王昀 著

音乐与建筑

Music and Architecture

Wang Yun

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内容提要

“建筑是凝固的音乐，音乐是流动的建筑”这句为人所熟知的语句虽流传已久，但二者之间的联系究竟在何处却往往很难说得明白。中国当代著名建筑家王昀博士，试图将从音乐乐谱中抽出的空间图式与建筑实体空间建立关联性，并将乐谱空间转化为建筑空间。而这种将乐谱与空间之间建立起联系的思考以及将这种联系的转化过程加以示范的努力过程构成了本书的整体结构。本书是一本适合建筑设计者、音乐家和艺术爱好者阅读的跨界设计的思考性图书。

序　Preface

乐谱不单纯是记录音乐的一种符号性的表达方式，同时乐谱的空间性内容也视觉性地呈现在作为音乐的符号性记录的乐谱之中。将音乐进行视觉空间化的尝试不仅可以发现乐谱中隐藏着的空间性特征，同时也会引发能否将空间性的片段转化为乐谱，从而转化为对音乐的思考。

这本书呈现给大家的是我对音乐空间与建筑空间对应性关系的思考。希望通过本书能引发读者产生更多音乐与建筑之间相互关联的共鸣，更期待能有音乐家将建筑空间转化为音乐。

Music sore is more than simply a symbolic way of expression to record music. At the same time, music score as symbolic record of music also offers a visual demonstration of its space content. The attempt to visualize and spatialize music may not only discover space features hidden in music score but also provoke thoughts of whether space pieces can be transformed into music score and even into music.

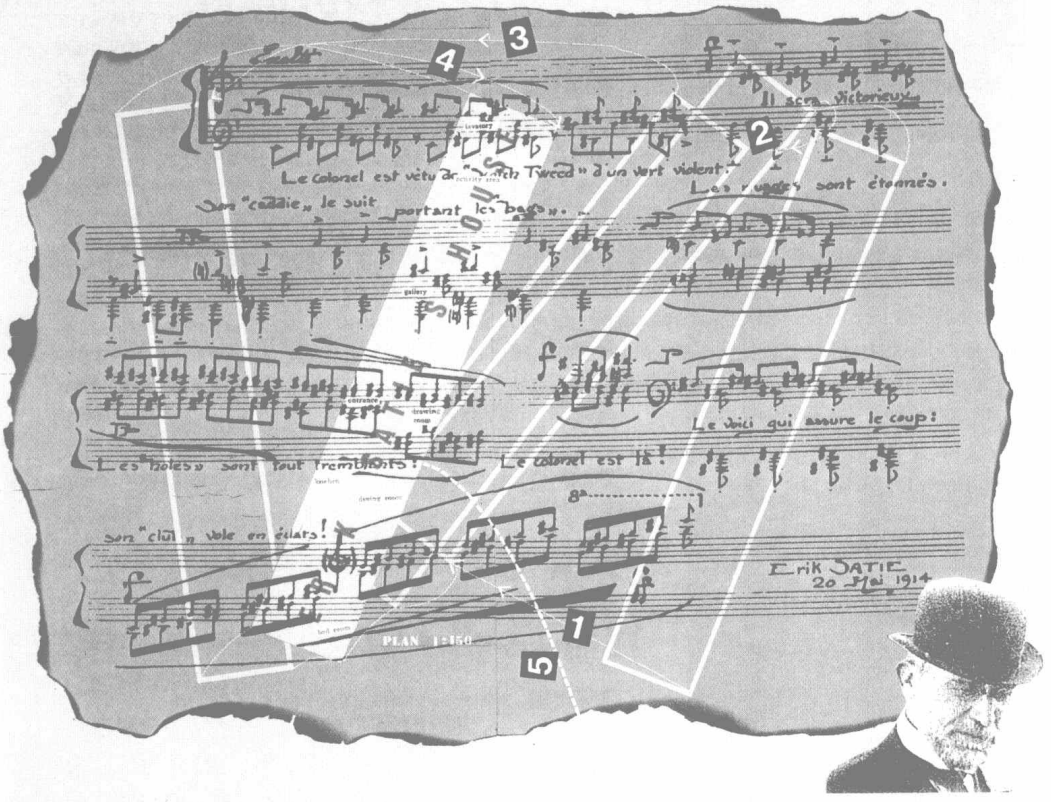
This book reveals my thoughts on correlation between music space and architecture space. I expect this book can produce more resonance from readers regarding correlation between music and architecture, and what is more, some musicians may transform architecture space into music.

王　昀

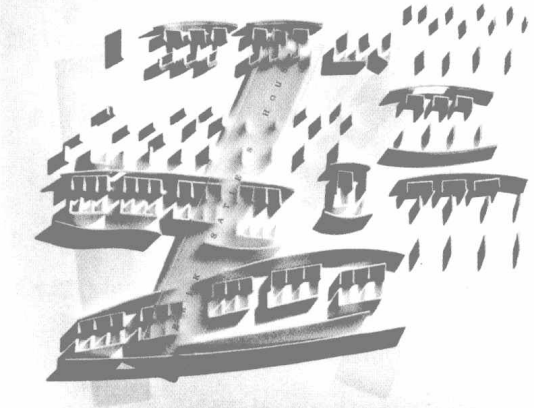
2014年6月

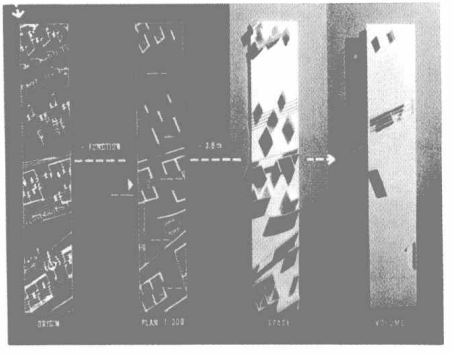
Erik Satie's house

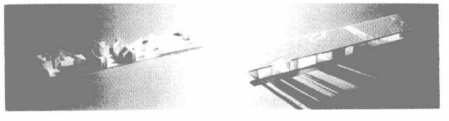
BE SELECTED WITH MOVING (48×8×3.6m³) IN (MUSIC SCORE) FREELY



MOVE THINK AND SELECT WITH FREE EYES







第4回エス・バイ・エル住宅設計コンペ

左图是作者1993年参加《埃里库·萨蒂的家》国际设计竞赛获得大奖的设计作品

The figure on the left is the design work winning the grand prize of Erik Satie's House International Design Contest in 1993.

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一、论音乐空间与建筑空间的对应性

Ⅰ. Correlation between Music Space and Architecture Space

音乐瞬间产生，又在瞬间失去。为了将它记录下来，人们在方法上进行了各种尝试。据说古希腊时期就曾有过文字式的乐谱，到了中世纪出现了一种四线的记谱方式。尽管这种方式不如目前见到的五线记谱法成熟，但从中却可以对乐谱何以记录音乐的原理明确地读解到一二。图1便是一张中世纪时期的圣歌乐谱，谱面以方的黑点符号与四线之间的高低位置表现变化着的音，以符号与符号之间距离的远近表现整个乐曲。实际上，这里隐藏着乐谱表现音乐的两个关键点。

（1）音符各自在乐谱中的相对位置。

（2）音符与音符之间的间隔距离。

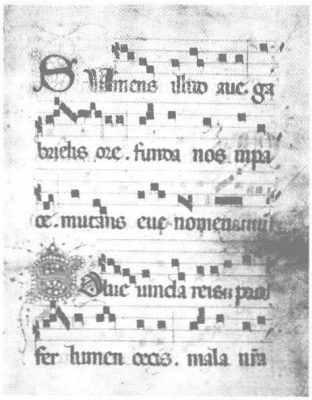

图1　1415年左右的中世纪时期圣歌乐谱

Figure 1　Music score of a holy song in the Middle Ages around AD 1415

Music is produced and then lost instantly. In order to record music, people have made all kinds of attempts. It is said in Ancient Greece there was a kind of music score in text style. In the Middle Ages there was a four-line music notation which, though not as mature as the current five-line music notation, still clearly reflects the principle to record music. Figure 1 shows a music score of a holy song in the Middle Ages. It used the high and low positions of black square dots in relation to four lines to show changing sound and the far and near distance of symbols to show the whole song. Actually, this embodies two key points of music score in expressing music.

(1) Relative positions of music notes in a music score

(2) Spacing distance between music notes.

Actually, music score also expresses a concept of

其实，乐谱表达的还有一个音乐空间和音乐场的概念。在谱面中，音的高低表达着一个声音的表情，而这些彼此高低不同的音在出现时所经过的时间距离，是所谓音乐的出现和音乐空间的生成。确切一点说，音乐空间之所以得以生成，其根本原因在于先后出现的音与音之间所经过的时间。而这一时间过程在谱面上则表现为音符与音符之间的距离。也正是通过谱面中音符间的距离的转换，才使音乐在实际演奏时得到时间上的还原，并最终通过人的听觉在头脑中产生空间的想象。所以我们可以说，乐谱中音符与音符之间的距离不仅是时间的延续，同时也是音乐空间在视觉上的表现。

音符与音符的距离产生了空间，距离的松散引来的是所谓节奏和空间感的变化。譬如，音符之间的距离越近，给人的紧张感便越强，空间就越感到局促。相反，音符之间的距离越远，音乐就越感到轻松缓慢，同时越感到空间的广阔和宽敞。可以说乐谱中展现出的音符与音符之间的距离关系是实际的音乐空间于视觉上的具体化，是视觉和听觉之间对应性存在的表现。

我们谈到了乐谱中音符之间的间隔问题，间隔本身所表达的就是一个空间概念。“我和他相隔2米”，这句话在表达一个距离概念的同时也是一个空间的概念。这就很容易让人联想到建筑空间的问

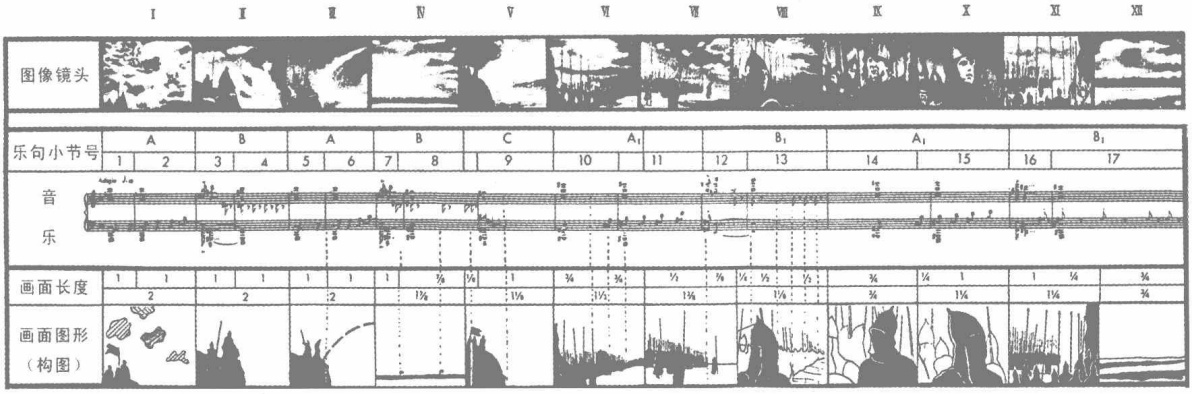

图2　爱森斯坦的音像对应图式

Figure 2　Corresponding pattern of sound and vision by Eisenstein

music space and music field. The high and low position of a music note demonstrates the expression of a sound, while the time duration of these high and low music notes forms the so-called occurrence of music and creation of music space. To be precise, the fundamental cause to create music space lies on time duration of music notes occurring one after another. This time duration is reflected in music score as distance between music notes. It is the transformation of distance between music notes that restores time of music in actual playing and finally creates space vision in people's mind through sense of hearing. It can be concluded that distance between music notes in a music score is not only continuation of time but also visual expression of music space.

The distance between music notes creates space, and different distance leads to change in rhythm and space sense. For example, the shorter the distance, the more tension and less space people feel. On the contrary, the longer the distance, the more relaxing and gentle music becomes, with a sense of broad and capacious space. The relation of distance between music notes in a music score is in fact materialization of actual music space in visual sense as well as demonstration of correlation between visual and auditory sense.

We have talked about the issue of distance between music notes in a music score, which expresses a space concept itself. The sentence 'He is 2 meters away from me' expresses not only distance concept but also space concept. It naturally leads people to think about architecture space, which, to a great extent, relies on

题，因为建筑空间的表现在很大程度上就是依靠建筑平面中墙与墙的相互位置关系来限定和表现空间的。由此便引发出一个关于建筑平面中表现出的墙与墙之间的距离与乐谱上表现出的音与音之间的距离，是否可能具有相互对应关系的问题。因为两者在表达空间的手法上极其具有相似性和共通性。亦即两者分别是通过音符与音符之间的距离以及墙与墙之间的距离来表达音乐空间和建筑空间的。而一旦我们站在这个层次上来对两者加以审视，下面的几个对应关系应当是成立的。

（1）墙是建筑中分割空间的音符。

（2）墙与墙之间的距离限定了建筑的空间。

（3）墙的位置不是随意确定的，它取决于建筑家的空间感觉，是设计者空间概念的具体表现。

（4）依靠音符间的距离，生成了音乐的空间。

（5）音符与音符的距离不是任意的，它取决于作曲家的空间感觉，是作曲家空间概念的具体表现。

（6）音符与音符的空间与建筑中墙与墙的空间表现是异形同构的。

沿着这样的思路，自然会感到“建筑是凝固的音乐，音乐是流动的建筑”这句名言不再抽象。因为在表现空间方面，它们之间具有本质上的共通性，即一个是音乐空间，另一个是建筑空间。

据此，我们理所当然地可以论及音乐空间与建

图3　乐谱
Figure 3　Music score

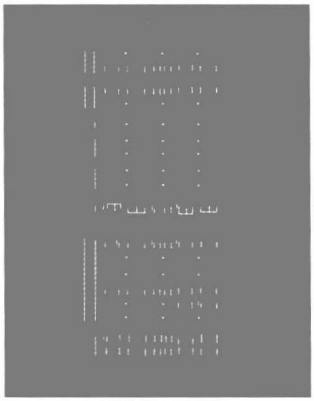

图4　抽出空间图式
Figure 4　Extracted space pattern

the relative positions of walls in architectural plane to define and express space. Therefore a question arises whether there may be a correlation between distance of walls in architecture plane and distance of music notes in a music score, as these two share much similarity and generality in expressing space. In other words, music space and architecture space are expressed respectively by distance between music notes and distance between walls. Once we view them from this level, then the following correlations should be feasible.

(1) Walls, like music notes, divide architecture space.

(2) Architecture space is defined by distance between walls.

(3) The position of walls is decided by architects' sense of space instead of decided randomly, which embodies space concept of designers.

(4) Distance between music notes creates music space.

(5) The distance of music notes is decided by composers' sense of space instead of decided randomly, which embodies space concept of composers.

(6) Space expressed by music notes and by walls is different in appearance and same in structure.

Following such a way of thinking, we can naturally feel that the famous saying “Architecture is solidified music, while music is flowing architecture” is not abstract any more. In terms of expressing space, music space and architecture space share fundamental generality.

Therefore we have good reasons to discuss the interchangeability of music space and architecture space. The creation of music space relies on distance

筑空间相互置换的问题。因为音乐空间的生成有赖于乐谱上音符与音符之间的间距，建筑空间的界定依靠墙与墙之间的间距。并且乐谱是以时间的延续构成空间，而建筑空间的判定依靠的是人在其内部的行走，时间的经过，视线的往复交换，从而得到对建筑的整体把握。从时间和空间两个方面看，两者之间的关系的确存在对应和互换的基础。

著名的前苏联电影导演爱森斯坦曾对音乐和视觉的对应关系作过宏大的实验，在1935年所拍摄的影片《亚历山大涅夫斯基》中，他力图从音符跳跃高低的趋势，时间的推移与电影空间的进深，画面的构图以及影片镜头的衔接中寻找出音与像的对应关系。图2便是这个尝试过程的表现。只要对图式略加分析，则不难发现爱森斯坦正是通过运用乐谱表现出的视觉与听觉的对应性来进行所谓空间上的操作，进而调动人的各种感觉器官，使音响与画面在垂直方向产生最大的蒙太奇效果，让音乐与视觉产生的同步关系，从而在观众心里引起最大的共鸣。

在我看来，音乐空间与建筑空间之间存在着同样的对应关系。为揭示这种关系，近几年来，我进行了多种实验性的工作，在此列举2个实验作品的实例，试以展现音乐与建筑的对应性。

作品1是以《沃采克·玛丽的摇篮曲》的一页乐谱为基本的空间图式（图3），从其中抽出空间图

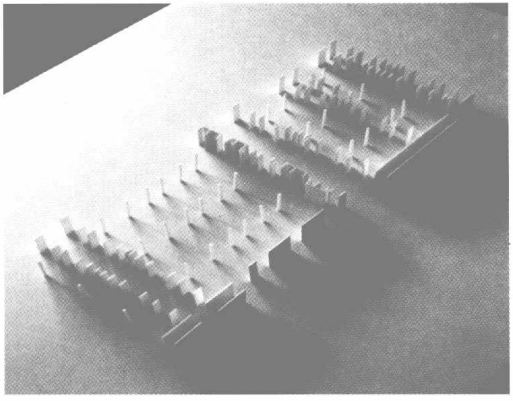

图5　空间图式立体化
Figure 5　Three-dimensional processing of space pattern

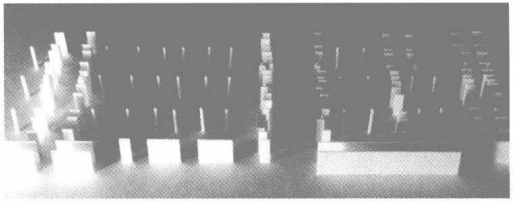

图6　空间图式立体化
Figure 6　Three-dimensional processing of space pattern

between music notes in a music score, and the definition of architecture space relies on distance between walls. Moreover, space in a music score is constituted by continuation of time, while overall grasp of architecture space is achieved by people's walking inside a building, elapse of time and frequent exchange of sight lines back and forth. From the two perspectives of time and space, the relation of music and architecture does have basis for correlation and interchange.

Mr. Eisenstein, a famous movie director in the former Soviet Union, once conducted a grand experiment regarding the correlation between music and vision. In a movie named Alexander Niefski, he tried to identify correlation between sound and vision by means of high and low trend of music notes, elapse of time, depth of movie space, composition of picture and connection between movie scenes. Figure 2 shows the process of such an attempt. With some analysis it can be found that Mr. Eisenstein tried to use correlation between sound and vision expressed by music scores to conduct space operation. Consequently, various human sensory organs are mobilized, maximum Montage effect is created between audio and video vertically, synchronized relation is achieved between music and vision, which then leads to greatest resonance among audience.

In my opinion, a similar correlation exists between music space and architecture space. In order to reveal such a relation, recently I have conducted many experimental works and the following two examples attempt to demonstrate the correlation between music

式要素（图4），再加以立体化形成建筑空间（图5、图6）。同样，作品2也是以《沃采克·玛丽的摇篮曲》的另一页乐谱为基本的空间图式（图7），从其中抽出空间图式要素，再加以立体化，形成建筑空间（图8~图19）。从上述两个实验作品中可以看出，在空间表达上，建筑与音乐之间确实存在着相同的对应性和一致性。

乐谱的形式是多样的，乐谱的魅力在于它表达着存在于人身体中各个层次上的韵律和节奏。一个好的音乐在本质上正是由于它符合了人身体的韵律的变化，拨动了人身体中固有的韵律，与人的身体的节奏产生了最大的共鸣。建筑的空间也当如此，外部空间给予人的空间的感觉，一旦与人体内部的韵律节奏产生呼应和共鸣，人就会被空间打动。而打动人的空间，是物质的建筑能否升华到精神表现的标志，创造这种在精神层次上打动人的建筑，才是建筑创作的真正本质。

and architecture.

For Work 1, it employs a page of music score of *Wozzeck and Marie* in as basic space pattern (Figure 3), extracts key elements of space pattern (Figure 4), then process in a three-dimensional way to form architecture space (Figure 5 and 6). Similarly for Work 2, it employs another page of music score of *Wozzeck and Marie* as basic space pattern (Figure 7), extracts key elements of space pattern, then process in a three-dimensional way to form architecture space (Figure 8-19). From the above two experimental works, it can be found that architecture and music do have similar correlation and consistency in expressing space.

There are various forms of music scores, whose charm lie in expression of rhythms and tempos that exist on various levels of human body. A good music work, in essence, matches rhythm change in human body, stirs inherent rhythm in human body and produces maximum resonance with rhythm in human body. Architecture space should follow the same rule. Exterior space provides people with sense of space, and when it resonates with internal rhythms and tempos in human body, people will be spiritually touched by space. The space that is spiritually touching is the signpost that material architecture is sublimated towards spiritual expression, and the real essence of architecture creation is to create such architecture works that can touch people spiritually.

二、音乐中的数与建筑中的数

Ⅱ. Number in Music and Number in Architecture

“建筑是凝固的音乐，音乐是流动的建筑”这一名言大家并不陌生。但建筑和音乐之间存在着怎样的联结点？两者之间又存在着怎样的关联？

中世纪哲学家奥古斯丁曾经这样讲过：建筑和音乐都是数的子孙。而这为我们从理性的层面上来认识和理解音乐与建筑之间的关系带来了重要的启示。耐人寻味的是，在中世纪的西方，音乐曾隶属于理学学科。这就更进一步诱发笔者对“音乐中的数”和“建筑中的数”的关系进行思考和比较。

引入数的概念，是因为数的科学有一个特点，它可以使我们透过变化，接近事物的本质。

1．音乐中的数

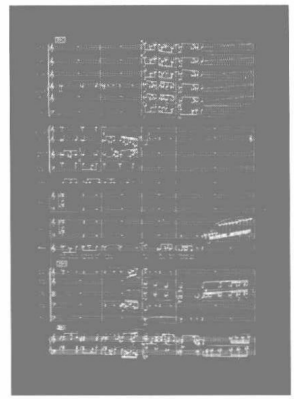

图7　《沃采克》乐谱
Figure 7　Music score of Wozzeck

As a well-known saying goes, “architecture is solidified music, while music is flowing architecture”. However, what is the connecting point and relation between architecture and music?

Augustinus, a philosopher in the Middle Ages, once commented that both architecture and music are offspring of numbers. This brings significant insights for us to realize and understand the relation between music and architecture from a rational level. It is worth pondering that the western world in the Middle Ages used to allocate music in the category of science. This further triggers my thoughts and comparison on the relationship between "number in music" and "number in architecture".

The concept of number is introduced because it has a distinctive feature enabling us to see through changes and approach the essence of things.

1. Number in Music

Music, apparently an art of time, actually conceals a very complicated mathematical system. It is said that Pythagoras, a famous ancient Greek philosopher, was the first person to discover the correlation between music and mathematics. One day when he occasionally passed by a blacksmith's door, he recognized three homophonic tones (4, 5 and 8) from the jingle sound of striking iron. At first he guessed that such homophonic tones may be related to the strength of blacksmiths. He went in and asked those blacksmiths to interchange their roles in striking iron, but the result showed no

从表面看来作为时间艺术的音乐，其背后隐藏着的却是一个复杂的数学系统。据说，最早发现音乐和数学之间存在着相互对应关系的是古希腊的著名哲学家毕达哥拉斯。传说，偶然的一日，他从铁匠铺门前路过，铺里面传出的叮叮当当打铁之声使他辨出了4度、5度和8度的3个谐音。开始，他猜想：这种谐音的产生是否会与铁匠的力气有关？他走进铺内要求几位打铁人相互轮换着进行打铁，得到的结果却是人的气力与谐音的产生并无直接的关联。于是他又让铁匠们更换不同的铁槌。这样一来，便发现不同谐音的产生源于铁槌的重量，并发现两把发出8度谐音的铁槌重量之间存在着2倍数的比例关系，而发出4度谐音的铁槌之间存在着4/3的重量比关系。铁槌重量比关系为3/2的那把发出的又是5度谐音。至此他得到了声音与铁槌重量之间所具有的相互对应的关系，即声音与数学比例之间的相互关系。要确认音与数字比例之间关系的存在，并验证这一判断的正确性，必要的条件就是以同样的数比例关系能够同样地还原出相应的谐音。为此，毕达哥拉斯在一根绷好的弦上作4等分，拨动琴弦。他发现弦的3等分部分的一半所发出的声音是5度谐音，即1.5/1，比例为3/2。比例为4/3时发出的是4度谐音……据此毕达哥拉斯便成功地将音与数的对应关系加以确立，并成为最先发现和表现声音与数字比例之间存在着相互对应关系的人。

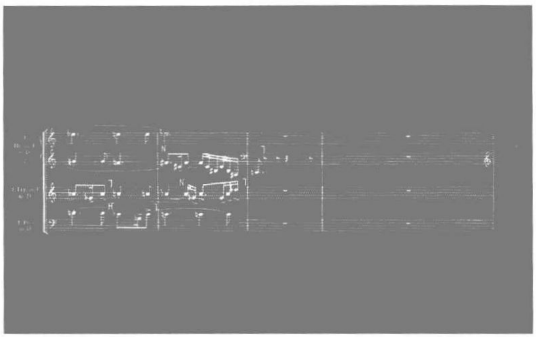

图8　乐谱
Figure 8 Music score

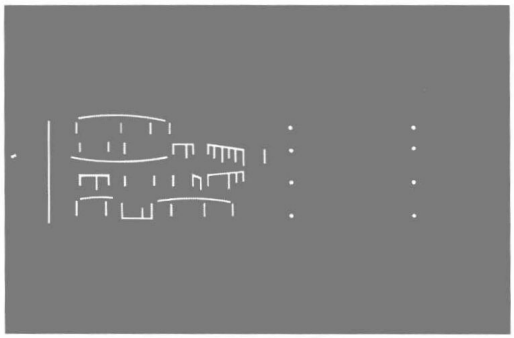

图9　抽出空间图式
Figure 9 Extracted space pattern

direct connection between strength and homophonic tones. Then he asked those blacksmiths to change their hammers. As a result, he found that production of different homophonic tones originated from and related to weight of hammers. For example, for two hammers producing 8 degree of homophonic tones, one is two times as heavy as the other, while 4 degree and 5 degree of homophonic tones correspond to hammer weight ratio of 4/3 and 3/2 respectively. Therefore he discovered a correlation between sound and hammer weight, in other words, correlation between sound and mathematics proportion. To verify this hypothesis, it is necessary to use the same mathematics proportion to reproduce corresponding homophonic tones. Therefore Pythagoras divided a tight music chord into four equal parts to strike it part by part. He found that 5 degree homophonic tone was produced at the half point of the three parts, i.e. 1.5/1 or 3/2, and 4 degree homophonic tone was produced at 4/3. Pythagoras then became the first one to discover, establish and demonstrate the correlation between sound and mathematics proportion.

Due to the establishment of correlation between music and number, it is possible to use the transformation of numeric proportion to record sound that occurs and vanishes instantly. Music relies on the continuous and repeated occurrences of sound, and the interval between continuous occurrences of sound can also be recorded and reproduced with the help of numeric relation, or in other words, intervals can be transformed into visual tempo distance and tempo

由于确立了音与数之间的对应关系，借以数比例关系的转换，瞬间生成又于瞬间消失的音的记录便成为一种可能。又因为乐的产生有赖于音的连续与重复地出现，而音的连续出现的时间间隔同样也可以用数的关系加以记录和还原，即将声音相互出现的时间间隔转换为视觉可见的节拍距离和节拍数。并可用这种节拍距离及节拍数的关系来对应和表达时间的延续间隔。于是，数以及数所构成的比例关系便成为乐谱产生的一个重要的和最为基本的要素与组成。

实际上，作曲家在音乐的作曲和表达时，有意识或无意识地都在使用着数的比例关系。比如乐谱的开始部分常常有4/4、4/3等分数式的表示，其分数式的分母表达着单位音的种类，分子则表示每一小节延续的拍子数。而这似乎又与建筑中比例尺的作用十分相似。又如，在相对的记谱法中的4分音符，其1厘米的间隔就表示1秒，2分音符是相对于4分音符的两倍，以2厘米表示2秒。这又表明作为时间艺术的音乐是以其音的相对距离关系来表现其时间关系的。据此我们可以说，流动着的不可视的音乐的凝固过程，实际上是建立于音乐与数的比例之间所存在的相互对应性和可转换性的基础之上的。乐谱本身便是这种凝固着的音乐的一种视觉上的表达。更进一步说，乐谱这一音乐在视觉上的表现，其本身便是音乐空间在二次元平面上的一种投射。

另外，从演奏的角度上看，音乐的演奏过程实质

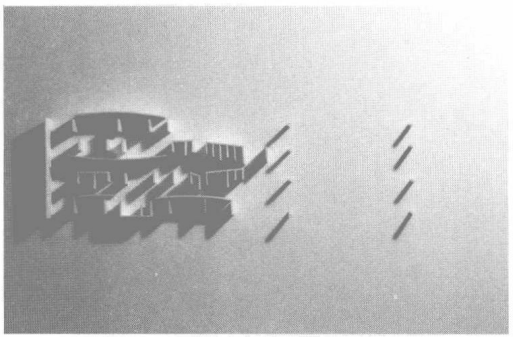

图10　空间图式立体化
Figure 10　Three-dimensional processing of space pattern

number, which can reflect and demonstrate the interval of time continuation. Therefore, number and numeric proportion become a significant and fundamental element and component leading to the production of music scores.

Actually, composers are, consciously or unconsciously, using numeric relation in music composition and expression. For example, music scores usually start with the marks such as 4/4 and 4/3, denominators represent the type of unit sound while numerators represent number of continuous tempos in each bar. This seems to be quite similar to the role of medium scale in architecture. Another example is for quarter note in relative notation the interval of 1 centimeter represents 1 second, while for half note the interval of 2 centimeters represent 2 seconds because half note is two times quarter note. This shows that music as art of time expresses time relation by relative distance between sounds. We may say that the solidification of flowing and non-visual music actually is based on correlation and interchangeability between music and numeric proportion. Music scores are visual expression of such solidified music, and furthermore, this visual expression of music by music scores serves as a projection of music space on two-dimensional plane.

From the perspective of music players, actually the process of playing music itself is to de-solidify music previously solidified. Music players, through the relation between symbols in music scores and by unconscious judgment of mathematics proportion, transform music