MUTUAL CAUSALITY IN BUDDHISM AND GENERAL SYSTEMS THEORY

THE DHARMA OF NATURAL SYSTEMS

JOANNA MACY

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The Dharma of Natural Systems

Joanna Macy

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Preface

Encounters between modern Western thought and ancient Asian philosophies figure among the more fruitful features of the twentieth century. Buddhism, with its reliance on direct experience and its sophisticated, psychological analysis, offers particular rewards to Western inquiry. It reveals remarkable relevance to a major shift occurring in contemporary thought and science—the shift toward a dynamic, systemic, process view of reality.

In my own encounter with Buddhism, which started a quarter century ago among Tibetans in India and continued with doctoral studies in the West, the teachings which I first found most compelling point to the process nature of the self. They reveal the self as a changing, fluid construct created by the dynamics of mind. Through attention to these dynamics, without recourse to supernatural entities or absolutes, these teachings explain the suffering we create, the traps we fabricate through fear and greed, and the possibility of liberation from them. I apprehended this at first through the doctrine of *anattā* (no-self), aided by instruction in *Vipassanā* or insight meditation. Later, in my studies of the early texts, I realized the extent to which this perspective on the self arises within a more comprehensive view of reality.

The contingent nature of the self—and the consequent spaciousness and workability of experience—is, I soon learned, grounded in the radical interdependence of *all* phenomena, set forth in the Buddha's central doctrine of causality, *paṭicca samuppāda*, or dependent co-arising. In this doctrine, which the Buddha equated with the Dharma, or saving teaching itself, everything arises through mutual conditioning in reciprocal interaction. Indeed the very word *Dharma* conveys not a substance or essence, but orderly process itself—the way things work.

This fact was initially obscured to me because of the tendency, evident in all major religions of the last two and a half millennia, to posit metaphysical absolutes as source of value and goal of spiritual life. Even in Buddhism, at various points in its history and despite the original teaching of dependent co-arising, supraphenomenal levels of reality came to be postulated, with consequent value dis-

tinctions between the realms of mind and matter. Furthermore, perhaps because a hierarchical view of reality and its concomitant, a one-way linear view of causation, is endemic to mainstream Western thought, it led many Western scholars, as I point out in Chapter 3, to ignore or distort the distinctive meaning of *paṭicca samuppāda*.

It took me a while, therefore, and some dogged study of early texts, to realize that such a hierarchical view of reality was not true of the early teachings of the Buddha. No aspect of reality, even *nibbāna*, the cessation of suffering, is separate from dependent coarising. Not only suffering but liberation from suffering unfolds according to the Dharma of mutual causality, without the necessity of supraphenomenal absolutes. I was struck by this radical departure from the one-way causal notions that imbue much of both Western thought and Hindu philosophy.

This recognition was aided by general systems theory, which I encountered some eight years after meeting Buddhism. The systems view of reality as process, its perception of self-organizing patterns of physical and mental events, and the principles it discerned in the dynamics of these natural systems struck me as remarkably consonant with the Buddha's teachings. Like the doctrine of *paṭicca samuppāda*, systems theory sees causality as reciprocal, arising from interweaving circuits of contingency.

Furthermore, because general systems theory draws its data from contemporary physical and life sciences, it reveals this kind of causality at play throughout the observable universe. This helped me discern in the early Buddhist scriptures the breadth and import of *paṭicca samuppāda*. Systems theory cast light on the Buddha's distinctive teachings about the relation of mind to body, the relation of past actions to present choices, and the relation of the self to society and nature. Conversely, I also found Buddhist teachings illuminating the import of systems concepts.

I found myself engaged, therefore, in a mutual hermeneutic between these two bodies of thought as I used each to interpret the other. Despite the obvious contrasts in their origins and purposes, each of them—early Buddhism and contemporary systems theory—can clarify what the other is saying.

Through this reciprocal hermeneutic, intricate and overarching patterns and principles of order emerge. They constitute a Dharma of Natural Systems, which I perceive as a philosophic basis and moral grounding for the ecological worldview emerging in our era. This emerging dharma discloses moral values that do not stem from divine commandments nor from human nobility alone but instead

inhere in the fundamental causal interconnectedness of all phenomena. This interdependence sets the limits and provides the scope for our conscious participation in reality.

I wrote this book out of religious and philosophic concerns made urgent by the global crisis of our time. The progressive destruction of our biosphere, the acceleration of human need and desperation, and the risks of deliberate or accidental use of nuclear weaponry are the context for this work. These developments overshadow all our lives. My own active engagement with these issues over the past three decades, as researcher and organizer in the U.S. and overseas, ran parallel to my scholarly work on this book and posed some of the questions I sought to clarify.

How is reality organized? I wanted to know, so as to allow effective action for the healing of our world. How are we connected with each other and all beings? Are the dynamics which can free us from egocentricity—and which I glimpsed in Buddhist practice—reflected in patterns of nature and society as well? What do these systemic patterns tell us about our power to act and our resilience in the face of severe political and economic dislocations?

My pursuit of these questions was shaped by certain moral and philosophic biases concerning the source of values and the locus of power. In a hierarchical view of reality, and in the linear, one-way view of causality to which it leads, both value and power are attributed to an absolute or entity or essence, unaffected by the play of phenomena. I describe this in Chapter 1 where I also show that even when belief in an absolute erodes, habits of thought bred by the one-way view persist in the assumption that power works from the top down. This notion becomes particularly dangerous in a time of increasing planetary disruptions and scarcities. It tempts people to assume that personal freedom is inimical to collective survival, and that order must be imposed from above. Indeed the political fanaticisms and religious fundamentalisms of our time give voice to the belief that common will and coordinated action require subservience to a particular leader or deity.

While exploring both Buddhism and general systems theory, I uncovered a radically different perspective on the source and nature of power. As both these bodies of thought make clear, order is not imposed from above, by mind exerting its will on dumb material forces; it is intrinsic to the self-organizing nature of the phenomenal world itself. When we recognize our participation in its co-arising patterns, we can claim our power to act. We can then, through our choices, give expression and efficacy to the coordination at play in

all life-forms. The political implications of this view, in terms of the free flow of information and the welcoming of diversity, are elaborated in this book in both Buddhist and systems theoretical terms.

To act for the healing of our world, we must move beyond the fear and hatred of matter that we have inherited from hierarchical views of reality and the unidirectional causal paradigm. My own bias in this regard helped me discern how both Buddhism and general systems theory revalorize the material realm. Indeed, they present it no longer as a separate realm from mind, but as causally co-arising with mental events or inseparably correlative to them. The relief and spaciousness that this perspective allows to human consciousness is, I hope, conveyed in this book.

The dharma of living systems presented here focuses on its most distinctive feature: the mutual causality of all phenomena. It does this in scholarly terms, drawing from the two bodies of thought which most clearly articulate this causal paradigm. I take this academic approach for three reasons. I want to present the case for mutual causality in the broadest philosophical terms. I want to correct and enhance scholarly understanding of the Buddha's teaching of *paṭicca samuppāda*. And I want to show the philosophic and moral implications of general systems theory.

The focus on scholarly goals excludes discussion of the political and social activities that accompanied and encouraged my study of mutual causality. During the years that this book has been in preparation, I undertook work in the U.S. and overseas which let me see the dynamics of mutual causality in practical terms. The forms of this work have been described in three books, but I refer to them now to convey some of the wider contexts of my thought and experience and some particular applications of mutual causality.

In the late 1970s and early 1980s I studied and participated in a Buddhist-inspired community development movement in Sri Lanka called Sarvodaya Shramadana. With the support of a Ford Foundation grant I researched this movement's use of Buddhist teachings to motivate local villagers in self-help projects differing from the dominant Western model of centralized, mechanized, capital-intensive development. I took part in training programs for rural organizers, cut roads and dug latrines in Sarvodaya work camps, and sat in on countless meetings with villagers and local Sarvodaya monks and organizers. My findings from this rewarding experience are detailed in my book *Dharma and Development*.[1] As it describes, I found that the movement applied Buddhist teachings more pervasively and explicitly than I had expected. In particular, I saw how

the Buddha's teachings of *paṭicca samuppāda* was conveyed in ways that empowered villagers to take charge of their lives.

The teaching of dependent co-arising is painted on the walls of Sarvodaya village centers, with the four Noble Truths portrayed as wheels of causation. These wheels illustrate the interdependence of phenomena. Interlinked factors of disease, illiteracy, poverty and conflict portray the co-arising causes of degeneration. On the positive side, causal wheels showing the mutual interaction of health workers, teachers, and cooperating groups of mothers, farmers, and youth reveal how they can mutually reinforce each other, and how the process of awakening can begin at any point. Sarvodaya's modes of organizing, through collaborative work camps and self-help projects, provide the practical, persuasive basis for this understanding. I repeatedly saw in action what the movement's president, A. T. Ariyaratne expressed in words: "A Sarvodaya workers learns to understand and to experience the interrelationship that exists between different manifestations of the living world."[2]

A quote from *Dharma and Development* conveys some of the terms they use: "Because reality is seen as dependently co-arising, or systemic in nature, each and every act is understood to have an effect on the larger web of life, and the process of development is perceived as multidimensional. One's personal awakening (*purushodaya*) is integral to the awakening of one's village (*gramodaya*) and both play integral roles in *deshodaya* and *vishvodaya*, the awakening of one's country and one's world. Being interdependent, these developments do not occur sequentially, in a linear fashion, but synchronously, each abetting and reinforcing the other through multiplicities of contacts and currents, each subtly altering the context in which other events occur."[3]

Tragedy has overtaken Sri Lanka since the years of my local participation in the Sarvodaya movement. Tragedy and civil war, fostered by extremists in the conflicting ethnic populations of Tamils and Sinhalese, and aggravated by external interventions and supplies of arms, rip the society apart. The fact that the Sarvodaya movement has survived as a major force for reconciliation and rehabilitation is in large part due, I believe, to its understanding and teaching of interdependence.

Work for social change in the West provided an equally instructive arena for perceiving and applying the dynamics of mutual causality. Alarmed by the health effects of nuclear power plants, I engaged over the years in efforts to organize fellow citizens to take

action for a safe environment. In this process I became increasingly aware of the psychological factors which impede people from responding to the massive dangers of our time, even when they suffer from them in their own lives. Clearest among these are avoidance, denial, and psychic numbing.

Buddhist experience led me to understand these phenomena, and the powerlessness to which they give rise, in terms of dysfunctional notions of separate selfhood. Drawing from both Buddhist practice and the perspectives of general systems theory I developed an approach which took form in group processes and training and came to be known as "despair and empowerment work." This approach helps people to overcome denial by acknowledging their pain for the world, to experience this pain as healthy evidence of their interconnectedness in the web of life, and to recognize this systemic interdependence as the source of their power to take effective action. The theory and methods of this work are described in my book *Despair and Personal Power in the Nuclear Age.*[4]

That book sets forth "the psychological and spiritual work of dealing with our knowledge and feelings about the present planetary crisis in ways that release energy and vision for creative response. . . . This work helps us to increase our awareness of [this crisis] without feeling overwhelmed by the dread, grief, anger and sense of powerlessness that it arouses in us."[5]

"As our pain for the world is rooted in our interconnectedness with all life, so surely is our power. But the kind of power at work in the web of life, in and through open systems, is quite different from our customary notions of power."[6] To elaborate that kind of power, and to offer group methods for perceiving it, I draw directly from the considerations of mutual causality described in this present book.

Working with many thousands of individuals in hundreds of workshops in this and other countries, I learned a lot about our dependent co-arising. I saw how the acknowledgment of pain for our world, when understood as evidence of our interconnectedness, can shift people to an awareness of their profound mutual belonging, and how that awareness in turn helps them instigate creative, collaborative projects for social change.

The Norwegian philosopher Arne Naess coined the term *deep ecology* for this mutual belonging that extends beyond the individual or family or even species. I found this term to be an appropriate, secular referent for *dependent co-arising*—and it is easier to say. I began to use it increasingly in connection with the methods that I and

my colleagues were developing to free people for constructive social action. These methods continue to draw from Buddhist practice and general systems theory, and they provide personal experience of deep ecology—in accordance with Naess's call for forms of community therapy appropriate to our planetary crisis. Deep ecology work, as it has come to be known, seeks to expand the notion of self beyond the confines of ego and personal history, and to extend concepts of self-interest to include the welfare of all beings.

A popular approach to this work, with group processes, is offered in the book I co-authored with Arne Naess and rainforest activists John Seed and Pat Fleming called *Thinking Like a Mountain: Toward a Council of all Beings.*[7] Since its publication, the methods this book describes have spread widely, especially among environmental activists in North America, Australasia, and the countries of Eastern and Western Europe.

"Once we have experienced the fierce joy of life that attends extending our identity into nature, once we realize that the nature within and the nature without are continuous, then we too may share in the exquisite beauty and effortless grace associated with the natural world."[8] These words of John Seed become more real for me each time I facilitate deep ecology work, and see the healing and empowerment that occur as people open to the dynamic interconnectedness that links them to each other and their world.

These three areas of action—Sarvodaya, despair and empowerment work, and deep ecology work—have provided me fresh perspectives on mutual causality. Yet, reflecting particular political and social concerns, they are tangential to the philosophic purposes of this book. My aim here is more fundamental: to explore the nature and causal implications of the systemic co-arising of phenomena. This dharma of natural systems is offered in the hope that it will serve not only systems theory and Buddhist scholarship, but also our common welfare.

Notes

1. Macy, *Dharma and Development.*
2. *Ibid.*, p. 33.
3. *Ibid.*, p. 33.
4. Macy, *Despair and Personal Power.*

5. *Ibid.*, p. xiii.
6. *Ibid.*, p. 30.
7. Seed, *et al.*, *Thinking Like a Mountain.*
8. *Ibid.*, p. 16.

Introduction

Causality, usually defined as the interrelation of cause and effect, is about how things happen, how change occurs, how events relate. The Buddhist term *Dharma* carries the same meaning. It also refers to the Buddha's teachings as a whole, stemming as they do from his central doctrine of causality; for the ways that life is understood and lived are rooted in causal assumptions.

A major shift is occurring in our time from notions of linear, unidirectional causality to perceptions of dynamic interdependence where phenomena affect each other in a reciprocal or mutual fashion. A mutual causal paradigm emerges, and the conceptual tools for understanding it can be found in general systems theory, an interdisciplinary approach arising from science. The systems view of causal process also reveals striking convergences with the Buddha's teaching of causality, called *paṭicca samuppāda*, or dependent co-arising. These convergences are illuminating, although they arise between bodies of thought that are distant from each other in time, culture, data, and methods.

The purpose of this book is to use these two bodies of thought—general systems theory and Buddhism—to illuminate the character of mutual causality and to let a Dharma of Natural Systems emerge. It examines the causal processes at work in a dynamically interdependent world; it studies their implications for our notion of the self and its experience; and it explores the ethical imperatives inherent in a world view where no absolute exists to constitute an ultimate locus of power and moral sanction.

Early Buddhist teachings and contemporary systems theory provide the basis for this book because I find that they yield the clearest and fullest articulations of mutual causal process that are available. In addition to providing complementary perspectives on mutual causality, one from the ancient East and one from the modern West, these two bodies of thought also offer tools for understanding and interpreting each other. Despite their differences in origins, methods and goals, a useful, reciprocal hermeneutic can function between them.

Systems concepts provide explanations and analogies which can illuminate Buddhist ideas that are less accessible from a linear

causal point of view. Systems theory also offers a broad range of data showing the operation throughout the phenomenal universe of the causal principle the Buddha taught. For its part, Buddhism reveals the existential, religious, and ethical implications of the systems view of process. It allows us to see, in the arising and interaction of self-organizing systems, causes of suffering and of liberation from suffering.

For my examination of the Buddha's teaching of causality, I rely chiefly on the *Sutta* and *Vinaya Piṭakas* of the Pali Canon. Because these scriptures are generally agreed to represent pre-Abhidharmist thought, I call them "early Buddhist teachings." In the long, vast, multi-cultural Buddhist tradition, the texts are accepted as authoritative by all. I focus on them, furthermore, because their presentation of dependent co-arising differs from the Abhidharma in some subtle but significant ways, which, as I delineate in Chapter 3, have implications for our understanding of mutual causality. These differences are often overlooked since the Abhidharma has tended to influence later interpretations of the Pali texts as a whole, and *paṭicca samuppāda* in particular. While the later concept of emptiness (*śunyatā*) in Mahayana Buddhism renewed the emphasis on radical relativity found in the early teachings, such similarities fall outside the focus of this book.

Since I draw from the Pali texts, Buddhist terms are generally given in their Pali form. An exception is my usage of the words *dharma* and *karma*, whose later Sanskrit forms have become so prevalent in the West as to make their Pali forms (*dhamma* and *kamma*) seem unnecessarily specialized.

My exposition of general systems theory is based on the foundational works of its pioneering thinkers in the life sciences and systems cybernetics. For my discussion of the wider implications of its causal premises, I draw as well from a wide range of systems theorists in philosophy, psychology, and the social sciences. Mathematical formulations and graphs of systems properties and circuits are, perhaps fortunately for the general reader, beyond the purview of this book.

In the course of a paradigm shift, terminology can be awkward, for the words at our disposal are stamped by previous usage. This is particularly true in the case of *causality*, which carries connotations accumulated in the linear, unidirectional paradigm, where to a large extent, as I show in Chapter 2, causation is linear by definition. In this paradigm, causality excludes the notion that the cause of an effect could be influenced in turn by the effect itself. From

Part One

Background

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1

Considering Causality

The clear bead at the center changes everything.

—Rumi[1]

Assumptions about causality are basic to the choices we make. Whether we are brushing our teeth or casting a vote, they impinge on our expectations and actions. Yet theories about the interrelationship of cause and effect rarely claim our attention outside the classroom or the philosopher's study. They seem too abstract to be relevant to the concrete situations in which we find ourselves, where our attention focuses on more pressing questions—like why and how something is to be done.

Stepping back, however, we recognize that the very questions of why and how are the substance of causal theories, which spring from the primordial human desire to understand why things are as they are and how they change. Just as these theories vary, so can a problem be approached in different ways. Once we shift the focal length of our thought to include these underlying assumptions, new possibilities emerge—both in the way we understand our world and in the way we respond to it. Then, like "the clear bead at the center" of which Rumi spoke, these possibilities "change everything."

Like the Air We Breathe

Presuppositions about cause and effect are as invisible and pervasive as the air we breathe. They are implicit in every world view, at work in every enterprise.

In science they influence the selection of empirical data and the tests to which the data are put. In medicine they inform the

diagnoses of disorders and prescriptions for their cure. They imbue the goals of religious belief systems and the practices they enjoin. They shape a culture's perceptions of power as well as the means by which it is attained and exerted.

In our personal lives assumptions about cause and effect are no less telling. They provide the very ground for our sense of coherence—that is, the ways we find the world intelligible and the ways we posit our relationship to it. Do we see events as random, discontinuous, and beyond our control? Or do we see effective relationships that give leverage to our actions? These are essentially questions of causality and they shape our attitudes and behaviors. They are basic to our notions of responsibility and our attributions of blame and guilt. They color our encounters with conflict, guide our efforts to find solutions. Causal assumptions even affect the relative reality we ascribe to ourselves and our world. For the relationship we see between the mental and material realms of experience can lead us to ignore one or the other as a significant determinative factor.

In eras when a world view goes unchallenged, given notions about causality are taken for granted. Considered self-evident they are no less operative for being tacitly assumed, whether by voodoo priest, Zen monk, of IBM executive. These assumptions constitute a *paradigm,* to use the term widely adopted from the work of Thomas S. Kuhn, philosopher of science.[2] As a mindset about how things happen, a paradigm represents the mental context within which problems are perceived and endeavors mounted. These endeavors tend to justify the assumptions on which they are based until problems—queries and data which do not fit the paradigm—accrue to dramatize the inadequacy of the paradigm's assumptions. In periods of radical change, dissonance arises between previous assumptions and present experience; the paradigm is brought into question—and into consciousness.

This is happening. Words like *synergy, feedback, causal loops, symbiosis* have become current and useful. They suggest that events affect each other in a back-and-forth manner, creating circuits and networks of contingency where causes and effects interact reciprocally. They express a paradigm which challenges the assumptions about causation that have dominated Western culture for over two millenia.

What this new paradigm challenges is not the notion of causality itself, that events modify each other in objective and intelligi-

ble ways, but rather the manner in which causality has been perceived. It challenges the idea that causal action flows in one direction only, from cause to effect, from producer to produced, like a series of billiard balls or falling dominoes. To understand the momentous nature of this development that is taking place in our time, let us look at what it replaces: the linear unidirectional paradigm.

The Linear Unidirectional Causal Paradigm

As the words suggest, we refer here to a one-way flow of influence from the cause *A* to the effect *B*.

$$A \rightarrow B$$

The direction of causal efficacy is from the producer to the produced, from the action of the agent or actor to its results in the acted-upon. This causal model implies that there is no new behavior in the effect *B* which cannot be traced back to its cause *A*. Another way of putting this is that there is no less information in *A* than in *B*. A corollary of this assumption, operative in scientific research, is that distinctive features in the effect *B* must correspond to similar features in the cause *A*. Hence it is assumed that similar causes yield similar effects, and that different effects derive from different causes.

By the same logic causal chains arise, as *B* acts on *C*, and *C* in turn effects *D* and so on.

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow \ldots$$

The chains carry the causal impulse or efficacy onward in a series of effects, like a chain of command. By these chains of cause and effect, both explanations and predictions are made. Explanations are contrived by tracing the chain backward, to find out what started it all. Predictions are formulated by extrapolating it forward. The operative assumption is that from a complete knowledge of the present (hypothetical as that may be), the past and future can be inferred.

The unidirectional causal flow is also called "linear." In physics and mathematics the term *linear* denotes a uniform progression which, when its formula is graphed, yields a straight line. Put in informational terms, we can say that, in linear causality, inputs de-

lessened.[6] The Neoplatonic postulation of one single, unaffected source of being, along with its persuasive imagery of light, entered Christian theology through Augustine and others, and firmly anchored one-way causality in the Western mind.

A millenium later the monumental work of Thomas Aquinas carried forward the one-way notion of causality and in explicitly Christian terms. Thomas used the logical necessity of the Unmoved Mover as a proof of God's existence; continuing to assume a one-way causal flow, he argued that God was necessary to avoid the only other and untenable alternative, infinite regress. In this fashion the Hebrew God who interacted with his Chosen People, scolding and making covenants with them, as well as the God of the New Testament, who entered the world to suffer in human flesh, took on the Greek mantle of static perfection. From this fusion derives God's awesome features of omnipotence, immutability, and impassibility—for by logical necessity, God is incapable of being affected by his creation. Though considered to be all-powerful, he is yet unable to change and is above all emotion or response.

Mary and the saints filled the gap between divine aloofness and human need. They were moved by the prayers of the faithful and interceded on their behalf. But when the Protestant reformers evicted these mediators, their followers were left with an absolute Unmoved Mover. His omnipotence and omniscience made the doctrine of predestination reasonable and even believable.

To be aloof from the actions of others and unaffected by them became a sign of one's moral strength.

> Who, moving others are themselves as stone
> Unmoved, cold and to temptation slow:
> They rightly do inherit heaven's graces
> And husband nature's riches from expense.
>
> (Shakespeare, Sonnet 2)

Descartes' rationalism did not mitigate this one-way causality. In the radically dualistic move that separated mind from matter into two discontinuous realms, he accorded all efficacy to his idea of God, "infinite, eternal, immutable, independent, all-powerful, and by which I myself and everything else, if anything else does exist, have been created."[7] God's unilateral power extends to the very concepts the thinker can make about him; that is, as Descartes ex-

plained, he can derive the idea of himself from the idea of God, but not the idea of God from the idea of himself. Therefore, he concluded, the source of the idea of God must be God himself. By virtue of the Cartesian separation of mind from matter, the aloofness of this God now becomes emulated and mirrored in the aloofness of the human mind from the phenomenal world. Categorically distinct from this world of contingency and matter, mind can now imagine itself acting upon the world in a similarly impassive and unidirectional fashion.

The rise of modern science incorporated the unidirectional causal model, although Unmoved Movers and Ideal Forms, as well as Aristotle's formal and final causes, were rejected as both unnecessary and unempirical. Only material and efficient causes remained appropriate to scientific inquiry—and both, in their different ways, were assumed to have a one-way relation to the conditions they produced. Explanations were sought by reducing phenomena to their basic components, to building blocks that could be uncovered by dissection and analysis. Changes in their condition were assumed to derive from an efficient cause or external agent impinging upon them. With Newton's law of inertia, movement no longer appeared to be a secondary characteristic, less real than stability, but the notion persisted that an external force was needed to explain changes in velocity and direction.

Newton's Third Law of Motion, stating that every action produces an equal and opposite reaction, might seem to challenge the unidirectional causal paradigm. But Newton's religious beliefs remained firmly anchored in one-way causality. The God he described is so unilaterally powerful that he need not obey the very laws he created, and so unmovable that he cannot respond to prayers.[8]

The logic of the one-way paradigm led to determinism, as Pierre Laplace, the French astronomer, demonstrated. For if everything is moved by something else, how could it act otherwise than it does? Novelty, as Parmenides had asserted, is precluded. If we could conceivably detect all the external forces at work, then we could predict the movements of every star and every atom, claimed Laplace.

In contrast to such a view and in a radically empiricist move, philosopher David Hume denied causal necessity altogether. Events have no necessary and objective connection, he said, beyond our observation of the way they succeed each other in time. To escape from the determinism implicit in the unilateral causal paradigm,

Hume and his followers had to reject the objective nature of causality itself and retreat from any claim to know the external world.

Even with the later advent of dialectical and process philosophies, unidirectional causal assumptions held sway. Hegel's dialectical progression of thesis, antithesis, and synthesis seemed to allow the new and unprecedented to arise. But what unfolds in this process is the rational principle or idea that is aloof from the random and inert material stuff of the world, and shapes it unilaterally. Alfred North Whitehead's process thought of a century later strove to give scope to creativity and the emergence of novelty. Yet he posited a Platonic realm of God and 'eternal objects' endowed with a one-way causal connection with the phenomenal world. As systems philosopher Ervin Laszlo pointed out, "Whitehead's eternal objects can ingress in actuality and thus qualify its course, but actuality does not affect them."[9]

Process theologian Charles Hartshorne, writing a generation later, made these operative assumptions about causality quite explicit. "We shall assume . . . that a 'cause' in the widest meaning of the term is always independent of its particular effect, while this is always dependent on its cause."[10]

Linear causal notions have shaped the scientific method in various and telling ways. An area of research is chosen and circumscribed so that causal chains can by hypothesized and detected. The variables are reduced to those that can be empirically tested and controlled. Seeking the root cause or "active ingredient," variables are artificially separated and tested one at a time, in disregard or ignorance of their action on each other. As he proceeds, the scientist makes the caveat of "all other things being equal," although that assumption is empirically unverified.

This methodology has yielded powerful results. They seemed, at least until recently, to have served the goals of analysis, predictability, and control. But, as the tools and inquiries of scientists expand, it is increasingly evident that the universe does not always conform to expectations. When events interact and patterns are superimposed on each other, they yield novel, unpredictable, nonlinear results. As Ian Stewart, a mathematician working in chaos theory, states: "Linearity is a trap. The behavior of linear equations—like that of choirboys—is far from typical. But if you decide that only linear equations are worth thinking about, self-censorship sets in. Your textbooks fill with triumphs of linear analysis, its failures buried so deep that the graves go unmarked and the existence of the graves goes unremarked."[11]