Dialogues with Chinese Ancient Technology

——The Exception of the Technical Theory of Ellul

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China's ancient science and technology achievements are magnificent. From the Qin and Han dynasties to the middle of the Ming Dynasty, China was in the world's leading position. Gunpowder, compass, papermaking, and printing are outstanding representatives of the progress and prosperity of scientific and technological development. According to historian Joseph Needham, "The Chinese had some scientific and technological inventions in many important respects, were ahead of the legendary figures who produced the famous Greek wonders, were on a par with the Arabs who possessed all the cultural wealth of the ancient Western world, and maintained a level of scientific knowledge that the Western world could not match between the third and the thirteenth centuries."[1]Chinese ancient technology has made great contributions to the social change and the rise of science in modern Europe, and the progress of the whole human civilization. The fact that such an important period of technological history has not attracted Ellul becomes an "exception" in Ellul's research: On the one hand, in the Society of Technology, Ellul had very little discussion of China, and his analysis of the world's ancient technological history also missed China, the bright pearl; on the other hand, although China's ancient technology was highly developed and advanced at that time, it did not develop to a "technological society" as Ellul termed, and even failed to produce modern science and technology.

Because of the close relation between Chinese ancient science and technology culture and ancient Chinese philosophy and political culture, the ancient Chinese science and technology culture presents its own unique characteristics. It is of great significance to study the history of ancient Chinese technology from the perspective of Ellul's technology theory. At the same time, the history of ancient Chinese technology can well reflect Ellul's theory of the world's ancient technology analysis. From a new perspective, this paper addresses some questions within Ellul's framework, such as what can people do in the technological society, Also looks for an alternative to the technological society through the Chinese traditional culture of "harmony between heaven and man（天人合一）" hidden behind the history of ancient Chinese technology.

Technological Society's neglect of ancient Chinese technology

1. The absence of ancient Chinese technological history

In *the Technological Society*, the word "China" only appears 12 times. Apart from the translator's notes and the references, Ellul mentions "China" 10 times, mainly focusing on China's modern and modern technological development. He only mentions ancient Chinese technological civilization when discussing the four characteristics of traditional technology, "Certain important covariations traditionally existed, and these factors,

covariant with technique, changed according to the type of civilization. There was, for example, the association of technique and the state among the Egyptians and the Incas; of technique and philosophy in Greece and China."

In addition, Ellul skates over China in the macro analysis of technique. For example, in speaking of the universality of technology, Ellul argues that "This does not mean that they have all reached the same point, but they are situated at different points along the same trajectory. The United States represents the type that France will represent in thirty years, and China in possibly eighty."[1] Then, when analyzing the expansion of technology, Ellul argues the export of technical personnel is also an important reason. He writes, "Since 1956 we have been witnessing the same diffusion of technicians from the Soviet Union, and more recently from China, to Syria, Guinea, Ghana, and Cuba."

In almost all references to China, Ellul uses only the word "East" to summarize, but does not specify directly. In section 3, analyzing Christianity and technology, Ellul notes, "Another embarrassing fact: when in her decline Greece applied herself to technical inquiry and the development of industry, she looked to the East for methods. And in the first century, when Rome— the perfect example of the technical spirit in antiquity— took up industry, she too turned to the East for industrial techniques the refining of silver and gold, glassmaking, the tempering of weapons, pottery, ship construction, and so on. All these techniques came to Rome from the East, either early, through the Etruscans, or much later, after the conquests. We are far indeed from being able to support this traditional cleavage between East and West. In fact, during classical antiquity, it was the East which possessed the concrete, inventive mind that grasps the truth and exploits it [2]

Or, "At the beginning of the 12th century, a technical movement began to form, very weak at first, which developed under Eastern influences." [3]"The technical impetus of our civilization came from the East, at first through the intermediacy of the Judaei' and the Venetians, and later through the Crusades. But even so, it limited itself to imitating what it had seen— except in art Certain autonomous discoveries did take place, especially as a result of commercial necessity; but this development was no more intense than it had been under the Roman Empire." [4]It is obvious that it is perfectly correct to replace the word "East" with "China" in these sentences. "Gunpowder, the compass, and printing are the three great inventions that heralded the coming of bourgeois society. Gunpowder blew the knighthood to pieces, the compass opened world markets and established colonies, and the printing press became the instrument of Protestantism in general, the means of scientific revival, the most powerful lever for creating the necessary prerequisites for spiritual development."[5]

Ellul is not completely ignorant of China. He has a certain understanding of China's modern history. Ellul frequently uses China as an example in *The Betrayal of the West* and also studies Mao Zedong's propaganda theory in *Propaganda*. All these books reflected his familiarity with China's modern history. Indeed, Ellul does not mean to write a history of "Technological Society." His purpose is to study the characteristics and essence of

technology in modern times, rather than systematically analyzing the technological history of countries and civilizations around the world. As Ellul writes in chapter 1, section 2 of *the Technological Society*, “It is scarcely possible to give here a history of technique in its universal aspect, as we have just defined it", " My book is not a history. I shall speak in a historical vein only when it is necessary to the understanding of the technical problem in society today."[6] Ellul believes that the understanding of the history of technology can only come from reading. It is enough to recall the works of Andre Leroi-Gourhan, Richard Lefebvre des Noettes, Marc Bloch, and others. This is probably an important reason why Ellul does not touch on the history of ancient Chinese technology. Then in the second and third sections, Ellul briefly analyzes the characteristics of the technological development of Greece and Rome respectively. It is a great pity that Ellul has neglected the history of ancient Chinese technology in *the Technological society*.

Firstly, the history of ancient Chinese technology has an important historical position in the development of science and technology in the world. With great wisdom and creativity, the ancient Chinese people created a brilliant ancient Chinese culture. Chinese civilization has lasted for thousands of years, forming a rare cultural system in the world. Science and technology culture, as part of Chinese culture, has outstanding achievements in various fields, such as mathematics, physics, chemistry, astronomy, geography, biology, agriculture, medicine, architecture, metallurgy, machinery, textiles, vehicles, ships, weapons, ceramics, papermaking, and printing, which have made significant contributions to the development of China's science and technology culture. In the 1920s, some Western historians of science and technology who questioned the "European scientific center theory" gradually shifted their research focus to the traditional science and technology history of ancient China. Hegel pointed out in his *History of Philosophy* that "while the Yellow River and the Yangtze River had already nurtured splendid ancient culture, the inhabitants of the Thames, the Rhine, and the Mississippi were still wandering in the dark primeval forests." In the preface to the Chinese translation of his book "The History of Science in Antiquity," another famous British science historian, G. Bernal, said: "China has been one of the great centers of human civilization and science for many centuries... It can be seen that in the process of the Western Renaissance from Greek abstract mathematical science to modern mechanical and physical science, China's technical contributions -the compass, gunpowder, paper, and printing-played a role, and perhaps a decisive one. I am sure that China's great past contributions to technology will be surpassed by its future contributions."[7] The *Frankfurter Allgemeine Zeitung* of November 13, 1990, had an article titled *Many Western Inventions Owe Their Origin to China*, which said: "... m*any innovations and inventions that played an important role in the world's development originated in China, but the Europeans did not have to know about them. Even the Chinese themselves often forget that some things were invented by them first.* " Japanese professor Yabuuti Kiyosi in Kyoto University, when discussing the development and influence of ancient Chinese science and technology, has given a fair evaluation by saying: "China once created a highly civilized society... It is generally believed that science originated in Europe, and that science is only a product of Europe. But this is not true. China had great scientific and technological inventions long before

Europe. The well-known compass, gunpowder, and printing are typical examples." He also said, "China's four great inventions... were one of the driving forces that opened up European culture, which played a decisive role in promoting the flourishing of the European Renaissance movement." To put it bluntly, without these Chinese inventions, there would have been no Renaissance in Europe, and therefore no modernization of Europeans. This is something that Europeans themselves also acknowledge.

Secondly, the history of ancient Chinese technology is different from the history of any other country. Ancient Chinese technology is significantly different from the technology of ancient India, ancient Greece, and medieval Arab countries. Ellul summarizes China with the term "East" in *the Technological Society*, which is simplistic and less specific. Ancient Chinese science and technology, as an important part of the ancient Chinese civilization, developed under the unique historical conditions and geographical environment of China, as well as under the social conditions of various historical periods in China. Its development path, method of dealing with and solving problems, and even the content included have a special tradition that is different from other countries, with independence and specificity. In this sense, we can say that ancient Chinese science and technology has its own system, whether as a whole or in individual branches of science. It is unique. The development path of ancient Chinese technology is completely different from that of the West. The geographical environment, political system, ideas, and the way of small peasant agricultural economy determined the direction of ancient Chinese technology development and limited its development as well, forming a unique history of ancient Chinese technology development. Although there was a certain degree of exchange with the outside world, the system of ancient Chinese science and technology was indeed formed independently. The basic tone of Chinese thought and cultural patterns remained spontaneous and uninterrupted, with China's geographical environment being relatively closed off enough to influence the distinctive tone of her culture and science.[8]

Thirdly, the history of ancient Chinese technology has an unusually rich collection of historical materials, which facilitates research. Joseph Needham believes that "no civilization has a greater historical tradition than China, and the records of real events that occurred in various eras are the result of the meticulous and dedicated work of thousands of scholars. They have done everything that historians can do, and archaeological discoveries have repeatedly proved that their records are correct, and some are amazingly accurate. No other civilization has produced such a masterpiece as the Twenty-Four Histories, and these history books are supplemented by a vast number of unofficial histories." "China's social environment is actually conducive to the study of the history of science and technology. Those inventions and creations were not favored by Confucianism, so no one would want to This social environment also prevented businessmen from forging non-artworks such as scientific instruments or weapons to pass them off as antiques. No one wanted to collect such items, and there was no profit in collecting them. Confucian bureaucrats always looked down on warriors, and military commanders were usually lower in rank than their corresponding civil officials. Those

military classics gave people the impression that they were written in an extremely realistic manner, without the indirect and elegant style of other works. Falsification was indeed rare in these works. In short, we believe that the statements of Chinese historians and military writers are almost always reliable. "[9]

2. Exceptions to the Theory of Technological Society

Ellul believes that no matter how brilliant a civilization is, it is gradually being replaced by technological civilization. He pointed out that in a technological society, technology has saturated all fields. Without technology, nothing new can be discovered, no problem can be solved, and few ways of life do not rely on technology. Under the autonomy of technology, "Henceforth, every component of civilization is subject to the law that technique is itself civilization. Civilization no longer exists of itself. Every activity—intellectual, artistic, moral— is only a part of technique. This fact is so enormous and unpredictable that we are simply unable to foresee its consequences." [10] Thousands of years ago, ancient Chinese society, like many societies today, had world-leading technology. However, the progress of discoveries and inventions in ancient Chinese society did not cause major damage to culture and civilization. Technology has always been a subordinate of civilization—rather than Ellul's "technological society". This provides a positive example for Ellul's question of whether there is a civilization that is "inclusive of technology".

China, as a country with highly developed science and technology in ancient times, failed to produce modern science. Even when modern science was introduced into China from the West, it was met with indifference and resistance. Joseph Needham raised his doubts: “China had highly developed science and technology before 1500, and was the most advanced society in the world in science and technology at that time. Why did capitalism and modern science originate in Western Europe instead of China or other civilizations?” The "Needham Question" is the focus of many scholars, and many Chinese scholars have given many answers. There is no unique answer. Moreover, this question has now far exceeded the understanding and evaluation of Chinese science and civilization. Joseph Needham raised this "question" from the perspective of world history, and his ultimate goal was to promote mutual understanding between different cultures. Since Joseph Needham asked the question of "why" rather than "what", the "Needham Question" is both profound and comprehensive. It covers both the history of science and technology and the history of culture, both Chinese and even Eastern civilizations and European civilizations, and both ancient and modern times.

In the preface to the Chinese version of The End of Certainty: Time, Chaos and the New Laws of Nature, Prigogine wrote: "Western science and Western philosophy have always emphasized the duality between subject and object, which is contrary to Chinese philosophy that emphasizes the unity of man and nature. The results described in this book bring modern science closer to Chinese philosophy. The self-organizing universe is also a 'spontaneous' world, which expresses a holistic view of nature that is different from the classical reductionism of Western science. We are getting closer and closer to the

intersection of two cultural traditions. We must retain the analytical view of Western science, which has proven to be quite successful, and at the same time we must restate the laws of nature that include the spontaneity and creativity of nature." Mr. Le Daiyun said that in recent years, Western culture has shown a strong interest in other cultures, especially Chinese culture. Mr. Le also specifically mentioned that a French scholar once wrote an article entitled "Why can't we Westerners study philosophy by bypassing China?" The author believes that "traveling through China is also to better read Greece."

As Carl Mitcham pointed out, in such a technologically advanced environment, ancient China did not move toward Ellul's "technological society". "This is a refutation and challenge to some of Ellul's views. [11]Such exceptions in Ellul's "technological society" theory provide some possible ideas for the technology-dominated Western social order that Ellul is worried about.

The coincidence between the history of ancient Chinese technology and Ellul's technology theory

Ellul never demonstrated his understanding of the history of ancient Chinese technology, but many of his theoretical analyses in "Technical Society" coincide with the development process and essential characteristics of ancient Chinese technology.

1. The practicality of ancient Chinese technology

In analyzing the history of Greek technology, Ellul notes that, "Technique is essentially Oriental: it was principally in the Near East that technique first developed, and it had very little in the way of scientific foundation. It was entirely directed toward practical application and was not concerned with general theories, which alone can give rise to scientific movements. This predominance of technique in the East points up an error which is found throughout Western thought: that the Oriental mind is turned toward the mystical and has no interest in concrete action, whereas the Western mind is oriented toward 'know-how' and action, and hence toward technique. In fact, the East was the cradle of all action, of all past and primitive technique in the present sense of the word, and later of spiritual and magical technique as well." [12]This is exactly the case with ancient Chinese technology, which had very little scientific basis and was entirely focused on practical applications.

The number of various types of documents is directly proportional to the role of the discipline in governing the country, maintaining peace, and benefiting the people in ancient society. For example, traditional Chinese medicine is closely related to life and has a strong practicality, so medical documents have the largest number among ancient Chinese scientific and technological documents. According to the *ZhonghuaYiJiKao* （Chinese Medical Books）, there were about 3,000 kinds of medical documents from the Qin and Han Dynasties to the Daoguang period of the Qing Dynasty, such as the *Huangdi Neijing*" (The Yellow Emperor's Canon of Medicine) in the Warring States Period, Zhang Zhongjing's *Shanghanzabinglun* (Treatise on Febrile and Miscellaneous Diseases),

Shennong's Herbal Classic in the late Han Dynasty, and Wang Weiyi's bronze acupuncture status. Besides, agriculture is the foundation of the national economy and people's livelihood. Therefore, agricultural documents are also very rich, such as *Shennong* and *Yelao* in the Warring States Period, Ban Gu's *Han Shu·Yiwenzhi* in the Eastern Han Dynasty, and Jia Sixie's *Qimin Yaoshu* in the Northern Wei Dynasty... According to the *Catalogue of Ancient Chinese Agricultural Books* edited by Zhang Fang and Wang Siming, there are 2,368 extant and lost Chinese agricultural books, and Chinese agriculture has formed a complete set of agricultural production technology systems.

The determination and continuous strengthening of the humanistic ideology of traditional Chinese culture exert ancient science and technology, which is the directional effect. It guides, restricts, and promotes the development of ancient science and technology in the direction of serving people as its main content. The practical concepts generated around the development of production not only became the basis of ancient Chinese social psychology, but also became a distinctive feature of the development of ancient Chinese science and technology, and culture. Chinese Ancients rarely had the opportunity to think about abstract issues unrelated to production development. The four pillars of ancient Chinese science: astronomy, mathematics, agriculture, and medicine all started from serving human life as their basic value orientation. If the characteristics of ancient Greek mathematics are abstraction and systematization, traditional Chinese mathematics is mainly known for its calculations and combines mathematical theory and practice by directly integrating mathematics theory with practice. This obvious practical orientation embodies a style that is completely different from Western mathematics and is on par with ancient Greek mathematics. For example, ancient Chinese mathematics focuses on mathematical problems from daily life and production practice, forming mathematical concepts, refining mathematical methods, and then putting them into practice to solve specific problems after mathematical operations. "Nine Chapters on Arithmetic", written in the Han Dynasty, is the core symbol of the establishment of the ancient Chinese mathematical system and the formation of mathematical characteristics. It contains a total of 246 questions, which are all practical problems in production and life at that time. It is divided into nine chapters. The content is: Chapter 1, *Flatfield*: explains the calculation of the area of acres and fraction calculations of various plane graphics; Chapter 2, *Millet*: explains the exchange ratio between grain and rice and the four ratio algorithms; Chapter 3, *Cuifen*(decrease progressively): explains social class, business, the proportional distribution problem of handicraft industry; Chapter 4, *Shao Guang*: Know the area, volume, find the length of one side and the diameter, etc.; Chapter 5, *Shang Gong*: explain various projects (building cities, building embankments, digging canals, piles of grain, etc.); Chapter 6, *Equal Loss*: explains the taxation and tax calculations under the equalization system at that time, including complex proportional distribution calculations such as compound proportions and continuous proportions; Chapter 7, *Profit and Deficiency*: explains the solution to the profit and loss problem and the use of the profit-deficit technique (method of finding unknown number by two assumptions); Chapter 8, *Equations*: linear equations problem; Chapter 9, *Pythagorean*: using the Pythagorean theorem to solve and predict (calculate height and distance , depth and

breadth). These contents, distinguished by modern mathematics, can be divided into three major categories: firstly, computing technology, including four arithmetic operations, fraction operations, square root operations, four proportion and proportion distribution operations, method of double setting, etc.; secondly, algebra, Including the arrangement and solution of linear equations, which introduces the concept of negative numbers and the operation of positive and negative numbers; thirdly, geometry, including rectangles, triangles, trapezoids, circles, bows, annulus, spherical and other planes Calculation of the area of graphics and calculations of cubes, cylinders, cones, right prisms with equal trapezoidal sections and other complex three-dimensional figures, as well as calculations of many graphics and actual measurement problems based on the Pythagorean theorem.[13]

2. The craftsmanship spirit of ancient Chinese technology

Ellul points out that in different societies before modern society, the status of technology was generally low. Ancient people did not attach importance to technology, but only regarded it as a mediating tool, and did not think that it was related to human destiny. Technology was only applied in certain narrow and limited fields. Ellul believes that "The time given to the use of techniques was short, compared with the leisure time devoted to sleep, conversation, games, or, best of all, to meditation. As a corollary, technical activities had little place in these societies. Technique functioned only at certain precise and well-defined times; this was the case in all societies before our own. Technique was not part of man's occupation nor a subject for preoccupation."[14]

Due to the lack of theoretical summary and generalization, the development of technology depends only on the accumulation of one's own experience, and the transmission of technology can only be completed through human senses and actual operations. "Father-son inheritance" or "master-pupil teaching" is the main form of technology transmission, and it is even spread in the form of secret recipes. "The master leads the way, and the practice is up to the individual" is an accurate description of this situation. "Realization" has an important position in the research and inheritance of ancient science and technology. Many famous technical experts' craftsmanship is directly realized from practice, and they are often unprecedented and unparalleled. Therefore, there are also a large number of exquisite technologies in China that have been lost. For example, when describing a skilled craftsman, the ancients often said that his skills had reached the peak of perfection, but how did he reach this level? This depends on the accumulation in many aspects, such as Ouyang Xiu's description in *Oil Seller*, whose amazing oil-making skills are "nothing else but skilled," which means the key is the accumulation of experience.

In 1978, two Bingjian (utensils containing ice) were unearthed from the tomb of Zeng Houyi of the Warring States Period (as shown in Figure 1). They were wine vessels used by Zeng Houyi, the king of Zeng State during the Warring States Period, to hold important ceremonies or entertain important guests. According to the *"Tian Guan" section of the Zhouli* (the official book of the Zhou Dynasty), "Bingjian are offered for sacrifices." This

shows that primitive refrigerators already existed in the Zhou Dynasty, but the ice was not available all year round, especially in the hot summer when ice was extremely precious. The Bingjian are symmetrical and regular, with eight small dragons clinging to the four corners and the four central areas of the chest, each dragon's head supporting eight bracket-style bronze decorations (as shown in Figure 2). The hind legs of the beast's bodies crawl on the ground. Bingjian's intricate and exquisite patterns make it full of beauty. The bronze Bingjian requires high precision, and its casting is mainly done by the lost wax method. Bronze objects cast by the lost wax method have a smooth surface and high precision. Even today, people still use the lost wax method to cast precision components such as aircraft parts. This ingenious and exquisitely crafted ice chest is the earliest refrigerator and air conditioner in human history. Bingjian has two layers, with ice placed in the outer layer and the inner layer used to chill fruits, vegetables, and wine. The lid of the ice chest also has a few holes, so in addition to being a refrigerator, it can also expel cold air through these holes, making it a refrigerator and air conditioner in one. The 2008 drums used in the Beijing Olympic Games, arranged in neat rows and producing thunderous drum sounds, were inspired by the Bingjian.

(Figure1. Bingjian)

(Figure2. Details of Bingjian)

3.The Endless Development of Ancient Chinese Technology

Ellul believes that before the 18th century, the technological world had a third characteristic: it was local. Social groups were very powerful and not open to the outside world. In terms of material, there was almost no communication between them, and in terms of spirit, there was even less communication. The technology spread very slowly. In the thousands of years since ancient China entered the civilized society and established the country, although the borders had changed, and there were constant struggles and integrations between the various ethnic groups in the region. But as a nation, it was basically stable in general. Geographically, our ancestors have lived on the Eurasian continent since ancient times. To the north of our country is the cold Siberian wilderness, to the east is the vast ocean, to the southwest is the towering Himalayas, to the west is the Altai Mountains, the Karakoram Mountains, as well as the desert and Gobi. This environment facing the sea on one side and having extremely inconvenient land transportation on the other three sides, with fairly wide internal room for maneuver, has created a state of relative isolation from the outside world. Ancient Chinese science and technology were mainly created under their own existing conditions and were passively

generated within their own scope. In the absence of external forces, this technology can only run along its independent trajectory.

The development of ancient Chinese technology mainly depends on the vigorous development of the feudal dynasty. From the current situation of world science and technology development, this closed geographical environment is undoubtedly not conducive to the development of science and technology. Although ancient China has had constant contact and exchanges with other regions, other nations, and other countries, there has not been a large-scale exchange of economy, thought, culture, and science and technology. However, in ancient times, the development of Chinese science and technology was less disturbed by the outside world, and it always maintained an independent and consistent development system without the technological faults caused by foreign invasions in other ancient civilizations such as India, Egypt, and Rome. This is also in line with the fourth characteristic of technology listed by Ellul—the possibility of choice reserved for human beings. Ellul divided many different types of societies into two types of civilizations: active civilization and passive civilization. Active civilization is oriented toward the exploitation of the earth, toward war, conquest, and expansion in all its forms. Other societies are inwardly oriented; they labor just enough to support themselves, concentrate on them- selves, are not concerned with material expansion, and erect solid barriers against anything from without. From the spiritual point of view, these societies are characterized by a mystical attitude, by a desire for self-dissolution and absorption into the divine.[15] Obviously, Chinese civilization belongs to the latter. Ancient Chinese society has continued to multiply in such a specific geographical environment, with an intensive small peasant economy: agricultural production and various handicraft production as the main production activities, the concept of "harmony between man and nature" from beginning to end, and a centralized unified state was built relatively early, which formed a unique economic, political, ideological and cultural tradition, and naturally also formed a unique traditional science and technology.[16]

Compared with other ancient civilizations in the world, the most prominent feature of ancient Chinese civilization is that China's culture and civilization process has never been interrupted. That is to say, although the maps and the country have been constantly changing in Chinese feudal society, the basic economic structure, cultural traditions, political system, and social lifestyle have never changed significantly, and there is obvious inheritance and stability. This inheritance and stability are also beneficial to the development of science and technology. Under the condition that feudal land ownership has always been dominant, the continuous adjustment of production relations has ensured that the productivity and scientific and technological power allowed by the feudal system have been maximized. Marx pointed out in the first volume of *Capital* that under the conditions of centralization, the feudal dynasty can " Using the power of the state, that is, using concentrated, organized social violence" to promote the development of science and technology. [17] Specialized scientific research institutions such as the Imperial Astronomical Observatory and the Imperial Hospital appeared in China very early, and the state recruited a large number of specialized talents to engage in research in

astronomy, mathematics, medicine, technology, and other fields. For example, the astronomical data recorded in historical books of various dynasties, and the medical books and pharmacopeias published since the Tang Dynasty, were all completed through the cooperation of large-scale scientific and technological personnel organized by the government. Although dynasties have risen and fallen, this tradition has been passed down from generation to generation and continued. In fact, without the support of the country, the development of many scientific research projects would be out of the question. For example, Zheng He's seven voyages across the ocean marked the world's advanced level of navigation technology. In addition, organizing large-scale astronomical observations and building new large-scale water conservancy projects are all difficult to do with individual strength. Therefore, during the development period of feudal society, the strong support and effective organization of science and technology by the state under the centralized power ensured that Chinese science and technology could always develop relatively smoothly.

The unique role of the concept of heaven and man in the evolution of ancient Chinese technology

The development of ancient Chinese technology was mainly influenced by traditional Chinese culture. Ursula M. Franklin believes that technology, as a practice, is directly related to culture.[18] As Ellul said, "Technique was an intrinsic part of civilization, and civilization consisted of numerous and diversified elements— natural elements such as temperament and flora, climate and population; and artificial elements such as art, technique, the political regime, etc. Among all these factors, which mingled with one another, technique was only one. It was inexorably linked with them and depended on them, as they depended on it. It was part of a whole, part of the determinate society, and it developed as a function of the whole and shared its fate." [19] In other words, technology was not objective in the past, but subjective and related to its own culture. This is a rather large concept, including institutions, customs, academics, religions, and other aspects, among which academic thought plays a vital role in the development of technology. "Heaven and man as one" is the core of traditional Chinese culture and also the guiding ideology of traditional Chinese science, and the core of scientific and technological thought. It emphasizes the unity of man and nature and their overall harmony, as Zhuangzi said: "天地与我并生，万物与我为一(Heaven and earth are born with me, and all things are one with me）." [20]Ancient Chinese mathematics, astronomy, traditional Chinese medicine, agronomy, and other science and technology were all placed in the ideological framework of "heaven and man as one", which made the Chinese people's understanding of efficiency always constrained by the pursuit of this thought, and gradually formed China's unique and traditional holistic natural science and technology view. There are already many studies on the Confucian "view of man and nature", so I will not repeat them here. This study will elaborate on the Mohist "view of man and nature" and its unique role in the evolution of Chinese technology.

1. The concept of heaven and man throughout the history of Chinese philosophy

The philosophical thought of ancient China originated in the distant past, flourished in the Spring and Autumn Period, and boomed in the Warring States Period with a "hundred schools of thought competing." Since the pre-Qin period, there have been hundreds of schools of thought. According to the *the Story of Han Dynasty,* there are a total of 189 named academic schools of thought and 4,324 works, which were later summarized into 12 schools. During the Spring and Autumn Period and the Warring States Period, the three major philosophical systems represented by Confucius, Laozi, and Mo-tse gradually evolved into the dominant Confucian culture, which gave Chinese traditional culture a distinct ethical characteristic.

In ancient Chinese philosophical thought, the relationship between heaven and man is the primary issue. The unity of heaven and man is the general summary of Chinese traditional culture, emphasizing the unity and coordination between man and nature. It can be said to be the core spirit and the most basic way of thinking in Chinese culture, which deeply influenced the development of ancient Chinese technology. After completing his masterpiece "Records of the Grand Historian", Sima Qian talks about his ambition to "also want to explore the relationship between heaven and man, understand the changes of ancient and modern times, and form a school of thought."[21] "The relationship between heaven and man" refers to the relationship between heaven and man. Sima Qian believes that only by first exploring the relationship between heaven and man can we understand the evolution of ancient and modern times, and thus have our own unique insights. Sima Qian's words reflect the extremely important theoretical significance of the relationship between heaven and man in ancient Chinese philosophy. The idea of "the unity of heaven and man" is also the primary issue in the history of traditional Chinese scientific and technological thought, and is the core of the traditional Chinese "relationship between heaven and man" thought. It can be said that ancient Chinese philosophy started from the discussion of the relationship between heaven and man, and developed and matured around the discussion of the relationship between heaven and man. The concept of the unity of heaven and man has played a good role in maintaining the country's political order and social stability, and has also contributed to the emergence of Chinese religion to a certain extent.

The meanings of the concepts of "Heaven" and "man" in Chinese history are extremely complex and diverse, and the theoretical issues involved in the thought are very wide. Different times and schools of thought lead to different viewpoints and perspectives. Regarding the "relationship between heaven and man", many people interpret it as the "relationship between nature and man". Here, "heaven" is regarded as "nature", and "man" is regarded as "human being". However, the two concepts of "Heaven" and "man" are not clearly defined and divided in ancient philosophical documents, and ancient philosophers used the words "Heaven" and "man" with various meanings. Sometimes there is inconsistency in a philosopher's writings. In fact, the meanings of "heaven" and "man" are far from limited to nature and human beings.

In the history of Chinese philosophy, the meaning and name of "heaven" are varied, and they have been enriched and improved over time. Feng Youlan once summarized that "the word 'heaven' in Chinese characters has at least five meanings. One meaning is 'material heaven', which refers to the vast sky that we see in daily life and is opposite to the earth, which is what we now call the sky; one meaning is ' supreme being', which refers to the 'supreme god' with personality and will in religion; one meaning is 'the heaven of destiny', which refers to the so-called luck in the old society; one is 'the heaven of nature', which refers to the so-called nature of materialist philosophers; one is 'the great righteousness' or 'the moral heaven', which refers to the moral law of the universe invented by idealist philosophers." In theory, the relationship between heaven and man includes at least two aspects: "the distinction between heaven and man" and "the unity of heaven and man". Mr. Zhao Jiaxiang gave a relatively comprehensive explanation of this in *On the Thought of 'Relationship between Heaven and Man' in Ancient China and Its Theoretical Value and Practical Significance*. In his view, the first premise of "the relationship between heaven and man" is "the distinction between heaven and man", and the first ancient Chinese thinker to discuss "the distinction between heaven and man" was Zichan of Zheng State in the Spring and Autumn Period. Based on this, various attitudes of man towards heaven emerged: ① "passive inaction"; ② "man conquers nature"; ③ " mutual victory between heaven and man"; ④ "the unity of heaven and man". Therefore, we should regard "the relationship between heaven and man" as an organic whole composed of multiple ideological elements that are both mutually distinct and interconnected, interacting and influencing each other.[22]

2. Mo-tse and the Concept of Heaven and Man

Mo-tse (468-376 BC), whose surname was Mo and given name was Zhai, was the founder of the Mohist school. He was a famous thinker, educator, military strategist, social activist, mechanic, mechanic, optician, logician, and military engineer. In his early years, Mo-tse studied Confucianism. Due to his dissatisfaction with the complexity of the Zhou rituals, he founded his own school, taking Dayu as his model, and was reflective and critical of Confucianism. Mohism and Confucianism were two prominent schools of thought in the pre-Qin period. However, after the Han Dynasty, Confucianism became the orthodox thought of ancient China, while Mohism represented by Mo-tse 's thoughts became a "lost school". It was not until the Qing Dynasty that the study of Mohism began to revive.

The Mohist school was the most significant and influential school in the history of Chinese science. Disciples of Mohism have been with civilians and craftsmen for many years and many of them were skilled craftsmen, so they were able to achieve many scientific achievements. The representative work of Mohist thought, *Mojing*, is a remarkable book in Chinese culture. Two thousand years ago, it gave precise definitions or propositions to mathematical concepts or problems such as circle, multiple, straight line, and square, and physical concepts or problems such as end (atom), gravity, resistance, light, lever theorem, sound propagation, pinhole imaging, plane mirror, concave mirror, convex mirror (200 years earlier than Archimedes). The Mohists not only explored philosophy, politics, society, and human relations, but also explored the material world and the microscopic world.

They can be fully integrated with the modern world, thus crossing history, regions, and nationalities, surpassing the various schools of thought, and becoming the pinnacle of Chinese culture. Mo-tse 's thought is an important part of the study of Chinese intellectual history.

Mo-tse advocated "respecting the virtuous, respecting the same, universal love, non-aggression, frugality, frugal burial, heaven's will, understanding ghosts, non-music, non-fate", etc. Among them, "heaven's will, understanding ghosts, non-fate" are the main ideas of his theory of the relationship between heaven and man. The relationship between heaven and man is a four-dimensional structure of heaven, ghosts, monarchs, and people. With the help of "heaven and ghosts", public opinion is checked and balanced on the monarchy. Mo-tse 's political thought has the tendency of people-oriented thought, walked out of the shackles of primitive religion, embodied the spirit of humanism, and opened up a new face of Mo-tse's philosophy. Mo-tse strongly opposed Confucius' "destiny". He believed that determinism helped tyrants deceive the people, making the people content with the situation and unwilling to rebel or take action. In Mo-tse's study of heaven and man, "Tianzhi (heaven's will)" is the will of "heaven", "heaven" is the good of the people in the world, and the will is kind. Heaven is omnipresent, all-knowing and all-powerful, examining everything in the world. Heaven has the ability to reward good and punish evil, and is the only standard for measuring right and wrong in the world. In the first part of *Tianzhi*, Mo-tse points out that, If a man offends his parents or the monarch, there is still a place to escape, but if he offends Heaven, there is nowhere to escape. Heaven's Will constrains and regulates the behavior of "sage kings" and their subjects.

"Ming Gui(Knowing ghosts)" is another important concept in Mo-tse's view of the relationship between heaven and man. The meaning of "knowing ghosts" referred to by Mo-tse can be divided into two aspects: on the one hand, accepting and acknowledging the existence of "ghosts" in the traditional sense; on the other hand, explaining the gods of "ghosts" and regarding ghosts and gods as an important force to practice the will of heaven and supervise society. Ming means knowing and insight. Ghosts are the spirits of mountains and rivers or the spirits of ancestors.

Among philosophers, only a handful share Mo-tse's unwavering conviction in the existence of ghosts and gods. While other schools of thought tends to sidestep discussions on this topic, Mo-tse staunchly emphasizes their reality and presented specific rebuttals against atheistic arguments. From an empirical standpoint, Mo-tse insists that ghosts and gods were undeniably real entities. In his understanding, "ghosts" served as celestial aides to "Heaven," omnipresent observers who acted as messengers and enforcers of retribution for good deeds and punishment for evil ones. Although distinct in identity, both "Heaven" and "ghosts" shared the common purpose of monitoring human behavior. At times, Mo-tse even amalgamated the concepts of "Heaven" and "ghosts." Comparatively speaking, while ghosts played a role in surveillance and punishment, it was "Heaven" that represented the ultimate benevolence. Ghosts were

omnipotent overseers who could even reward or punish emperors themselves. Their pervasive influence extended across various aspects of human life; they constituted an extraordinary force that could not be disregarded or manipulated easily.

The heavens and ghosts are external, superior to all people, and yet able to embody human will and interests. The ghosts embody specific, local, individual, and direct will, and can embody the all-knowing ability and supervisory function of the heavens for human beings, as well as convey human will and prayers to the heavens. Thus, ghosts become the mediators for communication between heaven and human beings. The implementation of the will of heaven or the communication between heaven and human beings is manifested through spirits and the interaction between spirits and people. Through the reconstruction of the concepts of heaven, ghosts, etc. in traditional beliefs and their relationships with people (rulers and commoners), Mo-tse highlights the value and subjectivity of human beings. The control of the heavens over human beings is not direct and harsh. Therefore, the relationship between heaven and human beings is not a complete unity, nor is it an absolute opposition. On the one hand, people have the awareness of the separation of heaven and human beings, and then produce the recognition of "self," which is one of the manifestations of human spiritual awakening. On the other hand, the relationship between heaven and human beings is not an absolute opposition. The relationship between heaven and human beings is not a master-slave relationship, nor is it a simple hierarchical relationship of superiority and inferiority, but an interactive and constructive relationship. What is meant by an interactive and constructive relationship between heaven and human beings is that the relationship between heaven and human beings is not entirely determined, but is interconnected through mediating forces, that is, humans will influence the will of heaven, and the will of heaven influences the living environment, behavior, and social order of human beings. The will of the person who can influence the will of heaven is the will of mankind as a whole, rather than the subjective whims of any individual, especially not the will of the nobility and officials, but the great interests of the common people of the world and the public opinion that reflects these interests.

"Non-destiny" refers to Mo-tse's rejection of the concept of predestination. Mo-tse adhered to the principle of "Heaven's Will" and posited that it rendered individuals passive and inert, leading them towards self-destruction. Consequently, he proposed "non-destiny" as a counterforce to resist and transcend the notion of predetermined fate. Mo-tse harbored deep disdain for the idea of predestination, asserting that societal and individual destinies were not governed by an external force but rather determined by one's diligent efforts. He believed that through industriousness and striving for progress, ordinary people could alter their own destinies, embodying an active and proactive philosophical stance. The doctrine of predestination inevitably fosters complacency with the status quo while discouraging advancement. Standing in solidarity with common people, Mo-tse opposed the influence of fate on human lives, contending that through concerted endeavors one could transform their present circumstances.

Mo-tse 's highly tense relationship between heaven and man is a powerful tool for promoting "universal love" and "non-aggression," and is also an affirmation of human order and human spiritual values. However, it was not accepted by those in power and was subsequently submerged in the traditional Chinese culture with Confucianism as the mainstream thought. Many experts also believe that it was the lack of attention paid to Mohism in its later period that led to the failure of the development of ancient Chinese science and technology to reach the level it should have.

3. The limitations of the concept of heaven and man on the development of science and technology in ancient China

China has always had a traditional view of science and technology that is based on the traditional concept of "harmony between man and heaven". Dong Zhongshu's summary of this traditional concept of "harmony between man and nature" is the most famous: "The relationship between man and heaven is unity." In traditional culture, man and nature (the three elements of heaven, earth, and man) are both "the basis of all things". They are mutually responsive and mutually influential, and together constitute an organic whole. This concept of harmony between man and nature has, to some extent, driven the development of ancient science and technology. Especially in the early development of science, people integrated man and heaven, overcame the excessively mystical understanding of the sky in the primitive period, and could know heaven from oneself, and could also know oneself from heaven. This actually affirmed the necessity and possibility of understanding nature, which is most obvious in astronomy. Understanding heaven can be obtained through observation of celestial phenomena. Astronomy connects human affairs and heaven, which in turn affirms the importance of astronomy.

However, traditional Chinese culture significantly constrained the trajectory of traditional science and technology. Reflecting on the historical development of ancient Chinese science and technology, Confucianism's dominant position within Chinese culture prioritized ethics and morality as the central tenets of traditional knowledge. Conversely, scholars and officials regarded science and technology with disdain, considering them menial pursuits rather than abstract scientific theories or crafts. The prevailing cultural politics in ancient China led to a devaluation of various technical knowledge and skills that lacked direct practical applications by both ruling elites and the general populace. The feudal rulers harbored an inherent apprehension towards non-official scientific and technological advancements, resulting in direct government control over agriculture, medicine, astronomy, arithmetic, and geography. Notably, although astronomy had reached a considerable level of sophistication in Chinese history, it progressively faced stringent restrictions and prohibitions imposed by successive dynasties since the Jin Dynasty. It became monopolized by the state to such an extent that during the Song Dynasty, public laws were enacted forbidding the study of astronomy under penalty of death. Consequently, this oppressive environment led to the regression of previously advanced astronomical knowledge. China established Confucianism as its official philosophy which emphasized veneration for tradition and adherence to classical texts; thereby constraining intellectual freedom. Furthermore, literature was prioritized over

science while skills and technology were belittled as mere trivialities—a perspective that compelled scientists to strive for knowledge amidst exceedingly challenging circumstances. As a result of these factors, numerous remarkable scientific achievements have been lost throughout history and remain unknown today; many exceptional technological inventors like Song Yingxing and Jia Sizhi have remained unrecognized. This starkly contrasts with the philosophical tradition prevalent in ancient Greece and beyond which consistently esteemed reason and revered scholars.

Ji Xianlin once said that Mo-tse was an encyclopedic cultural giant. His profound attainments and great achievements represented the height of an era in the history of human civilization, which was enough to make the Chinese people today excited and proud. Mao Zedong highly praised Mohist thought. He pointed out that Mo-tse was a saint who was better than Confucius. In January 1856, Joseph Edkins, a British sinologist in the 19th century, published *A Review of Mo-tse's Personality and Works* in the Journal of the Northern Branch of China. "His (Mo-tse' s) views, although very similar to Christian doctrines in form, may be close to the thoughts of Bentham and Paly in practical terms. If these two scholars lived in the same era as Mo-tse, they would definitely regard Mo-tse as an ally without hesitation." [23]Needham set aside two chapters in his multi-volume *History of Science and Technology in China* to discuss the natural science content of Mohism and gave it a very high evaluation, thus making the value of Mohism widely recognized by the international academic community. In his study of the Mohist school and the book *Mojing,* Needham put forward thought-provoking views from a macroscopic perspective and a comparative cultural approach. After analyzing the general characteristics of Chinese civilization and comparing the similarities and differences between the scientific methods of Mo-tse and other schools of thought, he pointed out the reasons for the emergence of Mohist science and technology and its prominent characteristics. He pointed out that the Mohist practice in city building and defense led to their interest in basic methods and their research on mechanics and optics. Joseph Needham made a special study of the natural science content of *Mojing* according to the Western scientific classification research method of the scientific and technological content of the book *Mojing* according to the categories of physics and mechanics, mathematics, and geometry. In the sixth part of the fifth volume (Military Technology: Projectile Weapons and Attack and Defense Technology), Joseph Needham and his collaborator Ye Shan used almost one-third of the space to explore the chapters on preparing city gates in *Mojing*, thus putting forward many refreshing views. Joseph Needham believed that "in many respects, Mohism is more similar to Confucianism, but what distinguishes Mohism from Confucianism is its greater enthusiasm for the interests of all people." [24] One thing that cannot escape the reader's attention is that the Mohist debate on "normative thinking" has a strong similarity to the view that the logical discussion of models of contemporary science is progressing... From this point of view, the seven definitions of Mo-tse or his followers have a peculiar modern flavor. [25] British historian Toynbee once asserted in "Looking to the 21st Century: Toynbee and Daisaku Ikeda Dialogue": "... Mo-tse 's way is more suitable for the actual situation of modern people than Confucius' way." [26] He highly praised the constructive potential of "universal

love" in Mo-tse 's thought in modern society.

Among the hundreds of schools of thought in the pre-Qin period, Confucianism, Taoism, Legalism, and Yin-Yang all regarded science and technology as the lowest branch of knowledge, either disdaining it or looking down upon them. Only the Mohist school showed a unique scientific spirit, attaching importance to the study of natural sciences and the exploration of applied technology. In the classic work of the later Mohist school, *Mo Jing*, many research results of this school on natural sciences and applied technology are preserved, representing the highest level of science and technology in the pre-Qin period, and occupying an important position in the history of science and technology in China and even in the world. There are many skilled craftsmen in the Mohist group, but they are different from other schools that are separated from production labor. They engage in production labor while conducting academic activities and scientific research. They are a school with a scientific spirit and logical cultivation. In the scientific thought of the Mohist school, there is both a rigorous experimental spirit and a rigorous logical method, which are indispensable for the development of science.

However, the rich scientific thought of Mohism did not align with the needs of the feudal ruling class and had nothing to do with political ethics. Therefore, it was not appreciated by the rulers at that time. Mohism opened up a very favorable path for the development of ancient Chinese science and provided a better development direction for Chinese traditional culture. The extinction of Mohism is an irreparable loss to both ancient science and technology and traditional Chinese culture. Due to the extinction of Mohism, the spirit of focusing on science pioneered by Mohism was submerged and did not occupy the due position in traditional culture. From then on, the scientific spirit was lacking in traditional Chinese culture. The lack of use of Mohism is a huge loss to the development of ancient Chinese science. If the scientific spirit of Mohism occupied the due position in traditional Chinese culture, the status and fate of science and technology in ancient China might have been different. Our ancestors' contributions to the world are far more than the four great inventions, and they may have reached Ellul's technological society.

Conclusion

Looking at the history of traditional Chinese technology from Ellul's perspective is an interesting and worthy perspective. Ellul carefully observed, pondered, thought, and predicted the modern world. A large part of his theory coincides with Chinese technological civilization. Such a surprise also reflects the scientificity and correctness of Ellul's research. On the contrary, in the 5,000-year history of Chinese civilization, there is indeed quite a lot of traditional Chinese culture that is worth studying and learning from. "Stones from other mountains can be used to polish jade", and it also means that talents from other countries can serve their own country. The difference between Chinese and Western scientific models comes from the difference in thinking mode, and the history and culture of other countries can also provide solutions to some theoretical dilemmas. I believe that the rich and long history of ancient Chinese technology can bring a new perspective to the study of Ellul's theory.

Technological society is the fate of modernity, but this fate is not unchangeable and reversible. Ellul tried to explore a way out by himself, and at the same time encouraged us to find answers ourselves while thinking. "At the end of my books, readers are called to take action and make their own decisions, and they surely say to themselves, 'This is very annoying. I don't see which action I can take. 'They would prefer a last chapter in which someone would tell them, 'Here is what you must think and do. ' This last chapter I will never write." [27]

As a cultural value, the concept of heaven and man has had a significant and profound impact on the evolution of ancient Chinese technology, but the factors that affect its evolution are not limited to this. In fact, as Joseph Needham said in *The Titration of Civilization*, the characteristics of the evolution of ancient Chinese technology cannot be reduced to a single reason but to various complex systems. Therefore, when we discuss the impact of the "concept of heaven and man" culture today, we are also looking for the value dimension that has been lost in the development of technology. The technological society only grasps the function of technology itself and the efficiency it brings but ignores its connection with people's overall life, which is one of the ancient Chinese wisdoms. Wu Jing, a historian of the Tang Dynasty in China, mentioned in *Zhen guan Zheng yao* that "using the past as a mirror, we can know the rise and fall; using people as a mirror, we can understand gains and losses." Attaching importance to history, studying history, and learning from history are the fine traditions of the Chinese nation's 5,000-year-old civilization. We believe that we can learn a lot of wisdom from the ancients. If we examine Ellul's technological society issues from the perspective of the application and constraints of Chinese traditional culture on technology, both of them will gain new and positive research significance and value today, and burst out with new vitality.

Notes

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