Greek and roman contributions to modern society

Society

Both Greece and Rome made significant contributions to Western civilization. Greek knowledge was ascendant inphilosophy, physics, chemistry, medicine, andmathematicsfor nearly two thousand years. The Romans did not have the Greek temperament for philosophy andscience, but they had a genius for law and civil administration. The Romans were also great engineers and builders. They invented concrete, perfected the arch, and constructed roads and bridges that remain in use today. But neither the Greeks nor the Romans had much appreciation fortechnology.

The technological society that transformed the world was conceived by Europeans during the Middle Ages. Greeks and Romans were notorious in their disdain for technology. Aristotle noted that to be engaged in the mechanical arts was " illiberal and irksome. " Seneca infamously characterized invention as something fit only for " the meanest slaves. " The Roman Emperor Vespasian rejected technological innovation for fear that it would lead to unemployment. Greek and Roman economies were built on slavery. Strabo described the slave market at Delos as capable of handling the sale of 10, 000 slaves a day.

With an abundant supply of manual labor, the Romans had little incentive to develop artificial or mechanical power sources. Technical occupations such as blacksmithing came to be associated with the lower classes. With the collapse of the Western Roman Empire in the fifth century AD, a Dark Age in philosophy and science descended upon the Mediterranean region. But the unwritten history oftechnological progresscontinued. In northern and western Europe, there was never a period of regression. As early as 370 AD, an

unknown author noted the " mechanical inventiveness" of the " barbarian peoples" of northern Europe.

The Christian ethic of universal brotherhood slowly spread through Europe, and slavery began to disappear. Tribes and peoples became united under a common creed. Europeans not only embraced technology, but they also developed the idea of a universal society based uponrespectfor the dignity and worth of the individualhuman being. From the sixth through the ninth centuries AD, Europeans adopted new agricultural technologies that dramatically increased productivity. One of these innovations was a heavy wheeled plow that broke up the soil more efficiently than the Roman " scratch" plow.

Formerly unproductive lands were transformed into arable cropland. The Greeks and Romans had harnessed horses with a throat-and-girth harness that consisted of a strap placed across the animal's neck. As soon as the horse began to pull, he would choke himself. In the ninth century, Europeans began to use a padded horse collar that transferred the load of a draught animal to its shoulders. Horses harnessed with collars were able to pull four to five times more weight than those with throat-and-girth harnesses. Horse power was also facilitated by the introduction of the iron shoe.

With fast-moving horses harnessed efficiently, it became possible to transport goods up to 35 kilometers in one day if a sufficiently good road was available. There was now a way to dispose of agricultural surpluses and create wealth that could be used for investment in technology and infrastructure. Thus, the introduction of the lowly horseshoe and collar fostered commerce, civilization, and the growth of towns. Under the Roman

system of two-field crop rotation, half the land was left fallow and unproductive at any given time. In the eighth century, Europeans began to practice three-field crop rotation.

Fields lay fallow for only a third of the year, and grains were alternated with legumes that enriched the soil with nitrogen. The cultivation of legumes such as peas and beans added valuable protein to European diets. In the tenth century, the climate began to warm, and Europe entered the High Middle Ages. By the thirteenth century, the new agricultural technologies had doubled per acre yields. Population surged; architecture and commerce flourished. Europeans began a program of aggressive territorial expansion. They reclaimed Sicily in 1090 and systematically drove Muslims out of Spain.

The First Crusade was launched in 1095, and Jerusalem was captured from the Seljukian Turks in 1099. The prosperity created by the new agricultural technologies subsidizededucationand the growth of knowledge. In the late eighth century, Charlemagne had revived education in Europe by setting up a general system of schools. For the first time, not just monks, but also the general public were educated. As the European economy prospered, students multiplied and traveled, seeking the best education they could find. Christian Cathedral Schools evolved into the first universities.

The Universities of Paris and Oxford were founded c. 1170, Cambridge in 1209 AD. The harnessing of water power began around 200 BC with the invention of the quern, a primitive grain mill consisting of two rotating stones. The Romans had been aware of water power but made little use of water wheels and mills. In contrast, by the tenth century, Europeans had begun a wholesale conversion of their civilization from human and animal

power to water power. The water-mill came to be viewed not just as a grain mill, but as a generalized source of power that could be adopted for many uses.

This new approach was to fundamentally alter the fabric of human civilization. By the thirteenth century, water power was being utilized in sawmills, tanning mills, and iron forges. Mechanical power derived from moving water was used to process beer mash, to turn wood lathes and grinding stones, to power bellows, to drive forge hammers, and to manufacture paper. Because water power was available only where streams were located, Europeans developed other sources of mechanical power. Tidal power was used in Dover and Venice in the eleventh century. The first windmill in Europe appeared in 1085 AD.

Over the next hundred years, windmill technology spread rapidly over the plains of northern Europe. Windmills provided power in the cold of winter, when water mills were shut down by frozen streams. The utilization of mechanical power in these many forms required that Europeans develop methods for transferring and redirecting power, crucial technologies for the Industrial Revolution of the late eighteenth century. Most important of these was the crank. The crank is a device that allows rotary motion to be converted into reciprocal motion, or vice-versa.

For an industrial or technological civilization, the importance of the crank is second only to that of the wheel itself. Without the crank, " machine civilization is inconceivable. " Water clocks had been known since ancient times, but they were notoriously inaccurate and inconvenient. Near the end of the thirteenth century, it became possible to construct the first

mechanical clock when some unknown genius invented a device known as the verge escapement. The verge escapement enabled the power delivered by a falling weight to be modulated and delivered evenly at a constant rate.

The techniques developed in clockwork for regulating and transferring power were essential for the complex machinery of the Industrial Revolution. The introduction of mechanical clocks also made it feasible to adopt standardized timekeeping. This was a necessary step for the eventual development of a technological civilization that needs to coordinate complex administrative and commercial interactions. Modern science traces its roots to the natural philosophy of the ancient Greeks and the pre-Socratic enlightenment c. 600-400 BC.

The Greeks began the evolution of what became modern science by introducing naturalism and rejecting supernatural explanations. Describing epilepsy, a Hippocratic author noted that the disease was " no more divine nor more sacred than other diseases, but has a natural cause from which it originates like other affections. " But neither the Greeks nor the Romans ever hit upon the experimental method. Greek philosophers favored the deductive logic used in geometry. They had several reasons for being skeptical of a science based onobservation.

The world was in state of continual flux, different people observed things differently, and the only data available to them were anecdotal. Modern science began in the thirteenth century when Christian theologians such as Robert Grossesteste became seduced by Aristotelian logic and the Greek principle of demonstrative proof. But when Grossesteste and his student Roger Bacon contemplated the mysterious properties of the magnet, they

were forced to conclude that logic alone could never uncover the secrets of the cosmos.

Magnetism was a phenomenon that could never be predicted by logical reasoning. It could only be observed. Thus the need for a systematic experimental method. Gunpowder originated in China, but firearms were a European invention. Cannon date from the first part of the fourteenth century in Europe, and they were common by 1350. The use of cannon in particular helped break up feudalism, as it made central fortifications obsolete. Even the strongest structures were now vulnerable. The protection offered by a stone castle was eviscerated.

The possession of personal firearms gave individuals more political power and was an engine for social and political change. The firearm was also the first internal combustion engine and demonstrated the enormous potential power that lay in confined and controlled combustion. Like gunpowder, many of the technologies developed and utilized by Europeans originated in China. But the Chinese were never able to fully develop the promise of these inventions because their economic development was strangled by a " bureaucratic, state controlled economy. "

In Europe, the leaders in developing medieval technology were not philosophers, but craftsmen, merchants, and businessmen -- in a word, entrepreneurs. There were profits to be derived from the new technologies. A water-powered mill required a considerable capital investment, but the investment was likely to return a significant profit. Inventive, free people looked for ways to improve their productivity. Individuals profited, and society prospered. Thus, the Industrial Revolution that began in England c.

1760 was the inevitable outcome of a thousand years of European technological progress fostered by economic freedom.

During the nineteenth and twentieth centuries, the technological innovations pioneered in Europe began to spread throughout the world. This process continues today, most notably with the transformation of the world's most populous countries, China and India. The most undeniable benefit of the technology that Europeans bequeathed to the world was a dramatic increase in life expectancy. Before the Industrial Revolution, average life expectancy at birth was only 25 years, no higher than it had been in Roman times.

But as of 2009, life expectancy in the world had reached 69 years. And Japanese women now enjoy a record life expectancy at birth of 86 years. Thus the world was transformed -- not by philosophers, scientists, or politicians, but by engineers, craftsmen, and entrepreneurs. Writing in 1768, Joseph Priestley predicted that " whatever was the beginning of this world, the end will be glorious and paradisaical, beyond what our imaginations can now conceive. " Thanks to European inventors, Priestley's prediction was fulfilled.