FRACTALSTEIN

Ralph Abraham

AND THE CHAOS REVOLUTION

AN INTERVIEW BY SALE

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The image of Frankenstein's monster as a composite of various parts from different bodies all sewn together makes me think of the holist maxim — any one thing is greater than the sum of its parts. In 1968, just prior to the chaos revolution in dynamic systems theory, Arthur Koestler penned *The Ghost in the Machine*. In it he coined the word "holon," a term he used to bridge psychological holism with the atomistic approach of Behaviorists, for whom the mind was nothing but the mechanistic firing of neurons. A holon is basically a whole part or a part whole.

In 1996, after a personal, decade-long archaeological dig into deep psychology, the geometry of nature, chaos theory and even the occult, I began to pen *Fractalstein: Chaos, Culture and the Third Millennium*, a collection of essays devoted to reconciling the parts of popular culture — from Doc Martens to Yanni to Batman — into the whole of the chaos revolution. In search of an ally, I contacted Ralph Abraham, mathematician, chaos theorist and author of *Chaos, Gaia, Eros: A Chaos Pioneer Uncovers the Three Great Streams of History*. No great surprise that he had himself recently penned a piece titled *Chaos and the Millennium*.

Salem: I rediscovered geometry when I was writing a term paper on fractals and aesthetics in 1987. Through books like *The Geometry of Art and Life* and *The Divine Proportion*, I recognized that the Golden Mean (aka the Golden Section) — the static counterpart of the dynamic recursive Fibonacci series — was a fractal. And, I realized that it was pervasive — a mathematical skeleton inherent in the form of the spirals of a pineapple and the ratios of bones in the human hand. What are your thoughts about the Golden Mean?

Ralph: What could be more cool? One might speculate that the Fibonacci sequence was learned from nature deep in the paleolithic past. Certainly the Neanderthals were sufficiently capable in arithmetic, as their musical instruments testify. And from the Fibonacci series, they could have learned to revere the Golden Rectangle, and its ratio PHI. However, there is no evidence whatever for this speculation, and PHI could also have been learned from the problem of Babylonian algebra, which it solves. Many different means were known in ancient Babylonia. The high level of math in Babylonia is attested by a number of cuneiform tablets. As well, bas reliefs of ancient Egypt strongly suggest that the relation PI ~= 6 * PHI/5 (accurate to 15 parts per million) was known, and used in the great pyramid. This gives a more accurate estimate of PI than is known to history until quite recently. By any account, PHI was increasingly special, from ancient times up until the Renaissance Greek vases,

Renaissance window frames, and all those examples given in books devoted to PHI. According to Rupert Sheldrake, the increasing veneration of PHI (and the reason it is considered most perfect in psychology experiments) would be due to the co-evolution of the mathematical sphere and the collective human psyche. That is, the morphic field.

S: Numbers, specifically whole numbers, have long held spiritual/mythical/magical value. From "seventh heavens" to the numbers chosen for lotteries, collectively we still exhibit a superstitious relationship with numbers. Why do you think this is so?

R: Again, the ideas of Rupert Sheldrake suggest that number mysticism is a relic of very old wisdom — like the lore of the zodiac. The antiquity of the zodiacal myths has been convincingly established. Number mysticism enters the record with Pythagoras, who is said to have learned it in India or Egypt. Along with ancient Egypt, India, and China, number mysticism occurs in all cultures — and so your question, "Why is this?" My idea on the source of these things is that the number lore evolved in a time when arithmetic was done mentally; before the earliest number signs and symbols were invented — before the earliest alphabets. Evidence for early arithmetic is given by the blanchard bone of marshak and the recently found Neanderthal musical instruments in China. The earliest number symbols, such as the scratches on the blanchard bone, are still used today according to *Alternative Archeology*, Jonathan West, etc. An Atlantean culture over 12,000 years ago may have had a highly evolved math; our sacred geometry, number mysticism, and zodiacal lore may be but remnants of that forgotten knowledge.

S: You talked about the Fibonacci series and the Golden Mean. Where in chaos theory are we going to find PHI? Or are we going to find that at all?

R: I'm not too up on that. I heard that there's a chaotic dynamical system where PHI figures, but I don't remember where it is. These certain systems that exhibit magic numbers, and these numbers might be in the future what the Golden Mean was in the past — I never thought they were too important. Maybe my viewpoint is too small. What inhibited me about these concepts is that there's so many of them. Whereas in ancient times they only had a few, so it was easier to review them.

Among the most important irrational numbers of the past,

the square root of two probably figures as the most important one. I think I'd call it the Silver Section, just to contrast it to the Golden Section. There's this Danish guy, Brunus, who wrote two volumes on sacred geometry. He's sort of coming from a freemason background or viewpoint. Sacred geometry was made by builders who were high initiates of the secret societies and so on. So he makes a very interesting case for this Silver Section, which is basically just the square root of two. Of course that was the number, at least in historical times, that first confounded the Pythagorean number mystics. They related to the number mysticism of the musical scale; all of the musical intervals are rational numbers — although sometimes the important ones have huge numerators and denominators. To do that kind of arithmetic took phenomenal skill — multiplication and division of very large numbers. And they of course hoped you could approach any number this way. And approximately you can, but exactly you can't. And that was in versions of the history of the mathematics of ancient Greece. It was the Pythagoreans who first proved that the square root of two is not a rational number.

Well it was long, long before then that the square root of two was found in sacred architecture. The pyramid at Giza has the Silver Section in it, as well as the Golden Mean. So Brunus makes this extensive argument on the priority of the importance of the square root of two, and this magic rectangle the Silver Section.

S: So are the magic numbers today primarily irrational?

R: Yeah. Well, I guess they're irrational. See, they're too new, and there's no theory about them, and we don't even know exactly what they are. Because they appear in computer experiments they're known approximately, and the longer the experiment goes on, the better they're known. But nobody can really prove that they're irrational or transcendental or something.

The square root of two's proof is actually a part of ancient Greek mathematical lore. And I think that PI and PHI were proved only recently to be transcendental — like in the same century or something. (A transcendental number is a number that cannot defined by an algebraic equation.) So it takes a long time to *really* establish these numbers as to their value, their meaning, and their

chief characteristic features.

In ancient times there were integers, all of which were special. And, incidently, there are many of them. But practically, they're just some very large numbers. And then there were these few irrational numbers that were important, very important. The square root of two, and PI, and PHI, and the square root of three, and the square root of five — a few square roots but not all of them were important — and a prime numbers.

But now a days there's too many of them. There's all the constants of physics. And then there's the idea that the constants of physics aren't really constant — like the speed of light, or something. It's a constant of physics but it's not really a number. It depends on units like CGs or metric or English units. It's a different number but it has the same significance. And so it's hard to have a numerology of it.

So I personally don't think, the Feigenbaum constant, although it's a pure number, is going to have fundamental importance in our culture. In fact, I don't think any number will. I think instead that what plays the role of number mysticism today are space-time patterns; they're movies that have special importance in being universal models for orthogenesis. That is to say universal emergence of form in nature. And we see mathematical models for orthogenesis that apply in many different realms in nature. For example the formation of galaxies is similar to smoke rings. The sacred geometry of our time is fractal geometry and the space-time patterns of chaos theory. This provides for a better connection between the human species and the complexities of nature. Because we have more complex mathematical models from chaos theory and fractal geometry, more and more complex mathematical models for space-time patterns emerge in nature as a massively complex dynamic system. And some of these patterns we see just by closing our eyes in psychedelic trips and meditations. We're not necessarily seeing them for the first time. Renaissance artists have seen them. And merkabah mystics, the ancient Jews have seen them, but have not necessarily grokked them because there was no mathematical extension of language that provided a basis for a cognitive strategy for understanding and dealing with it. So you could see an archetypal space-time pattern in a DMT trip

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let's say, and not be able to say anything about it or even remember it very well when the trip comes down because there's no cognitive strategy for defining it. But then you go to a friend's computer lab at the university and you see it there on the screen. It's an archetypal pattern of sacred space-time geometry, which can be experienced in inner-space and also manifest in nature as space-time patterns of universal multigenetic sequences, like embryogenesis, neurogenesis, cosmogenesis, or noogenesis. At the turn of the century, the theosophists revived "visual music", an art-form that was then dead. Using swirling colored patterns, abstract patterns of motion — like abstract paintings — were created by playing color organs, which were made with rheostats. These were attempts to create artistic representations of space-time patterns; the spatial patterns that move theta, are the sacred space-time geometry of the whole universe.
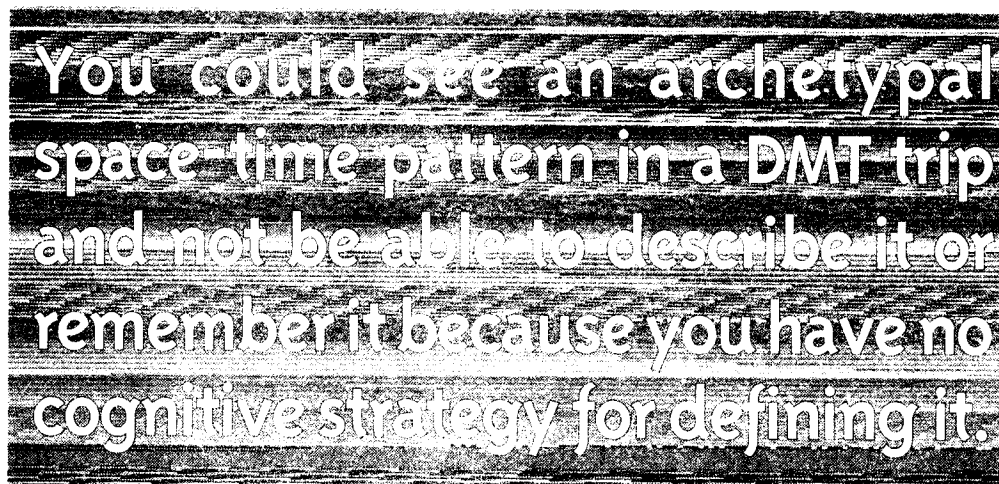
We've managed to get a mathematical language extending ordinary language in a sense. We have a compact representation for a space-time pattern as a simple equation for a dynamical system. A computer simulation draws this archetypal space-time pattern on the screen,

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then you realize that computer program that draws the movie — that creates the movie — that program is a name for the movie, as it were. It's an extension of language in a way that deals cognitively with these space-time patterns. Chaos theory, or in other words dynamical systems theory, has been called the study of space-time patterns. And in fact recently the American Mathematical Society has even redefined the mathematics as the study of space-time patterns.

So among all the space-time patterns I'm suggesting that certain ones are special... that they're archetypal. And the simplest and most frequently encountered morphogenetic processes, like the formation of a spiraling galaxy, rotating chemical waves, all those familiar fractals from the cover of books, *The Beauty of Fractals, The Science of Fractals...*

S: When I first saw Gleick's *Chaos* I was in a University of Washington bookstore. This was during the heyday of my private psychedelic experimentation, which wasn't about parties, but about meditation, reading Lilly... and I'd found that last frontier — my head. And I walked into the bookstore and I saw this book with a psychedelic cover and picked it up. It seemed in a way that what so many people were coming across for the first time — through chaos — had been established in so many different ways as the geometry of nature... well, like Goethe's ideas about

the growth in plants and so forth. Why do you think the chaos revolution is happening now? Why do you think people are saying let's look at space-time patterns instead of the ping-pong ball trajectories of atoms?

R: One reason is definitely the computer revolution. Or more specifically the computer graphics revolution. We now have the means of making these mathematical objects visible. Some mathematicians of the past, and some other visionary people of the past, such as Goethe who have seen these forms in nature, have understood them. Poets, painters, and so on. But with the advent of computer graphics, the whole movement of mathematics is tremendously amplified, because now the general public can see the mathematical objects. When asking the question, "Why didn't the chaos revolution happen earlier?" there's a parallel question, "Why didn't the chaos revolution happen later?" I mean, what helped it to happened in computer graphics isn't enough, and that's where the controversy over psychedelics plays into the equation.

S: One could extrapolate that the chaos revolution is a second-wave psychedelic revolution.

R: Maybe you're right and the chaos revolution is a second wave. On the other hand I think the revolution has a prehistory and a post-history and so on like a wave out on the beach was formed out in the mid-pacific when a storm passed by. So we have chaos theory before the chaos revolution. We have a century of arcane mathematics before it has a ripple in popular culture. So the emergence of the theory didn't happen in ancient times, it happened recently. It happened a century ago and it's affecting the sciences more recently.

I've speculated that not just psychedelic movement, but hip culture — this fantastic cultural transformation of the 1960's — was a factor in the chaos revolution. So I would say maybe

GLOSSARY OF TERMS

The Fibonacci series - a series of numbers (starting with 1) created by adding the two preceding numbers in the series together, (i.e - 1, 1, 2, 3, 5, 8, 13, 21, ad infinitum). This series appears many places in nature, and the ratio of any two consecutive numbers approximates PHI.

Fractal - A simple equation which produces and endlessly repeating series of numbers, often simulating complex geometrical topographies.

PHI, The Golden Mean - An irrational number approximating 1.618. PHI is a ratio which appears over and over in art, architecture, and many natural forms.

Morphogenetic Field - A theoretical field which allows physical and non-physical information to spread throughout a species or organized system on a non-local level. Hypothesized by British biologist Rupert Sheldrake as an holisitc evolutionary alternative to Darwin's natural selection.

PI - An irrational number approximating 3.1415 which is essential to many formulas in Euclidean geometry.

Rupert Sheldrake - British biologist and way cool dude. See *Morphogenetic Fields*.

Sacred Geometry - A religious belief that numbers and mathematics are a direct representation of the mind of God and nature.

Transcendental Number - any number or mathematical constant that cannot be defined by an algebraic equation.

Theosophy - An occult belief system based on mystical practice and experiential insight into the nature of God.

Morphology - The study of patterns which recur in nature.

Orthogenesis - The growth and genetic development of a species.

Embryogenesis - The development and growth of an embryo.

Neurogenesis - The development and growth of a brain or neurologic system.

Cosmogenesis - The development and growth of a galaxy or universe.

**Noogenesis** - The development and growth of everything.

Space-time - A dynamic field of particles and energy waves held together by the forces of gravity and electromagnetism.

the chaos revolution second wave is the first wave — part of the initial breaking of hip culture and the psychedelic revolution in the 60s.

S: I hadn't seen McKenna's book *The Archaic Revival*. I was in Seattle, involved in the arts scene, and I knew people who belonged to underground sadomasochistic clubs — people who were pierced and tattooed. And I saw this aboriginal stuff coming through when I started thinking about culture and how we're reintegrating the archaic. But we don't know that the kid sitting in a coffee shop who has piercings is thinking, "Well I'm doing this because I'm desperate for an initiation rite," or "I'm being initiated into the popular culture of the chaos revolution." I think it's more about cultural patters. When you talk about mathematics being redefined as space-time patterns, to me what you're talking about is the reacceptance of space. And here we get into really simple terms like left brain, right brain. When you start being able to look at mathematics on a computer screen, you're using a part of the brain, I think, that is much closer to what we call the collective unconscious. And if that's some noosphere, or whatever, there's no way I can prove it. Except to say that based on the statistics of all this information, I don't think I'm proposing a quack theory when I say that popular culture can be read symbolically as an extension of waveforms that represent chaos in all these different ways.

R: In the 60s, in my psychedelic period, I discovered for myself that the mathematics that I knew could be seen as an overlay on the ordinary, daily life experience, which informed it. That is that everything that happened fitted into a kind of mathematics of space-time patterns, that made it a little easier to understand the complexity of what was happening. So I was, in my own experience, kind of led out the mathematical ivory tower. Without becoming an applied mathematician in any way I began seeing mathematics as being more important, perhaps, than I thought it was. Before this I thought it was important because it was beautiful in itself. And it was useful only in the most arcane sciences like quantum mechanics and relativity theory and that stuff. I hadn't really taken seriously the idea of a mathematics of ordinary life like astrology and number mysticism. But what led me into talking about history was the popularity of Gleick's book, *Chaos The Making of a New Science*. That was phenomenally popular just because of the right place and the right time. And that wave was happening anyway in the chaos revolution, maybe in the way you're talking about it. Kind of an externalization of the collective unconscious. Or you could say the opening of a window between the collective unconscious and the collective conscious, so that a larger piece of territory moved into consciousness. And we can call it the chaos revolution.

Anyway with the popularity of that book these journalists started to call me up, asking really difficult questions, like, "What does chaos really mean?" "What does the mathematics of chaos have to do with what we call chaos in ordinary life?" And in trying to answer these questions I was led backwards in time further and further. I had to start reading these books, history books. And in history books I found references to other history books with much older models of history. There were so many of them that I tried to order these as a kind of a taxonomy of historiography. And I came up with "the history of history." I saw that when you spread them out on the table like a game of solitaire, you're playing cards in which each card is a historiographical model of the whole of history. Then you see

I associate the chaos revolution with the utopian ideal of saving the world
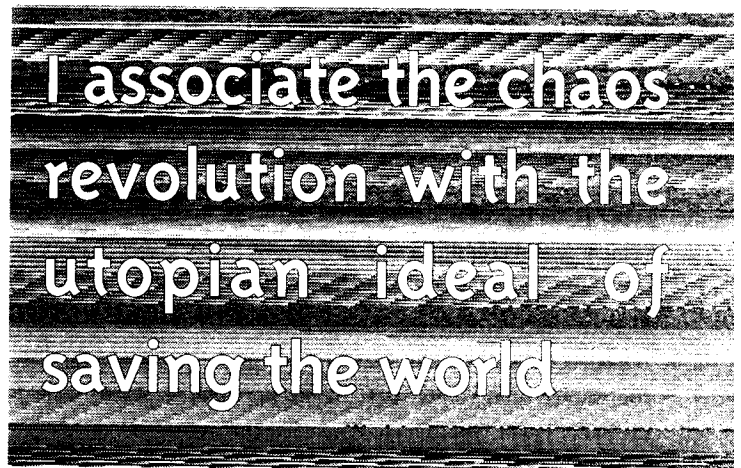
that the familiar mathematical forms based on the universal morphogenesis known first in biology, then in the physical and social sciences, is also the morphogenesis of ourselves — our story. At the same time that chaos theory was a historical event of significance — a morphogenetic event — a revolution also provided a new card on the table of historiography. So at the same time it was an historical event, it also gave a new model for all historical events, including itself. It has a kind of self-referential structure that is only familiar to us because of chaos theory. It's cool!

S: I think maybe what I'm doing or trying to do in my own small scale way is access that part of history (pop culture) that people like yourself aren't thriving in and living amongst. So that my understanding of these big patterns in history came from these very small patterns I was seeing locally on a very small scale level. And I found that this superhero, Batman, carried so much symbolic weight that people don't grasp. As soon as I gave that Batman paper to my editor friends, it was very comprehensible to them. And I don't think they're running around the world thinking that there's a chaos revolution — except that I'm convincing them that there is one.

I know you're very hopeful about what visual mathematics can do, especially getting it in at the youngest age possible.

Why are you so earnest about that, what do you think could happen? Are you deliberately trying to push that paradigm along?

R: Well, yes. The damage that science can do to the environment (through the lack of understanding of the web that connects us) is not the criminal activity of individual sciences. And its not simply the fact that science is a dogmatic religion. It's more that science is the surgical knife. It's such a powerful tool of the culture at large, which has a dangerous obsession with order. So I associated the chaos revolution with the utopian ideal of saving the world. I consider the chaos revolution as a revolution that is happening now in all levels of culture. And it's important. Like other all revolutions of the past, there is a backlash movement that tries to conserve the old order. And this backlash might succeed from fear. At the time the Italian Renaissance was followed by the so-called enlightenment — and the idea of all the progress that was made — the troubadours were annihilated in the Albegensian crusade. Hundreds of thousands of enlightened people were burned! So my interest is in the support of the chaos revolution with the goal of succeeding somehow and creating a new order — or a new disorder even — for better or for worse. I'm abandoning this one, and even if another one is an experiment that might fail, I'm up for it. Which is a fairly radical position, and if I didn't have this kind of childish foolishness that's been part of my personality since birth, I probably never would have taken LSD the first time!

But that's my position now. So how do you get serious about furthering a revolution? Well it is going nowhere if it doesn't get into school. Chaos has to go to school, because the job of school is to maintain the old system. The maintenance of a culture is an important concept. I'm not arguing against it. The structural stability of culture is very important to everybody's success in life even. And the function of the school in a society is as a stabilizer — a skeleton. If you want the system to change then you have to focus on the schools — so we want chaos to go to school.

S: That would be a great cartoon — "Chaos goes to school!"

R: I'm actively involved in a school actually, making a new curriculum that is not based on chaos, but which focuses on the chaos revolution as one of a sequence of revolutions that characterize our picture of history. So world cultural history in the curriculum for this elementary school is mapped out into grades. The agricultural revolution happens in the first or second grade, and I guess and the first city-states happen in the fifth. Ancient Greece happens in the sixth grade, and in the eleventh grade you get the chaos revolution. If this curriculum were followed, children would not be immersed in the chaos revolution at kindergarten because they have parents. And their parents have their own view. So this is like the traditional curriculum, and it aims to move people from A to B. So that's what we mean when we say chaos goes to school. It's not just having a course in chaos theory. I'm also interested in seeing the chaos revolution as an historical event, and seeing — through an appreciation of the mathematical dynamic — the whole of history as we know it... at least of the holocene of the last 12,000 years.

S: So how does something like that happen? Does chaos just slip it's way into the curriculum somehow, or do you have to lobby for it? Maybe we can use the web to get new ideas through...

R: You know, I went to Portland to give some lectures, and part of the deal was I should meet with several high school classes to discuss whatever they wanted to talk about. So I discovered in this class of juniors and seniors that the students had a pretty good idea of what chaos was all about, and the teachers had none. Not all, but mostly. And the teachers thought it was cool that the students were interested in this and that, but the funny thing is that the understanding of chaos they had came from *Jurassic Park*. So I asked them about the chaos concepts that they knew, and I was surprised that they weren't too bad. So I went and I read the book!

S: I did the same thing. I know a lot of people who are familiar with chaos through that book.

R: And it wasn't too bad. Because the author is a scientist and he appreciates the idea. And that was how the influence transcended school. I'm interested "chaos goes to school," but apparently the really important thing is that chaos goes to Hollywood!

S: Yeah, you got to start thinking marketing. "Chaos needs an agent."

R: Exactly!   ❖

"Why didn't the chaos revolution happen later?" that's where the controversy over psychedelics plays into the equation.