# The Pattern That Connects 

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#### Abstract

The current interest in interdisciplinary study calls for a search for a common pattern that connects the many and varied disciplines to one another. This paper proposes such a pattern. This inquiry, which began as "What is art?" in 1983, led beyond the boundaries of art toward a deeper underlying reality of existence itself, and this added both a spiritual and a scientific dimension to the inquiry.

An early finding was that the same form-building rules (patterning) that apply to artistic composition also apply to the forms of living and nonliving systems (science). Subsequent research revealed that this form-building geometry, which underlies human sight, exists in the depths of the human unconscious mind as a unifying Archetypal figure, as the "pattern that connects." It stands for the concept of wholeness or spirituality. Finally, it became apparent that this unifying pattern is the source from which is derived the known dynamical patterns associated with symmetry. Symmetry is the active governor of the structures and processes that exist in both art and nature's varied systems. Thus this paper begins with several explanatory diagrams that show how symmetry governs form. Having discussed symmetry's organizing powers, first in art and then in nature, these discussions then show that symmetry, as an operation (action), involves the relationship of part to part, of each part to the whole, and of the whole to each of the parts. This principle, which is represented here as the "pattern that connects," echoes an important spiritual idea: Love God (whole), and love one another (part).


## Le Modèle qui relie

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## Résumé

L'intérêt actuel pour l'étude interdisciplinaire requiert la recherche d'un modèle commun qui relie des disciplines diverses et variées l'une à l'autre. Cet article propose un tel modèle. Notre enquête, qui a débuté en 1983 dans « what is art » (qu'est-ce que l'art), nous a conduit au-delà des frontières de l'art vers une réalité plus profonde, sous-jacente, de l'existence elle-même : cela a ajouté une dimension spirituelle et en même temps scientifique à notre enquête.

Nous nous sommes bien vite rendus compte que les mêmes règles de construction de formes (modèles) qui s'appliquent à la composition artistique, s’appliquent également aux formes des systèmes vivants et non vivants (science). Les recherches ultérieures ont révélé que la géométrie de construction de formes, qui sous-tend la vision humaine, existe dans les profondeurs de
l'inconscient humain comme une Figure Archétypale unificatrice, à savoir un « modèle qui relie ». Elle représente la notion du tout, de la spiritualité. Enfin, il est devenu évident que ce modèle unificateur est la source d'où proviennent les modèles dynamiques connus associés à la symétrie. La symétrie régit de manière active les structures et les processus qui existent dans l'art et dans les divers systèmes de la nature. Cet article commence donc avec plusieurs schémas explicatifs qui montrent comment la symétrie régit la forme. Après avoir examiné les pouvoirs organisateurs de la symétrie, tout d'abord dans l'art et ensuite dans la nature, notre exposé démontre ensuite que cette symétrie, étant une opération (action), implique la relation d'une partie à une autre partie, de chaque partie à l'ensemble et de l'ensemble à chacune des parties. Ce principe, qui est représenté ici comme le « modèle qui relie », fait écho à un concept spirituel important : aimez Dieu (le tout) et aimez-vous les uns les autres (la partie).

## El patrón que conecta

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## Resumen

El interés actual en el estudio interdisciplinario exige una búsqueda de un patrón común que conecta las muchas y variadas disciplinas entre sí. En este trabajo se propone un modelo de este tipo. Esta investigación, que comenzó en 1983 en "lo que es arte", llevado más allá de los límites del arte hacia una realidad subyacente más profunda de la existencia misma, y esto añade un tanto espiritual y una dimensión científica para la investigación.

Un hallazgo inicial fue que las mismas reglas de creación de formulario (de modelado) que se aplican a la composición artística también se aplican a las formas de los sistemas no vivos (ciencia) y de vida. La investigación posterior reveló que esta geometría en forma de la construcción, lo que subyace en la vista humana, existe en las profundidades de la mente inconsciente humana como una figura arquetípica unificadora, como el "patrón que conecta." Representa el concepto de totalidad o la espiritualidad. Por último, se hizo evidente que este patrón unificador es la fuente de la que se derivan los patrones dinámicos conocidos asociados con la simetría. La simetría es el gobernador activo de las estructuras y procesos que existen en ambos sistemas variados de la naturaleza y el arte. Así, este documento comienza con varios diagramas explicativos que muestran cómo la simetría rige formulario. Que tiene poderes de organización de simetría discutido, por primera vez en el arte y en la naturaleza, estas discusiones a continuación, muestran que la simetría, como una operación (acción), implica la relación de una parte a otra, de cada parte con el todo, y de la totalidad de cada una de las partes. Este principio, que está representado aquí como el "patrón que conecta," se hace eco de una idea importante espiritual: Dios del amor (completo), y aman el uno al otro (parte).

## O Padrão que conecta

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#### Abstract

Resumo

O interesse atual pelo estudo interdisciplinar requer uma pesquisa de um padrão comum que conecte as muitas e variadas disciplinas. Este artigo propõe tal padrão. Essa investigação, que começou em 1983 sobre "o que é arte", se estendeu para além dos limites da arte na direção de uma realidade fundamental mais profunda da própria existência, o que acrescentou uma dimensão espiritual e científica à investigação.

Uma descoberta inicial mostrou que as mesmas regras de construção de forma (padronização) que se aplicam à composição artística também se aplicam às formas dos sistemas vivos e nãovivos (ciência). Pesquisas posteriores revelaram que essa geometria de construção de forma, que serve de base para a visão humana, existe nas profundezas do inconsciente da mente humana como uma figura arquetípica unificadora, como o "padrão que conecta". Defende o conceito de plenitude ou espiritualidade. Finalmente, torna-se claro que esse padrão unificador é a fonte da qual derivam os conhecidos padrões dinâmicos associados à simetria. A simetria é o governador ativo das estruturas e processos que existem tanto na arte quanto nos sistemas variados da natureza. Dessa forma, este artigo começa com vários diagramas explicativos que mostram como a simetria controla a forma. Tendo discutido os poderes organizadores da simetria, primeiramente na arte e depois na natureza, essas discussões mostram então que a simetria, como uma operação (ação), envolve o relacionamento de parte para parte, de cada parte para o todo e do todo para cada uma das partes. Desse princípio, que é aqui representado como o "padrão que conecta", ecoa uma importante ideia espiritual: amar a Deus (todo) e amar uns aos outros (parte).


## Ein Muster, das verbindet

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## Zusammenfassung

Fachübergreifende Forschungen sind derzeit sehr begehrt und suchen nach einem gemeinsamen Muster, das die vielen unterschiedlichen Wissenszweige mit einander verbinden könnte. Diese Abhandlung unterbreitet ein solches Muster. In 1983 wurde anfänglich untersucht „was Kunst ist" und diese Untersuchung führte über die Grenzen der Kunst hinaus zu einer grundlegenden Realität der Existenz selbst. So wurde der Untersuchung eine weitere spirituelle und wissenschaftliche Dimension hinzugefügt.

Anfänglich fand man heraus, dass die gleichen formbildenden Gesetze (Muster) sowohl für Kunstwerke als auch für die Formgebung lebendiger und nicht lebendiger Systeme (Wissenschaft) galten. Weitere Untersuchungen ergaben, dass diese formgebende Energie, die für das menschliche Auge verborgen ist, als eine vereinende archetypische Instanz in den Tiefen des menschlichen Unterbewusstseins vorhanden ist. Sie entspricht also „ein Muster, das verbindet" und steht für das Konzept der Ganzheit bzw. der Spiritualität. Zum Schluss wurde auch offensichtlich, dass dieses vereinende Muster die Quelle der bekannten dynamischen Muster, welche man gerne mit der Symmetrie in Verbindung bringt, darstellt. Die Symmetrie ist ein aktiver Regler für Strukturen und Prozesse, die in den unterschiedlichsten Systemen der

Natur und der Kunst vorhanden sind. Daher unterbreitet diese Abhandlung erst verschiedene erklärende Diagramme, die zeigen, wie die Symmetrie die Form lenkt. Die Wirksamkeit der Symmetrie wird erst in der Kunst und dann in der Natur, besprochen, anschließend zeigen wir, dass folglich die Symmetrie, als Funktion (Aktion), eine Beziehung von einem Teil zu einem anderen Teil, von jedem Teil zum Ganzen und vom Ganzen zu jedem Teil mit sich bringt. Das Prinzip, das hier als „ein Muster, das verbindet" vorgestellt wird, findet sich wieder in einer wichtigen spirituellen Idee: liebet Gott (das Ganze) und liebet Euch gegenseitig (das Teil).

## Introduction

In a general way, one might characterize everyday human activity as encompassing three large categories: science, which deals with the physical world; art, which reveals the world of imagination; and spirituality, which reflects the world of soul. Until recent times, these categories have operated so as to exist relatively independently of each other. Now there is an interest in establishing interdisciplinary relationships among the many separate disciplines that are being taught in our schools. In the main, the proposals toward reconciliation of the distinctions that characterize the three categories tend to stay on a philosophical level. There is talk of a "seamless" fundamental reality. The present paper aims to specifically identify the unifying, comprehensive, patterning mechanism that governs science, art, and spiritual life as the "pattern that connects."

The author approaches the task of revealing this unifying pattern to the reader by introducing the topic of symmetry in the first section. Having defined symmetry, we turn in the next section to the use of symmetry in art. The analysis of Leonardo's work in the third section acquaints the reader with the organizing patterns in art that derive from the nature of human sight. The sections that follow deal with Science (nature), Art of Ornament (pattern), Soul (psyche), Rhythm (number), and Universal Mind, respectively. These topics enable the reader to identify, understand, and then apply to practice the archetypal universal pattern that explains the relationship of the part to the part, the part to the whole, and the whole to each of the parts, which is presented here as the "pattern that connects." ${ }^{1}$

## Symmetry

Symmetry can be defined from four different perspectives. We can speak of it from the point of view of physics, mathematics, psychology, or aesthetics. The popular belief with respect to aesthetics is that symmetry means harmony or balance. But symmetry's role in picture making is far broader than just harmony or balance. We no longer regard picture making as just a representation of a static idea; rather, we perceive it in its parts as a dynamical process that in its totality exemplifies completeness and wholeness. Symmetry is the key player in picture making. Symmetry, as it is meant here, involves motion. Let us first acquaint ourselves with a mathematical example of what we mean by symmetry as motion; then, after we have grasped this perspective, we will apply what we have learned to art.

The following thought experiment demonstrates that an object, or a geometric figure in a plane, can be moved so as to reveal its symmetrical properties. We take an equilateral triangle with the points labeled as A, B, and C to illustrate this. (A is at the top of the triangle; B and C are at its
bottom left and right sides, respectively.) Imagine such an object lying on the table in front of you. Now pick it up. Having done so, replace the triangle just as it was. It looks the same. This act reveals that objects possess at least one symmetry-restoring the object to its original position after having moved it. Now imagine picking up this same object and rotating it clockwise so that point $A$ is now where $C$ was, $C$ is where $B$ was, and $B$ is where $A$ was. Having moved the triangle, we observe that the triangular shape in its new position is indistinguishable from that in its original position. We repeat this clockwise motion two more times, which returns the points A, B, and C to their original positions. Our experiment has established a 3-fold rotational symmetry for an equilateral triangle. What has this experiment to do with art? This notion of portraying the same object in a variety of positions in space, so as to reveal the object's properties under changed conditions, is fundamental to the artistic method. It is the foundation of what in art is called "theme and variations."

The mathematical method of illustrating symmetry operations by moving an object differs from the methods of the artist in picture making. In art it is this: the artist renders a shape, let's say an equilateral triangle. To represent rotation (without actually moving anything), he or she must construct a series of at least three equilateral triangles. The first triangle's angles are shaded white, gray, and black, corresponding to points $\mathrm{A}, \mathrm{B}$, and C as in the above mathematical experiment. The shadings are then shifted in the next triangle in the series so that white is where black was, black is where gray was, and gray is where white was; and so on. This arrangement suggests clockwise motion, and it illustrates the rotational symmetry of the triangular shapes. The top row in Figure 1 shows a series of three equilateral triangles that mimic this rotation, using white, gray, and black colors for the corners.


Figure 1. The triangles in each row mimic rotation
The bottom row in Figure 1 gives a different artistic portrayal of rotation: the second triangle in the series is turned 90 degrees, and the third triangle is inverted (a rotation of 180 degrees), with this sequence suggesting counterclockwise rotation, and with a change in the appearances of the rotated shapes.

As we examine art's mysteries further, we learn of symmetry's deeper implications for art and for art's source. We now have two objectives: (1) to clarify the role of symmetry as a unifier in picture-making (how it makes the parts come together to form a whole); and (2) to show that these picture-making principles originate in the Mind’s Eye; that is, in nature.

When we refer to the way things are arranged, or repeated, in some order, we generally use the word pattern. Pattern making (grouping) is an expression of symmetry. Many people think that
symmetry pertains to just the bilateral symmetry of (e.g.) animals, plant leaves, and the forms of certain human-made objects; but symmetry has a broader scope. It is at the very heart of the structure of nature's objects (including both regular and irregular shapes), and of processes (including both living and nonliving functions, such as vision, digestion, learning, thinking, weather, lightning, and subatomic particle interactions). Any complex object-one that has constituent parts-was put together (patterned) in its own particular way at the time when it came into being, either by an action of nature or by human hands. Its coming into being involved a process in space and time. The history of how it came to be is its symmetry. Consider the following thought experiment: Imagine stepping outdoors and seeing a tree; think how it came to have the form it has. Now look back on the house you just left, and think how it came to have its particular form. The tree structure-the arrangement of its trunk and branches-and the house structure-the arrangement of its walls, floor, and roof-each reveal in their present form a history of how their structural parts came together in space and time. In building a structure bit by bit, the builder-nature, animal, or humans-follows a patterning procedure that involves one or more symmetry operations. Symmetry in this sense is a verb-an event in time. Consider the following activities: bees building their honeycomb; a writer composing a novel; a musician composing a melody; a mason erecting a brick wall; a carpenter building a house; a bird building a nest; waves forming on the surface of the sea; clouds forming in the sky; ice crystals forming in the clouds; an artist painting a picture. These step-by-step procedures, which bring into existence a particular form, involve one or more of three basic symmetry operations: rotation to form a ring-that is, a circular closed shape, such as a nest; translation to form a chain-that is, a linear open-ended shape, such as a simple decorative border pattern, or a melody; and reflection to form the bilaterally symmetric body of a butterfly. This third operation is more complex than a translation, since the reflected motif is a "repeat" which has been both shifted (translated) in space and, at the same time, flipped to face the opposite direction (mirror image). There are more elaborate symmetry operations based on various combinations of these three fundamental schemes. For example, the idea of balance, which stems from reflection symmetry, is not necessarily a mirror image. Balance is achieved on a teeter-totter by placing the smaller object farther away from the fulcrum than the larger object.

## Symmetry in Art

Having reached some understanding of how symmetry principles affect form-building in nature's objects and processes through grouping, we now ask: How do these three basic symmetriesrotations, translations, and reflections-apply to art? Our specific aim here is to observe the mechanisms (symmetries) that determine how the relationship of the parts come together to form an organized whole.


Figure 2. Enthroned Madonna and Child, showing reflection symmetry
The example shown in Figure 2, which displays a Byzantine painting entitled Enthroned Madonna and Child, exemplifies reflection symmetry when we look at the whole picture. However, closer examination shows that the details break up the effect of an exact mirror image. This type of alteration of strict symmetry is a common practice in art composition.

We turn now to translation symmetry as it is employed in picture making and in architecture. In architecture, translatory symmetry is used to give design and unity to a building. This is commonly expressed as a series of windows, arches, or sculptured figuration. As an example, Figure 3 portrays a series of arches in a library building of the High Renaissance in Venice. It was designed by Jacopo Sansovino in 1536.


Figure 3. Translatory symmetry in architecture

In picture making, translation symmetry is commonly used by artists to portray a pictorial sequence that gives the illusion of moving across space and time; it is better known as a perspective device. Figure 4 is an example of translatory symmetry in picture making. It shows a sequence of objects whose combination moves the viewer's eye along a line (path) that suggests translation. The path for the eye begins with the figure in the frontal plane and moves toward the farthermost plane in the horizon.


Figure 4. Translatory symmetry in picture making
Having considered reflection symmetry and translatory symmetry, we now turn to rotational symmetry. See Figure 5, which shows a chapel of the High Renaissance, The Tempietto, which was designed by Bramante in 1502, when centricity was a popular idea in architecture. There we see rotational symmetry in the arrangement of its pillars.


Figure 5. Rotational symmetry in The Tempietto, San Pietro in Montorio, Rome

Rotational symmetry in picture making serves the important function of closing the entire pictorial form and giving the picture completeness and wholeness. The use of unifying patterns is valuable in composition. So we want to know why and how artists unify the many and varied parts of the pictorial image through the use of rotational symmetry. To appreciate the importance of the formal work accomplished by the rotatory pattern, let us refer to the example shown in Figure 6. In this example, the photographer has arranged six bicycles in a circle, and then photographed them so that the center of this circular arrangement and the center of the photograph correspond. Our attention is drawn to this vital center by the man's pointing finger; he seems to be insisting that we make a formal analysis of this picture's design. Let us do so, since its analysis reveals the hidden pictorial axes that comprise a 6-rayed pattern. Their exposure makes clear that it is the horizontal and diagonal axes in the pattern, like spokes in a "wheel" if you will, which establish the rotational symmetry that unifies the complex details in the picture.


Figure 6. The left picture (a) shows a circular arrangement of bicycles that represent rotational symmetry in picture making; the right diagram (b) shows axes that suggest circulation as a surface pattern

After studying Figure 6a, shown above, study Figure 6b and identify the horizontal axis in the 6rayed pattern. On the picture's left side (6b), the bicycle wheel's bottom rim (situated just over the man's right shoulder) lines up with the man's open mouth to suggest the beginnings of a virtual line; these lined-up elements connect to the terminal point of the man's pointing finger, and also to another eye-catching point on the picture's right side, where the bicycle frame (the cross bar between the bicycle's two wheels) intersects the bottom rim of the bicycle's front wheel. Our mind connects these four points, and we obtain a horizontal axis that divides the picture into upper and lower halves. A diagonal axis begins in the lower left corner of the picture and moves upward toward the prominent angular shape in the lower edge of the man's white jacket; it touches the edge of the dark shape of the movie camera near the picture's center, and then continues upward toward the rear of the bicycle seat situated in the upper right corner.

The complementary diagonal starts in the lower right corner of the picture and moves upward through the oval shadow cast by the bicycle wheel sprocket; it touches the edge of the dark camera shape, and continues upward toward the rear rack of the bicycle in the picture's upper left corner. The horizontal and diagonal axes that are arranged around a common point, when combined with a "felt" dotted vertical (gravity) axis, act in fact like spokes in a wheel pattern. Having recognized this virtual wheel, we can now "rotate" this pattern into a new position where each spoke "moves" into a position that was previously occupied by its neighboring spoke. The rotated pattern of spokes looks the same as it did before. This completed operation fulfills the requirements for the mathematical concept of rotational symmetry. It is similar to the mental mathematical experiment we carried out earlier (Figure 1) using an equilateral triangle with points A, B, and C. The 8-spoke wheel pattern in Figure 6b includes the "felt" vertical axis.

What propels the wheel? The man's extended arm carries our eye upward to the bicycle that occupies the highest position in the picture-its handlebar touches the frame's top edge. The man, in relation to the arrangement we have just described, occupies the lowest position in the picture, with his foot almost touching the bottom frame. This low placement of the man creates a drop on the picture's left-hand side in relation to the high placement of the bicycle on the righthand side, and our eye is led counterclockwise. The upturned brim on the right side of the man's hat and the direction of his right foot assist in this counterclockwise motion. Imagine the brim being down (horizontal) and the right foot turned so that it parallels either the side frame (vertical) or bottom frame (horizontal), and you will sense the difference. This photograph, which was contrived to sell tickets for a Brainwash Movies Festival (1997), is poking fun at the traditional principles of pictorial art. It is intended to be funny to professional photographers, who in some cases take these compositional rules too seriously.

Dynamical pictorial design involves competing centers-the picture's "center of interest" competes with the true center of the page (or canvas). Let us return to the bicycle photograph and verify the importance of this concept for pictorial art. The center of interest in this composition is the man's grimacing face; it pulls us into the picture frame. Our eyes move from his face to his pointing finger. Finding nothing there, our eyes return to his face. He wants to tell us something. He wants us to make a circular journey around the picture by following the bicycle arrangement so that we will get a feeling for the picture's formal (compositional) center, which in this case cleverly matches the true center of the rectangular frame. So there is this tension (dynamical play) between two distinct centers - the picture's center of interest (the man's face) and the true center of the rectangular frame (which in the present instance corresponds with the compositional center).

The picture's design in Figure 6 (bicycles), with its circular plan and its competing centers, is a clear example that it makes no difference what kind of "building blocks" the artist uses in creating his or her composition. Jackson Pollock (~1950) used blobs of paint, brush strokes, nails, buttons, cigarette butts, etc.

What matters in artistic composition (as in nature's systems) is that the artist has put the basic elements together so as to form a dynamic whole through the use of symmetry principles. Are these junk assemblages art? Yes, but not all artworks are of equal quality. This becomes evident when we remind ourselves that the meaning associated with a composition can range from trivial to profound. Compositional richness depends on how masterfully (subtly) the basic symmetries are represented. In view of these requisites for art, it becomes evident that the simple lattice plan (wallpaper symmetry) in picture making, as in Andy Warhol's famous 100 Campbell Soup Cans (1962), ${ }^{2}$ a stacked array of soup cans, carries less symmetry (is organizationally less rich) than is Marc Chagall's Birthday (1915). ${ }^{3}$ (Both of these works can be viewed by searching the website "wikiart.org" for the titles.) Figure 7 is the author’s "birthday cartoon," showing Chagall’s lovers floating in a richly developed interior. Warhol's wallpaper symmetry (a grid) involves just translations in two directions, and is useful in crafting objects-weaving fabrics or rugs, decoration, etc. (Wallpaper symmetry characterizes the lattice arrangement of atoms in crystals.) Chagall's work includes three basic symmetries: the male figure initiates a counterclockwise rotation in the picture (note how the bouquet pulls the viewer's eye downward and the feet draw the eye upward); perspective lines depict translatory pathways; reflection is represented as balance. Also, there are two competing centers: the center of interest and the center of the canvas. Warhol's Campbell Soup is sufficiently clever to invite momentary interest, while Chagall's joyful Birthday message invites staying with the picture for a more leisurely perusal.


Figure 7. The author's cartoon of Marc Chagall's Birthday displays complex order

## Leonardo's Mona Lisa



Figure 8. Leonardo da Vinci, Mona Lisa, High Renaissance (1503-1505)
We now consider the use of symmetry by a great painter-Leonardo da Vinci, as exemplified in his world famous painting Mona Lisa. One of the seminal paintings of all time, Mona Lisa is displayed here in Figure 8. It is a highly complex work. Its ordered composition portrays the physical characteristics of the human world by representing the properties of space realistically, and representing the property of time with a compositional device that moves the viewer's eye around the picture. At the same time, it subtly expresses human psychological characteristics through the artist's sensitive interpretation of his or her sitter's intellectual and emotional faculties. How does he accomplish this?

A product of Leonardo's mature years, the Mona Lisa is a 16th-century High Renaissance painting. It is more complex than his Last Supper, which is closer to the efforts of the Early Renaissance painters of the 15th century. For comparisons between these two pictures, we display Leonardo’s Last Supper in Figure 9.


Figure 9. Leonardo da Vinci, Last Supper, Early Renaissance (1495-1498)

The important concept of centricity, which is embodied in the one-point perspective scheme of the Last Supper, is also the basic organizing principle in the Mona Lisa. However, Leonardo’s use of one-point perspective is less obvious in Lisa's portrait, because the pictorial space (depth) in the Mona Lisa is not shaped by "hard" rectangular walls as it is in the Last Supper. Faced with the compositional problem of how to construct empty pictorial space (empty volume) and at the same time render movement, Leonardo solved this problem by inventing a scheme based on curved lines. His new scheme involved the use of a sphere instead of a cube (box) to structurally define the empty space. The Mona Lisa plan called for arranging rocks, trees, bodies, or body parts in such a way that, taken together, these objects form a virtual ring around an imaginary hub (Lisa's body) that is situated in an illusory 3-dimensional pictorial space. This circular arrangement of objects represents a depth plan, and it also serves as a surface pattern. Because our eye follows the circular pathway, this circulation also gives the picture its motion plan. In creating this new geometric order, Leonardo successfully combined two concepts: (1) he constructed a one-point perspective depth scheme through the use of virtual perspective lines, and (2), within this perspective framework he positioned a dynamical virtual wheel composed of a ring of objects. This approach to picture making, which combines order and movement, both in depth and on the surface, is very different from the Last Supper's crisply drawn stage with its obvious walls and ceiling. Before taking a closer look at the Mona Lisa and examining Leonardo's subtle new strategy in more detail, let us first consider some basic rules and language relevant to composition.

Every blank (untouched) rectangular canvas (drawing paper, wood panel, wood block, etc.) has a felt vertical axis - a line of symmetry - that divides the plane (surface) of the canvas into two equal parts, and is perpendicular to its bottom edge. This vertical symmetry line demands a balance of weight on the left and right sides of the picture even before the artist begins his or her work. The artist also takes notice of the implied horizontal line between the top and bottom halves of the canvas. This division of the canvas into halves produces a horizontal axis that intersects the felt vertical axis midway to form a cross, as indicated in Figure 10a.


Figure 10a, the cross of balance; Figure 10b, the 6-rayed pattern.
The cross resulting from this combination is implicit in the blank canvas, and it defines a balance pattern that interacts with the picture design placed upon its surface. Henceforth we denote this balance pattern as the cross-of-balance. In addition to these two axes (vertical and horizontal), there are diagonal axes that move from the two lower corners of the canvas to the opposite upper corners. When we combine these two diagonal axes with the canvas' horizontal axis, we obtain a 6-rayed pattern that is uniquely related to the shape of the rectangular canvas. (See Figure 10b, which shows the 6-rayed pattern inside of two different rectangles.) Both examples also include the felt vertical axis of symmetry (dotted line). The vertical axis of symmetry plays a vital role in
the balance we attribute to a picture, since it corresponds to our experience of gravity in the real world.

Leonardo realized that the felt vertical, horizontal, and diagonal axes are vital surface patterns in picture making. Like the two-by-fours that are used to build the shell of a house, the pictorial axes are the fundamental elements in the building of pictorial form. The cross of balance and the 6-rayed pattern establish formal unity and stability in the composition. When these "felt" patterns (axes) are referenced in the composition, they "bind" the pictorial image to the rectangular canvas and form a whole, as we now observe in Leonardo's Mona Lisa.


Figure 11. The cross of balance pattern and the 6-rayed pattern in the Mona Lisa
The lines drawn upon the surface of the Mona Lisa in Figure 11 represent the cross of balance and the 6-rayed pattern. Let us identify the cross of balance. Observe that the vertical axis of symmetry passes through two important points of interest: Lisa’s left eye and the fingers of her right hand. (This is what we mean when we say the artist references the felt patterns in his or her composition.) Because our eye "reads" these two lined-up points, we feel verticality, even though we do not see an actual vertical line. The horizontal axis, which divides the picture into equal top and bottom parts, touches (references) the neckline of Lisa’s dress. Its presence is strengthened by the strategic placement of the lower end points (terminal points) of the various light-colored, sinuously shaped rivers and hills in the landscape that appear on the left- and right-hand sides of Lisa. The vertical and horizontal axes combine together to form an organizing surface patternthe cross-of-balance.

Now let us identify in detail the 6-rayed pattern in the Mona Lisa. A diagonal axis begins in the lower left corner of the picture, and is picked up by the edge of the sleeve at Lisa's right wrist; it moves to the opposite corner through a "prominent shape" on the horizon. A complementary diagonal originates in the lower right corner, and is aided in its path by the crook in Lisa's left arm. As it moves to the opposite upper corner, it passes through the point where the contours of her garment's neckline and shoulder-drapery intersect, and then through an eye-catching wiggle in the horizon. (It is useful to know that, in painting, a mere blip in the contour of a regular shape
is an eye catcher when it occurs in a simple surround, and it is sufficient for establishing virtual lines as patterns.) The horizontal axis (described above) combines with the two diagonal axes to make the 6 -rayed organizing pattern. Because this important pattern belongs to both the image and the surface of the canvas, it binds the image to the rectangular shape of the canvas, while at the same time unifying and stabilizing the image itself. The pictorial result is wholeness.

There is yet another important surface pattern, which we now describe. It involves the horizontal line that corresponds to the artist's eye level. In real life, when our eyes focus on a scene, the gravity line (which we sense) is joined to the distant horizon line (which we see), and this combination forms a felt cross. Henceforth we denote this felt pattern as the cross-ofexperience. ${ }^{4}$ The cross-of-experience is more than just a surface pattern; it is as crucial for the viewer's appreciation of pictorial space (depth) as it is in his or her realization of space in everyday vision. For example, when the picture represents an everyday scene, the painter's eye level determines the furthermost plane, just as in real life. The juncture where the horizon line (eye level) and gravity line intersect is the observer's point of focus (the vanishing point in onepoint perspective). The painter's point of focus, and hence the cross-of-experience related to it, can be projected onto any part of the canvas. In this way, the cross-of-experience plays a dynamical role in picture making, both on the surface and in depth. It is important that we recognize the different roles of the two organizing patterns-the cross-of-experience and the cross-of-balance, for the reasons that are now explained.

In creating a dynamical image, the artist uses the cross-of-balance in two significant ways: (1) he or she works with the balance pattern in order to stabilize and unify the pictorial image, and to integrate the image with the rectangular canvas; (2) he or she works against the balance pattern in order to obtain a dynamical design. In fact, the pictorial process involves just this manipulation of the design so as to create a pictorial form that contrasts with, and at the same time subtly alludes to, the stable structure that is inherent in the untouched canvas. This dynamical method was not employed in the Last Supper (Figure 9), where Leonardo's one-point perspective scheme pulls our eye into the picture's "interior," pinpointing the face of Christ, which he placed precisely at the juncture of the cross-of-balance. The cross-of-experience and cross-of-balance coincide! The coincidence of these two crosses in the Last Supper makes the position of Christ's face doubly compelling. The picture's design has effectively frozen a crucial moment in the story of Christ's life. Leonardo's bold plan is both dramatic and economical. It unites the geometric perspective order associated with human sight (depth) with the geometric order that is inherent in the surface flatness of the rectangular wall on which the picture is painted. Leonardo's Supper design is aesthetically effective because other surface patterns (the competition of circle and square) supply the needed contrast.

The Mona Lisa's composition displays a more subtle depth than does the Last Supper. Let us first describe the "hidden" one-point perspective pattern in Lisa’s portrait, and then the innovative device that gives this portrait its dynamical (motion) properties. The following formal analysis shows that the Mona Lisa's composition is an advance over that of the Last Supper.

Although not visibly drawn for us to see (as they are in the Last Supper), the converging perspective lines in the Mona Lisa are subtly felt in the orientation and receding size of the various winding objects (rivers, streams, eroded hills) behind Lisa. (Consult Lisa's portrait in

Figure 8 as an aid in finding these felt perspective lines.) The objects in this landscape are shaped and located so as to draw our eyes to the vanishing point on the picture's horizon, which is located just behind Lisa's head. Because Lisa's head overlays the vanishing point on the horizon, we focus instead on her left eye. The diagram in Figure 12 shows that her left eye is located precisely at the juncture in the cross-of-experience where the horizon line (the eye level of Leonardo) and the gravity line cross. The location of the vanishing point on the horizon, behind Lisa, represents the furthermost plane (depth) in the pictorial space; her hands are in the foremost plane; and the wall behind her is in the middle plane. Consult Lisa's portrait to confirm what Figure 12 illustrates.


Figure 12. The vanishing point that lies in Lisa's left eye
Having described the organizing surface and depth patterns in Leonardo's portrait, let us now discuss his innovative motion plan. This plan provides a circular pattern along which our eye moves, both on the picture's surface and in depth. Figure 13 shows that the Mona Lisa's circulation plan features three wheels, A, B, and C, all of which share a common center with that of the cross-of-balance. Only Wheel A lies in the plane of the picture's surface.


Figure 13. Lisa's motion plan, showing three wheels

Lisa's left eye is located on the rim of Wheel A. This point of interest in the picture diametrically opposes another significant point of interest-the place on the wheel's rim where Lisa's hand touches the vertical axis of symmetry. These two points of interest constitute the end points of a line that forms the diameter of Wheel A. Other lesser points of interest in the foreground and background combine with these two end points to form a ring that defines Wheel A's shape. Because Wheel A's circular movement parallels the surface of the painting, it organizes the image and relates it to the shape of the canvas.

The upper rim of a second wheel, Wheel B, touches the horizon at the point directly behind Lisa's left eye; its lower rim touches the picture's bottom edge (the picture's foremost plane). This second wheel is not parallel with the surface of the canvas. Wheel B is oblique to the plane of our face when we observe the picture. As its rim approaches the top of the picture, Wheel B "recedes" into the distant landscape. We can identify the planes through which this depth pattern (oblique wheel) moves by consulting the barely visible details of Lisa's portrait in Figure 8 and also the diagrams in Figures 12 and 13. Beginning at the bottom of the picture, we read Wheel B's component parts clockwise: the chair arm in the foremost plane on which Lisa's hands rest; the elbow of her right arm; the barely visible balustrade (wall) behind her upper right arm; the various winding objects in the landscape on the picture's left side that recede toward the horizon behind Lisa's head; and finally, the landscape details on the picture's right side that return us to Lisa’s left shoulder and her left elbow. Wheel B concludes its circular movement in Lisa's left hand, which is resting on the chair arm in the foremost plane. These various objects situated in the pictorial depth can be interpreted as orbiting Lisa's body like a merry-go-round. In our imagination, this circular arrangement of objects gives shape to an imagined disc-a "firm" ground plane-with Lisa in the foreground, and with rivers, rocks, and trees in the distance.

Wheel C has a larger sweep in depth than does Wheel B, as shown in Figure 13. Its upper rim touches the horizon, and its lower rim extends beyond the limits of the picture frame and includes ourselves. Our position as viewer is indicated in the diagram as "X." The landscape objects on the left and right sides of the picture imply a much larger space than just what we see in the picture. Lisa herself is the hub of this third wheel pattern. Taken together, wheels A, B, and C, with their common center, unify the composition of the Mona Lisa both in depth and on the surface. Because their rims all reference the horizon, they strengthen the dynamic interplay between the juncture of the cross-of-experience (the horizon line plus the gravity line) and the juncture of the cross-of-balance (the felt center of the canvas).

The role of circulation in Mona Lisa is important, because this movement is the reason that we, as observers, stay with the image to discover the picture's finer details. Our eye is literally guided around the picture again and again as we follow its designated pathways. Having identified the wheel patterns' pathways, we now examine the specific visual device that, by its effect on our muscle sense, propels (rotates) wheels A, B, and C, both on the surface and in depth. This device has application to pictorial art generally.

Refer to Lisa's portrait and note that the "distance planes" situated at the horizon on either side of Mona Lisa do not quite match. The horizon on the right-hand side of the picture is higher up than on the left-hand side. Other features in the landscape enhance this mismatch (shift) in the horizon. The "shift device" gives the effect of a rising movement on the picture's right-hand side
and a falling movement on the left. This difference in the horizon propels wheels $\mathrm{A}, \mathrm{B}$, and C in a counterclockwise direction. The many circular fragments that are placed throughout the Mona Lisa assist in the turning of these three wheels. In some cases, the curved fragments are obvious drawn lines-as, for example, the rounded neckline, the veil's curved edge on Lisa's forehead, the shawl's curved contour on Lisa's shoulder, the rounded shape of her head, and the curved attitude in the posture of Lisa's arms. In other instances, several geometrical elements (fragmentary lines and eye-catching points) are grouped together in such a way as to suggest an extended curved line, which our eyes follow. This type of virtual curve forms the rims of Wheels A, B, and C. Wheel C is the most subtle and mysterious of the three. Its illusion of depth derives from three related collinear points: the vanishing point on the distant horizon, Lisa's eye, and our eye. (Our eye now replaces Leonardo's eye.) We identify with Leonardo’s experience, and we join him in the meditation of a mystery as we are caught up in the turning of the "wheel of life." The dynamical properties of the Mona Lisa constitute an important advance over Leonardo's earlier painting of the Last Supper.

Lisa seems to be sitting behind the picture plane, behind its surface, in an idealized realm we cannot enter—and yet she interacts with us! This compositional complexity, which establishes depth and at the same time confirms the flatness of the picture plane, is a carefully thought out plan with a purpose. It effectively supports the psychological dilemma that Leonardo had in mind to convey: humans exist as a solid object in the outer objective world and yet experience themselves as an abstract idea in their inner worlds. There is a contradiction in these two realities. We sense this contradiction in Lisa's enigmatic facial expression, which is both intimate and unfathomable. We are puzzled. We want to get at the mystery of the woman's soul: What is she thinking? It has been suggested, and a reliable argument has been put forth, that this is a portrait of Leonardo himself. It is a well-known fact that painters often portray themselves in their work. If so, then what Lisa (Leonardo) is thinking is that she is the center of the universe. All streams of information collect in her Eye. She possesses the power to solve the mystery of the universe-its order and movement. She mirrors how humanity viewed itself in Leonardo's time. Her eye and Leonardo's are one and the same. On this note we conclude our analysis of the Mona Lisa portrait, which symbolizes humanity's discovery of its individuality-its potential to discover truth for itself through Reason.

## Science (Nature)

According to Joseph Campbell, reason means finding the ground of being and the fundamental structuring of order of the universe. ${ }^{5}$ When we ponder being, and when we examine nature, we are discovering Reason. We are discovering the laws of symmetry. This is also self-discovery. Know thyself. Leonardo's art and his science productions reveal that he used not only his imagination, but also more importantly, his intuition. His intuition reached into the physical aspect of nature in its parts and into the mystical (mystery) aspect of soul, the Cosmic whole, the "I am." His approach to life, which combined the physical aspect of the intellect with the feeling aspect of soul, resulted in his expanded human consciousness. The coming together of intellect and feeling produced a higher third element. This is the principle of emergence, an important mechanism in creativity.

We have established in our minds the organizing function of the symmetry pattern belonging to sight, which we called the cross of experience - the combination of the horizon line and the vertical line of gravity. Two unlike things-verticality and horizontality—are brought together to produce a higher-level concept: emergence. This higher-level concept attests to humanity's higher level of consciousness over animal consciousness. Related to the idea of emergence is the principle of wholeness-Gestalten, which applies to nature and to art; it's an organizational concept that needs explaining.

Gestalt scientific theory, which started in Germany early in the 20th century, concerns human perception. After the rise of Nazism, and before the beginning of WW II, the main proponents of this new theory brought their ideas with them when they came to America. These scientists maintained that the parts of a square-the four points (or the four sides)-interact with one another so as to produce a perceived whole which is distinct from the sum of its parts. ${ }^{6}$ Their lesson was that squareness is an "emergent property" whose qualities are not inherent in the separate parts (the four points or four sides) that make up a square shape. The crucial factor in the occurrence of emergent properties is the organization or relationship of the parts. When four points are arranged equidistantly around a common center, the resulting four corners combine together to form a figure whose squareness yields a fourfold rotational symmetry.

Because emergence is an important dynamic in nature, we need to discuss it in greater detail. Consider nature's example of emergent properties in liquid water ( $\mathrm{H}_{2} \mathrm{O}$ ). Because its constituent parts ( H and O ) fuse together, we require scientific analysis to confirm that the composition of liquid water is in fact a combination of hydrogen and oxygen gases, which in themselves exhibit very different physical properties. The water molecule is an organized system of hydrogen and oxygen atoms that dynamically share their electrons.

But not all organized-systems have parts that fuse to form a new whole. For example, in human affairs, when five women join together to make a basketball team, we see five separate individuals. Because they do not fuse together, we cannot point to the team as a single tangible entity. If you doubt this, consider the following: when these members are living out their everyday lives, are they a team? Or are they a team only when their organized interaction (activity) brings about a virtual entity that in its function is greater than the sum of its functioning parts? What is it in the organization of the parts that brings them together so as to create a whole with new functional properties?

In nature, complex systems that function as a single entity are characterized by the presence of either (or both) of the following: hierarchical order, which in its composite structure of nested levels is arranged vertically; and (or) heterarchical order, which in its composite structure is arranged in a single level horizontally. These two orders establish all of the known complex, open and closed, formal systems in the familiar world. Let us elaborate on these two kinds of arrangement that pertain to composite forms.

Hierarchical order is exemplified in the structure of a living tree (an open form), whose anatomy is represented as a trunk with large branches that support smaller branches, which in turn support even smaller branches, as displayed in Figure 14.


Figure 14. A hierarchical pattern of tree branches


Figure 15. A hierarchical pattern in the flower Queen Anne's Lace
Another example of hierarchical order is demonstrated in plants by the organization of the florets in the flower Queen Anne’s Lace, as displayed in Figure 15. The photograph shows the rounded mound of the whole flower, which consists of smaller mounds, which in turn consist of yet smaller mounds (florets).


Figure 16. A Star of Stars of Stars hierarchical pattern
In Figure 16, we substitute stars for mounds and florets, and show the same hierarchical order as in Queen Anne's Lace. The graduated size of the constituent stars in this Star diagram demonstrates the concept of a group of groups of groups-ranked order. Now we ask the reader to carry out the following experiment: Think only of the essential ordering principle in the tree
structure, then do the same with Queen Anne's Lace. Having done this, hold these two concepts in your mind, and, while you are doing so, establish in your mind the concept of their equivalence. Now return to the Star diagram in Figure 16, and you will see that it represents in an abstract way the ordered nesting principle that applies to both the tree and Queen Anne's Lace. This type of nested (ranked) organization serves the painter, the writer, the dramatist, the choreographer, and the cabinetmaker. It is a well-recognized fact by experts in the various artistic disciplines that the overall nested organization of a great piece of art, whether in painting, music, ${ }^{7}$ dance, novel, or drama, is hierarchical. (Think how coded writing involves words, phrases, and sentences.) Hierarchical form represents oneness and completeness. However, in the arts the dynamical components of a formal system manifest more freedom than we have just outlined. We need more information on how dynamical hierarchical systems function.

A simple hierarchical organization in the workplace is symbolized by the shape of a pyramid. Authority is at the top. The top administrative body dictates to lower level members, and so on down the pyramid. ${ }^{8}$ Although many human organizations function hierarchically, their operations on deeper levels are more complex and more flexible than simple pyramidal order. For example, a tangled hierarchy is one in which members within a given level consult with one another without having to consult the top authority; a more complex tangled hierarchical system consists of simple pyramidal systems that are themselves grouped together to work interactively for a common purpose. Contact between such tangled systems, where rank is disregarded, is heterarchical-the communication flows "horizontally," and not just vertically (from the top). The result is a more creative and less deterministic organization than what exists in strict pyramidal order. ${ }^{9}$ Flexible hierarchical order is exemplified in the union of the American States: ${ }^{10}$ federal government overrides state government, which in turn overrides city government. This aspect of the system is hierarchical. But each of these constituent levels is made up of people (elected representatives) who consult with one another heterarchically. At the bottom of this ranked system is the body politic, which elects the officials in the upper ranks. It is reasonable to suppose that this type of tangled, nested order, with both hierarchical and heterarchical elements, characterizes the creative work in the Mind's Eye.

Having identified several organizing patterns, we now turn to the art of ornament, and we learn that the knowledge of organizing patterns is an ancient idea.

## Art of Ornament

The art of ornament is a body of knowledge that spells out the rules of patterning for all of the visual arts. We pointed out that this knowledge was not invented by any school of art; rather, it represents the fundamental laws that nature imposes on composite forms. According to Hermann Weyl, it contains "in implicit form the oldest piece of higher mathematics known to us, and holds the key to how things work in the world. ${ }^{11}$ Let us now look at Figure 17 and acquaint ourselves with the rules for the art of ornament.


Figure 17. Art of ornament patterning
We begin by consulting the art-of-ornament diagrams in Figure 17. Cell A features a diamond lattice. Cell B adds to the diamond lattice a rectangular grid. This grid's specific proportions yield rectangles that are similar to the rectangular cell they occupy (see the upper right hand corner, which shows broken lines); hence Cell B carries self-similar symmetry-the part resembles the whole. Cell C represents a comprehensive plan that features reflection, translation and rotation. That is, when the rectangular grid overlays the diamond lattice, as in Cell D , the combination generates two equilateral triangles-one points up and the other down-which share a common boundary (see broken lines); together the two triangles represent reflection symmetry. This arrangement of the combination of the lattice and the grid also generates a new geometric configuration: a hexagon, whose center is the center of Cell D . (It is also the center of the 6-rayed pattern.) The circle at the center of Cell D represents rotation (as do all the circles in Cell C, which are indicated inside the small-sized diamond shapes). Hence, Cell C sums up the symmetries of the circle, the balanced cross, and the six-rayed pattern that we identified in Leonardo's Mona Lisa.

The art of ornament rules derive from the visual system itself. When Cell C's six basic axes are represented in a visual work of art, the work calls forth all the muscles of the viewer's eye and leaves the viewer's eye in perfect equilibrium. Owen Jones, the author of "Grammar of Ornament," says, "True beauty results from the repose which the mind feels when the eye, the intellect, and the affections, are satisfied from the absence of want." ${ }^{12}$ Jones' claim is based on fact. The mind's repose is related to the physical structure of the human eyeball, which possesses six external ocular muscles that "rotate" the eye, as illustrated in Figure 18.


Figure 18. The six external ocular muscles
Let us now return to Cell D, where the combination of the diamond lattice and a rectangular grid (field) yields a hexagon. This field, which generates a hexagon, leads to the birth of the Star of

David pattern, as shown in Figure 19. Henceforth, we recognize Figure 19 as a comprehensive organizing pattern of vision. It includes the circle, cross, 6-rayed pattern, triangle, rectangle, and Star of David. It represents the focalizing function of eyesight; it symbolizes the visual system in its organizing (relational) structure; it is the supplier of the geometric figurations that comprise the language of vision; and it is the sum of all the possible integrative functions in the Mind's Eye. The Star of David in its lattice context is a visual metaphor for the brain's global work, the work that takes place in the Mind’s Eye, where images are created.


Figure 19. The comprehensive Star of David pattern embedded in a diamond-lattice and rectangular-grid field

Let us take a closer look at the comprehensive Star pattern in its lattice and grid context, and consider its interactive capacity. Note the Star's relationship to the field. Because the Star pattern is a closed form (built around a specific center), it, like a circle, can be isolated (taken out) from its context. As such, it represents an individual entity-whole and complete. Because the Star of David pattern owes its comprehensive properties to its field-to its diamond lattice and its rectangular grid-the field's properties inextricably connect this single Star to other potential Stars: Stars of the same rank (same size), and Stars of higher and lower rank. The relationship of the Stars to each other on a given level (same size) is heterarchical. The important flexibility in this hierarchical/heterarchical system comes from the tangled relationship of Stars across the levels: large Stars relate to smaller Stars and larger Stars. Note that the interior structure of any given Star includes at its core a hexagon, which has the potential to generate smaller (lesser rank) Stars; the hexagonal (diamond) lattice, with its generative powers, is contained within every sixpointed Star. This potential of the Star pattern to relate both to the Stars within its own interior and to those at its boundaries gives the Star pattern both individuality and universality. As a fractal figure, the Star of David pattern goes to infinity when it is carried forward in either direction-toward ever-larger stars or toward ever-smaller stars.

Great art is great because the art-of-ornament symmetry rules underlie their formal structure. In making the above claim for great paintings, we realize that in creative work, the Star of David pattern, like the other standard geometric patterns, is subjected to a treatment we may call "rubber-sheet geometry." We leave it to the reader’s imagination to picture what happens when you distort a standard geometric pattern by stretching it in its vertical, or its horizontal, or its oblique dimension.

We have examined the Star of David's individual and universal character. We have seen its interactive and integrative potential in a field of Stars. With respect to the principle of duality, the Star of David's two superposed equilateral triangles (one points up, the other down) symbolize the combination of opposites (as complementaries) that together form a single whole. In the region of their overlap, the two superposed triangles fuse, and they give birth to a new entity-a hexagon, with 6 -fold rotational symmetry. This new entity (hexagon) exhibits a new global property-a higher symmetry (emergent property) than the 3-fold rotational symmetry of each of the equilateral triangles that compose it. Although the Star of David does not have the full symmetry of the circle, its hexagonal symmetry enables it to generate diverse forms, which the circle cannot do. It is relevant here to point out that the circle in itself is a limited form. Visualize in your mind a system wherein the hexagons become circles, and inside these circles are circles of circles. It is difficult to establish distinction (locality) with just circular lines, since any single point on a circular line is the same as all the others. The circle is not sufficient by itself to represent the psyche, nor is the cross sufficient by itself. If we combine them into a mandala, the result is still not sufficiently diverse to represent the integrative work of the psyche.

May we now designate the comprehensive Star of David pattern as a master pattern to represent the psyche? Not yet. We have shown its adequacy from the standpoint of structure, but to qualify it as a master pattern we must identify its dynamical properties. Let us examine it to determine the requisites that are necessary for it to represent motion (process). This search carries the present inquiry into the domain of soul.

## Soul in Art (Psyche)

What do we mean when we speak about soul in art?
The dictionary defines soul as the animating principle in human beings: the moving spirit, fervor, the emotions; the total self. This definition suggests that there are two aspects to soul: (1) the total self implies the existence of a composite structure; and (2) spirit implies motion, which we associate with process. Since these two aspects also describe the human psyche, which the dictionary equates with soul, the two terms are used here interchangeably.

Our discussions assume that the psyche is a composite system (in the Jungian sense), which includes both the conscious mind (the self-aware ego part of the human psyche) and the unconscious mind (the part of the human psyche of which we are not aware, or incompletely aware). The ego (the thinking, feeling, perceiving, willing, memory-laden entity that serves the individual in everyday affairs) is only the outer expression of a complex multi-leveled psychic structure. The following discussions also assume, in addition to Carl Jung's theory of the "structure of the psyche," his theory of the personality-development process, which is based on that structure.

According to Jung, there exist in the psyche's unconscious (among other systems, such as the instincts) both the personal unconscious, where we store unwanted traumatic experiences that the ego is unwilling to accommodate; and the collective unconscious, the transpersonal part of humanity's nature (which has a status similar to that of instinct). ${ }^{13}$ Jung says that the collective unconscious is made up of motivational forces which are common to all people, and which he
calls archetypes. ${ }^{14}$ He believed that personality development is shaped by stages, and is influenced by the interplay between the conscious ego and the personal and collective unconscious. ${ }^{15}$ (This has an analogy to dynamical art composition, which calls for competing centers - the center of interest and the geometric center of the untouched canvas.) For Jungian followers, the collective unconscious represents the soul's true center. How does Jung's definition of the psyche's structure and function stand up to a description of the soul as given by a primitive who has had no contact with modern culture? The example of the Naskapi Indian is described in Jung’s book Man and His Symbols. ${ }^{16}$

The lone Naskapi Indian, ${ }^{17}$ a hunter, who lives in the forests of the Labrador Peninsula, relies on his own inner voices and unconscious revelations to guide his outer life. He has no religious teachers, no ritual, no festival or custom to help him along in facing life's vicissitudes. To him, the soul of humankind is simply his "inner companion," whom he refers to as "my friend" or Mista-peo, meaning "Great Man." The Naskapi Indian will tell you that Mista-peo dwells in the heart of humankind and is immortal. For this reason one pays close attention to his or her dreams, an attitude that the Great Man favors by sending better dreams. And here is the Naskapi's important testimony: he believes that he has a responsibility to give his dreams permanent form by translating the contents of the dream into art. This testimony of the Naskapi Indian, that he feels moved to do art by a psychic force, an intelligence, which he regards as "greater" than his conscious mind, confirms the relationship between the conscious self (ego) and the unconscious mind. It confirms Jung's theories of both the psyche's structure and the psyche's developmental process (the relationship of the ego to a higher unconscious "power"). It confirms that art originates in conceptual (imagined) images that surge forth from the psyche.

Some scientific thinkers who are outside of the Jungian perspective equate the soul with the Mind's Eye. The Mind's Eye is where thoughts and sensations converge to produce the organized images that we associate with meaningful experience. Its geometrizing means have been termed the language of vision. In children, the early appearance of the language of vision appears as scribbles. By age three, children produce the universal mandala pattern. ${ }^{18}$ Jung believed that a mandala drawn by an adult (or a child) represents the self (the soul).


Figure 20. A Child's Mandala
Jung claimed that he learned the meaning of the mandala from drawing his own mandala. ${ }^{19}$ His personal experience is that this monad represents the whole personality. He says the mandala is the center to which all paths lead that present themselves in the course of an individual's personal development. ${ }^{20}$

Picture making is allied to mandala making, as we have already observed; both endeavors are products of the visual process-hence of the Mind’s Eye. Both the mandala and picture making have behind them the same intention as the Naskapi Indian's art (he sought to make a permanent form of his dream contents by creating art).

Artistic imagery springs forth not from the conscious mind, but from the deeper unconscious realm. This author attests to the validity of this claim. She has herself recorded her artistic experience over a four-year period while sculpting a head of Ishi, the last wild American Indian. Her published journal, Face to Face With Ishi, ${ }^{21}$ reveals what happens in the mind and heart of the artist after receiving a compelling inspiration from the unconscious. Does art mirror its source? Can we infer the nature of art's source if we establish the nature of art? These questions are relevant to answering the question: what do we mean when we say art has soul?

We said that soul denotes motion. In this paper it is proposed that soul supplies the motive force that drives archetypal patterning into action, which results in its outer expression. The outward evidence of soul's work in the arts and in nature's forms is the presence of rhythm. Like the footprints we leave behind, soul leaves an imprint of its work. (For an example of rhythm in art, the reader is advised to visit the local library, or go online to wikiart.org and see Wassily Kandinsky's works during the years 1911-1913, ${ }^{22} 232425$ particularly his Improvisation.)


Figure 21. A cartoon showing figurations taken from several Kandinsky abstract paintings

This author's cartoon in Figure 21, based on several of Kandinsky's paintings during this period, alludes to the sort of figurations that Kandinsky rendered after his decision to paint abstract imagery. This intention to abstraction reflects his interest in Anthroposophy, a spiritual discipline familiar to this author. His renderings reflect nature's diverse forms rather than copied objects. By examining these renderings from the 1911-1913 period, we find the tangled rhythm that is the expression of soul. It is helpful to start this examination by identifying the rhythmic angular figurations that speak of a peaked mountain range. Look for the rhythmic curvilinear figurations that resemble a meandering river. Then look for rhythmic figurations that suggest wings, drumming, walking, kissing, falling, rising, pairing, blowing, breathing, spinning, vibrating, pumping, aspiring, thinking. Have these rhythmical expressions something to do with soul in art? In art, as in nature, rhythm is formed by repeating a motif, visibly or in sound. This is symmetry expressed as motion.

When we say that great art has soul, we tend to mean that soul (spirit) expresses the basic rhythmic symmetries that give life to "humankind and its world." Think of the beating heart, the breathing lungs, the sound of the river's flow, the rustle of leaves, birds' warbling, and the sound of walking. Now imagine yourself walking through the forest and hearing all of these many rhythms tangled together at the same time. Simple rhythms in combination yield more complex rhythms. Kandinsky’s abstract paintings demonstrate that great art involves the tangling of many, and varied, rhythms, as in music. This tangling has analogy to the constructive and destructive interference that occurs in electrical wave phenomena. The tangling of simple rhythms (figurations) produces "higher-level phrasing" in the language of vision. Be conscious of the way these tangled phrases combine together to form a single whole, as for example in your own body. You are now "reading" the language of vision: the diversity in unity and the unity in diversity!

## Rhythm as Number

Number is mysteriously connected to feeling (soul). Within the Arab culture that produced the 14th-century Alhambra, the artist, the mathematician, and architect were one and the same. Think of the quantitative properties of architecture, of a building's proportion and size. Think of the meaning of a single rose as opposed to a bouquet. Think of a couple sitting on a bench as opposed to a single person, a mob filling a plaza, a parade. When you think about a parade, think also of marching feet and drumming. This is number; it is rhythm. It is soul animating our receptors. Our feelings are moved (stirred) by a parade. In art, the rotational rhythms, reflexive rhythms, and translatory rhythms excite our senses just like the parade does. In learning to recognize symmetry in art, we open ourselves to the language of vision and its universal message-Reason.

Art's visual message about multiplicity in oneness is a more direct communication of the concept than can be explained with just the spoken or written word. Artistic imagery (mental imagery) is closer than are words to the natural impulses, or urges, that drive personal experience and connect us to other humans and to our world. Having lost our understanding of this fundamental visual vocabulary somewhere in our early childhood, we adults must be re-initiated into it. Appreciation for all of the visual arts-pottery, dance, photography, film, sculpture-is enhanced when we restore our familiarity with the language of vision, the language of the Mind’s Eye (soul).

The visual symbolic language that we read in artistic productions today evolved along with the biology of our bodies as archaic patterns. Jung says we can contact these primordial images by focusing on the meanings of the basic symbols that spring from the collective unconscious through dreams and during periods of relaxation. We need to re-learn what these archetypal symbols stand for; we need to ask how these symbols can help to better our lives today. Let us now turn to nature and look for the presence of primordial patterns in the nonliving matter that provides the substance of our own body's building blocks.

Jung says that, at the bottom, the collective unconscious is simply world; and this world in its materiality is just carbon-it is impersonal matter. ${ }^{26}$ Our eyes do not perceive the human body's many "description levels." We see only the top visible level, which consists of a variety of
grouped organs. At deeper levels, the organs are formed of grouped living cells (tissue); the cells consist of grouped molecules; and the molecules of grouped atoms. The top levels of the human physical form are dependent upon the lower-level forms, whose building blocks are nonliving matter. The psyche, according to Jung, having evolved along with the human body, "partakes" of the information contained in all of these levels, living and nonliving. To help create a mental picture of what the psyche's structure "looks like" at its fundamental level, we look at the rhythmic organization of atoms in carbon, as displayed in Figure 22A.


Figure 22A. Carbon backbone


Figure 22B. Buckyball

The carbon atom has a specific capacity to form interactive bonds with itself and with other elements. ${ }^{27}$ This patterning power gives the carbon atom its unique role in forming the carbon backbone that is the main support for the organic molecules which make up our flesh and bones. Of the 92 naturally occurring elements, carbon binds with five-hydrogen, nitrogen, oxygen, phosphorus and sulfur-to make up some 99 percent of all living matter. ${ }^{28}$ Figure 22A shows a ball and stick model of a carbon backbone (carbon bonded to carbon). The balls in this figure represent the carbon atoms, and the sticks represent the atom's potential to bond with another carbon atom, or with another element, hydrogen or oxygen, for example. Think of this bonding between atoms as an expression of rhythmic geometry, or rhythmic phrasing of the elements. To get a picture how atoms combine together to form complex patterns, study the diagram in Figure 22B which illustrates a faceted $\mathrm{C}^{60}$ sphere made up solely of carbon atoms. ${ }^{29}$ Concocted in the laboratory, $\mathrm{C}^{60}$ is nicknamed "buckyball" after the soccer ball (which it resembles) and the inventor of the geodesic dome, engineer R. Buckminster Fuller. The symmetries implicit in Fuller's dome and in the soccer ball are the same as in the buckyball. Having looked at buckyball, take a minute to reflect in your imagination on the notion that at the rock-bottominformation level (atomic level), our bodies can be represented as facet-like geometric structures. This faceted-object metaphor was intuited in African art. Yes, "God geometrizes."

Rhythm in art, expressed as a symmetry operation, gives movement to the geometric elements. Kandinsky visualized the play of elements in his art when he introduced the portrayal of attractive and repulsive forces. (See Figure 21.) His art pictures the "interactive play" of process itself. His approach opens our minds to how things happen, not only in subatomic worlds, but also in galactic worlds. As to the everyday world, picture your own inner body processes as tangled (interactive) configurations: digestion, metabolism, catabolism, circulatory respiration, chemical reactions, etc. Refer to Figure 23A and ponder the structural similarities between tangled relationships of forms in pictures (art) and tangled forms in your body at its deeper molecular level. Think of the relationships of the atoms at even deeper levels in the tangled


Figure 23A. Globular protein molecule


Figure 23B. Linear molecules (a), (b), (c), (d).
bonding structure of the globular protein that is shown in Figure 23A. Study part B in this same figure, and give some thought to what happens when the bonds that form a linear molecule (a) such as an amino acid sequence (a simple chain of atoms) interact spontaneously with each other to form a helix (b), a secondary structure. This helical shape, by folding in upon itself (c), brings about a new potential for bonding-the previously widely separated bonds have now become neighbors, and the resulting new relationships (new bonds) that arise between the new neighbors create a globular molecule (a tertiary structure). An even more complicated quaternary structure (d) results when there are interactions (bonding) among the chains and between two or more chains. ${ }^{30}$

The above example of globular protein demonstrates how higher forms in nature result from simpler forms through higher-level bonding that is due to the sharing principle. Connectivity, which is called "passage" in art, is a very important patterning rule in great painting. An important lesson to be gleaned from great artists is that the artistic motive (push), which originates in the unconscious mind, represents only the beginning of a great painting. Having received this inspiration, the artist's conscious mind picks up the idea and develops it by formalizing the idea and making it perceptible through geometric means. In this collaborative activity between the conscious and the unconscious, universal timeless information integrates with the particular everyday information. Think about this: the universal mind expresses its power of infinity by individualizing it!

Finally, we mention recent research that confirms the relevance of the Master Pattern. In the January 2016 issue of Scientific American, the article ${ }^{31}$ entitled "Where am I? Where am I going?" reports that the hexagonal firing of grid cells in the brain of a rat produces a hexagonal cognitive map, with a pattern that is based on a hexagonal grid. Also, in the July 2008 issue of Scientific American, an article ${ }^{32}$ entitled "The Self-Organizing Quantum Universe" shows a geometric model of microscopic building blocks interacting with one another in spacetime that resembles the spatial "cognitive map" described by the researchers in the above rat experiment. Both articles feature a picture of the Master Pattern.

## The Universal Mind

Today, certain quantum physicists are researching human consciousness; they hope to connect human consciousness to the universe. They envision one's mind and his or her "world" as a single global conscious system, a seamless whole. ${ }^{33}$ According to their view, the new physics can bring an understanding of global brain function, which will in turn lead to an understanding of human consciousness and the consciousness of the universe (Universal Mind).

The Master Pattern, as it is revealed in both art and science (nature), gives a glimpse into the character of the Universal Mind as having both structure and process. This enables us to realize the manner in which one's Mind's Eye is made in his or her Creator's image. It is in this fundamental sense that the whole (Creator or God) is reflected in humankind as "soul."

The expanded human consciousness that comes from an understanding of the relationship of art, science, and human spirituality increases humankind's awareness of how things are connected to each other and to the whole. This higher potential enables one to commune as an individual with the Universal Mind (God). Christian mystics in their communion with God over the centuries tell us that the kingdom of heaven is within. What do they mean? What is that kingdom? The Master Pattern helps us to visualize such a world. It can be considered as a matrix for how things work in the world as a Whole.

## Summary

Let us recapitulate what we have learned about the "pattern that connects." These pages have shown that the Master Pattern represents the whole that exists in the parts, not as a thing or place, but as an organizational principle that, through symmetry laws, governs the many diverse forms of being. Form building (patterning) in nonliving systems (carbon backbone) is the same as form building in living systems (in art and in human sight). As a lattice, the Master Pattern satisfies the Cosmic idea of allness; that is, as a hierarchical/heterarchical seamless whole. It also satisfies in its parts the Cosmic idea of a dynamical self-similar system of interacting stars of stars. Each star carries within itself its own structure and process, which mirrors that of the whole. The star is the particularity (individuality) within the universality of the lattice. Thus we can visualize the Master Pattern in action as the Universal Mind expressing its power of infinity by individualizing it in the part (man or woman). The whole and its parts, manifesting within symmetry laws, form one complete unified system, or existence itself. This completeness, which is spiritual existence, is inclusive and impartial. We must, as individuals, acknowledge its archetypal presence in the human psyche as a motivational force, and we consent to expressing it outwardly by our seeking to become whole as we grow upward toward the higher consciousness that is necessary for humankind's physical survival. In our everyday practice of symmetry laws, it means: Love God, and love one another.

That which destroys humankind's progress upward is against its development. That which diminishes individuality diminishes humankind. The lessons given by the great avatars teach that symmetry laws apply to humankind's everyday moral behavior. Both Buddha and Christ recognized that the most fundamental symmetry law in human relations is this: to treat others as you wish to be treated. This golden rule of reciprocity arises out of the concept of balance-out of the law of reflection symmetry; it is an expression of Reason in human activity. Reciprocity assures equilibrium in human affairs; it is intellect wedded to emotions.

The close bond between an artist, his or her unconscious mind, and its realization in his or her art, is illustrated by the fact that Leonardo da Vinci never parted from the Mona Lisa, his masterpiece. He carried it with him wherever he went, and kept working on it until the end of his life. The painting reached its final form only when the "Great Master" took away his brushes.
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${ }^{6}$ Irvin Rock and Stephen Palmer, "The Legacy of Gestalt Psychology," Scientific American 263 (December 1990): 84.
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${ }^{8}$ Margaret Boden, Artificial Intelligence and Natural Man (New York: Basic Books, 1987), 126.
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${ }^{16}$ Marie-Louise von Franz, Part 3, in Man and His Symbols, ed. Carl Jung (New York: Dell Publishing Co., 1964), 162-163.
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${ }^{20}$ Ibid, 196.
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${ }^{22}$ Wassily Kandinsky, Composition IV, 1911, oil on canvas, 62.8 in. $\times 98.6$ in., Kunstsammlung NordrheinWestfalen, Dusseldorf.
${ }^{23}$ Wassily Kandinsky Improvisation 26,1912, oil on canvas, 38.2 in. x 42.3 in., Lenbachhaus Gallery, Munich, Germany.
${ }^{24}$ Wassily Kandinsky Improvisation 28, 1912, oil on canvas, 43 7/8 in. x $637 / 8$ in., The Solomon R. Guggenheim Museum, New York.
${ }^{25}$ Wassily Kandinsky Improvisation 30, 1913, oil on canvas 43 11/16 x 43 13/16 in., Art Institute of Chicago, Chicago.
${ }^{26}$ Carl Jung (2), Man and His Symbols (New York: Dell Publishing Co., 1964), 310.
${ }^{27}$ Helena Curtis, Invitation to Biology (New York: Worth Publishers, Inc., 1983), 26.
${ }^{28}$ Ibid, 30.
${ }^{29}$ Robert Curl and Richard E. Smalley, "Fullerenes," Scientific American, 265 (October 1991) 56.
${ }^{30}$ Helena Curtis, Invitation to Biology (New York: Worth Publishers, Inc., 1983), 68.
${ }^{31}$ May-Britt Moser and Edvard I. Moses, "Where am I? Where am I going?" Scientific American 314 (January 2016), 28-33. They received the Nobel Prize in 2014 for the discovery of the brain’s positioning system.

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