

Zhu Zaiyu's Twelve Mean Law and European Music Revolution -Take "Well Tempered Clavier" in Bach for example

Ziyu Wang

School of Art, Jiangxi University of Finance and Economics, Nanchang, Jiangxi, 330013, China

Abstract: *Zhu Zaiyu is a famous Chinese musician in Ming Dynasty. His research results laid the theoretical foundation for the development of modern music. Joseph Needham called it 'the saint of Chinese Renaissance', and equal temperament is the most important part of his music theory. Taking Bach's "Well Tempered Clavier" as an example, this paper explores the theoretical significance of equal temperament through the causes and exploration process of the equal temperament, so as to study the influence of Zhu Zaiyu's Equal Temperament theory on the European music revolution, and summarize the influence of this theory on the development of Chinese and Western music, so as to understand more comprehensively the important contribution of Equal Temperament to the development of Chinese and Western music.*

Keywords: *Zhu Zaiyu, Bach, Equal Temperament*

1. The exploration process of Equal Temperament of averages

1) The emergence of Equal Temperament: Sanfen Sunyi Method and Circle-of-fifths system.

At present there are three mainstream legal systems, namely equal temperament "Pure Laws" and "Circle-of-fifths System". Nowadays, the laws adopted by western music and mainstream pop music are mostly equal temperament. However, in ancient times, before equal temperament were studied and calculated, the main law of birth adopted by ancient Chinese music was "Sanfen Sunyi Method", that is, "Circle-of-fifths system".

The undisputed earliest record of China's "Sanfen Sunyi Method" comes from "Lu Shi Chun Qiu": "Huang Zhong gave birth Lin Zhong, Lin Zhong gave birth Tai Cu, Tai Cu in Nan Lu, Nan Lu gave birth to Gu Xi, Gu Xi gave birth to Ying Zhong, Ying Zhong gave birth to Li Bin, Li Bin gave birth to Da Lu, Da Lu gave birth to Yi Ze, Yi Ze gave birth to Jia Zhong gave birth Wu She. Those bon with three points benefit more than one point. If you are born in three points. You will be born under one point this method roughly determines a standard sound as "Huang Zhong", and determines the interval relationship between pure fifth and pure fourth degree by reducing the corresponding chord length by one third, which is called "loss" and increasing the corresponding chord length by one third, which is called "benefit". It is much the same as the "Circle-of-fifths system" proposed by the West that "every 1/3 of the chord length is removed, the sound value rises by five degrees", and the sound value corresponding to equal temperament is formulated. Circle-of-fifths system is very suitable for playing and singing monophonic music.

However, there are two problems inevitably, whether it is Circle-of-fifths system or Sanfen Sunyi Method. The first is that five degrees can't generate octaves. After the fifth degree is born 12 times the obtained sound is not in octave relationship with the fundamental tone, which has become an eternal problem that "the yellow bell cannot be restored" in China. Another problem is that, as equal temperament, their allelic sounds should be the same sound, that is, $G\# = Ab$, $E\# = F$, etc. However, the allelic sounds are not the same sound in the sound train obtained by five degrees. These two problems lead to the inconvenience that Circle-of-fifths system is directly used in the manufacture of musical instruments, but it needs to be improved to some extent, and it is impossible to give the tone. This uniform system is also the cause of equal temperament.

2) The formation of equal temperament: Zhu Zaiyu's contribution and influence to the development of temperament.

Scholars throughout the ages have tried to solve the eternal problem that "Yellow Bell cannot be restored". Finally, it was Zhu Zaiyu, a musician of Ming Dynasty, who wrote "Lu Li Rong Tong" in 1581,

"Lu Lu Xin Shuo" in 1584 and "Lu Lu Jing Yi" in 1594, emphasizing the necessity of reforming calendar and law. It is mentioned in New Theory of Law that "the law was made in ancient times, followed by listening to sounds and then calculating the law". The new secret rate (i.e., Twelve Mean Laws) invented by Zhu Zaiyu in Lvlv Jingyi and Lelv Quanshu was first calculated in the world with complex mathematical calculations and practical experiments of musical instruments. The root number of the ratio is 2 to the 12th power = 1.059463094359295264561825, which is accurate to 25 digits after the decimal point, and the octave is equally divided into equal temperament, and the corresponding laws are actually produced.

According to "The History of Ming Dynasty, Arts and Culture Records", Zhu Zaiyu wrote 40 volumes of "Yue Lu Quan Shu", three volumes of "Jia Liang suan Jing", four volumes of "Li Li Rong Tong", one volume of "Yin Yi", one volume of "Wan Nian Li", two volumes of "Preparation for Wan Nian Li", two volumes of "New Theory of Li Xue", etc. The books "Lu Li Rong Tong" and "Yin Yi" are all included in the "Music Book", covering music, astronomy, calendar, mathematics, dance, literature, etc. He is a heavyweight scientist who can be on the same name as Li Shizhen, Song Yingxing, Xu Guangqi and Xu Xiake, and is also an encyclopedic scholar. Among his works of millions of words, The Complete Book of Music temperament is the most famous.

Any music theory is summed up after music practice. Zhu Zaiyu died in 1611 and Bach was born more than 70 years later. Equal temperament was gradually popularized and widely used by him in Europe, and the western music theory became more and more mature. Gradually, most of the "basic music theory" we discussed today came into being. Zhu Zaiyu has also become a well-documented scholar who is the first in the world to work out the algorithm of equal temperament, and the accuracy of his calculation is even less than that of European mathematicians who worked out detailed solutions after half a century. The theory of the equal temperament was brought to the West by missionaries, which had a far-reaching influence, and Prince Zhu Zaiyu became famous in Europe.

2. The influence of the equal temperament of averages

1) the law of tuning, musical instrument manufacturing.

Zhu Zaiyu used the extra-large abacus spanning the 81st gear to calculate the square root and the square root, and put forward the theory of "reducer", which was used as the basis for the design and manufacture of string and pipe. Equal-temperament theory was brought back to the west by French missionaries, and then a series of musical instruments such as piano and violin were invented, and it was widely used in keyboard instruments all over the world, including piano, so Zhu Zaiyu was known as "the originator of piano theory". Zhu Zaiyu was not satisfied with this. He didn't like to follow the old theory, dared to question the legal system theory of historical authority, advocated the attitude of seeking truth from facts, applied the theory of equal temperament to practice, and produced the world's first fixed musical instrument—"Xian Zhun".

Nowadays, the tuning of common western musical instruments is based on the equal temperament, and the equal temperament has become the universal law system in the world. The greatest advantage of the equal temperament is that it is average and easy to calculate. As long as you get the pitch of any one note, you can calculate the pitches of other notes. And can be freely and accurately transposed, so that the musical instrument is in a harmonious state.

2) Equal Temperament and European Music Revolution

The equal temperament in Zhu Zaiyu were introduced into Europe by French missionaries, which initiated the European music reform. Musicians represented by Bach are deeply influenced by it. Equal temperament are widely used in Bach's polyphonic piano works. His piano works mainly pay attention to the symmetry and equality of different melodies, and most of the music is performed smoothly. For example, his "Well Tempered Clavier" is called the "Old Testamentin Music", which is mainly because Bach emphasized logicity in his usual creation. In the "Well Tempered Clavier", Bach maintains the same proportional relationship among the scales, and uses the polyphony technique of vertical and horizontal movable counterpoint, which develops polyphony technology into a fascinating artistic situation.

3. Historical reasons of European music revolution in Baroque period

During the Renaissance, the greatest change in music was to make music return to music itself, the

core of which was humanistic music, that is, music with "people" as the mainstay. Since the collapse of the Roman Empire, monks have been the only intellectual class in the western world for a long time, while the church is the authority of all disciplines. At that time, the ruling bureau thought that music had become flashy and wanted to revive church music similar to Gregory's chant. The music value of this period became a church anthem, which was "the voice of heaven" and took the Bible as the basis of music. In the 14th century, the polyphonic music in Italy and France was developed in the "Art Nouveau" period, so that music was not only an accessory to religious ceremonies, but also an independent art discipline.

At first, the church condemned "new music" and "new art" in the Pope's Decree in the early 14th century, but this pursuit of beauty has become an irresistible huge wave. With the historical torrent rolling forward, it constantly breaks through the imprisonment of traditional church music. With the development of polyphonic music, chants are beyond recognition. After the development of Paris Notre Dame composers, the independence of polyphonic music "Olganon" has been greatly enhanced, and the original Gregorian chant is no longer the main line of music. Finally, the compromise of the church also killed the revolution of music. Since then, the development of music has got rid of the shackles of tradition.

Bach's "Well Tempered Clavier" mainly pays attention to the fingering of melody lines and polyphony of piano works, so it pays attention to four aspects when playing: First, the rhythm is rigorous and steady, which is also one of the musical characteristics of Baroque period, which is in sharp contrast with the freedom of romanticism. The second is the layered processing of voice and timbre, which requires each finger to have strong independence and control. Third, the elegance and softness of decorative notes, and the unique playing method of rich and gorgeous decorative notes are also the characteristics of Bach music. When playing Bach's decorative notes, the rhythm needs to be stable and calm. Finally, it is the careful and skillful use of pedals. Because in Baroque period, keyboard instruments did not have pedals, so the use of pedals should be light and shallow, which is beneficial to distinguish the timbre of voices from the integrity of voices.

4. Conclusion

Zhu Zaiyu is a great scholar in the history of our country. His academic scope involves literature, science, art and other fields. Among them, the theory of equal temperament he founded has been widely used in keyboard instruments all over the world. At that time, although there was no huge wave in China due to historical reasons, it had a profound impact on the European music revolution in Baroque period through the spread of French missionaries, which was also reflected in the works of Bach, the "father of music". The theory of twelve laws is a new breakthrough in the study of law, which lays a solid foundation for the development of world music culture and makes a great contribution to the study of world music history.

References

- [1] Xuan yidan. *on the history of piano art-taking Bach's piano music with average rhythm as an example* [J]. *Northern music*, 2020(13): 4-5.
- [2] Ding Xin. *Exploration of Music Style in Baroque Period* [J]. *Popular Literature and Art*, 2015(8).
- [3] Geng Ge. *Analysis of Music Formation in Baroque Period* [J]. *Cultural Vision*, 2015(07): 84.
- [4] Zhou Sha. *Research on Twelve Average Laws of Zhu Zaiyu* [J]. *Art Evaluation*, 2016(01): 52-53.
- [5] Dong Dayi. *Discrimination of Gan Long's disparaging of Zhu Zaiyu's Twelve Average Laws — Focusing on the music literature of Jingbu in Sikuquanshu* [J]. *Guizhou Literature and History Series*.2021, (02): 58-65.
- [6] Dai Nianzu. *Zhu Zaiyu's Science and Art Superstar in Ming Dynasty* [M], Beijing: People's Publishing House, 1986:224-231.
- [7] Zhuang Yuan. *Summary of Research on Contemporary Chinese Music Law* [J]. *Huang Zhong*, 2005, (03).
- [8] Ye Dehua. *Zhu Zaiyu.a great legalist in the world music scene* [J]. *Northern Music*. 2007, (3): 14-15.
- [9] Wang Min. *Bach, the father of music, and Zhu Zaiyu, the father of music* [J]. *Writer*. 2008, (4): 208-209.