THE EVOLUTION OF JUNG'S ARCHETYPAL REALITY:

PSYCHOLOGY & G. SPENCER-BROWN'S LAWS OF FORM

> The archetype itself is empty and purely formal, nothing but a *facultas praeformandi*, a possibility of representation which is given *a priori*. The representations themselves are not inherited, only the forms.
>
> - C. G. Jung.[1]

Jung's concept of the archetype evolved slowly over his lifetime, moving increasingly toward abstraction as he gradually stripped away the clothing the archetype wears when it emerges into consciousness. His initial recognition was of *primordial images* inhabiting our dreams and fantasies. Gradually he came to realize that the image was only a manifestation of an essentially content-free archetype. Then, with the understanding that image and behavior were two faces of the same coin, Jung developed the ideas of a *psychoid* reality which encompassed both matter and psyche. Finally, late in life, he speculated that perhaps when all personifications were removed from the archetype, we arrive at *number*, which "may well be the most primitive element of order in the human psyche . . . an *archetype of order* which has become conscious."[2]

Jungian psychology has amplified many facets of the archetype, but no one attempted to go deeper into the fundamental structure of archetypal reality itself. With one exception: the brilliant twentieth-century mathematician and logician, G. Spencer-Brown. Spencer-Brown developed a formal mathematical system to answer the most basic question about archetypal reality: how does something emerge from nothing? He showed how the mere act of making a distinction creates space, then developed two "laws" that emerge ineluctably from the creation of space. Further, by following the implications of his system to their logical conclusion Spencer-Brown demonstrated how not only space, but time also emerges out of the undifferentiated world that precedes distinctions. In this paper, I propose that Spencer-Brown's distinctions create the most elementary forms from which archetypes emerge. In this paper I will introduce his ideas in order to explore the archetypal foundations of consciousness. I'll gradually unfold his discoveries by first outlining some of the history of ideas that lie behind them.

Jung's Identity of Opposites & George Boole's Laws of Thought

> The place or the medium of realization is neither mind nor matter, but that intermediate realm of subtle reality which can be adequately expressed only by the symbol.
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> - C. G. Jung.[3]

In the 1950's Spencer-Brown left the safe confines of his duties as a mathematician and logician at Cambridge and Oxford to work for an engineering firm that specialized in electronic circuit networks, including those necessary to support the British railways system. Networks are composed of a series of branching possibilities: left or right, this way or that way. At each junction, a choice must be made between several possibilities. From a mathematical perspective, a choice between multiple branches can be reduced to a series of choices between only two possibilities. Thus network design involved virtually identical problems with logic, where one constructs complex combinations of propositions, each of which can be either true or false. Because of this, the firm hoped to find in Spencer-Brown a logician who could help them design better networks. Spencer-Brown in turn tried to apply a branch of mathematics known as Boolean algebra to their problem, initially to little avail, as we will see.

If we can translate from the world of mathematics and logic to the world of Jungian psychology, we might say that Spencer-Brown was presented with the "problem of opposites" which was Jung's central concern throughout his lifetime. Jung found that "identity of opposites is a characteristic feature of every psychic event in the unconscious state."[4] Yet "so long as consciousness refrains from acting, the opposites will remain dormant in the unconscious".[5] How can consciousness evolve out of the unconscious, undifferentiated state of the "identity of opposites"? Are there any rules that govern this emergent process? Before we can we present Spencer-Brown's ideas, we need to know a little about the first attempt by mathematics to deal with the problems of opposites in the mind: Boolean Algebra.

By the mid-19th century, mathematics was undergoing a sea-change. Where previously mathematics had been considered the "science of magnitude or number", mathematicians were coming to realize that their true domain was symbol manipulation, regardless of whether those symbols might represent numbers. In 1854, the English educator and mathematician George Boole [1815–1864] produced the first major formal system embodying this new view of mathematics, an astonishing work: *Laws of Thought*.[6] His ambitious purpose was no less than capturing the actual mechanics of the human mind. In Boole's words: "The design of the following treatise is to investigate the fundamental laws of those operations of the mind by which reasoning is performed; to give expression to them in the symbolical language of a Calculus, and upon this foundation to establish the science of Logic and construct its method."[7]

With some degree of hyperbole, philosopher and logician Bertrand Russell once said that "pure mathematics was discovered by Boole in a work which he called *The Laws of Thought*.[8] In contrast, Boole was not only ambitious, but realistic; even in the throes of his creation, he understood that there was more to mathematics than logic, and certainly more to the mind than logic. In a pamphlet Boole's wife wrote about her husband's method, she said that he told her that when he was 17, he had a flash of insight where he realized that we not only acquire knowledge from sensory observation but also from "the unconscious."[9] In this discrimination, Boole was amazingly modern, almost Jungian. He was intuiting a new approach to explore the fundamental nature of archetypal reality at its most basic level. G. Spencer-Brown was to bring that new approach to fruition.

Algebra vs. Arithmetic

> A recognizable aspect of the advancement of mathematics consists in the advancement of the consciousness of what we are doing, whereby the covert becomes overt.[10]

Spencer-Brown quickly discovered that the complexity of real world problems far exceeded those he had studied in an academic setting. He started out using traditional Boolean algebra, but found he needed tools not available in Boolean algebra. In essence he needed an arithmetic, which was a problem as Boolean algebra was commonly considered the only algebra that doesn't have an arithmetic. Now what is the difference between arithmetic and algebra? Put most simply, arithmetic deals with constants (the familiar numbers 1, 2, 3,…for the arithmetic we all grew up learning to use), while algebra deals with variables. Again, if you cast your mind back to the algebra you may have taken in junior high school, high school or college, variables are simply symbols which can stand for unknown constants. That is, an X or a Y or a Z might represent any number at all in an equation.

Boole had formed his logical algebra by close analogy to the normal algebra of numbers, using the normal symbols for addition, subtraction and multiplication, but giving them special meanings for logical relationships. In his "algebra", the equivalent of numbers were simply the two conditions: "true"and "false". Just as the solution to an equation in normal algebra is a number, the solution to an equation in Boolean algebra is either "true" or "false".

Boole’s concept of making his algebra almost exactly parallel to numerical algebra (in the symbolic form that it was normally presented), made it easier for later mathematicians to understand and accept (though, as is unfortunately all too usual, that had to await his death.) But the symbol system most usual for numeric algebra isn’t necessarily the best for logical algebra. In practice, complicated logical statements lead to complicated Boolean equations which are difficult to disentangle in order to determine whether or not they are true. And the absence of an arithmetic underlying the algebra meant that one could never drop down into arithmetic to solve a complex algebraic problem.

Since computers and other networks deal with just such binary situations—yes or no, left or right, up or down—it was natural to look to Boolean algebra for answers for network problems. But because Boolean algebra had developed without an underlying arithmetic, it was exceptionally difficult to find ways to deal with the problems.

Spencer-Brown was forced backwards into developing an arithmetic for Boolean algebra simply to have better tools with which to work. As with so many of the hardest problems encountered in mathematics, what he really needed was an easily manipulable symbol system for formulating problems. Mathematicians had grown so used to Boole’s system, which was developed as a variation on the normal algebra of numbers, that it never occurred to them than a more elegant symbolism might be possible. What Spencer-Brown finally developed, after much experimentation over time, is seemingly the most basic symbol system possible, involving only the void and a distinction in the void.

The Evolution of Archetypal Reality: The Emergence of Some-thing from No-thing

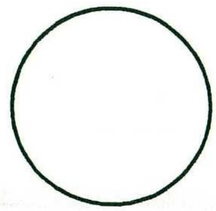
> Nothing is the same as fullness. In the endless state fullness is the same as emptiness. The Nothing is both empty and full. One may just as well state some other thing about the

> Nothing, namely that it is white or that it is black or that is exists or that it exists not. That which is endless and eternal has no qualities, because it has all qualities.
>
> C. G. Jung.[11]

Try to imagine nothingness. Perhaps you envision a great white expanse. But then you have to take away the quality of white. Or perhaps you think of the vacuum of space. But first you have to take away space itself. Whatever the void is, it has no definition, no differentiation, no distinction. When all is the same, when all is one, there is no-thing, nothing. Paradoxically, in Jung's words: "nothing is the same as fullness."

Now make a mark, a distinction, within this void. As soon as that happens, there is a polarity. Where before there was only a void, a no-thing, now there is the distinction (the mark) and that which is not the distinction. Now we can speak of "nothing" as some-thing, since it is defined by being other than the distinction. As Jung argues: "Conscious perception means discrimination. Thus, structures arising from the unconscious will be distinguished when they reach the threshold of perception; such structures then appear to be doubled, but are two completely identical entities—the one and the other—since it has not yet become clear which is the one and which is the other."[12]

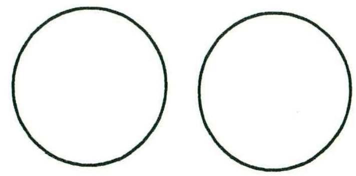
Don't throw up your hands in despair at trying to understand the abstract nature of all this. Let's bring it down to earth with an example. For our void, our nothingness, imagine a flat sheet of paper. Let's imagine that it has no edges, that it keeps extending forever. In mathematics this is called the plane. Of course, this infinitely extended piece of paper isn't really nothing, but it is undifferentiated—every part of it is the same as every other part. So it can at least be a representation of nothing. Now draw a circle in it, as below. You'll have to imagine also that this circle has no thickness at all. It simply separates two different states, which we would normally think of as "inside" and "outside." Following Spencer-Brown's terminology, we'll call this the "first distinction."



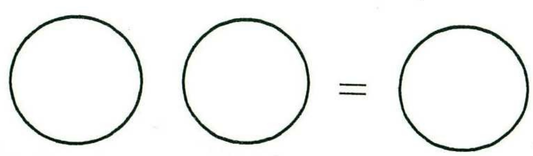
In discussing the emergence of such archetypal forms out of the unconscious, Jung was fond of quoting the alchemical Axiom of Maria Prophetissa: "One becomes two, two becomes three, and out of the third comes the one as the fourth."[13] Elsewhere, he says this about the first of those stages, the one that concerns us here:

> With the appearance of the number two, *another* appears alongside the once, a happening which is so striking that in many languages "the other" and "the second" are expressed by the same word. . . . Thus there emerges a tension of opposites between the One and the Other.[14]

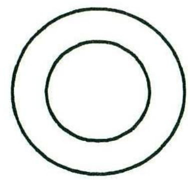
Where before there was no-thing, drawing the circle creates two things: an inside and an outside (of course, we could just as readily call the outside the inside and vice versa. The names are arbitrary.) Let that which is enclosed be considered the distinction, the mark, and what is outside "not the mark" (remember, the circle has no thickness whatsoever.) Now, of course, any distinction whatsoever would do. Any difference one could make which would divide a unitary world into two things would be a proper distinction. Freudians like to point to an infant's discovery that the breast is separate from itself as the first distinction that leads to consciousness. For many early cultures, the first mythological distinction was the separation of land and sea, or light from darkness. In Jungian work, one first draws a circle, a mandala *in potentia*, into which one projects emerging distinctions in one's personality and consciousness. But there are infinitely many distinctions possible within the world.



Now let us flesh out this space we have created, discover its laws. Start by drawing a second circle beside the one we've already drawn. Imagine you are blind and wandering around the plane represented above. You bump up against one of the circles and pass inside. After wandering around inside a while, you come up against the edge of the circle again and pass outside. Wandering some more, you encounter the edge of the second circle and again pass inside, then later outside. Is there any way you could possibly know that there were two circles, not one? How could you know whether you had gone into one of the circles twice or into both circles once? All you could know was that you had encountered what you regarded as an inside and an outside. Hence for all practical purposes, two distinctions (or three, or a million) of the same nature are the same as one. Nothing (remember literally no-thing) has been added. Spencer-Brown calls this the law of condensation; i.e., multiple distinctions of the same sort simply condense into a single distinction.

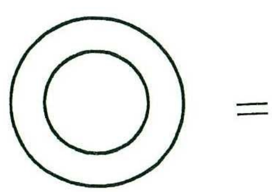


Are there any other laws we have to find about this strange two-state space? Bear with me, there is only one other situation to consider. Let's go back to our original circle, the "first distinction." Let us draw a second circle, but this time draw it around the first, creating nested circles.



Once more imagine you are blind, wandering around the plane. You encounter the edge of a circle and pass within, thus distinguishing what you consider to be inside and outside. Once inside, you wander some more, then again you encounter the edge of a circle and pass outside. Or did you? Perhaps the edge you encountered was the edge of the inner circle and you passed within it. You are not able to distinguish between the inside of the inner circle and the outside of both circles. (I hate to keep reminding you that our circle has no thickness at all, it merely divides the world into two states.) In such a world, two insides make one outside.

Let's assume that the outer circle stretches farther and farther away from the inner circle until you are no longer aware that it even exists. As far as you are concerned there is only the single circle through which you pass inside or outside. But a godlike observer who could see the whole plane would realize that when you passed inside the inner circle, you were actually reentering the space outside the outer circle. It all depends on how privileged your perspective. Nested distinctions erase distinction. Spencer-Brown refers to this principle as the law of cancellation.



I'm proposing that all of what we usually call "psychological dynamics" emerges from these two simple laws. These two laws govern all two-valued worlds, including those that Jung was struggling with when he talked of the "problem of opposites" or "polarities." Chaos Theory is a contemporary scientific attempt to describe how change occurs through progressive series of *bifurcations* (still another term for the basic split between the *one* and the *other*.) In a recent article in *Psychological Perspectives*, Jungian analyst Ernest Lawrence Rossi has shown how, in the dream of a modern woman the tension between conscious and unconscious can be traced through a progressive series of bifurcations. He terms this process the "Feigenbaum Scenario" after Mitchell Feigenbaum, who discovered a basic mathematical law that underlies chaos theory.[15]

We recognize that the tension between conscious and unconscious is as old as life itself. Even the simplest one-celled creature has to distinguish between food, which it wants to eat, and danger, from which it needs to flee. It is forced to make a Spencer-Brown distinction, to take one or the other of two paths. Life began by first developing the skill to make distinctions, to create boundaries, at the molecular level. Evolution progresses by making ever more complex distinctions until the emergence of consciousness itself. Carl Jung, Erich Neumann, and most recently, Julian Jaynes, have each discussed this progressive emergence of consciousness from their own perspective. From the extension of Spencer-Brown's perspective that we are presenting here, we could say that consciousness itself is the progressive emergence of a self-reflective, recursive cycle of ever more subtle distinctions. Mathematician Norbert Wiener invented the term "cybernetics" to investigate the self-reflective, informational dynamics of such distinctions. I'm suggesting that Jung's archetypal dynamics are an over-arching integration of how matter, life and mind emerge from the evolution of self-reflective distinctions. Or as von Franz said: "Jung's view of reality is an evolutionary one, we are all in a process of evolution on this planet . . . the aim of evolution on this planet seems to be to create more consciousness."[16] And consciousness emerges ineluctably from the process of making distinctions.

The Archetypal Nature of Reality: Laws of Form

> In the beginning God created one world (unus mundus). This he divided into two--heaven and earth. . . . The division into two was necessary in order to bring the "one" world out of the state of potentiality into reality. Reality consists of a multiplicity of things. But one is not a number; the first number is two, and with it multiplicity and reality begin.
>
> - C. G. Jung.[17]

> Although all forms, and thus all universes, are possible, and any particular form is mutable, it becomes evident that the laws relating such forms are the same in any universe.
>
> - G. Spencer-Brown.[18]

These two laws are the only ones possible within the space created by a distinction. No matter how many distinctions we choose to make, they simply become combinations of paired or nested distinctions.

These almost transparently obvious laws are all that Spencer-Brown needed to develop first his full arithmetic, then his algebra. In proper mathematical form, they are presented as axioms from which all else will be derived, but there is something unique going on here. In formal mathematical system axioms are not themselves open to examination. Axioms are considered primitive assumptions beyond questions of true or falsity. The remainder of a system is then developed formally from these primitives. In contrast, Spencer-Brown's axioms seem to be indisputable conclusions about the deepest archetypal nature of reality. They formally express the little we can say about something and nothing.

This is one of several reasons why Spencer-Brown's *Laws of Form* has been either reviled or worshiped. In this respect Spencer-Brown's reception has been much like Jung's. In both cases, they are dealing with areas more basic than are traditionally addressed within science. Mathematicians are deeply suspicious of any attempt to assert that axioms might actually be assertions about reality, and with good reason. For over two thousand years, the greatest minds believed that Euclid's geometry was not only a logically complete system, but one that could be checked by reference to physical reality itself. Only with the development of non-Euclidian geometries in the nineteenth century did it become apparent that Euclid's axioms might be merely arbitrary assumptions, and that a different set of assumptions could lead to an equally complete and consistent geometry.

Once bitten, twice shy—mathematicians became much more concerned with abstraction and formality. They separated what they knew in their mathematical world from what scientists asserted about the physical world. Mathematics was supposed to be the science which dealt with the formal rules for manipulating meaningless signs. Spencer-Brown's attempt to develop axioms that asserted something important about reality definitely went against the grain of modern mathematics. This is remarkably similar to Jung's situation in trying to present symbols not as mere signs, but instead as "the best possible description or formulation of a relatively unknown fact, which is none the less known to exist or is postulated as existing."[19]

The Dynamics of Spencer-Brown's Archetypal Distinctions

Let's consider the elegant symbol system Spencer-Brown used to express and manipulate distinctions. Instead of our example of a circle in a plane, let the following mark represent distinction: ⏋

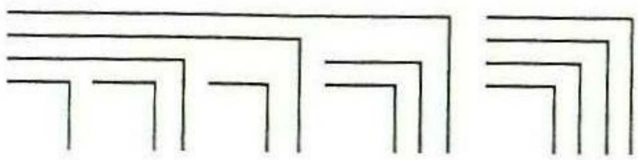
Our two laws then become:

┐ ┐ = ┐

and

 =

Using only those two laws, the most complex combinations of marks can be reduced either to ┐ or to ; that is, to a mark or to nothing. Try yourself to use the two laws to reduce this example to either a mark or to nothing (hint: it should end up as a mark.):



These two laws are the full and complete set of rules for Spencer-Brown's arithmetic. As we have already stressed, it's a very strange arithmetic in which the constants, comparable to 1, 2, 3, . . . in normal arithmetic are simply the mark, ┐ , and the non-mark, .

Though any combination of marks, no matter how complex, can be reduced using this simple arithmetic, Spencer-Brown found it useful to extend the arithmetic to an algebra by allowing variables; i.e., alphabetic characters that stand for combinations of marks. For example, the letters p or q or r might each stand for some complex combination of marks. He then developed theorems involving combinations of marks and variables which would be true no matter what the variable might be. Since his whole point was to develop the arithmetic which underlay Boolean algebra, of course the algebra he developed was equivalent to Boolean algebra.

But, as he points out, the great advantage is that since his arithmetic was totally indifferent to what two-valued system it was applied to, the resulting algebra is equally indifferent to its application. It can certainly be interpreted as a Boolean algebra, but it can equally well be interpreted as an algebra of network design, or any other two-valued system, a point which has been either ignored or dismissed by critics.

Self-Reference, Imaginary Numbers, and Time

> . . . we should not be at in the least surprised if the empirical manifestations of unconscious contents bear all the marks of something illimitable, something not determined by space and time.
>
> - C. G. Jung.[20]

> Space is what would be if there could be a distinction. Time is what would be if there could be oscillation.
>
> - G. Spencer-Brown.[21]

Spencer-Brown's Laws of Form are an examination of what happens when a distinction is made, when something emerges from the unconscious into consciousness. Hopefully, the first of Spencer-Brown's two rather oracular statements above now makes sense. We have seen how space emerges from the mere fact of making a distinction. Neuro-biologist and cybernetics expert Francisco Varela has called the latter, the creation of time, "in my opinion, one of his most outstanding contributions."[22] Let's see if we can bring equal sense to it.

In solving many of the complex network problems, Spencer-Brown (and his brother, who worked with him) used a further mathematical trick which he avoided mentioning to his superiors, since he couldn't then justify its use. He had been working with his new techniques for over six years and was in the process of writing the book that became *Laws of Form* when it finally hit him that he had made use of the equivalent of imaginary numbers within his system.

Imaginary numbers evolved in mathematics because mathematicians kept running into equations where the only solution involved something seemingly impossible: the square root of -1 (symbolized by $\sqrt{-1}$.) If you will recall from your school days, squaring a number simply means multiplying it by itself. Taking the square root means the opposite. For example, the square of 5 is 25; inversely the square root of 25 is 5. But we've ignored whether a number is positive or negative. Multiplying a positive number times a positive yields a positive number; but also multiplying a negative number times a negative number also yields a positive number. So the square root of 25 might be either +5 or -5. But what then could the square root of a negative number mean?

This was so puzzling to mathematicians that they simply pretended such a thing could not happen. This wasn't the first time they had done this. Initially negative numbers were viewed with the same uneasiness. The same thing happened with irrational numbers such as the square root of 2 (an irrational number cannot be expressed as the ratio of two integers). Finally, in the 16th century, an Italian mathematician named Cardan had the temerity to use the square root of a negative number as a solution for an equation. He quickly excused himself by saying that, of course, such numbers could only be "imaginary." The name stuck as more and more mathematicians found the technique useful, and the symbol for $\sqrt{-1}$ became *i* (short for imaginary).

Jung was fascinated by this mathematical concept, which he mistakenly thought was called a "transcendent function" (mathematicians actually call such numbers "complex numbers"). He drew on it for analogy to his concept of the "transcendent function."

There is nothing mysterious or metaphysical about the term "transcendent function." It

> means a psychological function comparable in its way to a mathematical function of the same name, which is a function of the real and imaginary numbers. The psychological "transcendent function" arises from the union of conscious and unconscious contents.[23]

Spencer-Brown had come up with an equivalent situation in solving network problems. Instead of the square root of a negative number, he found equations where a variable was forced to refer to itself, like E2 and E3 below:

$$f_2 = \overline{\overline{f_2\,}|\,}| \qquad\qquad f_3 = \overline{f_3\,}|$$

Remember that f has to stand for some combination of marks that ultimately reduces to either a $\rceil$ or (i.e., a mark or nothing). There is no problem with the first equation, where it works equally well whether we substitute $\rceil$ or . But in the second equation, if we assume that $f_3 =$ $\rceil$, then $f_3 =$. Similarly, if $f_3 =$, then $f_3 =$ $\rceil$. That is, if the value of the function is a mark, then it's not a mark; if the value is not a mark, then it is a mark. Just as with imaginary numbers, we are dealing with an impossibility, in this case caused by self-reference.

Spencer-Brown simply made use of these impossible numbers in his calculations without understanding what they meant. With the realization that these were equivalent to imaginary numbers, he not only understood what they represented, but had an insight to how imaginary numbers could be interpreted as well: both imaginary numbers and his self-referential functions were "oscillations" in and out of the normal system. Let's pause and make that very clear. In the system created by Spencer-Brown's Laws of Form, there are only two possible solutions to an equation: the mark and no-mark. Yet these self-referential equations have a 3rd solution, one that oscillates in and out of the system: first the solution is the mark, then it's not the mark, and so forth endlessly. Since this solution cannot be found within the space created by the system, it has to be a movement in time.

Without being aware of Spencer-Brown's conclusions, Marie-Louise von Franz posited the same result: "In the number two we are dealing first of all with a polarity that manifests itself dynamically as an oscillatory or systolic-diastolic rhythm. It's numerous repetitions then engender a "path," and thereby a time-, or space-vector, the third element. This thereness is implicitly contained in the number two, but not yet explicitly indicated by its (two's) presence."[24]

Just as the space created by Laws of Form has no dimensions, neither does the time created by it. You can't refer to it in seconds or minutes; it is more primitive than that. Jung struggles to capture a similar sense of time when he contrasts the "three-dimensionality of space" with the "one-dimensionality of time."[25] Or when he says that "place and time are the most general and necessary elements in any definition . . . A definite location in place and time is part of man's reality."[26]

This concept of dimensionless time as a resolution for problems of self-reference has become a commonplace through the wide use of computers. Computer programmers use the term "iteration" to describe the movement of a program from one state to another. For example, computer programs commonly count the number of times a sub-routine has run by adding an instruction like "n = n + 1", then checking the value of "n" to see if the sub-routine has run enough times. It is understood that the "n" on the left side of the equation is a later stage than the "n" on the right side. Time has entered the picture. But note that this time is dimensionless. We can't say that one "n" is a day or an hour or a minute or a second later than the other "n"; all we know is that one state of "n" is later than the other state. This is analogous to how we created a space without dimension by the simple act of making a distinction.

$$f = \overline{f\;}\!\rceil$$

Spencer-Brown realized that his simple but puzzling little equation brought time at its simplest manifestation into the timeless world of his Laws of Form. Such equations simply "oscillate" between one value and another, just as imaginary numbers provide the possibility of oscillating between values that lie first on the real number line, than off it, then on it again, and so forth.

Spencer-Brown's Laws of Form provide the simplest and most basic foundation of Jung's concept of archetypal reality. They describe explicitly what it means for something to emerge from the unconscious, which is beyond limitations of space and time, into reality, *any reality*. They present two laws that hold for any pairs of opposites that might be considered. As long as reality consists only of these opposites, there are only those two possibilities: if we try to multiply them, they condense into a single value; if we try to nest them, they cancel each other out. For example, if the most basic distinction is light and dark, there can be no shadings: more light is simply light, more dark, simply dark. If we combine light and dark, nothing is left. These laws always hold whether we are talking of Spencer-Brown's "mark" and "non-mark", light and dark, hot and cold, male and female, yin and yang, yes or no. From these simple pairs of opposites, all reality emerges, including the hexagrams of the ancient book of wisdom, the I Ching, the bits and bytes of the modern computer languages.. Let me give Jung the last word on all this:

> In nature the opposites seek one another--les extremes se touchent--and so it is in the unconscious, and particularly in the archetype of unity, the self. Here, as in the deity, the opposites cancel out. But as soon as the unconscious begins to manifest itself they split asunder, as at the Creation; for every act of dawning consciousness is a creative act, and it is from this psychological experience that all our cosmogonic symbols are derived.[27]

1.C. G. Jung, *Collected Works, Vol. 19i: The Archetypes and the Collective Unconscious, 2nd ed.* (Princeton: Princeton University Press, Bollingen Series XX, 1969), par. 155.

2.C. G. Jung, "Synchronicity: An Acausal Connecting Principle", 1955, *Collected Works, Vol. 8: The Structure and Dynamics of the Psyche, 2nd ed.* (Princeton: Princeton University Press, Bollingen Series XX, 1969), par. 870.

3.C. G. Jung, *Collected Works, Vol. 12: Psychology and Alchemy, 2nd ed.* (Princeton: Princeton University Press, Bollingen Series XX, 1968), par. 400.

4.C. G. Jung, *Collected Works, Vol. 12: Psychology and Alchemy, 2nd ed.* (Princeton: Princeton University Press, Bollingen Series XX, 1968), par. 398.

5.C. G. Jung, *Collected Works, Vol. 12: Psychology and Alchemy, 2nd ed.* (Princeton: Princeton University Press, Bollingen Series XX, 1968), par. 440.

6.George Boole, *An Investigation of the Laws of Thought: On Which are Founded the Mathematical Theories of Logic and Probabilities* (New York: Dover, 1854/1958).

7.George Boole, *An Investigation of the Laws of Thought*, p. 1.

8.Quotation in Carl B. Boyer, *A History of Mathematics*, p. 634, among other sources.

9. E. T. Bell, *Men of Mathematics* (New York: Simon and Schuster, 1965), pp. 446-447.

10.G. Spencer-Brown, *Laws of Form*, revised edition (New York: E. P. Dutton, 1979), p. 85.

11.C. G. Jung, "VII Sermones ad Moruos," Stephan A. Hoeller, trans., in Stephan A. Hoeller, *The Gnostic Jung and the Seven Sermons to the Dead* (Wheaton, Illinois: A Quest Book, Theosophical Publishing House, 1982), p. 44. See C. G. Jung, *Memories, Dreams, Reflections*, revised edition (New York: Pantheon Books, 1973), appendix V (Septum Sermones ad Mortuos) for a different translation by Richard and Clara Winston.)

12.C. G. Jung, quoted in Marie-Louise von Franz, *Number and Time* (Evanston: Northwestern University Press, 1974), p. 92.

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