Communication Complexity Theory as Model and Metaphor for the Church



Complexity Theory as Model and Metaphor for the Church

David A. Wollert

No doubt, most churchgoing Christians have at one time or another, while sitting in a pew on Sunday morning, posited the question "Why am I here?" They are not asking this question in the grandiose sense of "What is the meaning of life?" Rather, they are pondering "Why am I here at Walnut Street Church this morning, interacting with fellow Christians, singing hymns, reading Scripture, and breaking bread? What is the purpose of the church? And how does Walnut Street Church fit into the broader context of God's Kingdom?" In an attempt to address such questions, it might be profitable to consider an equally vexing problem in science. It is a problem that is beginning to be solved (to the extent that it can be solved), and it may provide some useful metaphors, if not outright models, for understanding our roles as individuals in the church, both the church local (i.e., Walnut Street) and the Church universal (i.e., God's Kingdom).



David A. Wollert

A new tool in science [called complexity theory] is beginning to provide additional insight into the problem [of explaining consciousness].

their wholes.² CONSCIOUSNESSJ. **David Wollert** teaches biology at Northeast State Community College in Blountville, TN. He began his scientific career as a senior research assistant with the Health Sciences Research Division of Oak Ridge National Laboratory. A strong interest in teaching led him to accept faculty positions at Black Hawk College and Northeast State. David is an active member of Grandview Christian Church in Johnson City, TN, and enjoys speaking about topics in science and religion at local colleges and churches. Correspondence can be sent to him by email: dawollert@NortheastState.edu

Indeed, reductionism has brought us some

And so, scientists have sought to explain

consciousness by studying the component

parts of the brain-the nerve cells and the

biomolecules that comprise them – and then

seeking linear cause-and-effect relationships

that can be built up piecemeal to form

thoughts, memories, emotions, and con-

sciousness. Although considerable progress

has been made in the understanding of neu-

ral networks, a systematic description of

consciousness simply has not been forth-

coming. A new tool in science is beginning

to provide additional insight into the prob-

lem. The tool is called complexity theory,

and it seeks to understand complex systems

holistically, in terms of both their parts and

of our greatest scientific triumphs.

cience has always had a difficult time accounting for consciousness. Just what is consciousness? Is it a physical phenomenon? Is it metaphysical? Traditional scientific orthodoxy claims that reality is fundamentally physical. Whatever consciousness is, it must somehow or other be reducible to patterns of electrical and chemical signals inside the brain. But how then do we account for the introspected first-person awareness of conscious experience? David Chalmers has termed this paradox the "Hard Problem" of consciousness, in contrast to the "Soft Problem" of mapping out the neural interactions that correlate to conscious mental events.1

Yet even the "soft problem" of consciousness appears to have defied the reductionistic tools that have traditionally served science so well. Reductionism, of course, is the notion that a large-scale structure or phenomenon can be understood by breaking it down into its component parts, studying the parts, and then using knowledge of the parts to reconstruct and explain the whole. It is a method of explanation that has proven enormously successful over the centuries.



Complexity theory is a set of mathematical tools for addressing the dynamic behavior that results when rich interactions within a system allow it to self-organize.

Communication

Complexity Theory as Model and Metaphor for the Church

Complexity Theory

Complexity theory is a set of mathematical tools for addressing the dynamic behavior that results when rich interactions within a system allow it to self-organize. Self-organization refers to a wide range of processes in both living and nonliving systems. The systems are characterized by simple "rules" that direct localized interactions between the subunits of the system. Despite the simplicity of the rules and the short range of their immediate effects, the system gives rise to the spontaneous emergence of pattern, order, and structure on a global, system-wide scale.³ Of particular interest are self-organizing systems operating away from equilibrium. Complex systems of this type often generate hierarchies of emergent systemmaintained properties that cannot be predicted from studying the parts alone.

As a simple example of a complex, selforganizing system, consider the formation of Bénard cells in water. Imagine a thin layer of liquid water between two parallel plates as shown in Figure 1A. If the liquid and the two plates are at the same temperature and the liquid is motionless, then the system is in equilibrium. Suppose now the bottom plate is heated slowly so as to induce a thermal gradient. The heat will pass from the bottom plate to the liquid, where it will then be transferred upward through the liquid by the process of thermal conduction. In thermal conduction, there is no bulk motion of the liquid. Rather, thermal motion of the individual molecules causes the transfer of heat from the warmer layers to adjacent cooler layers.

However, as the temperature of the bottom layer is increased, a critical temperature is reached where the liquid overcomes its viscosity (the internal friction which opposes movement) and begins to undergo bulk motion. A bifurcation occurs in the system as the highly variable motions of the individual molecules suddenly become organized into coherent flow patterns that dissipate heat more effectively than simple thermal conduction. At the critical temperature, convection (transport of heat by mass movement) in self-organized spatial structures becomes the dominant process and a new behavior emerges (see Figure 1B). If the temperature gradient is increased further, the convective rolls undergo a further bifurcation to produce hexagonal Bénard cells of the type shown in Figure 1C. This leads to periodicity in the spatial variation of temperature within the system, as opposed to the simple gradient generated by conduction alone. If the temperature of the lower plate continues to be increased, other periodic modes appear, grow in amplitude, and contribute to the motion (i.e., convective rolls within convective rolls). The result is a series of bifurcations yielding increasingly complex patterns of flow and spatial variations in temperature.

Eventually the system crosses another threshold. Turbulence sets in and the motion of the water molecules becomes chaotic. Turbulence, however, is not a stochastically random process. Chaos theory tells us that turbulence reflects a system exhibiting nonlinear properties that are deterministic, but not predictable.⁴ The nonlinear equations



Figure 1. Formation of Bénard Cells

describing the system follow an ordered trajectory that bounds the system while never actually repeating itself. Such trajectories are called "strange attractors" and their discovery has lead to the now common saying that "there is order in chaos." The famous Lorenz Attractor, one of the first strange attractors discovered, is shown in Figure 2.

An important aspect of the system described above is that once the first critical point is crossed and selforganization occurs, causation operates in two directions. Convective flow is an emergent property of the dynamic water molecules and is, therefore, partially explainable in terms of the molecules themselves. But, the self-organized flow patterns in turn influence the behavior of the molecules that initially gave rise to the patterns. Thus, the system is not fully explainable in terms of its parts. Higher-level equations are also needed.

In Search of Self-Organization

At first glance, the process of Bénard cell formation may appear to be a scientific curiosity relegated to the specific conditions allowable in a laboratory experiment. But selforganized patterns of convective flow are quite common in the natural world and manifest themselves on many hierarchial levels. Self-organizing flow patterns of air can produce the configurations of sand dunes observed in the desert, can bring about localized weather conditions, and even can direct the Earth's climate (see Figure 3).

Many complex chaotic systems appear to be selforganizing. For example, a living cell is composed of a rich and complex matrix of chemical cycles which self-organize in such a way as to regulate the overall activity of the cell. Indeed, several biologists have suggested that the total ongoing product of this matrix of activity is no less than the cell itself.⁵ Thus, the principle activity of a living cell, when all its complex metabolic activities are summed up, is the continuing creation of itself. This process has been termed *autopoiesis*, or self-creation.⁶ Autopoiesis manifests itself at many hierarchial levels—cells, organisms, and ecosystems. A variety of other complex systems exhibit autopoiesis, such as the international economy⁷ and even human societies. All of these systems, in addition to being self-creating, are capable of evolving over time.⁸

A Model for Consciousness?

The fact that nonlinear and chaotic systems can give rise to order and new complexity at higher levels in the system has led many scientists to suggest that similar models might provide an understanding for the emergence of consciousness itself. Some even have come to view consciousness as an emergent, self-organizing phenomenon – an autopoietic, quasi-physical phenomenon emerging from the complex interactions of component parts.⁹ Such a system would also evolve over time as external stimuli continually influence the system and become integrated within it.

Again, the interesting thing about this type of emergent phenomenon is that causation operates in two directions. The dynamic interactions of the parts, in this case the nerve cells, influence the properties of the emergent consciousness, but consciousness in turn influences the interactions of the component parts. As a result, the system exhibits nonlinear properties that are deterministic, but not fully predictable.¹⁰ It is for this reason that the reductionistic approach has failed to explain consciousness. Reductionism only accounts for information flow from the bottom up. In reductionism the interconnections between components are lost, and with them all of those higher-level constructs that make our world so interesting—constructs that cannot be collected, observed under a microscope, and stored in museums.

Another notable feature of complex systems is that the interactions between component parts need not, indeed must not, be *complicated*. Social insects, such as termites and army ants, display wonderful examples of emergent



Figure 2. The Lorenz Attractor



Figure 3. Global Patterns of Airflow Contributing to the Earth's Climate

Communication *Complexity Theory as Model and Metaphor for the Church*



If the metaphor is valid, then "the church" simultaneously represents both an eschatological community (we are to live as an end-times people) and an ontological community (God's Kingdom on earth is in a state of becoming in which we play an active role).

behavior. But while colonies of social insects behave in complex ways, the capacities of individuals are relatively limited. Army ants engage themselves in one of a few basic behaviors, switching from one type of activity to another in response to local concentrations of pheromones laid down by individual members of the colony.11 Individuals do not gather, store, and process information by themselves. Instead, they interact with each other in such a way that information is manipulated by the collective. Similarly, the rules governing communication between nerve cells are quite simplistic, with each nerve cell limited to only a few basic responses to incoming stimuli from neighboring cells. Complexity emerges from the vast array of neurons involved in co-dependent localized interactions.

A Metaphor for the Church?

So what, if anything, does complexity theory have to do with the church? Whether as model or metaphor, it seems that God's earthly Kingdom could be viewed as an emergent self-organizing phenomenon—a large-scale phenomenon of love, compassion, peace, and forgiveness emerging from the interactions of Christians following a few simple rules. Viewed in this way, we, through our interactions with others, are to a large extent responsible for making God's Kingdom manifest here on earth. But our participation implies that the Kingdom itself will in turn influence us—our behavior and our lives. Causation flows in both directions.

Complexity theory may provide a scientific framework for the ideas of Jesuit priest and scientist Pierre Teilhard de Chardin. He argued that as people come closer together in their activities and communications, their interactions take on an internal dynamic leading to a new and higher level of being, a planetary consciousness, which he termed the *Omega Point*.¹² According to psychologist Allan Combs:

The Omega Point unifies and "centralizes" the activities of its constituent minds in a fashion not unlike that in which the activity of the individual human mind draws together and centralizes the activities of the nerve cells of the brain. This process occurs, however, not through loss of individuality, but through a mutual enfolding of the most personal inwardness of each individual.¹³

Teilhard de Chardin identified this most personal inwardness with the experience of love. He wrote: "Love alone is capable of uniting living beings in such a way as to complete and fulfill them, for it alone takes them and joins them by what is deepest in themselves."¹⁴ For Teilhard de Chardin, the highest expression of love is selfless love, which he understood through the Christian faith.

Combs reminds us that "the Omega Point is not something that might possibly come into existence in some ideal future. It is taking form during this very moment of evolutionary time, and its deep personal and mystical dimensions tend to draw us toward it as an organizing principle already felt as a presence in the world."¹⁵ If the metaphor is valid, then "the church" simultaneously represents both an eschatological community (we are to live as an end-times people) and an ontological community (God's Kingdom on earth is in a state of becoming in which we play an active role).

Unlike passive components, such as water molecules, human beings presumably can direct their own interactions. Thus the connectivity of "the church" itself is a dynamic process and not a static map. How we interact with one another becomes one of the major defining features in an emergent systems view of the church. If we isolate ourselves, then the church will tend toward a static or fixed attractor; if we interact with everything around us, then the church will tend to become chaotic and overextended to the point of failure. Maintaining an optimum autopoietic state requires an adaptive form of connectivity, sufficiently self-contained to maintain stability and individuality, yet sufficiently responsive to the world to benefit from the synergy of working together. In the jargon of complexity theory, the church must exist at "the edge of chaos."

Making It Happen

The apostle Paul clearly promoted a complex systems approach to the Church. In his first epistle to the Corinthians, Paul writes: "The body is a unit, though it is made up of many parts; and though all its parts are many, they form one body. So it is with Christ. ... If one part suffers, every part suffers with it; if one part is honored, every part rejoices with it. ... Now you are the body of Christ, and each one of you is a part of it."¹⁶

Perhaps no better example of Christ's teachings manifesting themselves in an emergent self-organizing way can be found than in the formation of the Church itself as described in the book of Acts.

The final question, then, is by what simple rules should we, the component parts of the Church, operate? The answer is deceptively simple and was provided by Christ in his explication of the greatest commandment: "Love the Lord your God with all your heart, with all your soul, and with all your mind, and love your neighbor as yourself."¹⁷ Perhaps no better example of Christ's teachings manifesting themselves in an emergent self-organizing way can be found than in the formation of the Church itself as described in the book of Acts. The following account is taken from Howard Vos' *Exploring Church History*. Bearing in mind the discussion of Bénard cells, note the phase transitions that precede two critical points in the story, specifically following the gathering in the upper room and Peter's preaching of Christ.

The Passover season was ended. The crowds that had gathered for the occasion dispersed, and Jerusalem returned to normal. Some were puzzled, however, by the unusual circumstances surrounding the crucifixion of a certain Jesus of Nazareth, who appeared to be revolutionist — for he had talked about setting up a kingdom of His own. A rumor had spread concerning His resurrection from the dead, but certainly that was impossible, they thought. Had not the soldiers who guarded his tomb reported the theft of His body by His followers? That was sufficient explanation for most. Another Galilean rabble-rouser had come to a grisly end.

One hundred twenty of His followers who had gathered in an upper room in Jerusalem knew otherwise. Having seen and talked with the risen Lord, they awaited at His command the coming of the Holy Spirit. On the day of Pentecost (fifty days after the crucifixion and ten days after the ascension), they were rewarded. A sound as of a rushing wind filled the house. On each of the group lighted what appeared to be a tongue of flame. Immediately they were filled with the Sprit and began to speak in other tongues. Rapidly word of this phenomenon spread among Jews gathered for the feast of Pentecost, and a crowd came running to investigate. Upon arrival each heard the message of truth in his own language. Some marveled. Others accused the disciples of being intoxicated. But that was a foolish assertion; drunkenness would only produce gibberish, not intelligible conversation in another language. Besides, it was early in the day—too early for such a large group to be drunk.

At that point Peter, who had been the leader of Jesus' disciples, arose and addressed the throng. He argued that this remarkable phenomenon was a result of the Holy Spirit's ministry among them. Then he preached Christ: His death, resurrection, and ascension and the present necessity of receiving Him by faith as Savior and being baptized in His name. The Holy Spirit so wrought that three thousand believed on that memorable day.

Thus the church was born. And wonderful was the experience of believers during succeeding days. They held to the true doctrine, were faithful in prayer, partook frequently of the Lord's Supper, enjoyed each other's fellowship, were in one accord, and lived joyous lives. Those who met them were strangely moved and awed; many believed daily. Soon the number of believers swelled to about five thousand.¹⁸

Notes

- ¹D. J. Chalmers, "Facing Up to the Problem of Consciousness," *Journal of Consciousness Studies* 2 (1995): 200–20.
- ²For an overview of complexity theory see: Richard Solè and Brian Goodwin, *Signs of Life: How Complexity Pervades Biology* (New York: Basic Books, 2000); Roger Lewin, *Complexity: Life at the Edge of Chaos* (New York: Macmillan Publishing Company, 1992); and Stuart Kauffman, *At Home in the Universe* (New York: Oxford University Press, 1995).
- ³S. Camazine, "Patterns in Nature," *Natural History* (2003): 34–41.
 ⁴James Gleick, *Chaos: The Making of a New Science* (New York: Penguin Books, 1987), 121–53.
- ⁵H. R. Maturana, F. J. Varela, and R. Uribe, "Autopoiesis: The Organization of Living Systems, Its Characterization and Model," *Biosystems* 5 (1974): 187–96.

- P. Anderson, K. Arrow, and B. Arthur, eds., *The Economy as an Evolving Complex System* (Reading, MA: Addison-Wesley, 1987).
 *Solè and Goodwin, *Signs of Life: How Complexity Pervades Biology*.
- ⁹Allan Combs, *The Radiance of Being: Complexity, Chaos, and the Evolution of Consciousness* (St. Paul, MN: Paragon House, 1995).
- ¹⁰Ben Goertzel, Chaotic Logic (New York: Plenum, 1994).
- ¹¹Solè and Goodwin, Signs of Life: How Complexity Pervades Biology, 147–78.
- ¹²Pierre Teilhard de Chardin, *The Phenomenon of Man* (New York: Harper, 1959).

¹⁴Teilhard de Chardin, The Phenomenon of Man.

- ¹⁶1 Cor. 12:12, 26-27 (NIV)
- ¹⁷Matt. 22:37, 39 (NIV).
- ¹⁸Howard Vos, *Exploring Church History* (Nashville: Thomas Nelson Publishers, 1994), 3. Used by permission of Thomas Nelson, Inc.

⁶Ibid.

¹³Combs, The Radiance of Being, 87.

¹⁵Combs, The Radiance of Being, 87.