

## Chapter Six

### The Cosmology, Ecology, and Biology of Consciousness

#### The Phenomenology and Physical Conditions of Consciousness

In the next sections I shift focus from a predominately phenomenological description of consciousness, covered in the opening sections of this chapter, to an examination of the physical conditions of consciousness, which includes cosmology, physics, ecology, and biology. What fundamental physical conditions in the natural world are *associated* with consciousness? Are there certain basic factors in physical reality that are *necessary* for consciousness? In what manner or fashion are such physical factors essential for the realization of consciousness? These are key questions in understanding the nature of consciousness, and how consciousness is connected with physical reality and the totality of existence as a whole.

At the start of this present inquiry I should note that there are numerous theories, reviewed in the earlier chapter on theories of consciousness, that have provided explanations of how physical reality is connected to consciousness, especially so, in many of these views, highlighting the presumed intimate connection between consciousness and the physical brain. I will reference and discuss a number of these explanatory perspectives in the sections below.

I should also note at the beginning of these coming sections that in the opening sections of this chapter on the phenomenology of consciousness I argued that at least in a couple of key ways consciousness does appear intimately connected with physical reality. I proposed that in perceptual-proprioceptual consciousness we experience a seamless interface between our consciousness and both the surrounding physical environment and our physical bodies. Furthermore, we experience our consciousness and the consciousness of others as embodied; our consciousness and the consciousness of others appear manifested within and through physical (biological) bodies. I critiqued theories of disembodied consciousness in these earlier sections. In the coming sections I present various hypotheses regarding the physical conditions of consciousness that illuminate and to degrees explain, from a physical point of view, these apparent intimate connections of consciousness and the physical reality, as well as other connections between physical reality and features of consciousness.

My examination of the physical conditions of consciousness will be informed by and highlight an ecological and evolutionary perspective on our cosmological reality. I apply this ecological-evolutionary perspective to understanding physical reality and the relationship between physical reality and consciousness. Providing numerous illustrations to demonstrate the applicability and validity of this perspective, I describe and explain the physical conditions of consciousness within an ecological and evolutionary theoretical framework.

In my view, reciprocity is one central concept within this evolutionary-ecological theoretical framework that is especially relevant to understanding the relationship between the physical reality and consciousness. See my earlier extended examination of the principle of reciprocity in Chapter Three.

As one key illustration of how the principle of reciprocity illuminates and informs our understanding of the relationship between consciousness and the physical reality consider the following: To recall from my review of theories of consciousness, the contemporary philosopher Thomas Nagel identified two alternative viewpoints on reality: From a *third person* “objective” perspective on reality what is observed in the world around us is physicality—physical objects in physical space. This perspective aligns with the materialist theory of reality. On the other hand, from a *first person* “subjective” perspective on reality what is revealed and seems fundamental is the pervasiveness and essentiality of consciousness. This perspective aligns with the idealist theory of reality.

In Nagel’s mind, these two perspectives on reality need to be connected together without eliminating one view in favor of the other, or deriving one view from the other. In the history of human thought on consciousness each of these two basic theories has, indeed, aspired to assimilate the other ontological perspective. The entirety of existence, depending upon which perspective is taken, is seen at the foundational level as either physicality (the thesis of materialism), or consciousness (the thesis of idealism). In Nagel’s mind, though, neither idealism/subjectivism nor materialism/objectivism provides a complete understanding and explanation of reality; each is incomplete. For Nagel, a complete understanding of reality needs to acknowledge and bring together in some intelligible and non-reductive fashion both of these two perspectives.

Applying the principle of reciprocity to understanding consciousness and physical reality and their relationship with each other, as one important illustrative point, we should note that our descriptions of physicality (and more specifically the physical conditions of consciousness) are articulated within the medium of the conscious investigation and apprehension of the physical world, in which the physical world identified and described is revealed and understood through consciousness. Our understanding of physicality originates and is grounded in a conscious first person perspective of reality. But conversely, innumerable identifiable physical conditions (in particular, in the brain and biological body) appear clearly and intimately involved in, if not necessary, for the manifestation of consciousness. Specific conscious states appear correlatively, if not causally connected, with specific bodily/brain states. Our subjective first person consciousness seems to depend upon various objective physical realities.

All in all, what we find is a circle of dependency, where each reality, although distinct, appears dependent on the other reality; that is, we find reciprocity. The revelation and comprehension of the physical requires consciousness, but reciprocally, the manifestation of consciousness depends upon the physical. There is an essential loop of interdependency in the relationship between consciousness and the physical world.

In my mind, there are a whole set of significant physical conditions that seem necessary for and involved in the manifestation consciousness—indeed that are critical to understanding the nature of consciousness—but we always need to keep in mind that these identifiable physical conditions are revealed and articulated through the conscious apprehension and inquiry of the physical world.

## **The Cosmic Ontology of Consciousness**

As I proposed early in this book (Chapter One), understanding consciousness requires understanding the fundamental all-enveloping nature of the cosmos, in that consciousness exists as part of and expressive of this fundamental reality. Consciousness exists within the cosmos and, as such, our understanding of consciousness must be contextualized within a basic cosmic ontological framework.

Reflective of this cosmic perspective on consciousness, different theories of consciousness contain, as core features, fundamental ontologies (theories of reality) to ground and frame these different theories. There are primal source theories of reality—philosophical, scientific, and spiritual-religious—which posit some ultimate reality that serves as a foundation for understanding consciousness and its place in the totality of reality. Idealism posits a fundamental core cosmic reality of consciousness or mind; materialism posits a fundamental core cosmic reality of physical matter and energy; dualism proposes two fundamental forms of reality, the mental and the physical; and panpsychism and identity-dual perspective theory posit a pervasive inner (subjective) reality of consciousness and a pervasive and aligned outer (objective) reality of physicality.

In my view, articulated at length in Chapters One and Three, at this point in time the best current theory of cosmic reality we possess—supported by vast amounts of interdisciplinary evidence, articulated in incredible detail and intricate conceptualization, and possessing the greatest degree of explanatory power—is an evolutionary and ecological understanding of cosmic existence. The totality of reality is dynamic and transformative with new more complex entities and types of processes emerging from simpler constituents, and this evolving plethora of entities exists as an interactive and interdependent network or array. Although to a great degree formulated within the physical-materialistic scientific perspective and aligned fields of research, evolutionary and ecological perspectives on reality are not exclusively physical in nature; both perspectives have been extensively applied and illustrated within psychological, social, ethical-aesthetic, and even spiritual domains as well. In my view, if we are to place consciousness within a fundamental cosmic ontological context, that context should be an evolutionary and ecological perspective on the totality of reality. In considering the physical conditions of consciousness I begin with an examination of such physical conditions within the framework of an evolutionary and ecological understanding of reality.

## **The Cosmic Evolution of Hierarchical and Nested Complexity**

To review from Chapter One, according to the theory of cosmic evolution new levels of reality of increasing complexity—of more complex entities and patterns of interaction among these entities—have emerged (or evolved) across the temporal history of the cosmos, beginning with the simplest and most primordial of constituent entities and processes, and progressing over time toward more complex realities.

Applying the theory of cosmic evolution to the physical universe, the most primitive level of postulated physical entities in this temporally evolving reality—the most ancient and earliest—were (as understood at this point in time) sub-atomic particles, such as

quarks and electrons, in motion, coupled together with fundamental forms (waves and fields) of energy and interactive forces among these primitive entities. Although there is still ongoing debate, inquiry, and research regarding what are the most fundamental and chronologically earliest of foundational physical features of the universe—see for example, string theory—evolutionary theory postulates that all the more complex physical realities in the cosmos (atoms, molecules, planets, stars, solar systems, galaxies, geo-ecological systems, and biological forms) emerged in time from the simplest physical foundational factors.

In that the progressive evolution of increasing physical complexity in the cosmos involves as one key dimension the combination or concatenation of simpler entities into more complex entities (atoms building from constituent sub-atomic particles and, in turn, chemical molecules building from constituent atoms, etc), the evolution of physical complexity across time creates a hierarchy of levels of reality. Each progressive level in the hierarchy of nature manifests higher levels of complexity, both in the entities involved and the forms of change and patterns of interaction among the entities, and moreover, although each progressive level of complexity involves a combinational process—of simpler unites coming together—each new level manifests an array of unique and distinctive entities and patterns of interactions that are not simply aggregations of its parts. There are emergent realities at each more evolved level in the hierarchy. As one interesting implication of this hierarchal evolution of physical reality, within our complex biological bodies, which consist of multiple levels of increasingly complexity and emergent parts, the history of evolution of the physical cosmos is embodied.

Believing, as I do, that disembodied consciousness is impossible, if we think there are certain basic physical conditions in the cosmos essential or necessary for the manifestation of consciousness, we should begin with the most salient and ubiquitous feature of the physical universe, which is its evolutionary nature. Consciousness has manifested itself within an evolving physical cosmos consisting of multiple, successively emerging hierarchal levels of increasingly complex physical realities, involving the progressive manifestation of a plethora of unique, ever more complex physical entities and processes. Does the existence of consciousness require as a fundamental physical condition an evolutionary physical universe—such as the type of evolutionary universe in which we exist—and if so, why?

For a number of reasons, it seems to me that an evolutionary physical cosmos is essential for the manifestation of consciousness. As such, I propose as a first and fundamental necessary physical condition of consciousness that consciousness *requires* for its existence an evolutionary universe, and more specifically, an evolutionary physical universe of increasing physical complexity and succession of new emergent unique forms and processes.

One argument for this proposal is that consciousness—at least as it appears to us within our existence—is a complex ontological phenomenon. Of particular note, drawing upon the phenomenological description of consciousness provided earlier, consciousness involves (at the very least) the capacity for existence to be cognizant of its own reality, and for conscious entities within the plethora of reality to apprehend their distinctive existence and the situation and surrounding conditions of their existence. Consciousness is not some simple elementary reality.

If consciousness is intimately connected with the physical reality of the cosmos, then consciousness in its fundamental complexity requires a complex physical reality in which it exists and manifests itself. The complexity of the physical universe, though, is not an ontological given, but rather is realized through a process of evolution. Hence consciousness as a complex reality requires an evolutionary physical universe to realize the necessary supporting physical complexity for its existence.

Moreover, since consciousness exists embedded in an evolutionary cosmos, it would stand to reason that consciousness is an evolutionary phenomenon that follows the same basic pattern of evolution, as the rest of the universe, in its own realization. Indeed, the phenomenon of consciousness appears to be an evolutionary reality. In numerous respects, it appears to manifest a dynamic evolutionary history. Mirroring the evolutionary development of complexity in the physical universe, consciousness manifests (at least with respect to the history of life forms on the earth) both an evolutionary history across expansive epochal time toward increasing complexity, and a more temporally limited developmental history of increasing complexity in individual life forms that are conscious beings. These evolutionary trajectories within the nature of consciousness itself would seem to require an evolutionary directionality in the physical conditions with which consciousness is aligned. In sum, since consciousness involves an evolutionary dimension of increasing complexity, then consciousness requires an evolutionary physical dimension for this process to be realized.

Moving forward, even though when we think about evolution we may emphasize and focus upon the phenomenon of change (or transformation) as its fundamental feature, as discussed in previous chapters (Chapters One through Three), the universe, our earthly ecology, biological life, and human existence all manifest a combination of relative changes and relative stabilities. The hierarchal structure and make-up of the physical cosmos manifests this combination—indeed synthesis—of relative stabilities and relative processes of change. Each level in the hierarchy of the cosmos consists of a population of distinctive entities that persist for varying lengths of time—achieving relative stability—but these populations are also dynamic and transformative as well; there are ongoing changes within and dynamic interactions among the relatively persistent entities at each level. Taken as a totality, the physical universe manifests two fundamental patterns or extended histories of change—evolution and entropy—but through this dual (reciprocal) historical process, a hierarchal structure to the universe has emerged in evolution that has persisted across the eons. Different types of entities in the hierarchy exhibit different lengths of relative stability, some longer-lived, some shorter; the earth has persisted a lot longer than individual life forms. (Eventually, of course, following from the process of entropy, it may all fall apart.) Regarding the physicality of the universe, it appears integral to its very nature that it manifests these dual dimensions of relative stability and relative change.

Aside from an evolving physical cosmos, as a second essential feature to the physical conditions of consciousness I would add the dual and coupled dimensions of relative stability and relative change, which, indeed, is a key feature of the nature of evolution. This basic combination of stability and change in the physical cosmos sets a fundamental “scaffolding” or context for the manifestation of consciousness. Our ecology in which we exist is a combination of stability and change; our biological bodies manifest the same interwoven combination; and consciousness considered

phenomenologically shows both features of stability and persistence, and change and transformation (becoming and passing away). One can conceptualize this fundamental cosmic feature of the physical universe as a key aspect of the structure of time and this structure to time is reflected in the temporal dimension of consciousness. It seems to me that neither a physical universe of pure chaos and flux, nor a physical universe totally fixed and static—both possibilities precluding the potential for evolution—could support the existence (or evolution) of consciousness (at least the type of consciousness with which we are familiar). It seems to me that both the emergence and the basic structure of consciousness require an ontological foundation that includes the dual and coupled dimensions of relative stability and relative change within the physical cosmos, in which consciousness is realized.

The next relevant physical factor connected with consciousness is that the hierarchal structure to the cosmos can also validly be described as a multi-leveled pattern of nested differentiations relative to the ambient universe. Each type of entity manifested in the cosmos, from quarks to plants and animals and to galaxies is a differentiation of itself relative to its surroundings. All entities have relatively differentiated boundaries—with clear differences between the inside and outside of these boundaries—and achieve relative degrees of separation from their surrounding conditions. Although all entities within the cosmos exist embedded with the ambience of the cosmos, each entity is a relatively localized and structured differentiation—occupying a delineated and bounded spatial position—relative to the surrounding cosmos. Although each complex entity in the universe “builds up” from simpler entities—creating a bottom-up hierarchy of forms—it simultaneously creates in this concatenation process increasingly complex differentiations (differentiated entities) relative to and set in the context of the whole.

Recall from open systems theory that natural systems are differentiated wholes relative to their surroundings. The identity of an open system is a relatively circumscribed distinctiveness achieved and maintained through interaction with its surrounding context. When a new emergent level of open systems arises in the cosmos, collections of constituent parts, which integrate into a more complex whole, form a more complex distinctiveness and differentiation relative to the surrounding cosmos. The simpler, more elemental constituents of the emergent whole exist as nested or embedded differentiations within it. Sub-atomic particles maintain their relative distinctiveness within conglomerate atoms; atoms maintain their relative distinctiveness within chemical molecules; and molecules maintain their relative distinctiveness within biological bodies. The hierarchy of constituent parts within parts is a multi-level set of nested distinctive entities, each level of distinctive parts embedded in a surrounding whole.

As a complementary way to describe the evolutionary complexity of the cosmos, instead of describing it as a process of putting together simpler elements into more complex wholes, we can just as accurately describe the process as the creation of more complex differentiated entities emerging within the universe. Describing the evolutionary hierarchy of nature as a nesting of differentiations highlights the fundamental facts that the distinctive nature and identities of entities in the cosmos are established by differentiations relative to their surrounding, and that everything in the cosmos exists within a surrounding.

Thus the evolution of complexity in the physical cosmos involves the concurrent and coupled processes of integration (parts combining into wholes) and differentiation (more complex forms of distinctiveness relative to the surround).

Keeping in mind that the evolutionary development of the physical cosmos is both a progressive combination of simpler entities into more complex and unique emergent wholes, and a process of increasingly complex differentiated entities (relative to the surround), a number of important points should be made regarding how this ongoing evolution of complexity in the cosmos is relevant to understanding the physical conditions of consciousness.

The first is that the physical universe that has emerged in this ongoing evolutionary process, with its plethora of nested hierarchal levels within levels of unique entities and modes of interaction is an amazingly rich and intricate, if not resplendent reality. Observing the vast and magnificent cosmos of stars, nebulae, and galaxies through current astronomic technologies and telescopic devices, the multifaceted intricate realm of microscopic forms and processes—of chemical molecules, viruses, bacteria, and single-cell life forms—revealed through numerous technological instruments, or simply attending to, without the aid of technologies, the rich and varied display of transformational patterns and resplendent forms of nature in our earthly environment, the physical universe presents itself as an overpoweringly elaborate, dynamic, magnificent, and diverse existential manifestation. When arguments are made that consciousness could not emerge from “dumb matter,” we do not appreciate or acknowledge the incredibly multifarious, complicated, and interconnected nature the processes and forms of physical reality.

As a second point, it seems to me that the coupling of integration and differentiation in the evolution of complexity in the universe is an essential physical condition of consciousness. This coupling of integration and differentiation has direct relevance to understanding the organization of ecological systems, biological bodies and nervous systems, and indeed the structure of consciousness (see later sections). Physical realities that manifest consciousness exhibit complex multi-level couplings of integration and differentiation.

A third point is that when we discuss the physical conditions of consciousness we should keep in mind that the general directionality in cosmic evolution is the emergence of increasingly complex entities differentiated from their surround and consequently relatively localized in space. Those entities in nature that are conscious (humans), or at least strongly appear to be conscious (animals) are complex physical entities differentiated and localized within the surrounding ambience of the cosmos. The manifestation of consciousness does not appear to be connected with undifferentiated, diffuse, or non-localized features of physical reality. Arguments have been made in some theories of consciousness that consciousness in some manner or form pervades or is spread out throughout the universe, but consciousness, in so far as we observe it manifested in the universe, manifests in complex locally differentiated entities.

Assuming that consciousness requires some level of complexity within the physical universe, and the evolution of physical complexity is strongly associated with relatively localized evolving differentiated entities, it seems reasonable to argue that another essential physical condition of consciousness is the emergence of complex localized

physical entities. Consciousness is not spread pervasively across the cosmos, but manifests itself in relatively localized complex forms. Such a requirement would not necessarily, in and of itself, preclude the possibility that complex planetary or stellar bodies could be conscious; such entities, although vastly larger than biological forms (at least those that we have encountered), are both complex and relatively localized and differentiated from their surroundings, rather than being diffuse and spread across space. Within this framework, perhaps ecological systems could be conscious as well. In my view, the phenomenon of relatively localized differentiated entities as critical to consciousness is intimately connected with the subjective and individualized dimensions of consciousness (see below).

Fourth, as a reciprocal corollary to the above point, it seems to me that consciousness is not just associated with sufficiently complex localized differentiated entities, but equally associated with a sufficiently complex surrounding ambience of other localized and differentiated entities. As the universe has evolved, the ambient surround of increasingly complex entities within the universe has correspondingly become increasingly rich and complex. Emergent complex entities are surrounded by similar complex entities, thus creating more complex environments. It seems to me that a key factor in the necessary physical conditions for consciousness is the level of complexity—the intricate plethora of entities and modes of interactions—in the environment surrounding conscious entities.

Consciousness, I believe, requires that a certain level of complexity in the ambient surround be realized for the manifestation of any conscious entities. An amorphous surround would preclude the emergence of consciousness for any entities existing within it. Just as consciousness can not arise from a diffuse and non-differentiated foundation, consciousness can not arise in a diffuse and non-differentiated surrounding ambience. A conscious being requires a sufficiently rich and complex ecology enveloping it. This point contributes to the general thesis that consciousness should be conceptualized in an ecological framework; consciousness requires sufficiently complex differentiated entities existing in a sufficiently complex ambient surround.

All in all, I propose that the fundamental cosmic physical conditions in which consciousness manifests itself requires an *evolving* hierarchal plethora of increasingly *complex* relatively localized entities, which are nested differentiations within a complex *surround* of sufficiently complex differentiated entities. Also, the entire assemblage of nested differentiated complex entities and their ambient surroundings will involve a combination of both relative stabilities and relative changes.

### **Open Systems and Energetic Manifestation and Interaction**

Recalling the earlier section on “open systems” (see Chapter One), the plethora of complex entities that have evolved in the cosmos, by and large, can be described as dynamic and interactive open systems, which both impact their surroundings and are impacted by these surroundings. Open systems *interact* with their environment, affecting and being affected by surrounding conditions. In so far as the complex entities in the universe consist of open systems, all such entities exist surrounded by other open systems with which they interact.

Moreover, open systems are internally complex and dynamic; open systems are composed of simpler dynamic constituents and are not internally inert entities. There are various processes occurring within open systems, which can be described as internal interactive processes occurring among its dynamic constituent components.

Also to recall from the previous discussion, differentiated living open systems, require the inflow of energy and material from their surroundings to maintain their differentiated and dynamic individuality and structure, and also expel energy and materials as a result of their internal dynamics and structure. There is a necessary inflow and outflow in open living systems for such systems to maintain their differentiated individuality.

The fact that most—if not the entirety of—complex entities in the cosmos consists of open systems further helps to understand the necessary physical conditions of consciousness. First we should highlight that all open systems are differentially impacted or affected by their surrounding conditions. Those living open systems that are conscious (certainly or probably) are all clearly affected by and reactive to their surroundings. It seems to me that an entity that was not affected by its surroundings could not be conscious. As such, it is not enough that a conscious entity is engulfed in a complex surrounding, but a conscious entity must be affected by this complex ambience. Hence, it would make no sense to postulate a conscious being that was conscious in and of itself, impervious to or causally unaffected from any external reality or ontological surrounding. (The solipsistic position that consciousness could exist within a self-contained reality, as such, seems implausible.)

As a second point, open systems are internally dynamic. Hence, we can propose that any entity possessing consciousness can not be an internally inert (or still) reality. Again, observing those life forms that are certain or probable candidates for consciousness, one striking feature of all of them, is the amazingly multi-faceted and energetic internal dynamics of such entities. An awful lot is continuously going on within the physical architecture of a conscious being. Consciousness could not ride on a sea of tranquility anymore than it could ride within a sea of uniformity; the physical foundation of consciousness is a complex fluidity.

Combining the above two points together, I propose that as a necessary physical condition of consciousness, for those entities (open systems) which are conscious, they are affected by external factors through modification of their internal dynamic processes. Conscious beings are physically dynamically open to the dynamic surrounding physical environments. A conscious being is associated with a dynamic set of processes within its physical body that are affected by dynamic surrounding physical conditions.

As noted above, open systems not only are impacted by their surrounding conditions, but also impact in turn those surrounding conditions. Would it make sense to suppose that a conscious being associated with a physical body would not be able to affect its surroundings? From the above, I proposed that a conscious being must be open to being affected by its surroundings. The reciprocal proposition would be that a conscious being must be able to affect its surroundings, if it is to be conscious.

As described earlier in Chapter Two, I hypothesized that one of the primal forms of consciousness is conscious purposeful behavior, coupled with conscious perception and proprioception. Consciousness (at least on the earth) appears to have emerged

and manifested itself in living creatures, which are able through their physical behavior and processes to affect their environments. Consciousness without the capacity to impact the environment would be a passive process—to observe and internally react but not able to act—and from a functional point of view, such an incapacity would make consciousness without evolutionary value or cosmic significance. The capacity of consciousness to affect the surrounding environment is tied to the general phenomenon of conscious agency; consciousness is not passive but proactively efficacious. The basic dynamic feature of open systems to impact or affect their surroundings—as the physical embodiment of a basic attribute of consciousness—seems to me to be a necessary physical condition for the emergence of conscious beings.

Let us now specifically focus on the emanational or outflowing energetic dimension of physical entities (or open systems) within the cosmos. All entities in the universe (regardless of whether they are conscious or not) generate (or produce) specific patterns of energy, through direct energetic output or reflected energy, that permeate out into the surrounding reality. Taken as a totality, the physical universe as a plethora of complex entities, at all levels of magnitude or scale, structures the forms of propagated physical energy within it—through the energetic output and reflected energy from the totality of constituent entities in the cosmos—and these patterns of structured energy, created by the structure of the universe itself—the population of complex constituents—permeates throughout the universe. Intricate patterns of energy emanate off all entities and structures in the cosmos (even “black holes”), and in so far as most (if not all) entities in the universe appear to be open systems, most entities have complex energetic effects on their surroundings, rippling and permeating out into the universe. Hence, physical realities produce specific structured energetic effects within the universe providing detailed information about their existence and make-up. The constituents of the physical universe broadcast their presence, structure, and composition into the universe. We could state that the constituents of the universe *manifest their reality* to each other via patterns of energy and their consequent effects on their surroundings.

In sum, the entities of the universe, by and large, although differentiated from each other are open to each other. The entities of the universe both differentially impact their surroundings through differentiated patterns of energy specific to the make-up of such entities, and are impacted by the ambient differentiated patterns of energy emanating from surrounding entities. The universe, in essence, is energetically open to itself.

I see this collective structured energetic openness of entities in the universe differentially manifesting their presence to each other through their complex energetic effects as a critical physical condition within the cosmos essential for the realization of consciousness within it. Conscious beings in the universe can be conscious of the universe because the entities of the universe differentially manifest their structure and make-up through complex energetic effects emanating from such entities out into the universe. Hence, not only is a sufficiently complex surrounding a necessary condition for conscious entities within it (see above), but within our physical universe the plethoric configurational array of complex entities generates and emanates complex patterns of energy into the surrounding space by means of which they manifest their make-up and complexity to each other. One could argue that this pervasive

phenomenon of energetic structured manifestation of the physical manifold into the surrounding space is another necessary physical condition for the realization of consciousness.

### **Energetic Structured Ambience & the Ecological Containment of Consciousness**

Because of this pervasive differentiated expanse of energy filling the universe, at each and every location within the universe there is a multi-faceted and structured energetic array converging from surrounding entities deterministically specific to that particular location and the relational physical configuration of its surroundings. The universe, as a totality, differentially and deterministically impacts, via structured energy and physical effects, each and every location within it.

Consequently, for spatially localized entities in the universe there are converging and engulfing patterns of energy emanating from entities around them that reflect the structure and make-up of those entities. Localized entities in the cosmos exist within and are engulfed by a structured energetic ambience that is a deterministic result of their surroundings.

We can compare this general deterministically structured emanational phenomenon in the cosmos with Gibson's specific idea of "stimulus information." Using Gibson's terminology and description for animals on the earth, the environment, in which perceiving-behaving animals exists, generates stimulus information, which "specifies" the configuration and make-up of the environment. The environment manifests and reveals itself to perceiving-behaving animals through energetic stimulus information.

Thus, we can propose that the physical conditions of consciousness at the most basic level consist of relatively localized open systems that are differentially impacted by an energetically structured ambience that reflects/is a manifestation of the specific complex structure and make-up of surrounding open systems. The types of physical entities that can be conscious must satisfy these basic conditions of physical (environmental) existence. Life forms on the earth, as dynamic and relatively localized open systems within a surrounding complex context of other open systems and a highly structured energetic ambient array, satisfy these physical conditions.

Further, we should also note that dynamic open systems, and especially living open systems, generate internal patterns of energy reflective of their inner states and ongoing processes; the internal structures of an open system are complex open systems themselves that produce complex energetic effects. Mobile life forms also generate patterns of energy specific to changes in bodily configuration. Moreover, given that the external ambient energetic array reflects in its structure a particular location within a surrounding environment, the ambient energetic array, to use Gibson's terminology, contains stimulus information regarding the location of a perceiving-behaving animal occupying that position; change in location (or movement) is also reflected in the transformative structure of the energetic array. All in all, the states, bodily spatial configuration, and location of a living open system are manifested through its structured energetic effects revealed to that open system.

Hence, since another foundational feature of consciousness is proprioceptual awareness (as discussed previously), we could propose as another essential physical

condition of consciousness, that open systems, which are conscious, must be open with respect to their own physical states of existence. Their own physical states of existence must be energetically and specifically manifested to the system and the system must be impacted by such states. The system is open to itself. In essence, this openness to itself sets up a loop of interactivity within itself, just as spatially separated open systems in an engulfing context exist in states of interactivity.

This dual energetic manifestation of both the surrounding structure and make-up of the physical environment and the internal states and configurations of a potentially conscious open system make possible the dual conscious processes of perception and proprioception. Just as the surrounding environment manifests itself to a perceiving-behaving living system (an animal), creating the physical foundation for perception, so does the biological body of a perceiving-behaving living system reveal itself to itself, creating the physical foundation for proprioception.

Moreover, the total ambient energetic array surrounding a localized perceiving-behaving animal reflects the particular relational configuration existing between the animal and its environment at a particular point in time. The structured energetic ambient array is a dual result of the structure of the surrounding environment and the particular localized position of a potential observer within that surrounding environment. This structured array thus provides an ongoing informational basis for being conscious of not just the environment (perception) and the body (proprioception), but of the relationship between the two realities—the environment and the body—supporting the simultaneous and relational perceptual-proprioceptual awareness of the environment and the body.

Given the fact that the particular manifested energetic structure emanating from the environment is contingent upon the relative location of a potential observer, perceptual-proprioceptual consciousness, grounded in this localized and relativistic energetic array, is from a physical point of view relative to the location of the observer in the environment. Given that potential observers in the environment are localized in ecological space, the ambient energy array surrounding the potential observer is relativistically specific to that observation point. At any particular point in time, a potential observer is presented with a particular spatial perspective on the cosmos (or environment). Stated reciprocally, the totality of the cosmos (or environment) is relativistically and uniquely manifested to localized potential observers within it at each and every point within it.

Over time, mobile observers can move through multiple perspectives of their surrounding physical reality. Observers can broaden or expand their perspective on the cosmos. Still, since observers, which would include humans, are physically situated and localized, as well as are all the technological instruments humans utilize in observing the universe, human observers are fundamentally bound to perspectival manifestations and corresponding observations of the world, no matter how many different perspectives are accumulated. Although we can expand our perspectives on reality, we can not transcend our grasp of things to some type of non-perspectival apprehension at the perceptual-proprioceptual level. If this relativistic manifestation of reality through structured energetic ambient arrays at localized observation points is a key (essential) physical condition of consciousness, at the foundational level of

perception and proprioception, consciousness arises and is grounded in a relativistic framework of awareness.

The imaginative possibility has been proposed that the totality of the universe could be observed (and presumably apprehended and understood) if there was some way to stand outside of the universe, so as to be able to view the cosmos as a whole and not relative to a point of view from within it. Yet, the problem with this idea is that sensory-perceptual observation is a reality that requires that the observer is within the universe and occupying some position within it, even if that position changes over time. The physical conditions of consciousness, as outlined above, involve a localized and differentiated complex physical entity that is embedded in the cosmos and is an open system interactive with the surrounding cosmos. It affects and is effected by the cosmos by being within it, occupying a position that is surrounded by other open systems. Consciousness can not be realized, and as such an observational consciousness of the cosmos, from outside the cosmos. To be conscious of the cosmos one must be within it, at a particular relativistic location, and interactive with it. There can not be some kind of absolute (non-relative and non-situational) all-encompassing consciousness of the whole.

The basic fact that conscious entities exist *within* the cosmos leads to a fundamental phenomenological fact about consciousness. We experience our consciousness as contained within our surrounding ecology and the universe as a whole. Our consciousness does not appear as separate, detached, or outside of the world of which we are conscious. We experience ourselves as conscious beings surrounded and embedded within the physical universe that we consciously perceive.

### **The Physical Conditions of Consciousness, Subjectivity, and Objectivity**

Highlighting certain key points from the previous sections, to review my examination of the physical conditions of consciousness, I have proposed that: consciousness exists within and is a manifestation of the cosmos; consciousness is not an ontological given, but requires an explanation for its emergence, nature, and basic features through an understanding of the nature of the cosmos; the cosmos has a physical structure and this physical structure provides important essential conditions for understanding consciousness; two main features of the physical structure and dynamics of the cosmos are its evolutionary and ecological organization; within an evolutionary and ecological cosmos, dynamic, localized, differentiated, and interactive open systems of increasing levels of complexity have evolved, providing a set of key physical conditions for the realization of consciousness; the complexity of consciousness requires as its physical support an evolutionary cosmos that generates increasing physical complexity; the energetic structured manifestation of open systems to each other and to themselves provides the physical foundation for perceptual and proprioceptual consciousness and the physical impact of open systems upon each other provides the physical foundation of conscious purposeful behavior; and the energetic manifestation of entities in the physical universe creates localized deterministically structured ambient energetic arrays that surround localized complex open systems in the cosmos, thus providing relativistic (and perspectival) displays of the make-up and structure of the universe.

In so far as any conscious observation of a conscious open system within such an energetically structured universe is physically relativistic, all observations of conscious beings, at a foundational perceptual level, are “subjective”—that is from a relative point of view. Conscious open systems that can move about can expand their perceptual perspectives, thus approximating toward a more “objective” apprehension of the cosmos. Still, there can be no absolute objectivity realized in such a reality, since “objectivity” is only progressively and approximately realized through an expansion of subjective perspectives. Although we can meaningfully distinguish between observations that are more subjective or more objective, the distinction is only relative rather than absolute. Subjectivity and objectivity are not two distinct realities, independent of each other, but rather this polarity is a continuum. A subjective point of view still embodies some sample of the totality of existence and an objective point of view still rests upon some sample of subjective perspectives. Thus to return to the “objective” versus “subjective” distinction introduced earlier in the discussion of Nagel’s philosophical viewpoint on consciousness and the physical world, we should note that this distinction is not some absolute duality of existence, but rather a relative one.

There is a particular meaning often given to the concept of subjectivity, in which the concept makes reference to the felt and experienced reality of an inner state of being. A conscious being—specifically a conscious human person—may distinguish between their experienced inner state of being and conditions and factors outside of this inner reality. The distinction of “I” versus the “other” is often used to articulate and explain this concept. Within some theories of consciousness, the reality of consciousness itself is seen as a subjective reality in this sense: consciousness is an inner reality to be distinguished from an outer reality, which can be manifested to another. The philosophical concept of “zombies” has been used to envision a being which does not possess this inner subjective reality, but rather only manifests an outer reality. In sum, subjectivity, understood in this fashion, is the intrinsic reality of a being as manifested to that being.

Yet, in spite of the intuitive sense that what is intrinsic to a being can be established and understood (or experienced) without reference to anything beyond it, the very concept of intrinsic can not be understood without contrasting it with extrinsic. Indeed, in our conscious apprehension and understanding of our “inner” reality (our “I” or consciousness), we frequently conceptualize this inner reality in relative distinction to an outer reality. “Inner” and “outer” is a distinction, and without the latter, the former evaporates in substance and meaning.

When we consider the emergence of distinctive entities in the cosmos, these entities emerge as localized differentiations within a surrounding context. Open systems establish and maintain their distinctiveness and inner nature in relationship to a surrounding cosmos. Distinctive identity is relational rather than absolute. This physical condition of distinctive identity of an open system—a differentiation—aligns with the above point that “inner” and “outer” are interdependent concepts, and the psychological distinction between the “I” and the “other.”

Hence, I would propose that the emergence of subjectivity, as a conscious state of inner reality, is grounded in a relative, as opposed to absolute physical foundation. We experience a distinctive inner reality in so far as our physical bodies are localized

differentiations within a surrounding environment. But we need to keep in mind that our conscious sense of an inner distinct “subjective” reality is a relative distinction supported by a relational distinction at a physical level. Our inner reality does not feel like it pervades the whole, since our physical body is localized and is experienced as localized, but it is also experienced in relationship to the whole (the other)—rather than as an absolute—since our bodies are differentiated and exist in relationship to the whole.

In line with these above points, as I proposed earlier, our conscious self-identity—our sense of a distinctive conscious being—is grounded in our proprioceptual awareness of our body. (Indeed, as I stated, phenomenologically our bodies appear conscious of themselves.) And to also recall, I proposed that this conscious sense of our bodies is a relational distinction relative to our perceptual awareness of the surrounding environment. Our sensory consciousness, as such, involves this relational distinction between ourselves (the inner) and the other (the outer).

### **The Ecology of Consciousness**

A standard definition of the term “ecology” is “the scientific study of how living organisms interact with each other and their nonliving physical surroundings.” The term is “derived from the Greek *oikos* (‘house’) and *logy* (‘study’). As such, ecology literally means the ‘study of our house.’” I will use the word “ecology,” though, to refer to the domain or sphere of physical nature, or the “house” itself, as studied by the science or discipline of ecology. A key term to highlight with respect to the nature of this domain is “interact;” as a distinctive feature of its nature, ecology is an interactive reality.

In this section I examine the ecological conditions of consciousness. Are there basic features of a physical ecology that appear to be highly significant, if not essential in the realization of consciousness? As an important opening point, we should note that human and animal consciousness exists within our earthly ecology. Hence, are there significant features of our earthly ecology essential for consciousness? But more broadly, we can ask are there more general conditions for any type of ecology, inclusive of all types of planetary or stellar ecologies, that are essential for consciousness? Science fiction has created a host of imaginatively postulated different types of non-earthly ecologies that could conceivably support consciousness.

To use the terminology and concepts developed in the previous sections, we can restate and refine the above question as: Within a universe of dynamic, complex, and relatively localized interactive open systems, what types of distinctive, collectively determined interactive ensembles of entities are associated with the emergence of consciousness? What types of interactive physical ecologies support consciousness?

In addressing this question we should note that all open systems in the cosmos exist within relatively localized and distinctive surrounding physical ecologies populated by other open systems. Open system entities on any planet exist within a planetary ecology; planets (as open systems) exist within solar system ecologies; and stars and solar systems exist within galactic ecologies.

In an earlier section, I argued that a necessary physical condition for the emergence or manifestation of consciousness in an open system is a sufficiently complex surrounding, multi-faceted context or ecology of other complex interactive open

systems. As such, consciousness can not arise in a single relatively isolated entity without a surrounding complex ambience of other complex interactive entities. Consciousness arises in open systems situated and surrounded by complex interactive physical pluralities. Consciousness requires a complex engulfing ecology.

Moreover, if consciousness requires a certain level of evolved physical complexity in an open system possessing consciousness, that level of physical complexity in such a conscious system can only be realized in an interactive context (ecology) of sufficiently complex surrounding systems. Individual physical complexity requires surrounding physical ecological complexity.

So as a general cosmic question in addressing the ecological conditions of consciousness, we can ask does an ecology (such as on a particular planet, moon, or even a star) generate a sufficient level of pluralistic complexity to support consciousness. Relevant to this broad question, we should note that astronomers and astro-biologists are engaged in the intensive study of what necessary levels of dynamic complexity on planets could support the emergence of life. Without a certain level of planetary dynamic complexity, presumably life could not emerge. A common assumption, which seems highly plausible although not absolutely certain, is that consciousness requires life as an evolutionary prelude. As such, a sufficient evolutionary level of dynamic complexity within a planetary ecology is necessary for both life and consciousness.

Over its four and a half billion year history the earth has evolved a highly complex and multi-faceted planetary ecology that is an interactive (and even interpenetrating) effect of diverse living forms and inorganic physical processes and conditions. Due to the interpenetrating interaction of life and the inorganic, the dividing line between the two spheres is blurred and complex. James Lovelock's published work on his Gaia hypothesis has traced in considerable detail the multi-stage history of the interactive and interpenetrating evolution of the ecology of the earth. The ecology of earthly conscious life forms is a complex ambience of both inorganic features and diverse interactive and interdependent life forms.

In what ways does the evolutionary development of the earth's planetary ecology of life forms and inorganic structures and substances provide significant, if not essential conditions for the realization of consciousness on this planet? As one noteworthy factor, planetary ecologies (earthly or "other worldly") do manifest relatively stable configurations of interactive systems, but such ecologies (including that of the earth) are also (to various degrees) collectively dynamic, both transformative and evolutionary. Except for a "totally dead" planet (and planetary ecology), which clearly does not apply to the earth, the "natural" planetary state of affairs is neither absolutely stable nor harmonious; there is flux, the unsettling of balances, and repeated and pervasive evolutionary transformations and developments over time. As has been argued and documented, the evolution of complexity in life, and the particular evolution of indices of consciousness in hominids and humans, has been significantly and repeatedly instigated by pervasive ecological and environmental transformations. As stated earlier, physical reality, which would include planetary realities, is a combination of relative stabilities and relative change; the emergence and evolution of consciousness on the earth clearly has been realized within a complex mixture of relatively stable and transformative dimensions within earthly ecology.

As another important ecological condition, individual life forms on the earth exist in the ambience of other individual life forms. Since on the earth, consciousness has manifested itself within living forms, we could propose that an ecological condition for the emergence of consciousness has been this environmental ambience of very large numbers of life forms populating the surroundings of any individual life form. Conscious life forms on the earth exist in ecologies of innumerable other life forms and these populations of life-forms participate in various types of complex interactions (inclusive of interpenetration and assimilation) with each other. It makes sense to support that this ecological condition of surrounding biological diversity is essential for the emergence of consciousness.

As a corollary consideration, it is possible, if not plausible, to suppose that the emergence of consciousness in any individual life form requires an ecological context of other conscious life forms. Consciousness within any living creature is supported and developmentally facilitated by other conscious life forms. Social-cultural theories of the psychological development of individual conscious humans have long argued that many key features of human consciousness, such as self-identity, require essential nurturant guidance and teaching from mature humans for the manifestation and articulation of such features of human consciousness.

All in all, a sufficiently complex ecology of life forms and in particular conscious life forms appear critical, if not essential, for the manifestation of individual conscious life forms. Consciousness appears to emerge as a collective result of a living ecology.

One general feature of the interactive reality of conscious life forms, especially so regarding conscious animate life forms, is the ecological loop of affordances and reciprocal effectivities that define and structure their ways of life. Affordances and effectivities (introduced and discussed in Chapter Three) provide the physical underpinnings of conscious perception and proprioception, conscious purposeful behavior, and conscious emotion and motivation. Affordances and effectivities are the physical-ecological foundation of: “To know the world; to engage the world; to feel the world; and to desire (at least parts of) the world.”

Beginning with the concept of affordances of the environment, the physical environment of earthly life forms is not simply a collection of complex open systems, but rather an array of systems, structures, and events in the environment that are integral and meaningful to the functioning and ways of life of living creatures. In order for life forms to engage in the various processes and behaviors essential for their survival and the actualization of their distinctive ways of life, such life forms engage with and utilize different essential aspects of their environment. As such, different features of the environment possess critical value and functional uses for the life form. Such “affordances” of the environment are integral to the distinctive existence—of their being in the world—of life forms; in essence, the life form’s very nature is ecological in so far as it includes the utilization of affordances. Conscious life forms perceive such affordances, and consciously feel the value of such affordances and desire them.

Effectivities (modes of behavior) are the reciprocal of affordances. The behavioral engagement with and utilization of affordances of the environment requires complex and purposeful forms of action. Effectivities match up with and align with the affordances of the environment. Effectivities use affordances. As conscious purposeful forms of behavior, effectivities require, for their realization, engagement with the

affordances of the environment. Effectivities are ecological realities (involving interactive relationships of life and the environment), because they can only be described with the inclusion of the affordances of the environment utilized in their execution.

Connecting together the concepts of affordances and effectivities with the complex pluralistic environment of life forms that supports and provides the ambient context for any individual life form, a key source of affordances for any life form is other life forms. Many features of the ways of life of any individual life form involve utilizing affordances provided by other life forms. Indeed, life provides the richest and most complex set of affordances in the environment.. Life needs life in order to exist. Reciprocally, many executed characteristic effectivities (types of behavior) of any life form involve engagement with other life forms. Much of the “doing” and “acting” of life is focused on engaging surrounding life. The most complex effectivities of a life form are forms of engagement with other life forms.

Another pair of key ecological features in the existence of conscious life forms is competition and cooperation/collaboration. These dual processes can occur without the involvement of consciousness, but this pair of processes is clearly manifested within conscious life forms. As fundamental and contrasting types of complex interaction among life forms, both competition and cooperation/collaboration have a significant impact upon the nature and evolution of life and consciousness.

Increasingly higher levels of complexity within living open systems on the earth are instigated by the dual processes of competition and cooperation/collaboration. Competition embodies an “either-or” logic of survival and evolution; cooperation/collaboration involves a “both-and” logic of survival and evolution. Competition frequently generates selective elimination of evolutionary pathways; cooperation/collaboration generates selective integration of simpler entities into more complex entities, in some fashion or another, preserving the entities which are integrated. An strong example of integration in the evolution of life on the earth is the emergence of multi-cellular life forms during the “Cambrian Explosion.” In this period, earlier single cell life forms integrated together—in a symbiotic type of arrangement—into more complex, hierarchal multi-cellular creatures. The contrasting process of competition in evolution appears to have been strongly at work in the subsequent “whittling” down of evolutionary trajectories in the whole array of diverse “body plans” that emerged during the Cambrian Explosion. (Chance or luck may also have been a key factor in the selective reduction of different types of multi-cellular creatures.) It should be noted, though, that competition can generate mutual amplification of different evolutionary trajectories, for example, in predator and prey lineages reciprocally driving each other toward further evolutionary development. Also, competition and cooperation/collaboration can mix together in evolution: Was the Neanderthal evolutionary line eliminated through competition with the *Homo sapiens* evolutionary line, or was the Neanderthal line assimilated into the *Homo sapiens* line through interbreeding, or is the answer, in a sense, a combination of the two?

Both competition and cooperation/collaboration manifest their effects at the level of the evolution of human consciousness. Contrasting belief systems and philosophies have competed with each other throughout human history—often with victors emerging—but other times with different conscious mindsets of humans blending and

integrating together into more complex paradigms of consciousness. The history of human consciousness is a complex tapestry of selective destruction/extinction and blending/integration. Presenting a resonant type of explanation in describing the evolution of human consciousness and human civilizations, Howard Bloom has argued that human history unfolds as a dual result of war (destructive elimination) and reciprocity (mutual exchange and enrichment). To use a different terminology that is also conceptually in line with this perspective, evolution and human history can be seen as a dual result of “zero-sum” and “non-zero sum” engagements; sometimes if one party wins, the other must lose; other times both parties can win (a win-win scenario).

Another key idea to mention in discussing the ecological evolution of consciousness is the proposed hypothetical possibility that a sufficiently complex ecology of conscious beings might be able to realize some type of integrated collective “intelligence” or consciousness. Could a sufficiently complex planet achieve a collective consciousness or intelligence? Could a star achieve a consciousness? There are numerous science fiction stories that imaginatively speculate on such possibilities. Such possibilities have also been suggested in both philosophy and science. The question has been raised whether “Gaia”—the exceedingly complex, dynamic, evolutionary, and integrated living earth—might already possess some form of integrated intelligence. With the growing technological network enveloping it, perhaps Gaia can achieve consciousness in the future? If a planetary consciousness could emerge, what would happen to the numerous individualized conscious life forms within such a planetary mind? Various philosophers and scientists have proposed that the earth—with its immense collection of human and animal conscious life forms—is evolving (or “should” evolve) some type of planetary consciousness—a “noosphere.”

### **The Ecological-Evolutionary Biology of Life and Consciousness**

In this section I describe the ecological and evolutionary nature of life and further consider the connection between life and consciousness. I address the question of “What is life?” In considering this question, I propose that life, in some essential respects, is an ecological and evolutionary phenomenon. Based on this analysis of life, I address the question of “Is life a necessary ‘physical’ condition of consciousness?” If life is necessary for consciousness, why? The reader is referred to my much more extensive and detailed discussion of the nature of life in my book *The Future of Science, Technology, and the Cosmos*, especially pages 314-346. See also Chaisson’s *Epic of Evolution* Chapter Six “Complexity Sustained” for an examination of the nature of life viewed within a cosmic evolutionary hierarchical perspective.

There is a long-standing puzzle within the history of scientific inquiry of how life evolved from a non-living physical universe, although I should note that there are numerous scientific theories regarding how this evolutionary development occurred. Certain features of life (see below) appear to be distinctive qualities separating life from the non-living universe. One significant part of the challenge of explaining the evolution of life is accounting for the emergence of sufficient chemical complexity needed for biological/genetic reproduction.

Yet, life clearly seems to build upon the non-living features of the universe, incorporating into its make-up, for example, numerous chemical molecules that emerged in the universe before the emergence of life. Living cells are composed of chemical molecules or combinations of chemical molecules that evolved prior to the emergence of life. In this important sense, life is an hierarchal evolutionary development involving the integration into more complex wholes of simpler chemical constituents. Life is a manifestation of the ongoing hierarchal evolution of complexity in the cosmos. This feature to life is generally listed as one of the key defining features of life (see below).

Drawing upon different scientific sources, the following characteristics are commonly listed as strongly associated with life. In describing these characteristics I highlight how these features align with key themes in the previous sections on the physical conditions of consciousness, particularly emphasizing the evolutionary and ecological aspects of these defining features of life:

- (From above) Life possesses a complex internal physical organization, which is a multi-level hierarchal structure (that has evolved through a series of stages) and this structure is a relatively self-contained differentiation relative to the ecological surroundings of a living form.
- Life, as an ongoing dynamic dimension to its nature, exhibits metabolism, defined as the acquiring and utilization of energy and materials essential for its sustained maintenance. Both anabolic (constructive) and catabolic (destructive) processes are involved as well as numerous chemical (circular) cycles. Metabolism is a feature of open systems, which maintain their distinctive identity by drawing upon energy and material from their surroundings.
- Life manifests the quality or capacity of homeostasis, defined as maintenance of a relatively steady internal state through the active regulation of those internal states. Homeostasis requires both the capacity for internal self-monitoring and the capacity for self-adjustment. This capacity for self-monitoring aligns with the basic conscious process of proprioception.
- Yet, even if life manifests a homeostatic dimension—the active perpetuation of a steady state—life also exhibits the distinctive qualities of growth and development. Life is a transformative dynamic reality. Living forms show life-span developmental growth, often beginning from minuscule single cells and growing and differentiating in much more complex multi-cellular mature forms.
- Life manifests sensitivity and responsiveness to its surrounding environment. This is also an open systems feature and aligns with the conscious capacity of perception. It is an ecological feature of life, in that it involves an active relationship between life and the environment.
- Life manifests a reproductive dimension, an individual life form being able to replicate itself. Although reproduction seems to imply a preservation of form across generations (a manifestation of stability), there is also a recurrent mutational dimension to reproduction; there is some level of variation (relative change) across generations. This transformative feature of reproduction is a necessary condition for evolution across generations. Biological evolution manifests a degree of relative stability across generations, but also necessarily a degree of change.

- The process of evolution, frequently defined as improved adaptation to the environment, is generally listed as a key feature of life. Evolution, defined as progressive adaptation to the environment, is an ecological concept, identifying a change in the relationship between life and its environment. As I argued earlier, biological evolution is a unique continuation of cosmic evolution, involving an evolution in evolution (an acceleration in pre-life evolution). Biological evolution, as a process for explaining the complex array of life forms, contradicts the theory of static creationism.

Three succinct summary definitions of life, highlighting many of the above identified features of life are:

- Life is self-sustaining chemical system capable of “Darwinian” evolution. (This definition identifies the physical-chemical substratum of life and synthesizes the dual processes of stability and change. )
- Life is an integrated system able to sustain, grow, and evolve in an environment. (This definition highlights the holistic organization of life, the dual processes of stability and change, and the ecological nature of life.)
- Life, as defined by the principle of “autopoiesis,” is the creation and maintenance of a differentiated entity (negative entropy) in the ambient context of entropy. (This definition highlights self-creation and self-maintenance of a differentiation relative to the context of a non-differentiating (entropic) environment.)

All in all, the above definitions of life build upon the open systems analysis of physical reality provided in earlier sections; frequently highlight key ecological features to life; and in line with the evolutionary conception of the physical cosmos, introduce a distinctive type of evolution operating in life (an evolution in evolution) that is built upon self-reproduction and natural selection (“Darwinian evolution”). Life appears to be an emergent phenomenon in an open systems ecological-evolutionary universe that is consistent with, but adds unique features to the dynamic hierarchical organization of the cosmos.

One thing, though, is clear: Our understanding of life indicates that life is a natural phenomenon that has evolved in the universe and possesses the distinctive power to continue to evolve. On the earth, at least, we have found fossil records of the emergence of life after the earth had realized a certain level of geological-meteorological complexity, and a detailed record of ongoing biological evolution of increasing complexity following life's appearance.

At this point in our growing understanding of life, scientific study has been limited to life on the earth. If life exists elsewhere in the universe, our definition of life may need to be broadened or modified to incorporate non-earthly life forms. There is, though, active ongoing research into the possibility of life outside the earth, and there is accumulating evidence that complex chemical molecules associated with earthly life are present on other planets and moons in our solar system, or even in interplanetary space. The ecosystems of other planets and moons are also being studied for indications of life. A plethora of imaginative possibilities have been described in numerous science fiction stories about “aliens” (or alien life forms) that include: ideas on entire planets, as a

single integrated organism, being alive; life existing in dramatically different types of planetary environments than the earth; or life forms emerging from (or evolving into) a non-carbon based chemistry. Could life exist within a star? Could life exist in an interplanetary or interstellar medium (ecosystem)?

In addressing the question of the connection between life and consciousness, at this point we can plausibly argue that, at least on the earth, consciousness is a phenomenon that only appears with the presence of life. Even if we were to propose that aside from animals, perhaps plants or even bacteria are conscious, in all such cases the candidates for consciousness are alive. Anil Seth has argued that only living forms can be consciousness; life is a necessary condition for consciousness. Adopting an “autopoiesis” understanding of life, and emphasizing the quality of an active metabolism in both individual living cells and complex organisms as a whole, for Seth consciousness emerges out of, indeed, is the sense of being alive. (Metabolism is an essential process for self-creation and self-maintenance.)

Seth’s argument for the necessary connection between life and consciousness is a key element in his argument that computers (A.I.), at least as they are presently constructed, could never become conscious. Computers/A.I. are not alive; there is no active ongoing metabolic process within its constituent elements for the purpose of self-maintaining those elements; computers/A.I. do not actively resist entropy. We should note that Seth’s position runs counter to all those proposals or visions in science, technological thinking, and science fiction of computers/robots/A.I. realizing consciousness. Supported with argument and evidence, Seth’s position that computers/A.I. are not alive depends upon his definition and conception of life. Could a computer/robot/A.I. be alive? If so, how would such a reality transform our conception of life?

In agreement with Seth, I propose that life is a necessary condition for consciousness. I am going to base this hypothesis on a particular conception of life that is holistic and ecological, and grounded in the above cited key qualities of life. Life is a form of directed active engagement of an open system (possessing a dynamic metabolism) with an environment that functions to perpetuate, modify, develop, and evolve the existence of that system. Single-cell life forms, fungi, plants, and animals all possess these essential features. Life’s active engagement with its environment usually includes activities that modify the environment (active adaptation), which contribute to the perpetuation and further evolution of life. (See Lovelock’s general thesis that life on the earth has actively transformed the non-living earthly environment.)

In the above proposal I highlight the concept of active engagement. This concept is resonant with the idea of effectivities introduced. Life acts upon the environment to produce effects integral to its survival, growth, and evolution. Also to note, this concept of life goes beyond simply identifying some set of properties within life forms, but rather emphasizes an essential connection between life and its environment; life by definition engages the world; life is an ecological phenomenon.

One particular reason for emphasizing the concept of (ecological) engagement is to establish an important connection between life and consciousness. From a materialist perspective on consciousness, consciousness is viewed as a causal “effect” of complex physical matter (such as the brain). But instead of viewing the relationship of physical matter and consciousness in this fashion, we should highlight that

consciousness is an active engagement with physical matter. As a prelude to consciousness, life engages with the environment. Consciousness enriches upon this active ecological mode of existence.

### **Nested Ecological-Biological Systems**

Although I am not precluding the possibility that single-cell life forms or plants are conscious, in the next sections I am going to focus on animal life forms, and in particular, those animals that possess brains and central nervous systems, and consider how such evolved biological structures are connected to consciousness. I examine the role of the brain, the nervous system as a whole, and the total biological configuration of a living body—possessing such differentiated neural structures—in the realization of consciousness, and connect these biological structures with the ecological nature of consciousness.

The evolution of the brain and the nervous system in animals has been an ongoing process over at least the last 500 million years; trilobites had central nervous systems and rudimentary brains. The evolution of the brain within our *hominin* genetic lineage (back to *Australopithecus*) has been ongoing for the last five million years. In both cases there has been a general evolutionary trend (with notable exceptions) toward larger and more intricate brains. I discuss both these topics in Chapter Two.

Focusing on humans—although much of what follows applies to other groups of animals, such as other mammals, and reptiles and birds—first, I should note that the brain, as a relatively distinct anatomical structure, is embedded within and part of the more extensive nervous system which spreads throughout the entire body. The brain, as a distinctive anatomical structure in the nervous system, evolved from more primitive (relatively brainless) nervous systems in earlier animals. As a whole, the brain/nervous system is embedded within the biological body of animal life forms. The nervous system (including the brain) evolved within the biological bodies of animals, concurrent with the evolution of those biological bodies.

Moreover, as explained earlier, the biological (living) body is embedded—as an active engaging open system—within the surrounding physical environment. Biological bodies, including animal forms, evolved interactively with the surrounding environment; as the environment transformed, biological bodies transformed, and reciprocally, as the bodies and behavior of life forms transformed, the environment was transformed.

Whatever the brain, nervous system, and the biological body as a whole contribute into the phenomenon of consciousness, these structures have evolved and exist as a configurational nesting (of wholes within wholes) within the ecology of the earth. The brain, the nervous system, and the body in normal circumstances (which give rise to consciousness) do not operate alone or in isolation from the bio-ecological nesting in which they exist. Brains do not function independent of the extended nervous system; nervous systems do not function in isolation of biological bodies; and biological bodies do not function independent of ecologies. Each embedded level in this nesting of systems evolved interactively with the system in which it is embedded.

Although there is this hierarchal nesting of complex wholes within wholes within the brain-body-ecosystem organization, it's also important to note that each level in this hierarchal arrangement is a relative differentiation in a field of differentiations. The brain

differentiates from the remainder of the nervous system; the nervous system is a relative differentiation with the biological animal body; and the animal biological body is a differentiation relative to the surrounding environment. Each of the nested biological structures manifests internal metabolic processes that make possible the ongoing continuation of life in that structure, and contribute to the active maintenance of that differentiated structure relative to surrounding structures.

### **Localization and Holism and Integration and Differentiation in the Nervous System, Brain, and Body**

A multi-cellular biological body is a complex and dynamic configurational structure with multiple internal systems (such as respiratory, circulatory, and digestive) that relatively specialize in various different biological processes in the body; different physiological functions are relatively localized in different anatomical systems. This relative localized specialization within the parts of a multi-cellular body would include the nervous system as one of the various specialized systems.

These specialized systems frequently include, as parts of their overall configuration, distinctive organs that are localized in the body; for example, the respiratory system includes the organs of the lungs, the circulatory system the heart, the digestive system the stomach and intestines, and the nervous system includes the organ of the brain.

But these different specialized active systems do not operate independent of each other, and as diverse parts of the whole, such biological systems only have their distinctive functions and anatomical structures due to the fact that each is a part of a supportive biological whole. For example, the nervous system requires the digestive, respiratory, and circulatory systems in order to operate and maintain its existence.

In general each system in a multi-cellular biological body requires the whole body to realize its distinctive reality, and each system distinctively contributes in some fashion or form into the total operation of the body. Hence, the biological systems of the body, although relatively distinctive structures with distinctive functions, are reciprocally integrated in the biological whole of a multi-cellular body. All in all, the different systems of the biological body are both internally active and interactive with each other.

If we focus our attention on the nervous system, this system can be anatomically divided into the central nervous system, which includes the brain and the spinal cord, and the peripheral nervous systems, which includes the branching set of nerves and smaller neural pathways that extend off of the central nervous system, and are distributed throughout the entire interior of the body. In general, there is a spreading out of neural tissue from the centralized brain into the peripheral nervous system—a divergence or radiation outward relative to the center, or a convergence of neural tissue and pathways toward the center relative to peripheral nervous system.

The peripheral nervous system can be further subdivided into the somatic (voluntary) and autonomic nervous systems, the former connected with the voluntary muscles of the body that allow for movement, and the latter connected with the various internal systems and organs of the body. In general, the former is associated with purposeful conscious behavior, whereas the latter is associated with relatively unconscious actions and processes in the body.

Moreover, the autonomic nervous system can be divided into the sympathetic and parasympathetic nervous systems, the former associated with increasing arousal in the body and the latter associated with rest and relaxation.

The nervous system is also intimately connected via sensory nerves with various sense organs (such as the eyes and ears) that are distributed across the surface of the body and which interface with the ambient energetic array surrounding the body. Additionally, the nervous system is intimately connected via muscular nerve pathways with the various muscles of the body, which empower the embodied conscious individual to move itself about through the environment and in various ways manipulate and influence the environment.

As a general principle, when we consider the biological underpinnings of consciousness, at least regarding perception-proprioception and purposeful behavior, the entire holistic configuration of the brain/nervous system, sense organs, and muscles is invariably active—indeed interactive—in these conscious processes. These systems—neural, sensory, and muscular—evolved, embryologically developed, and operate as an integrative whole.

It's also important to note that the nervous system is intimately connected and interactive with the endocrine system, the latter consisting of a set of glands distributed through the body that generates and regulates chemical hormones spread throughout the body. Diffusions of hormones, which can vary in concentration, impact the entire state of the biological body. The nervous system and the endocrine system intimately interact with each other via the brain structure of the hypothalamus and the adjacent (master) pituitary gland. Endocrine chemistry has diffuse effects on the entire body and is clearly associated with a variety of conscious states, especially emotional and motivational states.

If we dive deeper into the detailed internal structure of the nervous system, and in particular the human brain (in many key respects similar to the brain structure of other mammals and animals), the human brain can be divided into numerous relatively distinctive sub-structures. On the outer surface (the cortex), the brain consists of two relatively symmetrical (mirror image) hemispheres. The two hemispheres are typically divided into four lobes apiece: The frontal, parietal, temporal, and occipital. Under the cortex, moving down toward the spinal cord, we find the thalamus, hippocampus, amygdala, hypothalamus, the pons, and medulla oblongata, and toward the rear of these structures the cerebellum. The spinal cord, which connects with the medulla, is composed of sensory nerves and motor nerves connecting the central nervous system with the body. I will come back to this point, but generally these different structures are associated with different psychological processes and conscious phenomena; for example, the temporal lobes are associated with hearing and speech, the occipital lobes with vision, the amygdala with various emotions, the hippocampus with memory, the hypothalamus with motivational-emotional states, the medulla and pons with basic autonomic life functions, sleep, and wakefulness, and the cerebellum with balance and action. We should though keep in mind that these substructures are intimately connected together anatomically and physiologically and do not operate in isolation of each other.

At an even more fine grain analysis, the brain and the rest of the nervous system are composed at the cellular level of neurons (roughly 86 billion in the human brain and 15

billion in the rest of the human nervous system). This huge number of neurons are intimately and profusely networked together with over 100 trillion individual synaptic connections among the neurons. Neurons both affect adjacent neurons and are affected by other neurons through chemically mediated electrical impulses across interfacing synapses. Neurons are internally active, generating pulsatory electro-chemical impulses across their axonal bodies at different rates depending upon the electro-chemical impact of other neurons through their synaptic connections. Neurons can both excite (increasing the base rate of axonal impulses), or inhibit (decreasing the base rate of axonal impulses) the activity of connected neurons. All in all, the neuronal structure of the brain and the nervous manifests qualities of both differentiation (among the individual neurons) and integration (across the individual neurons).

A central issue in the study of the brain and nervous system has been the issue of localization versus holism. Does the brain operate as a relatively distinct set of localized areas, each performing some distinctive biological or psychological function, or does the brain work as an integrative whole, with the entire ensemble (or large regions) of neural structures collectively and interactively contributing to the generation of bio-psychological functions, as well as conscious states? One particular issue, among many others, which has been of considerable interest in physiological psychology is whether individual memories and habits are specifically localized in circumscribed areas of the brain, or are individual memories and habits distributed across large areas of the brain? Another important issue on the localization versus holism theme is whether there are certain specific regions of the brains (for example within the cortex or within cortical-thalamic circuits) associated with consciousness (see below).

Regarding particular psychological functions or consciousness as a whole, in so far as the brain-nervous system is both a large set of relatively differentiated anatomical structures and a highly complex network of interconnected and interactive structures it is reasonable to believe that both localization and holism have degrees of truth. The brain-nervous system is both differentiated and integrated. Stated somewhat differently, the brain-nervous system is an integrated system of an immense and multi-level array of differentiations, or a multi-level array of differentiations embedded in a holistic system. A similar point can be made regarding the biological body and its set of major anatomical-physiological systems: The biological body is a holistic and integrated system consisting of a set of relatively differentiated systems that are also highly interactive with each other. The body is an integrated and interactive set of differentiations.

The coupling of integration and differentiation can be applied to a basic functional feature of our sensory-perceptual systems. It appears that within perception there are two complementary activities involved, namely integration and differentiation. We simultaneously experience the world as an integrated whole and as an array of distinctive features within that integrated whole. Perception is integration and differentiation.

More broadly, the coupling of integration and differentiation at the anatomical-functional level of the body, and the brain-nervous system in particular, has a noteworthy parallel within the general phenomenon of consciousness. Following the lead of IIT, Edelman's theory of consciousness, and Gestalt theory, consciousness

appears to manifest a combination of both integration and differentiation. Conscious states are integrated (holistic Gestalts) states consisting of complex and connected differentiations (emotions, thoughts, perceptions, and memories all making up distinctive elements in a holistic conscious state). The phenomenological field of consciousness can be described as a highly differentiated experiential integration. (A whole consisting of numerous related parts.) We could describe consciousness as a complex blending of integrative and differentiating features.

In both scientific biological research and scientific-philosophical theorizing, one key question is the bio-anatomical location of consciousness. (If we believe that the biological body causes consciousness; or resides in the biological body; or in some manner or form is intimately connected with the biological body.) One common answer has been that consciousness is localized and generated in the brain. As has been ascertained in an immense number and a variety of physiological experiments, the selective direct electrical stimulation of different areas of the brain provokes different types of conscious experiences in the experimental subjects. Complementarily, also as demonstrated in numerous case studies and experiments, damage to different parts of the brain produces selective deficiencies in consciousness. (All this research supports the localization theory of distinctive conscious states and functions residing in distinct parts of the brain.) Although it has been an ongoing challenge to specifically isolate which particular anatomical structures or patterns of neural activity are the presumed core causative agents in generating consciousness, as just noted, it is a common view in biological and psychological science that it is the brain that is intimately connected with consciousness. (Different theories of consciousness conceptualize this connection differently; see my review of dualist, materialist, and identity theories of consciousness.)

Yet, it should be noted that whenever reports of conscious states are provided by experimental subjects, it is a holistic biological entity and personified consciousness that is reporting these conscious states. Would a brain ever develop or experience consciousness independent of its embedded configuration within a biological body and surrounding ecosystem? Of course, a brain could not be alive in such an isolated state, let alone possess consciousness. There are numerous science fiction scenarios, as well as current scientific research paradigms, which postulate the possibility of a technologically supported maintenance of a living brain, disconnected from a body, that presumably would be able to have conscious states. But at this point in scientific research, it is only embodied and personified conscious individuals that report conscious experiences (or the lack thereof) if their brains are stimulated or damaged.

As noted above, in our normal state of consciousness our bodies feel conscious. We have conscious feelings (tactual and haptic) within our hands, our feet, our arms, and legs. Consciousness is manifested as an anatomically diffuse reality. When we think, imagine, or remember, our consciousness of such processes feels relatively localized around the head, as well as, various forms of perceptual consciousness, where the respective sense organs are located within our head (the eyes, ears, nose, and tongue/mouth). For example, we experience conscious seeing as localized in the eyes and conscious hearing as localized in the ears. But all in all, our consciousness is not experienced as exclusively and specifically localized in our brains or heads. As embodied conscious persons, our consciousness appears *relatively distributed* within

our entire physical body. And to re-emphasize, it is this embodied and personified consciousness that reports conscious states in physiological experiments on the brain.

In concluding this section on the brain and the nervous system, let me return to an issue identified earlier: Are single-cell life forms or plants conscious? In the above section I highlighted the complex integrative and differentiated anatomical-physiological nature of human-animal bodies and nervous systems. It seems to me that a take-away from this section is the proposal that a sufficiently integrated-differentiated biological life form is a necessary physical condition of consciousness. Brains and nervous systems manifest this dual feature (embedded as they are within the totality of a life form). But we should leave open the possibility that single cell life forms or plants may possess a sufficiently complex blending of integration and differentiation to satisfy this essential biological condition of consciousness.

### **Sensory Input, Brain Integration, and Motor Output Theory of Nervous System**

Let's delve deeper into the anatomy and physiology of the nervous system and associated sensory and muscular systems in order to further understand the relationship between the body, the brain, and consciousness. The standard view of the organization of these systems is that sense organs on the surface of the body are energetically stimulated at the localized level of individual receptor cells by forms of physical energy coming from the environment, and these sense organs via receptor cells differentially react to these external stimuli provoking patterns of energy that travel into the body via sensory nerves that are connected to the sense organs. For example, the eyes, possessing arrays of retinal receptor cells, are stimulated by light and generate patterns of energy (consisting of huge assemblages of neural impulses) which propagate inward into the body via the optic nerves. The patterns of energy, traveling across the sensory nerves, converge into the central nervous system and the brain. Different sensory nerves connect with different parts of the brain (often multiple parts) and consequently different streams of patterned energy feed into different parts of the brain. Up to this point, the energy flow could be described as input.

The brain in various complex ways reacts, through interactive flows of patterned energy within itself, to this sensory input. Within a localization model of brain function and its conscious accompaniments, perceptual consciousness results from this brain activity; visual consciousness, for example, being generated in the occipital lobes; auditory consciousness in the temporal lobes; and tactual-cutaneous consciousness in the parietal lobes.

As a consequence of these reactions and reverberations in the brain, patterns of energy are transmitted outward through muscular nerves attached to the brain (in the frontal lobes) and through the spinal cord that ultimately terminate in the muscles of the body, causing the muscles to contract or extend, and thus generating behavior in the animal. This second half of the process, from the brain to the muscles, can be described as output.

Based on this model, the brain is understood as a receiver, processor, and integrator of sensory input, and a central instigator and coordinator of muscular behavior. Patterned energy flow, in this model, is linear or uni-directional, with input running up the sensory nerves, and output running down the motor nerves. Presumably

consciousness is manifested at the way station point between input and output. The brain receives and interprets the sensory input (generating conscious representations) and initiates and coordinates purposeful conscious behavior output as a consequence/ in reaction to this input. The cognitive theory of consciousness (reviewed earlier), among other brain-based theories of consciousness, subscribes to this general model of the brain-nervous system and associated sensory and motor pathways.

Such a model of the brain and consciousness situates the brain, as the source of consciousness, separated from the environment—it receives messages or input indirectly from the environment via the sensory nerves. The resultant conscious effects generated by the brain are at best “internal” representations of the outside world. Moreover, the conscious brain, like a detached commander of the actions of the body, existing behind the scenes, sends its directives for behavior down communication pathways to be delivered to the appropriate distal muscle groups. All in all, this model of the brain creates a figurative “little man in the head,” who consciously views images delivered from the outside, thinks about the images, and consciously pulls the appropriate strings in the command center to move the puppet of the body.

### **Nested Loop Theory of the Nervous System, Sensory-Motor System, and the Environment**

Although the nervous system has a branching structure with sensory nerves converging onto the trunk of the central nervous system and the brain, and motor nerves fanning out from the trunk, this picture of the structure of the nervous system and the flow of patterned energy is incomplete and decidedly misleading.

Consider the sensory side of this branching structure: At multiple locations along the way from the sense organs to the brain—for example, at ganglionic clusters of interconnected neurons in the sensory nerves and pre-cortical sensory junctures in the brain—there is patterned energy moving outward from the central nervous system influencing the incoming energy patterns along the sensory nerves and lower regions of the brain. As such, there are multiple loops of activity running in both directions along sensory pathways. Also, due to ongoing motor adjustment and exploratory activity during perception, incoming sensory patterns of energy are continuously being modified by the active behavior of a sentient perceiving animal. The sensory pathways are not passive conduits of external input that is simply delivered to the brain.

Relevant to the above point is an argument that has been articulated in theories of the physiology of perception that perception is an active anticipatory and predictive process. As the argument goes, brain processes are continuously creating anticipations and predictions of what is likely to be perceived in the coming moments based upon past encounters with similar environmental realities. Such anticipations and expectations formed by the brain are continuously guiding perceptual activity and being compared to incoming sensory input. In this model of perception, sensory awareness is far from a passive process of reception, but rather an active process of searching out and confirming expectations generated in the brain. The physiological process of sensing/perceiving the world is not simply input, but an ongoing anticipatory engagement of the brain/nervous system with the world.

Turning to the simple unidirectional model of motor output and pathways, we instead find in the motor system interdependent loops of activity, rather than unidirectional motor output from the brain to the muscles. The ongoing output along the muscular nerves is modulated or influenced by input from the sensory nerves as it travels toward the muscles. Again, there are loops of activity running in both directions in the muscular nervous system, as was the case in the sensory nervous system.

The brain is neither a simple receiver of sensory input, nor a central absolute command center for muscular output. Input is being modified by output and output is being modified by input along the whole distributed system of the brain/nervous system, sense-organs, and muscles. (See my previous discussion of active perceptual systems in Chapter Three.)

This loop configuration of flows of pattern energy can be further extended outward into the surrounding ecosystem, in which a biological body is embedded. First we should note that perceptual-proprioceptual and muscular-behavioral processes in animals form a loop of interdependency. The former provides an ongoing guidance system for the latter, and the latter actively moves about and adjusts the sensory systems responsible for perception and proprioception. To recall, Gibson saw the perceptual systems as active and exploratory, rather than simply passive receivers; external sensory stimulation is actively modified through exploratory behavior. All in all, behavioral output adjusts and modifies sensory input and this transforming input guides and modifies the output.

Moreover, although we could think that the environment causes reactions in the biological body and that input to the body is determined by the environment, animals are continually modifying environmental impact by changing body position, as well as actively changing the environment. Hence, we can also view the animal-environment relationship as a loop of interdependency. This ecological loop of causal interdependency is a key defining feature of the reciprocal relationship between the animal and the environment. It is key to understanding the physical structure and organization of the process of engagement between conscious animate life forms and the environment.

In summary, the neuro-bio-environmental dynamic organization form is nested loops within nested loops within nested loops supporting a multi-leveled ecological relationship; loops in internal neural bodily activities are embedded within sensory-behavioral loops which are embedded within animal-environmental loops.

Hence, neither the brain, nor the nervous system, nor the body as a whole should be viewed as passive receivers of stimulus (energetic) input coming from its surroundings. At all these levels of organization there is active modulation and control of the surroundings, with the flow of causality circular, rather than linear. These loops form a multi-level nesting structure of activities with the animal-environment loop subsuming the various other loops of causality embedded with it.

### **Consciousness and the Brain**

In materialist, as well as various dualist, panpsychist, and dual-aspect identity theories of consciousness the belief is that the brain either generates consciousness, or the inner states of the brain are composed of conscious realities. In the cognitive

perspective, consciousness aligns with intermediary activities between input and output occurring in the brain. In all these cases, the brain is identified as the physical causal foundation (and locus) of consciousness.

In many of these theories, some type of sufficiently complex interactive and integrative activity takes place in the brain—which can include both cortical and subcortical structures, such as the thalamus—that is necessary for the emergence of consciousness. But such a postulated integrative process would have to incorporate the incredible level of differentiated conscious elements—perceptual, emotional, motivational, and ideational—that make up integrated conscious states, and this incredible diversity of conscious elements arises across numerous distributed areas of the brain that are associated with these different psychological dimensions and elements.

As noted earlier, brain centered theories of consciousness are supported by the huge amount of experimental evidence linking particular locations with different types of conscious experiences, as well as copious amounts of research connecting the loss (or damage) of particular regions in the brain with specific losses in the scope and richness of consciousness. But also, as noted earlier, these observed correlations between localized brain activities (or lack thereof) and reported conscious states (or lack thereof) are all based upon input provided by living holistic conscious beings (rather than “somehow” isolated brains).

A hypothetical science fiction experiment to explore this question: Place a brain, detached from its body, in a technologically created, supportive environment that can keep the brain alive; attach to the brain transmission devices such that the brain can communicate what it is experiencing (assuming it experiences anything); and then stimulate regions of the brain and observe what such an isolated brain would report.

It should be noted though that brain-based theories of consciousness do not in any simple fashion solve the “hard problem” of consciousness, to wit, why do electro-chemical physical activities in the brain cause consciousness, or adopting a panpsychist or dual-aspect identity theory, why are the intrinsic states of such physical activities composed of conscious phenomena?

There are the additional problems of: How do so many distinctive types and elements of consciousness (for example, emotions, thoughts, and perceptions) all arise from basically the same type of biological structure (neurons)?

And if we assume that what we consciously perceive are actually states of the brain or caused by states of the brain, then the postulated physical brain in this theoretical framework becomes an absolute unobservable. Indeed, one's own body becomes an unobservable, because proprioceptual aspects of consciousness are also either states of the brain or caused by states of the brain. In essence, as Descartes realized in his famous thought experiment, if the brain-based theory of consciousness is true, then we all might actually be isolated brains in experimental laboratory set-ups; there would be no way to tell.

So as not to throw the baby out with the bath, it still seems to me that the brain is an integral bio-physical component in the consciousness of life forms who possess brains (which includes humans). The question is how do we fit the brain and its complex workings into a general theory of the physical conditions of consciousness?

## **The Ecological and Relational Nature of Consciousness**

What I would propose is that instead of thinking of consciousness as a brain-localized effect, we should see consciousness as grounded in the active engagement and selective resonance between a physically embodied life form and its environment. As noted in the earlier section on the nature of life, a key defining holistic feature of life is its interactive and directive engagement with its environment. Consciousness, which appears to arise within living beings, at least on the earth, manifests this key feature of ecological engagement between life and the environment.

In highlighting the concept of active engagement in describing consciousness (and life as well), I am proposing that consciousness is a relational reality, rather than an intrinsic state. This relational reality is achieved by life forms in interaction with and set in the context of a surrounding environment. Consciousness is a mode of relating with the world.

This process of active engagement between life and the environment is physically supported by nested loops of interactivity between a conscious life and the environment, which in the case of animals with nervous systems and brains will include loops of activity of neuro-sensory-behavioral system. (Parenthetically, these loops of activity are also interactive with the endocrine system coordinated via the hypothalamus and the pituitary gland.) The brain, in such life forms, is integral to these nested loops of activity. It is though the whole interactive physical system, manifested as an embodied personified conscious being, that is conscious.

Consciousness as a relational engagement of life forms with the environment applies at a foundational level to both to the active exploratory process of perception (perceptual consciousness) and directed muscular/bodily behavior or effectivities (conscious purposeful behavior). Both these processes are processes of ecological engagement. But consciousness, also at foundational level, is engaging and relational with respect to emotion and motivation; we emotionally react to meaningful features (affordances) of the world and experience various desires and purposefully act on these desires (effectivities) with respect to the world. All in all, consciousness is a relational sensing-doing-feeling-desiring engagement of life forms with the world.

We do though experience our consciousness as relatively anchored within our bodies, but it is the whole dynamic body, as a set of nested active systems with multiple loops of interactivity, which manifests the phenomenon of consciousness (e.g., our hands are conscious). Moreover, although anchored to our living bodies, consciousness is a relational reality established between a living body and its environment.

Indeed, as a relational reality consciousness reaches outward and interfaces with the physical environment it is embedded within. The phenomenal objects of our consciousness at the perceptual level are experienced as features of the environment—indeed are features of the environment—that the active engaging body reaches out into, explores, and manipulates. Beginning at the perceptual level, consciousness as a relational reality is “outer-directed.” I should additionally note that the physical bodies

of conscious life forms are also phenomenal objects of consciousness, as well, keeping in mind that the experienced body is apprehended in relationship with the surrounding physical world. I should also point out that conscious behavior is a relational engagement with the physical environment; our conscious actions serve the functions of changing our relationship with the world, changing the world, and utilizing affordances of the world.

The active and outward directed nature of consciousness is supported by a set of nested anatomical structures and physiological processes that engage with and modulate the surrounding environmental conditions. Indeed the nested loops of physical interactivity extend outward and include the dynamic physical environment.

If one were to ask “what” is conscious, and in particular, what is it that is conscious of the environment and the living body, keeping in mind that consciousness is a relational reality or capacity, the answer would be the living body itself. This living body (at least for humans and other conscious animals) is a multiple-nested, holistic dynamic system, including the brain and nervous system, embedded perceptual systems (including sense organs), connected muscular systems, and surrounding biological supportive tissue. This multi-level organization—a neurologically infused holistic, dynamic, and engaging body—is what possesses consciousness, keeping in mind that this realization of consciousness is achieved in the context of an surrounding supportive environment.

Consciousness has a dimension of being private and “subjective” because it is anchored to a particular relatively localized living body within an ecological configuration, but consciousness also critically connects with a reality that exists beyond its localized embodiment.

I would describe consciousness holistically as an emergent relational property of an evolving universe. I tend to side with emergence theories of consciousness—it evolved in the history of the universe rather than being primordial—but I would not agree with the view that consciousness is an emergent property of physical brains. Rather it is an emergent property of ecological realities (embedded in and supported by a cosmic reality) that contain highly complex, interactive living forms.

To connect the above theory of consciousness with a couple of key points made in previous sections regarding the physical conditions of consciousness, the universe is a highly complex cosmic reality that generates and structures a correspondingly complex energetic field that permeates throughout it. As conscious relatively localized living forms, we occupy localized positions within the universe, and as such, our interface with the surrounding universe is always selectively perspectival from a physical point of view. The energetic ambient array surrounding an active exploratory perceiving-behaving animal possesses structure, with various patterns, involving both invariants and transformations. Based on perceptual system resonance to these invariants and transformations, the perceived environment possesses qualities of both relative stability and relative change. Indeed, based on resonant sensitivity to invariants and transformations in the energetic array, we perceive the environment as an integrated and relatively stable holistic configuration with various embedded differentiations and transformations.

In line with a number of scientific theories on both consciousness and the brain-nervous system, we could argue that the embodied nervous system (inclusive of the

brain) engages in two fundamental and complementary processes: the system selectively integrates (identifies and extracts holistic relationships) and differentiates (selectively discriminates between different realities)—the system resonates to wholes and parts—and correspondingly, consciousness is an ongoing flow of integrated differentiated parts. This ongoing process, bio-neurologically and consciously, of integration and differentiation is grounded in those features of the structure of the ambient energetic array, both holistic and differentiated, that we are selectively sensitive to through our senses (or perceptual systems).

In summary, consciousness at the foundational level of perception-proprioception, directed behavior, and emotion and motivation, is grounded in a complex engagement, physiologically and psychologically, between the animal and the environment. This holistic and intricate ecological relationship is supported through a set of nested loops of interactivity both within the body and between the body and the environment. Although consciousness is experienced as relatively localized and anchored to the body, perceptual and behavioral consciousness are ecological events, enveloping the perceiver-behavior and environment. Consciousness is realized at the structured and dynamic energetic interface and interactive relationship between a localized perceiving-behaving animal and an ambient (surrounding and engulfing) environment. What emerges in consciousness is an integrated and differentiated, and selective and directional, engagement with and experience of physical reality.

### **The Issue of Conscious AI**

There is an extensive and long history in science fiction of stories dealing with intelligent and even conscious machines, including mechanical automata, robots, computers, computer networks, and even entire planetary ecosystems consisting of machines. Such stories often address the questions of how such conscious technologies could be created; how would such conscious technologies progressively evolve; and how would they interact with and impact humanity. Such speculations go back to ancient times. (See Lombardo, *The Evolution of Science Fiction*, Volume One).

Indeed machine consciousness, as envisioned in both science fiction and speculative science, has even been proposed as the primal cause of the entire universe; the creator of the experiential universe of conscious entities, such as humans (the *Matrix* scenario); or the evolutionary all-enveloping ultimate direction or asymptote of the physical cosmos. (See Lombardo, *The Odyssey of the Future* and *The Evolution of Science Fiction Webinar Series*.)

The plausibility of conscious machines has been defended, among others, by advocates of the computational functionalist theory of mind and consciousness. Mind and/or consciousness is simply seen as some complex configuration of information content and information processing, at this point in time having been realized in sufficiently advanced life forms and biological brains, but quite conceivably being a plausible development in the future evolution of artificial intelligence technologies. In such a model of consciousness, its realization is substrate independent; what matters is dynamic informational complexity. Although our brains are composed of (as the physical substrate of consciousness) carbon-based living cells, a silicon-based

electrical (or electro-chemical) circuitry could achieve a similar level (and even beyond) of informational complexity.

But there has been a long-standing and ongoing series of critiques that AI, computers, or robots can ever achieve consciousness, no matter how intelligent they may appear to become. Seth's argument, for example, is that computers/AI, as presently constructed, can never realize consciousness because such machines are not alive—there are distinctive differences between AI and living forms—and being alive, for Seth, is a necessary condition for consciousness. Seth proposes a number of key features of life, such as pervasive metabolic processes throughout all individual cells of a living body, which clearly appear not to be present in AI. There are numerous other critiques of the idea of machine/AI consciousness as well; for example, they merely mimic conscious processes rather than realize them (The Chinese Tea Room Thought Experiment of Searle).

As I argued, though, in an article dealing with this issue, we can not justifiably reject the possibility of machines realizing consciousness if we do not have a credible theory of how consciousness arises, or is supported within our physical universe (See Lombardo, 2012).

Still, throughout the preceding sections I have presented a number of proposals regarding the nature of consciousness and the physical conditions of consciousness that are relevant in considering the general question of whether machines/AI could realize consciousness. To highlight some basic points:

I proposed that consciousness, as it has manifested itself in nature on the earth, is grounded in perceptual cognizance of the surrounding environment, proprioceptual awareness of the body and its relationship to the environment, and the behavioral capacity, informed by perception and proprioception, to purposefully act upon that environment. All these conscious capacities are built upon the fundamental dimension of life to engage (interact) with its environment in order to survive, grow, and evolve. Consciousness is built upon informed interactive engagement with the environment. It is not at all clear to what, if any degree, AI/machine intelligence realizes any of these fundamental attributes of life and consciousness.

Following from the theory of autopoiesis and self-creative open systems, conscious life forms manifest the powers of creating and maintaining their distinctive existence through interaction with their surrounding environment. I would add that conscious life forms, as a general property manifested in all of life, demonstrate the capacities for growth and evolution as well. Assuming consciousness builds upon the capacities of life, then consciousness requires physical systems that are capable of purposeful self-creation and self-maintenance, as well as growth and evolution. Machine/AI systems do not seem to have the abilities to self-create, self-maintain, or evolve and grow themselves.

In my discussion on feeling, emotion, and desire I proposed that feeling was an essential feature of consciousness. Machine/AI systems demonstrate at least simulations of cognitive processes (such as memory and thinking), and the focus in developing AI has been on these dimensions of mentality. But do intelligent machines/AI demonstrate anything that is indicative of feelings, and moreover how would we go about bringing this dimension of consciousness into such mechanisms? Can AI have

emotions? Can AI have desires? Robots, though, have been designed which realistically mimic the facial expressions of varying emotions.

Using the terminology developed in this book, computers/AI have been purposefully evolved by humans. Although I do not believe that life was either purposefully created or evolved—relatedly I do not think the physical universe as a cosmic whole was purposefully created or evolved—purpose and purposeful evolution emerged as life realized a conscious dimension. Conscious humans purposefully evolve both themselves and their environment. As such, at least at this point in their development, AI/computers are passive with respect to their ongoing purposeful evolution in the cosmos. They do not purposefully evolve themselves; rather they are purposefully evolved by us. I acknowledge, though, that all of the above critical points can be debated.

Yet, as a caveat to this last point, humans in their evolution have manifested repeatedly enriching and ever more complex functional syntheses between their bio-psycho-social realities and invented technologies. We are evolving “cyborgs.” These functional integrations are, at least to some degree, being purposefully created and directed by our purposeful consciousness. We could plausibly state that such cyborg integrations (of our bio-selves and our instrumentalities) are holistically conscious. As a holistic integration of the biological and technological, we, as cyborgs, are conscious. We consciously perceive and consciously guide and manipulate the world *through* our tools and instruments.

Inspired by a line of thinking proposed by Arthur C. Clarke, perhaps we should view robots and AI as our evolutionary children. We are reproducing ourselves in a new more advanced form through our intelligent machines. Perhaps there will come a day when our technological children will realize consciousness within themselves (satisfying the above stated criteria for consciousness). But at the moment, at the very least, our technological children are highly dependent upon us in important key respects.

### **Conclusion on the Physical Conditions of Consciousness and the Relationship between Consciousness and Physicality**

In presenting in the above sections a number of proposals regarding the physical conditions of consciousness I have highlighted a number of key evolutionary developments in the physical evolution of the universe that plausibly can be seen as necessary physical conditions for the emergence of consciousness. Instead of assuming that consciousness is a primordial feature or reality in the cosmos, I have offered a series of key evolved features of the physical universe that are essential for the emergence of consciousness and which help to articulate and explain key features of consciousness. Consciousness evolved, and its evolution is illuminated through looking at the evolution of the physical universe in which consciousness is embedded. It's important to note that this physical “explanation” goes way beyond, although it includes, attributes and processes of a physical brain and nervous system. In general, the physical explanation offered is cosmic and ecological, subsuming the biological and neurological.

Yet, this physical explanation does not entail a purely materialist theory of consciousness. First, to note, I propose that the above physical conditions are

necessary, rather than sufficient. (I clearly acknowledge that there may be more physical conditions to consciousness that I have missed, and all these proposed physical conditions are contingent hypotheses, open to revision.) A physical “explanation” of consciousness may not be a complete explanation of consciousness, although in my mind it is an essential (necessary) part of the big picture.

Second, as I stated earlier, and inspired by the thinking of Nagel, although consciousness may be intimately connected with the structure and dynamics of the physical cosmos, our apprehension and understanding of this physical universe is through the medium of consciousness. Consciousness and the physical universe (as we understand it) form a reciprocal loop. How are we to couple and integrate these two perspectives on reality, without reducing one to the other? As I continue to explain my ecological-evolutionary theory of consciousness in sections to follow, I continue to explore this basic question from a variety of different perspectives.