

How Was the Bow and Arrow Invented? An Investigation of its Origin

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THE INVENTION OF THE BOW and arrow has an epoch-making significance in the early history of human society whether it is viewed as a tool of production or a weapon. As Friedrich Engels points out, "A bow and arrow was for savagery what the iron sword was for barbarism and fire-arms for civilization—the decisive weapon."¹ This assertion may be difficult for a person living in the contemporary age to comprehend. Nevertheless, if we trace human history back to the late Paleolithic, twenty to thirty thousand years ago, we can see that the bow and arrow was the most "modernized" tool of production and an up-to-date weapon. And we will not be surprised at Engel's evaluation of the significance of the invention of the bow and arrow if we correctly understand the profound import and the penetrating historical materialistic method contained in his well-known saying: "In spite of the gigantic liberating revolution which the steam engine is carrying through in the social world—which is not yet completed by half—it is beyond all doubt that the generation of fire by friction has had an even greater effect on the liberation of mankind. For the generation of fire by friction for the first time gave man command over one of the forces of nature, and thus separated him forever from the animal kingdom."²

What a great pity it is that although the emergence of the bow and arrow has such a great significance in the development of human society, yet there

is, up to now, nothing that provides a reasonable explanation and convincing proof on the question of the origin of the bow and arrow. As a result, there remains a real, though not very big, blank or puzzle in the history of the development of tools of production and weapons. Indeed, no explanation or proof is given for the historical origin of the bow and arrow in the works of such world-famous specialists in history of science and technology as J.D. Bernal, W.C. Dampier, Stephen F. Mason and Joseph Needham of Britain, R.J. Forbes and E.J. Dijksterhuis of the Netherlands and Masanori Oonuma of Japan, as well as many Chinese specialists. And on the question of the invention of the bow and arrow, these scholars, like Engels, only make brief comments on its epochal significance or give a rough estimate of the age of its invention, or simply ignore the whole issue.

Then, why is it that so many specialists in history of science and technology have not made clear such an extremely important invention in the history of tools of production and weapons? In the writer's opinion, the reasons are as follows:

1. There are no historical remains of the primitive forms of the bow and arrow. As the Dutch scholars R.J. Forbes and E.J. Dijksterhuis have rightly put it in their joint work, *History of Science and Technology*, "[a]t present, we can only search for the ancient attempts at such invention and creation from the relics unearthed by the archeologists. As the remains of human bodies and historical sites in different parts of the world have all been subject to various climatic destructive effects, now we can only see a very small bit of the relics from among the historical sites that have survived the vicissitudes of many a century. Besides, as there is a lack of written material which can manifest the thought, beliefs, achievements and ideals of the pre-historic man, our knowledge of the pre-historic man is just fragmentary."³

Historians of science and technology base this opinion and the assumption that the bow and arrow must have been invented during the late Paleolithic, about twenty-eight thousand years ago, on stone arrowheads unearthed in Zhiyu Valley, Shuoxian County, Shanxi Province at a historical site of that period. As there are stone arrowheads, there must have been bows and arrows—this is beyond all doubt. Nevertheless, the archaeologists of the various countries in the world have not, up to now, unearthed—it is doubtful if they will ever unearth—any remains of actual bows and arrowshafts belonging to the initial stage of their invention. For in the late Paleolithic the only materials that human beings could use for making bows and arrows were bamboo, wood, tendons, muscles and skins of animals, and certain

plant fibers, and bows and arrowshafts made of such materials could not remain intact, having been buried for twenty to thirty thousand years under natural conditions. Only the arrowheads, made of stone or bone and bound onto the arrowshafts, can irrefutably prove the existence of the arrowshafts, together with which the arrowheads were catapulted at the goals, and the existence of the bows which shot off the arrowshafts. However, the excavation of stone or bone arrowheads from late Paleolithic sites can only help to ascertain the latest age of the invention of the primitive bow and arrow. These finds cannot tell us exactly how the bow and arrow was invented.

2. The catapulting principle of the working of the bow and arrow has no similar phenomenon to match it in the physical world. The invention of many primitive tools was due to insights into the functioning of natural things by the people in their course of life and production—a result, essentially, of direct observation and simulation. This is to say that all these man-made tools have natural prototypes in the physical world. For example, we can compare pointed tools to natural sharp rocks, scrapers to clam shells, and bone needles to fishbones or thorns of certain plants. But for the bow and arrow there are no natural things corresponding to its shape or catapulting mechanism that an ancient people could observe and copy. Therefore, the contemporary archaeologists have no way to make conjectures and explanations by utilizing any clues that the physical world may provide.

3. Even if the archaeologists excavated perfectly-preserved remains of the primitive bow and arrow, it would remain quite difficult to find a direct answer to the question of how they were invented and created. For the bow and arrow was a compound tool, produced by primitive men living before the late Paleolithic on the basis of the scientific knowledge (though it was a kind of experiential scientific knowledge in the embryonic state) which they had gained through the invention of numerous simpler tools. And the primitive method for making compound tools cannot be restored on the basis of the unearthed objects alone. Consider, for example, the simple stone tools of the Paleolithic, contemporary archaeologists can easily trace the basic methods for making these tools—impact drilling, hammering, rolling, direct or indirect knocking—from knowledge of the raw material, shape and use of such stone ware; and archaeologists can reproduce stone ware, similar to that used by primitive men, according to these methods without difficulty. But even if we were fortunate enough to excavate a set of the primitive bow and arrow from the late

Paleolithic, we would be hard pressed to answer from the relics alone the question of how—by what principle or method—they were invented.

Then, how did the primitive men discover the working mechanism of the bow and arrow and produce the first bow and arrow?

Looking at the matter from the scientific and technological angles, the making of the bow and arrow is the first terrific invention in the technical history of human tools: “The bow, the string and the arrow is a kind of complicated tool and a marvelous mechanical structure. It is a great creation resulting from the combination of the hand and the brain of the primitive men. To make the bow and arrow, it is necessary to know how to choose the best wood for the bow proper and to use the animal tendons, skins or plant fibers for the string and to use stone, bones or animal teeth for the arrow-heads. Feathers are often attached to the arrowshaft so that the arrow can better fly in a fixed direction.”⁴ This marks a leap from the simulative manufacture of tools by human beings based upon direct observation of the shape of natural objects, to the creation of such very complicated tools and weapons by abstraction and summarization of working experience and the functions of other tools.

The British scholar J.D. Bernal assumes, without elaborating, that the ancient people invented the bow and arrow through an accumulation of their experiences in hunting.⁵

But the conclusion from my own investigation is that the bow and arrow originated from the fishing gear of ancient people.

In the Stone Age, the level of production was extremely low. Most of the primitive men used to live close by the water. While going hunting and gathering edible plants by means of simple and rough tools, they also caught fish and shrimp in the rivers and lakes for food. The accumulation of practical experience in production enabled them to improve their method of fish-catching by hand and gradually they created the earliest fishing gear, which was called 𦉳/gǔ/(fishing gear) by the ancient Chinese. The Chapter *Xici* of the Chinese classic *The Book of Changes* of the Zhou Dynasty has an account of *gu*, which reads as follows: “In remote antiquity, our fore-father Paoxi (the legendary earliest ancestor of mankind) knotted ropes into 𦉳/wǎng/(net) and 𦉳/gu/ for hunting and fishing.” The age of Paoxi in Chinese legend approximately corresponds to the late Paleolithic. The creation of *gu* was undoubtedly a tremendous progress in the tools of production of that time.

It must be emphatically pointed out that both the ancient and contemporary Chinese scholars have had an incorrect comprehension of the Chinese character 𦉳/gǔ/. According to the poem *Xiaoming* of Chapter *Xiaoya* of

the Chinese classic *The Book of Songs*, annotated by Mao Heng of the Western Han Dynasty, “*gu* means a net.” All the Chinese philological books, from *The Book on Chinese Characters* by Xu Shen of the Eastern Han Dynasty up to the various contemporary Chinese dictionaries, follow this version. This explanation which regards the Chinese characters 𦉳/gǔ/ and 𦉳/wǎng/ as equivalent in meaning is unwarranted. In the writer’s opinion, *gǔ* is a kind of fishing gear and *wǎng*, which is a net made by knotting the rope, is only a component part of *gu*. Then, what else is there to form *gu* besides the net? There is also 𦉳/gǔ gǒng/ (the bow of *gu*), which is the solid frame on which the flexible rope net is tied and spread out to take shape. From the forms of the characters 𦉳/gu/ given in *The Book on Chinese Characters* in the ancient seal script, 𦉳, we can see that the ∩-shaped frame is the basic component member of the fishing gear *gu*, without which the rope net would have no prop. The original morphological form of *gu* is a pictographic character. Doesn’t it look like a man (in ancient China the graph 𠂇 was also used to represent a person) holding a 𦉳-shaped fishing gear to catch fish?

The real object of remote antiquity represented by the character 𦉳/gǔ/ cannot be found now. However, the writer thinks that this kind of simple fishing gear has been miraculously handed down through twenty to thirty thousand years—some of the fishing hobbyists in the present Chinese cities and countryside often use a kind of 捞网/lāo wǎng/ (fishing-catching net) to catch fish in the shallow water of the river, lake, harbor and branching stream. This kind of fish-catching net is made of a wooden stick or a bamboo strip, bent to form a ∩-shaped frame (bow) and a rope (called the string) stretched taut between the two ends of the frame, with a rope-woven net fixed on the bow proper and the string. In actual practice, the fisher holds the two ends of the frame and presses ahead in the water to catch fish (see Figure 1).

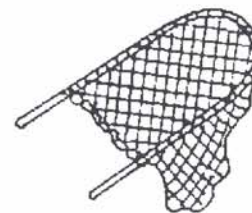


FIGURE 1. *Laowang* (fish-catching net).

Thus, 弓 /gōng/ (the bow of the bow and arrow) is evolved from 𦏧 /gǔ /gǒng/ (the frame) of *gu* (the fishing gear). For in the process of making *gu*, the first step is to bend the wooden stick or bamboo strip into the 冂-shape and then to tie a rope (or string) tautly to the two ends of the frame. At this very moment, a bow (of the bow and arrow) is practically accomplished. The reasons why the discovery of the catapulting mechanism and function of the bow (of the bow and arrow) resulted from the making of the fishing gear *gu* will be given in a later part of this paper.

The writer has noticed that, from the phonological and semantical aspects of the Chinese language, there is also a close inherent link between the characters 弓 /gōng/ and 𦏧 /gu/. This provides valuable information for us to trace the origin of the bow and arrow.

In the course of the formation of the Chinese characters or words, the pronunciation, name and meaning are given as an extension of the functional link or interrelationship between the material things, e.g., the connection between 中 /zhōng/ (impartial, middle) and 仲裁 /zhòng/ (arbitration), between 固 /gù/ (solid, hard) and 痼 /gù/ (a stubborn disease), between 旁 /páng/ (side, lateral) and 螃 /páng/ (crab, a kind of shellfish that moves sideways), between 方 /fāng/ (square) and 坊 /fāng/ (ancient square-shaped compound of dwelling houses; a block), etc. There exists certain relationships between the things (or ideas) represented by these characters that may account for the same or similar pronunciations given to these characters. According to this theory, as the pronunciations of 𦏧 and 弓 are /gǔ/ and /gōng/ respectively (having the same consonant /g/), we can easily see the inherent connection between the objects represented by *gōng* and *gǔ*. The process of making *gu*, or the evolution of the making of *gǔ* (fishing gear) to the making of *gōng* (bow) may serve to explain the phonetically-related names given to the two objects. Thus, it is reasonable to say that the pronunciation of *gōng* is derived from that of *gǔ*.

The earliest comparatively mature written language discovered in China up to now is found in the inscriptions on bones or tortoise shells of the Shang Dynasty, which was in use from sixteenth to the eleventh centuries B.C. They are mainly pictographic characters. In the inscriptions on bones and tortoise shells, the character 弓 /gōng/ was written as 𦏧, which is a symbolic depiction of the comparatively advanced compound bow that was used at that time. But we can see that it is still directly related to the shape of *gǔ gōng* (bow of the fishing gear).

The assumption that *gōng* (bow) derives from *gu* (the primitive fishing gear) is quite convincing. It explains why, in remote antiquity, primitive men scattered over the various parts of the globe, separated by rivers and moun-

tains in secluded environments of existence, could invent the bow and arrow by themselves under similar conditions of development of their productive forces.

The writer cannot agree with Mr. J.D. Bernal's viewpoint that after the earliest bow and arrow was invented, "the use of the bow and arrow seemed to spread rapidly over the world."⁶ For in remote ancient times, the situation was entirely different from that of the modern society in which a new invention in a certain locality can be quickly passed on to other places by means of the modernized means of communication. But the discovery of the magical effect of the bow and arrow resulting from the making of *gu* is a process of invention that could be realized independently by any primitive human community. For instance, at least before the end of the Neolithic Period, there was no intercourse between the Oriental nations and the European nations, but the bow and arrow had been in use among the primitive people in Asia and Europe respectively without each knowing the other; also the primitive tribes in the hinterland of Africa and the continent of America had made use of the bow and arrow before the arrival of the Europeans. Although we don't know what they called this kind of fishing gear in their respective communities, or whether there was any connection between this kind of fishing gear and the bow and arrow in the languages of other nationalities, yet we are quite sure of one thing—they all had the wisdom and capability to create independently a kind of fishing gear similar in shape to the ancient Chinese *gu* and to provide the basis for the invention of the bow and arrow in accordance with the course of development of the productive forces of primitive men and the accumulation of their experience in fish-catching, just as they could learn to make various stone ware and earthen ware of similar shapes and functions independently. Only by investigating the origin of the bow and arrow from the common historical conditions of the development of the productive forces, or, more specifically, the development of the tools of production, can we avoid falling into the mire of historical idealism or agnosticism.

Some people have made the remark that the ancient Chinese classic, *The Book of Changes*, has explicitly stated that the ancient people "knotted ropes into *wǎng* and *gǔ* for hunting and fishing," which means that the bow and arrow might also be invented through the hunting activities. They may thus raise the question: why does the writer think that the bow and arrow only originates from the fishing gear? The ancient Chinese authoritative work on textual research of Chinese characters, *Annotations of the Book on Chinese Characters* by Duan Yucai of the Qing Dynasty, has given a definite answer to this question: "According to *The Book of Changes*, people knotted ropes

into *wǎng* and *gǔ* for hunting and fishing, meaning that *wǎng* and *gǔ* are not exclusively used for fishing. But *gu* was, in effect, the fishing gear, and was also used for catching birds and animals. Thus, in the ensuing text appeared the terms 鸟罟 /*naiao gu*/ (bird-catching net) and 兔罟 /*tu gu*/ (hare-catching net)."

Gu was first made by the ancient people exclusively for fishing, but later on people discovered that it could also be used to catch birds and hares, and accordingly such hunting gear as *niao gu* and *tu gu* came into being.

Therefore, we can assume that *gu* was the earliest fishing gear, made by stretching a net on the 冂-shaped frame. Later on, it became the collective term for the various fish-catching, bird-catching, hare-catching and other animal-catching apparatus. This can be proved from the forms of the ancient Chinese characters (See Figure 2).

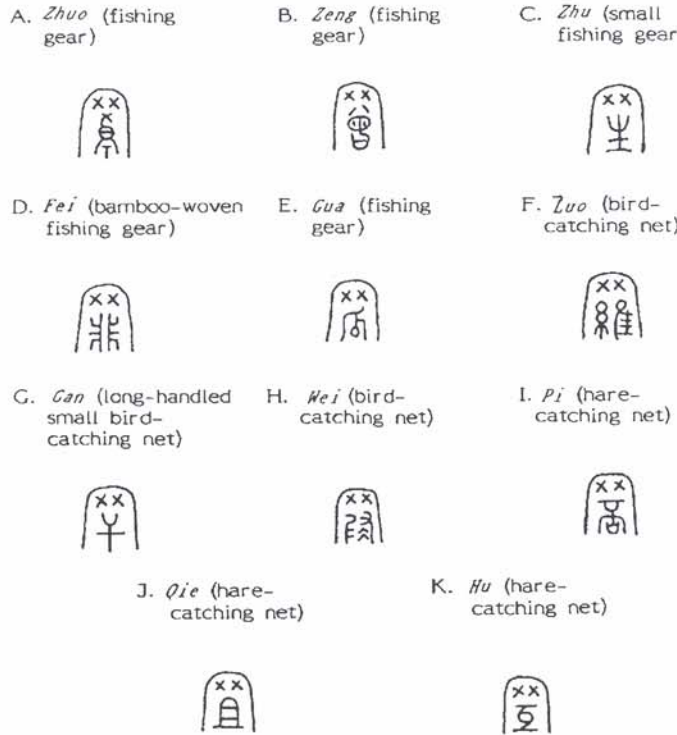


FIGURE 2. Forms of the ancient Chinese characters.

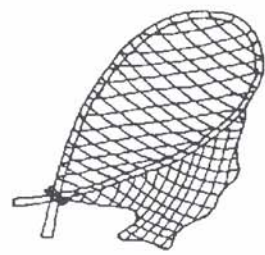


FIGURE 3. Dawang (pigeon-catching net).

Today we cannot see the actual forms of these kinds of gear, but in our modern society, we can still find some traces of the evolution of the bird-catching and hare-catching apparatus. The pigeon breeders in the Chinese cities and countryside often have a kind of pigeon-catching net called 搭网 /*dawang*/, which consists of a slender wooden stick or bamboo strip bent into a ring with a pointed lower end where the intersect is tied up with a string and a rope-net attached to the rim (see Figure 3).

Although this kind of *dawang* has no taut string, we can be sure that it is the successor of the above-mentioned *niao gu*. Furthermore, doesn't the butterfly-catching net used by the contemporary entomologists for catching insects in the fields look very much like 罟 /*gan*/, the ancient long-handled small bird-catching net? As to *tu gu*, it's quite possible that at first primitive men used *yu gu* directly to catch the hare—they might round up the hares and try to catch them by *yu gu*, or set *yu gu* at the outlet of the cave to trap the hares—and then gradually made improvements and developed the special-purpose hare-catching gear: the various kinds of *tu gu*. Such hunting gear as the hare-trap and the iron-trap or ground bow trap for catching larger beasts now used by the hunters in the countryside or mountain areas must have been gradually developed after the discovery of the elastic function of the bow.

To sum up, the bow must have originated from *gu* used in catching fish. However, for primitive men to invent the bow and arrow, there are three prerequisites:

1. The discovery of the catapulting mechanism of the bow and arrow must be made in the course of the productive labor of mankind and in the course of making other productive and living apparatus that are linked with the making of the bow and arrow.

2. There must be the three essential elements, the bow, the string and the arrow, that consist of the entire catapulting mechanism of the bow and arrow.

3. The opportunity for making such a discovery has a universal nature. When the development of the productive forces reached a certain level, the secluded primitive communities were all capable of discovering the catapulting mechanism of the bow and arrow independently.

From the above analysis of *gu*, we can see that after the primitive men had created the fishing gear, they already possessed the material and technical bases and intellectual conditions for the discovery of the catapulting mechanism of the bow and arrow. These bases and conditions are:

1. As the development from molding clay into vessels to baking clay into pottery, or the development from coarse stone ware to fine stone ware, so the development from catching fish by hand through killing fish by stone or spearing fish by fishfork to making *gu* to catch fish was a natural outcome of the repeated practice, the summing up and accumulation of experiences by primitive men in their struggle in production and life over a long period of time. This was an advancement that any primitive community could attain and realize by itself.

2. From the making of the fishing gear we can see the embryo of the bow. Bending the wooden stick into an arc and using a rope as the string—this in itself had accomplished the making of a complete bow. Although its catapulting function was not immediately recognized, the embryo of the bow and the catapulting mechanism had appeared, making discovery of the function of the bow inevitable. Its possibility was paving the way for its actuality.

Certainly we cannot now imagine how joyfully surprised the primitive men were when they happened to discover the catapulting mechanism of the bow and arrow in the process of making the *gu*. However, backward areas in various parts of the world, where the level of productive forces has remained almost at a standstill for thousands of years, are like a museum of tools of production and have preserved for us precious historical data about tools of production in remote antiquity as well as traces of ancient invention and creation. Certain processes in basket-weaving by peasants in the remote mountain areas of present North China may provide valuable hints as to how primitive men discovered the catapulting mechanism of the bow and arrow while they were making the *gu*.

When weaving the basket, the peasants first make the bow of the basket. A hard and elastic wooden stick is chosen and put on the fire for curing. A rope is attached to one end of the stick, which is slowly bent into a semi-circular arc, and the rope is then tied to the other end of the stick to get into the shape. This set of arc-shaped stick and the rope string is, in effect, a real bow. What is worth noticing is that in making the large-sized basket, as the stick is thick and long with high elasticity, the strength of the rope may not get the bow into the required curvature in the first attempt, and the basket-maker has to step on the bow and put in a second stick between the bow proper and the string as a propping device to bend the bow further into the final shape. As the bow proper is round and smooth, the propping stick may by chance slip off, that way clearly revealing the catapulting function (see Figure 4).

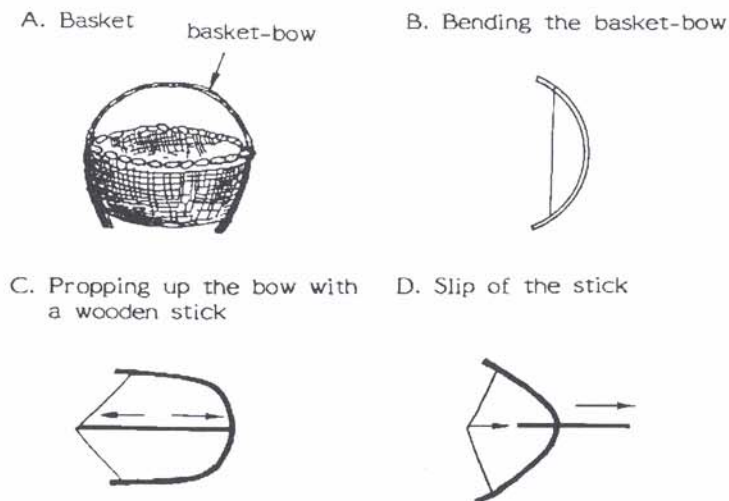


FIGURE 4. Catapulting mechanism of the bow and arrow as illustrated in the making of basket-bow.

Then, what bearing does this method of “utilizing the present to explain the ancient” have on our effort to infer how primitive men invented the bow and arrow out of the discovery of such catapulting mechanism?

1. The method of making *gu gong* by the primitive men should be quite similar to that of *long gong* (bow of the basket) by the contemporary

peasants of the mountain areas. For the making of *gu gong* also needed rather hard and highly elastic wooden or bamboo materials to be bent into the arc shape. When the curvature was not up to the requirement, primitive men could think of using a stick to prop up *gu gong* so as to make it more curved, judging from their level of intelligence and experience.

2. Whether the fishing gear, or the bird-catching net, or the hare-catching net, once these apparatus were created by mankind, they already comprised the two essential elements: the bow proper and the bow string. Although there was a soft net on the bow, the catapulting function of the bow proper and the string remained there and could often have revealed itself. What was needed was just a slender wooden or bamboo stick to be set on the string. When the string was drawn and the stick let off, the catapulting mechanism of the bow and arrow was revealed to the full.

The writer believes that after primitive men had created the fishing gear, the bird-catching net, and the hare-catching net, and over the long years of making and using such indispensable and life-sustaining tools, they could invent the bow and arrow by chance or by necessity just as they could accidentally or inevitably discover and develop the other tools of production.

And after the invention of the bow and arrow and before the appearance of the stone and bone arrowheads, there must have been a long period of time in which wood and bamboo was cut and made into arrows, as is mentioned in *The Book of Changes*: “The wooden stick is strung into a bow, and wood is cut into the arrow. The bow and arrow has the advantage of overpowering the world.” Therefore, the earliest age of the invention of the bow and arrow should not be determined by the earliest period of the use of stone arrowheads, but it should have come in a much earlier, more remote year.

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Notes

1. Friedrich Engels, *The Origin of the Family, Private Property and the State*, Foreign Languages Press, Peking, 1978, p. 25.
2. Friedrich Engels, *Anti-Duhring*, Foreign Languages Press, Peking, 1976, p. 145.
3. R.J. Forbes and E.J. Dijksterhuis, *History of Science and Technology*, translated by Liu Janjun, Qiu shi Publishing House, Beijing, 1985, p. 6.
4. Chen Changshu and Yuan Deyu, *A Short History of Natural Science*, Liaoning Science and Technology Publishing House, China 1984, p. 6.
5. J.D. Bernal, *Science in History*, Watts Co. Ltd., London, Second Edition, 1957, translated by Wu Kuangfu, China Science Publishing House, 1959, p. 46.
6. *Ibid*, p. 46.