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Analysis of the Shape, Music Theory and Musical Performance of Stone Chime Unearthed in the Pre-Qin Period

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ABSTRACT

The pre-Qin period was the early stage of the development of music theory, musical instruments and performance in China, and his music theory laid the foundation for the later development of musical instruments, and also provided research inspiration for the design of musical instruments and materials. At present, the study of stone tablets excavated in the pre-Qin period is mainly based on the analysis of completeness and music theory, while ignoring the study of their connotation and expression. In this paper, with the help of Min-phone M2023 (Guangdong, China), GIS 2022, SPSS 17.0, and Analysis 2020 software, the data analysis was carried out, and the material, expression, shape and music theory connotation of the stone chime were tested, and the musical value and archaeological value of the stone rock were excavated, which provided a reference for the theoretical analysis of musicology in China. The results show that the stones of the pre-Qin period are mainly made of granite and quartz, and the process is formed by polishing, showing the shape of water droplets, and its loudness is improved through the form of combined research. Among them, the changes in substances and assemblages before the Western Zhou Dynasty were small, mainly in shape. Xia Shang and Chunqiu mainly changed materials and craftsmanship, while Chunqiu changed in weaving combinations to improve musical performance. At the same time, before the Western Zhou Dynasty, Xia Shang and Spring and Autumn Period, the interval, timbre, loudness and other aspects were studied, and certain results were obtained. Therefore, the pre-Qin stone rock provides a reference value for the study of music theory, modeling design and music performance analysis in China, provides a reference for archaeological research, and also promotes the development of national music.

Keywords: Pre-Qin, Chime, Shape, Music Theory, Connotation, Performance.

INTRODUCTION

The pre-Qin period is the early stage of the historical development of pre-Qin stone rocky music, and it is also an important period for the production of musical instruments, music theory analysis, and music development. The gong is a body sonorous instrument made of stone, which has an important position in the pre-Qin period (Amiri,et al., 2022a), so the gong once became the focus of the study of the ritual culture of the pre-Qin period. In the pre-Qin period, the gong was a musical instrument and a symbol of the status and status of the ruling class, with the dual functions of "musical instrument" and "ceremonial instrument" (Amiri,et al., 2022b). It is often used in various ceremonies, court performances, and important events. From the perspectives of modeling, music theory connotation and musical role, this paper focuses on the role of stone rocks excavated in the pre-Qin period, and its purpose is to study musical instruments and music culture in the pre-Qin period. In the history of the pre-Qin stone people (Candiani,et al., 2022), "Gong" has always been a musical instrument with great research value, is a percussion instrument made by the ancients using stone, and is one of the earliest musical instruments in history. "Chime" belongs to the "stone" sound in the "eight-tone method", so it is called "stone qin". From the perspective of glyph structure, the upper part of the character "Chime" is like a hanging stone piece, while the lower part looks like a person holding a mallet in his hand and gently tapping the stone chip, so the rock can be

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seen as hanging and beating at the same time. In ancient China, music was a relatively high-class enjoyment, such as a relatively high-grade musical instrument popular with the stone royal family and nobles during the Shang Dynasty, which would appear in the royal court's banquet or the orchestra performance of the sacrificial ceremony. It can be seen that during the Shang Dynasty, the stone rock belonged to a kind of "ritual vessel", and everyone who could enjoy the fun of the music it brought had a certain identity, status and power. According to historical records, when Dayu governed his tribe, he once asked people to hang five musical instruments on the palace gate, including stone rocks. The stone chime unearthed in the pre-Qin dynasty have a variety of shapes and have obvious characteristics. Although there are still not many stone stones unearthed at present, in the pre-Qin stone stones, we can better grasp the culture of the pre-Qin period and better understand the music theory of the pan (Cassanelli,et al., 2022).

AN OVERVIEW OF THE SHAPE AND MUSIC THEORY OF THE STONE CHIME UNEARTHED IN THE PRE-QIN DYNASTY

In the Shang Dynasty, "chime" was a particularly important burial product for the tomb owner, so many nobles had the sound and dance of the rock as a ceremonial funeral product in the sacrifice. It can be seen that in the Shang Dynasty, the stone rock was a very key musical instrument, and it was also a typical ceremonial instrument, which could play a role in funerals.

Research Methods

In this paper, with the help of Min-phone M2023 (Guangdong, China), GIS 2022, SPSS 17.0, and Analysis 2020 software, the material, expression, shape, and music theory of the stone chime were tested with the research object of the stone chime in the Western Zhou, Xia, Shang, and Spring and Autumn periods, and the musical value and archaeological value of the stone chime were excavated. Among them, the test samples are imitations, and have been agreed by experts in the field of museums and archaeology, and the samples have not been damaged during the research process, mainly surface analysis and measurement analysis.

The Shape of the Stone Brick Excavated in the pre-Qin Dynasty

In terms of shape, the stone rock shapes unearthed in the pre-Qin Dynasty are generally divided into several types, namely fish-shaped, rectangular-like, diamond-like, trapezoidal, hexagon-like, pentagonal-like, flat-rectangular, pentagonal, inverted trapezoidal, curved ruler, cloud-shaped, folded ruler-shaped, triangular-like, obtuse angle rectangle, guqin-shaped, etc. Through the development of the shape of ancient times and Xia Shang Zhou, the stone rock presents the characteristics of constant change and diversity (Chawla,et al., 2022). Among them, there are some novel shapes, such as , inverted trapezoids, cloud shapes, etc., which can reflect the aesthetic changes at that time to a certain extent, or at least illustrate the exploration spirit of people at that time on the shape of stone instruments. Pre-Qin musicians hoped to explore their influence on musical characteristics through different shapes, so as to form the pronunciation system of stone rocks. See Table 1 for the various shapes of the stone rocks during the Shang Dynasty.

Table 1. Stone Sculpture from the Pre-Qin Period

1	rectangle	8	Flat rectangle
2	Rhombus-like	9	Cloud-shaped
3	Class rectangle	10	pentagon
4	Guqin shape	11	Folded ruler
5	Class triangle	12	Fish-like
6	Curved ruler	13	Blunt rectangle
7	Inverted trapezoid	14	arc

From the contents in Table 1, it can be seen that the overall evolution process is: triangle → rectangle → rectangle → flat rectangle → diamond-like, guqin → curved ruler → inverted trapezoid → cloud → pentagonal → folded ruler, fish-like → obtuse rectangle → arc. Among the stone chimes unearthed in the pre-Qin period, the number of fish-shaped stone chimes is the largest. For example, the "Yongqi" stone chimes in Anyang are similar to fish-shaped. The "Yongqi" stone chime is relatively well preserved, and its manufacturing material is black sedimentary rock, the surface is not carefully polished, the manufacturing is relatively rough, and the bottom is uneven. After sound measurement, it can be seen that the specific pronunciation pitch of "Yongqi" in Anyang is down b2, and the back is engraved with the word representing its device name, that is, "Yongqi".According to Shuowen's mastery of characters, "Yong" and "Yong" mean the sound of music and singing, while "Qi" means "development" (Choi & Kim, 2023). Therefore, the academic circles master that "Yongqi" means "singing the first

music". In addition, the shape of "Yaoyu" stone chime unearthed in Anyang area is similar to fish shape, which is made of black sedimentary rock, which is consistent with the "Yongqi" stone chime in Anyang, and the surface and edge of the back chime body are not very flat.However, unlike the "Yongqi" stone chime in Anyang, the bottom of the "Yaoyu" stone chime has been polished to some extent, and the bottom forms an obvious straight line. After measurement, it is found that the pronunciation pitch of "Yao Yu" is c3, and the stone chime is also engraved with its own instrument name, that is, "Yao Yu" (Curran &Ogilvie, 2022), which means to relieve the performance of music rhythm in dance situation. It can be seen that "Yao Yu" is very apt and quite "fits" with its shape.Rectangular stone chimes are common, and the shape of stone chimes is regular, and the production is rough. Drums and strands are faintly visible, which are actually used for hanging. In addition, rhombic stone chimes and polygonal stone chimes are common. Before the Shang Dynasty, the shapes of stone chimes were generally fixed, often rectangular and fish-shaped. After the Shang Dynasty, the shapes of stone chimes began to become very rich, showing the characteristics of irregularity and many shapes. However, although the change of shape is an exploration, obviously, it does not leave valuable clues for archaeological research in the pitch and other musical theory features of Shi Qing.

According to the statistics of stone chime unearthed in the pre-Qin Dynasty, the stone brick era unearthed in Shanxi is basically the ancient and Xia Shang periods, while the stone chime of the Zhou Dynasty, especially those of the Western Zhou Dynasty, are less numerous. In some stone rocks from the Western Zhou period unearthed in Shanxi, their shapes are often trapezoidal, for example, the Jin Hou M8's weaving 1 and weaving 2 are trapezoid-like modeling designs. Shanxi is a large number of stone chimes unearthed in the pre-Qin Dynasty nationwide, and the stone stones unearthed in Shanxi are generally woven stones, and their grinding is often very fine (Curtin et al., 2023), and the shape is very regular. Stone rocks unearthed in Shanxi before the Spring and Autumn period generally show a variety of shapes, while after the middle of the Spring and Autumn, the stone stones unearthed locally are generally arc-arched. From the current research, the pitch of the stone rocks in the Shang Dynasty is within the range of small print 2 groups, that is, within C2~B2, and its frequency range is about 523.26-981.11Hz, which is within the range of pitch spectrum that can be heard by human ears. According to modern research, the human ear will have a very sensitive response to sound waves of 400-1000Hz. It can be seen that the sound wave range of the Shang Dynasty stone chime unearthed so far and the hearing range of the human ear remain unified. Therefore, the music theory research of stone rocks unearthed in the pre-Qin period is valuable for the study of artistic laws and sounds, and also has certain music theory connotations. In addition, the stone rocks of the Shang Dynasty had different sizes and relatively many shapes, and the back often had engravings and painted patterns and inscriptions (Desai, 2023). Therefore, the stone rocks in the late Shang Dynasty had a higher level of development and production, which proved that the stone rocks in the Shang Dynasty were relatively sophisticated and had reached a certain height. From the appearance and shape and ornamentation of the Shang Dynasty stone rocks, there are many changes, and the pitch is excellent. After the middle of spring and autumn, the shape of the stone rock has been relatively regular, and the shape is relatively fixed. The shape of the stone brick in the middle of spring and autumn changes with the pursuit of the overall pronunciation of the stone rock. Generally speaking, the arc base of the stone rock is made because of the quality of the sound effect of the stone rock, and it will be processed with the experience of the craftsman to improve the sound effect (Dong, et al., 2023). Therefore, it can be seen that after the development of different periods of the Eastern Zhou Dynasty and the Western Zhou Dynasty, the craftsmen's understanding of pitch, rhythm, timbre and other aspects has gradually improved, mastered the grinding process of stone rocks, and improved its pitch and acoustic effects. Therefore, the pre-Qin pursuit of stone sound has changed greatly, no longer pursuing a variety of different shapes, but focusing on acoustics.

The Musical Connotation of Stone Chime Unearthed in the Pre-Qin Dynasty

During the Shang Dynasty, the exploration of the musical rationality of the stone rock has not yet achieved a significant breakthrough, and the production of the stone rock is "according to the sound on the material" or "according to the sound on the sound", so the focus of the study of the music theory of the stone rock in the Shang Dynasty should be the Eastern Zhou and Western Zhou periods.

Expand the width of the vocal range

At present, in the Eastern Zhou Dynasty Qiao that has been unearthed, there are only 6 sets of sound measurement result data, and the sound measurement results of the stone rock can reflect the characteristics of the scale and tuning of the stone rock in the Spring and Autumn and Warring States periods, so the existing stone rock should be tested for sound measurement. For example, Luoyang's Eastern Zhou weaving is currently relatively well preserved, and according to research, only 2 drum parts have broken in this group of weaving. Therefore, it is impossible to grasp the specific vocal range, etc., but the remaining 21 pieces of arrangement have a wide range spanning 4 octaves, and they are basically concentrated in the middle and high ranges, such as small

print 2 groups and small print 2 groups (Funk et al., 2022). After converting (+15) according to the average corresponding to the modern pitch complement number, some tones have appeared twice in the range of 1 octave, and when they appear twice, their frequencies are very close, more like homonyms, such as 59 and 50, 41 and 53. Preliminary judgment suggests that the basic reasons for this may be:

Propose a preliminary concept of sound intervals

The 23 pieces are not actually unified, it is not 1 set, but 2 sets mixed with each other. Second, in homophonic arrangement, the repeated gong may be a backup preparation. If the pitch of the two brooders with damage problems is set to C2 and C3, this set of arrangements can form a whole positive scale, lower emblem scale, and Qingshang scale. In the past research data, it can be found that the concept of "absolute pitch" has appeared in the pre-Qin period, especially from the research of Zeng Hou Yizhong (Goldman, Fried, Lindsey, Pham, & Dettori, 2023), it has been learned that in the Spring and Autumn and Warring States periods, the domestic rhythm was 12 rhythms, and there was a complete theory and practice of 12 spiral palaces. That is to say, all the different interval concepts of size increase and decrease in the current music theory, and the concept of "8 degree position", in fact, existed very completely in the Spring and Autumn Warring States period, and in the Spring and Autumn Warring States period, each princely state already had its own legal name and law standard. Therefore, the musical culture of the Spring and Autumn and Warring States periods has been developed to a certain extent, and the research on the music system of various princely states has been better based. Judging from relevant research and some materials (Good et al., 2023), the social situation in the Spring and Autumn and Warring States periods was turbulent. Therefore, each country had some different degrees of development and progress at that time, but there were regional performances. However, some more developed areas, such as Henan at that time, the development level of their music culture and music theory connotation will appear relatively high, and they should not be comparable to the Chu State at that time (Grisamore et al., 2022). Although it is not comprehensive enough, it can almost increase people's understanding and mastery of this, that is, although the stone stones unearthed in Anyang, Henan have some damage problems, but the overall preservation can still be affirmed, at the same time, although it can be estimated that the sound level of the Warring States period gong musical instruments in the Anyang area will not be very bad, but because the current information is still relatively limited, it is difficult to really grasp the true level of the local unearthed stones, especially in all the stones unearthed so far, the 5-tone column of the arrangement still does not exist。 Therefore, it is not possible to grasp the overall situation of the national rhythm system in the Warring States period in a deeper way. Therefore, more subsequent compilation data is needed to be demonstrated before a more comprehensive evaluation of the musical level in ancient times can be made.

Use shapes and materials to improve acoustics

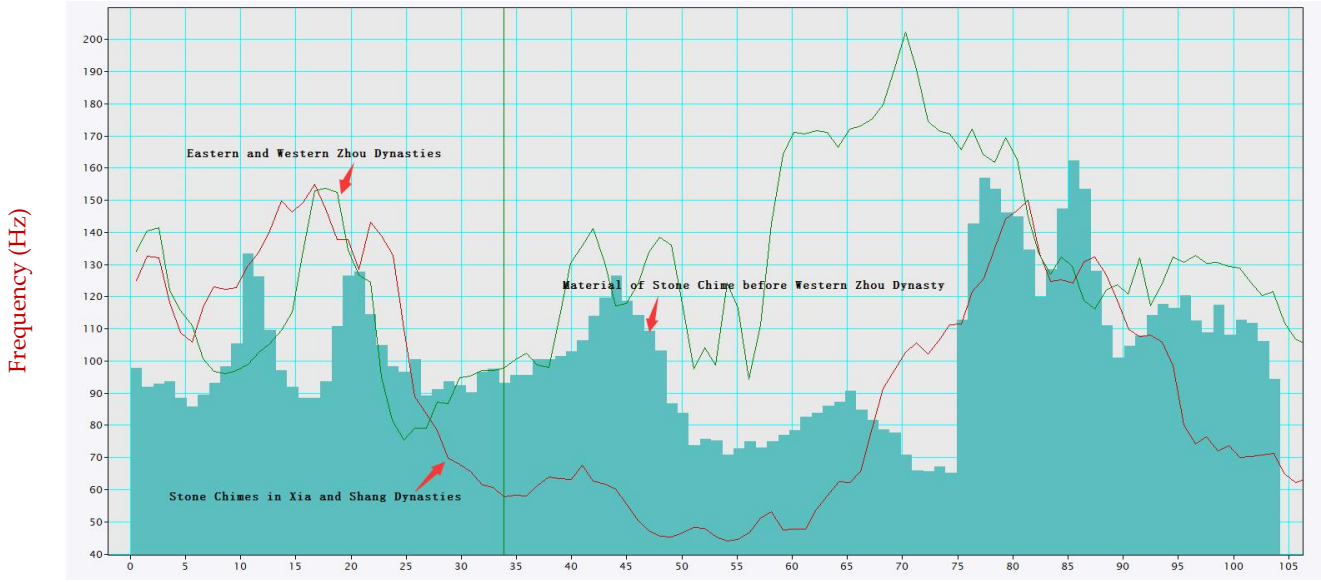
It is certain that with the deepening of the production process of stone rocks and the deepening of the study of music theory, the results of the acoustic performance research of stone rocks in the pre-Qin period began to be slowly improved. Although in the early days, the stone rock had the basic function of a rhythmic instrument, the acoustics were unique. Therefore, at the earliest times, it even became a certain status symbol (Guo et al., 2023). The difference in the relevant actual and musical performance of the stone rocks in the Shang Dynasty can show that the stone rocks in the Shang Dynasty began to have higher acoustic performance, and became more and more prominent, and at the same time, the stone rocks began to be gradually arranged and used according to a certain interval relationship, which was the basis for the emergence of the stones (Haddad et al., 2022). Because with the passage of time, the concept of fixed pitch began to affect the stone brick process of the Shang Dynasty, and based on the needs of the pitch setting of the stone rock, it can be processed to make it a body of different shapes and sizes, or use the way of polishing the surface of the rock body to obtain better pitch and sound effects. For example, the late Shang Dynasty tiger stripe large stone rock unearthed from the military attaché village, its body is relatively large, the sound is relatively low, is a single hanging large rock, from the surface, its surface is relatively smooth, it can be seen that after polishing, according to the sound measurement results obtained by relevant research, the vibration number of this rock reaches 280.7, and the pitch is higher than #C1 is slightly higher, and the pitch is more semitone higher than in C key. This rock can play different songs, and only need to be gently tapped, and it can produce a very clear and melodious acoustic effect. From specialized acoustic research, it can be seen that several of these rocks belong to fixed frequencies and behave harmoniously from the perspective of music acoustics. It can be proved that the Shang Dynasty people have learned how to use their own experience to combine reality and carry out certain processing according to certain pitch requirements. Therefore, it can be seen that the early days of the Shang Dynasty were still in the stage of "making sound according to materials", and until the last period, there was a change in concept, and they began to design the sound of the rock according to certain standards, laws and specifications. That is, follow a certain specification to find the desired sound (Hatton-Bowers et al., 2022). Therefore, it promotes the development of the musical performance of the stone rock at that time, which has a certain musical connotation. During the two-week period, the production and use of stone rocks

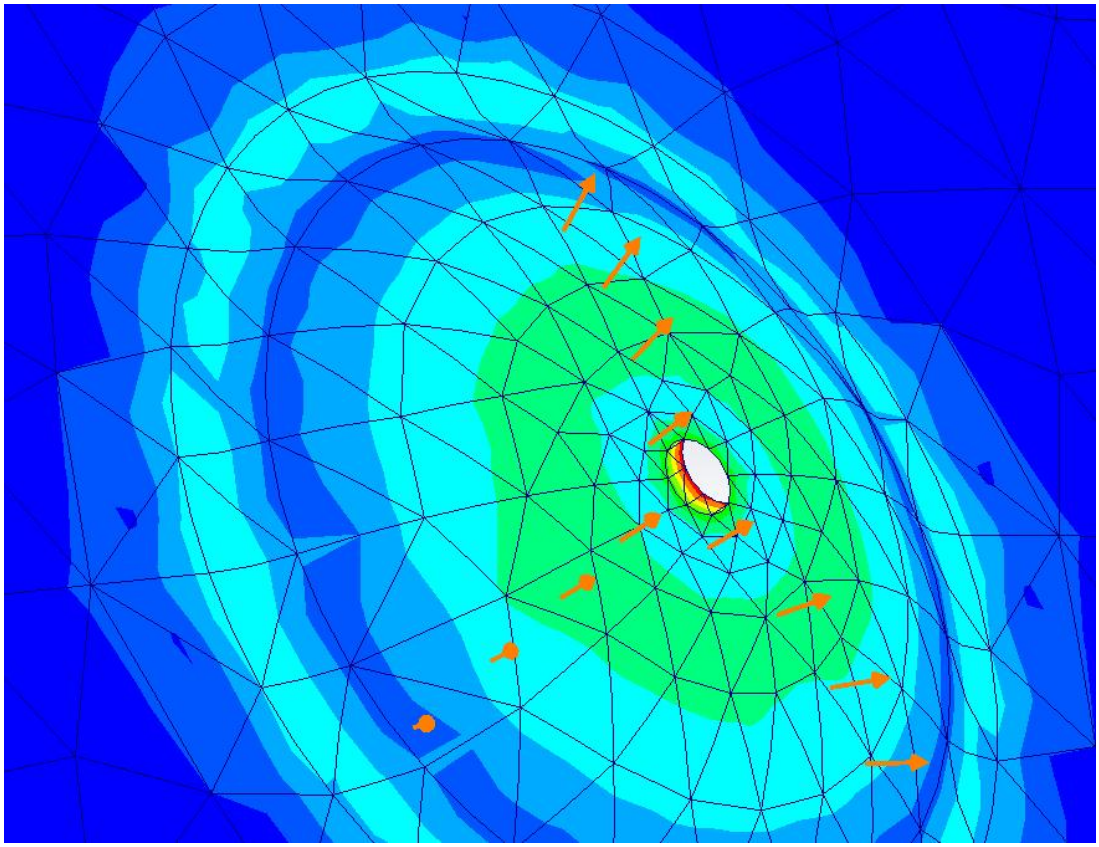
began to become relatively stable and fixed. At the same time, with the improvement of the variety of arrangement combinations, the arrangement has begun to be combined with other instruments and show more stable musical performance. With the continuous enhancement of the musical instrument function of the stone rock, the connotation of music theory is constantly enriched and becomes more and more important. In short, from the actual perspective of the pre-Qin compilations unearthed so far, it has high research significance in the study of Chinese music cultural history, and at the same time, it can show the development of music theory at different stages in the Chinese pre-Qin period.

ANALYSIS OF MUSICAL PERFORMANCE OF STONE ROCKS EXCAVATED IN THE PRE-QIN DYNASTY

Before the Western Zhou Dynasty

The stone chime unearthed before the Western Zhou Dynasty are often single-function stone stones, and their pitch performance is different, and the stone rocks are often Neolithic or Xia Shang period made of stone stones, to the specific pronunciation of the stone stones unearthed in Shanxi to master and analyze, among them, the special stones made in the new period era, its vocal range is in the range of C2~B2 (Y. He, Zhang, Xiao, Wang, & J. He, 2022), and the resonance frequency range is between 523.260-981.110Hz, which is the most sensitive range of the human ear. Among them, according to research, the stone rocks in this period have the characteristics of loudness that is more in line with the natural hearing needs of human ears, and the length and timbre have metal percussion sound and stone tool percussion sound. When the stone is struck, it will resonate with the fundamental frequency. The roughness of the surface, whether the thickness and density of the body are balanced, the strength of the impact, and the position of the impact will all affect the timbre, loudness, length and volume. Therefore, the stone rocks before the Western Zhou Dynasty were mainly stone tools, so the fundamental frequency during the percussion process was low, and the vocal range and loudness were relatively low, as shown in Figure 1.





The principle of sounding of all materials

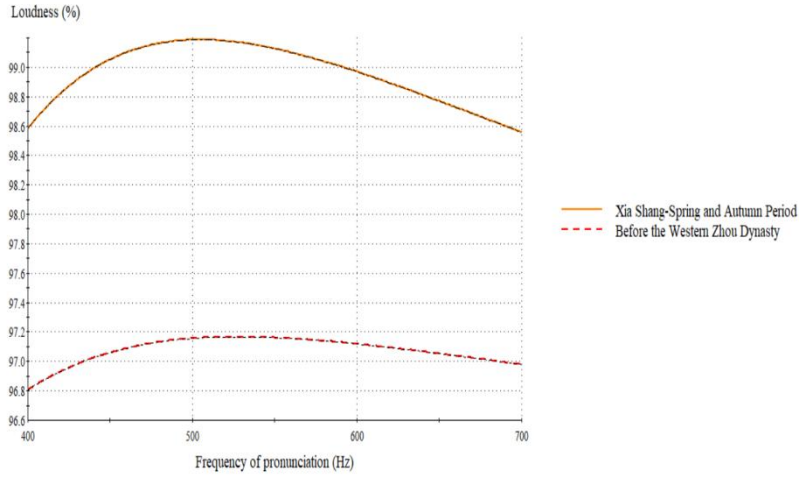
Figure 1. Stone Brick Material from Different Periods

It can be seen from Figure 1 that the materials before the Western Zhou Dynasty were mainly stone tools, jade tools in the Xia Shang period, and bronze in the Spring and Autumn Period, indicating that the stone chime have evolved from simple stone tools to jade and bronze. However, by adjusting the shape and thickness, the stone rock can still expand the vocal range and loudness. In the excavated Western Zhou Terong, most of the shapes are very irregular, and the surface appears rough and uneven. Therefore, the stone rocks before the Western Zhou Dynasty had the characteristics of fundamental frequency division and low loudness, but the loudness and vocal range processed the range that the human ear could easily identify. Another example is that many different Neolithic stone rocks were unearthed at the site of Xiangfen Tao Temple, each of which is a special pan, and the pronunciation range of the special pan is the range that the human ear can naturally hear. Therefore, it can be seen that the stone rocks before the Western Zhou Dynasty belong to rhythmic ringers, which mainly play the role of accompaniment, and are not veritable musical instruments.

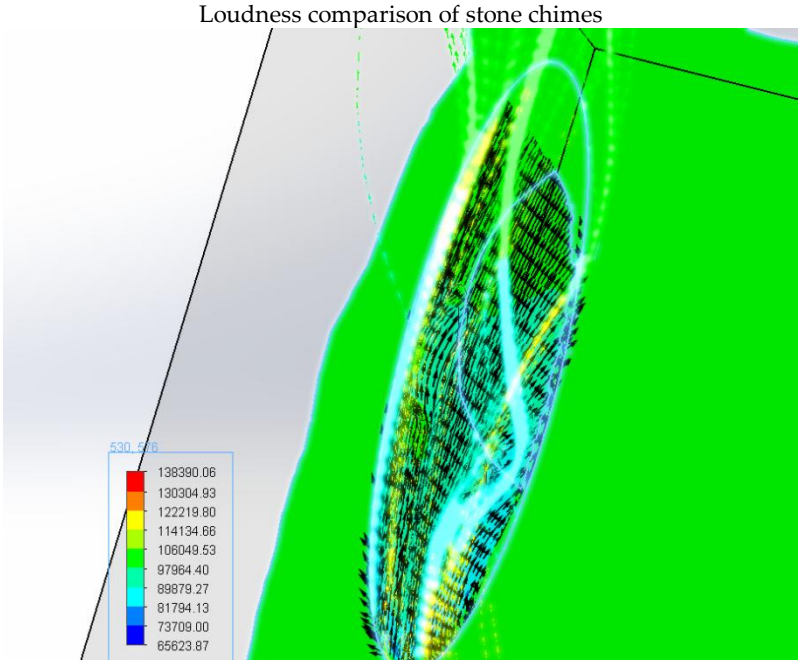
Stone Chime of the Xia Shang Dynasty

The stone rocks made in the Xia Shang era already have a wide pronunciation range, and the vocal range is basically between C1~B1, and the sound wave frequency in this range exceeds the sensitive range of sound waves of the human ear. Moreover, it was found from the stone chime unearthed by Lingshi Jingsuke that the stone brick making had been refined and the grinding ratio was larger. Therefore, it can be reflected from one side that craftsmen have abandoned the past method of making rocks in the process of stone brick making (in the past, it was generally based on sound), in order to pursue a wider range of pitches and superior percussion effects. The stone slabs of the Xia Shang period were relatively wide, and the low-frequency overtones of vibration were relatively strong, and the intervals were extended. Taking the stone chime of the Xia Shang period unearthed in Shanxi as an example, most of the bottom of the M8 stone chime in Jinhou is in a slightly upward arc shape. From this scholar, it is believed that after the stone rock is tuned, the resonance of the arc is formed. From the perspective of the production period, the production time of the Jinhou M8 stone is relatively late, and it is the same as the Jinhou M64 stone rock, and the arc bottom shape of the two is basic. In addition, the bottom of the rock body is a major part for tuning, according to the relevant records, there have been some stone rocks, the position near the bottom of the arc because of the filing of tuning, so it becomes relatively thin, the billet of the stone wall, in the process of grinding and gradually forming, to have a tuning stage, on the rock body, the bottom middle part of the stone is the most sensitive place to the pitch, if the pronunciation of the stone block does not

meet the expected pitch requirements, but is low, the two ends should be polished to ensure the tuning effect, the result is shown in Figure 2.



Loudness comparison of stone chimes



Stone chime combination loudness conduction

Figure 2. Analysis of Loudness of Rocks in Different Periods

As can be seen from Figure 2, the stone rocks before the Western Zhou Dynasty were relatively low, while the loudness was higher during the Xia Shang-Spring and Autumn period. However, the overall sound interval and frequency are basically the same, but there are differences in loudness, so the shape, material, and production process of the stone rock will have an impact on its loudness, and make it show better musical performance. Otherwise, the pitch of the stone rock must be lowered, so it is necessary to polish both sides of the rock and keep it smooth. During the Xia Shang period, a three-tone column of stone chime appeared, which was arranged in groups of three pieces and was the prototype of the three-tone column. For example, the Anyang stone rock in Henan and the compilation of the Yin Shang period. The Anyang area has 3 tones, namely BB2 and C3, BE3, and can form 2 specific scale forms, namely 5-6-1 and 2-3-5, while the ancient Qi arrangement is a two-degree relationship of 2 tones, plus a clear inscription on the instrument, such as "right eight". Therefore, it is not very clear that the scale composition form. From some stone stacks with a large number of pieces, the study found that from the analysis of the existence of 3 sound columns, it can be concluded that the most ideal combination of 3 sound columns is the structure of 3 stone blocks. If it was a combined form, then many stone stones were needed as a foundation, and the conditions at that time were relatively backward and could not be realized. In the three-tone column, the form of 5-1-2 appears three times, basically reaching 50% of the total number of arrangements, while the 5-1-3 structure appears twice, and the other structural forms appear at most 1 time. It can be seen that

the 5-1-2 form is the main form of the 3-tone column, that is, the pure fourth-degree and major second-degree interval structure forms are more common in the 3-tone column compilation in the pre-Qin period, and are the main structural patterns among them. At present, there is a view in the academic community that the scale of 5-1-2 is often only used as a backbone sound. However, from the author's point of view, the thesis is still debatable, after all, 1 scale structure form, it reflects the application of a set of Shi Yan's own music theory theory, and its practical application is not necessarily the same thing. In fact, some national music in China that is formed by 3 tones is not uncommon, especially in some folk songs, and it is no longer a minority. Therefore, the 3-tone scale is capable of playing melody.

Spring and Autumn Period

Take the stone chime unearthed in Shanxi as an example. In the Spring and Autumn Period, there were many sets of stone rocks in Shanxi, but for some reasons, such as the impact of tomb robbery and the effect of poor water solubility caused by the stone problems of the stone rocks themselves. As a result, many of the Spring and Autumn stones unearthed here have been found to be somewhat incomplete, but to varying degrees. During the Eastern Zhou Dynasty, the shape of the arc base became a new pattern, and the angle of the arc arch at the bottom was increased. Therefore, it can be seen that in the continuous practice of Pangong, he may have discovered the relationship between arc base shape and tuning. Therefore, the shape of the bottom of the arc is affirmed and gradually retained. It is difficult to find the data or content of its musical theory connotation from the relatively incomplete stone blocks. Although the number of fragments of the Spring and Autumn Shanxi stone chime is relatively large, there are still a few relatively complete excavated cultural relics. Among them, 3 sets of representative stone rocks of Spring and Autumn unearthed in Shanxi can be used as examples for this study. In tomb No. 1002 in the Spring and Autumn Tomb Group in Linqicheng Village, Shanxi, the stone chime have been excavated to belong to the weaving type, a total of 10 pieces, mainly placed in 2 groups. On the body of this group of gongs, there are obvious traces of tuning after filing, which belongs to the utility. Although the stone is slightly damaged, it is basically well preserved and can be measured for sound measurement. The sound measurement data of 10 stone rocks in the middle and late Spring and Autumn period are shown in Table 2.

Table 2. Unearthed Sound Measurement Data of 28-36 in the Middle and Late Spring and Autumn Period

Numbering	27	28	29	30	31	32	33	34	35	36
Original sound	a3+32	g3—44	g3+19	C3-4	b2-29	crack	#g3+24	e3+2	crack	c2—24
Tone and cent conversion	a3+36	g3-40	g3+13	C3	b2-25	-----	#g3+28	e3+6	-----	c2—20

It can be seen that although there are still some damaged stone blocks in the group of stone blocks, it cannot be directly concluded, but the group of stone blocks can be seen after sound measurement, and it can still be determined in the sound column structure of feathers, palaces, horns and signs. Comparing with the stone rocks of the pre-Western Zhou Dynasty and the Xia Shang period, the loudness and interval of the tone series combination were tested, and the results are shown in Figure 3.

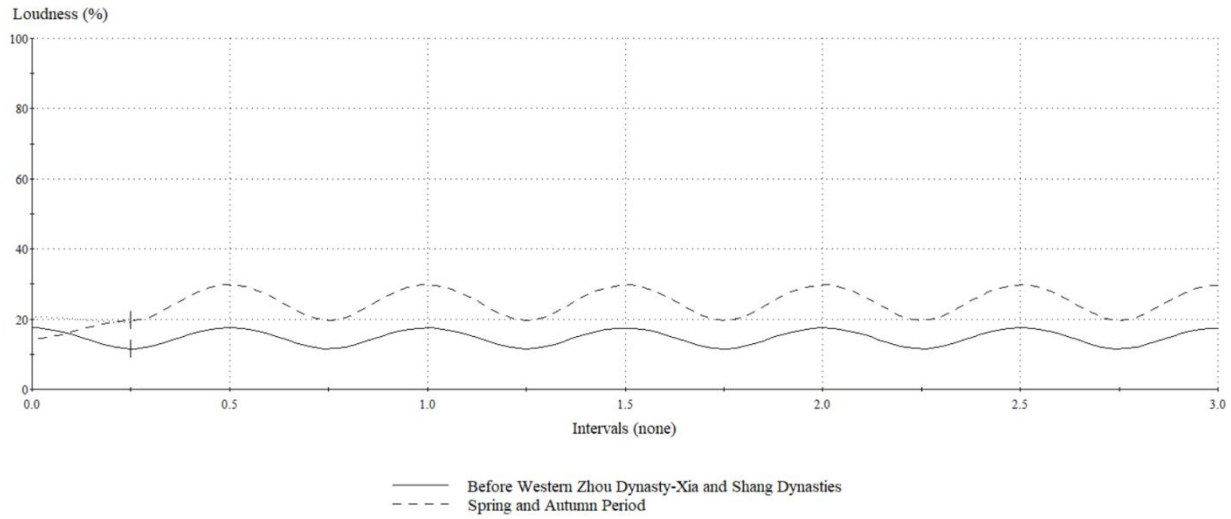


Figure 3. Comparison of the Loudness of Stone Rocks in Different Periods

It can be seen from Figure 3 that the combination of the orchestration can improve the loudness, but the interval is not improved, indicating that the orchestration has not made a great breakthrough in the production process and material, and also indirectly shows that the pre-Qin period has paid attention to the display of combined music, so as to improve the grandeur of performance and the performance effect. Therefore, the compilation can still exist as a research data, which can provide certain value for the subsequent research of the stone, and is conducive to the deepening of the mastery of the production of the stone brick in the middle and late Spring and Autumn, and has a certain musical connotation. In view of the above analysis, this paper compares the influencing factors of stone chimes in the Spring and Autumn Period, Shang and Zhou dynasties, and the results are shown in Table 3.

Table 3. Comparison of the Sound Effects of Stone Chimes in Different Periods

index		Before the Western Zhou Dynasty	Xia Shang Dynasty	Spring and Autumn Period	p
loudness	Material	0.787	2.296	-1.510	0.000**
	sculpt	0.787	0.639	0.148	0.479
	combination	2.296	0.639	1.657	0.000**
timbre	Material	0.997	1.009	-0.012	0.001**
	sculpt	0.997	0.996	0.001	0.689
	combination	1.009	0.996	0.013	0.001**
Transmission distance	Material	2.650	1.988	0.663	0.586
	sculpt	2.650	3.393	-0.743	0.542
	combination	1.988	3.393	-1.406	0.322

In addition, there are parts worth studying in a group of ancient tombs of the Spring and Autumn Warring States in Qiujiazhuang. The whole group of production is relatively fine, because the grinding is very smooth, the sound quality of the pronunciation is very good, crisp and long, the following data can be obtained after the sound measurement of this group of stones. It can be seen that the four tones of it, namely feather, gong, horn, and micro, actually appear in the same set of sounds, so it may indicate that the four-tone column settings of the period have been finalized. In the small print group two, of the above 4 tones, except for the palace sound, the rest appear, in addition to the addition of the business sound. Therefore, from the research point of view, in all the sound measurement data of the group of stones, the appearance of the palace sound is unfixed, and it appears repeatedly in the small print 1 group and the small print 3 group, so it may be because the sixth pitch is actually the palace sound in the small print 2 group. If this is the case, then the group 2 group has 5 scales, from which it can be inferred that when the set of stone rocks is made, it may already have 5 sound scale settings, according to research, in the spring and autumn, the positive drum tone of the button bell has a 5 sound scale setting, so in the Eastern Zhou, the development of the 5 sound scale setting is very fast. In this case, the stone rock as one of the hanging instruments, is likely to be affected, and therefore set with a 5-tone scale to achieve the rationality of the sound sequence, after some expert identification, the above stone rock is from the Eastern Zhou Dynasty. Therefore, it may be set using the 5-tone scale, of course, this is still only speculation. In this set of stones, because one of the stones is currently transferred for use, there are only 9 cases of sound measurement data obtained so far, and the stones have been tested and all perform in addition to good timbre. In addition, there is a group of stone rocks in Jiaokou Yaowa Village, and in its tone structure there are already 5 complete manifestations, namely palace sounds, shang sounds, horn sounds, micro sounds, and feather sounds, all of which appear on the small character 3 groups, so it can basically be clear from the above arguments that in the stone rocks in the Shanxi region during the Warring States period, there has been a clear setting of 5 sound columns.

Four-tone columns of stones. In the stone rocks in the Luoyang area that have been unearthed so far, some of the main stones basically have a small two-degree interval relationship, and when they are unearthed, the stones are basically stacked in 2 groups, so in general, it can play 2 or more averages, and the 2 averages do not interfere with each other. Therefore, there is basically no overlapping problem in the stones, because some of the stones are defective, so it is difficult to determine. From the study of Shi Yan, it was found that its musical arrangement was as follows: Gong-jiao-Hui-Yu (1-3-5-6) appeared 5 times, Gong-Shang-Jiao-Hui (1-2-3-5) appeared 3 times, and Gong-Shang-Hui-Yu (1-2-5-6) appeared 1 time. Therefore, it can be seen that the palace-angle-emblem-feather is the more important and common scale structure mode, and it can be seen that the status of the four musical levels in the pre-Qin Shiyan ethnic group is relatively high. In the process of practical application, the ancients would evolve different melodic forms according to the interests of each nation, thereby enriching the performance of music.

CONCLUSION

The stone rocks unearthed in the pre-Qin Dynasty had relatively fixed shapes in the early days, such as fish shapes and rectangular shapes, and during the Shang Dynasty, the shapes of stone rocks became very numerous, and various and relatively novel shapes appeared. Moreover, at the beginning, the shang gong existed as a relatively simple single instrument, until later, it began to be combined into a weaving, and then formed a weaving, and used certain laws to organize the performance, in a certain sense to improve the musical theory connotation of the stone rock. Subsequently, the stone rock has been relatively well developed. Therefore, pre-Qin stones unearthed from Luoyang and other areas in Henan often have a complete 3-tone or 4-tone performance. Although few cultural relics have been unearthed at present, it can be seen from some clues that the pre-Qin period has been able to play different melodies, and each stone gong can play at least 2 notes. All in all, the excavation of stone rocks in the pre-Qin period is an important historical witness to the development of Chinese music culture, and it is of great significance to the study of pre-Qin stone rocks music.

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