his invitation to join the ambassador's entourage. Barrow's official position as Comptroller of the Household afforded him numerous opportunities for interchange with Chinese at all social levels from porters to mandarin officials. Contacts with the latter opened the way for him to travel quite extensively in the Qing empire. He claimed to have some familiarity with the Chinese language, presumably also self-taught, and was confident that his personal observations and experiences had given him the qualifications to write an authoritative insider's account of Chinese civilization.

Despite its title, Barrow's *Travels in China* was intended to be much more than a travelogue. He undertook the same sort of detailed appraisal of Chinese society and history that Mill later attempted for India. Barrow interspersed descriptions of his travels and personal experiences with lengthy discussions of varying aspects of Chinese culture, from the grand themes of legal codes and the treatment of women to such minutiae as the appalling lack of water closets or other "decent places of retirement."¹²⁰ He began with the assumption that China had once achieved a high level of civilization—higher than that of Europe until the fifteenth century—"if not in the sciences, at least in the arts and manufactures, conveniences and luxuries of life."¹²¹ His judgments on the quality of Chinese life and material culture tended to be favorable at the beginning of his residence in China but grew more and more disparaging as time passed. On first seeing Beijing, for example, he hailed it as the greatest city on earth, with "streets that are much cleaner than those of its European counterparts." He initially commended the Chinese for their hospitality, honesty, industry, and skill. By the later stages of his travels, however, Barrow had come to regard Chinese cities as filthy and overcrowded breeding grounds for disease; he found China's laws "barbarous," its women degraded, and its lower classes oppressed. In the course of a discussion on the "gross and vile" amuse-

¹¹⁹William Proudfoot, *Barrow's "Travels in China": An Investigation* (London, 1861), pp. 15–17.

¹²⁰John Barrow, *Travels in China* (London, 1804), p. 333.

¹²¹Ibid., p. 289.

ments of the general populace, he concluded that Chinese civilization "exists more in state maxims than in the minds of the people."¹²²

Although similar criticisms can be found in the works of earlier writers,¹²³ Barrow went much further than even China's severest critics in challenging what he characterized as Jesuit fabrications that China was a major center of scholarship, wonderful inventions, and advanced material culture. Developing a theme that would become a major presumption for China "experts" in the nineteenth century, he argued that the Chinese had nurtured in ancient times a sophisticated civilization that had advanced steadily until about the fifteenth century, when it stagnated and went into long-term decline. Unlike the philosophes and many later writers, he had little to say about the causes of China's arrested development, though he did allude to the stultifying effects of China's despotic regime and its arrogant refusal to acknowledge the discoveries or skills of foreign peoples. It is not likely that Barrow had read the eighteenth-century writings of Hume and Condorcet, who had done much to advance the notion of the progressive development of human societies, but his account as a whole did provide an implicit contrast between static, past-minded, backward China and the continually improving, forward-looking, industrializing states of Europe. Architecture, social customs, and legal codes figure in his judgment of the relative worth of the two civilizations, but much of his commentary is devoted to an extended comparison of the woeful state of scientific learning and technological innovation in China with the splendid accomplishments of the Europeans in these fields.

Barrow acknowledged in a general way that ancient China had been a major source of invention and discovery, but his narrative includes little that is favorable about specific aspects of Chinese technology or science. He found Chinese ships "clumsy" and their navigation techniques antiquated and inept. He credited the Chinese with the invention of the compass but deemed those in use at the time of his visit far inferior to those employed by European navigators—which, he added, the Chinese were unable to read. He also doubted that they had ever made great sea voyages. Barrow found little to admire about Chinese tools or machines, manufacturing techniques, or modes of transportation. He judged Chinese agricultural implements to be on a par with those of Ireland—that is, very backward indeed. He contrasted the "simple machines" of China with the size and complexity of those he had worked

¹²²Ibid., pp. 90, 98–99, 138–39, 208, 222, 349.

¹²³See esp. George Staunton, *An Authentic Account of an Embassy from the King of Great Britain to the Emperor of China* (Philadelphia, 1799), vol. I, pp. 9, 12–16, 33–34, 82, 106–12, 226–29.

with in the English Midlands. He pointed out that China's carts lacked springs and inside seats, which had been in use in Europe since the late seventeenth century.¹²⁴ Even in papermaking and silk textile weaving, where Barrow conceded Chinese excellence, he qualified his praise by pointing out that the techniques of manufacturing these products had not changed for centuries. Though he extolled the splendor of the Great Wall and the Grand Canal, he refused to see these structures as typical or as evidence of a general aptitude for either engineering or architecture; he found Chinese buildings for the most part monotonous and awkward in design.¹²⁵

Barrow's views on the state of the sciences in China differed little from those of China's harshest eighteenth-century critics. He thought Chinese learning even further behind that of Europe than Chinese technology and averred that it had advanced little in two thousand years. He claimed that algebra, geometry, and chemistry were "totally unknown" to the Chinese and that their arithmetic was "mechanical" and wholly based on the abacus, a device which he thought useful for calculating sums but hardly suitable for conceptual breakthroughs. He suggested that the study of anatomy would "shock the weak nerves" of the timid Chinese and sought to illustrate the backward state of their medicine in general with the observations that they never resorted to bloodletting and that their medical texts were "little better than herbals." To impress upon his readers the extent of Chinese deficiencies in the sciences, he quoted one of the delegation's physicians, a Dr. Gregory, who reckoned that the best medical care to be found in China would be roughly equivalent to that provided by a sixteen-year-old apprentice to an Edinburgh physician.¹²⁶

Barrow ridiculed the Chinese for their unbearably arrogant supposition that foreigners had little to offer the Middle Kingdom. He pointed out that they had borrowed heavily in both the sciences and technology in recent centuries. He stressed the role of the Jesuits in transmitting knowledge and inventions from the West and noted that the emperor was dependent on them for accurate calendars and clocks and effective artillery pieces. Barrow saw this dependence as a symptom of China's general backwardness and evidence of the degree to which it had fallen behind the West: "They can be said to be great in trifles, whilst they are really trifling in everything that is great."¹²⁷

¹²⁴T. K. Derry and T. I. Williams, *A Short History of Technology* (Oxford, 1960), p. 212.

¹²⁵Barrow, *Travels*, pp. 25–26, 38–41, 61, 90, 215, 298–300, 301–5, 307–10, 312, 334–38, 564–66.

¹²⁶Ibid., pp. 274, 295, 297, 344–54.

¹²⁷Ibid., pp. 189, 284, 300–301, 342, 355 (quoted portion).

As Mill had done in regard to India, Barrow concluded that China had been considerably overrated by earlier writers, particularly the Jesuits and the philosophes. He deemed the Chinese "totally incapable" of excellence in machine technology and scientific theory, or even of appreciating recent European accomplishments in these fields. For this reason, and despite his early comments on the enthusiasm of the "Tartars" for European swords and carriages, Barrow did not recommend mechanical presents for the emperor or other notables. In fact, these were the very sorts of gifts that had been brought by the Macartney mission, as evidenced by the many contrivances presented to Qian-long and the presence in the British retinue of a Dr. Dinwiddie, whose chief task was to oversee the running and repair of the machines and to introduce Chinese officials to the wonders of European science.¹²⁸ In contrast to George Staunton, who reported intense Chinese interest in European inventions,¹²⁹ Barrow was dismayed by the lack of curiosity and understanding evinced by the emperor and his highest officials for the ingenious devices that the mission had carried to Beijing. He wrote that the Chinese confused planetariums with musical instruments—an error that revealed much, he felt, about the state of astronomy and mathematics in China. He further observed that because the head eunuch was unable to explain the purpose of air pumps and assorted electrical devices to the emperor, he simply informed the ruler that they were intended as "playthings" for the imperial grandchildren. So low was Barrow's estimate of the capacities of the people who had contributed such a large share of humankind's basic inventions that he strongly urged that future presents consist mainly of articles of gold and silver, childrens' toys, and other trinkets.¹³⁰

Although *Travels in China* has received far less attention than James Mill's *History of British India*, John Barrow's doubts and criticisms anticipated most of those that were raised throughout the nineteenth century. As his harshest critic William Proudfoot conceded, *Travels in China* was widely quoted and very favorably received by reviewers, who considered it one of the best travel accounts of the period.¹³¹ Even before it was published, Barrow's fellow ambassadors cited his opinions extensively and referred to him as an authority on Chinese affairs.¹³² By 1805 the work had been translated into German and French and published in an American edition. As Proudfoot admitted, Barrow became some-

¹²⁸Proudfoot, Barrow's "Travels," p. 18.

¹²⁹Staunton, *Authentic Account*, pp. 25, 82, 226–27.

¹³⁰Barrow, *Travels*, pp. 112–13, 311–12, 343.

¹³¹Proudfoot, Barrow's "Travels," p. iii.

¹³²Staunton, *Authentic Account*, pp. 2, 82, 112–13, 117–18.

thing of a celebrity in the late Georgian era, and his work was long regarded as one of the fullest and most reliable accounts of China. Later travelers and missionaries did not often footnote their works, but opinions and observations almost identical to those of Barrow abound in nineteenth-century writings, and he is explicitly cited by James Mill and numerous other authors.¹³³ His importance has been obscured, however, by the emphasis placed by twentieth-century historians on the Qing dynasty's humiliation in the Opium War of 1839–42 as the turningpoint in European thinking about China and the Chinese. Barrow's impact is also difficult to measure because several of his contemporaries, especially J. C. L. de Guignes and John Davis,¹³⁴ published descriptions of China expressing similar criticisms, though none provided the same detail or claimed the expertise that Barrow assured his readers he possessed.

The observations and opinions of John Barrow and his contemporaries formed the nucleus of a cluster of ideas about China that informed virtually all nineteenth-century accounts of the Qing empire. These ideas also shaped the assumptions and prejudices that were a vital part of the cultural baggage carried by missionaries, diplomats, and traders when they went out to the "Far East." As time passed, successive Chinese defeats at the hands of the Western powers, and the spread of economic distress and social disturbances within China as the Qing dynasty entered a period of irreversible decline, prompted harsher judgments and more extreme condemnations of Chinese customs and institutions. Diverse aspects of Chinese culture came under scrutiny. But China's failure to develop scientific thought or to advance technologically was seen by many of its most prominent European and American critics as the central cause of its backwardness and its greatly diminished standing in the "family of nations." Through the middle and late nineteenth century, European and American writers never seemed to tire of chronicling Chinese deficiencies. Barrow had anticipated most of their criticisms, denigrating Chinese accomplishments in such convincing detail that most later writers contented themselves with sweeping generalities. The veteran missionary Evariste Huc, for example,

¹³³Mill, *History*, vol. 2, pp. 311, 512; Jacob Abbott, *China and the English* (New York, 1835), pp. 149–51; Clarke Abel, *Narrative of a Journey in the Interior of China* (London, 1819), pp. 189, 202; F. S. Feuillet de Conches, "Les peintres européens en Chine et les peintres chinois," *Revue Contemporaine* 25 (1856), esp. 234; and William Ellis's introduction to Charles Gutzlaff, *China Opened* (London, 1838), pp. vii–viii, x–xi, xxx–xxxii.

¹³⁴For sample criticisms, see respectively J. C. L. de Guignes, *Voyages à Peking, Manille, et l'Ile de France* (Paris, 1808), vol. 2, pp. 161, 167–68; and John Davis, *The Chinese: A General Description of the Empire of China and Its Inhabitants* (London, 1836), vol. 1, pp. 6–7, 221–23, 240–41, 275–77, 301, 309–10.

lamented the decadence that had taken hold of China, where “old vices” (not specified) were on the increase. He compared China with its chaos and decrepitude to progressive Europe where “almost every passing day marked some new discovery.”¹³⁵ Equally typical was the sort of summary dismissal written by Captain John McLeod, who visited China several decades after Barrow: “With people who still imagine the earth to be a plain, and China in the middle, with all her tributary kingdoms around her; who are equally uninformed with regard to astronomy; who in the prohibition of the study of the human frame preclude the attainment of the very basis of medical knowledge; and who, in fact, are equally ignorant; and determined to continue so; it is evidently impossible to connect the term science in any shape or manner.”¹³⁶

The French economist Michel Chevalier put the case for Chinese inferiority to Europe even more succinctly. Tiny England, he boasted—in a rare instance of a Frenchman in this era lauding the attainments of his nation’s old and bitter rival—contained more machines, roads, and canals and produced and consumed more iron than all of the vast Qing empire.¹³⁷ Robert Knox made the comparison both simpler and more sweeping: he wrote in the 1860s that a single English engineer possessed more practical knowledge than all the savants of China.¹³⁸ His glib dismissal lacked the eloquence of Macaulay’s earlier quip that a single shelf of books from the library of an educated Englishman was worth all the learning of Asia, but Knox’s remark more effectively captured the sentiments of his age. Most nineteenth-century writers came to see achievements in the applied sciences—which engineering perhaps best exemplified¹³⁹—rather than in poetry, law, or philosophy as those most responsible for Europe’s global ascendancy, as well as those that best measured the extent to which Chinese civilization as a whole had fallen behind that of the West.

From the earliest centuries of European overseas contact with China, the military vulnerability of the scholar-gentry of the Middle Kingdom had drawn sweeping censures from adventurers and sea captains such as Galeate Pereira and the feisty George Anson. From the first decades of

¹³⁵Evariste R. Huc, *The Chinese Empire* (London, 1855), p. xxiii. For similar views see also W. H. Medhurst, *China: Its State and Prospects* (London, 1838), pp. 97–98.

¹³⁶John McLeod, *Voyage of His Majesty's Ship Alceste to Cathay, Corea, and the Island of Lew Chew* (London, 1819), p. 184.

¹³⁷Michel Chevalier, “L’Europe et la Chine,” *Revue des Deux Mondes* 23 (July 1840), p. 210.

¹³⁸Knox, *Races of Men*, p. 284. For further examples of this key theme, see James Wilson, *China* (New York, 1887), pp. 811–13, 285; and J. Dyer Ball, *Things Chinese* (London, 1892), pp. 1, 7–8, 29, 48, 229.

¹³⁹Layton, “Mirror-Image Twins,” esp. pp. 576, 580.

the Industrial Revolution, China’s military backwardness was elevated from a specific but significant fault to one of the most glaring manifestations of its technological inferiority to Europe. An incident related by George Staunton nicely illustrates the deeper significance that members of the Macartney mission assigned to what they viewed as the grave military shortcomings of the Qing empire. Staunton recounted that among the presents intended for the Qian-long emperor were six “elegant” brass cannon. When the Chinese legate assigned to the Macartney party discovered the cannon among the presents about to be sent to the imperial palace, he insisted that they be left behind. Staunton observed that the “whole conduct [of the Chinese official] seemed to indicate a mind agitated with apprehension,” and he concluded that the artillery pieces were refused because their obvious superiority to anything the Chinese could devise might well have led the latter “to entertain a higher idea of the prowess of the English nation than [their] own.”¹⁴⁰

In 1819 John McLeod told of a minor armed clash between a British frigate and a fleet of Chinese war junks. After a quarrel with the port officials at Canton, McLeod’s warship fought its way past the junks and the forts in the Bogue or delta area that guarded the approaches to the city. Noting how easily the defenses of the great port had been breached, McLeod observed that “almost any European gunners with the same advantages would have blown the frigate out of the water.”¹⁴¹ In the years that followed, which were filled with recurring Anglo-Chinese tensions, numerous writers commented on the military weaknesses of the Chinese empire. Perhaps the fullest discussion appeared in an anonymous essay published at Canton in the *Chinese Repository* of 1836. The author argued that the Chinese with their antiquated cannon and unruly armies were “powerless on land” and dismissed the imperial navy as nothing more than a “monstrous burlesque.” He viewed these weaknesses as mere symptoms of much more fundamental deficiencies in Chinese society as a whole. In fact, he prefaced his detailed critique with the claim that “there is, probably, at the present no more infallible a criterion of the civilisation and advancement of societies than the proficiency which each has attained in ‘the murderous art,’ the perfection and variety of their implements for mutual destruction, and the skill with which they have learned to use them.”¹⁴² Though most European observers would have balked at making military prowess so central a gauge of the level of social development, its growing importance in

¹⁴⁰Staunton, *Authentic Account*, pp. 33–34.

¹⁴¹McLeod, *Voyage of His Majesty's Ship*, pp. 163–65.

¹⁴²*Chinese Repository* 5/1 (1836), 165–78 (quoted portion, p. 165).

shaping European assessments of the overall merit of non-Western peoples boded ill for the Chinese, who had fallen far behind the aggressive "barbarians" at their southern gates.

With the Opium War of 1839–42, the full meaning of China's military backwardness was brutally revealed. In a series of engagements on land and sea—rather modest confrontations by European standards—British ships and British-led Indian infantry routed the numerically superior Chinese forces. Britain's decisive military advantage was perhaps most dramatically demonstrated by clashes between the iron-clad paddle steamer *Nemesis* and the Chinese war junks. In addition to the most advanced naval artillery pieces, including two pivot-mounted thirty-two pounders, the newly built *Nemesis* was armed with a rocket launcher. In what proved to be the most memorable clash of the war, it singlehandedly engaged a fleet of fifteen Chinese war junks. The British ship took the initiative by reducing the lead junk to a roaring ball of smoke and fire with a Congreve missile. As the remaining junks fled or were hastily abandoned by their demoralized crews, the *Nemesis* continued up the coast, forced the panic-stricken inhabitants of a small town to evacuate their homes, sank a second war junk and captured another.¹⁴³

The contrast between the *Nemesis* and the Chinese junks—which with their mat sails and painted eyes struck one British officer as "apparitions from the Middle Ages"¹⁴⁴—cast further doubt on the already much-contested image of China as a powerful and advanced civilization. These and later military setbacks convinced virtually all European observers that China was no match for Europe¹⁴⁵ and reduced the Chinese in the eyes of the European public to the pitiful creatures ridiculed in an 1859 *Punch* jingle:

With their little pig-eyes and their large pig-tails
And their diet of rats, dogs, slugs, and snails,
All seems to be game in the frying-pan
Of that nasty feeder, *John Chinaman*.
Sing lie-tea, my sly *John Chinaman*
No fightee, my coward *John Chinaman*

¹⁴³The best narrative of the political and military aspects of the war is provided in Peter W. Fay, *The Opium War, 1840–1842* (Chapel Hill, N.C., 1975). The historical background is skillfully surveyed in Hsin-pao Chang, *Commissioner Lin and the Opium War* (Cambridge, Mass., 1964). Frederic Wakeman, Jr., *Strangers at the Gate* (Berkeley, Calif., 1966) treats the broader social issues in depth and with great insight.

¹⁴⁴Fay, *Opium War*, p. 222.

¹⁴⁵See, for examples, Huc, *Chinese Empire*, pp. 402ff.; Knox, *Races of Man*, p. 282; and John L. Nevius, *China and the Chinese* (New York, 1869), p. 278.

John Bull has a chance—let him, if he can
Somewhat open the eyes of *John Chinaman*.

In order to imagine that China was Europe's equal, John Crawfurd mused nearly a decade later, "we must fancy a Chinese fleet and army capturing Paris and London, and dictating peace to the French and English."¹⁴⁶

Chinese ineptness at using up-to-date military technology provided the material for most of the anecdotes of bumbling "natives" which European commanders and travelers, like their counterparts in Africa, included in their memoirs to illustrate the great distance that separated the scientifically minded, industrializing Western peoples from all others. During the Opium War, J. Elliot Bingham, a lieutenant aboard the British corvette *Modeste*, mocked the ignorance and credulity of the Chinese, who had attempted to block the passage of the English fleet up the Pearl River to Canton by lining up large earthen jars in the hope that the Europeans would believe them to be batteries of cannon. Bingham assured his readers that such "childish" ruses were commonly employed by the Chinese against the British invaders.¹⁴⁷ Later authors cited similar attempts at deception—lighting fires in huge iron tubes to frighten the English with smoke; wearing huge and hideous masks to make the Europeans think they were "fighting monsters"—to demonstrate the "tricks worthy of children" to which the Chinese were forced to resort because of their technological inferiority. Frederic Farar sneered at the "asinine ignorance of the Chinese gunners who held lights near their cannon to allow them to fire at night." The English journalist Henry Norman noted that the Chinese were so foolish that they dried percussion caps and dynamite on steam boilers. Lord Curzon claimed that when Chinese soldiers were given modern weapons, they tended to jam them because they regarded all rifle cartridges as identical and thus did not bother to make sure they had the right gauge for the weapon they were using. Curzon went on to aver that superstition was widespread among the Chinese (adding, in a characteristic burst of snobbery rather than relativism, that the same might be said of the European masses). He claimed that it was widely believed in China that Christian missionaries used parts of the human body to concoct medicines and to mix chemicals such as those used in photography.¹⁴⁸

¹⁴⁶John Crawfurd, "On the Conditions Which Favor, Retard, or Obstruct the Early Civilisation of Man," *T.E.S.L.* (1861), 165.

¹⁴⁷J. Elliot Bingham, *Narrative of the Expedition to China* (London, 1842), vol. 1, pp. 303–4, 345.

¹⁴⁸Knox, *Races of Man*, p. 285; Farrar, "Aptitudes of Races," p. 124; Henry Norman,

As if to compensate for the awe with which European travelers in earlier centuries had responded to China, nineteenth-century writers delighted in stories showing Chinese amazement at and admiration for simple Western devices. Bingham and McLeod boasted of their ability to "dazzle" crowds of Chinese onlookers with crude telescopes and noted that even the lowly bilge pumps of British battleships astonished Chinese visitors.¹⁴⁹ The American missionary Arthur Smith reported that the Chinese were utterly bewildered by Western science and technology. Their inability to comprehend the "miracles" of Western invention, he argued, forced them to feign indifference or to seek fantastic explanations. Above all, Smith believed, the ignorance of the Chinese rendered them extremely vulnerable to deception on the part of their European rivals. To illustrate the point, Smith told the story of a carriage master at a European legation who convinced a group of curious Chinese that the springs of the vehicles in his care were able to propel them without horse or donkey; he insisted that donkeys were used only to show respect for Chinese custom.¹⁵⁰

Two basic positions developed in the nineteenth century regarding China's failure to match European achievements in technology and the sciences. Elements of the first approach, which stressed early advance and then stagnation, had been suggested by eighteenth-century writers. Their stress on stagnation was supplemented in the nineteenth century by a sense of overall decline, which appeared to be confirmed by the breakdown of the Qing empire. In 1855 an anonymous reviewer of E. R. Huc's account acknowledged that China had been responsible for the three inventions—the compass, printing, and gunpowder—which had been the "principal material agents of the progress of the modern world." In singling out these inventions, the writer continued a tradition that extended as far back as the sixteenth-century works of Jean Bodin and Louis Le Roy, which had been pivotal in the gestation of the idea of progress in the Western intellectual tradition.¹⁵¹ But the reviewer, writing when England's industrial supremacy was at its height,

The Peoples and Politics of the Far East (London, 1895), p. 286; and G. N. Curzon, *Problems of the Far East* (London, 1894), pp. 329, 352. In fact, as Frederic Wakeman has argued (*Strangers at the Gate*, pp. 27–28), the resort to trained monkeys and talismans with firecrackers to ward off the Western invaders was adopted only in desperation by Confucian scholar-officials, who were normally disdainful of the necromantic currents in Chinese culture.

¹⁴⁹Bingham, *Expedition to China*, pp. 274–75; McLeod, *Voyage of His Majesty's Ship*, pp. 71–72, 165–66, 173.

¹⁵⁰Arthur Smith, *Chinese Characteristics* (Shanghai, 1890), p. 42.

¹⁵¹J. B. Bury, *The Idea of Progress* (New York, 1960), pp. 40–41, 44–45, 52–62, 212, 215, 220, 292, 332; Morris Ginsburg, *The Idea of Progress* (Westwood, Conn., 1972), pp. 1, 53–54; Pollard, *Idea of Progress*, pp. 10–11, 20–22, 26–30, and chap. 2 *passim*.

merely used this praise for China's past accomplishments to set up an extended critique of its present backwardness and its failure to develop the full potential of these important inventions. He noted that the Chinese had not used the compass to explore the globe or expand trade, that they had not advanced beyond firecrackers after their initial discovery of gunpowder, and that their invention of printing had not led to a distinguished literary tradition. The reviewer went on to argue that though the Chinese knew about the circulation of the blood, their general knowledge of human anatomy was on a par with that of the rudest savages. He asserted that even in areas of manufacture in which they had displayed the greatest skill, such as the production of silk textiles and porcelain, Chinese tools and techniques had not improved for centuries.¹⁵² This assumption was so routinely accepted that Paul Champion could insist on the continuing relevance of mid-seventeenth-century texts on Chinese manufacturing techniques which he edited in the 1860s, because little or no change had occurred in the intervening centuries.¹⁵³

Numerous authors commented on the stultification of Chinese creativity and a related reluctance to import innovations from other civilizations,¹⁵⁴ but none matched Frederick Farrar's utter disdain for things Chinese. Having established that the "Aryan" race had excelled over all others in all fields, Farrar singled out the "semi-civilized" Chinese as a perfect example of "arrested development" and "mummified intelligence." He contended that their early inventions had "stopped short" at the "lowest point" in contrast to the constantly modified and improved devices of the Europeans. Farrar declared that the Chinese looked upon the compass as a plaything, that their ships were little more than "painted tubs" and their gunpowder "mere pyrotechny." He found all Chinese endeavors from religion to politics lacking in "progressiveness," "enthusiasm," "warmth," and "vigour." Reiterating the arguments of Captain Anson a century earlier, Farrar asserted that because the Chinese reduced everything to the "dead level of practical advantage," their learning, arts, and inventions had been marked by a

¹⁵²*Edinburgh Review* 101 (1855), 423–44. The arguments made by John Crawfurd in an essay written half a decade later are so similar that it is reasonable to conclude that he was the author of the Huc review. See "Conditions," p. 161.

¹⁵³See Champion's introduction to Julien M. Stanislas, *Industries anciennes et modernes de l'empire chinois* (Paris, 1869), p. 2.

¹⁵⁴See, e.g., Jean Bory de Saint-Vincent, *L'homme: Essai zoologique* (Paris, 1827), pp. 259–61; Hugh Murray, J. Crawfurd, et al., *An Historical and Descriptive Account of China* (Edinburgh, 1836), vol. 2, pp. 15–16, 301–4; William Lawrence, *Lectures on Physiology, Zoology, and the History of Man* (London, 1819), p. 483; and Le Marquis de Courcy, *L'empire du milieu* (Paris, 1867), pp. 184–85, 444–45.

"plague-spot" of "utilitarian mediocrity." Even their language, which, he said, had not developed beyond "hieroglyphics," exuded a sense of rigidity and stagnation; it was, he concluded, little more than a "petrified fragment of primeval periods."¹⁵⁵

The explanations for Chinese inertia offered by the proponents of the early invention-long term stagnation approach varied considerably, from Farrar's insistence on innate racial deficiencies to a focus (similar to that of such eighteenth-century writers as Parennin and Sonnerat) on Chinese despotism and veneration for tradition.¹⁵⁶ John Barrow touched on the latter but emphasized the absence of theory in Chinese thought as a whole. He expressed his displeasure at several mandarins' lack of curiosity regarding the reasons why alum caused mud particles to sink to the bottom of a vessel filled with water. He commented that though they were adept at dyeing and tinting "all manner of objects," the Chinese had no theory of colors. He pronounced them "totally ignorant" of the "basic principles" of astronomy, which, he snidely added, they professed to "value so much" but in fact "understood so little." It was this lack of interest in underlying principles, Barrow concluded, that had prevented the cumulative increase of scientific knowledge in China: "The practical application of some of the most obvious effects produced by natural causes could not escape the observation of a people who had, at an early period, attained such a high degree of civilization, but satisfied with the practical part, they pushed their enquiries no farther."¹⁵⁷

Barrow believed that the poverty of Chinese scientific theory had stunted technological development throughout their history. He noted that the Chinese were well aware that the heat of steam is much greater than that of boiling water and that they had long enclosed steam in ceramic vessels to soften animal horn for lanterns. Barrow was convinced that if this applied knowledge had been placed in a broader theoretical framework and improved through observation and experimentation, the Chinese would eventually have discovered the principles of the steam engine. This had not happened because the Chinese "seem not to have discovered its [steam's] extraordinary force when pent up; at

¹⁵⁵Farrar, "Aptitudes of Races," pp. 123-24.

¹⁵⁶The positions of Farrar and other racist thinkers on these issues are discussed in the third section of Chapter 5, below. For discussions stressing despotic rigidity and intense conservatism, see the anonymous review of De Guignes, *Voyage*, in *Edinburgh Review* 14(1809), 415, 422-26; Virey, *Histoire naturelle*, p. xxxiii; McLeod, *Voyage of His Majesty's Ship*, p. 191; and Samuel W. Williams, *The Middle Kingdom* (New York, 1879), vol. 2, p. 143.

¹⁵⁷Barrow, *Travels in China*, pp. 284, 297-98, 340-41 (quoted portion).

least they have never thought of applying that power to purposes which animal strength has not been adequate to effect."¹⁵⁸

Barrow's contemporary John Davis concurred with these pronouncements on Chinese deficiencies. Though his overall assessment of Chinese civilization was a good deal more favorable than Barrow's, Davis too was convinced that the Chinese had fallen far behind the West in many areas but especially in science and technology. Davis averred that much of the blame for China's stagnation could be traced to an obsession with custom and intense conservatism. These traits, he argued, had prevented the Chinese from fully exploiting the potential of their own inventions or those they had imported from the West and elsewhere. But like Barrow, Davis believed that the Chinese indifference to abstract knowledge and failure to apply the inductive method were critical liabilities. He noted an incident reported by another traveler, Clarke Abel, in which a Chinese scholar-official had shown no interest in potassium when Abel could not tell him of any practical use for it. Davis asserted that because the Chinese lacked curiosity, an interest in underlying principles, and a commitment to developing a cumulative body of knowledge, they must have "stumbled by mere chance upon useful inventions, without the previous possession of any scientific clue." Though Davis may have overestimated the direct impact of scientific knowledge on invention in Europe prior to the eighteenth century, he displayed an acute awareness of the increasing links between the two in his own era.¹⁵⁹

The judgments of Barrow and Davis were repeated by numerous later writers. Even though E. R. Huc, for example, had high praise for Chinese bridges and metalworking and mathematical skill, he faulted Chinese invention and science for their lack of systematic investigation and "fixed general principles." Huc, who wrote one of the most widely read accounts of China in the mid-nineteenth century, concluded that the absence of these qualities rendered Chinese efforts at innovation and discovery "scattered and desultory." He claimed that the natural sciences had no place in formal education in China, that the preservation of scientific knowledge and technical knowhow was left to "ignorant workmen." Consequently, the Chinese had actually lost scientific ideas and had forgotten techniques they had once mastered. Later observers pinpointed similar failings; Charles Gutzlaff, for example, concluded

¹⁵⁸Ibid., pp. 297-98.

¹⁵⁹Davis, *The Chinese*, vol. 1, pp. 6-7, 221-23, 240-41, 273 (quoted portion), 275-76, 301, 309-10.

that unless remedied by influences from the West, China could never produce "Bells or Pasteurs."¹⁶⁰

The second and minority position regarding China's technological and scientific backwardness, despite its promising beginnings, was even less flattering to the Chinese than the early creativity-stagnation thesis. As early as 1819 William Lawrence suggested that Caucasians from Persia had been the source of the artistic and scientific accomplishments of "the East" (by which he appears to have meant China, Japan, and India). Similar theories were proposed by several authors later in the century. The most influential of these, the Count de Gobineau, substituted Aryan invaders for Caucasian migrants. As late as the first decade of the twentieth century Robert Douglass, professor of Chinese at King's College (London) and Keeper of the British Museum, argued for the Middle Eastern origins of China's discoveries. He claimed that the Chinese had originally migrated from the Fertile Crescent, taking with them the scientific learning and philosophy of the earliest civilizations.¹⁶¹ Other writers were even more fanciful. Georges Pouchet, suggested that Greece had been the source of the "flowering of science in the East." The anonymous author of an 1865 essay in the *Anthropological Review* was more vague about the origins of Chinese science and technology. He felt, however, that the stagnation of Chinese inventiveness could best be explained by the fact that the ingredients for civilized development had come as a "gift from without." Thus, though the Chinese were able to advance until the impetus from these imports was spent, they lacked the "inherent intellectual vitality" to sustain their early development.¹⁶²

In the writings of such extreme Anglo-Saxon supremacists as Robert Knox, China's backwardness and stagnation were seen as proof that its past achievements had been highly overrated. Knox insisted that the Chinese had neither "invented nor discovered" anything, and that what they had borrowed they had not understood and thus could not improve upon. Unable to generate their own scientific and technological breakthroughs, the hapless Chinese had waited passively since the time of Alexander the Great for their destruction at the hands of more creative

¹⁶⁰Huc, *Chinese Empire*, pp. 301–3; Gutzlaff, *China Opened*, vol. 1, p. 507, and vol. 2, p. 159; S. W. Williams, *Middle Kingdom*, vol. 1, pp. 143–45, and vol. 2, pp. 178–79; George W. Cooke, *China* (London, 1858), p. 416.

¹⁶¹Lawrence, *Lectures*, pp. 483–84; Gobineau, *L'inégalité des races humaine*, vol. 1, pp. 353, 363–64; Robert Douglass, *China* (Akron, Ohio, 1903), pp. 504–5. See also A. Smith, *Chinese Characteristics*, p. 273.

¹⁶²Georges Pouchet, *De la pluralité des races humaines* (Paris, 1858), p. 2; "Race in History," *Anthropological Review* 3/11 (1865), 246.

and dynamic peoples.¹⁶³ Though total denials of Chinese achievement like Knox's were more rare than contemporary dismissals of African invention and science-mindedness, or of the African origins of Zimbabwe and Meroe, the pattern and its implications were similar. The refusal to acknowledge China's great contributions to technological innovation and scientific discovery facilitated the efforts of the more extreme advocates of white supremacy to denigrate the one civilization that had clearly rivaled and, in many categories of material achievement, surpassed Europe in the preindustrial era.

In view of what they regarded as the obvious ignorance and inferiority of the Chinese, nineteenth-century observers repeatedly registered their surprise and frustration at the Chinese refusal to admit European superiority and China's need to borrow ideas and machines from the West. As early as the 1790s John Barrow had unfavorably compared the Chinese, who remained contemptuous of Western imports, with the Russians, who had admitted their backwardness and sought to remake their society to conform with those of western Europe.¹⁶⁴ A century later Arthur Smith compared the mind of a Chinese scholar to a "rusty, old smooth-bore cannon" on a "decrepit carriage": it required a good deal of hauling about before it could be aimed and even then was likely to miss its target.¹⁶⁵ But the consequences of Chinese backwardness, vulnerability, and resistance to outside influences were less amusing than Smith's analogy. In the late 1860s John Nevius, an American missionary who had resided in China for sixteen years and who had great respect for Chinese culture, regretted that "the Chinaman has almost become a synonym for stupidity and his habits and peculiarities afford abundant occasion for pleasure and ridicule. This impression has become so fixed and so genuine that correspondents and news editors to stir up interest search for the most preposterous and grotesque anecdotes they can find."¹⁶⁶ Writing in the same period but without Nevius's empathy, Frederick Farrar approvingly quoted Tennyson's famous preference for fifty years of Europe over a "cycle of Cathay." The schoolmaster then sought to outdo the poet in imagery and denigration of things Chinese by proclaiming the age of Pericles worth a hundred centuries of "that frightful torpor, that slumber of death, that immoral congealment which characterizes the so-called wisdom of China."¹⁶⁷

¹⁶³Knox, *Races of Men*, pp. 282–83, 451, 599.

¹⁶⁴Barrow, *Travels*, p. 284.

¹⁶⁵A. Smith, *Chinese Characteristics*, p. 133.

¹⁶⁶Nevius, *China and the Chinese*, p. 275.

¹⁶⁷Farrar, "Aptitudes of Races," p. 124.

Material Mastery as a Prerequisite of Civilized Life

James Mill was not only one of the first authors to stress the centrality of scientific and technological accomplishments as proof of the superiority of Europeans over non-Western peoples; he was one of the earliest to link material achievement to a new sense of what it meant to be civilized. Mill had little to say about the elaborate etiquette and genteel manners that were the essence of civilization for members of the French court cliques, who distilled the concept from earlier ideas of *civilité* in the middle of the eighteenth century.¹⁶⁸ He focused instead on detailed comparisons of laws, political institutions and material culture, asserting that though toolmaking abilities might not be a "proof of civilization . . . a great want of ingenuity and completeness in instruments and machinery is a strong indication of the reverse." Like his contemporary Henri Saint-Simon, Mill was convinced that there was no better "index of the degree in which the benefits of civilization are anywhere enjoyed than in the state of the tools and machinery" of a given people.¹⁶⁹

These sentiments reflected the fundamental shifts that were occurring in European perceptions of themselves and their relationship to non-Western peoples. French and British writers increasingly depicted the European historical experience as unique. Though religion, physical appearance, and modes of political organization remained important emblems of this distinctiveness, the Europeans' scientific outlook and capacity for invention were more and more frequently cited as the basic attributes that set them off from all other peoples. They were responsible for the vast distance in time and level of development that Sir William Lawrence, writing shortly after Mill's *History of British India* was published, saw as separating the "highly civilized nations of Europe, so conspicuous in the arts, science, literature" and "a troop of naked, shivering, and starved New Hollanders, the hordes of filthy Hottentots," and the rest of the "more or less barbarous tribes of Africa." As Lawrence's caricature suggests, there was little tolerance for visions of noble savages in this intellectual climate. Now, savages were just that—poorly clothed and sheltered, chronically hungry, incessantly engaged in warfare and at the mercy of nature's cruel whims.¹⁷⁰

¹⁶⁸These shifts are elegantly traced by Norbert Elias in *The Civilizing Process: The Development of Manners* (New York, 1978), esp. pp. 35–40, 102–4.

¹⁶⁹Mill, *History*, vol. 2, pp. 30–33. For Saint-Simon, see Frank E. Manuel, *The New World of Henri Saint-Simon* (Cambridge, Mass., 1956), pp. 227–28.

¹⁷⁰Lawrence, *Lectures*, p. 244. On the repudiation of the Noble Savage ideal in the nineteenth century, see Christine Bolt, *Victorian Attitudes to Race* (London, 1971), pp. 144–45; Robert Berkhofer, Jr., *The White Man's Indian* (New York, 1978), pp. 75–76, 138–40; and Léon-François Hoffman, *Le nègre romantique* (Paris, 1973), pp. 115, 138–40.

By the middle of the century most writers were lumping Africans and Melanesians together indiscriminately as savages or primitives. The term "barbarian" was reserved for peoples who, like the Chinese and Indians, had advanced somewhat and then stagnated and declined. Few thinkers would have dissented from John Crawfurd's view that "skillful industry" was "ever a proof of superior civilization,"¹⁷¹ though many might have added that it was a precondition for civilization itself. They would also have concurred with his sense that China ought to be ranked above India in level of development because the Chinese had shown a much greater aptitude for the "useful arts" than the Indians. Some might have challenged his view that the Africans were superior to the American Indians because the latter could not work iron, but they were likely to support their case for the Amerindians with references to Mayan astronomy and mathematics or the genius of Inca engineering and architecture.

The new sense of what it meant to be civilized and the conviction that only peoples of European descent measured up to standards appropriate to the industrial age owed much to the growing influence of "self-made" individuals in shaping European perceptions of non-Western peoples. James Mill, John Barrow, and Gustave Le Bon, for example, who played pivotal roles in shaping attitudes toward India and China in their respective societies, were from families of modest means and little status: Mill's father was a shoemaker, Barrow's a small landholder and agricultural laborer, and Le Bon's a provincial functionary. Each of these writers spent his early years far from the centers of political and intellectual life but was driven from an early age to rise above his modest origins and make his mark in society. Each aspired in particular to acceptance by the intellectual establishment of his respective society. Each sought acclaim as an authority: Mill on India and issues of political economy more generally; Barrow on China; Le Bon on a multitude of subjects from phrenology and mass psychology to India and Arabia.

Their schooling and professional careers made these men acutely aware of the sweeping scientific and technological transformations that were occurring in their respective societies. Though his studies were concentrated in the humanities, Mill's years at the University of Edinburgh—then one of the premier scientific and medical schools in Europe—and his extensive involvement in the Utilitarian movement served to underscore in his thinking the contrast between Europe's ma-

¹⁷¹John Crawfurd, "On the Effects of the Commixture, Locality, Climate, and Food on the Races of Man," *T.E.S.L.* 1 (1861), 77–78.

terial advances and India's stagnation. Barrow had firsthand experience of the new industry during his years as a foundry supervisor; he scaled the lower rungs of the social ladder because he was able to convince others that he was competent to teach mathematics and astronomy. His knowledge of these matters goes far to explain the confidence, even arrogance, with which he criticized the techniques and tools of the Chinese and the state of their knowledge in diverse areas of scientific endeavor. Le Bon's training as a physician initiated him into the sciences in a period when the French were making great advances in medicine and other areas.¹⁷² His penchant for invention, interest in physiology and phrenology, and success as a popularizer of contemporary scientific thought and discoveries ensured that he would devote considerable attention to the techniques of production and the modes of thinking of the peoples he encountered in his overseas travels.

Common origins and ambitions, of course, did not necessarily produce common views, even on fundamental issues. Le Bon clearly thought both the Indians and the Arabs civilized and gifted in a number of areas, whereas Mill and Barrow continually referred to the Indians and Chinese as rude and barbaric. Le Bon also had much greater reservations than his British counterparts about the disruptive effects of the process of industrialization, as distinct from the benefits of invention and technological change more broadly. But whether or not there was consensus on which peoples measured up, or on the advantages and drawbacks of the particular course that technological change had taken in Europe, there was widespread agreement in this era on the criteria by which one could distinguish civilized from barbarian and savage cultures. This was particularly true among the parvenus who were the most explicit in applying the new standards and thus instrumental in promoting their growing acceptance. Evidence of scientific and technological accomplishment was no longer peripheral or regarded as symptomatic of more fundamental values and institutional arrangements. Machines and equations, or their absence, were themselves indicators of the level of development a given society had attained. Civilization was not a state; it was a process. Individuals who through education and hard work had risen above their modest family origins placed a high premium on improvement, a term that is ubiquitous in nineteenth-century writings on colonial areas. Change was not only good; it was essential for the civilized. Stagnation and decadence were associated with barbarians; "primitive" and poorly developed material

¹⁷²For an insightful account of Le Bon's life and thought, see Nye, *Origins of Crowd Psychology*.

culture with savages.¹⁷³ The history of civilized peoples was a tale of progress, of continuous advance; that of barbarians, a dreary chronology of endless cycles of decline and recovery.

Nineteenth-century authors vied with each other to coin the most compelling labels to capture this contrast: J. R. Seeley offered "future" versus "past" societies; Charles Caldwell, "improving" versus "stationary"; Carl Carus, "day," "twilight," and "night" peoples; and there were many variations on the dichotomies of active and passive, male and female.¹⁷⁴ As the century passed, these broad contrasts were refined. Specific attributes, associated with the scientific and industrial revolutions, came to be seen as characteristic of those who had achieved civilization. These ranged from ways of perceiving time and space to patterns of work and discipline. Unlike Le Bon, most European observers deemed peoples who lacked these qualities beyond the pale of civilization. If there was controversy, it focused on how to get non-Europeans to adopt civilized ways and the extent to which different peoples were capable of benefiting from the colonizers' civilizing mission.

Though this parvenu syndrome can be traced in the lives of many of the colonial officials, explorers, missionaries, and social theorists who did so much to shape European attitudes of Africans and Asians in this era,¹⁷⁵ its importance ought not be overstated. Individuals from an aristocratic background (Bentinck, Dalhousie, the Marquis de Courcy) and *haute bourgeoisie* families (Gobineau—despite his pretensions to aristocratic origins—Bagehot, D'Eichthal) continued to play important roles in

¹⁷³See McLeod, *Voyage of His Majesty's Ship*, p. 15; W. Cooke Taylor, *The Natural History of Society in the Barbarous and Civilized State* (London, 1840), pp. 1–5; and J. Denniker, *The Races of Man* (London, 1900), p. 127.

¹⁷⁴For a general discussion of several of these classificatory schemes, see Philip Curtin, *Image of Africa* (Madison, Wis., 1964), pp. 369–70. For contemporary examples, see Seeley, *Expansion of England*, p. 176; Charles Caldwell, *Thoughts on the Original Unity of the Human Race* (New York, 1830), pp. 134–58; and d'Eichthal and Urbain, *Lettres*, pp. 15, 22.

¹⁷⁵An informal survey of the lives of some fifty individuals from these groups, for whom the necessary biographical information is available, reveals that a large majority had lower-middle-class or middle-class origins, and that well over 50 percent were seriously involved in science or technology in their youth. As George Stocking has shown ("What's in a Name? The Origins of the Royal Anthropological Institute," *Man* 6/3 [1971], 380–81), the English naturalists and anthropologists who were so influential in shaping nineteenth-century European attitudes toward non-Western peoples were split between Darwinists and "ethnologicals" on one hand and "anthropologicals" on the other. The former were from well-to-do, middle-class families and well ensconced in the scientific establishment of the day. Though some members of the rival anthropologicals' organizations were drawn from respectable families, their deliberations and writings were dominated by men of lower-middle-class origins such as Richard Burton and James Hunt, whose scientific credentials were suspect.

colonization and exploration, or their writings provided key sources of information for readers interested in overseas areas. Nor, as the careers of Pierre Sonnerat and Dominique Parrenin illustrate, were parvenus absent from the ranks of the authors concerned with non-Western cultures in the preindustrial era. Thus, the shift that occurred in the nineteenth century was in degree more than in kind: self-made individuals of middle-class and even working-class origins assumed an ever greater responsibility for European enterprises in Africa and Asia and became the main source of information about and opinions on these areas. As was the case in the eighteenth century, the standards of judgment applied to non-Western peoples in the industrial era and the conclusions derived from them were widely shared by literate individuals at all class levels in England and France. All had witnessed the profound transformations that were occurring in western Europe and contrasted these with what they perceived to be stagnation and decadence in Africa and Asia. Aristocrat and parvenu alike retained the eighteenth-century conviction that *laissez-faire*, capitalist enterprise and human liberties had been essential for Europe's development. But now they were more acutely aware of the unprecedented nature of the power and material wealth that the Europeans' unique scientific and technological advances had generated. Now they more often saw these advances as the source of Europe's global dominion, as standards by which to measure the accomplishments of others against those of Europe, and as prerequisites for civilized life as they had come to define it.