CHAPTER FIFTEEN

DIALOGUE ON CHAOS THEORY

CHAOS THEORY RAISES CONSONANCE AND DISSONANCE WITH RELIGION in regard to the purpose and direction of history. Is history under the direction of God? Is there a final outcome to history, and can we know the outcome beforehand? We will begin our discussion by reviewing the relationship between determinism and chaos.

What Is the Relationship Between Determinism and Chaos?

For nearly three hundred years, scientists thought that the deterministic laws of classical physics reflected nature. This view grew out of the triumph of Newtonian or classical physics. Classical physics began using the inductive method of Bacon (see chapter 1) to mathematically model observed phenomena. Galileo developed empirical laws (equations) to predict the behavior of falling bodies, while Kepler developed empirical laws (equations) to predict the behavior of planetary motion. Newton combined these two sets of motion into a single theoretical structure (his three Laws of Motion and the Law of Universal Gravitation). The predictive power of Newtonian laws became apparent with Newton's successful prediction of the return date of what is today called Halley's Comet. Newton's laws are deterministic; by knowing the position and momentum of an object, a scientist can use Newton's laws to predict (calculate) the position and momentum of that object in the future or the past. An almanac's listing of the dates of future eclipses of the sun or moon is an example of this type of calculation.

Since the laws of classical physics were deterministic, scientists began to assume that these equations reflected all of nature. They

assumed that nature was deterministic. Pierre Simon Marquis de Laplace (1749–1827) boldly stated this determinism as follows:

> All events, even those which on account of their insignificance do not seem to follow the great laws of nature, are the result of it just as necessarily as the revolutions of the sun. In ignorance of the ties which unite such events to the entire system of the universe, they have been made to depend upon final causes or upon hazard . . . but these imaginary causes have gradually receded with the widening bounds of knowledge and disappear entirely before sound philosophy, which sees in them only the expression of our ignorance of the true causes. . . . We ought then to regard the present state of the universe as the effect of its anterior state and as the cause of the one which is to follow.[1]

Scientists forgot how few and special were the systems that could be solved by classical physics. They ignored the fact that most systems could not be solved exactly. Even in astronomy, where Newton's laws had triumphed with the Halley's Comet prediction, approximations had to be used in dealing with three-body problems.[2] The behavior of gases was expressed in terms of statistics and probabilities; the behavior of the individual gas particle could not be predicted because so many gas particles were involved. Many phenomena were ignored or engineered out, with turbulence being an example. With hindsight, one sees that scientists of the classical physics period engaged in the fallacy of inducing from a too-small number of workable systems to the whole of nature. Also with hindsight, one sees that modern science would not have had such a success if there had not been systems that could be explained by deterministic mathematical equations. Without finding these patterns, there would not have been as much incentive to study nature.

Today scientists realize there are more chaotic systems than classical deterministic systems. They also realize that many of their classical systems can and do go chaotic. Some examples of systems that can exhibit chaotic behavior are three-body systems, chemical reactions, turbulence, heat flow, ecology, cardiac rhythms, population changes, the solar system, weather, and billiards. All of these systems have instances in which they become as irregular and unpredictable as a truly random system.

If one has a computer program that calculates random numbers and one wants to know the one-hundredth number generated by the program, one has to run the program one hundred times to

obtain the one-hundredth random number. There is no rule that allows one to take a shortcut to predict that number. Likewise, for chaotic systems, the only way to find out how the system changes with time is to watch it change. Again, there is no rule that allows one to go directly from the beginning to the end. There is no shortcut. But there appears to be a shortcut because in many cases Newton's laws explain the behavior at each step. Yet, chaotic systems are so sensitive to initial conditions that one cannot specify the values of the variable with enough accuracy to gain predictive insight beyond only a few steps.

If I want to know the outcome of a billiard game, I have to watch the whole game. Once the game is over, I can review each step to receive an understanding of why it turned out the way it did. Even though Newton's laws allow calculation of motion involving collision of balls and walls, I am not able to predict the outcome of the game from, say, the half-way point. Why? The behavior of the ball is too sensitive to initial conditions (collisions with other balls and table walls, vibrations of the table, impacts from air molecules, and so on) to allow a deterministic prediction. Again, I have to let the game unfold to determine how it will end.

Human history may be an extremely complex chaotic system. Historians have not been very successful at predicting the fate of elections or nations. As in the case of the billiard game, historians have to watch history unfold to be sure of what will happen. Also, like the billiard game, by reviewing past events historians gain insight into why certain events actually occurred. What consonance and dissonance does this chaotic view of history have with religion and its prophecies, its view that history has a purpose?

Relationship of Law and Chaos

What is the relationship between law and chaos? Is there any relationship at all? Do the two concepts represent mutually exclusive ideas? Does the presence of chaos prove that the physical laws are only the illusions suggested by Eastern thought? The problem of the relationship between law and chaos applies as much to the spiritual as to the physical realm. Given the apparent chaos in society, can we legitimately speak of moral law?

From the opening verses of Genesis through almost the last chapter of Revelation, the Bible describes people and society as chaotic. For over a thousand years in a variety of social settings, the writers who were responsible for putting the words of Scripture in

ink portrayed the human race in rebellion against the will of God. In spite of this chaotic situation, however, the Bible also describes a certain pattern or patterns to human behavior.

Not only Christianity but most religions of the world have within them some understanding of the consequences of bad moral behavior. In the present blip in cultural development in which moral values are viewed as relativistic and without objective meaning, we still know that bad behavior is behavior that hurts me. C. S. Lewis describes this universally understood concept in *Mere Christianity*. The universal experience that people do not like to have bad things done to them, however, does not prove that values have an eternal, objective quality about them.

Christianity holds that values derive from the existence of a Creator God. Universal values do not exist in and of themselves. Rather, they are the views, opinions, and judgments of the one who created all things. Because people are made in the image of God, they also have the ability to express views, opinions, and judgments that express their own essence as well. As a result, people inhabit a world filled with competing values. It is a world so filled with subjective and culturally contrived views, opinions, and judgments that people have a difficult time recognizing eternal values or distinguishing them from relative values.

Values exert a powerful force on people, depending on the source of the value. The expectations of individuals and groups represent forces that few individuals challenge on their own. Without a group consensus for the norms of behavior, on the other hand, society quickly descends into chaos. In the Bible, the Book of Judges comments on the absence of commonly held values in Israel before the anointing of Saul as king by saying, "In those days Israel had no king; everyone did as he saw fit" (Judg. 21:25).

Societies establish laws to exert force on the tendency of people to do as they see fit. The expectation of others is sufficient force to cause most people to obey the law. The fear of punishment will cause others to obey the law. Still, there will always be some who disregard the law. In that sense, human law is like Plato's Ideal. It describes the ideal society, but the way people behave may be quite different.

Science establishes laws to describe the forces at work in nature which have been observed. The expectation of science is that nature

will always behave according to the laws. In society, if people violate the law, they are punished. In science, if nature violates the law, the law is punished. In that sense, scientific law is like Aristotle's Form. It describes perfect order expressed in its substance. If perfection is violated, then the law must be wrong. Over the centuries, scientific law and human law have changed a great deal.

What about divine law? What is its purpose and how does it operate? God gave the law specifically to the nation of Israel, yet Israel became a corrupt society that oppressed the poor. God gave commandments related to worship within the law, yet the religion of Israel grew polluted and idolatrous. The law did not preserve Israel as a nation or keep it holy. The law of God was not intended to control the behavior of people the way gravity controls the orbit of planets around the sun. The law of God exerted a force upon people, but it was a personal force.

Even more than fear of punishment or concern for the expectation of the crowd, obedience to the law depended upon how highly people regarded the God who gave the law. We might call this regard *the fear of the Lord* or faith, but it is a highly personal, relational matter. In this regard, the law itself was never the point. Like Plato's Image, it is but a faint shadow of God's perfect will. Yet, like Aristotle's Substance, it points toward that which is perfect. In this sense, Paul described the law as functioning like a custodial schoolmaster in the ancient tradition: "But before faith came, we were kept under the law, shut up unto the faith which should afterwards be revealed. Wherefore the law was our schoolmaster to bring us unto Christ, that we might be justified by faith" (Gal. 3:23–24 KJV). The law teaches about the perfect will of God, but it is not the perfect expression of that will.

The greatest conflict Jesus had with the religious leaders of his day dealt with the distinction between the law and the will of God. Jesus explored this issue in the Sermon on the Mount in which he explored the laws on murder, adultery, divorce, oaths, and vengeance as well as the piety related to alms, prayer, and fasting (Matt. 5:21–6:18). Continually he taught that something higher lay behind the law, and he stressed the *fulfillment* of the Law (Matt. 5:17). He also taught that the law contained things which God allowed, but which were not God's perfect will, such as divorce (Matt. 19:3–9).

Is the Universe Determined or Open?

Is chaos theory, like quantum theory, another nail driven into the heart of determinism? Does the fact that chaotic systems lose their long-term predictability mean that the universe is open? As we saw previously, Laplace was convinced that there was no openness in the universe. His previous quote says that events in the universe attributed to religion (final causes) or randomness (hazard) are really determined. To Laplace, the "ignorance" of the observer causes the observer not to see the underlying determinism. As Laplace also said in the 1814 edition of *Analytic Theory of Probability:*

> If an intelligence, for one given instant, recognizes all the forces which animate Nature, and the respective positions of the things which compose it, and if that intelligence is also sufficiently vast to subject these data to analysis, it will comprehend in one formula the movements of the largest bodies of the universe as well as those of the minutest atom; nothing will be uncertain to it, and the future as well as the past will be present to its vision. The human mind offers in the perfection which it has been able to give to astronomy, a modest example of such an intelligence.[3]

This "intelligence" is not God, since Laplace replied to Emperor Napoleon Bonaparte that he had no need for that hypothesis. For generations, some theologians struggled to explain how God could act in such a determined universe.

In one regard, Laplace was wrong. Quantum mechanics has shown that one cannot simultaneously determine the position and momentum of atomic and subatomic particles. The accuracy of a prediction is limited by Heisenberg's Uncertainty Principle. Many see chaos theory as weakening Laplacian determinism even further. However, on the one hand, determinism is extended by chaos theory. Before chaos theory, processes, such as arrhythmic heartbeats or turbulence, were thought to be random. Now using the chaos theory's concept of "period-doubling to chaos," scientists can predict when these chaotic systems are going to occur and in many cases prevent their occurrence. In addition, the chaos theory's concept of "strange attractors" allows scientists to analyze these systems deterministically. Does Laplace have a last laugh?

On the other hand, chaos theory does set a limit to determinism. Although one can predict when chaos will begin, once chaos begins, predictability is short-lived. After only a few steps, cause

and effect are lost. At this point, one can only present probability values for the behavior of the system. Long-term chaotic systems are as unpredictable as a truly random system. Thus, there is a causal limit in dynamic systems. Although chaos theory gives insight into the behavior of a chaotic system, we are limited in that we do not know the outcome until after the fact.

Putting together the insights of quantum mechanics and chaos theory, what can one say about the openness of the universe? From quantum mechanics, one discovers that each measurement has a limit on its accuracy. This limit is much more important at the quantum level but is present in all measurements. From chaos theory, one sees that for complex systems there is a limit to predictability. One can gain an insight into the broad picture of what is going to happen (strange attractor), but one cannot know the actual outcome until after the fact. Thus, the universe is not the deterministic box that Laplace envisioned. It is more open than scientists since Newton have thought it was. The model of the universe has gone from the predictability of a rigid clock to the predictability and unpredictability of a complex organism.

Is the Fate of the Universe Determined or Open?

The Bible paints a picture of the outcome of the universe that has an inseparable link with the human race. The end of the cosmos and human history both emerge from chaos. The chaotic systems of the physical order may be observed and described by the scientific method. The social sciences, sometimes called "soft sciences," observe and describe people. These disciplines include psychology, sociology, anthropology, and history. The hard sciences have not extended the hand of fellowship and membership in the guild to the soft sciences because of the difficulty of legitimate observation and the unpredictability of human behavior. Oddly enough, these two features form the basis for quantum theory and chaos theory in modern science. By definition, science does not address the question of God because God as a nonphysical being cannot be observed by the senses.

The soft sciences, on the other hand, have had a great deal to say about God and religion. Because people are religious and the social sciences are concerned with the study of people, the social sciences must comment on God and religion. In an effort to gain a sense of legitimacy still denied by the hard sciences, the social sci-

ences have attempted to adapt the scientific method as practiced by physical science to the study of people. This adaptation of the methodology of one discipline to the study of another discipline has brought with it some philosophical baggage. While the social sciences must deal with religion, they do so only as an observable phenomenon. They search for some explanation for the practice of religion among people that comes from some source other than the existence of God.

For decades, the various social sciences followed a *reductionist* approach to religion as well as other facets of human behavior. They reduced the explanation for human behavior to one essential cause. Sigmund Freud reduced human behavior to sex and elaborated his explanation with discussions of guilt and suppression. God represented only a projected wish on the universe. Karl Marx reduced human history to economics and the materialistic dialectic that would eventually lead to the perfect state. Marx described religion as "the opiate of the people," a narcotic to prevent the masses from rising up against their masters. People who follow such a reductionist approach might attempt to isolate the cause of the American Civil War the way an epidemiologist might attempt to isolate a virus.

In examining the chaos of human history and behavior, one soon realizes that simple explanations will not do. How could a well-educated, technologically and artistically advanced society like that of Germany have embraced Adolf Hitler? The question defies a simple, reductionist answer. A complex system of undercurrents converged to make the time ripe for Adolf Hitler. One might also ask how Hitler could have possibly lost his war against Britain. A series of "ifs" might be posed to change the equation. If an isolationist Republican had defeated Franklin Roosevelt, could Britain have ever negotiated the Lend-Lease Treaty or would Japan have felt the need to attack Pearl Harbor? Human behavior and history are a swirl of unpredictable events that may be influenced by emotions, intellect, character, talent, or survival.

The Bible provides a narrative of selected episodes of human history that suggest that any number of motives and underlying causes may lie behind the behavior of people. Rather than a single cause driving human behavior, the Bible portrays a variety of people and groups driven by different causes at different times and places. One might expect the Bible to portray God as the driving

motive, yet the Bible shows very few people for whom God is the great passion. One might even expect the Bible to portray God as determining, decreeing, and causing every event and circumstance of all human life. While the Bible makes clear without qualification that God has absolute power and authority over time and eternity, the description of the exercise of sovereignty appears more artistic than totalitarian.

God did not cause Adam and Eve to sin, but he interacted with them to move beyond the great disaster. God consistently interacts with people in their own circumstances, in the chaos of human events. The Bible describes God as effortlessly interacting with all manner of human situations to move humanity toward his ultimate goal. Like a master chess player, it does not matter what move his novice opponent makes. He has the final victory in sight from the first move. It is all a matter of patiently taking time for all the moves. One of the most familiar passages in the Old Testament speaks of this interaction of God. After being sold into slavery by his brothers and eventually rising in rank to become prime minister to the pharaoh, Joseph said to his brothers: "You intended to harm me, but God intended it for good to accomplish what is now being done, the saving of many lives" (Gen. 50:20).

The central event of the faith of Israel occurred in the Exodus, when Moses led the Hebrew slaves out of Egypt. Behind this grand spectacle, however, lies another story that the Bible relates. It is the story of the collapse of Canaanite civilization. As it turns out, God had not chosen Israel because of the goodness of the Hebrew people but in order to bring an end to Canaanite civilization. The central feature of Canaanite religion involved child sacrifice. With the call of Abraham and the substitution of a sheep for the child whom Abraham intended to sacrifice to God, events were set in motion to show God's disgust for the Canaanite practice of child sacrifice. From the descendants of Abraham's son Isaac, who was spared from the altar, God would produce an army to destroy the Canaanite culture.

Centuries later, the Bible describes God as bringing the Assyrians to destroy the northern kingdom of Israel and the Babylonians to destroy the southern kingdom of Judah. Neither the Assyrians nor the Babylonians considered themselves to be the servants of the God of Israel. On the other hand, they did not give any evidence in the Scriptures that they felt in any way coerced, forced,

bullied, or manipulated by God into invading Israel and Judah. The armies of these pagan nations set about satisfying their own ambitions, yet in doing so they accomplished the purposes of God. At the same time, the ambitious motives of people stand in contrast to the righteous purposes of God: What people intend for evil, God uses for good.