

## GOD AND CHAOS: THE DEMIURGE VERSUS THE *UNGRUND*

by Philip Hefner

*Abstract.* The human quest for meaning is an attempt to bring experience into conjunction with illuminating concepts. The second law of thermodynamics is of wide human concern, because it touches experience which is existentially charged and therefore which humans must interpret in broad metaphysical terms. Five types of experience have been incorporated into the second law: running down, degeneracy, mixed-up-ness, irreversibility of time, and emergence of new possibilities. The dominant Western tradition (Plato) places these experiences within a metaphysical scheme that evaluates them negatively, whereas a minority tradition (Berdyaev) evaluates them positively. The former makes entropy anti-God; the latter places entropy within God.

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Human beings have perennially faced a dilemma when they try to match words and concepts with experiences. It is from this match that meaning emerges. Eugene Gendlin (1962) focuses on this state of affairs in his equation, meaning = experiencing + symbol. His term *symbol* corresponds to my use of the term *concept*. Concepts in themselves do not give meaning, because they are empty of concrete content when they stand alone. Experiences do not provide meaning, either, when they are isolated from concepts, because they consist only of the buzz and whirr of static on the screen of life. Immanuel Kant pointed to this when he wrote, "Thoughts without content are empty, intuitions without concepts are blind. It is, therefore, just as necessary to make our concepts sensible, that is, to add the object to them in intuition, as to make our intuitions intelligible, that is, to bring them under concepts" (1958, 93). We can document this very well in our own experience. Who has not at one time or another suffered from the blind experience of

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pain or another equivocal symptom, anxious whether the physician would assign to that symptom the concept which indicated serious illness or that which amounts to trivial ailment? Such is the art of diagnosis. Doctors, for example, may disagree whether a spot on the lung is a pleurisy scar or something more threatening that requires surgery—blind experience in search of a concept that will give it meaning. In 1974 I attended a conference of cosmologists and astrophysicists, a conference that was spiced with a sharp ongoing debate between Arno Penzias (since then a Nobel Laureate) and a young colleague who insisted that several observations of red shifts could not be correlated with dominant theories of velocity of stars and the concept of an expanding universe. A historian of science from Harvard leaned over next to me and muttered about the young disputant, “That fellow is trying to be another Thomas Kuhn; he’s looking for a paradigm shift and he won’t rest until he’s found one.” The historian meant, of course, that the astrophysicist was convinced that certain prevalent ideas in his field were breaking down, even though he could not find the evidence to document it. He had an empty concept of paradigm shift on his hands, in other words, and he was going to great lengths to find some experience that would match that concept.

I have taken these efforts to describe the painful, slippery interface between experience and concepts, because it is central to what I want to present in my discussion of the second law of thermodynamics and entropy. In the first section of my paper I report that the literature presents five different types of experience that can be described by the various concepts pertaining to the second law. In each case a different set of meanings results. In the second section I argue that traditional ways of thinking tilt heavily toward one particular way of speaking of the second law, a way that is negative and simplistic. There are also other ways of speaking in our tradition, but they are in a minority position. I will finally pit Plato’s concept of the demiurge and Nicolas Berdyaev’s concept of the *Ungrund* against each other, and will make a brief detour through ancient Babylonian myth. Section three attempts to throw light on the relationship between the science of the second law of thermodynamics and the myths. The relationship has to do with the experience that they both illumine. In the final section I present the major thesis of this essay, outlined as follows. In view of the almost universal interest in the categories used in scientific discourse about the second law (running down, final equilibrium, etc.), we have often asked, “Is there something of universal significance in the scientific categories that makes them applicable to wider concerns, such as the movement of world history?” In this context the use and abuse of the second law have arisen. I suggest approaching the question of the

wider significance of the second law from a different angle. The hub of our interest is the experience itself which the second law of thermodynamics interprets. That experience is particularly charged existentially, and it touches a broad base of human concerns. This existential depth and breadth of range makes it inevitable that discourse on the second law will be placed by many persons into a larger metaphysical frame of reference. Neither the most vocal protests of the scientist nor the greatest caution of the philosopher can avoid the thrust toward metaphysics.

#### HOW DO WE EXPERIENCE THE SECOND LAW?

We can discern at least five different kinds of experience to which scientists have attached the concepts associated with the second law of thermodynamics, with different meanings resulting in each case.

*Dissipation of energy—running down.* Are there occasions when we experience weariness, tiredness, or even that life is running out on us as we approach the end of life? Does a house left in winter without an active heating source grow cold? These experiences are common, and they have been explained by no less than Lord Kelvin and Hermann von Helmholtz as illustrations of the dissipation of energy, the increase of entropy. This is the meaning that is perhaps most often associated with the second law in the public mind. Cold storage death, or as the most recent *Encyclopædia Britannica* puts it in its article on the universe, written by a leading cosmologist, “in the evolutionary cosmologies, the present dark and relatively empty universe is doomed to greater darkness and emptiness . . . an eternal future lies gripped in a frozen state of meaningless death” (Harrison 1974, 1011).

*Change and alteration of a previous order—degeneracy.* For some persons, the experience of dissipated energy is not simply a neutral and impersonal running down but a change of hallowed forms and a degeneracy. This perception is advanced not so much by reputable scientists as by the literati, social critics, and philosophers, although Stephen Brush does cite physician Max Nordau as a leading proponent of this degeneracy view in the nineteenth century—and Nordau was formidable enough that George Bernard Shaw wrote a substantial article against him (Brush 1967, 508-10, 556). Henry Adams (1931), of course, is the most celebrated humanist scholar to relate perceived degeneracy to the second law, and he was well informed about science, albeit still a layman. His view is summed up in his pungent commentary on the American presidency, to the effect that the mere observation of the development from Thomas Jefferson to Ulysses S. Grant is in itself

adequate evidence for the refutation of the theory of evolution. It is the experience of *change* that is as important here as that of dissipation. This experience of change underlay both Nordau's catalogue of degeneracies—exhibitionism in dress, proliferation of strange colors in painting, dissonance or fake religiosity in music, obscurity and mysticism in literature (Brush 1967, 510)—as well as Shaw's refutation. The title of Shaw's piece was "The Sanity of Art: An Exposure of the Current Nonsense about Artists Being Degenerate." The point of the historians is that the concept of degeneracy, although it originated outside science influenced some scientists in their interpretation of the second law of thermodynamics and was associated with that law by nonscientists.

*The experience of "one-time-ness"—time's irreversible arrow.* Ilya Prigogine has written, "with thermodynamics the concept of history was introduced into physics" (Denbigh 1975, 63). Kenneth Denbigh (1975, 54-88) uses this as evidence for asserting an objective and physical basis for the human experiential perception of time's passage, the irreversibility of time, time's arrow. Who has not experienced this? The poetry of romantic love is full of talk about ecstatic moments once experienced that will never be recaptured. Søren Kierkegaard wrote a memorable book, entitled *Repetition* (1946), in which he describes his totally unsuccessful effort, at a later time, to relive a period of gratifying student life in mid-nineteenth-century Berlin. Others have reminded us that "you can't go home again." Parenting is sometimes rendered anguishing by the awareness that neither the mistakes nor the successes of family life can be undone or retrieved. Once they have entered history, they must stand forever. Such experiences, as Denbigh describes rather forcefully, are rendered intelligible by the second law's insistence that dissipative processes are irreversible and that life is constituted by that irreversibility. Growth from fetus through infancy to adulthood is constitutive of life. To reverse the process would not only seem eccentric and absurd; it would result in death and nonexistence for us. A contracting universe, as opposed to an expanding one, might produce some welcome energy, but it would be irrelevant for us, for we would certainly be soon eradicated.

*Mixed-up-ness and chaotic disorderliness.* Irreversible processes lead to what some have called the "mixed-up-ness" of a system. Denbigh (1975, 74) uses the example of a drop of ink in a glass of water. At first the rather well-organized blob of ink is composed of particles that are close together and that can relate to other particles in the glass of water in only a few ways. As the ink blob disperses, its particles can soon be

found anywhere in the glass, not just in close proximity to the place where the ink was first dropped into the water. And the more mixed up the ink becomes, the more difficult it is to guess exactly where any given particle of ink is located. There is a loss of information certainly and in this sense a loss of orderliness.

*Alterations that make for possibility.* Entropy is defined by some, including Denbigh (1975), Jacob Bronowski (1970), and Ahron Katchalsky (1971), as the increase of possibilities for transformation or organization, or the increase in the number of "accessible states." As such, it seems to be a condition for life as we know it. For example, it is the coexistence of hot and cold in an unstable, nonuniform, noncontracting universe and planet earth that enables the heat transfers and the radiational effects that make life possible. The temperature differential makes it possible for more things to happen, more possibilities, and one of those possibilities is the formation of the life that is dependent on one sector of temperature that results from the transfer. The irreversibility of the process of human growth means more possibilities in any moment for a teenager than for a fetus, even though the former's life is more mixed-up. A number of authors point out that the decrease in energy indicated by the second law is irrelevant to the development of some of the possibilities that are enabled by the increase in accessible states. For example, a bank robber and a school teacher are both caught up in the process of energy decrease, and neither consumes much more energy than the other. But one of them is devoted to raising the level of human life, the other to lowering it. The process of energy decrease is irrelevant to which activity either person engages in.

We have surveyed five different kinds of experience (using the term *experience* loosely, to be sure), the experiences of running down, degeneracy, irreversibility of time, mixed-up-ness, and increase of possibilities. Each of these has been rendered meaningful at one time or another by bringing it into conjunction with one or more concepts associated with the second law of thermodynamics, of which entropy is perhaps the chief concept. The experiences differ, and so do the interpretations of the second law. How does one account for this? David Breed (1972, 53-73) correlates differing interpretations of the second law with succeeding stages of scientific development. Thus, the running down concept is related to the "classical sense" of entropy during the period when physics was still dominated by Newtonian forms of thought. Breed refers to the "statistical" sense of entropy to account for the disorder concept and "entropy in the quantum sense" as the basis for the accessible states concept. Denbigh (1975, 81-85)

speaks of “various arrows,” apparently referring to the locus of the evidence for various dissipative processes. The arrows are the psychological, thermodynamic, cosmological, and electromagnetic. Psychological refers to the awareness of the passing of time, cosmological to the documentable expanding of the universe, thermodynamic to the transfer of heat from hot to cold bodies and electromagnetic to the direction of wave movement from a center to a periphery.

In any case, despite the sorts of explanation provided by Breed and Denbigh, the problem of meaning, that is, the problem of relating concepts of interpretation to experience, is still a major dilemma. Is my present sense of my own aging to be understood by me as my running down, my participation in time’s irreversibility, or as the insurgence of creative chaos that augments my possibilities (after all, if my particles do not go to the grave, they will never have the possibility of going beyond the Milky Way to fertilize the far reaches of the universe!)? Or are all of the above to be considered correct? Is one or more of these assignments of meaning more adequately related to the second law of thermodynamics or are all of them properly so related? The answer to these questions *does* make a difference.

I confess to not a little confusion as to how the concepts of the second law can be so varied. Of the five experiences I have discussed, four find solid mention in scientific literature; experience of degeneracy may be more a product of social philosophy than hard science. Nevertheless the sense data that underlie running down may be the same as those that underlie chaos and time’s irreversibility. Do all three concepts apply to the same experience? I can understand that my tiredness may be all three, but on other occasions, irreversibility might appear to be a step in the process of winding up, not running down. Is there a degree of unclarity in the concepts of thermodynamics?

We may summarize as follows the range of concepts that the second law provides for us who are lay persons to the world of physics. First, we recognize that most persons who graduated from college before 1960 learned to equate the second law with the process of running down. Although this is not incorrect, a great deal of research and reflection have taken place to augment that view. The second law research does speak of the decrease of energy that is available in the natural life of closed systems. Second, correlated to this decrease of energy, or entropy, is the tendency toward equilibrium and disorder. However, second law categories also include as a third concept what Denbigh (1975, 69) calls the “mixed-up-ness” or spreading-out of a system. The law speaks of all the possible microstates that a system may entertain without losing its macrostate identity. For example, a glass of water with sugar and lemon in it may retain its identity as sugar-lemon water

simultaneously with an incredibly wide range of microstates. It is still sugar water, for example, no matter what the physical dispersal arrangement of the sugar molecules is. Entropy speaks of all the possible ways the sugar can arrange itself in this water. We may also speak of this phenomenon in terms of the concept of maximum possible accessible states. Entropy pertains to all of the possible states that are accessible to sugar and water, and to the direction of the tendency of the materials involved to approach those states. Finally, second law research speaks of the capacity of systems to increase their level of organization while still not contravening the laws of entropy. This is what is referred to as “eddies” of organization, on which Prigogine (1980) and Manfred Eigen (Eigen and Winkler 1983) have thrown much light. Denbigh (1975, 99) speaks of integrality, which he describes as the product of  $c$  and  $n$ , that is the number of connections and the number of component parts in an entity; he distinguishes integrality from order, which is stability of pattern. Systems can increase integrality without violating the tendency toward entropy.

#### THE TILT TOWARD NEGATIVE EVALUATION OF ENTROPY—AND AN ALTERNATIVE

It is common to find discussions of chaos, disorder, and the passing of time that are inherently negative. Such judgments abound in both scientific and nonscientific accounts. Sir James Jeans (1930) is a powerful example of the former, as is the article on cosmology in the *Encyclopedia Britannica* (Harrison 1974). Adams (1931) and Oswald Spengler (1939) represent the latter. We do not really need to cite authorities, however, to be convinced that the kinds of things the second law conceptualizes strike a negative and even fearful note in our very being. Gerard Manley Hopkins captures this feeling vividly in his poem “The Leaden Echo,” written in the 1880s and describing the feelings of a woman as she contemplates the passing of the years and the fading of her beauty:

How to keep—is there any any, is there none such, nowhere  
 known some, bow, brooch or braid or brace, lace, latch or  
 catch or key to keep  
 Back beauty, keep it, beauty, beauty, beauty, . . . from  
 vanishing away?  
 O is there no frowning of these wrinkles, ranked wrinkles  
 deep,  
 Down? no waving off of these most mournful messengers, still  
 messengers, sad and stealing messengers of grey?  
 No there's none, there's none, O no there's none,  
 Nor can you long be, what you now are, called fair,  
 Do what you may do, what, do what you may,

And wisdom is early to despair:  
 Be beginning; since, no, nothing can be done  
 To keep at bay  
 Age and age's evils, hoar hair,  
 Ruck and wrinkle, drooping, dying, death's worst, winding  
 sheets, tombs and worms and tumbling to decay;  
 So be beginning, be beginning to despair.  
 O there's none; no no no there's none;  
 Be beginning to despair, to despair,  
 Despair, despair, despair, despair (1953, 52-53).

The philosophical and mythic roots of this negative feeling toward the fruits of the second law can be illuminated by Plato's explanation of the creation of the world in his dialogue *The Timaeus*. Early on in the piece Plato gives this account:

Let me tell you then why the creator made this world of generation. He was good, and the good can never have any jealousy of anything. And being free from jealousy, he desired that all things should be as like himself as they could be. This is in the truest sense the origin of creation and of the world, as we shall do well in believing on the testimony of wise men; God desired that all things should be good and nothing bad, so far as this was attainable. Wherefore also finding the whole visible sphere not at rest, but moving in an irregular and disorderly fashion, *out of disorder he brought order, considering that this was in every way better than the other* (italics added) (1937, 13-14).

There are some rather basic considerations embedded in this passage. One is that disorder is co-eternal with God, sharing as it were equal primordially with God. Chaos is prior to order, excepting God's own ordered being. But perhaps more significant, chaos is fundamentally other than God and opposed to God. In order to render the created world as much like God as possible, and thereby to make it good, irregularity and disorder have to be eliminated by bringing order to the world.

Such a view is consistent with Plato's entire philosophy. The argument goes something like this: a certain type of order is what actually constitutes the essence of eternity, ultimate reality; therefore, what human existence aims at is full unity with this order. The myth of the demiurge is told so as to throw light upon the implications of Plato's view for the very nature of the world. Plato's dualism is evident: the realm of being is set against the realm of becoming, changelessness against change, eternity against time and transiency, order against disorder. Later in *The Timaeus* itself, there is talk that death and disease are due to disorder and disarrangement of elements in the body. Health and beauty are based on due proportion and balance, and on learning the harmonies of the universe. Health, beauty, all the virtues, and immortality are possible only to the extent that humans focus on the order of the divine within them and separate themselves from the disorder that God had to overcome.



But he who has been earnest in the love of knowledge and of true wisdom, and has exercised his intellect more than any other part of him, must have thoughts immortal and divine, if he attain truth, and in so far as human nature is capable of sharing in immortality, he must altogether be immortal; and since he is ever cherishing the divine power, and has the divinity within him in perfect order he will be perfectly happy. Now there is only one way of taking care of things, and this is to give to each the food and motion which are natural to it. And the motions which are naturally akin to the divine principle within us are the thoughts and revolutions of the universe. These each man should follow, and correct the courses of the head which were corrupted at our birth, and by learning the harmonies and revolutions of the universe, should assimilate the thinking being to the thought, renewing his original nature, and having assimilated them should attain to that perfect life which the gods have set before mankind, both for the present and the future (Plato 1937, 90).

This Platonic scheme places four of our basic experiences of the second law in the anti-God position, as realities *to be overcome*, and it denies the fifth experience. Running down, degeneracy, the irreversible passage of time, and chaos are to be overcome. The thesis that disorder could be the source of possibility is simply rejected.

As ancient as the Platonic discussion, yet generally less noticed, is the richness of the Babylonian myth of Marduk's conquest of the primordial chaos represented by the goddess Tiamat. This myth is the *Enuma Elish*, and it has a number of Near Eastern variations. Here, as in the Platonic rendition, the god must overcome chaos. The conquest, however, is a bitter and violent struggle. It also is a theogony as well as a cosmogony, that is, it depicts the coming-to-be of the gods as well as the coming-to-be of the world. The world would not come to be at all if the gods had not come to be. Chaos is primordial; before there was anything else, there was chaos. Through the struggle with chaos the gods came into being, and then the world also. As Paul Ricoeur writes, "Order came to pass in the divine itself, and it came to pass by the victory of the latest forces of divinity over the earliest forces of divinity" (1967, 177).

Further, *disorder* in the form of Tiamat was overcome by *disorder* in the person of Marduk. Evil is applied to both instances of disorder—to Tiamat, the primordial chaos, and to the violent struggle by which Marduk kills Tiamat. (We shall overlook here that Tiamat is both woman and mother of the gods, whereas Marduk is male. In some versions a male god is chaos.)

From Tiamat's corpse the world is born; she is cut in two and the various parts of the universe are formed from her parts. Ricoeur says: "Thus the creative act, which distinguishes, separates, measures, and puts in order, is inseparable from the criminal act that puts an end to the life of the oldest gods, inseparable from a deicide inherent in the divine. . . . The man is made from the blood of an assassinated god, that is to say from the life of a god, but from his life ravished by a murder"

(1967, 180). The Hebrew references to this myth differ appreciably from the Babylonian version, in that it is the good high God Yahweh who slays chaos, and the slaying is not identical to the act of creation itself (Westermann 1984, 32).

There is no attempt to assign guilt for evil and struggle. Chaos and evil simply are, and the coming to be of all reality is dependent upon the evil struggle against evil. No story of the Fall is needed, nor a redemption, because "the problem of evil is resolved from the beginning and even before the beginning: before the creation of man, before the creation of the world, even before the birth of the god who establishes order" (Ricoeur 1967, 191).

What *is* needed is the cultic-ritual reenactment of the victory of Marduk, in which reenactment humans renew their unity with and participation in the foundational struggle of disorder over disorder. Ricoeur sums up: "In the final analysis, evil is not an accident that upsets a previous order; it belongs constitutionally to the foundation of order. Indeed, it is doubly original: first, in the role of the Enemy, whom the forces of chaos have never ceased to incarnate, although they were crushed at the beginning of the world; second, in the figure of the King, sent to 'destroy the wicked and the evil' by the same ambiguous power of devastation and of prudence that once upon a time established order" (1967, 198).

In this Babylonian myth we have quite a different approach to chaos, evil, the world, God, humans, and redemption than we saw in Plato. Chaos is not opposed to divinity, nor must it be overcome in order to eliminate it and produce the good. Rather, the overcoming has its own intrinsic worth, and that battle to overcome is no less a form of chaos and evil than the original. Chaos is not opposed to God, nor is divinity ever pure for not having participated in chaos and evil.

Ricoeur is surely helpful when he points out later heirs of the motifs that occur in the Babylonian myth. The Christian Redeemer also struggles with evil and chaos by making evil a part of himself and overcoming it in the embrace of the cross. Antecedents of this motif are found in Jewish traditions as well. The dialectical thinking of German philosophers like G. W. F. Hegel and of his offspring Karl Marx also bears these motifs. The dialectic speaks in a profound way of how good and evil, chaos and order, God and the world, human personhood, all emerge *through* a struggle. The true and the real are comprised of the whole struggle, not by a shaking free or separation from it.

These considerations lead us directly to Berdyaev (1960) and his concept of the *Ungrund*. Berdyaev was a Russian expatriate who lived in Paris during the first half of this century. He produced a powerful contemporary philosophical and theological rendition of Eastern Or-

thodox faith, which he brought into dialogue with modern Western philosophy, science, and theology.

Although Berdyaev's concept of the *Ungrund* is sometimes translated as the *un-ground* or *un-grounded*, it is more often referred to by the German term *Ungrund*. The concept is borrowed from the early seventeenth-century German mystic, Jacob Boehme (1978), and it is intended to designate ultimate reality as dynamic, nonobjective, and indeterminate. Boehme centered his reflection about God "on the contradiction inherent in reality, in its very root, its ground or its un-ground, its abyss" (1978, 17). In order to explain this contradiction at the heart of reality, Boehme began with Nothing. Nothing is subject, object, and beginning.

In order for Nothing to manifest itself fully in the world, created realities must out of their own freedom reflect divine majesty back to divinity itself. God must be glorified if God is to be fully God, but that glorification must be freely undertaken. Thus, *freedom* is at the center of reality—a freedom that God cannot control, else it would not be free. On the contrary, this freedom controls and even gives birth to God.

Berdyaev speaks of this freedom as *meonic* freedom, in Greek the freedom of *me on*, not being (1960, 25). Both God and freedom arise out of the abyss of the *Ungrund*. The *Ungrund* is pure potentiality, and God creates the world by bringing possibility into actuality—and not only actuality, but value that has actual, concrete, existential embodiment. In this sense God creates out of nothing, out of the *me on* of dynamic, nonobjective, indeterminate possibility.

Note the difference here from Plato. Plato's demiurge placed order upon chaos, to render it good, thereby eliminating chaos as much as possible. Berdyaev's God itself arises out of chaos and enables chaos to become actualized possibilities that retain their unquenchable freedom. He writes,

an esoteric theology is bound to recognize the presence of tragic conflict in God. It is what Jacob Boehme calls the theogonic process. It takes place in eternity and signifies not the birth of a previously non-existent God, but a divine mystery-play going on in the eternal hidden life of the Deity, the perpetual birth of God out of the *Ungrund*. The theogonic process and the presence of tragedy in God presuppose the existence of primeval freedom rooted in nothing, in non-being. On the secondary plane, where there is the Creator and the creature, God and man, the uncreated freedom may be thought of as outside God. We may not think of being as outside God, but we may thus think of non-being. This is the only way to understand evil without making God responsible for it. The distinction between being and non-being is merged in the last mystery of the Divine Nothing (Berdyaev 1960, 29).

Berdyaev's position assumes a stance different from Plato's toward the five experiences of the second law of thermodynamics that I de-

scribed at the outset. Berdyaev would elevate the fifth category of experience, that entropy is correlated to the increase of possibilities. The third and fourth categories, time's irreversibility and chaos, would be evaluated positively, or at least potentially so. Berdyaev would refuse to equate change and alteration with degeneracy in any simplistic manner, and I believe his view inclines us to be cautious in evaluating the experience of running down, since it, too, may be the seedbed of possibility.

#### CONCLUSION: WHAT HAVE THE MYTHS TO DO WITH THE SECOND LAW?

What is the significance of juxtaposing the two broad topics we have been discussing? What has the second law of thermodynamics to do with the philosophical, theological, and mythic discussions of chaos? As we conclude this set of reflections, let us consider three aspects of the interrelationship between the myths and the experiences conceptualized by the second law.

*The myths and human experience.* There is much discussion of whether the categories of the second law can be applied to areas of experience outside of the scientific context in which they emerge. Adams (1931) is commonly singled out as an example of the absurd application of the concept of entropy to interpret human history. In this discussion I have spoken of the experience of the second law, and I have by implication referred the myths to that experience, suggesting that the concepts that derive from the second law have interpreted certain types of experience. The question that arises in such analysis is this: Do the myths reflect upon the same experience that is rendered meaningful by the concepts of the second law? Let us examine the types of experience I have mentioned. I would argue that the experiences described as the irreversibility of time, the emergence of new possibilities or accessible states, and chaos are definitely the object of mythic reflection as well as scientific scrutiny. Historians like Adams and social critics like Nordau did not speak of these types of experience to a great extent in their influential works. They spoke of the experiences of running down and degeneracy. Degeneracy, as I have already indicated, is a nonscientific evaluation. Running down appears more ambiguous. Clearly it is the other three types of experience that provide the most useful areas of overlap between the myths and the scientific analysis. In these areas, the categories have been applied rather successfully to the large sweep of human affairs as well as to scientifically analyzable entities. An analyst of human affairs like Reinhold Niebuhr (1949), for example, who was one of the most

influential interpreters of American society and history, certainly handled the categories of irreversibility of time, chaos, and increase of accessible states, even though he did not relate them explicitly to the second law. Niebuhr is a useful example, because so far as I know no one ever accused him of being absurd, nonsensical, or farfetched in his analyses. No doubt the argument of this paper, that at least three of the experiences interpreted by the second law are easily accessible to broader humanistic analyses, will need further discussion. I state simply at this point that I believe that the three types of experience that I have singled out are legitimately selected as the object of mythic, philosophical, and theological reflection as well as scientific scrutiny.

*Can science learn to live with metaphysics and admit it?* In his article, Brush (1967) points out that scientific ideas are influenced by the larger culture in significant ways. He is concerned to relate the interpretation of entropy to late nineteenth-century *fin-de-siècle* pessimism. Other historians have related Charles Darwin's gradualism to the cultural mood of his times, and his view of natural selection to Adam Smith's concept of the "invisible hands." Other celebrated examples could be cited. In setting forth our cultural "tilt" in favor of Platonic dualism and the minority tradition of creative chaos, as exemplified in Berdyaev, I have drawn close to Brush's point. Despite the efforts of scientists to achieve objectivity, what they tell us about entropy *will* be placed within the larger metaphysical context of a Plato or a Berdyaev, whether scientists intend such a metaphysics or not. It may even be that scientists will themselves espouse Platonism or Berdyaev, perhaps unconsciously, and thus place their scientific views within a metaphysical context of their own accord.

This metaphysical interpretation will take place, because the experiences that correspond to the interpretations of the second law are charged with significance at several levels. The scientist may tell us that his or her findings are relevant in the context of microstates, closed systems, and the like. However, when the scientist says that the tendency of closed systems is toward entropy and chaos, that insight has immediate existential relevance to any person or group of persons who discovers that its life is dependent on the functioning of closed systems. The same holds in the case of the irreversibility of processes in time, and of what Arthur Peacocke (1979, 97-99) implies in his comments about the eddies of organization within the larger stream of the flow toward entropy; the flow of my own personal systems, whether it be the functioning of the brain, the eyes, or whatever, toward final entropy touches upon the very essence of my personhood and my purpose for being. Even though a heat death for planet earth may be two and

one-half billion years away, it is a present item of relevance, because it is pertinent to the discussion of the meaning and purpose of planet earth and the universe of which we are a part. For the same reason, but with different content, the phenomenon of my participating in a system that is capable of raising its level of organization, in an eddy of hyperorganization within the larger thermodynamic stream, is extremely significant for putting together the pieces of what I am about and what my possibilities are. It is this central place of the pieces of experience about which the second law discourses, this urgency in the experience which the law touches, that accounts for the repeated efforts in the last century to apply the concepts of the second law of thermodynamics to larger realities and issues, including the question of the relation between entropy and evil.

The human mind can scarcely allow these charged experiences to stand for a moment without interpreting them metaphysically. Is chaos good or bad? Is it positively or negatively related to the fundamental nature of things? Did chaos come first, prior to order, in which case order is an attempt to deal with chaos? Or is order prior, and chaos a "fall" or deviation from order? These questions cannot and will not be avoided. They will be dealt with responsibly and carefully in some quarters, impressionistically and carelessly in others. If the scientist deals with the charged experiences that seem to adhere to the study of thermodynamics, that scientist will have to live with metaphysics.

*Experiences of the second law and God.* Each of the five basic experiences of the second law elicits, to a greater or lesser extent, ambivalent responses from human persons. Irreversibility of time brings good and bad, happiness and unhappiness, but in any case it is just that—irreversible—and that renders it ambivalent. Did we miss an opportunity? It is too late to retrieve it. Did we perform exceptionally well? That performance can never be retained permanently nor can it be repeated exactly. Similar assessments can be made about the other four experiences.

Plato and Berdyaev cannot be adequately appreciated unless we recognize that they were wrestling with the basic question: How are these ambivalent experiences related to ultimacy? Each of these experiences possesses an element of the unsettling and the disrupting, and Plato assures his listener that such a dimension of experience is not foundational. It is rather epiphenomenal, adventitious, but not basic. In the Platonic myth it is antithetical to God, even though God ultimately cannot eradicate it. God can, with human cooperation, neutralize the deleterious effects of the epiphenomenal chaos and thus retrieve us from its clutches. This may be translated into language about evil as follows: God cannot control the emergence of evil, since

the primordial chaos provides an incubator for it at the very beginning. But be certain of this, God is opposed to evil and its ambience of chaos; hence God has waged a primordial war against it by imposing order on chaos, and by focusing upon the divine within us we can be saved from chaos and evil.

When we pose the question in this way, I believe we can understand the significance of the alternative offered by Berdyaev and the sources of his thought. He could not accept that chaos and evil were simply intruders, the object of divine wrath and opposition. He stands in the tradition of those who have a deep sense of the primordially of chaos and its dark side, whether that be called evil or not. This position recognizes that chaos provides the possibilities without which there can be no actuality; it is the womb of creativity and actuality. At the same time this chaos is both free and disordered—intrinsically and everlastingly. So long as it is both disordered and free, it stands also as the *nemesis* of actuality. Creation and chaos belong together by nature. Tragedy and the demonic harass the good, because the good contains within itself the seeds of its own destruction, without any external intervention necessary. This is not to say that God is good and evil. Such a judgment would be an anthropomorphism, laying on God our own standards of good and evil. It is to say, however, that the power that sources life is at the same time the energy of the good and the energy of the good's destruction, the energy of order and the energy of disorder. Listen to Paul Tillich discuss our subject:

Form of being and inexhaustibility of being belong together. Their unity in the depth of essential nature is the divine, their separation in existence, the relatively independent eruption of the "abyss," in things, is the demonic. An absolutely independent eruption of the "abyss," a mere devouring of every form, would be the Satanic, which for that very reason cannot take form or come to existence. In the demonic, on the other hand, the divine, the unity of bottom and abyss, of form and consumption of form, is still contained; therefore the demonic can come to existence only in the tension of both elements. The tension is really in everything which is produced by the creative power. The impulse for formation inherent in everything and filling it and the horror of decay of form is founded on the form-quality of existence. To come into being means to come to form. To lose form means to lose existence. At the same time, however, there dwells in everything the inner inexhaustibility of being, the will to realize in itself as an individual the active infinity of being, the impulse toward breaking through its own, limited form, the longing to realize the abyss in itself. The living form with the fullness and limits of its existence results from the conjoined effect of both tendencies. From the isolation and formless eruption of the abyss results demonic distortion. Demonry is the form-destroying eruption of the creative basis of things (1936, 84-85).

Tillich puts it better than anyone I know: "To come into being means to come to form. At the same time, however, there dwells in everything

the inner inexhaustibility of being, the will to realize in itself as an individual the active infinity of being, the impulse toward breaking through its own, limited form, the longing to realize the abyss in itself' (1936, 84). I believe that the reason we are interested in relating entropy and evil, the second law and human and theological affairs, is that we wonder deep down whether the second law is not touching upon the physical and biological dimension of what Tillich is talking about.

Does the second law of thermodynamics talk about good and evil? Can our metaphysical stance toward ultimacy and its relation to evil be illumined by the second law? That is not the way to put the question. I would prefer to put it in this manner: Does the second law appear to provide interpretation for human experience that is inescapably metaphysical in its reach? To the extent that it does, it is almost impossible to avoid a metaphysical expression of the interpretations provided within the framework of the second law.

In any case, what the second law of thermodynamics presents for our human consideration belongs, I believe, within the categories that I used at the outset, namely, those of the human quest to provide meaning by bringing experience into juxtaposition with appropriate symbols or concepts. We know what kinds of experience the second law touches on—whether it is the running down into cold storage death that Harrison speaks of or the eddies of organization and integrality that Peacocke and Denbigh have described. Both types of experience seem to be very important to us. But what do they mean? We do not know. We struggle, as the poets often remind us, to forge meaning, and we try to test our forged meanings to determine their reliability. We do not blame the Nordaus or the Adamases for attempting to give larger perspective to the second law concepts, but we are dismayed at the inadequacy of their attempts. The effort to relate the second law to human experience in more adequate ways will go on, as we seek deeper levels of the meaning of existence. Our own proposal in this quest for meaning is this: that the researches of scientists within the context of the second law provide physical and biological testimony to what a minority tradition within Western philosophy, theology, and mythology has underscored, that we live in the context of a basic polarity. The elements of polarity are being and nonbeing, chaos and order, *das Formgestaltende* and *das Formbrechende* (form-creating and form-destroying) good and evil, possibility and actuality—and they coexist at the very foundation of reality. Everything that is, most especially human life, not only depends upon that coexistence but is constituted by it.



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