

A
HISTORY OF
Metals
IN
COLONIAL
AMERICA



JAMES A. MULHOLLAND



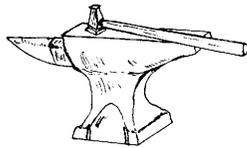
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The University of Alabama Press
University, Alabama

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Manufactured in the United States of America

Library of Congress Cataloging in Publication Data

Mulholland, James A. 1935-

A history of metals in colonial America.

Bibliography: p.

Includes index.

1. Metallurgy—United States—History. 2. Metals—
History. I. Title.

TN623.M84 338.973 80-15130

ISBN 0-8173-0052-X

ISBN 0-8173-0053-8 (pbk.)

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Table 1. Comparative Production of Iron in America

Preface



To one educated in an engineering tradition as I have been, the writing of history is fraught with perils. The adage that facts generated under controlled laboratory conditions and properly presented “speak for themselves” hardly provides a useful guide to the interpretation of historical events, the details of which, in engineering parlance, correctly belong to the realm of nonreproducible data. Rather, the facts of history provide the warp and weft for the historian’s loom, and the interpretations thence derived are patterns conceived by study, reflection, and continuous reappraisal. Despite one’s best efforts, such patterns rarely remain uncolored by the limitations of one’s knowledge or unavoidable bias. In writing history, then, the acclaim for achievement or criticism for weakness in any study inevitably and correctly falls on the shoulders of the author, who stands responsible for the integrity of his work.

No study as broad as the current one can be brought to a satisfactory conclusion without the advice and assistance of others. Here I would like to recognize those whose contributions made this work possible. Among them are George Basalla, John Beer, and George Frick at the University of Delaware and Robert Elliott of North Carolina State University, whose careful reading of the text at its various stages and timely suggestions prevented the perpetration of many an error. My knowledge of the processing of metals was increased by recommendations from Cyril Stanley Smith of the Massachusetts Institute of Technology. A major inspiration for the study was Eugene Ferguson of the University of Delaware, who also served throughout as my “conscience,” offering encouragement, criticism, and sympathy at the times and in the proportions needed. And to Malcolm MacDonald of The University of Alabama Press my special thanks for his enthusiastic support of this project.

Among the many who contributed time and effort on my behalf in specific areas I want to thank Carol Hallman of the Eleutherian Mills Library, Greenville, Delaware, Conley Edwards at the Virginia State Library, Michael Musick of the National Archives, Peter Parker and

Lucy Hrivnak at the Historical Society of Pennsylvania, and Lourdes More and Margaret Sugg of the D. H. Hill Library, North Carolina State University, for invaluable assistance in locating and obtaining needed materials. Kathryn Hardee and Ingrid Finnell deserve credit for the preparation of the final manuscript.

Finally, I owe a debt to my wife, Marillyn, without whose understanding and assistance this work could not have been written. As confidant and critic, she shared my frustrations and successes. To her this work is dedicated.

Foreword



A thriving technology for the smelting and manufacturing of iron and other metals is not normally associated with the colonial period of American history. A general conception prevails among both engineers and historians that the modern role of metals stems from the sweeping changes in the methods and organization of industry in the late eighteenth and early nineteenth centuries, the era identified as the Industrial Revolution. Histories of the metals industries in the United States rarely consider the iron industry significant before its expansion in conjunction with the building of the railroads just before the mid-nineteenth century. Although a few studies, such as those of Arthur Cecil Bining on iron manufacture, have attempted to examine facets of the introduction of metals technologies during the colonial period, the history of that period still is recounted with very little reference to the presence of any technology other than that related to agriculture. In view of the rapid growth of mining, smelting, and manufacture of metals in the early nineteenth century, I felt that a detailed survey of the introduction and early development of metals technology in America could provide an additional dimension for understanding and interpreting the industrialization of the United States. The initial purpose of this study, therefore, was a search for beginnings. It soon was necessary to consider the subject of colonial metals in a broader context.

Voltaire, the master of satire, is purported to have said, "History is after all only a pack of tricks we play on the dead."¹ As a diligent and perceptive observer of the deeds and misdeeds of mankind, Voltaire probably realized that history also is fully capable of playing tricks on the historian. As I set out to chronicle the history of metals in colonial America as a prelude to the study of the role of metals in the industrialization of the nation, a picture began to emerge that gave an altered perspective to the importance of metals in the colonial period. It became increasingly clear that the establishment and development of metals technology in America was essential to successful colonization by the English-speaking peoples and important in fostering the spirit of

independence that culminated in the American Revolution and the founding of a new nation.

Although at the time of the settlement of North America by the English-speaking peoples, European society was still agrarian in nature, there were few facets of life that did not involve the use of metal. Agriculture began with the clearing of land with the steel-edged ax, followed by the use of the iron-bladed plow to break the soil. Reaping and threshing with iron implements preceded grinding in a water-driven mill, where the wooden components of wheel, shafts, and gears were fashioned with metal tools and reinforced with iron bands. Crude houses could be constructed from natural materials using no other metal than the ax, but more substantial dwellings required nails and carpentry tools to build and iron, copper, and pewter utensils and hardware to furnish. Transportation also relied on the skills of metals craftsmen, from shaping wagon hardware and the horseshoe to the anchors and chains of sailing ships. On a comparative scale, the consumption of metal per capita has expanded greatly over the last few centuries, but the need for metals in the basic processes essential to civilized existence already had been firmly established before the seventeenth century.

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Foreword

The full significance of metals to an earlier, simpler age becomes more apparent when one considers the problem of attempting to create a society without metals. That significance has been brought home to me in teaching the history of technology and finding that students often manifest a deep mistrust for anything and everything labeled technology. It is an easy jump from the anxiety generated by nuclear arms races, ecological crises, and the erosion of individuality by the computerization of every facet of life to the conclusion that technology is out of control. Inevitably, probing reveals that in the minds of students uncontrolled technology is equated with too much technology. Their idealism conceives the goal of all human endeavor to be the "good life," a utopian society where man at last is free to realize his individual potential. But how does one create such a society? One approach is to ask the students to be master planners, to blueprint a self-sufficient community capable of enjoying the good life free from the pressures and anxieties created by the demands of modern society. Given the option to use or omit any technologies in creating their utopias, one fundamental fact always emerges from the students' efforts: all of the societies, however constituted, require the use of metals as a material base.

Sir Thomas More, the author of *Utopia*, whose work gave the generic name to subsequent speculations on the formation of ideal communities, reached an identical conclusion. Although writing before the industrial era and reflecting the prevailing agrarian basis of English society, he clearly perceived the role of metals in that society. Among the few occupations he listed for Utopians was that of metalworking, and other occupations such as masonry and carpentry required the use

of metal tools. Although More endowed his Utopia with independence in nearly all the necessities of life, the one essential commodity specified by name in a brief reference to imports was iron.²

If we regard the colonization of North America as the first great effort by Western civilization to create a utopian society, an idea that may warrant further study on its own merits, the colonists can be seen to have confronted in reality the same problems of material supply that concerned More's fictional Utopians. Survival in the wilderness for people nurtured in the habits and culture of Europe required the employment of metals, particularly iron. In the real world of seventeenth-century Europe, the colonists could have imported to satisfy their requirements, exchanging gold and silver for iron. More's Utopia possessed abundant precious metals, although it is often forgotten that Utopia's gold and silver, like its iron, were imported.³ Tales of great hordes of treasure among the natives of North America and of rich mines were common before and during the colonization period, their lure providing a chimerical magnet for many of the firstcomers. They helped to sustain an interest in finding mineral wealth that yielded only slowly to the more pressing problems of daily existence.

Europe possessed a sufficiently advanced technology to build fleets equipped with cannon capable of waging war on a global scale even before the English came to North America.⁴ As long as numbers were few and settlements were located near the coast and along the navigable rivers, that same capability supplied limited needs with relative ease. Thus for several decades the new utopia, like its fictional counterpart, was able to survive on imports. During that period, widespread interest in exploiting American resources was shown by colonists and companies of English merchants, particularly in the southern colonies. The hope was to find precious metals, an extension of the expectation that helped motivate the sixteenth-century voyages of exploration. When gold, silver, and copper were not found, the exploitative urge subsided to be replaced by an entrepreneurial stage in the colonies' development of metals. In the new stage, the knowledge and equipment to build ironworks were sent to the colonies, but the goal was to smelt iron for sale and use in England, not for the benefit of the colonists. Later, the same philosophy was applied to the mining of copper. It was a philosophy shared by English investors and prominent colonial officials and merchants. Like the exploitative stage, the entrepreneurial stage assumed a continuing dependence on England for basic metal manufactures.

History has no laws that define the stage of development in a colonial society, or one emerging from agrarianism, at which the introduction of a particular technology must occur. Neither has history explained the effects of the transformation of a society outwardly dependent for basic material commodities to one independent in the production of those commodities. Whether one degree of material independence fosters a desire for material independence in other areas

is a question that lies outside the scope of the present study, although the initial inclination would be to answer such a question in the affirmative. But the degree to which material independence, particularly in such a basic commodity as iron, contributes to a growing sense of political independence must be addressed in considering the development of metals in America. There is strong indication that here also a positive correlation may be found.

As the population grew and the pattern of settlement extended away from the convenient transport routes of the coast, the dependence on English manufactures became strained. The problems of supply were aggravated by political events in Europe and increasing limitations on the fuel necessary to smelt metals in England. The supply of manufactured goods was failing to keep pace with the growing demands for them on both sides of the Atlantic. Those were conditions More did not have to consider in creating his Utopian community. They are the points of departure between the static, ideal community of literary conception and the reality of a dynamic society for which demand and the corresponding problems of supply constantly increase. At some stage in the growth and evolution of society, the very character of need undergoes transformation. What has been an adequate solution to the satisfaction of human wants proves no longer adequate. Need becomes imperative. The alternative to continuing dependence upon technologies employed elsewhere is to import the technologies themselves.

In the early eighteenth century, a growing impatience with the supply of metals from England led to the creation of an indigenous American iron industry. Immigration had brought metals craftsmen to America with their valuable trades, but to build iron furnaces and forges it was often found necessary to import additional skilled workmen as the preferred alternative to importing metal. Amid the shifting fortunes of the early eighteenth-century English-speaking world, those men and their knowledge kindled a colonial desire for material independence that laid the foundations of the metals industries of future generations. Throughout the eighteenth century there was continuous and increasingly strong opposition by Americans toward any efforts by the British government to regulate the indigenous iron industry and metal manufactures. The political friction stemming from the threat to growing material independence represented by British regulatory legislation preceded by several decades the better known crises over stamps and tea. When the culmination of events led to an open break with England, the colonists faced the prospect of fighting a war against an acknowledged military power and the very country on which they had been materially dependent. By persisting in their course of action, the colonials displayed a confidence in their ability to wage war once that dependence had been severed. The existence of a viable metal industry, capable of supplying the materials of war, was a strong factor in inducing that sense of confidence.

The culmination of the revolutionary war ended the colonial status of the United States politically, but how successful had the Americans been in achieving material independence? In an article examining the state of the iron industry during the late eighteenth century, Joseph E. Walker has observed that the end of industrial colonialism did not coincide with the end of political colonialism. American manufacturing, and the iron industry in particular, still was subject to powerful economic restraints which Great Britain could exercise through the creation of trade barriers and the passage of laws to prevent the shipment of machinery or even new knowledge to America. The United States also had to depend on foreign raw material supplies of copper, tin, and zinc for manufacturing and of gold and silver for currency and jewelry well into the nineteenth century. Walker has suggested that for the iron industry the "colonial" period did not end until nearly the middle of the nineteenth century.⁵

For the current study, however, the terminal point chosen has been the decade of the 1790s. At the beginning of that decade, Alexander Hamilton issued the *Report on Manufactures*, strongly recommending the support of manufacturing as a national goal. In words reminiscent of More's conclusions regarding metals in the *Utopia*, Hamilton accorded iron the preeminent place among manufactures. Although actual federal encouragement of manufacturing remained highly variable until well into the nineteenth century, the direction the development of those industries was to take in the nineteenth century already had been delineated by 1800, as Hamilton realized.⁶

There is yet another reason to conclude the present study before 1800. I have attempted to examine, albeit sketchily at some points, the entire spectrum of metals as their mining or manufacture occurred during the colonial period. During the first decades of the nineteenth century, rapid expansion occurred in existing metals industries and new ones were added. The iron industry continued to grow along the eastern seaboard, particularly in the Pennsylvania-Maryland region, and it also accelerated the movement across the Appalachians begun in the 1790s. There were new developments in the mining and manufacturing of copper and lead, the beginnings of American brass and tin industries, new explorations and resultant mineral finds stimulated by the Louisiana Purchase and the westward movement of population. Finally, there was the discovery of gold in western North Carolina, the fulfillment of a quest begun before the colonization of North America. All but the last event more properly belong to a new era, to a continuous and accelerating growth of technology that transformed the United States from an agrarian to an industrialized nation. Hence the decade of the 1790s represents a watershed in the history of metals in America.

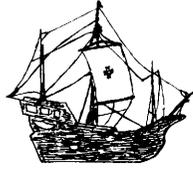
The story of the introduction and growth of the technology of metals in the colonial period, then, entails significant developments beyond

the transfer of the technology from the Old World to the New. In the determined struggle to create an indigenous industry, in the efforts to encourage and support the work of metals craftsmen, in the colonial defiance of British attempts to regulate manufacturing of metals, the importance of metals to colonial society is unmistakable. The establishment of metals technology, the basis for its future industrial greatness, was firmly intertwined with the political foundations of the United States in the colonial period.

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Before Jamestown



Men can no more do without iron than without fire and water. But gold and silver have no indispensable qualities. Human folly has made them precious only because of their scarcity.—Sir Thomas More, Utopia, 1516¹

Seagull: Come boys, Virginia longs till we share the rest of her maiden-head.

Scapethrift: But is there such treasure there, captain, as I have heard?

Seagull: I tell thee gold is more plentiful there than copper is with us; and for as much red copper as I can bring, I'll have thrice the weight in gold. Why, man, all their dripping-pans and their chamber-pots are pure gold, and all the chains with which they chain up their streets are mossy gold, all prisoners they take are fettered in gold; and for rubies and diamonds, they go forth on holidays and gather 'em by the seashore to hang on their children's coats and stick in their caps, as commonly as our children wear saffron-gilt brooches and groats with holes in 'em.—George Chapman, "Eastward Ho," act 3, scene 3, 1605²

When Sir Thomas More wrote his *Utopia* at the beginning of the sixteenth century, it was with the full and certain knowledge that iron supplied the material backbone of Western civilization. A new world recently had been discovered beyond the Atlantic. On the islands of the Caribbean and along the coasts of Central America the early explorers encountered relatively primitive tribes, uncontaminated by the institutions of European civilization, but also lacking any evidence of the technical skills and material culture deemed essential by Western man. More, intent on satirizing the growing corruption he perceived in his native England, seized upon the as yet uncharted expanses of America for the site of an idealized community. Certainly, it could be argued, the reports of explorers attesting to the unsophistication of the natives afforded a telling contrast to the social and moral degeneration that many felt characterized Europe. Nevertheless, More believed, the concept of an advanced civilization without metals would have been incomprehensible to any knowledgeable European. Because America in 1512 appeared to lack both metals and the skills to work them, he felt impelled to find some means to supply his *Utopia* with both. The

acquisition of Western technological skills More attributed to knowledge gained from a body of Roman and Egyptian artisans shipwrecked twelve hundred years prior to the pretended narrative. More circumvented the absence of metals by having the Utopians import them—iron for basic uses and, a point often overlooked by later seekers for utopias in America, gold and silver for commerce. As the source of much of the misery existing in contemporary society, the Utopians held gold and silver up to scorn and ridicule. “They have,” More noted, “no indispensable qualities,” whereas “iron is already greatly superior to either.” More’s observation was a sound reflection on recent developments in the use of metals throughout Europe.³

Since the late Middle Ages, Europe had been experiencing a steady growth in industry and trade. Expanding industries, increasing uses of power, the revival of cities, and changes in the technologies of farming and warfare all had made new demands upon the supply of raw materials. Widespread trade, reaching as far as the territories of the great Khan, encouraged an increase in the supply of precious metals. Mines abandoned since the period of the Late Roman Empire were reopened, and an active search for ores in hitherto little-explored regions gave rise to flourishing mining districts in Saxony, Thuringia, Hungary, and Sweden. In areas such as Devon and Alsace, where older mines existed, new veins of silver-bearing ores were discovered. Throughout Europe the production of metals, particularly iron, steadily increased.⁴

As the metal of paramount utility in Western civilization, iron’s abundant ores were recognized and exploited in every country. Iron, however, was difficult to recover. The high temperatures necessary to effect complete separation of the metal from its oxides were beyond the technical capacities of the furnaces used in Europe before the introduction of the mechanically powered blast in the fourteenth century. The evolution and spread of the blast furnace made iron more readily available with a corresponding increase in its use. The metal could be worked easily only when red hot and was subject to mysterious maladies causing some pieces to crumble under the hammer when hot and others to crack when cold worked. Moreover, the role of carbon in making steel was not understood before the late eighteenth century.⁵ For all its widespread use and utility, the smelting and working of iron constituted one of the most esoteric technologies discovered by Western man. As More observed, however, preoccupation with mining gold and silver from the twelfth through the sixteenth centuries often obscured the importance of iron.

Although far less common, the noble triad of gold, silver, and copper are relatively inert chemically so that they can be found in the pure or “native” state in nature. It had long been known that silver often occurred in association with lead ores, and techniques for the recovery of the small quantities of silver in lead ore had long been developed. Copper can be reduced from its ores at relatively low temperatures, the

same being true of the baser metals tin and lead. Together with gold and silver those metals can be worked extensively when cold. But the relative scarcity of the noble metals meant that far fewer people were familiar with their ores than with those of iron; hence, the ability to locate profitable lodes where native metal or lead ore outcroppings were not conspicuous generally was confined to the inhabitants of the active mining districts, most notably the German states. Given the European climate that fostered an awareness of the importance of metals, it was inevitable that the search for their ores would be carried to any lands beyond the Atlantic, but the emphasis was on the scarce metals, gold, silver, and copper.

Long before 1605, when George Chapman parodied More's words (Seagull's speech above is a direct recital of the passage describing the Utopians' contempt for gold), gold and silver had become a magnet drawing the Europeans westward. Spain reaped the benefits of early successes, inspiring a century of exploration by the European nations and invariable failure to discover new sources of precious metals. Rumor, however, proved more powerful than sober fact. The voyages of discovery—the quest for gold, silver, and copper in North America—set the stage for its colonization. Meanwhile, the lesson preached by More concerning the fundamental importance of iron was forgotten. During the sixteenth century, no one saw the necessity to relearn it.

Sir Thomas More still was twenty years away from writing *Utopia* when Columbus discovered America. In 1492, after fruitlessly offering his services to several European monarchs, including Henry VII of England, Christopher Columbus sailed westward under the banner of Spain to seek a new route to the Orient. Instead of a shortcut to the Indies, he found a new world, although at first he did not realize it. On subsequent voyages, the Spanish under Columbus planted the first European colonies in the Western Hemisphere since the Norsemen, and from them expeditions fanned out to the north and south, partly in the hope of finding treasure, partly still in search of a route to the East. In so doing, they established a pattern other nations, particularly the British, would follow in developing their interests in North America.

The coastal tribes first encountered by European explorers had little knowledge of metals, their sources, and uses; but, as Sir Thomas More had envisioned in *Utopia*, there were civilizations in the Americas that had extensive experience in the recovery and working of at least the more easily discoverable noble metals. Hernando Cortes's expedition to the central valley of Mexico in 1521 first brought Europeans into contact with them.

In the highly developed civilization of the Aztecs, and again in the Incan Empire in South America, the Spaniards encountered people skillful in the working of metals but with different attitudes toward metals from their own. Throughout Mexico and Central America gold