Iron and the Industrial Revolution

Among important European technological changes that accompanied the development of theoretical science were those in metallurgy, especially the production of iron. Innovations in iron production supported the advances that made possible the European industrial revolution, but the association of iron with power was not unique to Europe.

Iron and Power

In China, for example, the technology of iron and steel production had been central to the commercial revolution of the Song (960–1279), and by the late imperial period (Ming [1368–1644] and Qing [1644–1911]) metallurgy was a well developed technology that generated philosophical observations.

According to a sixteenth-century Chinese thinker, when observing the molten metal in the great blast furnace, one understood the origin of heaven and earth. For him, the fusion inside the furnace was like the beginning of the formless embryo, and its solidification was like the attainment of form. Similarly, the power of women to give birth was ascribed to the many African furnaces, including those of Bassari blacksmith smelters (1300–1800). Their furnaces, believed to be female, gave birth to red, glowing metal.

In the eighteenth century European depictions of blacksmiths and fiery furnaces provided imagery of the impact of the technology and its fearful, inferno-like qualities. Such imagery came to be synonymous with modern industrial life.

The Problem of Fuel

The demand for iron and steel accelerated in Europe after about 1000 because of an increased demand for weapons of war and conquest and a growing population’s need of more implements for farm, house, and industry. As a result, the scarcity of wood for charcoal, an essential ingredient of the smelting process, soon jeopardized the English and other European iron industries.
One effect of the charcoal shortage was to shift the center of iron metallurgy from one country to another. Sweden, for example, which had plenty of trees as well as iron ore, became the leading European iron producer by the eighteenth century, replacing Germany and France. In countries such as Great Britain, the shortage of trees resulted in the replacement of charcoal with pit coal, which was abundant there.

The key to increasing the production of iron and steel, once the major processes were in place, was clearly fuel, but the use of coal presented complicated problems. At all stages of iron making and steelmaking, the use of coal tended to impair the quality of the product. In 1614 a method was discovered for using coal in converting bar iron into a high-carbon product (steel), but for almost 100 years no advance was made toward the use of coal in the all-important blast furnace in which iron could be smelted in huge and continuous quantities.
West and Central African Cities

Ancient African cities were typically political, religious, and economic centers; after European contact, cities continued to perform some or all of these functions. For example, the cities of Ife and Benin (both in Nigeria) were built around the ruler’s palace, where industrial and economic activities took place and public rituals were performed. The palace was the hub of the city, and all roads to its hinterland radiated out from the city center.

Although new cities emerged after 1500 as coastal markets for the trade in slaves and other goods, centers such as Ife and Benin became sites of contested economic and political autonomy where the African rulers struggled to maintain control over the production of exports and the price and demand for imports in the rulers’ dealings with Portuguese, Dutch, and English traders.

One of the palace associations of specialists or guilds, Iwebo, was appointed by the Benin king to conduct affairs with the Europeans, and to this day its members speak a secret language they claim is derived from Portuguese, the language of the first Europeans. City artisans at Benin and other West African trading centers carved ivory objects as tourist art, which they sold to merchants and sailors. The Benin ruler also commissioned and collected items of material culture in his palace, according to the earliest European description:

*The king’s court is square, and is certainly as large as the town of Haarlem [in the Netherlands], and entirely surrounded by a special wall, like that which encircles the town. It is divided into many magnificent palaces, houses, and apartments of the courtiers, and comprises beautiful and long square galleries, about as large as the Exchange at Amsterdam, but one larger than another, resting on wooden pillars, from top to bottom covered with cast copper, on which are engraved the pictures of their war exploits and battles, and are kept very clean.*

The Lunda of Central Africa had established their capital, an elaboration of the royal enclosure (musumba), in open woodland east of the Kasai River. European visitors who saw several musumbas during the nineteenth century were impressed with their structures, orderly
roads, and open public squares and with the cleanliness and hygiene of their communities. In contrast, European travelers described the Portuguese city of Luanda as small and squalid.

The marginal placement of European traders in separate quarters for visitors was a widespread and traditional strategy for organizing the inhabitants of settlements according to ethnic affiliation, historical placement, and local importance.
Urban Landscapes in the Islamic World

The cultural encounter with Europe altered and transformed many parts of the world, but it was not the only source of global interaction and syncretism. The vast interactive sphere of the Islamic world depended on the existence of large cities and flourishing trade. The creation of Muslim empires led to the growth of large cities. The complexities and demands of urban life gave direction and impetus to long-distance trade that served the populations of cities.

Islamic Cities

The great Islamic cities were centers of trade and manufacturing, though the growth of European textile industries and the growing markets for East Asian goods were reducing the importance of Muslim manufactures in international trade. Surrounding the stable urban population of merchants, shopkeepers, and craftsmen was a larger population of unskilled workers, peddlers, street cleaners, and the semi-employed, a stratum that included a large proportion of rural immigrants. The line between country and city was not sharply drawn: market gardens surrounded and intruded into the city, whose outskirts attracted the floating rural population, which greatly increased in number in times of need and disorder.

The structure of Islamic cities reflected their purposes: trade and manufacturing, religion and scholarship, government and justice. Two or more complexes of major buildings were part of every Islamic city. One complex was the main mosque, surrounded by the chief courts, schools of higher learning, shops that sold objects of piety, and possibly the shrine of a saint identified with the life of the city. Another complex included the central market place (the main point of exchange), offices of money-changers, storehouses, and shops that sold locally made or imported goods. A third complex might be government offices.

The power of government was present in everyday urban life (as watchmen, market supervisors, and police), but it was expressed as well in large and sometimes ostentatious public buildings. Wealthy traders, merchants, and craftsmen resided near their complex, and scholars and religious leaders near theirs, but most of the urban population lived outside the center in quarters that were a mass of small streets and cul-de-sacs. Each quarter had its mosque (or shrine
or church or synagogue), local market, and public bath. The tendency was for each quarter to reflect common links: religious, ethnic, and regional. Farthest from the center, near or beyond the walls of the city, were the poorer quarters of rural immigrants and the workshops of noisy or malodorous crafts (such as tanning or butchering). Also outside the city walls were cemeteries.

**Urban Society**

Non-Muslims in Islamic cities were set apart from the families of believers. They paid a special tax (jizya), and Islamic law required that they show signs of their difference by dressing in special ways and avoiding colors (especially green) associated with Islam. They were prohibited from carrying weapons or riding horses (much as native populations in Spanish America were) and could not build new places of worship or repair pre-Islamic ones without permission. Laws about marriage were strictly enforced: non-Muslims could not marry or inherit from Muslims. And though Christians or Jews might occupy positions of importance in certain economic activities such as the arts, they were virtually excluded from others such as food preparation.
Technology, Textiles, and Trade in Asia

More than European technology helped to determine many of the qualitative aspects of human experience around the globe. In many parts of the world, power continued to be derived from control over technology and the valuable trade items that technology produced. Sometimes technological innovations were stimulated by the expansion of markets; elsewhere, artistic style and innovation were valued for their own contribution to sumptuous urban life as well as to individual or social identity.

Technological innovation and tradition helped create luxury goods for global distribution. The movement of material goods reflected the beginnings of a shared global culture. The biggest imports to Europe from Asia were raw and woven silk from China and linens and cotton muslins from India. The fast colors, fine weaving, and especially the imaginative designs of “Indian cloths,” as all Asian fabric came to be known in England, made it popular and subject to imitation all over Europe. The influence of Asian fabric designs extended far beyond silk, linen, and muslin.

Chinese Silk

In China sericulture, or silk production, was the major textile industry. There was a high demand for silk, not only by the court aristocracy but also by wealthy merchants who populated the prosperous cities of the Yangzi delta region. Picture patterns were woven on silk, and silk garments were highly prized.

The organization of labor in the Chinese silk industry was specialized and had some similarities to that of the European textile industry. The textile industry in Europe was directly fed by merchants who had capital at their disposal and would use it to advance raw materials to craftsmen. In China such capital support was most visible in the silk industry, which needed costly raw materials. In a typical Chinese silkweaving workshop, the workers might be members of a household who received yarn from wealthy commercial firms; or they might weave as either piece-rate workers or with their own materials.

By the eighteenth century commercial forces in the Chinese silk industry had reduced many highly skilled urban weavers almost to the status of daily wage workers completely dependent on export demand.

West Asian Textiles

In West Asia, in addition to the interest in ceramics, enormous attention was also given to the production of textiles, especially after 1500. Silk, linen, cotton, and wool were the raw materials. Satin, brocade, and velvet were the products. From diaphanous gowns to thick felt cloaks, the choices, as reflected by a vast technical terminology, were astonishing. Clothing and fabric became major items of international trade during the expansion of maritime commerce after 1500. This trade brought to other parts of the world such words as damask, sash, muslin, chiffon, cotton, and taffeta. Cotton and silk woven in all major urban areas of West Asia were supplemented by a woolen industry based on the manufacture of carpets and coarse materials.
Carpets

After the Turkish invasion of West Asia, carpets became major items of international trade. In their homes most West Asians sat on stools or sofas covered with textiles and ate and slept on the floor, making themselves comfortable with carpets, cushions, and mattresses. The textile industry therefore provided important products for daily life. Carpets in particular were utilitarian as well as decorative.

The appearance of Turkish carpets in European paintings from the fifteenth and sixteenth centuries demonstrates their significance as an item of trade. Persians rapidly adopted the art of carpet making from the Turks and then made their own innovations, producing some of the finest carpets ever made. The Persians, in turn, stimulated carpet production in Mughal India. From the sixteenth century on, Iran and Ottoman Turkey emerged as producers of highly prized wool or wool and silk rugs and carpets, which were produced not as part of the nomadic economy but as an urban industry, located especially in Bursa, Tabriz, and Isfahan.

A similar pattern of regional concentration of textile industries was found in the Indian subcontinent, which remained one of the greatest exporters of cotton goods to the world market. The four significant industrial regions of India specializing in the manufacture of cotton fabrics for the world market were Punjab, Gujarat, the Coromandel Coast, and Bengal.