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## ***A HISTORICAL PERSPECTIVE ON MINER'S CONTRIBUTION***

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### **1.1.2 The Miner's Contribution to Society**

The contribution of mining has played a bigger part in the development of civilization than is usually conceded by the historian or recognized by the ordinary citizen. In fact, products of the mineral industry pervade the lives of all members of our industrialized society.

Early man relied upon wood, bone, stone, and ceramics to fashion tools, weapons, and utensils. Civilization was advanced by the discovery of abundant supplies of high-quality flint in northern France and in the chalk beds of southern England. Culture after culture occupied the sites around the Acheuleum communities over a span of 200,000 years. Clay deposits supplied material for storage vessels as agriculture was introduced, and the metallic residues from pigments in the potters' kiln may have provided the first clue to these ancient peoples of the secrets of extraction of metals through smelting. Likewise, salt was recognized as essential in the human diet and, along with flint, became a prime medium of exchange that dictated early trade routes. During the initial development, the use of metallic minerals was in the form of pigments, decorative beads, and native metals that could be shaped into simple objects by hammering.

Most discoveries of these useful minerals were made by accident along trade routes. However, Egypt, which was not well endowed with mineral resources, sent out expeditions exploring for turquoise and gold as early as 4500 BC, resulting in an era of warfare for the acquisition of metals. The Mycenaeans followed by the Phoenicians broke this cycle of war and became wealthy, exchanging minerals for goods. These traders/prospectors sought deposits of silver, tin, lead, copper, and gold, acquiring them by barter rather than by conquest. By 1200 BC they had sea trade routes throughout the Mediterranean world, acquiring lead and silver from Spain, copper from Cyprus, and tin from Cornwall.

By 100 BC trade routes between China and the West, primarily for silk and spices, were well established. The roads passed through many countries and disseminated knowledge of "seric" iron (steel) and metallurgical technology to the known world. By 620, during the Tang Dynasty, China had become the most advanced society in the world culturally and technologically. The fact that mining technology never fully developed in China can probably be attributed to Guatarma (563-483 BC), who taught that "suffering is caused by the craving for that which one has not," resulting in governmental policies that alternately discouraged and encouraged mining.

The discovery of copper on Cyprus c. 2700 BC resulted in the fabrication of tools, weapons, and household utensils made of metal and turned the island into an important trading center. Wealth poured into the island allowing for luxuries and artistic and religious development.

Work in the mines by the Greeks and Romans was first done by slaves, either prisoners of war, criminals, or political prisoners. Easily exploitable deposits were eventually exhausted and mine economics demanded mining skills. As a result, beginning with the reign of Hadrian (AD 138), the Roman Empire began to recognize a degree of individual ownership and permitted mining by freedmen in increasing numbers. There was gradual improvement of mining technology through the Roman Empire that accompanied replacement of slaves by skilled artisans, though villeinage was still practiced.

One legacy largely the result of Phoenician trading was to create a system whereby power and prosperity could thereafter be measured in terms of actual, exchangeable wealth. In this capacity, gold and silver throughout history have been universally accepted coinage. Thus debasement of the Roman denarius resulted in its loss of creditability as the standard of exchange, contributing to the fall of the Roman Empire, and by the end of the 6th century, the Latin West reverted to an agrarian

economy and abandoned coinage and trade. The center of culture and technology shifted to the Byzantine and Islamic empires.

Charlemagne (768-814) recognized the need for metals and began the mining of lead, silver, and gold at Rothensberg, Kremnitz, and Schemnitz by enslaved captives. Charlemagne also reformed the coinage of his Holy Roman Empire, and these actions set in motion the establishment of new mints during the 10th century in Eichstadt (908), Cologne (960), Hildesheim (977), and Saxony (990), creating new and geographically dispersed demand for metals. Thus as Charlemagne's Empire gave way to more local kingdoms, a demand for precious metals had been created that aroused the spirit of enterprise and awakened interest in the development and use of metals; Europe saw a birth (or rebirth) of the traditions originally carried by the Celts of nomadic mining expertise. This rebirth was characterized as "bergbaufreiheit," or the rights of the free miner, whereby the poorest villein could become his own master merely by marking his own mining claim and registering its boundaries after making a discovery—subject to a tribute or royalty paid to the royal land owner. The miner thus ceased to be a serf and became a free man. The evidence of the foundation of this concept of self-initiation of rights to develop mineral ground includes a treaty initiated by the Bishop of Trent in 1185, where miners were invited to explore and mine that region of northern Italy as free men with rights of discovery; the charter of rights granted to miners by the various princes in the Germanic empire in 1209; and the results of the inquisition ordered by Edward II of England in 1288 to memorialize the ancient customs and practices of the miners within his realm. Thus the right of ownership based on discovery by a free miner became the foundation for mining laws carried by individual miners throughout Europe, then to the America, Australia, and South Africa.

Discoveries lured hordes of prospectors and miners, followed by farmers and merchants, eastward into Saxony and beyond to become settlers and developers of the land. Expansion east of the Rhine into the rich metalliferous province of Saxony resulted in discovery and development of mines at Schemnitz, Kremnitz, and Rammelsberg, and marked an awakening of metal mining, the revival of industry and trade, and the end of the Dark Ages in Europe. The metal from central Europe moved directly south to Venice and was largely responsible for the conversion of this poverty-stricken village of the 9th century into the richest port in southern Europe.

The affluence created by this industry had ultimate consequences in the arts, as Emperor Frederick II, supported by the wealth of Rammelsberg, became a noted patron of literature and science and contributed substantially to the Renaissance.

As mining extended underground, the free miner found that he could do little by himself, so he formed a partnership. As the operation grew, other men were required, and self-governing associations were born whose ownership and financial stake were supported by contributions memorialized in a "cost-book." The cost-book association formed the model for company organization. Wore the practice of issuing stock as evidence of proprietorship. In the 13th century, the German cost-book association usually consisted of 16 able-bodied men. As the scale of operation increased, it was necessary to add additional participating shares, and Agricola notes in his time that the number of shares at Achneeberg was 128, of which 126 were private owners in the mine, one to the state, and one to the church.

Initially, production was divided among the shareholders, but as treatment and marketing became more complex, the sale became centralized. When a profit was made, it was divided among the "adventurers," but when losses were experienced the adventurers were required to contribute in proportion to their holdings or risk loss of their ownership. Rarely was any money set aside as a reserve, and consequently, a decline in metal prices or grade generally resulted in mine closure.

Growing demands for capital forced a search for outside capital, and gradually operators lost control to investors. The miners became contract workers. Guilds, originally organized by miners for charity and insurance, assumed objectives of industrial aggression.

When public financing in Britain was made possible through the enactment of the Limited Liabilities Acts of 1855-1862 and repeal of the Bubble Act that had limited stockholders to eight, British capitalists came to the forefront in financing mineral development worldwide. Goldsmiths assumed a banking function and issued printed receipts (or notes) payable to any bearer—the forerunner of present paper currency.

During the 18th century, iron metallurgy made great strides and made possible the Industrial Revolution in Britain. Village craftsmen evolved into the factory system and the "Friendly Societies" legally took on the function of the trade unions after 1825.

An industrial revolution is a period during which the economy of an underdeveloped country is transformed into an industrial economy, stimulated by availability of energy sources and metal resources. This change took place in Britain during the 18th and early 19th centuries and spread to France, the United States, Germany, Japan, Russia, Sweden, Canada, Taiwan, and Korea in approximately that order. The developing technology was accompanied by a revolution in science and engineering, with empirical contributions from alert and observant workmen.

The machine age introduced by the Industrial Revolution of the late eighteenth century also required minerals as raw materials and as a source of energy. Industrial power thus became a measure of political and military power, and exploration for the acquisition of minerals resources extended to nearly all parts of the world. Nations' economies became interdependent. In an attempt to control the large-scale international flow of mineral resources, various commercial and political measures have been tried: monopolies, cartels, tariffs, subsidies, and quotas to name a few. The final result was that political and commercial control over mineral resources and their distribution played a leading role in both the maintenance and destruction of world peace .

No mention of coal mining appears in the historical record of the West until late in the thirteenth century. Early references are either to "quarries" or "drift" material. Development of coal mines in Britain, Europe, and the United States supplied energy that powered the industrial revolutions.

The structure of the coal industry traditionally was one of many small, low-capital, independent operators who supplied the retail and industrial markets, and a certain percentage of captive mines that supplied railroads, steel and electrical power requirements all operating within their national boundaries. Depressed coal prices resulting from competition from oil and gas forced reorganization of the industry through aggregation by mergers and acquisition of small operations, mechanization, and a move to surface mining operations by larger companies able to afford this capital-intensive approach. This first occurred in the United States during the late 1950s and early 1960s, and internationally during the late 1960s and 1970s as coal markets were likewise expanded.

The petroleum industry not only shared in the technological developments, but along with coal was in a large part responsible for supplying abundant, cheap, and flexible energy and chemical raw materials. It created demand as well as responding to demand.

The story of aluminum is one of human ingenuity in the creation of a new metal, a new way of life, and a spate of new industries and technologies, as well as combined chemical, technological, and geological cooperation and discovery. Aluminum was not isolated as a metal until 1825 and has been in commercial production for only 100 years. Its discovery was made possible through development of the dynamo by Faraday and Edison.

Uranium, consistent with the history of copper and iron, was first used as a weapon. Its technology began in 1896 as a curious clouding of a photographic plate and evolved into a weapon, less than a half century later, of horrible destructive dimensions, first witnessed on the New Mexico desert in 1945 with the man-made thunder and lightning that was the atomic bomb.

Finally, fascination for gold has lured explorers, invaders, investors, settlers, and "con men" to all parts of the world. It has served, and continues to serve, as an international medium of exchange and a measure of a nation's wealth and financial stability.

### **1.1.2.1 Minerals and National Policy**

With the final peace settlement after World War I, Germany lost 68% of its territory, all of its gold silver, and mercury deposits, 80% of its coal mines and iron-producing capacity, and entered into a period of depression and starvation. The German economy managed to recover with imported ores and a high degree of technical skill and efficient labor.

The depression years of the 1930s resulted in economic nationalism and protective tariffs, and many markets were effectively closed. Since Germany and Japan were both dependent upon international trade, their standard of living plunged, and hunger, bitterness, and resentment flared. The

Nazis came to power in Germany with promises of work, food, and prestige; rearmament began in 1933, and Japan followed suit shortly thereafter, leading the world into World War II.

The world's mineral resources since the latter part of the 19th century have been primarily developed by Britain, the United States, the Soviet Union, Japan, West Germany, and France. These countries have furnished the necessary science, technology, and capital and have supplied the markets

Local mineral wealth throughout history and social development has made first one nation rich and powerful, then another. The Phoenicians established worldwide trade and gained great wealth by developing and exchanging minerals for all manner of goods. Athens financed its ancient wars and "Golden Age" with silver from Laurium, Alexander funded his early conquests with gold from Macedon, the Romans expanded their Empire to acquire the silver of Carthage and the copper of Spain, and the Catholic crown of Spain became a world power by the exploitation of gold and silver from the New World. During the Middle Ages, Germany became the center of lead, zinc, and silver production and the leader in mining technology. Britain moved into the forefront during the Industrial Revolution of the 19th century and was successively the world's leading producer of tin, copper, lead, and then coal. Her resources were bolstered by those of a vast empire, and she became the wealthiest nation in the world. The greater resources of the United States subsequently supported its advance to become the richest nation; however, the future is already foreshadowed. Most of the Greek, German, and British high-grade mines are exhausted, and the United States is fast becoming dependent upon imports and preservation of peaceful world trade. Near East countries have experienced a rapid rise to great wealth based upon petroleum resources. This has been important in technological developments, but historically is of short duration. New discoveries of high-grade metal deposits are very likely in the Soviet Union and in China but less likely in the United States.

### 1.1.2.2 Future Contributions of the Minerals Industry

With few exceptions, no nation can achieve a high level of prosperity without a reliable source of minerals to supply its manufacturing industry. Through mining, emergent (Third-World) countries can finance growth progressively by the export of raw mineral resources, then by processing these raw materials prior to export, and finally by achieving progressive industrial development (Fig. 1. 1.1).

Mineral reserves, upon which the future of the human race depends, occupy less than 0.1 % of the continental areas. Unfortunately, we are not at present sufficiently skilled to determine exactly where they occur or how large they may be. They remain elusive targets.

Research in mining and metallurgical technology is essential. A new discovery may locate a mine, but a technological breakthrough can open up mines all around the world.

The economic evolution of society that began in Neolithic prehistory was based then, as it is now, on minerals, and has led man into modern times. The 104 elements of the periodic table, all but a few of which are recovered from widely spaced, often remote, mineral deposits using a variety of complex mining and metallurgical techniques, form the foundation of modern society. They provide its heat, light, shelter, transportation, communication, and food. The standards of living of the industrialized nations – which developing nations are striving to attain – are based upon minerals, and societies could not continue in their present state without them (Table 1.1.2 and 1.1.3 and Fig. 1.1.2).

**Table 1.1.2. Per Capita Consumption of Minerals in the U.S. (1970)**

Commodity	Quantity	Major Uses
Steel	1,400 lb	Transportation
Aluminum	44 lb	Kitchenware, bldgs
Copper	20 lb	Electrical appliance
Tin	1 lb	Cans

Petroleum	3.4 tons	Transport, heating, industrial
Natural gas	2.5 tons	Heating, industrial
Coal	2.3 tons	Electricity generation, steel production
Salt	440 lb	Chemicals
Sulfur	70 lb	Fertilizer
Sand and Gravel	4 tons	Roads, buildings

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**Table 1.1.3. Source of Power (1987). U.S. Utility Companies Generated 2.5 Trillion Kw-Hr of electricity in 1987**

Source of Power	kWh in billions
Coal	1464
Nuclear power	455
Natural gas	273
Hydroelectric	250
Petroleum	118
Geothermal, others	12

Mineral deposits within the border of any country represent potential national wealth: they can be transformed into actual material wealth (and contribute to the gross national product) only by being mined. Among the benefits to the state are an increase in employment levels (one mining job carries approximately a 5:1 multiplier effect), an enhanced level of self-sufficiency, and improved balance of trade. The latter results from fewer imports and greater exports of commodities mined, a spirited search for more minerals, a build-up of technical manpower levels by in-service training, attraction of overseas investment capital, and creation of national wealth.

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