

# The Heart of the Laboratory

## Or the Modest Newsletter Scientifical

### Chaos Theory

*Intended as an Introduction to the Much More Interesting Topic of Regenerate or Romantic Science*

Before we address chaos theory specifically, allow me to quote extensively and somewhat sporadically from a section of *The Abolition of Man* in which C. S. Lewis is discussing the goals and methods of modern science:

Now I take it that when we understand a thing analytically and then dominate and use it for our own convenience we reduce it to the level of 'Nature' in the sense that we suspend our judgments of value about it, ignore its final cause (if any), and treat it in terms of quantity. This repression of elements in what would otherwise be our total reaction to it is sometimes very noticeable and even painful: something has to be overcome before we can cut up a dead man or a live animal in a dissecting room....The great minds know very well that the object, so treated, is an artificial abstraction, that something of its reality has been lost (81-82).

Nothing I can say will prevent some people from describing this lecture as an attack on science. I deny the charge, of course....But I can go further than that. I even suggest that from Science herself the cure might come....

Is it, then, possible to imagine a new Natural Philosophy, continually conscious that the 'natural object' produced by analysis and abstraction is not reality but only a view, and always correcting the abstraction? I hardly know what I am asking for. I hear rumours that Goethe's approach to nature deserves fuller consideration—that even Dr. Steiner may have seen something that orthodox researchers have missed. The regenerate science which I have in mind would not do even to minerals and vegetables what modern science threatens to do to man himself. When it explained it would not explain away. When it spoke of the parts it would remember the whole. While studying the *It* it would not lose what Martin Buber calls the *Thou*-situation....In a word, it would conquer Nature without being at the same time conquered by her (87-90).<sup>1</sup>

What exactly is this New Natural Philosophy or Regenerate Science? If Lewis himself did not quite know, the rest of us are in uncertain waters. We know that the groundwork of the new science must be anti-reductionist, but beyond that, nearly nobody knows quite what to look for. In my opinion, that is a very good reason to keep our eyes open. Modern science goes through moods and philosophies like every other discipline, and perhaps its moods are not always so far away from something like a Regenerate Science as might be supposed. One of the most well-known recent scientific moods is chaos theory, which is making at least some scientists rethink some major elements in their approach to Nature. I find at least three aspects of chaos theory to be curious and perhaps worthy of more attention than we generally give to scientific moods.

The first curious thing about chaos theory is that it rejects *classical* (Newtonian) reductionism. This is different from the kind of *metaphysical* reductionism that Lewis has in mind, but perhaps the two are not wholly foreign to each other.<sup>2</sup> Chaos theory places great emphasis on the whole being greater, sometimes other than, its parts.

<sup>1</sup> Lewis, C. S. *The Abolition of Man*. New York: Macmillan Publishing Co., 1947.

<sup>2</sup> Lewis talks about *metaphysical* reductionism, the kind that occurs when you strip an object of value judgment. Thus, a scientist reduces water to a collection of H<sub>2</sub>O molecules without asking about the aesthetic appeal of a waterfall. In chaos theory, the kind of *classical* reduction being discussed is the emphasis on the smallest parts of a system determining the whole. It is the reduction of a thing to its

This is why it is called “chaos theory”—not because Nature is really chaotic but because if you reduce Nature to particles and pieces without looking at the whole, it *seems to be* chaotic because you are missing out on what is really going on. Chaos theory tells you to back up and look at the grand pattern, and then you will see that the apparently random pieces fit together in a more intricate order than you ever supposed. In fact, the emphasis on the “grand pattern” develops into an almost Platonic theory of form. Scientists start talking about Final Causes again, especially in relation to shape—but this time not just the shapes of physical things like trees but the “shape” of the processes by which, for example, a tree absorbs water. Although all of this is a radical departure from the established modern science, it still leaves open the question of Naturalism—whether the “grand pattern” is really all there is—as well as value judgments and aesthetics.

The aesthetic side of the issue is directly concerned with the second curious thing about chaos theory, which is the predominance of value-charged words in its promulgation. When one reads James Gleick’s book *Chaos: Making a New Science*, it is difficult to miss a profound sense of awe on the part of the discovering scientists. In numerous instances, scientists draw parallels between science and art.<sup>3</sup> The “aesthetic” attitude is most prevalent among the mathematicians involved with fractals, but the appreciation of intricate order and “something more” than hard math is found in all fields. Take, for example, the following quote from Michael Feigenbaum, one of the foremost chaos physicists:

I truly do want to know how to describe clouds. But to say there’s a piece over here with that much density, and next to it a piece with this much density—to accumulate that much detailed information, I think is wrong. It’s certainly not how a human being perceives those things, and it’s not how an artist perceives them. Somewhere the business of writing down partial differential equations is not to have done the work on the problem. Somehow the wondrous promise of the earth is that there are things

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most basic component. A classical reductionist looks at the motion of this particular molecule of H<sub>2</sub>O and then draws a conclusion about the whole river. Chaos theory rejects classical reductionism and insists that you look holistically at the river, determine what is happening overall, and then worry about the individual molecules—if they turn out to be important. For our discussion of the Regenerate Science, it is important to notice that one can reject classical reduction while still embracing metaphysical reduction. That is, one can examine the holistic behavior of the river without giving a thought to its worth or beauty. One of the potential questions to be raised at the Bash is whether the holistic approach on the physical level could be a step toward a holistic approach on the metaphysical level.

<sup>3</sup> Art and math both imitate Nature. One could say that art imitates nature by making its real meaning and value apparent, while math imitates nature by subtraction, stripping a thing down to its quantity. The curious thing is that the chaos theorists, as both scientists and art lovers, believe that mathematical reduction and art are aesthetically linked in opposite proportion. For example, they claim that fractal geometry is beautiful because it corresponds most closely to Nature—it is the geometry that reduces the least. Fractals do not represent trees as cones or lightning as straight lines. However, cubism or other forms of modern art that try to “reduce” Nature to cones and straight lines are ugly precisely because they reduce too much. By this argument, all Euclidean geometry (circles, squares, etc.) is ugly and useless, whereas fractal geometry is beautiful and useful. But this is a footnote of obscure speculation that is only intended to make people want to find out what a fractal is. Come to the Bash and prepare to gawk.

beautiful in it, things wondrous and alluring, and by virtue of your trade you want to understand them.<sup>4</sup>

Perhaps this new emphasis on the “something more” of nature is connected to a third curious thing about chaos theorists, which is the strange recurrence of the name of Goethe. Several of the scientists who formulated chaos theory were either avid readers of Goethe’s poetry and philosophy, or else they dug up Goethe’s long-buried scientific works and gave them serious thought. Feigenbaum even concludes that Goethe was more correct in his analysis of color than Newton was, because Goethe grounds his theory upon the *human* perception of light rather than the reduction of light to mathematical frequencies. All of this is quite interesting in light of Lewis’s remarks on the possible value of Goethe’s science. We might even consider doing an entirely separate Bash on Goethe’s “Romantic Science” and the science of Oliver Sacks and A. R. Luria (also called “Romantic Science”).<sup>5</sup> Sacks and Luria conducted their neurological careers with a strong emphasis on the *human* side of things when dealing with disease, and it was Luria who gave “Romantic Science” its name. The Romantic Science, of course, may or may not end up being the Regenerate Science, and chaos theory may end up being neither. The question before us is not whether chaos theory is the full-blown Regenerate Science but whether it is making some waves in the right direction. Or perhaps we really ought to nail down first what the right direction actually *is*, and what Lewis’s Regenerate Science actually *is*, and then decide which waves chaos theory is actually making. And if it is amenable to all, we can maybe spend more time on the Romantic Science in the future.

#### Suggested Chaos Reading:

Which will be found boring by some and engrossing by others simply grossing but which is absolutely necessary for an elementary understanding of what is actually going on.  
 “A Brief Introduction”: <http://www.imho.com/grae/chaos/chaos.html>

#### The Following Excerpt:

##### Misconceptions about chaos theory

Chaos theory has received some attention, beginning with its popularity in movies such as *Jurassic Park*; public awareness of a science of chaos has been steadily increasing. However, as with any media covered item, many misconceptions have arisen concerning chaos theory. The most commonly held misconception about chaos theory is that chaos theory is about disorder. Nothing could be further from the truth! **Chaos theory is *not* about disorder!** It does *not* disprove determinism or dictate that ordered systems are impossible; it does *not* invalidate experimental evidence or claim that modeling complex systems is useless. The “chaos” in chaos theory is **order**—not simply order, but the very ESSENCE of order.

It is true that chaos theory dictates that minor changes can cause huge fluctuations. But one of the central concepts of chaos theory is that while it is impossible to exactly predict the state of a system, it is generally quite possible, even easy, to model the *overall behavior* of a system. Thus, chaos theory lays emphasis not on the *disorder* of the system—the inherent unpredictability of a system—but on the *order* inherent in the system—the universal behavior of similar systems.

Thus, it is incorrect to say that chaos theory is about disorder. To take an example, consider Lorenz’s Attractor.

<sup>4</sup> Gleick, James. *Chaos: Making a New Science*. New York: Viking Penguin, Inc., 1987. (187)

<sup>5</sup> I do not know how “Romantic Science” came to be the label for both of these groups. I am certain that Sacks and Luria read Goethe’s poetry, but I have never heard of any scientific connection between them.

The Lorenz Attractor is based on three differential equations, three constants, and three initial conditions. The attractor represents the behavior of gas at any given time, and its condition at any given time depends upon its condition at a previous time. If the initial conditions are changed by even a tiny amount, say as tiny as the inverse of Avogadro's number (a heinously small number with an order of  $1E-24$ ), checking the attractor at a later time will yield numbers totally different. This is because small differences will propagate themselves recursively until numbers are entirely dissimilar to the original system with the original initial conditions. However, the plot of the attractor will look very much the same.

Both systems will have totally different values at any given time, and yet the plot of the attractor—the *overall behavior of the system*—will be the same.

Chaos theory predicts that complex nonlinear systems are inherently unpredictable—but, at the same time, chaos theory *also* insures that often, the way to express such an unpredictable system lies not in exact equations, but in representations of the *behavior* of a system—in plots of strange attractors or in fractals. Thus, chaos theory, which many think is about unpredictability, is at the same time about predictability in even the most unstable systems.

#### Miniature Glossary for Those Who Are or Will Be Hopelessly Lost:

**Attractor** – A point or pattern to which a system tends to settle down, regardless of how or where it got started.  
Ex: a playground swing eventually returning to its resting position.

**Bifurcate** – To separate into two parts or branches; to fork.

**Complex number** – A combination of real numbers and imaginary numbers (see below).

Examples:  $1 + 7i$        $2 - 3i$        $148 + 45i$

**Fractal** – A rough or fragmented geometric shape that can be subdivided in parts, each of which is at least approximately a smaller copy of the whole (think of ferns or broccoli). Fractals are infinite lines enclosing finite areas. They cannot be represented by classical Euclidean geometry.

**Imaginary number** – Square root of a negative number. An imaginary number cannot really exist, but sometimes it's useful to “imagine” that it could.

Examples:

Square root of  $-1$  is written as “ $i$ .” (Square root of  $1$  is  $1$ , and you add the  $i$  for “imaginary.”)

Square root of  $-4$  is “ $2i$ ”; square root of  $-9$  is “ $3i$ .”

**Iteration** – An act or instance of repeating (as in “reiterate”).

Example:  $y = x + 1$

To perform an iteration with this equation, begin by choosing any starting point. We'll say  $x = 1$ . We write the problem as  $y = 1 + 1$ . This gives us the answer  $2$ , so  $2$  becomes the next  $x$ . We write  $y = 2 + 1$ , which is  $3$ , so we plug  $3$  back into the equation as an  $x$ . The process of taking the answer and plugging it back into the equation is called iteration. If we graph what happens to the iterations as we keep doing them, we could end up with a fractal or an attractor.

#### The Power Point

by Joel Zartman

In response to the general and mephic opinions I have detected with regard to the introduction in Fundamentalists churches of digital projectors, I would like to vent my own (not altogether general perhaps). I deplore the superstition with which the use of power point is regarded. I deplore it exceedingly. It seems to me that people have got the idea that some mystical taint will come to the message because of that medium. I say

there is no great difference between seeing words on a page or seeing them projected on a screen, and I wholeheartedly believe it. I do not say it merely to provoke debate. It is sheer folly to believe that it would be better to see the words printed on a page before us rather than projected on a screen before us where we can all behold them with an upraised head. The danger is when you include the image. That is when you face the dark specter of the irrational and there is real danger. But to believe that simply because the word is projected it is substantially changed is to use the word medium without meaning. What is a medium? A medium is that through which something is conveyed. I understand that if water flows through a round pipe it will emerge with a generally round shape, but you will still have water. If you maintain that the medium is the message then you have to maintain that there is no medium. The medium is not the message itself or it could not be called a medium. It has to be something other than the message, because it serves to convey the message. If you describe the emerging water as a tube of water you have departed from the essential part of the water, it's waterness. Now, it seems to me that to maintain that the medium is the message is to make a part that is not as essential the essence.

I do not say that the shape in which things emerge from their medium is not important. What I say is that when you make that shape the whole of your message you have committed a logical fallacy. I do not say that we should be indifferent to the medium through which we send out message because I do believe that the medium has limitations it imposes on what you send. What I say is that projected words are not essentially altered, by the medium of projection, in a way that makes them more distorted than they already are on the printed page.

The problem that exists with mass media, the printed variety included, is the democratic demand. If you were independently wealthy you could finance a very fine radio station and play good music and air intelligent lectures and discussions and sermons and readings of fine books. All this is possible if you really don't care that your listeners will be a select few, those, more or less, with good taste. But suppose you depend on your listeners and therefore on what they want to hear, or on what those who finance you believe that your listeners want to hear. Then you have the democratic demand, false unity, and the lowest common denominator. Folks who value these last three things, it seems to me, could be admirably described as liberals. This is the main problem that you have with mass media; and, it seems to me, it applies to having a big church, at any level (local, or denominational, or national or what have you). This democratic demand is not the only problem that you have, but it is the one that is common to all mass media.

The other problem that one thinks about is the problem of the image and the deleterious effects its irresponsible use can have on rational discourse. Since I am pontificating already, let me proceed to do so on this second problem. Here is where the problem of power point comes in. You see, power point is boring. It is as childish as fill-in-the-blank notes to have the words zoom around like spoons laden with food approaching the mouth of a recalcitrant brat. But most of the errors of that sort happen because people are tedious. To simply project the printed page is as interesting as the printed page. It is when people try to make it more interesting by the superfluous addition of visual bells and whistles that the problem surges. What is dangerous is when the image makes irrational or sentimental contact with the proceedings. Both the ambulatory words and the disjunct illustrations seem to be driven by a desire to make boring things interesting. But it is artificial and extrinsic to the real interest of the subject.<sup>6</sup> In my mind it is the same principle as the principle of rewards against which so admirable a charge and skirmish was led by the valorous Don Quixote de la Andrea and his

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<sup>6</sup>This idea, that the main problem has to do with the addition being extrinsic, is one I should like to work out more thoroughly. The intrinsic-ness or the extrinsic-ness of the appendage to the essential matter is where the very heart of the problem lies. Any opinions about this?

squire Sancho Todd.<sup>7</sup> Essentially, it is the superficiality that characterizes materialism that is at work again.<sup>8</sup> The danger is not in the projection simply because it uses the image. It tends toward irrationality because of the way people use it. It is vague and without logical connection to simply and superstitiously mistrust the bare use of an image, and even more so the bare projection of text. I believe that some people think that a painting hung on the wall would be acceptable, but that the same projected on the wall would be somehow tainted and unacceptable. I spit on that attitude, with all my heart. That is my unvarnished opinion and I fling it with abandon and insouciance.

### Letters to the Editor

Dear Editor,

The opinions and attitude of the writer of “The Power Point” are as unreasonable as they are unprovoked. They are filled with intolerable bigotry and they are flung with inexcusable blatancy at the docile and demure readers of this notoriously modest newsletter. The arguments are shallow and cheap and cynical. If the arguments were merely bad arguments, one could tolerate the affront. But the irrepressibly obnoxious and dogmatical tone of the articles is an insult to the sensibilities of your audience and a strain on the charity of their spirit. Please exercise greater discretion in the choice of what you include. At least try to excise the more strident ranting and raving.

Sincerely,  
I. M. Miffed

Dear U. R. Miffed,

I do not doubt your sincerity. I should be surprised if it is not as perpetual as it is pathetic. It is a general rule that I prefer articles by authors who are foaming at the mouth, so to speak. It is perhaps not unlike the habit some people have of liberally dousing all their food with Tabasco sauce. Perhaps you object to the braying of jackasses, but it is music to our long ears.

Yours most truly,  
The Editor

### A Quotation

*Why one contradicts.* One often contradicts an opinion when it is really only the tone in which it has been presented that is unsympathetic.

*-Fred Nietzsche*

### A Reminder

Bring \$33 to the bash if you want to get in on the retreat. Feb. 28 is the deadline.

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<sup>7</sup>I use these appellations because I find them irresistibly amusing and not because I mean to imply that the whole discussion amounted to a tilt with some harmless windmills. And I make fun of our people because we do not take ourselves seriously, after all.

<sup>8</sup>I wonder if the idea has real connections with the law of parsimony, Ockham’s razor? I would very much like to hear some opinions about that.