

A Study on Baien's Diagrams, 'Gengo-zu', in Terms of Symmetry

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Abstract. 'Gengo-zu' are diagrams drawn by Baien Miura, a Japanese philosopher in the Edo era. 'Gengo-zu' is to schematize a structural principle of the universe based on the unified principle as a dichotomy. Almost all of his diagrams are drawn with symmetry as 'mirror reflection'. The purpose here is to investigate his diagrams in terms of symmetry. For this purpose, it is tried to analyze them from a new point of view. The author formulates a hypothesis that Baien's diagrams are to represent 3-dimensional structural concepts in two dimensions. In this paper, it is cleared the Baien's method for representing a 3-dimensional structure. Their 3-dimensional images are reconstructed and compared with these original diagrams from a point of view of symmetry.

1. Introduction

1.1. *Baien Miura*

Susumu Miura (1723–1789), commonly called Baien Miura, was a Japanese philosopher in the Edo era. His philosophy is based on the unified principle as a dichotomy, 'Jyori', which means that all ideas consist of two contrasting opposite concepts. Baien's thought about nature and the universe is based on this fundamental principle. In his book, 'Gengo', Baien Miura developed his philosophy with many diagrams which were called 'Gengo-zu'. These diagrams are schematization of the structural principle. However, these are not only for explaining his writing as illustrations, but also tools by which he constructed and developed his thoughts. Therefore, he was a philosopher who made up an unique diagrammatic system for representing his thought.

1.2. *Symmetry and Baien's philosophy*

He drew over one hundreds various diagrams from the time when he first started writing his book. Almost all of the diagrams are circular and symmetry as 'mirror reflection'. Why did Baien draw his diagrams with 'mirror reflection'? We should consider the relationship of Baien's philosophy and symmetry.

At first, we shall remind about the definition of 'mirror reflection'. Geometrically, mirror reflection is understood as follows, "in every space of n dimensions the 'mirror' is a 'surface' of $n - 1$ dimensions. In every space of n dimensions an asymmetric figure can

be made to coincide with its reflection by rotating it through a space of $n + 1$ dimensions” (GARDNER, 1964).

On the other hand, Baien thought that any concept was divided into two opposite concepts and they were unified as one concept at a higher level. In other words, one idea is conceived to be two opposite ideas from a point of view, while these are the same one idea in a comprehensive view. An example is shown in Fig. 1. If we regarded heaven and earth as two opposite ideas, they would be also regarded as the same one idea, the universe, in a higher comprehensive idea.

In this way, the hierarchical structure of Baien’s dichotomic theory is quite similar to the geometrical explanation of mirror reflection. That is to say, symmetry is an important concept in his philosophy and his unified principle is a symmetrical thought.

2. Structural Analysis of ‘Gengo-zu’ in the Earlier Books

In this regard, the present study is to investigate the structures of ‘Gengo-zu’ in terms of symmetry. For this purpose, it is tried to analyze the structure of ‘Gengo-zu’ from a new point of view. The author formulates a hypothesis that Baien’s diagrams are to represent 3-dimensional structural concepts in two dimensions. Here it is considered that the symmetrical representation of ‘Gengo-zu’ from a point of view of the 3-dimensional structure.

2.1. Analysis from a point of view of the position of concepts

Baien continued to rewrite his books over thirty years, and the forms of diagrams changed gradually. These forms of diagrams are roughly divided into two patterns of Baien’s earlier works (Fig. 2) and his middle and latter works (Fig. 12). The latter diagrams are more complete and complex than the former. It is commonly supposed that Baien’s earlier works were done until his 42 years old, 1764, and then his middle and latter works were done until near his end. Here, the earlier diagrams are treated at first.

In this analysis, I focused on a consideration that ‘Gengo-zu’ was drawn imagining a

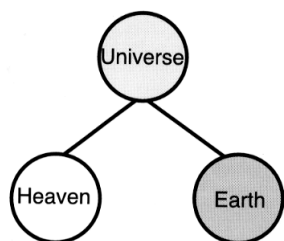


Fig. 1. The basic branching unit (R. Izuhara).

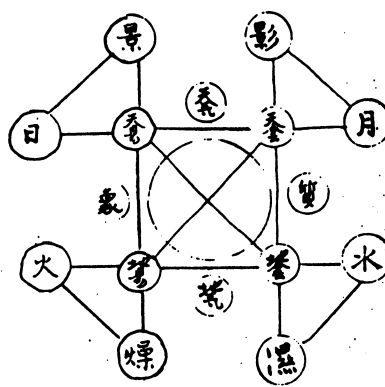


Fig. 2. Inyou-bouseki (B. Miura).

sphere. In his book he inscribed: "Don't regard all diagrams as flat and round form like coins. Regard these as solid and round form like hand balls" (MIURA, 1765). However, he didn't draw those spherical forms at all. Therefore, I analyze his diagrams from a point of view of 3-dimensional representations.

Almost all of his earlier diagrams are similar to the form shown in Fig. 2 (Reference Fig. 3). In these diagrams, the concepts are denoted by small circles with corresponding Chinese characters and disposed circularly in inside and outside and keep the same positions. Also, the relations among concepts are indicated by lines which connect two characters of the outer eight ones. In each diagram, these lines produce different symmetry as 'mirror reflection'.

As a result of analyzing the position of concepts denoted by Chinese characters, it seems to me that the diagram is based on three sets of two opposite concepts as shown in Fig. 4. In this observation, the author considers that three sets of two opposite concepts correspond to two poles of three axes in three dimensions (Fig. 5). For instance, two opposite concepts, heaven and earth, are represented by plus and minus directions of the vertical axis. Also, each character of the diagram is based on composing these basic concepts as they are layered up. Especially, each inner eight concept is made by composing

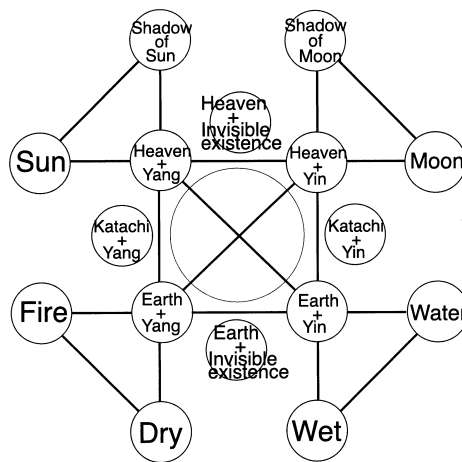


Fig. 3. 'Inyou-bouseki' English Version (R. Izuhara).

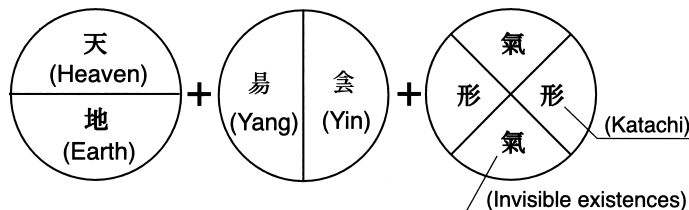


Fig. 4. Three sets of two concepts (R. Izuhara).

two any basic concepts and each outer eight one is made by composing three basic concepts (Reference Figs. 3 and 4). Therefore, these inner eight characters correspond to eight parts in three planes in the 3-dimensional structure as shown in Fig. 5. Furthermore, it is regarded that these outer eight characters can also be substituted with the eight parts of a sphere which are divided by three planes.

Therefore, the author formulates a hypothesis that his earlier diagrams represent 3-dimensional structural concepts in two dimensions.

2.2. Baien's method for representing a 3-dimensional structure

In the analysis, Baien's transformation method is cleared. It is considered that the diagram is divided into eight fan-shaped divisions made by layering up these sets (Figs. 4 and 6). Each outer eight character of 'Gengo-zu' corresponds to each eight fan-shaped

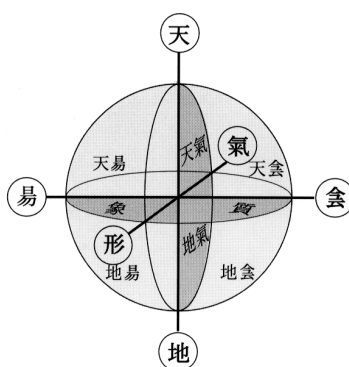


Fig. 5. The basic 3D structure of the earlier diagram (R. Izuhara).

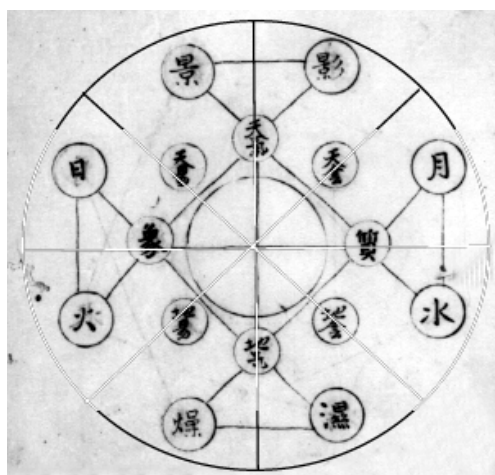


Fig. 6. 'Keiki-bouseki' with dividing lines (R. Izuhara).

division respectively.

In this regard, the earlier diagram is simplified as Fig. 7(a). Also, Fig. 7(a) is transformed into a 3-dimensional structure as shown in Fig. 7(b). As shown in these diagrams, eight points of a circle correspond to eight parts of a 3-dimensional structure. For example, four divisions of the circular diagram (1, 2, 3, 4 in Fig. 7(a)) are translated into the four parts in front of the sphere, and other four divisions of the circular diagram (5, 6, 7, 8 in Fig. 7(a)) are translated into the four parts at the back of the sphere.

The point I wish to emphasize is that this transformation method is Baien's own way for representing 3-dimensional structure in two dimensions. Generally, a perspective or an isometric drawing is used for representing 3-dimensional structures but his drawing method is quite unique.

In this connection, I would like to think about the inner eight characters of the earlier diagram, which correspond to eight parts in three planes as shown in Fig. 5. Figure 8(a) is to represent positions of the inner eight characters (indicated by a, b, c, d, e, f, g, h). Also,

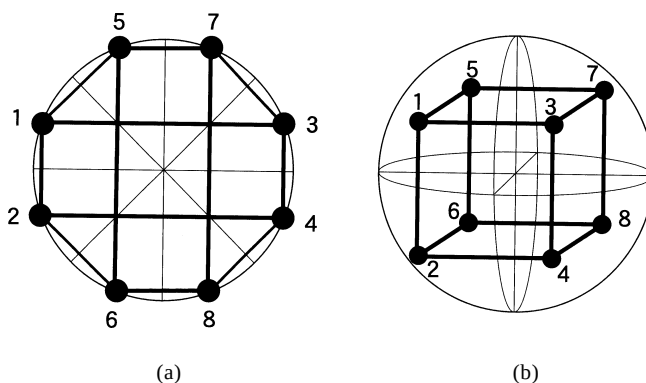


Fig. 7. Baien's method for transformation (R. Izuhara).

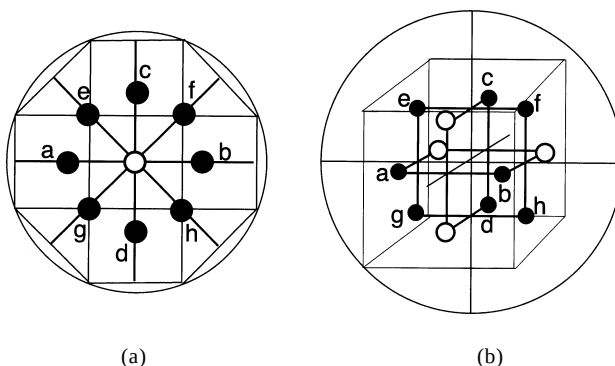


Fig. 8. The transformation of the inner eight characters (R. Izuhara).

Fig. 8(b) shows the transformation indicated by these eight points in three planes. Here it should be noticed that Baien's diagram indicates only these eight parts, nevertheless it is possible to divide three planes into twelve parts. Why aren't all twelve parts drawn in Baien's diagrams? Because, It is considered that the rest four parts indicated white points in Fig. 8(b) are corresponded to near the center of Fig. 8(a) according to his unique drawing method. That is to say, these points approach to the same position. Therefore, I guessed Baien omitted the four parts in his earlier diagrams.

3. Reconstruction of 'Gengo-zu' in the Earlier Books into 3-Dimensional Space

In order to confirm this hypothesis, the diagrams, 'Gengo-zu', was reconstructed into 3-dimensional space with a computer visual aid. In reconstructing, these 3-dimensional images are compared with these original diagrams from a point of view of symmetry. As a result, it has been found that almost all of 3-dimensional images are as symmetrical in the sense of mirror reflection as the diagrams. Namely, the symmetry is produced in three planes which are xy , xz and yz planes of the 3-dimensional structure. Figure 9 is the transformation of the earlier diagram as shown in Fig. 2. But It is found that only a few 3-dimensional images did not have mirror reflection, even though the original 2-dimensional diagrams have mirror reflection (Figs. 10(a) and 10(b)).

Why is the symmetrical difference occurred between both visual representations? We could find the cause of the symmetrical difference between the original diagrams and their 3-dimensional images in the Baien's drawing method. Of all symmetrical patterns of lines connecting two characters, only the two patterns shown in Fig. 11 are not mirror reflection in their 3-dimensional images. That is to say, these symmetrical four lines of the 2-dimensional diagrams are transformed into the same length but different direction.

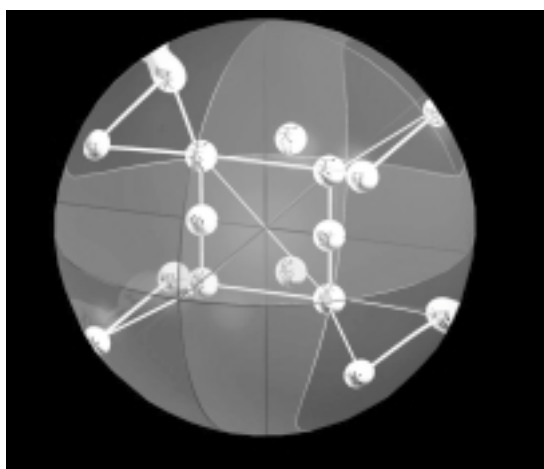
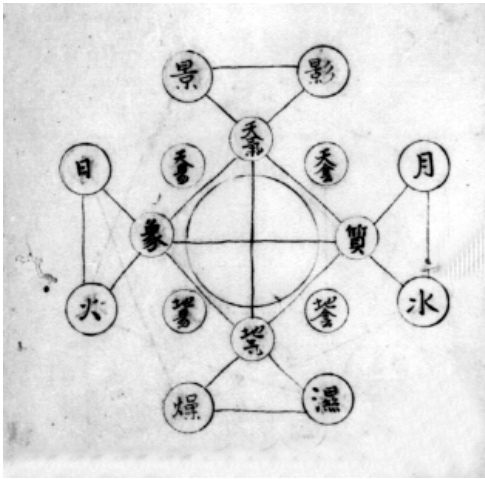
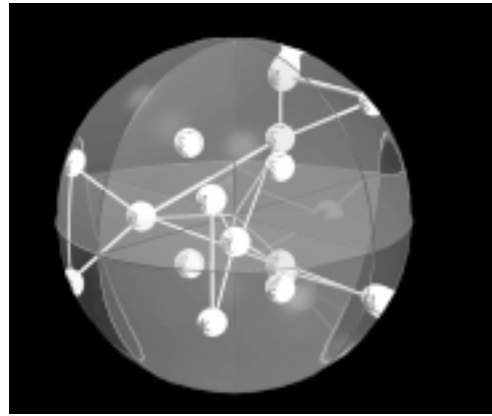


Fig. 9. The 3D image of 'Inyou-bouseki', Fig. 2 (R. Izuhara).



(a)



(b)

Fig. 10. (a) Keiki-bouseki (B. Miura), (b) the 3D image of 'Keiki-bouseki' (R. Izuhara).

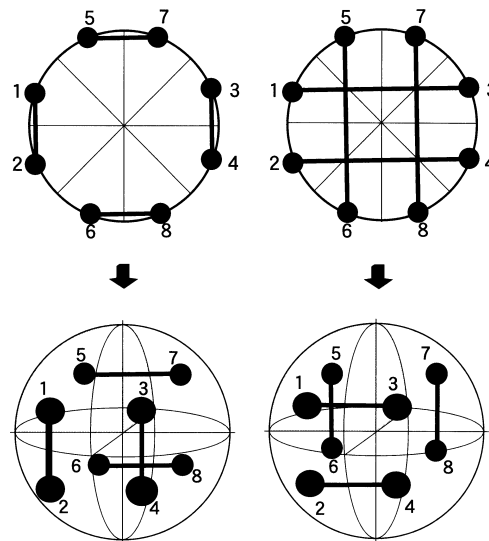


Fig. 11. Two patterns of the difference in terms of symmetry (R. Izuhara).

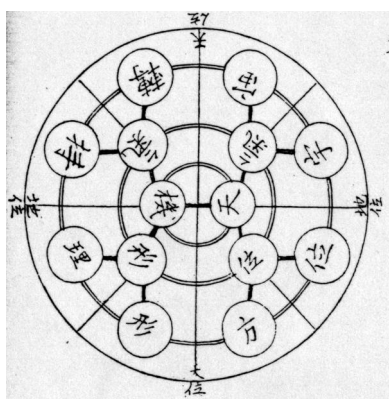
Baien's method causes another difference. In a 3-dimensional image, the parallel vertical lines are all the same length and are mirror reflection (as shown 1–2, 3–4, 5–6, 7–8 in Fig. 7(b)). But when drawn in a 2-dimensional diagram, these lines are different length. Also the parallel horizontal lines of the same length are mirror reflection (as shown 1–3,

2-4, 5-7, 6-8 in Fig. 7(b)). But these lines are drawn as different length in the 2-dimensional diagram. In this way, these weak points of Baien's method cause the differences in symmetrical representations.

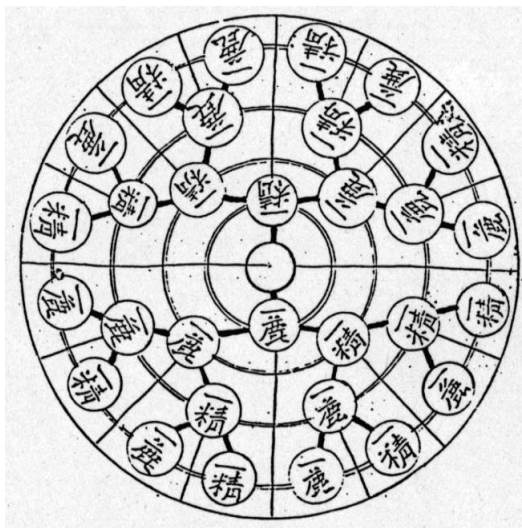
4. Reconstruction of the Middle and Latter Diagrams into 3-Dimensional Space

Next, this observation will be expanded into the 'Gengo-zu' of the middle and latter books. Do these diagrams represent 3-dimensional structures as same as the diagrams of his earlier works? Whether or not the symmetrical difference occur between 2-dimensional diagrams and 3-dimensional images.

Plenty of diagrams were drawn with various patterns in his middle and latter works. Therefore, I would like to focus attention on the most typical form of those diagrams. The diagram is quite unique, combining tree diagrams and concentric ones. (Figs. 12 (a) and 12(b)) Each branch line represents that one concept diverges into two opposite concepts. These diagrams seem to be different from the earlier diagrams but I notice that the form dividing a circle into eight divisions by diagonal lines is the same as the earlier diagrams. If the diagonal lines were used for the same purpose as the earlier diagrams, their 3-dimensional images could be transformed by using the same method. For instance, a diagram as shown in Fig. 12(b) could be transformed into a spherical image as shown in Fig. 13. The upper and lower quarters of the diagram are transformed into the back parts of a spherical image and the left and right quarters of the diagram are transformed into the front parts of a spherical image. Other diagrams of this pattern could also be transformed into 3-dimensional image by using the same method. It is considered that these diagrams are also



(a)



(b)

Fig. 12. (a) Uchu-tenji-zu (B. Miura), (b) Ichichi-seiso-zu (B. Miura).

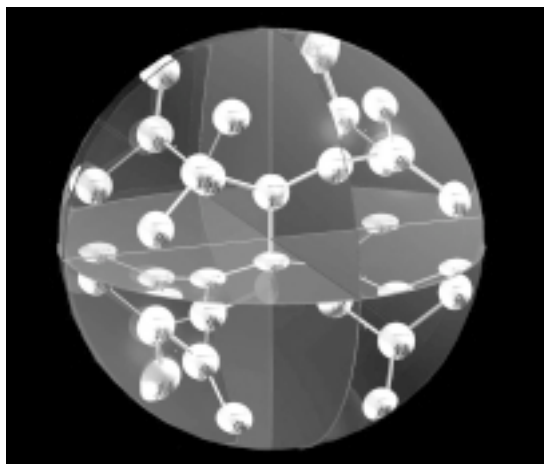


Fig. 13. The 3D image of 'Ichiichi-seiso-zu' (R. Izuhara).

based on the 3-dimensional structure.

Are there symmetry in the middle and latter diagrams? The diagrams in those days are all mirror reflection (Fig. 12). As a result of simulating this kind of diagrams, all 3-dimensional images keep the mirror reflection which the reflection planes is a horizontal plane and two vertical planes through a center of a sphere (Fig. 13). That is to say, these branch lines are made up of forms which do not lose mirror reflection in transformation. I thought that Baien avoided carefully the forms which lose mirror reflection in 3-dimensional structures in the middle and latter works.

5. Conclusions

Why did he draw mirror reflection in 3-dimensional structures? We are reminded that 'Gengo-zu' represent the structural concepts of the dichotomic thought. If the dichotomic thought of Baien's philosophy had meant only opposite concepts, the conceptual structure could be represented by simple bilateral symmetry as same as a general tree diagram and it would not have been necessary for drawing symmetry in the 3-dimensional structure. Basically, mirror reflection is made of each branch line to mean opposite concepts. However, his dichotomic thought contains more complex concepts. In 3-dimensional images, branch lines diverge to upper and lower nodes and these lines are mirror reflection to represent two opposite concepts at the first level. Next, the branch lines expand to left and right respectively, and these lines are mirror reflections in left and right, and upper and lower directions at the second level, and so on. That is to say, this diagram is 'multiple mirror reflections'. The number of the mirror reflection increases according to the proceeding divergent level. Thus, Baien's dichotomic thought contains these multiple relations of concepts. He imagined these spherical structures to schematize various relations of concepts. He thought that if we would like to understand one concept, we should think it dividing into opposite concepts of various points of view and then unifying

these ones. Therefore, it is considered that he imagined the diagrams with ‘multiple mirror reflections’ in 3-dimensional images.

In this study, it was considered that ‘Gengo-zu’ were diagrams which represent 3-dimensional structures in two dimensions from Baien’s earlier works until his latter works. Also, it was regarded that the Baien’s unique drawing method was used for the projection. An new approach for the structural analysis by reconstructing his diagrams into 3-dimensional space made clear the symmetrical structure and the complex relation of his dichotomic thought. It is regarded that Baien thought ‘mirror reflection’ in the 3-dimensional structure was the most suitable form for representing his symmetrical concepts of the unified principle theory of the universe.

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