Ralph H. Abraham, 18 april 1991, at Stanford University

THE GEOMETRY OF THE SOUL

It's quite an honor to speak on the Stanford campus, and particularly in a series called *Frontiers of Consciousness*. Would that be the same as the frontiers of unsciousness? As a student of chaos I feel more qualified in that area. The campus is very beautiful and large, grand, medieval, well planned. Coming up the drive, there's a loop which I experienced a few times while looking for a parking space, and I finally realized that the shape of the loop with the little cross at the bottom is actually an Egyptian ankh, a sacred symbol. I wonder if the architect for the Stanford campus -- did it have an architect? It was planned before the days of teams of architects, so maybe a single person planned it all. Perhaps she was a Rosicrucian adept because it has the feeling of a medieval academy, or even an ancient academy like the Alexandrian University -- the first university, founded in 321 B.C. by Ptolemy Soter the First, or the Platonic Academy, the first one of the sort. The architecture of the Alexandrian University was certainly very much like this, and if this isn't stretching it too much, those of you who live here could imagine yourselves actually living in the reincarnation of the Alexandrrian University, the source of the so-called Western tradition and the place where Christianity, or at least the philosophy of the Christian tradition, was born.

Above the gate of Plato's academy, in 400 B.C. or so, it said something like "Let no one enter who doesn't know geometry". It doesn't say that here, but as you enter through a geometric symbol, you could either get it or miss it. I wonder what you think of that. Can you imagine that it's actually important to know geometry for some reason to understand the all and everything? Or to understand a little bit beyond geometry itself? It's hard to understand now, because mathematics has suffered a complete dissociation from the rest of the world -- from the intellectual enterprise, the practical affairs of the world, and the defined affairs of the spirit. But this wasn't always so, and certainly not in the time of Plato. It wasn't so in the time of Plotinus and Hypacia in Alexandria. Could it be that this connection, which we can hardly imagine, is actually important for something that deserves our attention? Anyway, for those who care to make this journey I will try this evening to go from the gate of Plato's Academy to the entrance of Stanford University in a kind of continuous loop. This may well be ambitious to the point of being impossible, but maybe mathematics will help us to draw a little geometrical map of this journey.

First, I might try to say why I care, and why I think you should all care. You do care, or you wouldn't be here. Or maybe you would, because who knows what to expect in a talk entitled "The Geometry of the Soul". It was around 24 years ago that my visions began. At that time I was already established on the straight track of mathematical professordom, where success did not depend upon being aware of the world, or being connected to the world. You just had to know this kind of specialized trick that is done in the mathematical landscape far away. The visions began, and they had as much of a feeling of reality as this reality, so they couldn't exactly be ignored. There seemed to

be a kind of relationship between that reality and this one, which may suggest the pattern of things. It seemed to me then, because of my technical training in mathematics -- although I was never trained, I could just do it -- that this mathematical stuff was actually relevant, it was useful to the understanding of metaphysical realities. Not only because it's a model and a map. It's even more useful than that. The world beyond ordinary reality, which then opened for me, was mathematical. It was mathematics come to life. We have mathematical symbols, but mathematical symbolism is not mathematics. Mathematics is a reality as alive as this one, full of incredibly rich detail and surprises.

I remained interested in that phenomenon. It showed a possibility, a suggestion as in a dream, of the potential usefulness of mathematics in ordinary life and in the sacred. It goes beyond what is taught in school, and beyond the research of the professional and international mathematical research communities and the frontiers of academia. Perhaps one reason I got interested in computer graphics and created the Visual Math Project at U.C.Santa Cruz is the feeling that computer graphics would eventually be capable of some kind of simulation of the vision which could then be shared with people who had had the vision, so that as soon as they saw it they would realize that they had seen it, thus having their own visual imagery, their own interior life amplified, as it were, by a machine. If it worked, it could justify the existence of these machines, which, let us face it, are very expensive for the planet, for the biosphere, and for the water table.

Just a few years later, in the context of the Visual Mathematics Project, I organized a computer graphics film show. One night, while sitting in the auditorium, I had the experience of seeing Thomas Banchoff's pioneering computer graphic math film *Hyper Cube* projected on a large screen. It was so similar to my own vision that I wondered, had I really had this inner vision, or was it a precognitive flash of a night four years hence when I would be watching this particular film? The difference was that the inner reality is kind of interactive and the film is not. At any rate, it reinforced my idea that computer graphics can somehow be employed to share the vision if we can figure out how to program it. Banchoff's film suggested that mathematics as an algorithm for a computer graphics show could produce, let us say, a kind of simulation of a divine vision. Wow!

I began looking for some help with these concepts in the history of the various mystical traditions. These explorations included study and also experiences. And since I was lucky with experiences, I looked in the literature for studies that reflected experience -- you know, the kind where you feel that the author is talking about an experience instead of talking about what somebody else was talking about, which is what all literary criticism is about. That's all very good, I'm not putting it down, but you sometimes wonder about where, in the historical tradition of the western world, is direct experience to be found as the inspiration for the actual writing. I don't think that any generation should be without its shamans providing the illumination of real experience to the culture. It's not necessary for everybody to travel on a daily basis to the mystical realms, but it seems dangerous for our civilization to go on for years without direct experience, and this may be one reason why people should persue the legalization of marijuana, for example.

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So here's the roadmap. I could start in dimmest prehistory with the archeological excavation of the remotest ice age, but we only have about 30 minutes for this journey, so I'll just take us from Plato's door around 400 B.C. to the present. Plato was the follower of Pythagoras, who lived a couple of hundred years earlier. Pythagoras followed Orpheus, who was said to have been transplanted to Greece from Egypt, where he had been Osiris. The trinity was dominated by the goddess Isis, that was inherited from the prehistoric goddess tradition, the goddess Trivia.(???) And Trivia -- the three roads, the three faces, the trinity -- is important throughout. We'll see trinity after trinity that reflects this earlier history which I won't go into because a lot of literature on the subject exists.

Aristotle was a student at Plato's Academy. He split off and formed his own school, the Lyceum, nearby. Both academies had superb libraries which were later purchased by Ptolemy Philadelphus to add to the collection in the library in Alexandria. Alexander's dad Phillip was a big soldier from Macedonia who unified Greece and was murdered in his youth. Alexander, a mere kid, picked up dad's sword and conquered the known world, creating the first great empire of the time. When his lover, who was a general, died of the flu, Alexander died of heartbreak, and the empire was divided up by the generals.

One of them, Ptolemy Soter, inherited Africa, which didn't seem to be worth much except that Alexander had decided to put his capital there in kind of an empty spot. After Alexander's death Ptolemy built the capital according to Alexander's plan, employing a famous architect. There was a lot of money available because what the Romans ate was grown near the seaport Alexandria. It was a clever idea to put a town where you would never have to worry about money. Ptolemy and his line of relatives married each other and kept the Ptolemaic succession pure. Eventually, the clan included Cleopatra -- but that's another story. They believed in disseminating the knowledge of philosophy, of mathematics, of theater arts, of poetry, of history. The first history department and the first political science department were all at Alexandria, and there were books from everywhere.

Plato never wrote down his ideas; they were transmitted orally. Aristotle was the first of many authorities on these oral teachings that had to do with the geometry of the soul. It was not yet explicit, there were only hints. In Alexandria, the picture was completed, but the clear, geometric model of the soul they came up with was attributed to Plato. Hence they're called

Neoplatonists. This took a while. Alexandria was the intellectual capital of the Western world for a thousand years until it was destroyed in one day. Actually it took six months to burn all the books. But I'm getting ahead of my story.

From Asia Minor, from Palestine and so on came another line. It came from Egypt through Crete. In the Hebrew tradition, there is another philosophical style which is preferred by mystics. Unlike, as far as we know, the Platonic tradition, this style is characterized by experience. There was kind of a meditation trick you did by sitting down with your head between your knees. It led to an altered state from which visions were transcribed in stories using symbols that are very allegorical. There's a whole literature of them. One of the first written examples of this tradition is in Ezekiel, one of the later prophets of the Old Testament who supposedly lived around the time of Pythagoras. Know what I mean?

[Sings] "Ezekiel saw the wheel way up in the middle of the sky. The little wheel turned by faith, the big wheel turned by the grace of God." If you read that in Ezekiel, you get this incredible geometrical metaphor about the palaces of God. There are concentric spheres and you travel through them; they have a hierarchical structure because concentric spheres have a common center, so there's sphere within sphere within sphere. One of the outer ones, the celestial sphere, is where you get to the seventh heaven. Each time you go from one sphere to another, you have to go through a gate. Plato's geometry of the soul was one gate, and you had to have the knowledge to get through, including the passwords, which is the origin of ceremonial magic. The palace has four gates. Each gate has two guards. You have to choose one of the gates, and in order to pacify both guards you have to know the passwords and prove your sincerity. If you do all this, you can go through, and then there is a long journey and another identical palace with another four gates.

There are maps that apparently describe the shared experience of a whole culture. These came down to Alexandria through the so-called Diaspora, the diffusion of the Jews after one of the many destructions of the temple or the Babylonians taking over Jerusalem. When Alexander conquered Jerusalem, he was nice to the Jews for a while, and a great many Jews moved to Alexandria to help. When you start a capital city of a great empire, you need a lot of people. Almost a million people immediately moved to Alexandria. They built it up like Santa Cruz after the earthquake, there was a huge corridor of Egyptians with Egyptian temples, practicing the Egyptian religion with their priests, and next to that was a huge corridor of Jews up near the harbor, which included orthodox, reformed, and totally integrated Jews who didn't even know Hebrew anymore. These had the Pentateuch translated into Greek, because the rituals were done in Greek in the synagogue -- they were not called temples any more but synagogues.

The Ptolemys had the genius to create a religion which would be accepted by all these people as a single state religion. It was based on the goddess Isis. There were priestesses and philosophers and scholars of the goddess religion. Maybe they changed the name and the images and substituted Greek for the diverse languages. What they came up with was really quite popular, but people also went to their own synagogues and temples. This Hecalot(?) tradition migrated to Alexandria. A Jew named Philo Judeas lived in

Alexandria. He was one of the Greek-speaking integrated Jews who hardly knew Hebrew, but he did know the tradition of the direct experience of the Hecalot literature and was devoted to the knowledge that came from this experience. He knew the Greek tradition since he was a Greek scholar who had gone through the academy and knew all the literature. He realized that the Greeks had a superior philosophical system that had a hollow spot in the center because of the lack of direct experience. Philo attempted to remedy this. He was twenty-five years old when Jesus was born, which means that he lived before and after the actual life of Jesus. The foundation of Christianity and its philosophical underpinning took place in Alexandria in Philo's time. So here we have a crossroad in the history of philosophy and religion in Alexandria that happened at the time when Christianity was born. That was in the middle of the millenial history of Alexandria.

Eventually there was a new birth of Platonism, the Neo-Platonic tradition, which overlapped the Gnosis and the Gnostic Christian Tradition, and the Macabarmistics(?) and the Jewish mystical tradition continues. After this there were three lines for a while. The main teachers were Amonius Sakus and Alexandria Plotinus, students of Amonius; Porphyry, the student of Plotinus; Iamblicus, the student of Porphyry -- there were about half a dozen of them, ending with Hypacia and Procleus. And then it stops, because Omar the First, the advisor of Mohammed, began the Muslim conquest of the world upon Mohammed's death in 640 or thereabout, creating a new and larger empire, and in the process destroying Alexandria and burning all the books, because he said, "A book either agrees with the Koran, in which case it's not necessary, or it disagrees, in which case it's not necessary. Therefore burn them all."

It took six months of burning and 4,000 furnaces to eliminate the 700,000 scrolls of the Alexandrian library. Few books survived. Alexander's books survived because the general in charge befriended one of the librarians of the library at the Serapaneum and spared Alexander's books while burning all the others. Therefore the previous balance between the Platonic and the Aristotelean, between a mystical tradition and a practical, scientific, bottom-up sort of physical approach was disturbed, and our society still suffers from this weird historical accident.

The two traditions went on until the so-called dark ages and then the Platonic one stopped. It was revived in the Renaissance because people got the books and decided that it was important to translate them. They became devotees and actually tried to have the experiences. But by then there was an extensive literature and all three had come together by the designs of...well, I said I would make a road map. I would put all the academies between Plato and Stanford University on this map. Quite a few of them consciously tried to imitate Plato's academy or the Alexandrian library.

In Byzantium there was a continuous tradition, a Platonic academy that never closed. In 1432 its leader decided to export the Platonic corpus kept in that library since before Omar to Europe. The name of this leader was George Jalistus Plathon. He took this name in honor of Plato because he was the head of the only existing Platonic academy in the year 1400. He went to Florence, where he befriended Cosimo de Medici and persuaded him to reopen a Platonic Academy. He bought up all the books for an enormous amount of money and had copies made. With these he created a library and managed to get scholars who knew languages like Aramaic, Armenian, Old Church, Slavonic and so on. Pico

de la Mirandola, for example, a young kid with long blond hair, was very much at home in 14 languages, and he considered it his mission to unify these lines. He crossed the Kabala with the Neo-Platonic lore, thereby producing the so-called Christian Kabala. What we call the Western tradition was actually put together in the 15th Century by two or three men who followed their inspiration.

From there the line to Stanford can be easily traced. Perhaps you know about Thomas Taylor, the enlightenment, the romantic response to Thomas Taylor, and the revival of Neo-Platonism in recent times. All this is taught in European history courses. But let us get back to the geometry of the soul. I said in the beginning that there can be no understanding of divine experience without geometry. That was the belief of Plato; it is present throughout Neo-Platonism, and that's the reason why in our alchemical texts, like in John Dee and so on, we have all these geometrical maps of the cosmos. "As above, so below", for example.

I want to try to draw a map of the soul, so we can have something concrete, if you can call it concrete. I'll put energy, matter and ordinary reality, the whole known universe, into a little box that we'll call the physical level. In fact, Aristotle called them physicals. Then I'll draw concentric spheres with another box above it, and we'll call it the metaphysical plane. As I told you, there are trinities everywhere. These two are part of a trinity, and the third one, the connection between them, is the Logos. In the early Christian tradition, this was translated into body, soul, and spirit. The body and soul dichotomy was already known in the so-called old academy period immediately after Plato, and the spirit, the logos, was added by Philo Judeas. He considered it a sort of electromagnetic field which encompassed it all.

After Plotinus, three different layers called the three hypostases of Plotinus can be identified. They're called the One. Plato called it the Good, which is essentially the One -- God, Jahweh, or whatever, but not anthropomorphic. The next layer is intellectual, the nous, and the world soul, which the individual souls are little pieces of. Though Plotinus hardly wrote about this at all, he was exclusively interested in it, and as a follower of Philo, he was especially interested in the experiential aspect. We're talking about traveling to different dimensions and reporting on these travels, trying to put them into words, which is very difficult. This layer was identified with mathematics as an equation. The soul equals mathematics.

Mathematics had four parts which were called arithmetic, geometry, astronomy, and harmony. These component parts of the world soul were called the arithmeticals, the geometricals, the astronomicals, and the harmonicals. There are whole books about what these mean experientially. Harmonicals is about waves. Geometricals are not triangles and things, but whole recognizable forms. Arithmeticals are the numbers in the richer than (?) formulation of Pythagoras. Today we might call astronomicals dynamicals, because astronomicals are geometricals in motion. They are models for motion, what we would call dynamics. The word astronomical has degenerated into the particular case of the celestial motion, but in Greek times it meant more generally motion, and therefore we could call it dynamicals.

So there are three levels. Throughout history there are threes everywhere.
There is one at the very start of the Greek tradition, in Hesiod's Theogamy,
the first creation myth in our tradition. In the beginning, there are three
principles called Chaos, Gaia, Eros. These words in Hesiod are just abstract,
cosmic principles. I discovered this particular trinity -- I call it the
Orphic trinity -- when a journalist who had read Jim Gleick's book on *Chaos:
The Making of a New Science* called me and asked about the origin of the chaos
concept. I mentioned Poincare(?) and Burkoff (?) and a few others who spoke
about it about a century ago, but he said, "No, I mean the chaos concept, you
know, disorder, mess". I looked it up and found a Greek word, (?). You can
look it up. The entire Greek Corpus as it exists today is computerized. When
you look for the word chaos, you find that it shows up for the first time in
Hesiod's Theogamy, where it appears as one of three.

These are fundamental cosmic principles, like the Father, the Son and the Holy
Ghost. They have meanings after meanings after meanings and applications, but
they are abstract principles. It occurred to me that what's happening now is
the Chaos Revolution. We have the Gaia Hypothesis, and there is a new
movement of mathematical models in the social sciences that is associated with
Eros. So it seems that there is now a kind of revolution in science in which
these three cosmic principles are being recovered, forcing their way somehow
into the scientific tradition, which is traditionally sterile, orderly, and so
on. The chaos concept existed before the word chaos, because Hesiod lived in
800 B.C., and when we look further back we find the chaos concept under
different names in various traditions, most especially in Egypt, Babylon,
Sumer.

In Babylonia, Tiamat was the goddess of the Deep. In the Bible you have Tohu
Wa Bohu. These are manifestations of chaos, or of what we mean by chaos,
regarded as an abstract cosmic principle that went by various names in older
traditions. Tiamat goes back to perhaps 4000 B.C., about the time when the
patriarchal takeover occurred. And chaos is always associated with a goddess,
it's a feminine word in Greek; with the symbol of a serpent, Leviathan, a
water monster, chaos of the water, of the deep, of the deep unconscious. In
Babylonian times, Tiamat was killed by Marduk, the law and order king. Since
then, the chaos concept has been repressed. The very idea of chaos has become
synonymous with evil. There was the Fall; the serpent seduced Eve who then
told Adam and so on. The negative charge on chaos somehow comes from the law
and order god Marduk, who is identical with Jahweh, of course, and our entire
Judeo-Christian tradition somehow got a law and order bias at the expense of
chaos.

The fact that these revolutions are taking place in science today is an
example of what Riane Eisler called the Gailanic resurgence wave -- aspects of
the goddess partnership societies of the prehistoric past -- which may be
essential for the survival of our species on this planet...in case that's
desired, I'm not sure. They are, according to Eisler, constantly welling up
from the collective unconscious and manifest in some sensitive individuals as
a small revolutionary movement that tries to reestablish some sort of goddess
principle or the Platonic tradition. This happened in the Renaissance, the
hippie movement of the 1960s, maybe the Greens movement today. They
reestablish repressed goddess characteristics as a social transformation,
which is then immediately repressed again by the enormous force of the
patriarchal law and order god type. This is an absolutely prototypical

dynamical pattern from the world's soul. If we could learn the exact
mechanics of this dynamic, we could then perhaps work with it in order to
create a viable future.

This is why I believe it is vital for us today to figure out the geometry of
the soul. We must be guided by direct experience. We have to overcome 6,000
years of the repression of important knowledge which is our heritage, which
should be ours, in order to have a future, in case that's desirable. Or to go
out gracefully, if that's desirable -- to participate in the coming ice age
for the planet Earth and also for the rest of the solar system. Many people
now feel that we are on the way out, that our survival, the future of the
human species, lies in space. If that were so, we'd take our geometrical
limitations, our dynamical limitations with us, unless we learn to surmount
them. My suggestion then is that mathematics, including the dynamicals, of
which there are three kinds -- the staticals, the periodicals, and the
chaoticals -- is necessary. Let those who don't know this not pass through
the door. They can go through the door, but not enter. Our species is at the
gate to the future, but we don't even know what people knew 1000 years ago.
We have universities that teach all the bits. But are these bits ever
integrated? Isn't it our responsibility to put university behind us at some
point and carry on with our education to regain the all and everything, the
lifetime best of our species within ourselves and the integration of our
understanding to a level that deserves a future? If we don't, we won't go
through the door.

According to some, mathematics consists of algebra and geometry only, and
that's all. When I tell people that I do mathematical research, they say,
"Oh, I thought that ended with Plato, and Euclid polished it off." But one
area of development in mathematics, or in mathematical-type thought, has to do
with the chaos revolution. Here is what has happened: In mathematics we have
many frontiers of continuing research, but they are mostly the tail end of a
long development that started 300-400 years ago. There is one area, however,
which is a complete novelty and starts from absolute scratch, and that is
chaos theory -- dynamical models of chaotic phenomena. And since this study
is possible only because of the computer revolution, many traditional
mathematicians have rejected it. So it's controversial whether it should be
called mathematics or not, but the more forward-seeing people in the
mathematical community who have at least accepted computers as word
processors are now saying that mathematics is not number and form. It is not
algebra and geometry. Mathematics is the study of space-time patterns. Well,
space-time patterns is one way of describing the perceptual aspect of the
world we experience on inner journeys. It is full of space-time patterns for
which we have no name, therefore we cannot really say much about them when we
come back from an experience.

Thanks to the computer revolution and its effect on mathematics, we now have
the beginning of a brand-new branch of mathematics which is not dignified by
symbolic representation, by formalism of set theory and category theory and
symbols and so on. It's just in an exploratory experiential stage. I'll
describe one experiment to you to give you an idea. There are many different
mathematical models of chaos. The amazing thing is that when chaotic behavior
in nature is viewed through the new computer-based tools, you always seem to
get one of a few forms. I call this computer graphic technology the
chaoscope. You look around you through the chaoscope, and you see form and

something like order where you were used to seeing just random shapes --
shapes that you didn't understand. You could not cognate them. You could not
grok the space-time pattern because it was beyond what you were able to deal
with. Now you look through this chaoscope, which is something like a
telescope backwards, and you're able to see recognizable forms. You could
give them names like faces of human beings. "Oh, I've seen this guy before" -
- it's earthquake data, it's electrophysiology of epileptic seizures, it's
heart disease and stroke in its final phases. If you saw the documentary
films about chaos, you've seen all this stuff. Here's the chaotic data, and
here's this incredibly simple fractal geometrical form which is its image in
the chaoscope. This experiment, I believe, has to do with the geometry of the
soul.

Take 64,000 computers and put an essentially identical chaotic model in each
one. These models produce chaotic data, which looks like earthquake data or
an epileptic seizure seen through an EEG. You put them on the table in a way
that distributes them randomly all over the table. Each one makes a very
feeble contact with the four nearest neighbors. You just let this chaotic
mess run on a massively parallel super computer, and in a matter of minutes,
after a few thousand iterations, a form emerges that looks exactly like the
groundplan of Stanford University. A space-time pattern with regular regions
of chaos -- regular chaos. You get a computer graphics display and strobe it
-- and then you see this unbelievably faithful representation of actual trips
where people see palaces, the Hecalot literature, the gates, the wheels within
the wheels -- we're talking about the miraculous advance of the capability of
mathematics, of mathematicals, to actually represent our metaphysical
experience where words have failed.

We are looking for an encyclopedia of models for phenomena. In the future,
because we're dealing with complex systems, we're not going to make the
mistake of identifying a model with a phenomenon. There is Maxwell's equation
for the electromagnetic field, and there is Schroedinger's equation for the
hydrogen atom. These mathematical models are so good, they're such faithful
representations of those particular, simple systems, that you can just use the
one or the other interchangably. That's why the history of mathematical
physics has become identified with the mathematical model of the phenomenal
realm. With complex systems we're not going to be able to do that because our
models are not that good. That means we're going to have a lot of different
models for a given phenomenon. None of the models are too good. We would not
necessarily care if different models gave identical results. That is to say,
you couldn't tell from the results which model it came from. It would be of
interest to us only if one model was much cheaper than the other. That's why
these results about equivalence of models are theoretically interesting, but
they all have to do with a class of models which is too simple to actually
describe our behavior.

We're talking about making a model from the chaotic behavior. If it's a
compact model, it's useful. You can use it as a word, or as a symbol, and you
can dialogue with it. I don't think that the actual deterministic models are
very interesting. What's interesting is advancing cognitive capability so we
can grok their behavior. Maybe we need to enhance our understanding and our
acceptance of chaos. We do not really have to completely give up our
machinery, our extensive mechanics, in place of models and so on for order. I
think that in the future we will seek a partnership between order and chaos.

Tiamat would be placed on her throne again and elevated to her rightful place in history, and Marduk won't be sliced in two like he did to Tiamat.

We're not quite ready to simulate something as complex as embryogenesis, but a mathematical model for embryogenesis has been an outstanding problem in mathematical biology for 100 years. Eventually somebody will try to at least get a cell to divide in a mathematical model. If we're going to make a model for the human body as a collection of cells on that level of description, then we would do it with massively parallel machine where there is a machine for each cell. The communication between the cells would be this lookup table. If you have a successful model, which may never happen, and that would be okay with me, you'd start off with a single cell, and then you would see embryogenesis. You would see the formation of the embryo, and then the birth. That's model making. We make a simple representation of very complex data.

The model is not supposed to have the richness of the data because a model that rich wouldn't be useful. Our cognitive strategy is to get a simpler model representative of a more complex thing that kind of evokes it by a resonance phenomenon. If we applied these ideas to the human body, diseases might be cured through a kind of holistic approach that seems to the ordered forms of chaos like a kind of generalized resonance between the generalized oscillations of the different paths -- kind of a harmonic wave series through the whole thing where all the waves would be chaotic waves. And if the balance of the different chaoticals in the human system were somehow disturbed, it could be recognized by a chaoscope, and an appropriate homeopathic medicine or perhaps a physical manipulation could then restore the cell.

It's not the model we want, it's understanding. Our limitation in dealing with the environment and the health of the biosphere and our own relationship with it is that these are very complex systems beyond our comprehension. I can't tell whether to vote for this president or not because all of the consequences are in the real systems where I want certain results. I can't make a prediction because the situation, the system, is too complex. So I can't vote. We can't have a democracy on this level of dynamical ignorance. We need some kind of modeling to enhance our intelligence in grokking complex systems so we can decide what to do to go forward, or else we go on faith, which may not be too bad; we can get away with it forever.

There is a horizon of complexcity beyond which we cannot see. Along comes the chaoscope; the horizon is pushed back a little bit. All I am suggesting about the role of chaos mathematics is understanding. It's a small advance in the domain of complexity that we can now grok. If the horizon of complexity is among our problems, the systems that we need to interact with are too complex for us to grok, we are essentially completely blind when it comes to really complex systems. Physics is the study of simple systems. Biology studies more complex systems. And social systems are much more complex. We need strategies to deal with more complex systems. We don't know if the addition of one nation to the nuclear club would destabilize the whole world or create paradise on earth. We actually don't know. Maybe mathematics and the computer revolution in combination with traditional philosophies will come to our aid, and maybe not. Of course we're going to try everything.

In my view, our complexity horizon is really tightly drawn around us. Whether consciousness requires grokking or not, I don't know. We can see things and not understand them, and then there are things we can't even see. Mathematics is not the answer to everything. The most fundamental problem seems to be that people have gone to sleep and no longer have an idea what's important to accomplish and what isn't. There are no goals outside of creating an inheritance for your children or setting up a real estate empire or something like that. Whether this death of the human spirit has to do with the complexity horizon or not, I don't know. But I personally feel a great frustration in my life about what I read in the newspapers about world affairs, because I don't actually know what to do. I don't feel I can send a large check to Amnesty International, for example, because I don't know anymore who's running these things and what they're doing, and what the effect would be. What if they suddenly succeeded to acquire a pavillion at the Epcot[??] Center or at Disneyland and were able to portray their view of the world with music, would that be good or not? I'm not sure that the overall limitation of understanding is a problem that has anything to do with consciousness or unconsciousness. It's simpler than that.

John Dee had an interesting model of the all and everything. He talked of ordinary reality here and the world of spirit above, and he identified mathematics with the logos. He thought of mathematics as being sort of halfway between ordinary reality and the divine realm -- a kind of a bridge between the two, the way to get back and forth between divine and ordinary reality. He spoke of the application of mathematics for modeling the phenomena of ordinary reality. He called that applied mathematics, as we do today, and in his preface of the first English translation of Euclid by Billingsly in 1583, he wrote an encyclopedia of all known branches of applied mathematics. He spoke of the application of mathematics upward for modeling divine mind, and he called that Methesis. Since applied mathematics, including the chaos theory applications, neurophysiology, cellular biology and so on is to some extent known, it is advancing rapidly and is available in *Nature*, *Science, Scientific American* and so on. In fact the latest *Scientific American* has an article by Walter Freeman presenting pretty much the latest frontier in the application of chaos theory to brain models.

I don't want to leave the spirit out, because I think this is an important opportunity to fall in love with the spirit through mathematics, believe it or not. There is an opportunity in every one of the isolated sciences, whether physical, biological or social, for a fantastic advance of understanding, not equaled since Newton's invention of calculus showed us how to apply it to the physical sciences 400 years ago. There is an equally fantastic opportunity for linguistics, poetics, literary criticism and so on -- Chaos Theory is revolutionizing all these subjects. There is the possibility of synthesis, of synchrotism. When we have models made of a common technology in each and every one of these university departments, we will attain, for the first time in a long while, the capability, the possibility, whether we will take it or not, to link them all up. The reason why we don't have that possibility now is that the magnitude of detail and knowledge in all these departments exceeds the possibility of any one brain, no matter how large. If I did nothing but read and even went without sleep, I couldn't read the literature of half the specialty of chaotic dynamics in my lifetime. Reading won't do it. Grokking by intuition won't do it either. You go through these nonlinear wave equations and whew!

By using mathematics and computer technology to extend the human brain in its capability to synthesize all this information, we can, for the first time, gain for ourselves an enhanced understanding. I'm challenging everyone to synthesize all this learning in their own mind in their lifetime. Mathematics as a computer science can give you a hand. Here's a realm, somewhat like virtual reality, in which we can actually cooperate. We can put our models together without the necessity of understanding each others model separately. We will be able to understand their union in this altered reality which is our construction, which is the genius of our time and our science and technology. If we choose to use it in a divine way, we will put all this together and we will have applied mathematics, and all these different subjects will suddenly become one. You won't even have to know how the model is made. It will be just like a computer game taking place in virtual reality.

The reason why the acknowledgement and easy acceptance and function of chaos is necessary is that as soon as you take two periodicals and combine them, you almost certainly get chaos. People who were restricted to Fourier analysis, F.(?) synthesis, epicycles and so on, are limitated in their modeling capability in the context of complex systems. I'm not the first one who has the idea of making comparable models in all the subjects and putting them together. A generation ago, Jay Forester at M.I.T. had the idea to use linear differential equations for each organ and to combine them into an organism. Each of these linear systems did periodicals, but when you combined them, suddenly the whole thing behaved chaotically. The model was out of control, and they threw it out because they could not handle the chaos.

Today, the same people with the same strategies with reinforcement and support from the new acceptance of chaos would not have to throw those models out. They could work with them so as to make the chaotic behavior of the model sufficiently comparable to the chaotic behavior of the real systems. There is urban dynamics, industrial dynamics, there are models of cities, models of industries, models of the world economy, the Club of Rome model which was discredited because it didn't predict the economic future well enough. But today, Chaos Theory is reliably predicting the economic future. People are following it and making a lot of money. The problem with periodicals is that they tend to go into chaos, because somehow that is the natural state of nature.

There is a linkage between the Renaissance, the mini-Renaissance of the sixties, the Greens, and the partnership society of Riane Eisler's book *The Chalice and the Blade* that can give us more insights into how we could make a world that has an ongoing renaissance and is sustainable. The book is primarily historical or prehistorical, but in the end the author does have some definite suggestions. There is a whole popular movement around her book with people getting together in groups with a workbook called *The Partnership Way*. It gives definite suggestions for trying to discover the partnership way of school, the partnership way of relationships, the partnership way of cooperation, the partnership way of sex, the partnership way of families, of eating and so on. Her program is to try and revision every aspect of popular culture through the prehistoric partnership paradigm to see if we can't find a way that works. Among people who experienced hippie communal living in the sixties there is a theory that there were philosophical flaws and patriarchal biases in that social transformation which sort of doomed it from the start. If Riane Eisler's book had been published in 1963 instead of 1983, the sixties

might have been totally different, I believe. But somehow the partnership idea was totally unknown in the 1960s.

The key to chaos is that we have to overcome 6000 years of repression to have a future. We need to realize that things don't have to be so organized. Things can be a little more free. The medical practitioners are applying chaos theory to the heart, the brain and other organs, and they have found out that healthy states are more chaotic than sick ones. When the heart patient is about to die, the heart rhythm becomes actually periodical. These concepts will all eventually trickle down to the elementary level, because they are so simple. This is not higher mathematics. The only difficult thing about these concepts is their strangeness, because they were repressed. I think that the proper point of entry of the new mathematics into the educational system is at the kindergarten level, assuming of course that there are adequate desktop supercomputers and personal computers, which is inevitable in maybe five or ten years.