Analogy and Mysticism and the Structure of Culture

by Sheldon Klein

The cultures of China, Africa, Tibet, Japan, and the Navaho provide evidence in support of a model for human cognitive processing which assumes that a major component of the rules for calculating human behavior resides outside the individual, in the inherited, collective phenomena that anthropologists call "culture" (Klein et al. 1981). The model contains rules of behavior encoded as analogical operators that relate situational state descriptions. I have named this kind of operator an Appositional Transformation Operator, or ATO (Klein 1977), and the term refers to the theory, derived from split-brain research, that the division of labor between propositional and appositional models of reasoning is culturally determined (TenHouten and Kaplan 1973, Paredes and Hepburn 1976). My particular interest is in accounting for the way humans understand language and calculate behavior. That the answers may relate to the results of split-brain re-

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1This paper is dedicated to the memory of Chen Shih Huang (UC-Berkeley), who, in another era, encouraged my attempt to persuade him that the West had produced something of merit (Klein 1956-57). A portion of the analysis of the I Ching was presented at ECAI-82, the 1982 European Conference on Artificial Intelligence, July 12-14, 1982, University of Paris, Orsay, France, and is published in the conference proceedings (Klein 1982).

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The present paper was submitted in final form 20 v 82.
"surrealistic" image appears as an icon representing the concept of bigamy, an element not to be found in the original situation examples.

For this model of collective human cognitive processing to be considered valid, it is essential that illustrative examples be found in real societies in many parts of the world and at different times in human history. It is the purpose of this paper to demonstrate the existence of such a system in Chinese culture, in the form of the *I Ching*, a system that encodes the philosophy of Taoism and Confucianism and has played a significant role in the lives of individuals and governments for millennia. I also note the existence of such an ATO divination system throughout much of Africa and the apparent encoding of ATO structures in the iconic imagery of Buddhism and in that of Navaho sand painting.

Before undertaking an analysis of the *I Ching* as an ATO calculation system, I shall describe ATOSs and illustrate their use to calculate behavior by analogy, drawing upon the earlier paper just mentioned.
user to project the elements of a specific problem onto an abstract verbal image or text and to use that image/text as a model or metaphor for the problem. The I Ching, however, is part of a system that supplies the rules for quantifying its abstract images and guides the computation of metaphors. These rules consist of equivalence sets of abstract and concrete terms that are markers of classification categories covering the whole range of traditional Chinese world knowledge. The images and their commentaries encode a structuring of the Chinese universe in terms of naturalistic, social, and metaphysical concepts that are derived from very early philosophies as well as from Confucianism and Taoism. (Systems of classificational equivalence sets are to be found in the history of every society in the world; Western readers need only be reminded of the "earth, air, water, and fire" classification of alchemy.)

There are eight trigrams, and they are listed with their names and primary associations (Wilhelm 1967 (1923): 725–27):

--- 111
    THE CREATIVE, Heaven

--- 010
    THE ABYSMAL, Water

--- 001
    THE AROUSING, Thunder

--- 110
    THE GENTLE, Wind

--- 101
    THE CLINGING, Fire

--- 000
    THE RECEPTIVE, Earth

--- 011
    THE JOYOUS, Lake
The hexagrams are grouped into “houses” of eight members each:

1. The House of the Creative
   1.1 The Creative is Heaven 111 111
   1.2 Heaven with Wind is COMING TO MEET 111 110
   1.3 Heaven with Mountain is RETREAT 111 100
   1.4 Heaven with Earth is STANDSTILL 111 000
   1.5 Wind with Earth is CONTemplation 110 000
   1.6 Mountain with Earth is SPLITTING APART 100 000
   1.7 Fire with Earth is PROGRESS 101 000
   1.8 Fire with Heaven is POSSESSION IN GREAT MEASURE 101 111

2. The House of the Abyssal
   2.1 The Abyssal is Water 010 010
   2.2 Water with Lake is LIMITATION 010 011
   2.3 Water with Thunder is DIFFICULTY AT BEGINNING 010 001
   2.4 Water with Fire is AFTER COMPLETION 010 111
   2.5 Lake with Fire is REVOLUTION 011 100
   2.6 Thunder with Fire is ABUNDANCE 001 101
   2.7 Earth with Fire is DARKENING OF THE LIGHT 000 101
   2.8 Earth with Water is THE ARMY 000 010

3. The House of Keeping Still
   3.1 KEEPING STILL is Mountain 100 100
   3.2 Mountain with Fire is GRACE 100 101
   3.3 Mountain with Heaven is TAMING POWER OF THE GREAT 100 111
   3.4 Mountain with Lake is DECREASE 100 011
   3.5 Fire with Lake is OPPOSITION 101 011
   3.6 Heaven with Lake is TREADING 111 011
   3.7 Wind with Lake is INNER TRUTH 111 011
   3.8 Wind with Mountain is DEVELOPMENT 110 100

4. The House of the Arousing
   4.1 THE AROUSING is Thunder 001 001
   4.2 Thunder with Earth is ENTHUSIASM 001 000
   4.3 Thunder with Water is DELIVERANCE 001 010
   4.4 Thunder with Wind is DURATION 001 110
   4.5 Earth with Wind is PUSHING UPWARD 000 110
   4.6 Water with Wind is THE WELL 010 110
   4.7 Lake with Wind is PREponderance OF THE GREAT 011 110
   4.8 Lake with Thunder is FOLLOWING 011 001

5. The House of the Gentle
   5.1 THE GENTLE is Wind 110 110
   5.2 Wind and Heaven is TAMING POWER OF THE SMALL 110 111
   5.3 Wind with Fire is THE FAMILY 110 101
   5.4 Wind with Thunder is INCREASE 110 001
   5.5 Heaven with Thunder is INNOCENCE 111 001
   5.6 Fire with Thunder is HITTING THROUGH 101 001
   5.7 Mountain with Thunder is CORNERS OF THE MOUTH 100 001
   5.8 Mountain with Wind is WORK ON WHAT WAS SPOILED 100 110

6. The House of the Clinging
   6.1 The Clinging is Fire 101 101
   6.2 Fire with Mountain is THE WANDERER 101 100
   6.3 Fire with Wind is THE CALDRON 110 110
   6.4 Fire with Water is BEFORE COMPLETION 101 010
   6.5 Mountain with Water is YOUTHFUL FOLLY 100 010
   6.6 Wind with Water is DISPERSION 110 010
   6.7 Heaven with Water is CONFLICT 111 010
   6.8 Heaven with Fire is FELLOWSHIP WITH MEN 111 011

7. The House of the Receptive
   7.1 THE RECEPITIVE is Earth 000 000
   7.2 Earth with Thunder is RETURN 000 001
   7.3 Earth with Lake is APPROACH 000 011
   7.4 Earth with Heaven is PEACE 000 111
   7.5 Thunder with Heaven is THE POWER OF THE GREAT 001 111
   7.6 Lake with Heaven is BREAK-THROUGH 011 111
   7.7 Water with Heaven is WAITING 010 111
   7.8 Water with Earth is HOLDING TOGETHER 010 000

8. The House of the Joyous
   8.1 THE JOYOUS is Lake 011 011
   8.2 Lake with Water is OPPRESSION 011 010
   8.3 Lake with Earth is GATHERING TOGETHER 011 000
   8.4 Lake with Mountain is INFLUENCE 011 100
   8.5 Water with Mountain is OBSTRUCTION 010 100
   8.6 Earth with Mountain is MODESTY 000 100
   8.7 Thunder with Mountain is PREponderance OF SMALL 001 100
   8.8 Thunder with Lake is THE MARRYING MAIDEN 001 011

I have discovered that the arrangement of the hexagrams in houses is completely determined by ATO relations. The structure is a kind of 8 × 8 array in which each element is a hexagram and each column is a house. The term "product" indicates the result of any computation with ATO logic. Any house may be transformed into each of the others by taking the successive products of its elements with each of those hexagrams whose upper and lower trigrams are identical. These doublet hexagrams actually function as ATOs. For example, The House of the Abyssal may be transformed into The House of Keeping Still by taking the product of each of its hexagram elements and the ATO hexagram 001 001:

*010 010 100 100
010 011 100 101
010 001 100 111
010 101 , 001 001 = 100 011
011 101 101 011
001 101 111 011
000 101 110 011
000 010 110 100

Again, The House of the Joyous may be transformed into The House of the Arousing by taking the product of its hexagram elements and the ATO hexagram 101 101:

*011 011 001 001
011 010 001 000
011 000 011 010
011 100 , 101 101 = 001 110
010 100 000 110
000 100 010 110
001 100 011 110
001 011 011 001

Furthermore, all hexagrams occupying the same row position in the house classification can be calculated by the method for computing verbal analogies described above. Each trigram component of a hexagram is associated with a verbal image. If we take the product of the upper and lower trigrams to generate an ATO and then take the product of this ATO and each of the eight trigrams, we generate eight parallel row entries in the house classification:

4.2 = Thunder 001

Earth 000

ATO = *(Thunder, Earth) = *(001, 000) = 110

Thunder Fire 001 101

Earth ? 000 ?

? = *(Fire, *(Thunder, Earth)) = *(Fire, 110) = *(101, 110) = 100

But 100 = Mountain.

Therefore, Thunder Fire

Earth Mountain
Similarly, Thunder Lake 001 011

Earth
?

= *(Lake, *(Thunder, Earth))
= *(Lake, 110)
= *(011, 110)
= 010
= Water

Therefore, Thunder Lake 001 011 = 4.2 8.2.
Earth Water

In a similar fashion, one may derive 3.2 by computing *(Mountain, 110) = Fire; 1.2 by computing *(Heaven, 110) = Wind; 2.2 by computing *(Water, 110) = Lake; 5.2 by computing *(Wind, 110) = Heaven; 7.2 by computing *(Earth, 110) = Thunder. The other row equivalences are computed in exactly the same way.

The house classification reflects a system of verbal analogies which are defined by first-level ATO relations. Each of the verbal images is also the marker of one or more classes consisting of such elements as a corresponding color, season, direction, element, kinship term, climate, mountain, planet, sound, musical note, virtue, emotion, animal, viscous, body orifice, flavor, odor, emperor, etc. An I Ching commentary explains the motive (Legge 1964 [1899]: appendix 3, sect. 1, chap. 8 [38], 360): "The Sage was able to survey all the complex phenomena under the sky. He then considered in his mind how they could be figured, and (by means of the diagrams) represented their material forms and their character. Hence these (diagrams) are denominated Simbances" (and sect. 2, chap. 6 [48], 396) "the names (of the diagrams and lines) are but small matters, but the classes of things comprehended under them are large."

There are actually several systems merged in the trigram classification, including a two-element (yin-yang) system, a five-element system, and the eight-element system. A partial merged listing appears in table 2. The Po Hu T'ung, a commentary on the corrollations (A.D. 79), explicates the logic (Fung Yu-lan 1953 [1934]:41-42).

What are the five viscera? They are the liver, heart, lungs, kidneys, and spleen. . . Of these five viscera, the liver corresponds to love, the lungs to righteousness, the heart to propriety, the kidneys to wisdom, and the spleen to good faith. How is it that the liver corresponds to love? The liver is the essence of (the element) wood, and love likes to be actively productive. The east is (the quarter of wood and of the actively productive) yang, and is where all things are first born. Therefore the liver resembles wood, being green in color and (shaped as if) having branches and leaves. . . .

**Table 2**

<table>
<thead>
<tr>
<th>Element</th>
<th>thunder</th>
<th>wind</th>
<th>fire</th>
<th>mountain</th>
<th>earth</th>
<th>heaven</th>
<th>lake</th>
<th>water</th>
<th>thunder</th>
<th>wind</th>
<th>fire</th>
<th>mountain</th>
<th>earth</th>
<th>heaven</th>
<th>lake</th>
<th>water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>001</td>
<td>110</td>
<td>101</td>
<td>100</td>
<td>000</td>
<td>111</td>
<td>011</td>
<td>010</td>
<td>thunder</td>
<td>wind</td>
<td>fire</td>
<td>mountain</td>
<td>earth</td>
<td>heaven</td>
<td>lake</td>
<td>water</td>
</tr>
<tr>
<td>Color</td>
<td>East</td>
<td>South</td>
<td>red</td>
<td></td>
<td></td>
<td>Center</td>
<td>West</td>
<td>yellow</td>
<td></td>
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<tr>
<td>Season</td>
<td>spring</td>
<td>summer</td>
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<td></td>
<td>&quot;fang&quot;</td>
<td>autumn</td>
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<tr>
<td>Climate</td>
<td>windy</td>
<td>hot</td>
<td></td>
<td></td>
<td></td>
<td>humid</td>
<td>dry</td>
<td></td>
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<tr>
<td>Planet</td>
<td>Jupiter</td>
<td>Mars</td>
<td></td>
<td></td>
<td></td>
<td>Saturn</td>
<td>Venus</td>
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<tr>
<td>Sound</td>
<td>shouting</td>
<td>laughing</td>
<td></td>
<td></td>
<td></td>
<td>singing</td>
<td>weeping</td>
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<tr>
<td>Musical note</td>
<td>chih</td>
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<tr>
<td>Emotion</td>
<td>anger</td>
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<td></td>
<td></td>
<td>joy</td>
<td>sympathy</td>
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<td></td>
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<tr>
<td>Animal</td>
<td>dragon</td>
<td>fowl</td>
<td>peahen</td>
<td></td>
<td></td>
<td>dog</td>
<td>ox</td>
<td>horse</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family</td>
<td>1st son</td>
<td>1st da</td>
<td>2d da</td>
<td>3d son</td>
<td>mother</td>
<td>father</td>
<td>3d da</td>
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<td></td>
</tr>
<tr>
<td>Body part</td>
<td>foot</td>
<td>thigh</td>
<td>eye</td>
<td>head</td>
<td>belly</td>
<td>head</td>
<td>mouth</td>
<td>ear</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Attribute</td>
<td>movement</td>
<td>penetration</td>
<td>brightness</td>
<td>standstill</td>
<td>docility</td>
<td>strength</td>
<td>pleasure</td>
<td>danger</td>
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</tbody>
</table>


**Klein: Analogy, Mysticism, and Culture**

How is it that the lungs correspond to righteousness? The lungs are the essence of (the element) metal, and righteousness makes decisions. The west is also (the quarter of) metal, where all things, having reached maturity, are destroyed. Therefore the lungs resemble metal, being white in color.

How is it that the heart corresponds to propriety? The heart is the essence of (the element) fire. (The quarter of fire is) the south, where the exalted yang holds a superior position, while the lowly yin holds an inferior position. Propriety maintains (social differences between) the exalted and the lowly. Therefore the heart resembles fire, being red in color and pointed.

How is it that the kidneys correspond to wisdom? The kidneys are the essence of (the element) water, and wisdom proceeds unceasingly without any doubt or uncertainty. Water likewise moves forward without uncertainty. The north is (the quarter of) water (and has black as its corresponding color). Therefore the kidneys are black in color. Water is yin, and therefore the kidneys are two in number.

How is it that the spleen corresponds to good faith? The spleen is the essence of (the element) earth. The highest function of earth is to nourish all creatures so as to give them form. It produces creatures without partiality, which is the essence of good faith. Therefore the spleen resembles earth, being yellow in color.

If we say

<table>
<thead>
<tr>
<th>Thunder</th>
<th>Lake</th>
</tr>
</thead>
</table>

Earth Water

we also specify that

<table>
<thead>
<tr>
<th>East</th>
<th>West</th>
<th>Eldest son</th>
<th>Youngest daughter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center</td>
<td>North</td>
<td>&quot;Mother&quot;</td>
<td>Second son</td>
</tr>
</tbody>
</table>

Dragoon Sheep Ox Pig

etc. This basic classification scheme defines an entire universe of analogies; each of these terms is itself a symbol, a metonymic emblem of other classes of elements in the universe.

The house classification provides a reference-base set of analogies. However, the use of the I Ching as a divination device usually generates two hexagrams. The first is derived by a semi-random method that may include the additional information that certain of the solid or broken lines (1 or 0) are unstable and in a state of transformation into their opposites. This uniquely determines a second hexagram which is viewed as a transform of the first. This correspondence between the two hexagrams now determines a new system of verbal analogies which may differ from that implied by the basic house
classification. If, for example, a divination attempt yields the hexagram 001 000 (4.2) and the transform partner 101 111 (1.8), the ATO that relates these is *(4.2, 1.8) = *(001 000, 101 111) = 011 000. The implied verbal analogy is

\[
\begin{array}{c|c}
\text{Thunder} & \text{Fire} \\
\text{Earth} & \text{Heaven}
\end{array}
\]

\[\text{ATO} = *(\text{Thunder Earth, Fire Heaven}) = 011 000\]

But this ATO may be used, systematically, to obtain transforms of the houses in the original scheme. The result is a new house classification scheme that is related to the original by the analogy,

\[
\begin{array}{c|c}
\text{Thunder} & \text{Fire} \\
4.2 : : 1.8, or & \\
\text{Earth} & \text{Heaven}
\end{array}
\]

The products of this ATO and the second hexagram of each of the original houses are as follows:

\[
\begin{array}{c|c|c|c}
(1.2) & 111 110 & (4.8) & 011 001 \\
(2.2) & 010 011 & (3.8) & 110 100 \\
(3.2) & 101 100 & (2.8) & 000 010 \\
(4.2) & 001 000, 011 000 = (1.8) & 101 111 \\
(5.2) & 110 111 & (7.8) & 010 000 \\
(6.2) & 101 100 & (8.8) & 001 001 \\
(7.2) & 000 001 & (5.8) & 100 110 \\
(8.2) & 011 010 & (6.8) & 111 101 \\
\end{array}
\]

Doing the same for the seventh hexagram of each of the original houses yields:

\[
\begin{array}{c|c|c|c}
(1.7) & 101 000 & (7.5) & 001 111 \\
(2.7) & 000 101 & (6.5) & 100 010 \\
(3.7) & 110 011 & (8.5) & 010 100 \\
(4.7) & 011 110, 011 000 = (5.5) & 111 001 \\
(5.7) & 100 001 & (4.5) & 000 110 \\
(6.7) & 111 010 & (2.5) & 011 101 \\
(7.7) & 011 111 & (1.5) & 110 000 \\
(8.7) & 001 100 & (3.5) & 101 011 \\
\end{array}
\]

etc. Thus, the original hexagram transformation, 4.2 (001 000) to 1.8 (101 111), with its implied verbal analogy,

\[
\begin{array}{c|c}
\text{Thunder} & \text{Fire} \\
\text{Earth} & \text{Heaven}
\end{array}
\]

can actually generate a whole new system of verbal analogies quite different from that implied by the I Ching’s original classification into houses, e.g.,

\[
\begin{array}{c|c|c|c}
\text{East} & \text{South} & \text{Eldest son} & \text{Second daughter} \\
\text{Center} & \text{West} & \text{Mother} & \text{Father} \\
\text{Dragon} & \text{Pheasant} & \text{Ox} & \text{Horse}
\end{array}
\]

etc. Each divination, i.e., the determination of a hexagram and its transform, actually defines a total realignment of the categories and their analogical relations. The net effect is that the implications of a divination for all facets of the conceptual universe can be calculated directly.

The Po Hu Tung (Fung Yu-lan 1953 [1934]: 44–45) describes the manner in which the five elements and their associated seasons provide models for all social institutions:

What is the model for the succession of the son upon the death of his father? This is modeled upon the fact that when (the element) wood reaches its end, fire becomes king (in its place). What is the model for a younger brother to carry on after the death of his elder brother? It is the succession of summer after spring. What is the model whereby approbation of goodness is to be extended even unto sons and grandsons (of the person whose goodness is thus approved)? It is that the productive forces of spring await for summer to bring about further growth. And what is the model whereby hatred of evil stops with the person (who is thus hated)? This is modeled on the fact that autumn acts as the executioner without waiting for winter.

What is the model for the ministers to take over the administration during the minority of a ruler? This is modeled on the fact that (the element) earth exercises jurisdiction over affairs during the time from the last (month of summer) to the first (month of autumn). What is the model for a son avenging (a crime committed against) his father? This is modeled on the overcoming of (the element) water by earth, and of fire by water. What is the model for the obedience of son to father, wife to husband, and subject to ruler? This is modeled on the obedience of Earth to Heaven. What is the model for the fact that a man (who gets married) does not leave (the home of) his parents? This is modeled on the fact that (the element) fire does not separate from (the element) wood. What is the model for the fact that a woman (who gets married) leaves (the home of) her parents? This is modeled on the fact that (the element) fire flows away from (the element) metal. What is the model whereby (a man), when he takes a wife in marriage, goes in person (to her home) to receive her? This is modeled on the fact that when the sun sets, the yang descends into the yin. . . .

The association of the eight trigrams with the five elements links the models to the I Ching divination system.

I have demonstrated that the original arrangement of the hexagrams in houses described in the I Ching is based on an ATO logic. It is my personal extrapolation that the determination of a hexagram and its transform, as part of a divination process, actually implies a new classification of hexagrams, with a new system of verbal image analogies. Yet this extrapolation seems quite justified by commentaries on the role and function of the I Ching (Wilhelm 1967 [1923]: 263):

The hexagrams, consisting of six lines each, are, so to speak, representations of actual conditions in the world, and of the combinations of the light-giving, heavenly power and the dark, earthly power that occur in these situations. Within the hexagrams, however, it is always possible for the individual lines to change and regroup themselves; just as world situations continually change and reconstitute themselves, so out of each hexagram there arises a new one. . . .

The hexagrams give complete images of conditions and relationships existing in the world; the individual lines treat particular situations as they change within these general conditions.

A justification for considering the original grouping of hexagrams in houses basic and for viewing the semi-randomly determined divination hexagram as an index into this structure can be found in the following (Wilhelm 1967 [1923]: 280–81):

Nonchange is the background, as it were, against which change is made possible. For in regard to any change there must be some fixed point to which the change can be referred; otherwise there can be no definite order and everything is dissolved in chaotic movement. This point of reference must be established, and this alters the choice and a decision. It makes possible a system of co-ordinates into which everything else can be fitted. Consequently at the beginning of the world, as at the beginning of thought, there is the decision, the fixing of the point of reference. Theoretically any point of reference is possible, but experience teaches that at the dawn of consciousness one stands already enclosed within definite, prepotent systems of relationships. The problem then is to choose one’s point of reference so that it coincides with the point of reference for cosmic events. For only then can the world created by one’s decision escape being dashed to pieces against prepotent systems of relationships with which it would otherwise come into conflict. Obviously the premise for such a decision is the belief that in the last analysis the world is a system of homogeneous relationships—that it is a cosmos, not a chaos. This belief is the foundation of Chinese philosophy, as of all philosophy. The ultimate reference for all that changes is the nonchanging.

The role of ATOs in the I Ching is clear: they function both as high-level state descriptions and as operators. It is for the human user to quantify particular, abstractly described world-states. But the I Ching, with the systems of classification of world phenomena contained in Chinese philosophy, actually provides a guide for quantifying the state descriptions.

The I Ching is a consciously developed product of millennia of the functioning of Chinese social life. Similar systems for
categorizing the universe and for calculating relationships exist, or once did, in virtually all human societies. The fundamental contemporary work describing their nature and function is Lévi-Strauss’s *La pensee sauvage* (1962). His totemic operator is equivalent to a specification of the ATO concept; the *I Ching* appears to be a highly developed example. Articulated divination schemes are found in many societies; Western civilization is not exempt. Consciously articulated, analogical calculating systems can be found in a line of history that includes Pythagoras, Hermes Trismegistus, alchemy, Kabbala, and the *Ars Magna* of Ramon Lull. The influence of such work persisted through the Renaissance, and the latter is part of the acknowledged intellectual background of Descartes and Leibniz.

I have posited that ATO systems are unconscious means by which humans in social groups calculate behavior by analogy. If the *I Ching* is part of a cognitive system that is driven not by the stimulus of a randomly calculated hexagram, but by a sample of reality in the form of a situation description, then, given such an input, the system will automatically redefine its analogical relations globally. This is the basis for the calculation of behavior by analogy and for the perception and use of metaphor.

If the ATO model is valid, one would expect evidence from brain research psychology and functional computer modeling and, in particular, cross-cultural evidence, both contemporary and historical. I hope that the analyses presented here, representing the last category, will serve to stimulate the search for evidence in all of these areas.

### ATO Logic in African Divination Systems

ATO logic plays a major, overt role in the related, widely diffused divination systems of Africa (the Ifa of the Yoruba, the Sikily of Madagascar, etc.). In general, they resemble the *I Ching* in that they utilize sets of units consisting of elements that are interpreted as odd or even. These sets are, in part, generated by a semi-random method and then subjected to ATO logic manipulations. The systems are well known and well described (Maupoil 1943, Jaulin 1966, Gleason 1973). For example, in the generated set of 16 figures (Jaulin 1966:22) in figure 11, the odd and even elements may be interpreted as 0’s and 1’s. Columns 5, 6, 7, and 8 are obtained from Columns 1, 2, 3, and 4 by column-to-row transposition. Column 9 is the ATO operator for Columns 1 and 2, i.e., *1* = 2. Similarly, Column 10 is the result of *3*, 4, and Columns 11 and 12 are the ATO operators for Columns 5 and 6 and 7 and 8, respectively. The middle row appears as a set of first-order ATOs for the top row. The third row contains Column 13, which is equal to *9*, 10, and Column 14, which is equal to *11*, 12, Column 15 is the ATO for 13 and 14, and Column 16, appended to the right of the top row, is the ATO or *product* for Columns 15 and 1.

As in the *I Ching* system of houses, there is a base set of 16 figures that serves as a reference point for actively cast, derived sets. Each of the figures is correlated with the elements earth, air, fire, and water, with signs of the Zodiac, with night and day, with the nights and days of the week, with the months of the year, with numbers, with letters of the alphabet, with body parts, with planets and constellations, with colors, with parts of the house, with flavors, with shapes, with prophets and caliphs, and with metals (Maupoil 1945:61–75). Each of the figure positions in a divination construction correlates with a different domain of social life, and each of the possible 256 signs is associated with cases in common law (Gleason 1973:17).

For each of 256 signs-in-combination there are, in principle, 16 "rows" of discourse—each of which contains a case in the common law of Ifa. These cases, although presented as real precedents, are intentionally paradigmatic and involve an animal, a divinity, an exemplary king, or other special being as "client" whose situation runs parallel to that of any living person who identifies with it.

Unlike the *I Ching*, which is part of popular cultural knowledge, Ifa is the intellectual property of a limited group (Gleason 1973:9): "Ifa can only be revealed through its initiates, who themselves have acquired the secret teaching bit by bit, who alone may manipulate the sacred counters." It is impossible to rule out a historical connection with the *I Ching*. Caslant (1935:109, quoted in Maupoil 1943:51, translation mine) states:

> We may ... suppose ... that knowledge of geomancy continued in Persia approximately to the 8th and 9th centuries, to that epoch in high Iranian culture during which the universities of Gondeshapur and Baghdad flourished. The intellectual elite of all countries converged on these centers, and Arab and Jewish savants, molded in these universities, carried their knowledge of geomancy to Damascus, Alexandria, and Cairo along with their learning in philosophy and medicine. From these centers, the knowledge spread, via Upper Egypt, as far as the Sudan and Darfur and, via the Mediterranean, to Northwest Africa and Spain. ...

An apparent connection between the philosophy of the *I Ching* and that of the Pythagoreans suggests a historical link to later developments; the *I Ching* may have been known in Persia at the time of the Alexandrian conquest (Fung Yu-lan 1953 [1934]:95):

> Striking similarities emerge when we compare the doctrines of the Pythagoreans with the Chinese "study of emblems and numbers."**

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**"Nous pouvons ... supposer ... qu'elle (la Géomancie) était connue depuis fort longtemps en Perse aux VIIIe et IXe siècles tout au moins. C'est-à-dire à cette époque de haute culture iranienne où fleurissaient les Universités célèbres de Gondé-Shapur et de Bagdad, vers lesquelles convergeait alors l'élite intellectuelle de tout le pays. Ce sont les savants arabiens et juifs, formés dans ces universités, qui, en même temps que la science philosophique et médicale acquise, emportèrent la science géomantique à Damas, à Alexandrie et au Caire, d'où, d'une part, elle s'enfonça en Afrique par la Haute-Égypte jusqu'au Soudan et au Darfour, et, d'autre part, par la voie méditerranéenne gagna le Maghreb et l'Espagne...""
Appendix III of the Book of Changes, for example, contains the famous passage: "In the Changes there is the Supreme Ultimate, which produced the two Forms. . . . This is similar to the Pythagorean theorem that "from the monad proceeds the indefinite duad." Likewise, if we examine the series of ten pairs of antinomies enunciated by the Pythagoreans, such as Limit and the Unlimited, it is evident that what they call Limit corresponds fairly closely to what the exponents of the Book of Changes call yung, while the Pythagorean Unlimited similarly corresponds to the Chinese yin. In Greek philosophy it has been generally maintained that the Unlimited constitutes matter, Limit constitutes form, and that physical things are the result of the imprint of form upon matter. In China, likewise, the exponents of the Book of Changes maintained that the yung is active and hence gives forth, whereas the yin is passive and hence receives. Indeed, among the ten above-mentioned pairs of antinomies, there are only two that differ markedly from the theories of the exponents of the Changes. . . .

But what is it that may have been transmitted to Africa? First, the use of geometry based on a binary number system; second, the use of ATO logic in the arithmetic calculations; third, the use of analogy and projection of particular details of problems into the forms of canonical texts. What has changed in the transmission is the content. Either the new system was adopted as a calculating machine to be used with an already existing conceptual framework, or it arrived in a syncretic synthesis of more than one world framework, reconciled in the mathematics and referentia of the divination system.

BUDDHIST ICONOGRAPHY AND NAVAHO SAND PAINTING

There are strong indications that the structure of Buddhist iconography, and also that of Navaho sand painting, are based on ATO logic. If this is so, then questions of invention and diffusion versus brain physiology are thrust tens of thousands of years into the past. As a preliminary to the discussion, I offer an example of my own creation, a visual, iconographic interpretation of the house classification scheme of the I Ching. I do this to illustrate the ease of conversion between notational modes and to provide the reader with an intuitive example of fundamental ATO identity behind apparently profound surface diversity. Figure 12 contains an arbitrary visual interpretation of the first four houses of the I Ching. The visual features are in binary opposition, and a 0 indicates the upper element, a 1 the lower element. The reader may verify that the pictures are arranged in an order that follows the analogic relations of the hexagrams in the original classification. In creating the example, my intent was to demonstrate that the I Ching ATO system may be linked to an arbitrary visual domain, yet function with the same logic. I argue, accordingly, that whatever the source of ATO logic, it is a calculating device that is neutral to the content of the classification systems to which it is applied. ATO logic is not limited to binary features, but will also work for any number of choices that are powers of 2. For example, ATO analogical reasoning may be performed with a set of four colors by assigning each a two-digit binary number (00, 01, 10, 11) and treating them as if they represented pairs of binary features.

The Buddhism that was brought into Tibet in the 7th century was Mahåyåna combined with the 5th-century yoga doctrine of ecstatic union, the Mantrayåna doctrine of spells and charms, and the 6th-century Tantric doctrine of the worship of female energies in conjunction with male energy. Lamaism developed as an 8th-century fusion with Bon, the native religion of Tibet (Gordon 1959[1939]:8). The iconography of Tibetan Buddhism appears to follow ATO combinatorial logic of the sort seen in the I Ching and African divination systems. I have not verified this with overt calculations—this is a vast task, and the literature is in several languages—but the attempt should be made. Whitney (1959 [1939]:vi) likens the identification of Tibetan Buddhist iconic imagery to botanical analysis. As one might determine the division, family, and species of a flower, one can determine the class of image from its pose, expression, and dress. More detailed identification of the individual and its particular form are determined by the number of arms, legs, and faces, by hand gestures, by symbols carried in the hands, and by color (Bhattacharyya 1968[1924], Lauf 1972, Gordon 1959[1939]). Each of these elements is associated with other conceptual domains. Table 3 contains a listing of the five Dhyåni Buddhas and some of their correspondences. Bhattacharyya (1968[1924]:47) states:

The five Dhyåni Buddhas who are the embodiments of the five Skandhas or primordial elements are the progenitors of the five families of deities constituting the whole of the Buddhist pantheon. The emanated deities of these Dhyåni Buddhas, as a rule are usually of the same colour as that of the Dhyåni Buddha and are placed in the same direction as assigned to their sires. This very plan is followed most scrupulously in almost all the manåjalas or magic circles as described in the remarkable work Nispānna-yogavåti of Mahåpåndita Abhayåkåra Gupta [12th century A.D.; see Abhayåkåra Gupta 1949].

Mandalas are special forms of Thang-kas (paintings of divinities or groups of deities used to invoke deities) and are used for spiritual meditation (Gordon 1959[1939]:27; Lauf 1972:50-51). Gordon (1959[1939]:27) suggests that they originated from the yoga doctrine of the union of the world of ideas and the world of forms. Other forms of mandalas found their way to Japan (Ishida 1975, vol. 1:i):

The T’ang priest Hui-kou (A.D. 746-805) presented the Japanese priest Kûkai (alias Kôbô Daishi) with a set of Ryôkai Mandara (Manåjala of the Two Circles). This set, consisting of a pair of hanging scrolls representing the Taiizôki (Garbhahårta) and Kongôki (Vajradhårta) respectively, is known in Japan as the Genu Mandara... Concerning Manåjala earlier than the Genu type transmitted from Hui-kou to Kûkai we can cite, as an example of the Vajradhårta group, the Gobô Shinšû (Wu-pu Hsin-kuan) brought back from China by the priest Enchin, the study of which has seen some progress. On the other hand, however, detailed study of Manåjalas of the Garbhahårta group has almost never been made, due probably to its complicated composition consisting of innumerable divinities. This statement applies not only to researches by Japanese scholars, but to those by experts in other parts of the world. Their study of the Esoteric Buddhism of India and Tibet, for example, is mostly concentrated on Vajrayåna (Later Esotericism) in which many armed deities are recurrent, researches on Mantrayåna (Earlier Esotericism) prior to the Genu Mandara being next to nothing.

Mantrayåna which thrived at Nalanda has left nearly no relic even in India, so that it is hard to know what it was like. Fortunately, however, it was transmitted to China in quite early times, and many of its scriptures were translated from Sanskrit into Chinese; about a century later, it was introduced also to Tibet, where Tibetan translations of the sutras were established. In order to fill up the blank pages left by Early Esoteric Buddhism, therefore, our only available recourse is Chinese or Tibetan translation. In this respect, Japan, where Chinese sutras older than Tibetan ones have been known and where associated objects have been imported and preserved, holds a favorable situation for the study of Mantrayåna. Herein lies the purpose of this book. The present writer wishes to help in filling up the above-mentioned blank pages by casting light on Garbhahårta and Vajradhårta Manåjalas earlier than the times of Hui-kou and Kûkai...

Figure 13 contains a portion of a mandala from Ishida’s work (1975, vol. 2:120). The reader might compare it with the "mandala" of my figure 12, produced in a mechanical fashion from the house classification of the I Ching hexagrams. Figure 14 (Chandra 1971:249) contains an extract from another mandala.

Navaho sand-painting techniques appear to follow an ATO logic and to involve the creation of mandala structures. (I am indebted to Reichard 1950 and 1973 [1939], Newcomb, Fishler, and Wheelwright 1956, Newcomb and Reichard 1937, McAl-
**Fig. 12.** An arbitrary visual interpretation of the first four houses of the *I Ching*.

**TABLE 3**

**SOME CORRESPONDENCES OF THE FIVE DHYĀNI BUDDHAS**

<table>
<thead>
<tr>
<th>VAIROCANA</th>
<th>AKSOBHYA</th>
<th>RATNASAMBHAHA</th>
<th>AMITĀBHA</th>
<th>AMOGHASIDDHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Center</td>
<td>East</td>
<td>South</td>
<td>West</td>
</tr>
<tr>
<td>Hand position (mudrā)</td>
<td>Teaching (Dharma-cakra)</td>
<td>Witness (Bhūsparsa)</td>
<td>Bestowing (Vara)</td>
<td>Meditative (Dhyāna)</td>
</tr>
<tr>
<td>Throne animal</td>
<td>Lion</td>
<td>Elephant</td>
<td>Horse</td>
<td>Peacock</td>
</tr>
<tr>
<td>Element</td>
<td>Ether</td>
<td>Air</td>
<td>Earth</td>
<td>Fire</td>
</tr>
<tr>
<td>Color</td>
<td>White</td>
<td>Blue</td>
<td>Yellow</td>
<td>Red</td>
</tr>
<tr>
<td>Symbol</td>
<td>Wheel</td>
<td>Thunderbolt</td>
<td>Jewel</td>
<td>Red Lotus</td>
</tr>
<tr>
<td>Sense</td>
<td>Sight</td>
<td>Sound</td>
<td>Smell</td>
<td>Taste</td>
</tr>
<tr>
<td>World</td>
<td>First</td>
<td>Second</td>
<td>Third</td>
<td>Present</td>
</tr>
<tr>
<td>Bodhisattva</td>
<td>Samantabhadra</td>
<td>Vajrapāni</td>
<td>Ratnapāni</td>
<td>Avalokita</td>
</tr>
<tr>
<td>Earthly Buddha</td>
<td>Krakucchanda</td>
<td>Kanaka Muni</td>
<td>Kāṣyapa</td>
<td>Śākya Muni</td>
</tr>
<tr>
<td>Skandha</td>
<td>Consciousness (Vijnāna)</td>
<td>Form (Ṛṣa)</td>
<td>Sensation (Vedanā)</td>
<td>Name (Samjnā)</td>
</tr>
</tbody>
</table>

**Sources:** Waddell (1895:350–51); Lauf (1972:130); Gordon (1959 [1939]:31).
Fig. 13. A portion of a mandala illustrated in Ishida (1975, vol. 2:120; reprinted by permission of the publisher). Each column contains variant representations of the deity whose name appears at the top.