REDUCTIONISM AND REDUNDANCY IN THE ANALYSIS OF RELIGIOUS FORMS

by Volney Patrick Gay

In this paper I should like to discuss a problem common to social-scientific analyses of religious forms vis-à-vis the concepts "understanding" and "redundancy." The problem can be stated in the form of a question: Can science ever discover something in the nature of religious forms which would destroy fully the possibility of rational religious belief or activity? All those people who take discoveries in geology, astronomy, carbon dating, or psychoanalysis as refutations of religious claims would answer in the affirmative. This typical answer, however, raises the curious problem for the social scientist interested in the nature of religion that his subject matter, unlike other subject matters (e.g., economic activity), must disappear finally when confronted by the truths of science, history, and logic.

If we were to accept this conclusion, as Sigmund Freud did for instance in his later writings on religion, we would find the object of our inquiry, like any error, dissolving into its component parts (e.g., the motives, needs, or perceptions that created it). Thus our subject matter eventually would disappear, fully reduced, into the sea of errors from which it arose.

But this has not happened. Even after a century of rigorous sciences, religious forms flourish. In an initial attempt to account for this fact I will argue that religious forms are reducible and redundant but not, on that account, dispensable.

Evolutionary Edge of Reducible Systems over Nonreducible Ones

In the technical language of information theory as formulated by C. E. Shannon and W. Weaver redundancy is defined as that "fraction of the structure of the message which is determined not by the free choice of the sender, but rather by the accepted statistical rules governing the use of symbols in question."[1] Because information is de-

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fined in terms of the freedom of choice available to the sender it follows that those parts of a message which are not variable (e.g., the English rule that plural nouns require plural verbs) convey no information.[2]

It is intuitively obvious that it is prudent to increase the redundancy of a given message when one is doubtful about the clarity of transmission, that is, when noise is likely to obscure it. Thus telephone operators are trained to spell out personal names by assigning standard, highly redundant words to those letters subject to interference by noise: "B as in baby" distinguishes "V as in violin." Less obvious is the fact that ordinary speakers seem to require a high degree of redundancy, that is, around 50 percent, in order to use a natural language easily. By decreasing redundancy one can increase the complexity of the message. For example, Shannon estimates that if English were only 30 percent redundant one could construct three-dimensional (and hence insoluble) crossword puzzles.[3] When one struggles to understand headlines of newspapers written in a foreign language one is on the border where the lack of redundancy seriously impairs the task of communication.[4]

Less obvious is the fact that increasing redundancy (and so increasing the likelihood of accurate transmission) also decreases the total amount of information we can transmit. Indeed if we transmit a message whose entire content can be predicted before transmission occurs (i.e., we manifest absolutely no freedom of selection) that message imparts no real information. This hardly means that our message has no content or that its content is meaningless (in the sense of having no syntactic form or semantic reference). On the contrary, a state-run newspaper may report "Record Wheat Crops" every month or a political pamphlet may claim "Hitler Helps the Little Man" and so send perfectly grammatical and meaningful messages. However, if both these messages are perfectly predictable and they occur regardless of actual conditions, that is, there is no correspondence between their occurrence and actual examination of the facts, they transmit no information.

Since information is defined in terms of the freedom to choose among possible messages and since redundancy entails restrictions upon such choice, it follows that in order to increase the amount of information (the number of "bits") in any single message we must decrease its redundancy. Moreover, if one had no fear of extraneous uncertainty entering into transmission (i.e., noise) one could reduce the actual message length by as much as the symbol system (or language) is redundant: "Since English is about 50 per cent redundant, it

would be possible to save about one-half the time of ordinary telegraph by proper encoding process, provided one were going to transmit over a noiseless channel."[5]

A corollary of these principles is that one would expect to find that especially important messages (e.g., when one wants to go to war or to purchase a bride) will be highly redundant.[6] Indeed it is precisely because of this informational requirement which makes particularly important religious communications so highly structured that Freud, among others, likened them to the compulsive, repetitious behaviors of obsessional neurotics.[7] However, if those behaviors, rituals, dances, songs, myths, etc., are somehow vital communication displays, perhaps their redundancy is virtuous, not vicious.

Although the concept of redundancy was born in the labors of communication theorists, it has a significant place in the larger context of design theory and general systems theory. These two sciences describe the nature of interactions and relationships in complex systems (e.g., the U.S. army and neural networks), and their practitioners try to generate simple laws explaining those interactions. Thus Herbert A. Simon notes that a fully accurate description of a complex system or structure need not be a complex set of symbols.[8]

In fact it appears that progress in many sciences, such as physics, is measured in terms of their increasingly succinct ability to formulate and solve complex, descriptive, and explanatory tasks. It seems reasonable to suppose further that it is precisely because nature itself is composed of highly redundant systems that science works: "It is a familiar proposition that the task of science is to make use of the world's redundancy to describe that world simply."[9]

We can describe the world's redundancy in at least three ways:

1. Natural forms are often structurally hierarchic. Cells, tissues, organs, organisms, etc., are clearly discrete though functionally related structures organized in efficient hierarchies. At a social level general systems theorists long ago pointed out similarities between the corporate body (which often assumes the status and rights of an actual human being in a legal-political system) and political organizations. In the latter case leaders (brains), through manipulation of information and opinions, direct and control much larger energy systems maintained by less prestigious persons.[10]

2. Relationships between discrete entities are often reducible to or expressive of lexical or mathematical patterning (e.g., DNA molecules have a generative, pattern-giving relationship to RNA and ATP and in turn are related lexically to the information patterning controlled by genes).[11] In a similar way the early Greeks especially were en-

thralled by the particular power of mathematical formulae to describe and quantify natural progressions, such as those observed in the geometry of natural forms or harmonic scales.[12]

3. Many of the complexly patterned, highly structured organizations which compose the world are not, at every moment in time, causally related to one another in some clockwork fashion: "To get some idea of how much the world we live in shows reducibility, compare its ordinary behaviour with what would happen if, suddenly, the reducibility were lost, i.e., if every variable had an effect, immediate or delayed, on every other variable. The turning over of a page in this book . . . might cause the lights to change, the table to start moving, the clock to change its rate, and so on throughout the room."[13]

If the world were not redundant in some way, that is, if various parts of it did not exhibit some form of reducibility, or, in terms of information theory, if we can infer no aspect of its structure from knowledge of another, "then it is its own simplest description. We can exhibit it, but we cannot describe it by a simpler structure."[14]

In the following sections I wish to put forward various arguments in favor of the proposition that religious forms are redundant in these three ways.

It appears that religious forms such as rituals, prayers, theologies, myth cycles, traditions, and beliefs are complexly evolved structures which have definable histories. If this is so then the following should be true: (1) Religious forms are to some degree or another highly evolved behaviors. (2) As such they will show either high or low degrees of redundancy (in any one of the three ways described above). (3) If they have very little redundancy they will not be stable. (4) Increasing the stability of an evolved form enhances its likelihood of survival. (5) Hence to the extent that a religious form survives and adapts to forces which would otherwise dissolve it it will show redundancy.

Parts 3 and 4 of this argument are based upon speculations put forth by Simon and Walter Buckley.[15] In an instructive discussion of H. Jacobson's work on the likelihood of evolutionary change Simon compares the advantages assembly (or evolution) by stages has over assembly without substages.[16] To illustrate this principle he imagines the effects interruptions (infringements, distortions, noise) will have upon the productivity and hence, in evolutionary terms, the survival rate of two watchmakers. One assembles his thousand-piece watch in subassemblies of one hundred pieces each; the other uses no subassemblies but must run through the thousand successive stages without interruption. As we know from Henry Ford, assembly in stages is a much more efficient system and so too Simon notes that in many

evolutionary contexts survival of the fittest really means survival of the most stable, that is, products of subassemblies.[17]

One can formulate a similar argument about the viability of reducible systems from discussions in W. Ross Ashby's textbook on cybernetic theory.[18] Ashby argues that those systems that are highly reducible, that is, in the third way specified above, will be significantly easier to repair than nonreducible systems. And, all other variables being constant, it would seem that that system which is more reparable than another will tend to be more successful in competitive contexts. One need only think of the efficacy of repairing a complex system, such as an automobile, which permits trouble shooting among its discrete component systems (e.g., the drive train) to see the virtues of this kind of reducibility.

If we combine the insights Simon and Ashby offer regarding the virtues of reducible systems we can generalize and say that that system or machine which is constructed (or evolved) through a process of subassemblies will manifest a high degree of structural stability and efficient productivity, and, when compared to nonreducible systems, it will be a great deal easier to repair.[19]

All these factors suggest that reducible systems have distinct evolutionary and competitive advantages over nonreducible ones. In turn one could generalize from this principle and conjecture that, when one has a sufficiently large number of cases, those systems or organisms or organizations which survive in competing or hostile environments will tend to show reducibility. If this is a legitimate conjecture one can construct the following argument: (1) Religious forms have occurred and persist in all known cultures, including those in which scientific methodologies have high prestige. (2) Such longevity and persistence even in the face of strongly held competing claims is a (probable) sign of reducibility. (3) Hence religious forms are (probably) reducible and so redundant in the ways specified above.

Moreover, one can argue that many religious forms are structurally hierarchic in ways similar to those of natural forms mentioned above (the first kind of redundancy).[20] That is, many religious systems are more or less very strict institutions (e.g., the Church), which show typical hierarchies of management, lines of authority, control of information, dispensation of privileges, even taxation and economic powers analogous to those of highly centralized governments.[21]

These same institutions often manifest the second kind of redundancy as well. That is, one easily can find examples of religious forms, such as myths and theologies, whose contents are strictly parallel to and reflective of secular institutions and secular relationships; for example, the Homeric gods act out and exemplify certain

esteemed features of an economic and social organization founded upon small, self-reliant groups whose survival requires intense loyalty and personal bravery from their members.[22] In other words, these religious institutions manifest both formal-structural and content types of redundancy.[23]

Understanding Complex Systems

If, as Simon says, the task of science is to make use of the world's redundancy in order to describe it simply, it seems to follow that complex, nonredundant systems cannot be simply described.[24] I should like to expand this argument to suggest that because nonredundant systems cannot be simply described they cannot be simply understood either and that the fact that complex systems are understood supports my claim that those systems are reducible in one or all of the ways described above. In brief I should like to argue the following: (1) If a complex system is highly redundant, then it is possible to describe it in relatively simple terms. (2) It is easier to understand (grasp, comprehend, etc.) a simple description than complex descriptions. (3) Hence it is easier to understand complex systems which are highly redundant than those which are not. To these mostly unobjectionable propositions I should like to add the following rather more questionable ones: (4) If a complex system is easily understood, it is probably highly redundant. (5) Hence, if a complex religious form (e.g., Christian theology) is claimed to be understood by many people, it is probably redundant and shows some degree of reducibility.

As it stands proposition 4 is an unsupported statistical claim, not a logical one since the conclusion of proposition 3 does not rule out the possibility that there is a complex system which is both nonreducible and yet easy to understand.[25] However, in the light of my earlier arguments regarding the evolutionary edge highly reducible systems enjoy over nonreducible ones it would seem to follow that any contemporary complex system which has survived in a competitive environment and which is highly understandable, such as Christian eschatology, is most likely also reducible.

In addition to this rather weak example of speculative argumentation, one can generate a second argument based upon Ludwig Wittgenstein's analysis of the logic of the term "understanding."[26] In a series of arguments, examples, hints, and polemics Wittgenstein wages a kind of battle against privatized, sensationalist theories of meaning. In particular he intends to expose the mistake made by many philosophers who hold that the term "understanding" refers to special kinds of experiences (e.g., an "insight" experience) that bear special marks of their veracity.

In brief, he argues that when we examine the actual ways in which such terms are used we see that "understanding" *(verstehen)* and "knowing" *(wissen)* actually are related very closely to terms such as "being able" or "can" *(können).*[27] For example, no matter how many thrills, tingles, sighs, or other sensations of "insight" one experiences watching some one enumerate part of the series of whole integers, say starting at three and counting up to ten, if he cannot go on to complete the sequence, that is, count from eleven, say, to ninety-nine, he does not yet understand the nature of counting whole integers.[28] The same is true for languages. If someone claims to understand French yet he can neither comprehend simple spoken or written French sentences nor generate simple French sentences his claim is false regardless of the intensity and fervor of his feelings, sensations, "intuitions," etc., for French.

Wittgenstein, of course, does not pretend that these and other destructive arguments are sufficient to generate a single, monolithic theory of meaning. On the contrary, one of his major goals is to demonstrate that the term "language" does not designate a single, unified, autonomous entity which can be studied and described apart from the myriad ways in which language acts occur. Just as there is no nontrivial definition of the universal significance of the term "tool" which will account precisely for the very different operations saws, screwdrivers, and tape measures perform, so there is none for the term "language."[29]

In some peculiar way, to say one understands a language or how to add whole integers is to say that he has distinct skills or capacities whose development can be assessed. Wittgenstein argues that often the experience of "insight" is really an experience of "being able to go on," that is, one now can take over, as it were, from one's teacher and generate a potentially infinite stream of new numbers or new sentences: "To understand a sentence means to understand a language. To understand a language means to be master of a technique."[30] Moreover, to grasp the meaning of a sentence, that is, to understand it and therefore the language system which it entails, is to understand something about the environment in which it works: "It is easy to imagine a language consisting only of orders and reports in battle.—Or a language consisting only of questions and expressions for answering yes and no. And innumerable others.—And to imagine a language means to imagine a form of life."[31] It should be clear that Wittgenstein's delineation of the nature of natural languages is compatible with our earlier discussion of information theory and general systems theory, for in all three cases we see that by understanding (grasping, receiving, etc.) part of a highly redundant structure we can

understand (predict, generate, etc.) additional as yet undiscovered portions. Understanding an English sentence does not mean that I can therefore write a valid scientific treatise on the nature of English grammar, but I can go on to generate new, grammatically correct English sentences.[32]

This general principle is not limited to languages or language systems. It holds, I believe, for many kinds of rule-bound behavior, for example, driving a car. If a friend says "I understand [know] how to drive" but then demonstrates that, having memorized the sequence of motions for example, he only can back out of the driveway, one would be reluctant to agree. He knows how to back out of his driveway, but that does not constitute driving. On the contrary, we want to say that being able to drive (understanding how to drive) means that one can use an automobile to go literally anywhere a highway and his wishes lead him. In a sense, then, being able to drive is having the capacity to generate a potentially infinite series of actions—steering left, braking, for example—which are well formed and which will get one to a potentially infinite series of new places.[33]

I should like to condense these points into the following argument: (1) Understanding a linguistic, social, or behavioral institution entails the ability to generate well-formed formulae or well-formed behaviors which are potentially unique. (2) The ability to recognize and generate either well-formed formulae or well-formed behaviors in system *S* implies that *S* is structured by or according to rules, laws, grammars, boundaries, or causal or logical restraints.[34] (3) Such systems must be reducible in at least one of the three ways already described. (4) Hence the presence of the ability to understand *S* implies that *S* is reducible.

With regard to religious forms, it would follow that if someone correctly says he understands Christianity then Christianity is, for that person, reducible in one of the three ways described.

Persistence of Religious Forms

I can try now to explain why religious forms, especially religious rituals and other noncognitive behaviors, persist in the face of nearly overwhelming demonstrations of the power of scientific (reductionistic) methods. They persist, I should like to argue, because they are highly redundant. By virtue of their evolutionary past they can provide condensed formulations of past, successful problem solving and by virtue of their "emptiness," that is, their nonreferential character, they can restructure and so help solve new problems.[35]

People who are sympathetic to religion, whether or not they are traditional believers, frequently regard this capacity for religious

forms, especially religious symbols, to encompass or restructure new experiences as one of their cardinal values: ". . . modern hermeneutics brings to light the dimension of the symbol, as a primordial sign of the sacred. . . . it is one of the ways of rejuvenating philosophy. . . . Every symbol is finally a hierophany, a manifestation of the bond between man and the sacred."[36] Given this point of view, the fact that religious statements, symbols, histories, etc., are subject to myriads of interpretations is not a sign of their decadence or falsity: "If a proposition is going to be taken to be unquestionably true, it is important that no one understand it. Lack of understanding insures frequent reinterpretation. An important implication of such change through reinterpretation is that ultimate sacred propositions must remain nonspecific with respect to particular regulatory mechanisms. . . . When this [unique sentences are held to be sacred] occurs, the control hierarchy becomes highly resistant to adjustment through reinterpretation with perhaps disastrous results."[37] Although Roy Rappaport is using the term "understanding" in a more restrictive way than I am, his analysis is compatible with my earlier discussion of reducibility and hierarchic redundancy.[38] In brief he is arguing that sacred propositions and commands—for example, "Love God," "Christ is Risen"—are nearly empty formulae that serve to conceptualize and so inform decision-making processes in primitive societies especially since "the ability, of the members of a congregation to affirm through religious experience the ultimate sacred propositions which sanctify the control hierarchy may be in considerable measure a function of the effectiveness of the hierarchy in maintaining equilibria in and among those variables which define their material well-being in the long run, and thus adaptation."[39]

Some might feel that it is an error greater than that of atheism to say that religious claims are, in essence, empty expressions more like those of grammatical rules than ordinary statements. But if one considers some quite ordinary uses of religious language one sees that it often has precisely these functions. Consider the beautiful speeches in Shakespeare's *King Richard III* when each of the principals swears allegiance to maintain the newly won peace between the Houses of York and Lancaster: "King Edward: Take heed you dally not before your/ king;/ Lest he that is the supreme King of kings/ Confound your hidden falsehood and award/ Either of you to be the other's end" (act 2, scene 1).

Granted that this is true of some kinds of religious discourse, one cannot easily escape answering the theologian who insists that his propositions are claims about the nature of reality, not simply forms that dictate grammatically correct liturgies. It may be useful to divide

our answer to this by asking two additional questions: (1) What is the ontological status of these much discussed forms or structures vis-à-vis that of so-called material objects? (2) Can one make discoveries about the nature of reality through an examination of these structures?

With regard to the first, it would seem to be only the expression of certain metaphysical biases that terms such as "object" and "thing" are taken to denote entities which are more ontologically fundamental than the sets of relationships and systems which obtain between them. It is well known if not well understood that reigning conceptions among physical scientists about the nature of matter versus relationships between pieces of matter ("fields") contradict any simplistic materialist metaphysics which does not recognize that "things" such as billiard balls are themselves functions of complex interactions among structured energy units.[40] On more philosophic grounds I already mentioned that the Pythagoreans, among others, noted that terms such as "ratio," "harmony," and "memory" seem to denote relationships or structures of events that are more permanent and hence of a potentially higher ontological status than that of mere objects which are notoriously ephemeral.

Finally one can use a great deal of current thinking in information theory and general systems theory to argue against both traditional materialistic and idealistic ontologies since both ignore the importance of information, which is a statistical property of complex systems, in complex interactions.[41]

With regard to the second question, it appears that by reflecting upon the structure of reducible forms one can make real discoveries about the nature of "reality" to the extent that that reality is conditioned partly by our categories of understanding. One need not take a strongly Kantian or Whorfian position about the relation between epistemology and ontology to make this statement. On the contrary, one need only consider features typical to discovery in many areas of mathematics, philosophy, and aesthetic theory to realize that it is quite possible to discover new, meaningful (well-formed), and true propositions by analyzing relationships which obtain among well-defined members of each discipline. In mathematics and particularly in mathematical logic, to the degree that I understand them, one frequently finds that new proofs and new discoveries are the result of one person rethinking the implications of well-known propositions or theories. The fact that mathematics is at once totally nonempirical in any easy materialist sense of that term and yet the most important handmaiden if not queen of the sciences has confused logical positivists from the beginning.[42]

Philosophy, as it is practiced in English speaking countries, has

revolved around Wittgenstein's and J. L. Austin's distinct but sympathetic programs to reduce and cure the numerous mistakes made by professional thinkers isolated from the genius of their own language by returning them and philosophic debates to it. Although neither of these men dominates current literature as they once did, it is generally accepted that both were correct in many ways and that natural languages, while not sacrosanct, are highly evolved and highly efficient tools whose functions can be discovered by very careful attention to their ordinary settings.[43]

Finally it is worth noting that many thoughtful people of this and past centuries have claimed that through devotion to the inherent structures of his medium and obedience to his insights the artist may realize and convey to his audience truths which would not otherwise emerge.[44] Indeed, as Jürgen Habermas notes, it is only in the last few dozen decades that the realm of knowledge has so shrunk that it includes only the very latest pronouncements from major scientific research organizations.[45] The best and most esteemed minds of our times concentrate on occupations recognized as normal science while in the past men and women of that same quality were artists, especially painters.[46]

An ardent materialist might find that I have gone too far afield from my earlier discussion now that I am willing to quote romantic poets whose pronouncements are often less than orderly. But I should like to conclude this essay by noting that I am still within the bounds of my original topic (the analysis of reducible forms) and within the limitations of my proposal (to discuss structural similarities between religious forms and other complexly evolved behavior patterns). If this discussion is correct, the great discoveries of nineteenth-century materialist and evolutionary theorists that religious forms were in fact similar to natural forms are actually illustrations of the organicity of religious institutions, and one can discover this interesting fact by scientific means.

While many religious forms do manifest features typical of large control hierarchies, to say they are not more than this is to take an unsupported step into metaphysics. If we reflect upon the content of these religious forms we see that they also typically claim that they and all statements like them are essentially incomplete and hence inadequate to their task. For example, the religious form called Christian eschatology may appear to the outside investigator to be a distinctly reducible structure similar to those one can duplicate in controlled social-psychological experiments.[47] But to the insider, to the believer who occupies an emic point of view all statements about the coming of the Messiah, including those in the most esteemed text, are

essentially incomplete, limited, and hence in error.[48] This is so not just because our language is limited but because the world itself and all the sciences which examine it are themselves incomplete, apart from God, and fallen.[49]

The materialist can respond immediately that all such claims are simply covert means of controlling and then destroying insight into ruling ideologies. But this criticism does not arise out of a scientific comparison of religious and economic structures, for it too entails covert propositions about the nature of man, time, and the end of time.

NOTES

1. C. E. Shannon and W. Weaver, *The Mathematical Theory of Communication* (Urbana: University of Illinois Press, 1949), p. 104.

2. Ibid., pp. 100–101: The formal equation is $H = -\Sigma$ pi log pi, where H is the amount of information and Σ is the sum of the probabilities of each message expressed in logarithms to the base 2. E.g., if I have only two choices of content and send one, say by using lights in a church steeple, the total amount of information thus conveyed is the logarithm of 2 to the base 2, which equals 1 or unity (we recall that the logarithm of x to the base 2 will be the power to which 2 must be raised in order to equal x). John Tukey called this unit of information a "bit," a term he created by condensing the longer term "binary digit," which is related to the binary digit system (0 and 1). It may be recalled that the binary digit system not only is applicable to information theory but also nicely parallels the minimal capabilities of machine language where one can use the presence (+) or absence (0) of an electrical impulse to designate either of the two digits. By using bits as our units of information measurement we can see that "if one has available say 16 alternative messages among which he is equally free to choose, then since $16 = 2^4$ so that $\log_2 16 = 4$, one says that this situation is characterized by 4 bits of information."

3. Ibid., p. 104.

4. Example suggested by J. C. Robertson.

5. Shannon and Weaver, p. 112.

6. Roy Rappaport, "Ritual, Sanctity, and Cybernetics," *American Anthropologist* 73 (1971): 59–76, and *Pigs for the Ancestors: Ritual in the Ecology of a New Guinea People* (New Haven, Conn.: Yale University Press, 1968).

7. Sigmund Freud, "Obsessive Actions and Religious Practices" (1907), in *The Standard Edition of the Complete Psychological Works of Sigmund Freud,* trans. and ed. James Strachey et al., 24 vols. (London: Hogarth Press, 1953–74), 9 (1959): 115–27.

8. Herbert A. Simon, *The Sciences of the Artificial* (Cambridge, Mass.: M.I.T. Press, 1969).

9. Ibid., p. 111.

10. Herbert Spencer, *Principles of Sociology,* ed. S. Andreski (1896; London: Macmillan Co., 1969); Karl Marx, "The Communist Manifesto" (1848) in *Capital: The Communist Manifesto and Other Writings by Karl Marx,* ed. M. Eastman (New York: Modern Library, 1932), pp. 315–55; Talcott Parsons, *Societies: Evolutionary and Comparative Perspectives,* Foundations of Modern Sociology Series (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1966).

11. Jean Piaget, *Structuralism,* trans. and ed. Chaninah Maschler (New York: Basic Books, 1970); Harley C. Shands and James D. Meltzer, *Language and Psychiatry* (The Hague: Mouton, 1973); Noam Chomsky, *Cartesian Linguistics: A Chapter in the History of Rationalist Thought* (New York: Harper & Row, 1966).

12. D'Arcy Thompson, *On Growth and Form,* 2d ed. (Cambridge: Cambridge University Press, 1942), pp. 1028–29; William Keith Chambers Guthrie, *A History of Greek*

Philosophy, vol. 1 (The Early Presocratics and the Pythagoreans) (Cambridge: Cambridge University Press, 1962), pp. 181–319; F. M. Cornford, "Mysticism and Science in the Pythagorean Tradition," *Classical Quarterly* 16 (1922): 137–50 and 17 (1923): 1–12.

13. W. Ross Ashby, *An Introduction to Cybernetics* (London: Chapman & Hall, Ltd., 1956), p. 262.

14. Simon, p. 110.

15. Ibid; Walter Buckley, *Sociology and Modern Systems Theory* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967).

16. Simon; H. Jacobson, "Information, Reproduction, and the Origin of Life," *American Scientist* 43 (1955): 119–27.

17. Simon estimates that the watchmaker, named Hora, who uses subassembly in his procedures will make 111 times as many complete assemblies per watch as his competitor, Tempus. Assigning an arbitrary assembly time to each operation and a similar number of interruptions to each, he figures that it will take Tempus four thousand times as long as Hora to complete a single watch (Simon, pp. 91–93).

18. Ashby.

19. Ashby compares the time required to find a single atom somewhere in the universe of 10^{73} atoms (1) by examining each atom at a time or (2) by asking of the entire set, ". . . is the atom in this half or that?" (ibid., p. 261). In the former it would take more centuries than this page has room to enumerate. In the latter, provided that one can ask the "this or that" question in a second, it would take only four minutes to find that single atom. The formula for the latter operation obviously is $X = \frac{1}{2^n}$, where X = the number of atoms remaining and n = the number of trials. Thus we can see the total number of atoms remaining to be examined after only twenty seconds of picking is equal to one-half to the twentieth power or about one-millionth of the original number.

20. For examples of hierarchical analyses of religious and psychological systems see Parsons (n. 10 above); H. Mol, *Identity and the Sacred* (New York: Free Press, 1976); Gregory Bateson, *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology* (San Francisco: Chandler Publishing Co., 1972); Anthony F. C. Wallace, *Religion: An Anthropological View* (New York: Random House, 1966); Eliot D. Chapple, *Culture and Biological Man: Explorations in Behavioral Anthropology* (New York: Holt, Rinehart & Winston, 1970); David Rapaport, "The Structure of Psychoanalytic Theory: A Systematizing Concept," *Psychological Issues* 2, no. 2 (1960): 1–159; Karl H. Pribram and Merton M. Gill, *Freud's "Project" Re-Assessed* (New York: Basic Books, 1976); Emanuel Peterfreund and Jacob T. Schwartz, "Information, Systems, and Psychoanalysis: An Evolutionary Biological Approach to Psychoanalytic Theory," *Psychological Issues* 7, nos. 1–2 (1971): 1–399; John E. Gedo and Arnold Goldberg, *Models of the Mind* (Chicago: University of Chicago Press, 1973). For reviews of applications of cybernetics to social sciences see Buckley (n. 15 above) and Roy R. Grinker, "The Relevance of General Systems Theory to Psychiatry," in *American Handbook of Psychiatry,* ed. Silvano Arieti, 2d ed., 6 vols. (New York: Basic Books, 1974–75), 6 (1975): 251–72.

21. Cf. Sigmund Freud, "Group Psychology and the Analysis of the Ego" (1921) in Strachey et al. (n. 7 above) 18 (1955): 67–143.

22. A. W. H. Adkins, *Merit and Responsibility: A Study in Greek Values* (Oxford: Oxford University Press, 1960), pp. 46–57.

23. Religious institutions might well incorporate content redundancy in two distinct forms: content which represents or mirrors a generalized perception of the sacred and profane worlds and content which only indirectly models those worlds. The first type of content is similar to that which E. Jacobson (*The Self and the Object World* [New York: International Universities Press, 1964]) analyzes in the conscious and unconscious fantasies of normal psychic life. The second would be similar to that which design theorists mean by the term "model": "To an observer B, an object A^* is a model of an object A to the extent that B can use A^* to answer questions that interest him about A" (M. L. Minsky, as quoted by Margaret A. Boden in her *Purposive Explanation in Psychology* [Cambridge, Mass.: Harvard University Press, 1972], p. 125). Thus model and object need not be identical "forms" in order for the first to give one useful information about

the nature of significant relationships among component parts of the second (Simon [n. 8 above], p. 17).

24. Simon, p. 110.

25. Although it is not easy to conceive of one. This may say something about the logic of the term "complexity" in normal discourse. While one can imagine a complex system, say the intertwining roads of an ancient, unplanned city that follows no structural/formal laws of any sort, one would have difficulty imagining that he could find his way around it very easily.

26. Ludwig Wittgenstein, *Philosophical Investigations,* trans. G. E. M. Anscombe, 3d ed. (New York: Macmillan Co., 1958).

27. Ibid., sec. 150.

28. Ibid., secs. 153, 157.

29. Ibid., sec. 14.

30. Ibid., sec. 199.

31. Ibid., sec. 19.

32. Chomsky (n. 11 above).

33. This capacity is strictly parallel to the capacity for generating new myths or, as it amounts to the same thing, predicting the structure of as yet undiscovered myths which Claude Lévi-Strauss claims is a central pillar in the validation of structuralist interpretation: "Either structural analysis succeeds in exhausting all the concrete modalities of its subject, or we lose the right to apply it to any one of the modalities" ("The Raw and the Cooked," in *Mythology: Selected Readings,* comp. Pierre Maranda [London: C. Nicholls & Co., 1972], p. 271). For an example of him attempting to conduct just such an exhaustive analysis see his discussion of the inverted relationship between the myth sets typical of the Sherente and Bororo Indians of Brazil. In that discussion he tries to show that on the basis of a partial knowledge of the content of a Bororo myth about the origin of water he can predict the existence of a Sherente myth which is an inversion of it (ibid., p. 286). Having found such a myth, he claims that we have witnessed a kind of *contrario* proof.

34. Wittgenstein, sec. 207.

35. H. Hartmann, *Ego Psychology and the Problem of Adaptation* (New York: International Universities Press, 1939), pp. 78–79; Mol (n. 20 above), pp. 206–15.

36. Paul Ricoeur, *The Symbolism of Evil,* trans. E. Buchanan (Boston: Beacon Press, 1969), pp. 353, 356. Ricoeur's enterprise consists in an attempt to bridge the very real gap, or chaos, separating the worlds of professional philosophy which he feels have given up much of their rightful concern with the ontology of the sacred from the worlds of religious affirmation and religious experiences which constantly threaten to forsake a grounding in rationality. This enterprise is very similar to the one William James set himself in his *The Varieties of Religious Experience* ([1902; New York: Collier Books, 1961], pp. 389, 393, 401) where he again and again exclaims against the defects in a rationalism which everywhere shows its shallowing effects when not coupled with a consciousness of the "More." Carl G. Jung, of course, and a large percentage of the so-called third-force psychologists who followed him, both literally and chronologically, are entirely sympathetic to James's wholism, antireductionism, and proreligiosity.

37. Rappaport (n. 6 above), p. 71.

38. He means to argue that because sacred propositions rarely contain material terms of specific directives and because they are usually cryptic they are difficult to falsify and contravene and hence understand (ibid., pp. 70–71).

39. Ibid., p. 71.

40. Albert Einstein and L. Infeld, *The Evolution of Physics: From Early Concepts to Relativity and Quanta* (New York: Simon & Schuster, 1938).

41. Walter Buckley, "A Systems Approach to Epistemology," in *Trends in General Systems Theory,* ed. George J. Klir (New York: Wiley-Interscience, 1972), pp. 188–202.

42. In other words, the question is, What is the source or ground of mathematical truth? Or rephrased, What is it about the empirical world that wholly nonempirical formulae (mathematical or logical propositions) can describe it accurately? Strict positivists like Rudolf Carnap argue that it is natural languages which underlie logical

forms and hence they provide the ground for logical truth; others argue, with W. V. Quine, that "perhaps logical truths owe their truth to certain traits of reality" (*Philosophy of Logic* [Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970], p. 95).

43. G. J. Warnock, "John Langshaw Austin: A Biographical Sketch," in *Symposium on J. L. Austin,* ed. K. T. Fann (New York: Humanities Press, 1969), pp. 3–21. Cf. J. L. Austin's discussion of the differences among "looks," "seems," and "appears" and how they "are not the same; and very often, where we could use one word we couldn't use another" (*Sense and Sensibilia* [New York: Oxford University Press, 1964], pp. 37–38). With this reminder we should approach warily the usual arguments about "appearance and reality" in professional philosophical writings whose authors have not explored the topography of these central concepts.

44. This is especially true, of course, of romantic artists and romantic critics who felt certain that creativity and the artistic experience itself could provide revolutionary insights into the gloom of ordinary existence. See G. Bays's discussion of Arthur Rimbaud's aesthetic doctrine (*The Orphic Vision: Seer Poets from Novalis to Rimbaud* [Lincoln: University of Nebraska Press, 1964]).

45. Jürgen Habermas, *Knowledge and Human Interests,* trans. J. L. Shapiro (Boston: Beacon Press, 1972).

46. Arnold Hauser, *The Social History of Art,* 2 vols. (New York: Alfred A. Knopf, Inc., 1951), 1:311–40.

47. Messianic beliefs, conversion experiences, group pressure upon individual deviancies, and other features of the early church may be duplicated in certain ways by manipulation of social environments. See Jack Brehm and Arthur Cohen, *Explorations in Cognitive Dissonance* (New York: John Wiley & Sons, 1962).

48. Kenneth Lee Pike, *Language in Relation to a Unified Theory of the Structure of Human Behavior,* vol. 1 (Glendale, Calif.: Summer Institute of Linguistics, 1954), and *With Heart and Mind: A Personal Synthesis of Scholarship and Devotion* (Grand Rapids, Mich.: William B. Eerdmans Publishing Co., 1962); Marvin Harris, *The Rise of Anthropological Theory: A History of Theories of Culture* (New York: Thomas Y. Crowell Co., 1968).

49. Thus Wolfhart Pannenberg concludes his study of Jesus: ". . . the predestination of all things toward Jesus, their eschatological summation through Jesus, is identical with their creation through Jesus. Every creature receives through him as the eschatological judge its ultimate illumination, its ultimate place, its ultimate definition in the context of the whole creation. The essence of all events and figures is to be ultimately defined in the light of him because their essence is decided on the basis of their orientation to him" (*Jesus, God and Man,* trans. L. L. Wilkins and D. A. Priebe [Philadelphia: Westminster Press, 1968], p. 391).