

## Double-View Analysis on Educational Enlightenment from Ancient Greek Engineering

Wang Dan

School of Language and Literature  
Harbin Institute of Technology  
Weihai, China  
E-mail: hitwangdan@163.com

Zheng Zuolong

Economical Research Institute of State Farm  
Heilongjiang Province  
Harbin, China

**Abstract**—Engineering is a constantly growing and developing profession. It has played an important part in the western history of civilization, including the culture of ancient Greece. The social value of engineering has surpassed its professional field. Economy and politics become the two vital perspectives to help people analyze engineering. The interrelationships between engineering and the two social factors in ancient Greece contributed to the advance and development of society, and established an educational enlightenment and foundation for later generations as well.

**Keywords**- ancient Greece, engineering, economy, politics, educational enlightenment

### I. INTRODUCTION

The American Engineers' Council for Professional Development (ECPD, the predecessor of ABET) has defined "engineering" as, "The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property."<sup>[1]</sup> <sup>[2]</sup>

Engineering is a constantly growing and developing profession. It has been a potent instrumentality in the rise of Western life. It has played an important part in the history of the Western world, and the story has more than merely professional interest. William Barclay Parsons, who is an eminent American civil engineer once remarked, "It is not the technical excellence of an engineering design which alone determines its merit but rather the completeness with which it meets the economic and social needs of its day."<sup>[3]</sup> Thus, economy and politics become the two vital perspectives of double-view to help people analyze engineering.

Among all the peoples of the ancient world, the one whose culture most clearly exemplified the spirit of Western society was the Greek. In spite of the remarkable advances of Greek mathematics and mechanics, in spite of the notable contributions of Archimedes and others, in spite of those outstanding contributions of the human mind which have stimulated the thoughts and aspirations of Western man through the centuries, in spite of the glory of her art and

architecture, technology never became a dominant factor in Greek life. The few great Greek engineering works---water supplies, tunnels, harbors, drainage projects, city plans---all exhibit a remarkable advance in technical knowledge and understanding, but they appear to be more or less scattered and isolated examples of a very unusual ability which failed to find in Greek life the essential factors for widespread application and a continued evolution.<sup>[4]</sup> Anyway, technology and engineering in the ancient Greece still lay the foundation for the preferable development of engineering.

### II. VIEW FROM ECONOMIC INFLUENCE

The ancient Greeks did engage in economic activity which was necessary so far as the individual male citizen had to provide sustenance for his family. They also produced and exchanged goods both in local and long distance trade.

#### A. Agriculture

A life on the land, farming to produce only so much as was needed for consumption and leaving enough leisure time for active participation in the public life of the polis, was the social ideal of ancient Greece. Agriculture in ancient Greece was so labor-intensive that a lot of people are involved in it.

As in this period, the most important economic sector was still tied to the land and the majority of agriculture continued to be carried out on the subsistence level by numerous small family farms, even though the distribution of land among the population was far from equal. While usually sufficient to support the population of ancient Greece, unpredictable rainfall made agriculture precarious and there is much evidence for periodic crop failures, shortages, and famines. Consequently, competition for fertile land was a hallmark of Greek history and the cause of much social and political strife within and between city-states.<sup>[5]</sup>

#### B. Manufacturing

Although being a farmer was the social ideal, good land was scarce in Greece and people still had to take up other occupations for their livelihoods. Such occupations existed in the manufacturing. These "business" occupations

were not only socially disesteemed, but they also tended to be small scale. Wage earning was very much looked down upon, since working for another person was thought of as an impingement on freedom and akin to slavery.<sup>[6]</sup>

Metals were another important landed resource of Greece and so mining occupied an important place in the economy. Ancient Greeks typically used bronze and iron to make tools and weapons. Precious metals were used in jewelry, art, and coinage. Stone for building and sculpture was one more valuable natural resource of Greece. Limestone was available in abundance and fine marble could be found in Athens. The former was used in building the Parthenon and the other structures of the Athenian acropolis while the latter was often used for the most famous ancient Greek free-standing and relief sculptures.<sup>[7]</sup>

Ancient Greek values held in low esteem economic activities that were not subordinated to the traditional activities of managing the family farm and obtaining goods for necessary consumption. Thus, in comparison with agriculture, manufacturing comprised a small part of the ancient Greek economy.

#### C. Maritime Trade

On the eastern shores of the Aegean, the territory of Greece is mountainous, which prohibited free intercommunication by land between the settlements which developed into city-states in the intervening fertile valleys.

The Greeks were, therefore, forced to engage in maritime trade, and they became the first great harbor builders and developed shipbuilding. The number of shipwrecks found in the Mediterranean Sea provides valuable evidence for the development of trade in the ancient world. Archeologists have found 46 shipwrecks dated from the 4th century BC, which would appear to indicate that there occurred a very large increase of the volume of trade between these centuries. The economy of ancient Greece was also characterized by the extreme importance of importing goods, all the more so because of the relative poverty of Greece's soil. Beginning in the 6th century BC, craftsmanship and commerce (principally maritime) developed and became increasingly more important in the classical period.<sup>[8]</sup>

During the eighth century B.C., the Greeks reestablished trading links with western Asia, using new trading bases on Cyprus and the coast of Syria to gain access to commerce with wealthy Mesopotamia. As the Greeks' horizons broadened, they learned artisanal skills.<sup>[9]</sup>

### III. VIEW FROM POLITICAL INFLUENCE

Sustenance could be accomplished simply by agricultural economy. Besides, the male citizen was supposed to devote himself to the wellbeing of the community by participating in the public religious, political, and military life of the city-states.

#### A. City-state

About 800 B.C. the village communities, which rested mainly on tribal or clan organization, started growing into larger units centered on towns. Most often the towns were built on hills, and were little more than fortifications with marketplaces. As time went on they gained more and more permanent residents and came to look more and more like cities. Thus the polis or city-state emerged, consisting usually of a single city and all its surrounding territory. This was the unit that not only was to become the standard form of Hellenic political organization but created the modern notion of political life.<sup>[10]</sup>

It is worth pointing out the difference between Greek city-state government and our own. Government in the city-states was participatory, with no difference existing whatsoever between the state and its citizens. Consequently, the Greek city-state lacked a completely dominant governing class or representative and organized body of public opinion.

Behind the rise of the polis lay two interrelated developments: the invention of the Greek alphabet and the revival of trade and. Because the Greek alphabet was so simple, literacy became widespread, and many Greeks learned how to keep records. This trend spurred the Greek economy ever more, producing greater wealth, as well as an expanding population. As time went on the Greek city-states at home and abroad changed their forms of government, the general trend being toward a larger share in government for greater numbers of people. Expanding trade contributed to this trend, with newly rich elements in society seeking and gaining a greater share of the power.<sup>[11]</sup>

People lavished time in political activities. Therefore, so-called *banausic* work, which included manufacturing and trade, were considered to be contradictory to active participation in the affairs of the city-state.

#### B. Slavery

Undoubtedly, slaves comprised a large part of the labor force of ancient Greece. In fact, it is fair to say that Greece in the fifth and fourth centuries was a "slave dependent society."<sup>[12]</sup> None of the extraordinary Greek accomplishments in economy, politics, thought or art would have been possible had slaves not been forced to do the heavy labor while free men debated policy in assemblies, or discussed the true and beautiful while banqueting or strolling in the countryside.<sup>[13]</sup> Slaves became so thoroughly embedded into the daily life and values of the society that without slavery, ancient Greek civilization could not have existed in the manner it did.

Since a large proportion of the populations were slaves, slavery also affected engineering in ancient Greece. It is often said that technology and industrial organization stagnated in ancient Greece because the availability of cheap slave labor obviated any imminent need to improve them. All practical affairs, all activities of craftsmanship and hand labor, were left to menials. If one wanted to produce more, one merely bought a few more slaves. Thus, most

manufactured products were literally hand-made with simple tools. There were no assembly lines and no big factories. Most manufacturing was carried out in small shops or within households.<sup>[14]</sup>

Dr. Durant remarks on the difficulty of maintaining an advancing technology under such conditions: It was in industrial and technical invention that Greece fell farthest below the general standard of its unparalleled achievements. The Greek disdain of manual work kept everybody but the listless slave from direct acquaintance with the processes of production, from that stimulating contact with machinery which reveals defects and prefigures possibilities; technical invention was possible only to those who had no interest in it, and could not derive from it any material reward. Perhaps the very cheapness of the slaves made invention lag; muscle was still less costly than machines.<sup>[15]</sup>

#### IV. CONCLUSION: EDUCATIONAL ENLIGHTENMENT

Engineering in the past has aided in transforming man's dwelling place and also exercised a profound influence on the relationships of men, it has, within the past century or less, become a dominating force in shaping not only the lives of men but the destiny of nations. With only a limited cultural inheritance from the past upon which to build, the Greeks produced intellectual and artistic monuments that have served ever since as standards of achievement. Among "the seven wonders in the world", the Colossus of Rhodes, the Statue of Zeus at Olympia, and the Temple of Artemis at Ephesus are the remarkable perfection of Greek design and the accuracy of execution of Greek construction, which have also long claimed the admiration of later generations. "Wonders are many on earth, and the greatest of these are humans," the Greek tragic poet Sophocles proposed, to which we might well respond: "wonders were many in the ancient world, and the greatest of these were the Greeks."<sup>[16]</sup>

However, no matter in terms of economy or politics, it is easy to find that the leaders of Greek thought regarded manual work as destructive alike to the bodies and minds of the workers---a viewpoint which still occasionally crops up and which long caused engineering, because of its necessarily close association with the practical arts, to be regarded as a "navy" profession. Even Archimedes (287-212 B.C.), popularly acclaimed for his remarkable mechanical inventions, appears to have been ashamed of his interest in such works. Thus, while great and noble beginnings were made in the development of natural science, practical applications and experimentation were outlawed.<sup>[17]</sup>

Science was held to be a mental exercise, which might sharpen and invigorate the mind but should not be debased by use. In fact, science became natural philosophy and, as such, both completely divorced from engineering and incapable of further development. "As we shall later note, it took the human race close to two thousand years to rectify this Greek error."<sup>[18]</sup>

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