Chaos and Complexity: What Can Science Teach?

Keynote Address by Margaret J. Wheatley, Ed. D.

Everywhere around us and within us we experience complexity and diversity

Everywhere around us and within us we experience change, death, and renewal; order and chaos; growth and decay that becomes new life

Everywhere around us and within us we see pattern upon pattern, ever-deepening levels of complexity and variety

Why do we resist the vision or blind ourselves to the beauty or fail to embrace the learnings?

Each of us lives and works in organizations designed from 17th century images of the universe. The universe of Isaac Newton and Francis Bacon was a seductive place filled with clockwork images promising us prediction and reliability, teaching us to view everything, including ourselves, as machines. We learned to manage by separating things into parts. We engaged in planning for our future that we would determine. We sought for more and more precise and correct measures of a world we thought was objective.

For three centuries we have been planning, predicting and analyzing the world. We've held on to an intense belief of cause and effect and we've let numbers rule our lives. But at the end of the 20th century, our 17th century organizations are crumbling. Our world grows more disturbing and mysterious. Our failures to predict and control leer back at us from many places. Yet to what else can we turn? If our world is not predictable, then our approaches cannot work. But then, where are we?

Our organizations are strong complicated structures that are resistant to change, fearful of the future and we have built them that way deliberately. We built them that way to hold back the forces that seem to threaten their very existence. We are afraid of what would happen if we lose our grip. If we let the elements of our organizations recombine or reconfigure or even to speak truthfully to one another, we are afraid that things will fall apart. We do not trust that this is a world of growth, rejuvenation and process. We believe we must provide the energy to hold it together. By sheer force of will, we have resisted destruction. And if we let go, the world will disintegrate.

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Yet, throughout the universe, things work very well without us. Wherever we look, we see a landscape of movement and complexity, of forms that come and go, of structures that are not from organizational charts or job descriptions, but from impulses arriving out of deep natural processes of growth and of self-renewal. In our desire to control our organizations, we have detached ourselves from the forces that create order in the universe. All these years we have confused control with order. So what if we reframed the search? What if we stop looking for control and begin the search for order, which we can see everywhere around us in living dynamic systems?

It is time, I believe, to become a community of inquirers, serious explorers seeking to discover the essence of order—order we will find even in the heart of chaos. It is time to relinquish the limits we have placed on our organizations, time to release our defenses and fear. Time to take up new lenses and explore beyond our known boundaries. It is time to become full participants in this universe of emergent order.

To the early Greeks, the universe that they inhabited was peopled with many primordial beings. The first two founding parents of all that we observe in life were two gods: Chaos, the original abyss of darkness, and Gaea, the earth mother, the generative force. These two partners worked in tandem. Gaea knew that she would be unable to create anything that was alive without reaching into the dark abyss of Chaos and pulling forth what she needed from there to give form to life. These are very different assumptions about the workings of chaos and order than those that have played into our work.

To start, I would like to say that we function as a community of people who still want to make a difference. People who really want to change life in organizations for all of us. Who really want organizations to feel alive and worth working in, and adaptive and resilient; organizations that no longer worry about managing change, but instead, realize that change is a constant process of life. I assume that's who we are.

Given the assumption of our good hearts and our good intent, there are several other assumptions that, when I look at it, are severely hampering our work. I am going to list three, some of which are fading in potency already. But I also know how deep these assumptions are imbedded in me personally.

ASSUMPTION #1: ORGANIZATIONS ARE MACHINES

The first assumption is that organizations are, in fact, dead. They are machines. This is the 17th century imagery of Sir Isaac Newton, that the world is a clockwork machine. We have really bought this one! Just look at our language. We have tools and techniques. We have technologies. We have methodologies. We have mechanisms. We have levers for change. We have hands-on applications. It is really hard to avoid using a machine metaphor. I have tried to avoid it and they still just creep right in. It's part of our deep thought process.

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From Chandler to Michael Porter, people who have made enormous contributions to organizational strategy all came from engineering backgrounds. And today, what do we have? Reengineering! I hope this is the last gasp of the machine model.

ASSUMPTION #2: CHANGE HAPPENS AS A RESULT OF EXTERNAL INFLUENCES

The second assumption that we've labored under is that change happens as a result of some external influence. Here again, our language is quite revealing. We consider ourselves to be change agents or change masters. Our whole field of organizational development says that organizations need to be developed by us—who else but us. Change, in this assumption, is something we do. We make it happen. We impose it on the organization. We have long discussions on where to intervene—do you start at the top, do you start at the bottom, do you hope for the middle? We talk about strategies that need to cascade down throughout the whole organization. We talk about training designs in which everyone must participate. We see the change as some external force that is imposed on this inert lump of an organization.

ASSUMPTION #3: THINGS FALL APART

The third assumption is the one that I personally find the hardest to let go of—it is that "things fall apart." It is the natural tendency of all living things, as our culture has taught us. We subscribe to the second law of thermodynamics (which we have misunderstood but have deeply taken into our consciousness) that the natu-

ral state of everything is to decline and die, and to turn to rust in front of our eyes. And that the only way to avoid this tendency toward deterioration and death is to come in with our good creative energy and impose it on the system.

This has been a very fearsome and costly posture—for all of Western culture. But it is this great belief that, "without me, the world doesn't work." If you talk to me about letting go of control, it means the world is going to fail. I don't know what else this is if it's not playing God, and that is a fearsome prospect.

These assumptions blind us to some very wonderful truths.

TRUTH #1: ORGANIZATIONS ARE LIVING, DYNAMIC SYSTEMS

The first truth, which you have discovered in your own work, is that it is much more fun to view organizations as living, dynamic, breathing systems with a life of their own. These are wonderful beings, these organizations. We don't understand them but if we think of them as alive, a whole different approach is available to us.

Nothing held long enough to see a result. And among consultants that I talked with, there was always wonder if something really worked.

TRUTH #2: CHANGE IS AN INHERENT CAPACITY OF LIVING SYSTEMS

The second truth is that change is an inherent capacity of living systems. All of us are here, no matter what we are on the planet, no matter what kind of life form we are, have a deeply imbedded process to create ourselves, to maintain ourselves and to change ourselves if required, to survive. I don't think other living systems take classes on "resistance to change." But I don't know, because I don't communicate with them. We need to start observing that change is a process that we are capable of and that perhaps we even know how to handle, if we could clear away this debris of 20th century thinking.

TRUTH #3: ORDER IS INHERENT IN THE UNIVERSE

Lastly, our deep assumptions have prevented us from seeing that order is inherent in the universe. There is in each of us a tendency to organize toward greater and greater levels of order or complexity.

THE SEARCH FOR NEW LENSES

The question from yesterday's session with the Sages was, "Are we doing significant, authentic work? Are we not polluting organizations by our presence?" In working with other consultants, I noticed how rare it was for consultants to feel they had accomplished something of value that was going to last. There was far too much change, far too much turbulence. Nothing held long enough to see a result. And among consultants that I talked with, there was always wonder if something really worked.

Four years ago I embarked on work that was new and interesting, which I approached very fearfully. I was intrigued by natural science. I think there are many places to look for new ways of seeing, and I realized as I entered into that inquiry, that something was required of me that I wasn't quite ready to do. What was required was moving into a state of "not knowing," to be willing to give up the tools and techniques by which I had made my bread and butter. I wrote about this need to throw everything I knew into an abyss and to face the unknown. I must say that a few years down the road now I actually find this process fun. It has gotten to the point where I can say, "Well, what else can we throw away? Let's look for a deeper level of certainty here and let go of it." It was Voltaire, the French philosopher, who said, "Doubt is not a very pleasant status, but certainty is a ridiculous one."

Also I have had some experience now in letting go of some very tried and true techniques and being out there in an experimental mode. And it does take a particular kind of client to experiment. I say that as a casual off-hand, but the whole foundation for why any of us can do anything different is that clients are willing to step into the void with us. But I have seen many encouraging signs. I've witnessed large groups engaged in a self-organizing process who didn't need us as expert facilitators. I have seen people who were tired and cynical and just plain fed up, become hopeful and engaged because the work that they were engaged in was work of creation and not problem solving. I've seen learnings spread through an organization with a speed that no theory ever

predicted. And I've seen people become advocates of the power of learning that is available to them when they are willing to stay in a process that is fuzzy, ambiguous and open. And some of these people were SJs.

Now I painted that real fast brushstroke of things that feel interesting to me and even wondrous at times. I say this only to indicate what Joel Barker has been saying for years, that "What is difficult or impossible with one paradigm may be easy with another." Einstein said something very similar. He said, "No problem can be solved from the same consciousness that created it."

So what is this shift in consciousness that is required of us and what is the true paradigm that needs to change? I believe that it is a simple but profound world shattering recognition that we do inhabit a well-ordered universe. It functions well, even without us. Stewart Kaufmann, a scientist working in complexity theory, has said, "This is a world where you get order for free." Order arises spontaneously when you create simple connections. If you require simple connections among thousands upon thousands of individual elements, a pattern of organization emerges. We get order for free.

This discovery of order has moved most dramatically in the past 20 years in the area of science first known as chaos. Now it is a more complex science. Of course, mystics in every spiritual tradition have known about this order for a very long time.

FINDING ORDER IN CHAOS

One of the great gifts that chaos science provides is that order is found in chaos. A system in chaos is defined as a system that, from moment to moment, is totally unpredictable. You cannot predict where it is going next. With the creation of three-dimensional space on high speed computers, scientists could plot the movement of a system in chaos. When plotted on a two-dimensional scale, it looked totally unpredictable—like an EKG gone biserk. But when converted into multidimensional space, you could track many variables at once. The system, from moment to moment, zoomed from one part of the screen to another. You couldn't predict what would happen next. But over time, you came to realize that the system conformed to a boundary. It had an inherent shape that it did not violate. It would not move out of this boundary. Plots that are simple, nonlinear equations, over many iterations and after tracking behavior over a very long time, produced symmetrical patterns. Those images have been named "strange attractors." There are many other kinds of attractors in science. These were called strange by two scientists who said, "It was a suitable and psychologically suggestive name for these objects of astonishing beauty of which we know so little."

I think there are some very important learnings in chaos.

LESSON #1: YOU CANNOT SEE ORDER IN CHAOS MOMENT TO MOMENT

You cannot see the order in chaos if you are looking moment to moment. You cannot see order if you are micromanaging. You cannot see order if you are managing individual behaviors. These strange attractors draw attention to one of the great paradoxes of chaos science, which is that you get order without predictability. I urge you to think about that statement. We didn't grow up believing you got order if you weren't predicting it, controlling it and making it happen. So how do you get order without predictability? Through a strange combination of a rule of randomness, which at the human level is individual autonomy, and a rule of specification. There is an initial formula or equation. But you combine this initial formula with individual behavior. If you look moment to moment, you will not see a pattern. You will see what looks like a system out of control because the behavior jumps all over the place. But, if you stand back far enough, if you wait over time, scale or distance, you will observe the order that's in chaos. If we do that, then we can see the pattern.

LESSON #2: CHAOS BREEDS SELF-ORGANIZATION AND CREATIVITY

A second learning from the science of chaos is that chaos serves a function. It is in the darkness of chaos that our self-organizing processes, our creativity, comes forth.

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I would like you to think about a time in your life when you were confronted with a real darkness—a dark night of the soul, a time of utter confusion, a feeling you couldn't make sense of the world anymore in a way that you were accustomed to. Depression is a frequent com-

panion to these events in our lives. Think about what happened to you, the other side of your own personal chaos. What was available to you in terms of your experience and self-identity, once you had passed through this dark night of chaos? Now, there are two paths that one can take. The first is the path toward destruction and death. The other is the path that moves through chaos to a greater sense of peace, of enhanced capacity, knowing you can handle life, that you have survived. Some people feel quite pleased with their learning, they feel a new sense of hope. They return to a state that feels calm. That is the lesson of the uses of chaos for self-organization.

We believed in the path of the second law of thermodynamics: that any system moving into chaos was on the road to certain death. There was only one way through and that was pretty awful. At the end of the 1970s, Ilya Prigogene won the Nobel Prize for exploring what happens to living organic systems when confronted with high levels of stress and turbulence. He found that they reached a point in which they let go of their present structure. They fell apart, they disintegrated. But they had two choices. They could die or reorganize themselves in a self-organizing process and truly transform their ability, their capacity to function well in their changing environment.

We need to encourage more of the workings of chaos in our personal lives and in our organizational interventions.

This self-organizing process feeds on information that is new, disturbing and different. We are confronted with information we cannot fit into the present structure, and our first response to that kind of information (whether we are molecules or CEOs) is to discount it. We push it away. But the information becomes so large and meaningful that the system cannot hold it, then the system will fall apart. But it will fall apart with the opportunity to reconfigure itself around this new information in a way that is more adaptive and healthier. It can suddenly explode, grow and change.

Erich Jantsch, a systems scientist, said that "Self-organization lets us feel a quality of the world which gives birth to ever new forms against a background of constant change." That giving birth to ever new forms against a background of constant change is my personal quest for organizations. How do you create the self-organizing process? I am not going to give you answers; I don't have them yet. I think this is part of our work for the next decade. But there is something about the uses of chaos that could profoundly change our work right now. If self-organization is only available through this passage into chaos, then we need to be very thoughtful about how to create chaos intentionally at the right moment in our organizational interventions. You cannot get true transformation without chaos. Because in chaos, when people are overwhelmed, confused and fed up with you as a facilitator, they let go. And what they let go of is their present construction of reality. They hate being confused, but then something happens in which the intelligence and creativity of the group comes together and what they get is a transforming result.

This is a really difficult learning for 20th century Western folks who feel so good at getting themselves out of hard spaces. But, in fact, we need to encourage more of the workings of chaos in our personal lives and in our organizational interventions. It is a very powerful force.

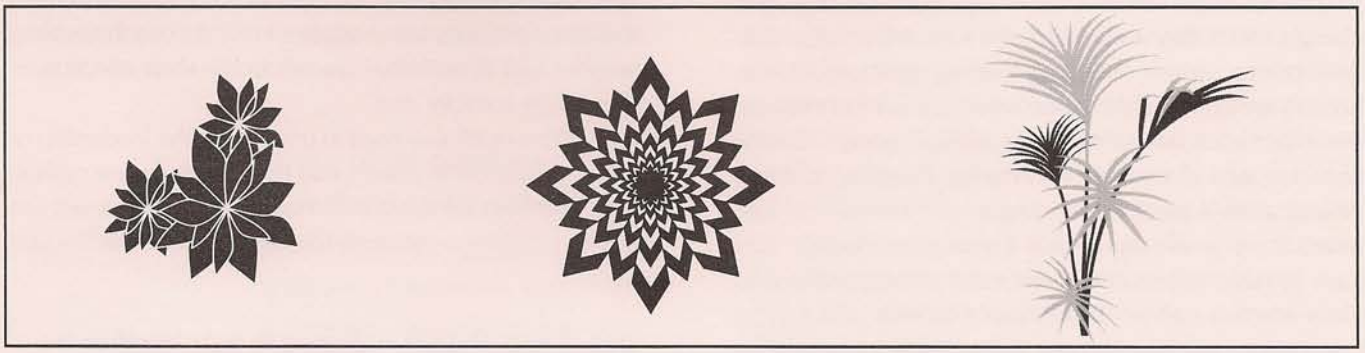
LESSON #3: COMPLEXITY ARISES FROM SIMPLICITY

The third learning of complexity science is that at the heart of complex systems is simplicity. Complexity seems to evolve from very simple patterns that build on one another. When we were all saddled with Euclidean geometry, we looked for perfect forms. We looked for perfect spheres, cubes, triangles, boxes, organization charts, etc., all of which are perfect Euclidean creations (useless as the geometry of Euclid was to explain what was really going on in real life.) Benoit Mandelbrot, who coined the word "fractal," said, "Look around us. Mountains are not cones, clouds are not spheres and lightening doesn't fall in a straight line. How can we understand this complexity of form that we are seeing?" He concluded that if you try and look for a pattern and look deeply into the object, you will see that the pattern repeats itself at different levels of scale. But if you identify the pattern, you have identified the essence of that very complex shape.

I want to look at a few natural fractals with you. A fern is a classic object because the dominant fern pattern is repeated on the fronds. Patterns in the branches of trees are replicas of the whole tree. As you look at finer and finer levels of scale you see the patterns repeating. Look for the dominant shape in clouds and see if you can

identify the shape in smaller segments. This is another way of understanding the geometry of mountains, clouds, beaches, forests and such. The figure below contains several examples of fractals.

This notion of looking for patterns as a way of dealing with complexity is quite profound. Instead of looking for linear solutions to problems, take a nonlinear approach. Look at behavior over time. Formulas are a process to be unfolded. Examine the behavior of an unpredictable evolving formula in the space of a computer. It reveals a deep inner creativity which is woven in the very fabric of existence. One of the great thrills of fractal observation is that it is very much like looking out into the night sky but reversing the projection. As you look deeply into a fractal, you are exploring regions that never end. And wherever you look, you will always see the same pattern.



There is something to be said here about identifying and managing patterns in organizations rather than managing people. I hope I am laying the groundwork for years to come, moving away from a focus on individuals to a focus on what are the key behaviors, patterns that we want to have in place in this organization and in the great dream of a fractal organization, we would see that behavior everywhere we looked. If we peered deeply into the organization, we would see the same pattern in place. I have worked with senior leaders who are very intent on trying to figure out the patterns of behavior they would like in place, and help them to realize that their task is to ensure that those patterns are well known and to remove themselves from the day-to-day management of individual behavior.

Now I have gone rather quickly through some very profound sciences, but those three key sensibilities, whether you take the sciences literally or metaphorically are that, first, in the heart of chaos, order is available. When you change how you look at the system, bringing in time, distance and multiple dimensions, you can see order. Second, chaos is the root to creativity. And without the passage of chaos and letting go, we cannot hope to truly transform anybody's thinking. Third, complexity can be understood as some very simple patterns or some very simple rules of interaction, that, over time, create wonderfully complex forms.

TRANSFORMATION THROUGH INFORMATION

Ikujiro Nonaka, a Japanese theorist who has been looking at chaos and self-organization for a few years now, said, "Whether or not an order is formed depends on whether or not information is created. The essence of order is in the creation of information." This is a profound quote. What is challenging about this is that this is not the way senior executives think about information. They don't see it as an ally in their search for order; they see it as a resource that must be carefully controlled in order to maintain their sense of order for their organization. But, if we truly want an organization to organize itself, to do it without the imposition of structures and plans and reengineering and templates and models, then we have to build a very different theory of information in organizations.

In the old model, information is power. If I choose not to reveal to you my sources, or what I know, or the timing of when I tell you something—I have power. We have used information as a way of controlling other people's behavior in organizations. We've held onto it very tightly. We've also used it to regulate behavior. To see if we are meeting plans, to see if we have met our goals, to see if our processes are up to performance standards. We have seen information as negative, as regulatory feedback that provides us with data so that we can correct our

behavior and get back to where we want to be. That kind of information doesn't take us into the future; it doesn't take us into any transforming processes.

The kind of information that does create fundamental shifts in the self-organizing system is always information that it doesn't want to hear. It is information that is new and disconfirming, that is difficult and challenging. Chaos is a state of information richness. One of the switches we made in our understanding of chaos is that it is no longer an abyss—it's filled with information that we cannot make sense of. Self-organizing systems only change when they are confronted with information that they cannot absorb into their existing structure. Or in Senge's words, would change when we couldn't absorb the information into our existing mental model. Claude Shannon, one of the early information theorists, said that "Information is that which changes us." Even in his definition there is this sense that if you want change, you have to have information. You can't change without it. Only when we allow organizations to look at troubling information and trust people within them to reorganize around that information that we get truly transforming levels of change. Only then can we get self-organization. What self-organization is saying is that the structure will emerge to fit the situation. If people have sufficient information and sufficient knowledge and good levels of skill for thinking, they will then form around the information. Their structure will change, it will be temporary, it will be fluid.

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However, most organizations do not trust their people to act as adults. The other stumbling block to using information as an organizing element is our great fear or our great belief that you cannot have order without predictability.

THE QUESTIONS WE NEED TO ASK

I want to close by putting out a few more areas in which a lot of thinking needs to be done. David Ruelle, who is a chaos scientist (now they are known as "chaologists"), said about his work in chaos, "My answers are modest and tentative but worth knowing" I would like to say that the questions I want to leave us with are tentative but worth asking:

Question 1: If we could manage complex organizations by simple patterns then how would that shift our work?

We would probably become much more seriously engaged in looking at processes that support the creation and sustenance of patterns. We would have to make sure that the right ones are in place. How do you know they are the right ones? Well, you examine their effects over time. This is tricky stuff.

We would also need to encourage the leadership of the organization to ensure that these patterns are consistent, that their concern is to manage the pattern, not the people. This is a vast area for inquiry and experimentation.

Question 2: If chaos is the root to truly transforming organizations, then how confident and supportive can we be about processes that use chaos intentionally?

I have to admit that I've worked with chaos science for a few years and intentional chaos with organizations for a year and a half and for the first year, every time a group went into chaos, I panicked. I wanted to whip out the flip charts and the markers and structure them into feelings of security. It Is a very difficult experience at the beginning to use chaos, because everything in us screams that something has gone very wrong. But each of us do have these experiences in our own lives of having seen the good effect of chaos. So we need to be, as one scientist asked managers to be, "equilibrium busters." We need to realize, as Burt Nanus said in *The Leader's Edge*, "If you're not confused, you're not thinking clearly."

PUSHING FOR CHAOS

I am pushing for more messiness, greater confusion, and greater ambiguity. We need to figure out how to create disconfirming information in our organizations and keep it present. We need scanning devises. We need to keep talking to more and more people who have a stake in the organization. We need to realize that diversity is the way in which life creates itself. Diversity is what is at the root of all life and we need to find ways to realize that it is the source of our creativity in organizations. It's a much bigger issue than we even thought.

My last assertion is that if information is the source of new order, then we need very different theories of information. We need to let down our barriers in organizations, and in ourselves. We need to move to a position taken by Gore Associates (manufacturers of Goretex), who use the metaphor that information is like salmon—they just had to release it. Salmon find their spawning grounds. Flush them into the system and see where they go. We need a different imagery around information.

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WHERE WE ARE NOW

Many learnings of chaos science are new, but I also want to recognize the elders who have gone before. In the 1940s, when Eric Trist was looking into what happened in coal mines in Great Britain, he noticed what is essentially a self-organizing process. In reading about the early years of OD on the walls yesterday, people talked about the magic, the sense of discovery, and the sense of invention. When flip charts and markers were the greatest thing because of what they allowed you to do, when suddenly you were focused on human issues and process and you were building networks among human beings rather than these old rigorous, scientific management, engineering models. The beauty of being part of that discovery was what was really compelling. I believe that kind of hope is available to us again. I believe that kind of gift of new visions, which allow us to peer more deeply into organizations and make sense of them in an age where there is not a lot of sense to be had, I believe that's available to us through many different lenses.

I like new science, so I use that. We could peer deeply into organizations through many different disciplines, but we cannot peer more deeply and with more efficacy and better resolve if we hold on to what has made us great. Some of these pathways have been established for us in the past 50 years, and yet the new lenses are different. We are no longer just peering into groups, we are peering into the universe—a universe whose order we barely noticed and seldom trusted in our work. So, to embrace these new visions, these new learnings, I think will take years of serious inquiry that I also hope is playful. True paradigm shifts are really hard.

Joel Barker also taught us that when the paradigm shifts, we all go down to zero. Past expertise doesn't carry over. This is a troubling truth. But we may be at a point in our field where everything, or almost everything that has made us who we are, that has made us useful is not going to work anymore. To stand at the edge of that abyss and to throw in our tools and techniques and to know that out of that process something more wonderful, more useful, more helpful can come, I believe, is the real challenge. It's not going to be solved in one conference; this is the work of our lifetime. As organizations are letting go of bureaucracy, we need to let go of the engineering machine imagery, which, at this point, is crippling us.

MY HOPES

Here are some hopes. I don't want "self-organization" to become a buzzword. We cannot just take our existing techniques and say, "OK, this is a self-organizing process." We cannot say that self-managing teams are necessarily self-organizing processes. We need to keep the lens open and peer into these learnings more seriously.

I hope we do this with care and rigor. That we just don't superficially glean onto chaos or self-organization or complexity. I hope that this community of inquiry builds on our knowledge and experience so that we truly feel in a community together. I hope that each of us is willing to throw into the abyss the tools and techniques and applications, reengineering—all of these things that are a holdover from a metaphor that doesn't make sense of the world anymore. In the midst of these hopes that I have for the profession is the good news of chaos! And the good news of chaos is that this is a very well ordered world. In his own inquiries into the whole strangeness of quantum physics, John Archibald Wheeler, the physicist, expressed a hope that I share: "To my mind, there

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must be at the bottom of it all, not an equation or a formula, but an utterly simple idea. And to me that idea when finally we discover it, will be so compelling, so inevitable, that we will say to one another, 'Oh, how beautiful. How could it have been otherwise?'"

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