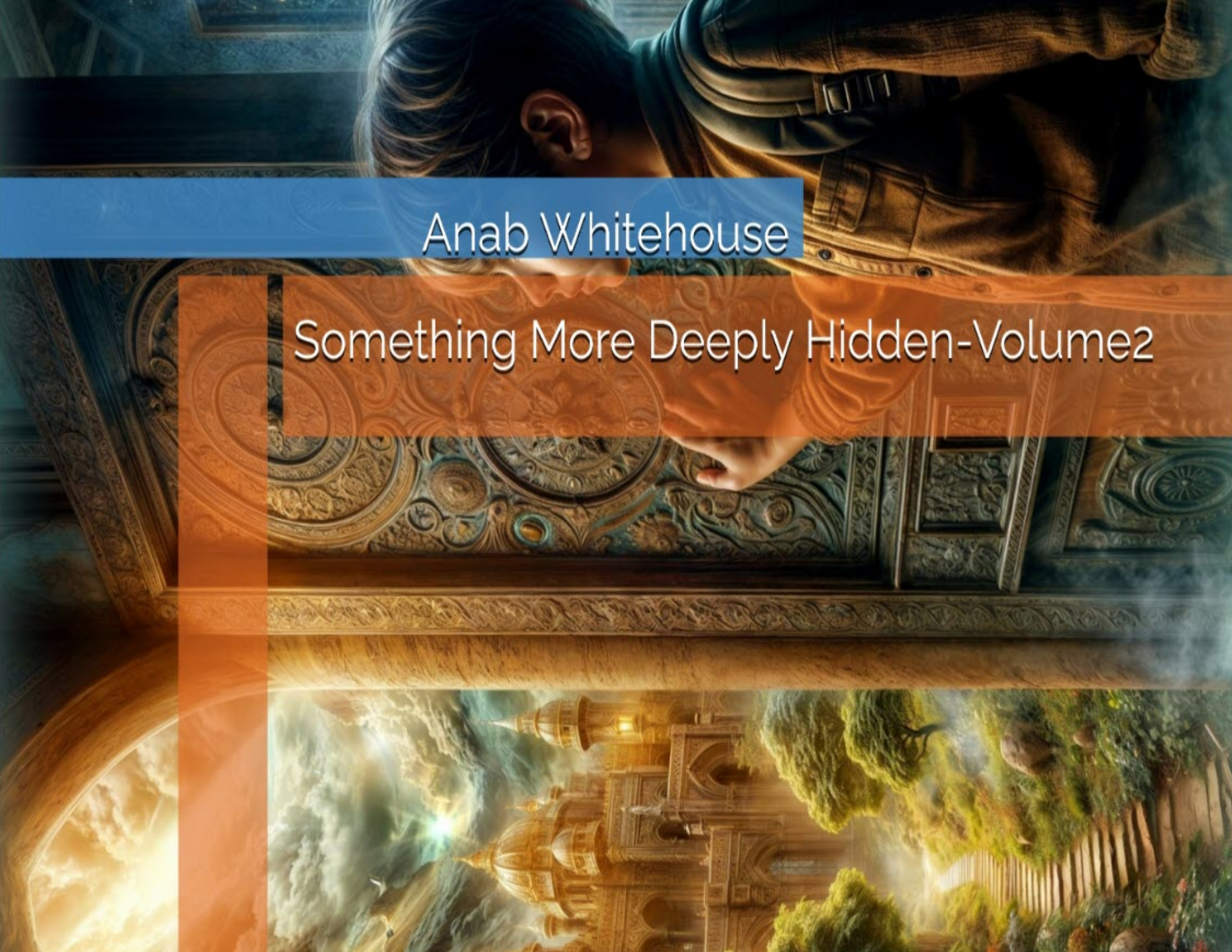
Anab Whitehouse
Something More Deeply Hidden-Volume2

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Interrogative Imperative Institute

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This book is **dedicated** to: Sabrina Dawn Wallace, her two young daughters, her husband, as well as her caretaker or care-giver. I have learned a great deal from Sabrina, and I not only greatly admire her phoenix-rising-from-the-ashes-like resiliency with respect to the many difficulties and challenges which have interdicted her life path over the years (and this admiration is constrained only by the limits of my understanding concerning the details of her existential journey), but I also have tremendous respect for her rigorous and compassionate dedication to the project she initiated a number of years ago which is attempting to induce people to seek to take control of their lives, beginning with learning about their own bodies -- especially their biofields.

There could be any number of the observations or comments that are given expression in the following pages with which Sabrina might take exception. However, I am quite confident in her ability – if she chooses to exercise it -- to clearly state what she considers to be problematic with anything that might be said in the ensuing set of conceptual exercises, and I also am confident in her willingness to acknowledge that whatever she might be saying is her considered opinion which could be incorrect – and, notwithstanding such a possibility, her perspectives are always well-considered and, at least from my perspective, frequently (bordering on invariably) correct. Furthermore, whatever she might have to offer in the way of point-counterpoint emerges out of a context that is rooted in the hope that the communication which takes place will give expression to an adult conversation through which people exchange ideas in an "I-Thou"-like interaction.

Thank you, Sabrina, for your support, encouragement, and willingness to share your understanding concerning an array of extremely important topics that are relevant to the essential lives of people. Along with thousands of other individuals, I am indebted to you.

Sorry for being so slow on the uptake. Nonetheless, the wine does seem to be improving with age – although this assessment might have more to do with the impact of the wine on my sensibilities rather than

having anything to do with the quality of my understanding improving with the passage of time.

Table of Contents – Volume 2

Introduction (same as in Volume 1) – 9

Chapter 14: Three Contributions – 23

Chapter 15: Energetic Potentials – 71

Chapter 16: Epigenetic Algorithms -- 99

Chapter 17: Endosome Linguistics – 135

Chapter 18: Bacterial Symbiosis – 151

Chapter 19: Cellular Theory – 181

Chapter 20: Transcending Cells – 211

Chapter 21: Developmental Dynamics – 235

Chapter 22: Chronobiological Considerations – 255

Chapter 23: Entangled Phenomena – 295

Chapter 24: Quantum Framing – 335

Chapter 25: Bohmian Perspectives – 373

Chapter 26: Field Manifestations –397

Chapter 27: Biodigital Convergence – 463

Bibliography – 499

Introduction

The title for the current work – namely, *Something More Deeply Hidden* – gives expression to a thought that occurred to me following my encounter with Sean Carroll's book: *Something Deeply Hidden: Quantum Worlds and the Emergence of Spacetime*. The aforementioned title for my own book bubbled to the surface of my consciousness in apparent response to the manner in which the title of Carroll's offering seemed somewhat perplexing to me as I went through the contents of his book.

Perhaps, the meaning of the phrase "something deeply hidden" is a way of alluding to the possibility that the true nature of quantum mechanics is something which tends to be deeply hidden from most people, even some of the quantum physicists themselves. Maybe this condition of quantum phenomena being a 'hidden something' is due to an unfortunate series of events that could be explored in a future volume by Lemony Snicket.

Alternatively, of course, a much more serious approach to addressing the ignorance which many people might have concerning the notion of quantum worlds would be to write a book that seeks to assist people to better understand quantum phenomena and, thereby, render that topic less deeply hidden from those who might possess little insight into such dynamics. Naturally, if one could show -- as Carroll tries to do in his book -- how "spacetime" emerges from quantum worlds, then, this would be an added bonus because there probably are as many individuals who consider the idea of "spacetime" to be a "something" which is as deeply hidden as the notion of quantum worlds appears to be.

"Spacetime" is a term that occupies a central position in Einstein's general theory of relativity. More colloquially, this latter theory gives expression to the mathematical framework Einstein employed to refine and modulate certain facets of Newton's work concerning gravity.

Surprisingly, one has to wait until page 310 of a 325 page book to discover that the title of Carroll's aforementioned book consists of words which Einstein once said. More specifically, Carroll relates a story told by Einstein about an experience the latter individual had as a young boy that describes his curiosity about, and mystification

concerning, the way in which the needle of a compass could be affected by unseen forces and Einstein had concluded: "Something deeply hidden had to be behind things."

What Einstein came to believe the nature of the "something deeply hidden" to be and what Carroll considers the "something deeply hidden" to be are really quite different from one another. Einstein never fully accepted certain facets of the quantum framework and always felt that the theory was an incomplete and inconsistent system of thought, whereas, contrary to Einstein, Carroll – based on the perspective put forth in his own book: *Something Deeply Hidden* -- clearly believes there is a way of making quantum mechanics both consistent and complete, and this 'something' has to do with his understanding of quantum worlds or the many worlds interpretation of quantum mechanics.

The reader will have to wait until Chapter 24 (Quantum Framing) to be introduced to a more extended discussion concerning some of the issues, problems, and questions that arise in conjunction with quantum phenomena -- including Carroll's "many-worlds" approach to those phenomena. For now, however, some contextual background will be provided that might help orient readers with respect to the nature of the disagreement which Einstein had with those individuals who became card-carrying members of the quantum physics club, and, in the process, this will begin to move readers toward discovering why the present book is entitled: *Something <u>More</u> Deeply Hidden*.

Let's begin with the 5th and 6th Solvay Conferences that were held in Brussels in 1927 and 1930 respectively. Although many talks, presentations, and discussions took place during those two gatherings, the dynamics which I would like to focus on, to some degree, have to do with the interactions between Niels Bohr and Albert Einstein concerning their discussions about the nature and foundations of physics.

Although Einstein was part of the planning committee for arranging speakers to address the participants of the 5th Solvay Conference, the purpose of those meetings was to explore various issues and questions concerning quantum mechanics. Consequently, despite the fact that Einstein had been invited to give a presentation during the conference, he declined to do so because, on the one hand,

he didn't feel sufficiently well-versed in the developments which had been taking, place in quantum research to make a meaningful contribution to the subject, and, perhaps, more relevantly with respect to present purposes, he didn't agree with the statistical perspective that constituted an important part of the foundations of quantum mechanics.

Einstein was more interested in the dimensions of reality which made the probabilities of quantum phenomena possible than he was in learning how to use mathematical techniques to calculate what events or properties were most likely to occur under certain physical conditions. Nonetheless, Niels Bohr, another attendee of the 1927 Solvay Conference, had a different approach to the scope and nature of physics – an approach which challenged Einstein's belief that: (a) there existed an objective reality which was quite independent of human conceptual activity, and (b) if human beings were to have any hope of understanding the phenomena to which objective reality gave expression, then, human thinking would have to find ways of capturing the structural properties and dynamics of physical events -- for example, through the mathematical techniques and methodology of physics.

In contradistinction to the foregoing possibilities, Bohr maintained that the phenomenon of wave-particle duality was an inherent aspect of reality which resisted attempts to uncover some fundamental, objective world which existed independently of human activities. Furthermore, according to him, quantum phenomena could only be properly understood through the lenses of complementarity.

Complementarity encompassed the idea that certain properties that were related to one another – such as momentum and position or time and energy – could not be simultaneously measured. In other words, the more accurately one might be able to measure one aspect of a given set of properties that were linked through the dynamics of complementarity -- say, momentum and position -- then, the fuzzier or less precise would one's measurement be with respect to the other component of that dynamic, and in the case of the property of position the other facet of this kind of complementarity would be momentum.

For Bohr, Heisenberg's "Uncertainty Principle" was not just a statement about methodological limits concerning the simultaneous

measurement of certain complementary properties. That principle was a reflection of the way reality inherently manifested itself.

According to classical physics (i.e., physics prior to the emergence of quantum mechanics), the process of observing nature did not alter the way in which nature took place. That which is observed is something which is separate from the process of observation, and, of course, the task of the latter process was to find ways of capturing or identifying the actual character of that which was being observed.

Bohr rejected the foregoing perspective. He believed that one could not separate observer and observed.

As a result, according to Bohr, reality had no intrinsic existence independent of observation. Consequently, a particle – whether it is a photon, electron, or some other kind of quantum entity – does not exist until a measurement takes place.

In other words, Bohr maintained that unobserved quantum particles do not exist. Such particles only come into existence through the dynamics of measurement, and, therefore, outside of the parameters of such a process, the notion of particles having an existence which was independent of the measurement process was meaningless.

As indicated previously, Einstein maintained that objects had an existence which was independent of human activity, scientific or otherwise. He believed that the challenge with which science was confronted was to discover the nature of that which had an existence independent of human beings.

In contrast, Bohr held that the task of science was not to become caught up in narratives about the nature of objects that were not being observed. Instead, he proposed that science was only about the process of making measurements and using such measurements to describe the physical phenomena which were manifest in observation.

The term: “Copenhagen interpretation,” was never used by Bohr as a way of categorizing his approach to science. Nonetheless, this is the term that has come to be identified with Bohr’s perspective concerning quantum physics.

From Bohr’s point of view – as well as those individuals, such as Heisenberg, who concurred with that way of thinking -- quantum

phenomena were about potentials rather than actualities. Observation or measurement was the way in which one turned potentials in to realities.

No one who adopted the Copenhagen interpretative approach to engaging quantum physics – and, in time, that approach became the dominant position within the community of quantum physicists – was ever able to account for the nature of the transitional process which turned potentials into actualities through the process of measurement. Consequently, quantum phenomena operated in a way that could not be reconciled with the world of classical objects of everyday life – such as human beings, scientific instrumentation, and the like – which seemed to have an on-going sort of permanence or reality, and while there have been many attempts to do so (such as Sean Carroll's book: *Something Deeply Hidden*), no one has ever solved -- to everyone's satisfaction -- the problem of how to account for the way in which quantum potentials were able to turn into the sorts of classical realities which seem to constitute our everyday world.

Bohr and those who agreed with him considered quantum theory to be a complete and consistent scientific position. Einstein felt that quantum theory was neither consistent nor complete.

For example, as noted in passing during an earlier portion of this introduction, one of the questions which always has haunted the shadowy corridors of quantum physics has to do with the issue of what, exactly, is a quantum potential, and how does it transition into a measurable something in conjunction with the process of observation. Einstein believed that the only way of resolving such a problem would be to argue for the existence of what came to be known as "hidden variables" – that is, objective realities which were present – although currently unseen -- and which gave rise to phenomena that were being described by means of Max Born's probabilistic reworking of, or re-interpreting of, Schrödinger's equation.

Apparently, according to Bohr and those who agreed with him, observable reality emerged from quantum potentials sort of like Athena allegedly came into existence fully formed from the skull of Zeus. Einstein contended that such a position entailed inconsistencies with respect to the dynamics of how quantum potentials became part of the world of observables, and he further argued that the key to

removing those sorts of inconsistencies could be found in the realm of hidden variables which were anathema to Bohr' ecclesiastical school of quantum thinking.

Bohr considered quantum mechanics to be as complete a system of physical description as one could achieve. However, though complete, he acknowledged that such descriptions were constrained by the way in which Heisenberg's Uncertainty Principle limited what could be measured at any given moment.

At various junctures during the Solvay Conferences of 1927 and 1930, Bohr and Einstein engaged in a series of discussions concerning the foundations of physics. Many of those discussions revolved about various thought experiments which Einstein proposed to Bohr as demonstrations indicating – possibly -- that quantum theory was inconsistent or incomplete in some way.

After each thought experiment was outlined, Bohr would point out some feature of the experiment that was problematic and which, consequently, vitiated the thought experiment's value as a possible counter to Bohr's approach to quantum physics. After his various attempts to throw a conceptual monkey wrench into Bohr's perspective were frustrated or blocked in one way or another, Einstein would retreat to his conference living quarters and begin to develop a new kind of thought experiment which would be presented to Bohr during their next session, only, subsequently, to be met with further objections by Bohr concerning some sort of faulty logic inherent in the new thought experiment which Einstein had assembled.

When people examine the details concerning the point-counterpoint of the Einstein-Bohr discussions during the two Solvay Conferences that took place in 1927 and 1930, most of those individuals tend to feel that Bohr came out on top of such interchanges. Nonetheless, pointing out the weaknesses in someone else's thought experiments is not necessarily the same thing as demonstrating that one's own position is unassailable.

Quantum physics gives expression to a powerful system of very precise descriptions – indeed, extending out to many decimal places of accuracy. Nevertheless, the questions to which Einstein was trying to allude through his thought experiments remain – namely, how do quantum potentials or possibilities transition into actual observable

dynamics with determinate properties, and how do probabilities suddenly turn into precise, determinate outcomes upon measurement?

In 1932, John von Neumann wrote a book – later translated into English (1955) -- with the title: *Mathematical Foundations of Quantum Mechanics* – and, among other things, the book addressed the issue of hidden variable theories. In this respect, the author put forth a theorem which supposedly indicated that the hidden variable issue was beset with certain problems which made them very difficult, if not impossible, to construct in any sort of defensible manner.

However, in putting forth the aforementioned theorem, von Neumann had made a problematic assumption with respect to his claim that hidden variable theories were inherently incapable of developing a system of quantum mechanics which was fully capable of generating the sorts of predictions that made quantum mechanics so powerful and accurate. In other words, if one put aside von Neumann's questionable assumption concerning what hidden variable theories had to be like, then, there might still be some conceptual or theoretical wiggle room that remained within which certain possibilities involving the notion of hidden variables might exist.

In effect, what von Neumann had done was to put forth an argument about why a particular kind of hidden variable theoretical structure could not possibly work. However, if one could come up with some other edition of hidden variable theory that which did not fall under the umbrella of the assumption which von Neumann was making about what hidden variable theories involved, then, although certain kinds of hidden variable theories might have been ruled out by von Neumann's work, nonetheless, the possibility still existed that there might be other kinds of hidden variable theories that were not covered by von Neumann's assumption concerning hidden variable theories, and, indeed, eventually, both Louis de Broglie and David Bohm did come up with a theory of hidden variables in quantum mechanics that could not be subsumed under the assumption which von Neumann had made about how hidden variable theories were structured.

The foregoing mistake or error was first pointed out by a German mathematician and philosopher by the name of Grete Hermann (1901

– 1984). Although written material by, and data on, Grete Hermann's ideas and life are, somewhat, difficult to find, nonetheless, a thesis by Giulia Paparo which had been written for the latter's master's degree in compliance with the requirements of Utrecht University, provides a great deal of insight concerning the life, times, and perspective of Grete Hermann.

The foregoing master's thesis introduces the reader to some of Grete Hermann's thoughts on: Quantum mechanics, science, philosophy, mathematics, education, ethics, history, and politics. Although some of that material will be revisited in the ensuing first chapter of the present book, for the time being, focus will be directed toward trying to summarize certain, limited aspects of Hermann's position on the relationship between hidden variable theory and quantum mechanics.

To begin with, as Giulia Paparo points out in a footnote on the very first page of her thesis, neither she, nor Grete Hermann, is making any claim that von Neumann had committed an irredeemable error which invalidated all of his thinking with respect to hidden variable theories. Rather, the mistake to which the attention of a reader is being drawn is that von Neumann was not justified in considering his treatment of hidden variable theory to be an exhaustive characterization of such theories, and, consequently, although what he did show was valid, nonetheless, what he claimed concerning hidden variable theories was not necessarily universally true, and, therefore, one had to place certain constraints on the applicability of his argument in relation to other possible kinds or forms of hidden variable theory.

Throughout her thesis, Paparo also clearly indicates that the mistake which had been identified by Grete Hermann in the work of von Neumann's mathematical systemization of quantum dynamics, the identified mistake did not appear to be considered by Hermann to be all that significant. For example, Grete Hermann believed that von Neumann had mathematically shown quantum mechanics to be a complete and consistent theoretical framework and, consequently, for all practical purposes – and irrespective of the mistake von Neumann had made with respect to his assumption concerning the structural nature of hidden variable theories – Hermann believed that there was

nothing of any substantial nature that was likely to challenge the idea that quantum theory was complete and consistent.

Grete Hermann's primary concern was to demonstrate that quantum mechanics could be reconciled with Kantian philosophy as developed by Jacob Fries and Leonard Nelson. Nelson was a mentor, of sorts, for Hermann, as Fries had been a mentor of Nelson, and all three of those individuals sought to operate out of a form of Kantian philosophy that was modified in various ways by Fries, Nelson, and Hermann.

Hermann was interested in, among things, preserving the fundamental role of a priori influences with respect to quantum mechanics. In addition, she wanted to show that the notion of causality was still present in quantum dynamics.

As intimated previously there will be a few critical reflections which will be offered in Chapter 1 of the present book concerning both the aforementioned issue of a priori judgments as well as the topic of causality. However, noting that notwithstanding the mistake my von Neumann which had been uncovered, nevertheless, for now, it is sufficient to point out that Hermann didn't seem to believe that hidden variable theories constituted any sort of challenge to claims of completeness involving quantum mechanics as mathematically presented by von Neumann will be sufficient.

Grete Hermann felt that von Neumann's assumption concerning hidden variable theories was somewhat circular in nature – that, in a sense, he was assuming his conclusions. Paparo also points out in her thesis that some thirty years later and, apparently, without any awareness of what Grete Hermann had discovered three decades earlier, John Stewart Bell (he of Bell's inequality and the issue of entanglement fame), noted the same sort of problem in von Neumann's treatment of hidden variables as Grete Hermann had done, but he referred to the nature of the mistaken assumption as being arbitrary in character and, therefore, unjustified.

Unlike Hermann, Bell maintained – and Paparo gives emphasis to this difference -- that the mistake made by von Neumann opened the door to the possibility of developing various kinds of hidden variable theories that would not be covered by the arbitrary assumption von Neumann had made concerning the alleged structural nature of hidden

variable theories. Conceivably, there was something more deeply hidden than von Neumann and others who accepted his perspective might have believed to be possible.

Although, as previously indicated, a more developed discussion concerning some of the issues related to quantum mechanics will have to wait for a later chapter, the following consideration will have to suffice for the moment. More specifically, the wave function is about probabilities, and Schrödinger's wave equation is used to work out quantitative identities which are related to those probabilities, and, yet, all too few individuals seem to grasp the tremendous disconnect that appears to divide, on the one hand, the probabilities of allegedly superpositional potentials from, on the other hand, the precise values that emerge through the collapse or decoherence of the probability distributions that are used to describe quantum dynamics. Even Schrödinger, who won a Nobel Prize for the foregoing wave equation was quite dissatisfied with the probabilistic interpretation of his mathematical treatment that had been proposed by Max Born.

Schrödinger believed that his equation was dealing with objective realities and not probabilities. He believed that those probabilities were a function of some more fundamental dimension of reality, and, yet, the only way that his equations actually appeared to generate useful results is if his equation were treated as if it were alluding to probabilities that collapsed into determinate results (i.e., underwent decoherence) through measurement or observation.

Apparently, Schrödinger – notwithstanding his Nobel Prize -- didn't understand what he had accomplished with his wave equation. He needed someone else – namely, Max Born – to show him what could be done with the equation as long as one didn't ask too many questions about the nature of the relationship between the equation and reality.

No one could provide any plausible answers concerning the actual dynamics of decoherence. No one could explain how potentials turned into actualities. No one could explain how probabilities turned into determinate outcomes through the process of measurement.

There seemed – according to Schrödinger (and Einstein) -- to be something more deeply hidden beneath the surface of probabilities.

Yet, under the philosophical influence of Bohr, Heisenberg, Pauli and others, no one was permitted to talk about those possibilities.

Einstein tried to talk about such issues during several of the Solvay Conferences, but he was stalled by Bohr's counter-arguments – arguments which were capable of casting doubt upon the viability of the thought experiments that Einstein had brought forth, but arguments which did not necessarily demonstrate that hidden variable theories couldn't be developed that might be viable. Von Neumann claimed he had demonstrated that all forms of hidden variables theory could be discounted, and, yet, even though Grete Hermann and John Stewart Bell had pointed out that von Neumann was mistaken in the assumption he had made about the structural nature of hidden variable theories, nevertheless, despite being unfamiliar with either the work of Hermann or Bell, most quantum physicists assume that the issue of hidden variable theory is settled science, and this was not, and is not, the case.

In some ways, there has been a sort of Overton window imposed on the issue of quantum mechanics. In other words, seemingly, constraints -- both official and unofficial -- are often placed on how one should engage and speak about the phenomena that are being described through quantum mechanics.

Those constraints come in the form of: Career opportunities, post-doctoral fellowships, jobs, book deals, speaking invitations, symposium offers, teaching positions, grant money, media accessibility, and journal publications. People (both within the general area of quantum mechanics as well as those who go about life outside of that field) are induced to believe that there is academic freedom as well as an absence of censorship with respect to research concerning quantum mechanics, but individuals -- all of whom are physicists -- such as David Bohm (*The Implicate Order*), (F. David Peat (*Infinite Potential*), Sabine Hossenfelder (*Lost in Math*), Alexander Unsicker (*The Higgs Fake*), Lee Smolin (*The Trouble With Physics*), and Peter Woit (*Not Even Wrong*) –– tend to paint a very different picture of what has transpired, and continues, to transpire, in certain areas of research connected to, among other topics, quantum physics.

Although the following incident is only anecdotal, it is consistent with the perspective that is given expression through the

aforementioned works. More specifically, approximately, 45 years ago, I had a conversation with a doctoral student in physics at a local but world-class university. She indicated that there was a cult-like atmosphere within her department, and unless one toed the party line with respect to how the professors in the department believed that physics should be done or what they considered were legitimate areas of research, one would be unlikely to secure one's doctorate.

The foregoing books and the one anecdotal incident noted above indicate that to varying degrees, an Overton-like window has been in effect in relation to quantum physics for nearly 100 years (starting, arbitrarily, with the Solvay Conference of 1927). One might even refer to the problem being alluded to in the last several paragraphs as a species of Orwellian Newspeak in which certain ideas and words tend to be banished from conversation to such an extent that those ideas and words begin to disappear from the minds of people, and, as a result, those individuals might no longer be capable of critically thinking about the subject in any way that touches upon those ideas or words.

The foregoing pages of critical reflection have not been undertaken with the idea of proving that some particular account of hidden variables is true. Rather, the intent has been to take the reader through a set of concrete contexts that disclose how there is often an array of considerations (some well considered and others less so) surrounding the notion that there might be something more deeply hidden than the theories that we use are willing to acknowledge – something more deeply hidden for which not inconsequential evidence can often be offered which indicates that references to something more deeply hidden should not automatically be dismissed without critically reflecting on a variety of issues which are relevant to such an issue.

During the course of this book, there will be nearly thirty chapters which explore different kinds of problems and dynamics indicating that our world -- does indeed -- seem to be governed by something more deeply hidden than many of our theories are willing to acknowledge. As such, the material in this book is offered as food for thought and, as well, presented with the belief that inducing people to engage in critical reflection concerning an array of issues and

problems is a constructive, heuristic process and should not be pre-judged as a waste of their time.

Perhaps, if a reader sticks with the book until the end, a line from the Jakob Dylan song, *One Headlight*, might be applicable. “Man, I ain’t changed, but I know I ain’t the same.” Or, maybe, an earlier line from that same song will describe what could transpire: “I turn the engine, but the engine doesn’t turn.” Obviously, my preference would be that the former line is more descriptive of your reading experience than the latter one might be.

Chapter 14: Three Contributions

Antoine Béchamp passed away on April 15th, 1908. However, research into the pleomorphic perspective -- for which, as was pointed out in an earlier chapter, he was an advocate -- did not stop with his death, and one might even argue that there is evidence to indicate that the notion of the germ theory of diseases was being questioned even before its formal inception by Pasteur. For instance, in 1860, nearly two decades before Pasteur proclaimed his monomorphic notion of germ theory, Florence Nightingale has been quoted as stating: "Is it not … a continual mistake to look upon diseases, as we now do, as separate entities, which must exist, like cats and dogs, instead of looking at them as conditions, like a dirty or clean condition …?" (Page 18, *The Persecution and Trial of Gaston Naessens* by Christopher Bird), or stated in an alternative fashion: 'as conditions like an unhealthy or healthy condition of terrain'.

Notwithstanding the foregoing sort of prescient insight, there were a variety of individuals who continued on with developing Béchamp's pleomorphic approach to microorganisms by generating concrete, empirical data in support of that position, and perhaps the most notable of those sorts of individuals – at least during the ensuing century following Béchamp -- were: Günther Enderlein, Royal Rife and Gaston Naessens. Royal Rife and Gaston Naessens are especially noteworthy in this regard because they each, independently of one another, developed advanced forms of microscopy which were not only capable of engaging events bordering on the nano-scale but which, unlike electron microscopes that study objects on such small scales as well, the microscopes of Rife and Naessens also were capable of enabling scientists to observe microorganisms while the latter were alive, whereas the process of electron microscopy kills whatever living organisms it seeks to observe due to the use of various kinds of enzymes, heavy metal dyes, as well as conditions of vacuum, directed energy bombardment, and heat – all of which are necessary for generating micrographs or images of whatever is being engaged via an electron microscope.

Not only, for the foregoing stated reasons, are electron microscopes incapable of observing living dynamics, but, in addition, there are problems of interpretation which emerge in conjunction

with that kind of technology. More specifically, one is not always able to determine whether, on the one hand,, what is being depicted in an electron micrograph (i.e., image) is a distorting or arbitrary artifact that has been created by an image-fixing process used in relation with such technology or whether, on the other hand, such images accurately reflect the structural properties of whatever is being engaged through such a microscope.

Notwithstanding the foregoing considerations concerning the issue of microscopy, Günther Enderlein did use a form of darkfield microscopy that while not nearly as powerful (in terms of near nano-scale potential) as the technology employed by Royal Rife and Gaston Naessens, nonetheless, such darkfield microscopy enabled Enderlein to observe the dynamics – and especially the transformations – that took place with respect to the pleomorphic nature of microorganisms. Normal light microscopes are unable to pick up on the foregoing sorts of transformative dynamics because, among other things, the lenses used in normal run-of-the-mill light microscopes are not quartz in nature, and, therefore, were unable to "see" objects that only become visible in the ultraviolet light range of frequency that is present with the use of special lenses made of quartz.

For nearly 60 years, Enderlein – who had expertise in microbiology, entomology, zoology, and medicine – conducted research and pursued practical, successful forms of therapy in accordance with the principles of pleomorphism. In other words, through microscopy, he empirically observed microorganisms transforming into different shapes, with different functional properties, and, then, on the basis of such studies he developed therapies that were actually capable of resolving or healing various forms of clinical pathology that were due to such transformations in microorganisms.

While Enderlein was born in 1872, he did not begin serious research into the topics that would occupy his time for nearly 60 years until the year 1914 which was 6 years after Béchamp had passed away. Although Enderlein had volunteered to serve as a bacteriologist at the start of World War I, instead, he was given a laboratory by the German government to pursue various medical issues, and, in addition, Enderlein put together a laboratory within his own place of residence,

and, as a result, Enderlein would often commute each day between the two labs in order to research different topics.

According to Pasteur, the blood of a healthy person is pristine or sterile. In other words, Pasteur maintained that there were no microorganisms in the blood of a healthy individual, but this was more of a conjecture based on what he could see with a normal, light microscope rather what could be seen through the more revealing process of darkfield microscopy.

As a result, Pasteur, along with many of his colleagues and later researchers, were allowing their physical and intellectual vision to be framed by a form of technology which was very limited in what it could show. Pasteur and others were looking but they couldn't really see what was taking place in the slides beneath their microscopes because their vision and understanding were being warped – that is, framed – by, among other considerations, the properties of the lenses that they used in microscopy.

On the basis of actual evidence using darkfield microscopy, Enderlein discovered the presence of tiny living entities in healthy blood samples that were capable of interacting with larger bacterial forms. However, when the foregoing sorts of dynamics took place, the resulting entity disappeared.

Using darkfield microscopy, Enderlein discovered that the foregoing interaction resulted in the formation of much smaller entities which disappeared from sight when using regular light microscopes. He referred to the new forms as "spermits", and these small life forms possessed flagella which enabled them to move about.

Along side of the foregoing discoveries, Enderlein observed, as well, several microorganisms of plant origin that also could be seen in the blood of healthy individuals. These were: Mucor racemosus Fresen and Aspergillus niger van Tieghem, and both were fungal in nature.

Enderlein referred to the two microorganisms, and a few others, as "endobionts" and noted that they were capable of exhibiting a variety of forms. However, apparently, he considered the Mucor entity to be somewhat more fundamental or primordial than the Aspergillus fungal microorganism.

He went on to develop a symbiotic notion of life forms – predating the work of Lynn Margolis and her theory of "endosymbiosis" concerning the origin of, among things, mitochondria -- in which organisms were not in competition with one another and were not necessarily always trying to destroy or consume one another, but, instead, were seeking to create a ecological terrain in which different organisms could have existential balance with each other. He introduced and developed these ideas concerning the symbiotic nature of life in one of his major works that was released around 1925 – namely, *Bacteria Cyclogeny.*

The term "cyclogeny" refers to the way in which microorganisms go through life cycles which start out in forms that cannot be seen with a light microscope – but can be seen through darkfield microscopy – and which, according to the health of the conditions of the terrain in which such entities exist – develop into various apathogenic or pathogenic forms of microorganisms. The pleomorphic stages of development of a microorganism are known as valences, and as a microorganism assumes forms and structures that tend to be more visible, the direction of pleomorphic development is said to be in the direction of higher valences.

According to Enderlein, the normal state of organisms is to exist in a state of balance both within, and in relation to, other such organisms. However, when through, for example, the introduction of various kinds of poisons or toxins into a given ecology, the foregoing sort of symbiotic balance is disturbed, then, disease or pathology of some kind will occur, and this comes about through the pleomorphic development of a microorganism into higher and higher valences.

The higher the valence of a developmental state of a given microorganism is, then, after reaching a certain threshold which demarcates apathogenic and pathogenic conditions, the more pathological is that condition of development. Moreover, as each higher, pathogenic form emerges, such forms are capable of releasing their own modalities of toxins and poisons which are capable of further destabilizing a given ecology or biological terrain and, thereby, exacerbate whatever toxins or poisons which were present and, initially, led to the departure from symbiotic balance and harmony in a given biological terrain.

Apathogenic forms of endobionts – such as spermits, chrondits, and fibrin (and the last entry has the highest form of, or valence for, apathogenic microorganism) – are considered by Enderlein to be essential for healthy forms of metabolism as well as various processes of biological defense and detoxification. These endobionts are assigned lower valence numbers relative to pathogenic forms of such microorganisms.

When conditions in an individual's biological terrain begin to change in an unhealthy direction (due, say, to the presence of toxins of some kind), then, pathogenic forms of bacteria and fungi (of higher valences) tend to emerge. Furthermore, if these conditions are left untreated or are treated inappropriately, then, more complicated illnesses, if not death, often result.

Beginning in 1955, Enderlein published a series of written works known as AKMON I – III. In that research he put forth his understanding concerning the nature of disease and how to treat it on the basis of his research into pleomorphic dynamics, starting with spermits or, as they also are called, "protits".

Like Béchamp before him, Enderlein maintained that the smallest unit of biological life was not the cell. Nonetheless, whereas Béchamp referred to the smallest units of life as microzymas, Enderlein argued that what he referred to as a colloid, which are of the order of .2 nanometers, were the fundamental unit of life.

A colloid is a mixture of microscopically small, insoluble entities that are suspended in some other kind of substance. According to Enderlein, the small entities that are suspended in another substance are the previously mentioned spermits or protits. Whether the spermits/protits of Enderlein are the same as the microzymas of Béchamp is uncertain.

One might note in passing that there is a certain amount of resonance between Enderlein's empirically-based ideas concerning protits or spermits and the notion of nano-protoplasm units that were explored in the chapter on Gilbert Ling. In both cases, one is referring to something which is more basic than, but fundamental to, the functioning of cells.

According to Enderlein, the life cycle of endobionts runs from: A colloidal state (protits or spermits), to: Chondrit, fibrin, bacteria, fungus, death of the organism, and a return to the fundamental form of endobiont. As will be evident later in this chapter, Enderlein was developing a life cycle for endobionts, just as Naessens did for somatids.

Enderlein maintained that protits, spermits, chondrits, and fibrin were apathogenic in nature. In other words, they played fundamental roles in symbiotic processes within an organism.

Pathogenic conditions arose when pleiomorphic changes of certain kinds arose. These involved various kinds of bacteria and fungi.

At one point during his research, Enderlein asserted that "Medicine knows a lot about disease but nothing about life." The reason he made such a claim is because he felt that medical practitioners were largely ignorant of endobionts and there modes of pleomorphic development, and, therefore, medical practitioners had little, or no, understanding concerning the value of endobionts with lower valences or the dynamics concerning the rise of pleomorphic forms of endobionts that had higher valences and, therefore, gave expression to, pathogenic properties.

According to Enderlein – and in opposition to modern microbiology – he believed that all bacteria have either a nucleus or a nucleic equivalent. On the other hand, modern microbiology maintains that bacteria have neither a well-define nucleus nor do any of the organelles that are contained with a given form of bacteria have well-defined membrane walls.

He claimed that bacteria are capable of reproducing either sexually or asexually. In 1946, Joshua Lederberg and Edward Tatum demonstrated – and subsequently won a Nobel Prize for their efforts -- that in addition to asexual forms of reproduction, bacteria also could reproduce through a process that is very similar to sexual reproduction, and, thereby, tended to confirm Enderlein's earlier claim in this regard.

Summing up, Enderlein empirically confirmed Béchamp's contention that, contrary to Pasteur's position – the blood of healthy people was not sterile but contained microorganisms. In addition,

Enderlein brought forth considerable additional evidence to indicate that pleomorphism (i.e., the idea that microorganisms can change their morphological forms as well as exhibit different functional properties depending on the condition of the surrounding biological terrain), rather than monomorphism (Pasteur's theory that microorganisms were not capable of changing their morphological forms) governed the life cycles of microorganisms.

Together with Béchamp, Enderlein believed that the cell was not the smallest unit of life. Enderlein used the term colloids to refer to the suspension of spermits in different substances as giving expression to the most primitive form of life, whereas Béchamp talked in terms of microzymas as being the most primitive form of life, and, as noted previously, whether the two terms (protits/spermits and microzymas) are equivalent to one another is not known. Furthermore, with Béchamp, Enderlein argued that disease of any kind was due to disturbances within the terrain that led to the formation of pathological forms of microorganisms and, therefore, was not due to the invasion of a given biological terrain by some form of externally attacking infectious microorganism.

Both Béchamp and Enderlein held that lower valence microorganisms do not attack healthy biological terrain or tissue. Instead, they believed that when the condition of a given instance of biological terrain deteriorates (due, say, to a poor diet, or the presence of synthetic drugs and medicines, or the impact of continued stress, or as a result of the effect of various kinds of environmental toxins), microorganisms are induced by such a deteriorating terrain to enter into higher valence forms of their cycle which are non-symbiotic and, therefore, pathogenic in nature. Consequently, both Béchamp and Enderlein agreed with the earlier pronouncement of the French physiologist, Claude Bernard, which stipulated that the milieu or terrain is everything and the microorganism is nothing.

The foregoing statement by Bernard supposedly (perhaps, apocryphally??) was alluded to by Pasteur on the latter's death bed. Allegedly, Pasteur said: 'Claude was right. The terrain is everything and the germ is nothing.'

One might note in closing this section of the present chapter, that Günther Enderlein is credited with curing many people throughout his

years of medical practice. His approach to medicine is referred to as Sanum Therapy, and it is predicated on: (1) Knowing the nature of the pleomorphic life cycle of the primordial unit of life that, under the "right" circumstances, can be induced to develop in different problematic directions according to the pathological condition of a given individual's biological terrain; (b) knowing what treatments are indicated at each stage of pathogenic development in a given microorganism which takes place during the cyclogeny or cycle of the primordial form of life so that a human being can be returned to a state of symbiotic balance or harmony in which only apathogenic endobionts are active and which constitutes nothing other than a condition of health or well-being.

There are many facets of the Royal Rife story which could be told, ranging from his deep desire to identify the cause of cancer as well as his dedication to establishing a form of treatment that would cure cancer once its cause was identified (efforts which began in the late 1920's and early 1930's and which he successfully demonstrated in 1934 – more on this shortly). Or, one could explore the way in which the head of the American Medical Association (Morris Fishbein) sought to acquire a financial interest in Rife's discoveries.

When the foregoing proposal from the head of the AMA was turned down, the latter individual directed the full power of the AMA toward ruining Rife as well as completely suppressed all knowledge about Rife's inventions. As part of the aforementioned multifaceted attack, an engineer, who worked for Rife, was induced to betray the inventor and claim that the revolutionary optical device that was being used to make fundamental discoveries, as well the frequency treatment technology that had been developed by Rife for the purpose of curing cancer and which was complementary to the foregoing breakthrough in microscopy were the result of the engineer's own work and not that of Rife.

Alternatively, in telling the story of Royal Rife, one might examine the way in which Rife introduced improvement after improvement to both what came to be known as a 'Universal' microscope as well as the frequency mechanism that he used to cure cancer during the aforementioned period of decade-long attacks by the AMA. Finally, in

recounting events in Rife's life, one might investigate the way in which, little by little, Rife's nerves began to become frayed as a result of the vicious legal and institutional attacks that were being leveled against him by the American Medical Association, and, eventually, he broke psychologically under the constant strain. Unfortunately, the only coping mechanism that Rife could find which was capable of quieting his nerves (at least in the beginning) was through the consumption of alcohol and, in time, this led to years of substance abuse and some degree of institutionalization.

In the end the judge who was trying the Rife case indicated that the engineer who had betrayed Rife had not adequately demonstrated that the invention of the 'Universal microscope' or the frequency treatment device were the result of the engineer's work rather than that of Rife. However, the damage already had been done, and, notwithstanding a legal verdict in his favor, Rife's professional reputation had been torn to shreds and, as a result of the concerted efforts of the American Medical Association, the scientific and medical world had been induced – without actually objectively engaging the issues -- to ignore, reject, or distrust Rife's inventions and his work.

Let's begin with a simple overview of an essential issue. In 1934, a group of prominent bacteriologists and medical doctors conducted a cancer clinic at the University of Southern California. The work at the clinic demonstrated three things.

First, cancer was the result of the presence of a microorganism that could be observed using Rife's microscope. Rife labeled the different forms of the microorganism as BX or BY depending on whether a given instance of cancer involved, respectively, a melanoma or a sarcoma.

Secondly, Rife had developed a form of frequency treatment which was capable of eradicating such microorganisms in a manner that was painless to human beings. The eradication process took just a short period of time.

Thirdly, the 1934 cancer clinic showed that the effects of cancer could be reversed. People who, previously, had been considered to be terminally ill with some form of cancer (and other serious forms of illness as well) were able to be restored to complete health.

For reasons that, shortly, will be indicated, the American Medical Association soon began to suppress the attempts of anyone who tried to inform people – professionals and potential patients alike -- about the discoveries and treatments entailed by the 1934 University of Southern California cancer clinic results. In addition (and rather inexplicably, unless one were to presume that the motivations for doing so had nothing to do with science, truth, or the well being of ill patients) the American Medical Association, along with like-minded confederates, not only refused to put Rife's discoveries, instruments, and treatments to any sort of objective study, but, as well, those individuals conspired to bring different kinds of pressure on doctors to discontinue pursuing the Rife approach to certain kinds of ill-health.

Millions of people die every year from cancer. Billions of dollars have been spent searching for variations on the cut (surgery), burn (radiation), and poison (chemotherapy) approach to cancer treatment that has become the so-called standard of care in medicine.

Yet, the American Medical Association in its infinite wisdom decided that it had the right – nay, the duty – to make sure that no one should be able to teach about, engage in research on, or publish material concerning the Rife microscope, his frequency-based treatment device, or the successful results that had been achieved through the Rife approach to cancer. The deaths which give expression to the colossal, tragic collateral damage which have ensued as a result of the foregoing sort of hubris, jealousy, greed, ignorance, and a desire to have complete control all of medicine and science cannot really be considered to constitute an example of iatrogenic death but would appear to better represent a clear cut case of murder, theft of taxpayer money, and defrauding of the public by many members of the medical establishment.

Royal Rife was not the only individual who became a victim of the arbitrary wrath and Machiavellian tactics of the head of the American Medical Association. For a little more than 25 years (from 1925 to the 1949 when he was ousted at a convention in Atlantic City), Morris Fishbein ruled the AMA with an iron, inflexible, dictatorial vice-like grasp that forced everyone within his medical sphere of influence to bow down and worship his interests, beliefs, values, as well as his way of doing things, or they would suffer some rather nasty consequences

including: (a) The loss of their medical license; (b) the loss of research funds since, at the time, whether directly or indirectly, a lot of that funding came via the AMA., (c) the loss of access to being able to have research published in the pages of the Journal of the AMA; as well as (d) the loss of the opportunity to be hired to explore and reflect on such issues with aspiring medical students. Furthermore, whenever medical practitioners were able to develop successful treatments, Fishbein had established a sort of tithing system in which medical practitioners were forced to pay tribute to the AMA in the form of advertising revenues, and if a medical practitioner was unwilling to submit to such an arrangement, then, no one would be permitted to find out about whatever form of successful treatment had been developed.

One might hope that after Fishbein had been removed from his position as the head of the American Medical Association, the course of medicine might have changed direction in the United States. Unfortunately, this was not the case, but, rather, the process of medical research, the teaching of medicine, the publication of medical papers, and the practice of medicine merely took on new overlords – including the 1930 transformation of the Hygienic Laboratory into the government run National Institutes of Health that took a few years to become organized, but, eventually, began to determine who would get research funding, and, as a result, came to control what got taught, and what got published, and who got hired, and who got to keep their careers, and what role pharmaceutical companies would have in the world of medicine.

The foregoing was especially true in relation to the manner in which the National Institute of Allergy and Infectious Diseases, a sub-division of the National Institute of Health, was run from 1984 to 2022 under the self-serving leadership of Anthony Fauci. In effect, although there were certain differences, Fauci conducted business at the NIAID with much the same kind of dictatorial ambience as Morris Fishbein had run the American Medical Association, and as was true with respect to the legacy of Morris Fishbein, so too, the fruits of that form of iron-handed control affected – in many negative, extremely destructive ways the development of medicine in America (the HIV causes AIDS fiasco being just one such tragedy and the COVID-19

travesty being another) – since researchers, practitioners, and teachers had to abide by the tenets of a medical form of theology which determined what ideas would be funded, and what ideas would be published, and what ideas would be taught at medical schools, and what forms of medicine would be suppressed.

However, before Fauci came along, there were other individuals such as Cornelius P. Rhoads who, for the decade lasting through the 1930s, acquired a perspective that was shaped substantially by the sort of petroleum-based pharmaceutical medicine that was being instituted at, and evangelically spread by, the Rockefeller Institute. Beginning in 1940, and continuing on through 1959, Rhodes took the razzle-dazzle of his petroleum-based pharmaceutical show on the road when he became the head of the Sloan-Kettering Cancer Center in New York.

From 1943 to 1945 he also served as the director of the chemical warfare service. This served to provide him with deeper insight into the capacity of chemistry to modulate, damage, and kill living systems.

After the war, he championed the process of using chemotherapy as a primary form of cancer treatment. As a result under Rhodes guidance – if such a description is actually warranted – Sloan-Kettering became the premiere center in the United States for testing cancer drugs.

As noted previously, Cornelius Rhodes not only had been inculcated or indoctrinated with the Rockefeller theory of medicine prior to becoming head of the Sloan-Kettering Cancer Center, but after he assumed control of the Center, he established deep connections with the American Cancer Society which had been established in 1913 by John D. Rockefeller as a means of promoting, and pushing for the development of petroleum-based pharmaceuticals in the treatment of, among other things, cancer.

Rhodes often attacked – verbally and in other ways as well -- anyone who had different ideas concerning the cause or treatment of cancer than he did. For instance, in 1950, he suppressed the research of Dr. Irene Diller when the Sloan-Kettering director made arrangements to stop her from addressing the New York Academy of Science concerning the discovery of a cancer-related microorganism –

a discovery that resonated with the findings of Rife nearly 20 years previously.

The approach of Dr. Diller went contrary to Rhodes fundamental belief that cancer was in some way a cellular problem that was set in motion by mutational damage to some aspect of an individual's genome. As such, he maintained that cancerous cells needed to be destroyed through the use of chemotherapy – an idea that is inherently resistant to a perspective such as the one being put forth by Dr. Diller which indicated that a microorganism of some kind might be responsible for the emergence of cancerous tissue and, therefore, one had to address the issue of cancer through the specific activity of that microorganism instead of, indiscriminately – as Dr. Rhodes wished to do -- on a general cellular level.

The head of the Sloan-Kettering Cancer Center was up to the same sort of Machiavellian tricks in 1953 when Dr. Rhodes sought to undermine the work of Dr. Caspe who made a presentation in Rome involving the discovery of the same microorganism as Dr. Diller had sought to speak about three years earlier – a discovery that, once again, supported the work of Royal Rife several decades earlier. In retaliation, Rhodes arranged for the funding of Dr. Caspe's laboratory in New Jersey to be pulled, and, eventually forced the laboratory to shut down.

According to Barry Lynes who wrote the book: *The Cancer Cure That Worked!*, the Sloan-Kettering Cancer Center actually had run a series of tests in 1975 indicating that there was pleomorphic activity present in all of the blood samples of the cancer patients who were being tested. However, because the official position of the Sloan-Kettering Cancer Center had always been that the notion of pleomorphism was a myth and that the principle of monomorphism accurately reflected the nature of microbiological organisms,, officials at the Center buried the evidence of pleomorphism to which such tests had given expression.

Consequently, if one wished to become a non-entity within American medicine during the twenty's thirties, forties, fifties, sixties, and seventies all one had to do was disagree with people like Rhodes and Fishbein. Such ego-driven individuals had established an oppressive scientific and medical atmosphere that would continue on

for another sixty years through people like Anthony Fauci at NIAID, and like-minded medical theocrats at the Center for Disease Control (CDC) as well as the Food and Drug Agency (FDA).

Initially, allusions to Royal Rife showed up – somewhat indirectly -- in Fishbein's medical crosshairs when the director of the AMA came to find out about an extraordinary cancer cure in relation to an elderly, 82-year old man from Chicago where the headquarters for the AMA were located. When the latter individual left to seek out the Rife frequency treatment via the facility that had been set up by Dr. R.T. Hamer in southern California that was based on Rife's work, the man had various cancerous growths on his face.

The elderly man wanted to take one last lunge of hope concerning the possibility of grabbing some extra time from the brass ring of life. When the man returned home from his encounter with the Rife frequency treatment at the Hamer facility in California, all of the cancerous growths were gone from his face, and there was nothing more than a small black mark on his face. The man's appearance had gone from grotesque to normal within a fairly short period of time.

The old man was so overjoyed with the result of the Rife treatment that he couldn't stop talking about his cure when he returned home. Fishbein, who lived in the same city, came to find out about the case and set up a dinner engagement with the gentleman in order to wine and dine the elderly man with the hope of finding out what, if anything, that individual could reveal about the Rife treatment procedure,

At some point following the aforementioned dinner engagement, Fishbein sent an operative from Los Angeles to meet with practitioners from the aforementioned Hamer facility who were successfully using the Rife frequency treatment. The operative had been instructed to put forth a proposal concerning Fishbein's desire to acquire a financial interest in their business -- a proposal that was refused.

Up to that point in time, the Rife frequency treatment had not been advertised. In fact, the practitioners were being so overrun with a steady stream of new cases involving individuals who had heard about the effectiveness of the treatment through word of mouth that Dr. Hamer had to hire and train several new technicians to deal with the increasing patient load.

On average, forty patients a day were being treated at his facility. Although many of those patients previously had been diagnosed as being terminally ill or had not been helped in any appreciable manner by so-called mainstream or orthodox modes of cancer treatment, the Hamer facility was actually curing individuals who were being told that, among other things, they should begin to put their affairs in order.

However, under extreme forms of professional, legal and financial pressure applied by the American Medical Association at the direction of Dr. Morris Fishbein, Dr. Hamer was forced to discontinue his practice. This process of termination took place despite the fact that Dr. Hamer had a wealth of documented, successful outcomes in cancer cases, as well as in relation to various other kinds of pathologies thanks to the technologies that Rife had invented and which Dr. Hamer had been using.

The forms of dissuasion employed by the American Medical Association and those who came under its influence were not restricted to professional, legal, and financial dynamics. For example, one of the annual reports of the Smithsonian Institute contained some positive coverage concerning Rife's inventions, discoveries, and treatments, but shortly thereafter, the author of the article was shot at through the front windshield of his car, and, as a result, he never wrote about Rife again.

Against the backdrop of the foregoing sorts of machinations, one might note that during the late 1800s and moving forward for another 40 years, or so, pathogens were divided into two classes. On the one hand, there were micro objects that were capable of being filtered from, or out of, a biological sample (such as blood or some other fluid from an individual), and, on the other hand, there were micro objects present in such samples that were not capable of being filtered from the latter fluids.

The former objects consisted of various kinds of bacteria, parasites, and the like. The latter class of smaller objects constituted something of an unknown nature, but they were referred to as filterable viruses (that is, poisons).

Eventually, using the term "filterable" before the word "virus" was discontinued. However, the understanding being alluded to here by

use of the term “virus” without the term “filterable” appearing in front of it does not necessarily have anything to do with the modern theory of a virus.

The original sense of the term “virus” had to do with some unknown kind of poison or toxin that was capable of by-passing the filtering process. The modern sense of the term “virus” refers to a nano-sized entity containing a sequence of DNA or RNA which is encapsulated within a protein sheath that, somehow, is capable of penetrating or gaining entry to the interior of cells and, supposedly, is capable of holding those cells hostage while such entities co-opt certain aspects of some of the biological mechanisms within the cells in order to be able to unleash whatever capabilities are supposedly present in the aforementioned DNA or RNA sequence that is believed to exist in the interior portion of the micro object that, theoretically, is surrounded by an outer protein sheath.

Rife referred to the microorganism that he had discovered and considered to be the cause of cancer as being a virus. However, he was not using that word in the modern sense of the term, but, rather, he was using the word in its original etymological sense of being a toxin or poison of some kind that was capable of passing through filters that were capable of separating out larger microorganisms from a biological specimen, but those filters were not capable of filtering out such smaller entities.

Bacteria that can be separated out of a biological specimen through the use of a filter are in the order of 1 micron, or so, in size. “Filterable viruses”, understood in the original sense of that phrase, tend to have a size that is a thousand times smaller than the typical bacteria -- a size that falls somewhere between 10 nanometers and several hundred nanometers, or two tenths, or so, of a micron.

There are good reasons for resisting the idea that Rife’s use of the term “virus” is equivalent to the modern notion of virus. For example, although, supposedly, viruses in the modern sense of the term require a cell to be able to propagate, Rife discovered that the small microorganism that he was observing and which could pass through filters that separated out larger bacteria, were capable of surviving, if not thriving, on something known as K-medium (the K standing for the inventor of the medium, Dr. Arthur Kendall, who collaborated with

Royal Rife beginning in 1928), and K-medium was a non-cellular form of nutrient that the nano-sized microorganisms being studied by Rife could use to sustain themselves, but which would have been useless to viruses in the modern sense of the term.

In addition, the smaller-sized entities that were passing through the filters that separated out larger, bacterial forms of microorganisms seemed to be exhibiting many bacterial-like properties. Indeed, based on his own observations, Rife maintained that the microorganisms that were passing through the filters were actually transformed versions of the bacteria that previously had been observed on a larger scale and – when not undergoing transformation to a smaller, different morphology from its original status as a large bacterial form – could be filtered from a biological sample.

In other words, Rife's observations of the life cycles of microorganisms appeared to indicate that the latter were pleomorphic in character. They could change their morphology, as well as function, and in the process could, among other things, transform from, on the one hand, a bacteria whose size was such that it was capable of being filtered from a biological sample, to, on the other hand, a bacterial-like microorganism that was capable of passing through the very same filter that, previously, had been able to be separated out in the form of the larger version of the much smaller edition of that same microorganism.

Due to the influence of Pasteur's notion of monomorphism – a notion for which Pasteur put forth conjecture in place of evidence – modern microbiological orthodoxy held (again on the basis of no actual proof) that bacteria were incapable of changing their morphology and/or function. On the others hand, Béchamp had put forth considerable evidence to indicate that microorganisms were pleomorphic in nature, and as pointed out previously in this chapter, Enderlein also had released a great deal more evidence to demonstrate that microorganisms were pleomorphic.

In addition, Rife was now providing live-action, microscopic proof concerning the existence of such bacterial transformations. These transformations were pleomorphic in nature rather than being monomorphic in character as Pasteur, without evidence, had misled subsequent generations of scientists and researchers to presume was

the case and which, as a result, framed their understanding of microbiology in problematic ways.

The journal *Science* actually published (December 11, 1931) an account of the research of Dr. Kendall (a colleague of Royal Rife) concerning this issue. The research documented the transformation of larger bacteria into smaller editions of the same bacteria which -- following such a transformation -- could pass through a filter that previously separated out the larger form of that bacteria.

Dr. Kendall had been invited to attend the May, 1932 session of the Association of American Physicians at Johns Hopkins University in Baltimore, Maryland in order to speak about his research. Upon hearing about the foregoing presentation, Dr. Thomas Rivers of the Rockefeller Institute tried to have that scheduled address cancelled. When this attempt to derail things failed, Dr. Rivers subsequently insisted that both he and Harvard's Dr, Hans (a physician, bacteriologist, and author of many papers and books) should be allowed to speak to the members of the Association of American Physicians in response to whatever Dr. Kendall might say.

In December of 1926 – six years prior to the aforementioned May 1932 gathering of the Association of American Physicians -- Dr. Rivers had put forth a proposal to the Society of American Bacteriologists that supposedly established a set of criteria that would permit people to distinguish between bacteria and virus-sized entities. At the heart of his perspective were several beliefs. For example, at the December 1926 meeting, Dr. Rivers proclaimed – on the basis of what evidence is rather unclear -- that: (a) viral entities were functionally dependent on the presence of living cells in order to be able to reproduce; (b) entities known as viruses could not possibly be bacterial in nature because bacteria are inherently incapable of assuming viral-sized forms.

The problem, of course, with the foregoing perspective is that, as was discussed previously, the research of Royal Rife and Dr. Arthur Kendall indicated that bacteria were not only capable of assuming the size of virus-like entities (in the original sense of the term) and, therefore, were able to pass through filters that had been able to separate out typical forms of bacteria of a much larger size. In addition, according to Dr. Kendall, the smaller sized bacterial-like

entities were capable of reproducing without the need for other cells to be present to help make such reproduction possible.

Obviously, the worldview of Dr. Rivers was being threatened by the research of Dr. Kendall. Consequently, Dr. Rivers intended to vigorously defend the position that he had announced to the world during the aforementioned December-1926 meeting before the Society of American Bacteriologists concerning the alleged differences between bacteria and viruses because, in effect, research was now being released by Rife and Kendall indicating that Dr. Rivers didn't really know what he was talking about.

Upon request – or demand – Dr. Rivers and Dr. Zinsser were provided with the directions and information needed to replicate the methods used to generate the research results of Dr. Kendall's work in 1931. However, following the presentation of Dr. Kendall at the May 1932 meeting of the Association of American Physicians at Johns Hopkins University, Dr. Rivers and Dr. Hans Zinsser both sought to dismantle the perspective of Dr. Kendall by, among things, charging the latter individual with having perpetrated scientific fraud because neither Dr. Rivers nor Dr. Hans Zinsser had been able to replicate the results that were reported in 1931 by Dr. Kendall.

Dr. Edward C. Rosenow, Jr. – son of Edward Rosenow Senior, who had been a supporter of, and who collaborated with, both Dr. Arthur Kendall and Royal Rife – notes that he once had been a student of Dr. Hans Zinsser while attending Harvard. The younger Rosenow indicates that during this period of time, Dr. Zinsser once confessed to him that he -- Dr. Zinsser -- had not actually bothered to follow the methodological protocol with which he had been provided to carry out the process necessary to – potentially -- replicate the 1931 results concerning the capacity of bacteria to change their morphology and functional properties, and, yet, nonetheless, Dr. Zinsser went ahead and had been critical of those announced results.

Apparently, many people in the audience at the May 1932 Association of American Physicians were influenced –-- at least in a rhetorical sense -- by what Dr. Rivers had to say on that occasion. This outcome – to whatever extent it is true – might well have been because many members of the audience permitted themselves to forget about such matters as empirical evidence, methodology, and demonstrable

results, and, instead became caught up in arguments from authority as well as the infamous capacity of Dr. Rivers to verbally and publically bully individuals in a manner that rarely had anything to do with the truth of an issue but was, instead, dedicated to Dr. Rivers' need to satisfy the hungers of his own ego at the expense of the feelings and reputations of other individuals.

Several decades prior to the verbal brawl before the Association of American Physicians in 1932, Peyton Rous had, in 1911, established a strong case – strong enough to lead to winning the Nobel Prize for his work some 55 years later -- that the cause of cancer might have something to do with the presence of a virus -– in the original sense of the term … that is, a poison or toxin of some kind that was capable of passing though a filter that was capable of separating out larger forms of bacteria. However, because, at the time of the foregoing discovery, the orthodox manner of depicting or framing the cause of cancer was considered to be a function of some sort of mutagenic change to the way in which DNA and/or RNA were being processed, and, therefore, such mutated cells became rogue centers of dysfunctional biological activity.

Later on, the work of Dr. Eleanor Alexander-Jackson established that the so-called Rous virus had been observed to generate both DNA as well as RNA sequences and since viruses in the modern sense only were supposed to contain either DNA or RNA but not both, the Rous virus was really more bacterial in nature. In a 1969 paper that was authored by both Dr, Alexander–Jackson and Dr. Virginia Livingston, the assertion was made that the reason why no one had been able to understand that the cause of cancer was due to the presence of a single Rous-like bacterial form was that most researchers had refused to be willing to entertain the possibility that the pleomorphic perspective -- which indicated that bacteria were capable of altering their morphology and functionality – might actually be correct. In short, researchers had been unwilling to undergo a process of de-framing in which various forms of fabrication which were shaping their perspective needed to be removed.

Five years later, in 1974, Dr. Lida H, Mattman, working out of the Biology Department at Wayne State University discovered the existence of what are referred to as "cell-wall deficient forms of

bacteria'. For example, what are now referred to as mycoplasmas give expression to such entities, and the data surrounding cell-wall deficient forms tends to further corroborate the pleomorphic idea that began with Béchamp, and was further substantiated through the research of individuals such as Enderlein, Rife, Kendall, Alexander-Jackson, Livingston, Mattman, and others.

Unfortunately, the sorts of people who had control over much of medicine and biological research back then were being led around by the nose by people such as Morris Fishbein, Cornelius P. Rhoads, and Thomas Rivers. Rivers had not only been a member of the Rockefeller Institute for more than a decade, but in 1935 he became the Director of the Rockefeller Hospital and served in this position until1959, and, in addition, he became the Vice President of the Rockefeller Institute from 1953 until in his death in 1962, and throughout these decades he vigorously served, protected, and defended the interests of the Rockefeller approach to medicine which was rooted in: (a) The monomorphic theory of microorganisms that had been first proposed, sans evidence, by Pasteur in the late 1800s, as well as: (b) The commercially extremely profitable notation that petroleum-based pharmaceuticals were the key to 'doing no harm'.

Like Fishbein of the American Medical Association and Cornelius Rhodes of the Sloan-Kettering Cancer Center (which had some rather incestuous ties with the Rockefeller Institute), Thomas Rivers sought to disparage, if not destroy, anyone – such as Rife and Kendall – who championed a perspective other than the one to which Dr. Rivers was committed. As a result, the foregoing three individuals took active steps, each in his own inimical manner, to discredit, suppress, harass, and undermine a great deal of the research that, among other things, was able to evidentially show or strongly suggest that a monomorphic view of microorganisms was an untenable theory and that, instead, the pleomorphic approach to microbiology was – from the perspective of actual evidence -- far superior to the empirically challenged idea of monomorphism. Therefore, a great deal of the research that was published, taught, and applied throughout America during their tenures as directors of the previously noted powerful organizations (tenures which loomed over the first six-plus decades of the twentieth century) was forced to genuflect before the likes and dislikes of such

power brokers and recite whatever catechism of medical theology and litanies of cognitive self-effacement that were called for by various sets of circumstances (such as: Needing a career, being able to publish, or receiving money for research).

Fishbein, Rhodes, and Rivers were all following the "leadership" model that had been established by Louis Pasteur. In other words, they were all people who were more interested in power and self-serving ideologies than they were interested in the well-being of individuals, and, consequently, they leveraged power as well as were leveraged by that which made such access to power possible, and, in the process, they betrayed both the truth and their fellow human beings.

To somewhat paraphrase or re-phrase the words of Günther Enderlein that were quoted during the opening pages of the present chapter, the foregoing three individuals were people who might know a lot about disease but knew very little about the nature of life or what constituted health. Nevertheless, they considered themselves to be gods of medicine – if not more -- and, therefore, they set about creating servants in their own image, but there were those who followed the sound of a different drum.

In 1913, Royal Rife was a happily married, twenty-five year old man. He had moved to San Diego (from Nebraska) in order to further pursue his life-long interest in electronics, microscopes, inventions, as well as biology, and, ne was able to pursue a number of those interests when he worked for the Navy during World War I and had been sent to Europe by the US government in order to investigate – for reasons that are unknown and, perhaps, classified – various laboratories in different countries.

A few years following the end of the war, Rife became intrigued with the possibility of finding ways to use electricity in some fashion that might help cure diseases of one kind or another. More specifically, he began to explore the idea that different electrical frequencies might have different effects upon biological organisms.

He was able to secure funding from a couple of interested San Diego industrialists who were willing to bankroll his scientific, medical, and inventive pursuits. Rife put the money to good use during the 1920s, and, as a result, he successfully invented both an

extraordinary microscope as well as certain frequency generating prototypes that seemed to be able to eliminate various kinds of pathogenic microorganisms.

Rife actually had begun work to construct the sort of microscope that he had envisioned in 1917. However, once his instrument had been built (and it consisted of thousands of parts), he proceeded to make a series of improvements to his novel form of microscope.

His microscope was unprecedented in a variety of ways. To begin with, at the time, the best microscopes of the day were capable of resolutions in the order of between 2,000 and 2,500 diameters, whereas Rife's initial microscope was capable of resolutions in the range of 31,000 diameters,

Piece by piece (eventually reaching a total of nearly 5,700 pieces), he expanded the original resolution capacity of his microscope to 50,000 diameters. As a result, he was able to observe the actual dynamics of life down to a size of $1/20^{th}$ by $1/15^{th}$ of a micron which enabled him to observe, among other things, the sorts of pleomorphic transformations in microorganisms that eluded normal light microscopes and which, for different reasons noted previously, could not be captured by electron microscopes.

His newly fashioned microscope contained a series of 14 lenses and prisms, together with an illumination unit, all of which were made from quartz materials that were transparent to ultraviolet light. These features enabled an observer to see objects that were invisible to normal light microscopes that did not use quartz lenses and which, therefore, framed or hid the presence of objects that were visible when one used lenses capable of transmitting ultraviolet light.

The Rife microscope had a second system of illumination that bent and polarized its light in a manner that could be controlled via the intricacies made possible by some 5,700 parts and which permitted the operator of the microscope to run through an array of very small changes in frequency gradation that were capable of bringing into focus those objects that had a chemistry which generated a frequency that interacted with whatever frequency of polarized, bent light which was being modulated within the microscope at a given time. In effect, the Rife microscope was able to paint microorganisms with frequencies of light to which those microorganisms responded in

characteristic ways (such as color) and through which the microorganisms became visible as entities with specific colors that were unique to the frequency that was characteristic of the chemical dynamics inherent in such microorganisms.

With the help of the foregoing capabilities of his microscope, Rife drew up a color-coding chart which enabled him to differentially and consistently identify numerous microorganisms as well as various stages of their pleomorphic life cycle. Each micro entity had a specific form of color emanation that never varied, and, therefore, if, after adjusting the microscope in certain ways, one observed a microorganism with a certain color emanation, then, one knew whether, or not, it was something that one had previously encountered or whether it emanated with a color that had not, yet, been catalogued and, consequently, constituted a new discovery of sorts.

Frequency not only played a role in enabling one to see, for example, certain kinds of microorganism in different stages of their pleomorphic life cycles, but frequency also played a role in the development of an instrument that was designed to terminate the existence of certain forms of microorganism. Through a process of trial and error, Rife was able to determine the MOR or Mortal Oscillatory Rate associated with any given microorganism that enabled one to disintegrate such entities into non-existence

Various kinds of directed energy weapons do the same thing in conjunction with human beings. It is all a matter of frequencies, and like everything else human beings have a MOR or Mortal Oscillatory Rate … or, perhaps, more accurately, human beings have a variety of such rates because human beings can be attacked through an array of frequencies.

Rife's initial investigations in the foregoing regard involved a search for a frequency that would terminate the microorganism that was believed to cause tuberculosis. However, after he located the proper MOR frequency and disintegrated the entity, he found, nonetheless, that some of the test animals continued to die from some sort of toxic poisoning.

Rife was aware that during the late 1800s Robert Koch had had similar experiences during his experiments with anti-venom. In other

words, despite giving the requisite anti-venom to animals, Koch discovered that some of those animals still died.

After some critical reflection, Rife began to suspect that in some of those perplexing cases it might be that before the targeted, pathogenic microorganism had been eradicated (the one that was believed to cause tuberculosis), then perhaps, different editions of the targeted, pathogenic microorganism had either released, or had been transformed into, some sort of virus – that is, a toxic or poisonous entity. If so, then, this toxin or poison (i.e., a "virus" in the original sense of the term) could be responsible for the death of some of the test animals that had died despite the fact that the original form of that microorganism had been treated with, or exposed to, an appropriate MOR.

If the foregoing conjecture were correct, then, Rife had to discover what the nature of such a "virus" was and, then, seek to determine what its MOR might be. Three years of intensive research and experimentation were needed for him to be able to resolve the problem.

Eventually, however, he found that two different frequencies were necessary. One MOR frequency was needed to terminate the original bacterial form which was capable of causing tuberculosis, but, as well, another MOR frequency was also needed to be able to terminate the "viral" form (in the original sense of "virus") of that same microorganism.

In other words, in order to properly treat tuberculosis once it has arisen, one had to learn how to simultaneously terminate two different pleomorphic stages or forms in the life cycle of a given microorganism. Yet, terminating the pathogenic stages of that microorganism's life cycle doesn't actually indicate what it is – or was -- in the terrain within which such a microorganism exists or existed that induced it to enter into those aspects of its life cycle that are pathogenic in nature rather than continue on in an apathogenic mode of existence.

One of the reasons why it took so long for Rife to find a solution to the foregoing quandary was that, initially, he had tried to find ways of staining the "virus" form of the microorganism in a traditional manner by using chemical dyes of one kind of another. After a considerable amount of unsuccessful trial and error, he came to the conclusion that

the "virus" mode of the pleomorphic microorganism was too small to stain in a traditional manner (i.e., through the use of chemical dyes), and, as a result, he began to search for alternative methods of staining.

It was at this point in his explorations that the intuition came to him concerning the idea of using frequencies as a means of rendering such entities visible. Consequently, he set about building a microscope that had the capacity to use frequency as a way of inducing what had been invisible to become visible through the unique color emanation that arose when the microscope used a certain frequency of light in conjunction with a microorganism that had a sort of receptive frequency.

Although Rife's first practical breakthrough came in relation to his work on the tuberculosis problem, his original impetus fur undertaking such work had been a function of his ultimate desire to find a cure for cancer. In fact, his cancer research had begun in 1922, but he was having difficulty identifying the precise form of the microorganism that he believed might be the cause of cancer.

Therefore, in the meantime, he worked a problem about which he did have some knowledge since he knew (from the work of Robert Koch and others) what the identity of one of the primary culprits was that seemed to play a causal role in the onset of tuberculosis. When he discovered the MOR or frequency for terminating that pathogen, and, then, upon further research, discovered that there was, in the original sense of the term, a viral form of that same pathogen which also had to be identified as well as eliminated, Rife became caught up in the many tasks that were entailed by the process of updating his microscope so that it could paint microorganisms with appropriate frequencies – and, thereby, make them visible – that induced those microorganisms to become manifest or resonate with unique colors.

During the latter stages of the foregoing research, Rife's work was assisted considerably by the presence of Dr. Milbank Johnson and Dr. Arthur Kendall. Both Dr. Johnson and Dr. Kendall were well-regarded in scientific and medical communities.

Dr. Johnson was a high-profile physician in Los Angeles who, among other things, was a member of the board of directors at the Pasadena Hospital in California. Dr. Kendal was the Director of Medical Research for the Evanston, Illinois-based Northwestern Medical

School, and, was not only a well-regarded microbiologist but the inventor of a culturing medium that, among other things, would play a central role in helping Rife in his cancer investigations.

The culturing medium that was invented by Dr. Kendall was protein-based and devoid of living cells that were capable of sustaining the "viruses" (in the original sense of the term; that is, denoting a toxin or poison) which could not be filtered out of, or removed from, say, a blood sample, Nevertheless, the K-medium was able to sustain those viruses despite the absence of such cells and, therefore, as pointed out earlier, contradicted the 1926 claims of Dr. Thomas Rivers which conjectured that one of the distinguishing features between "viruses" and bacteria was that the former could not reproduce in the absence of cellular life.

Since the modern notion of a virus presupposes that the foregoing assertion of Dr. Rivers is true, and since Dr. Kendall's invention of the K-medium demonstrated that one of the supposed primary differences between viruses and bacteria (according to Dr. Rivers) -- which had to do with the alleged need of viruses to live off the avails of living cells --, was, actually, false, then, one comes to the rather startling conclusion that evidence has existed for more than 90 years indicating that the modern theory of viruses is incorrect because that theory relies on a perspective – namely, the foregoing conjecture of Dr. Rivers – which the existence of K-medium served to show was untenable. Nevertheless, the mythology of modern virology is unwilling to abandon its insistence on carrying on with its counterfactual façade that one can differentiate between viruses and bacteria because viruses need a cell host to be able to perpetuate themselves. As Dr. Kendall and Royal Rife had shown by the early 1930s, viruses are actually a bacterial-like form of organism that is capable of engaging in metabolic processes quite independently of the presence of cellular life.

The K-medium of Dr. Kendall helped Rife to be able to culture (in the original sense of the term) the 'viral' form of the bacterial microorganism that, along with the latter bacterial form, was responsible for tuberculosis. Rife's new improvements to his microscope were capable of not only making such microorganisms visible in a manner that was capable of being replicated, but showed,

as well, the nature of the pleomorphic dynamics that gave rise to different stages of the life cycle of a single microorganism as those entities transformed into one another.

On November 30, 1931 the *Los Angeles Times* carried a story about a meeting held several days previously that had been arranged by Dr. Milbank Johnson on behalf of more than 30 prominent members of the scientific and medical communities in California in order to provide those individuals with an opportunity to learn about the work of both Royal Rife and Dr. Kendall. A photograph of the two scientists juxtaposed next to the new microscope was featured some five days later in the same newspaper.

A month later, on December 27, 1931, the *Los Angeles Times* published another story on the work of Royal Rife. This time the article was about a gathering of some 250 scientists who had been invited by Royal Rife and his colleagues to learn about the research and inventions of the latter group of individuals.

The research and work of Rife and his colleagues was given national exposure through the mainstream journal *Science*. Moreover, several weeks prior to the aforementioned Los Angeles Times article of December 27, 1931, an edition of *Science News*, a sort of supplemental magazine related to the journal *Science*, ran with a story about how filterable bodies – i.e., viruses in the original sense of the word of being toxins or poisons that could not be separated out by filters – had been viewable via the Rife microscope.

The foregoing kind of coverage and notoriety is what led to Dr. Thomas Rivers and Dr. Hans Zinsser trying to cancel the presentation of Dr. Andrew Kendall before the Association of American Physicists in May of 1972 that was to be held at Johns Hopkins. When they were not able to cancel the scheduled meeting, they wormed their way in to being allowed to make their own presentation and used that opportunity to engage in a series of attacks that were filled with rhetorical bombast and little more, but many members of the audience who were physicians seemed to find that sort of rhetoric to be comforting.

Apparently, only one individual in the audience is reported to have stood in defense of Dr. Kendall. However, what was missing in

numbers was more than compensated for by the prestige of that speaker – namely, Dr. William H. Welch.

Dr. Welch was the individual who first began to introduce, and teach about, bacteriology in the United States. Moreover, his scientific stature was such that at one point in time the library at Johns Hopkins had been named in his honor.

The thrust of the remarks offered by Dr. Welch on the occasion of the May 1932 presentations was that the work of Dr. Kendall had served to advance the cause of medicine. However, unfortunately, rhetoric, verbal bullying and unpleasantness seemed to carry the day.

Notwithstanding the foregoing sort of setbacks, Royal, Rife, Dr, Kendall, and other individuals such as Dr, Edward C. Rosenow of the Mayo Clinic continued to move forward with their research concerning, among other things, the pleomorphic nature of microorganisms, as well as with a continued search for medical protocols that might successfully treat different kinds of pathology.

Dr. Rosenow was of the opinion that as impressive as the substantially increased capacity of the Rife microscope might be with respect to being able to resolve the details of living objects on the sub-micron level, nonetheless, as far as Dr, Rosenow was concerned the capacity of that same microscope to be able to make visible what previously had been invisible by means of its ability to paint those microorganisms with a resonance that induced the latter entities to emanate with a color that uniquely identified them as being one kind of organism rather another was of far greater importance. This is precisely the feature of that microscope that, along with the K-medium of Dr. Kendall, led, in 1932, to the discovery of the microorganism that appeared to be the cause of cancer.

Through a series of fortuitous but unintended consequences, Rife discovered that when he took a cancer culture and sustained it with K-medium and, then, exposed that culture for approximately 24 hours to the lighting frequency of an argon gas-filled tube that had been heated by 5000 volt electric current, and, then, followed the foregoing processes by exposing the culture to a combination of water and vacuum for another 24 hours that was maintained at 37.5 degrees Centigrade, he was able to see that for which he had been looking for nearly a decade, In other words, after being exposed to the

aforementioned sequence of methodological steps, he observed a significant change in the cancer culture as part of it was induced to emanate at a frequency that was visible through his microscope as being purple-red in color.

The size of the particle was sub-micron in dimensions – namely, 1/20th of a micron by 1/15th of a micron. According to Rife, the cancer microorganism had four different pleomorphic stages.

The smallest of the discovered microorganisms was labeled "BX" and seemed to be responsible for inducing carcinomas and melanomas involving different kinds of skin cells. A slightly larger version of the same underlying microorganism was referred to as "BY" and it seemed to be related to the emergence of sarcomas (a form of cancer involving connective tissue such as: Fat, cartilage, and bone as well as vascular and blood stem cells). The other two forms of the cancer-related microorganism were a monococcoid form which has been observed to be present in the blood of roughly 90% of all cancer patients, as well as a fungal form of that same underlying microorganism.

All three of the latter forms of the same underlying microorganisms were capable of being transformed into the smallest form of the microorganism – that is BX -- within a period of 36 hours. Once such a transformation had taken place, the resulting BX microorganism was shown to be capable of inducing tumors to develop with all of their attendant pathological characteristics, and, in fact, Rife and his colleagues had been able to demonstrate this more than 300 times with precisely the same set of results.

Rife indicated – without necessarily knowing or understanding – that what induced the foregoing transformations to occur had something to do with the nature of the biological terrain in which those forms had been placed, Consequently, the actual cause of cancer was a function of the way such different forms of the same underlying microorganism interacted with or were engaged by the biological terrain in which they were placed.

While Rife maintained that when the terrain of a human body was properly balanced it was not susceptible to any of the foregoing sorts of cancer-related transformational activities taking place, nevertheless, what precisely constituted the character or nature of a properly balanced biological terrain was not clear or necessarily

known. In a sense the four forms of the pathogenic microorganism served as the toxic or poisonous inflammatory dynamic that appeared to constitute what might be referred to as necessary conditions, that lacked the sufficient wherewithal to be able to cause cancer, but the precise nature of the conditions that needed to be present in the biological terrain to enable such toxicity to take hold and come to dominance were somewhat elusive.

Once Rife had identified the pleomorphic forms of the underlying microorganism that played a role in the onset of cancer, he went in search of the MOR or specific frequency that was needed to terminate those forms. Through trial and error, he discovered the requisite MOR and proceeded to show that he could terminate those entities irrespective of whether they existed in isolation (that is, outside some sort of biological terrain), as well as when those microorganisms were located within test animals, and, in fact, during the course of his experiments, he was able to accomplish the foregoing process of termination in tests animals more than 400 times.

When the appropriate terminating frequencies were applied, the test animals became free of all cancerous dynamics. They were pathology free – that is, they had been "cured"

The next step involved human trials. While the complete story encompassing the cancer clinic that was held at the University of Southern California in 1934 might never be known because, in one way or another, all of the notes and documents were lost or mysteriously disappeared, nonetheless, there are enough eye-witness accounts of competent and trained observers to provide an overview of what appeared to have taken place.

The frequency treatments did not destroy tissue but only affected the pathological forms of the underlying microorganisms. Moreover, the treatment was found to be completely painless.

Initially, a patient was exposed to the frequency machine for a period of three minutes every day. However, subsequently, Rife and his colleagues discovered that applying the three-minute treatment every third day led to better results.

Apparently, the staggering of the treatment protocol to every third day seemed to provide a patient's body with the time it needed to

be able to detoxify (via the lymphatic system) and get rid of the dead carcasses of the pathological microorganisms that were being terminated by the frequency treatment. When the frequency protocol was run every day, this tended to lead toward the detoxification system becoming overwhelmed and, as a result, could lead to problems of toxicity of one kind or another if a given patient's body was not provided with enough time for the build-up of dead microorganisms to be eliminated.

A total of 16 individuals exhibiting an array of cancerous conditions were treated at the University of Southern California in 1934. All of the foregoing individuals had been diagnosed by various medical officials as suffering from conditions of incurable forms of cancer.

Following 3 months of the frequency protocol that had been developed by Rife, 14 of those individuals were pronounced as having been cleared of all traces of cancerous activities, and among the individuals who provided such a clean-bill-of-health determination were a number of prominent pathologists, physicians, microbiologists, and other people who were well-versed in the sciences.

Were any follow-up studies done with the foregoing individuals? I have not come across any evidence indicating that this was done, and, so, of course, there are unanswered questions concerning what the ultimate health status of those individuals might have been 5 or 6 years after the clinic ended in 1934.

Irrespective of what might have been happening with those individuals in relation to the issue of cancer later on in their lives, the purpose of this section of the present chapter has been to not only (a) provide an overview of a very exciting but, unfortunately, an almost completely unknown period of medical history in America (save for the research efforts of individuals such as Barry Lynes and Christopher Bird), but, as well, (b) for the purposes of the present book, to indicate that Rife and his colleagues had established, once again (following in the empirical footsteps of Béchamp and Enderlein before them) that microorganisms operate in accordance with pleomorphic principles rather than the monomorphic ideas of Pasteur, and, as a result, because the scientific and medical communities in the United States have permitted the dogmatic evangelical, power-seeking ideologues of

monomorphism to take control of how biology and medicine are: Taught, researched, written about, and practiced, many pathological conditions – cancer among them – continue to be improperly understood, and, therefore, improperly treated, and it is the public that suffers from such intransigence.

Like Rife, Gaston Naessens (1924 – 2018) was a genius who had: An abiding interest in science; a capacity for incredible inventiveness, as well as a commitment to discovering ways that might either cure an array of pathologies or, at least, help improve the quality of people's lives in substantial ways. Furthermore, like Rife, Gaston Naessens was harassed by medical authorities (e.g., Dr. Augustin Roy) who lacked his intelligence, character, talent, and success.

While still in his twenties (which would have been some 20 years, or so, after Rife had constructed his own ground-breaking microscope in the late 1920s and early 1930s), Naessens – completely independent of Rife's work -- invented a microscope that was as revolutionary in its own way as was the earlier Universal microscope of Royal Rife. The Naessens microscope – which came to be known as the "Somatoscope" – was capable of resolutions down to 15 nanometers (150 angstroms), and like Rife's Universal microscope, but unlike the electron microscope, the Somatoscope enabled one to observe actual living organisms as they went about their lives and pleomorphic transformations.

The Somatoscope employed principles of optics and physics that, apparently, still are not completely understood. However, less one suppose that the microscope was an exercise in trickery of some kind, one might note that individuals such as Rolf Wieland (who served as the head of microscopy for the internationally acclaimed German optics firm Carl Zeiss) indicated in 1989, after having had an opportunity to work with the Naessens instrument, that he considered the Somatoscope to be a significant improvement in light microscopy.

One might also note that the Somatoscope was capable of resolutions that were far superior to microscopes that were being constructed some forty years later than the time in the 1950s when Naessens came up with his invention. For example, the World Research Foundation announced in 1990 that it was releasing the

Ergonom-400 microscope that was capable of magnifying objects some 25,000 times (which was actually less than what had been achieved by Rife's Universal microscope) and which had a capacity to resolve objects down to 100 nanometers (1000 Angstroms) … some 85 nanometers (and 850 Angstroms) less than what Naessens microscope was capable of achieving.

The reason why the Somatoscope carries the name it does is because of the ultramicroscopic entities that Naessens discovered through the use of his optical invention. More specifically, in the blood of human beings as well as in the sap of plants, Naessens had observed a subcellular microorganism that was capable of reproduction and whose existence was entirely unknown prior to Naessens discoveries. Naessens referred to this organism as a "somatid" (tiny body).

Somatids were capable of being cultured independently of a host body or cell. In addition he found that they were pleomorphic in character – that is, they were capable of changing their forms of morphology and functioning during the course of their life cycle.

In fact, he determined that in healthy individuals, the somatid only underwent the first three pleomorphic transformations of a total of some 16-plus possibilities. However, in sick individuals, one could observe one, or more, of the other 13, or so, possible transformations, and which of these possibilities became manifest was functionally dependant on the condition of the biological terrain in which they existed.

Notwithstanding the importance of discoveries made by Béchamp, Enderlein, and Rife, Naessens, brought a level of detail to the study of pleomorphism and its varied roles within the lives of human beings (both apathogenically as well as pathogenically) that had not been attained by any of his predecessors. Naessens not only was confirming the earlier work of Rife, Enderlein, and Béchamp while also disconfirming the "research" of Louis Pasteur, but, he also was adding significant, additional information.

The pleomorphic life cycle of the somatid involved such entities as: Spores, double spores, bacterial forms, double bacterial forms, rod forms, microbial globular forms, yeast forms, fungal forms, mycelial forms, and fungal filaments – each of which had different morphological features as well as different biological functions.

Naessens maintained that if one knew how to read the somatid cycle in the blood of an individual, one could determine what manner of pathology was likely to emerge up to 18 months in advance of overt symptomology.

Naessens considered the microzymas that had been discovered and observed by Béchamp to be larger "cousins" of the much smaller somatid. Presumably, Enderlein's notion of spermits, protits, or endobionts might also be close relations, of one kind or another, to the primordial somatid.

One might also note that the somatid seems to be even more basic or fundamental than Gilbert Ling's nano-protoplasm units that were discussed during an earlier chapter. Conceivably, the nano-protoplasm units arise as a function of somatid dynamics.

Naessens ran the somatid through a number of experiments, and it seemed to have a relatively indestructible nature. For example, acid appeared to have no effect on somatids, and, furthermore, the outer aspect of a somatid seemed to be impervious to a diamond-tip drill.

Somatids also appeared to be capable of withstanding -- without adverse effect -- exposures of as high as 50,000 rems of radioactive exposure which, normally, is lethal. Moreover, somatids also seemed to be able to retain a full range of functionality after having been heated to temperatures such as 200 degrees Centigrade (392 degrees Fahrenheit).

One might recall that Béchamp's microzymas only seemed to be able to survive temperatures in the range of 100 degrees Centigrade. If so, then, perhaps Naessens' characterization of microzymas as being larger – and, apparently, less robust – cousins of somatids is worth reflecting on with respect to the way in which microzymas, endobionts, bions, and somatids are connected because they are not necessarily all the same phenomenon.

Like Béchamp's microzymas, somatids are believed to survive the decay and decomposition of a biological organism. Thus, just as Béchamp discovered microzymas in limestone samples taken from the Earth that were gauged to be some 60 million years old, and just as he detected the presence of microzymas in samples of street dust and

chimney soot, so too, somatids are believed to be present in every part of an ecological system.

Nonetheless, the origins of both microzymas and somatids, along with the spermits/protits of Enderlein are unknown. Moreover, the nature of the kind of dynamics which might transpire within those entities is largely unknown, and, as such, they are like black boxes that are capable of generating an array of intriguing dynamics through unknown means.

According to Naessens, somatids exhibit electrical properties. More specifically, the inner dimension of the particle appears to be positively charged, whereas the exterior portion of that particle is negatively charged.

When somatids are immersed within a liquid environment such as blood plasma, the particles repulse one another. This resonates with the behavior of healthy cells within a similar sort of liquid environment – namely, the cells tend to repel one another,

However, Naessens indicates that the charge associated with a somatid is actually much larger than what one finds in conjunction with cells. In fact, Naessens considers somatids to be energy condensers that might be able to underwrite, or make possible, various kinds of energy dynamics.

Naessens believed that the possibility of life was dependent on the presence of somatids. He maintained that while somatids could exist independently of life, he did not believe that life could exist independently of somatids, but what the precise nature of that relationship actually might be appears, at the present time, to be shrouded in mystery.

He contends that for each organ of our bodies, there are somatids that are unique to, and which service, that organ and only that organ. Furthermore, all of the different kinds of somatids that are dedicated to various kinds of organs are simultaneously present in either the circulatory system and/or the lymphatic system.

Experiments have been conducted by Naessens in which he has extracted the somatids from a white-furred rabbit and transferred those somatids at the rate of one cubic centimeter per day for two successive weeks into the bloodstream of a rabbit with black fur.

Within a period of about a month, Naessens indicates that the hair of the latter, formerly black-furred, rabbit will become lighter as roughly half of the hairs making up the fur continue to be black while the other half of the hairs making up the fur of the previously black-furred rabbit will have turned white.

Naessens indicates that the reverse of the foregoing transformation can also take place. All one has to do is start with the somatids from a black-furred rabbit and transfer those somatids to the bloodstream of a white-furred rabbit in accordance with the indicated rate and for the designated length of time, and one will end up with a gray-colored rabbit with half of the hairs of the previously all white rabbit continuing to remain white while the other hairs that make up the fur will have become black.

As interesting as the foregoing experiment is, it is not the most interesting discovery that was made in conjunction with such experiments. If one cuts roughly the same size patch of skin from rabbits that have previously undergone the aforementioned process of somatid transfer, and, then, one takes the skin patch of the rabbit from which somatids have been extracted and, then, grafts its patch of skin onto the body of the rabbit to which somatids have been transferred, the graft will exhibit none of the traditional signs of rejection.

If the foregoing experiment can be verified and expanded upon, the implications for the whole issue of organ transplants and accompanying rejection issues might become a thing of the past. Unfortunately, because medical orthodoxy has been so resistant to Naessens research and his discovery of the pleomorphic nature of the somatid life cycle, such orthodox practitioners seem willing to place their patients at risk so that those medical practitioners can save their own vested interests.

Somatids are viral-like in size. Yet, given the right kind of biological conditions, they are capable of all manner of pleomorphic transformations, and, therefore, they were not viral-like in functionality. In other words, they could survive and function independently of host cells, and, furthermore, during certain stages of the somatid cycle they were capable of exhibiting bacterial-like properties despite being able to resist the process of being filtered from a given sample.

From the perspective of toxicity or exhibiting poisonous properties, many stages of the somatid cycle resonate with the original etymological sense of the term "virus". In other words, many of those somatid stages give expression to entities or forms that have toxic properties or potentials, but all of those somatid stages exhibit a capacity for independent activity and, therefore, are not dependent on the cellular mechanisms of other organisms to carry out those activities as is required by viruses in the modern sense of the word.

Consequently, while somatids are capable of assuming morphological forms on the sub-micron or nano scales, and while they have the capacity to give expression to toxic/poisonous properties under certain condition, nonetheless, somatids are not viruses in the modern sense of the term. As such, they are a non-viral form of microorganism, because no viral species – theoretical or otherwise – has the properties, potentials, and capabilities of somatids.

Naessens refers to somatids as being precursors to DNA. However, what this means or entails is not at all clear.

In fact, the notion that somatids are precursors to DNA raises at least one important question. Given that the 16-plus stages to which the aforementioned pleomorphic cycle of a somatid gives expression, and given that RNA and DNA capabilities are present in the entities that are present in the bacterial, fungal and other kinds of biological forms that make up the components of that cycle, then, exactly how does such DNA/RNA capability arise if somatids – in their most primordial form -- are said to be precursors to DNA?

During a relatively brief discussion encompassing issues of viruses (in the modern sense of the term), evolution, and somatids that takes place fairly early in the book by Christopher Bird entitled: *The Persecution and Trial of Gaston Naessens*, there is reference to a report in the August 10th, 1989 edition of the British journal *Nature* concerning the alleged discovery – apparently for the first time – of large quantities of viruses (some 2.5 million such entities per liter) in unpolluted seawaters. Prior to the appearance of the Nature article by Ovind Bergh and his colleagues at the University of Bergin in Norway, biologists, apparently, had always believed that seawater contained extremely low concentrations of viruses (in the modern sense of the word).

According to the *Nature* article, the entities that were found by Bergh and his colleagues were less than 1.2 micros in size. This is roughly equivalent in size to some of the larger somatid forms that been discovered and observed by Naessens.

There are several problems with the foregoing considerations. For example, although the entities that were found in the seawater were referred to as viruses, how were the identities of the entities confirmed to be viruses? Were they dismantled, sequenced and demonstrated to consist of only DNA or RNA encapsulated within a protein package of some sort and nothing more?

How can one be sure that whatever entities were found in the unpolluted seawater weren't somatids, endobionts (e.g., spermits or protits), or bions (cf. Reich) of some kind? Perhaps, they were maybe even samples of microzymas.

How does one know that what had been discovered by the Norwegian research group were viruses? Were all 2.5 million entities per liter examined?

Furthermore what is the basis of the supposed claim by biologists that prior to the Bergh "discovery", unpolluted seawater was believed to contain only small amounts of viral entities? Does such a prior belief give expression to an actual empirical determination or is it just an unsupported conjecture that is awaiting empirical confirmation, and, if so, then, in point of fact, the alleged discovery of Bergh and his colleagues actually suggests that whatever the supposed empirical basis is for claiming that seawater was believed to contain low amounts of viruses is, obviously, actually wrong and had no real empirical basis.

The Norwegian researchers that wrote the *Nature* article are excited – and Christopher Bird is including reference to that study in his book with a similar sort of curiosity -- because they all believe they might have opened up a theoretical possibility which accounts for how DNA or RNA might have become dissolved in seawater in large amounts and, thereby, become sources for subsequent genetic experimentation in the open waters. However, to put first things first, before one begins to calculate the genetic possibilities that might come in the form of dissolved DNA from alleged viral entities in seawater, perhaps, one might explain how such a complex molecule as DNA was

able to arise or survive for long enough a period of time (both DNA and RNA are fairly fragile forms of molecules) to find their way into an encapsulated particle. Furthermore, without being able to rigorously prove that one is, in fact, dealing with viruses -- rather than, say, somatids, spermits, protits, or microzymas -- in the unpolluted seawater samples one is examining, then one might want to exercise a bit more scientific caution concerning what one believes one has found and what the theoretical ramifications of such a "finding" might be.

One might note in passing – although this is hardly the sort of thing that ought to be dismissed so quickly – that Naessens had discovered a formula that was capable of treating, among other things, an array of pathological disorders, including cancer. The compound, was given the name "714-X" (the "7" stood for the 7th letter of the alphabet -– "G," the first initial of his first name -- while the 14 stood for the 14th letter of the alphabet – "N," the first initial of his second name, and the X stood for the 24th letter of the alphabet and symbolized his year of birth – 1924).

Just as Rife ran into trouble with medical authorities as a result of his successes – rather than failures – in treating cancer, and just as Dr. Frederick Koch had been harassed by the American Medical Association for having developed a treatment for cancer –- namely, glyoxylide (an article – "Glyoxylide: A Cure For Cancer" appeared in the December 3, 1936 edition of the *New England Journal of Medicine*) and, subsequently, in the 1940s was forced to migrate to Brazil (a situation that national columnist Drew Pearson referred to as one of the biggest scandals in the history of American medicine), and just as Dr. Stanislaw Burzynski has been harassed constantly for more than 50 years by medical authorities in both federal and state governments as a result of having had success using antineoplaston compounds (amino acid-based) in the treatment of cancer, and just as Dr. Nicholas Gonzalez was harassed by an array of medical authorities for having developed a diet and supplement-based way of successfully treating various kinds of cancer, so too, Gaston Naessens was harassed by Canadian medical authorities (Dr. Augustin Roy among others) for his success, rather than failures, in treating cancer – and many of the cases he treated were diagnoses as being terminal in nature.

What Rife, Koch, Burzynski, Gonzalez, and Naessens (there also are others who could be added to this list) all shared in common was the development of a form of treatment – although the nature of the protocols being used as different for each of those individuals – which was capable of achieving successful outcomes in conjunction with the treatment of, among other kinds of maladies, cancer. What the opponents of the foregoing individuals all had in common was an inability to cure cancer, and in fact, the latter's legacy of a "cut, burn, and poison" approach to cancer has been, for the most part an abject failure, wasting billions of dollars and costing millions of lives across more than a hundred years.

As far as the current book is concerned, rather than becoming entangled in issues of cancer treatment, I am most interested in the way in which one can go from the research of Béchamp, and, then, proceed on through the research of Enderlein, Rife, and Naessens and be able to empirically substantiate the existence of a long-standing scientific tradition that is not only capable of demonstrating how microorganisms are pleomorphic in nature, but, as well, can show that the theory of germs introduced by Louis Pasteur and adopted by much of subsequent science and medicine is without reliable foundation. However, to the extent that cancer treatments have been mentioned in the present chapter, this has been done to indicate that while some individuals (Enderlein, Rife, and Naessens – among others) have had success in the treatment of cancer, nonetheless they have been harassed because of that very success by a cadre of authorities who insist – for ignoble reasons – on working against the former individuals , and, therefore, one is confronted by a very fundamental issues – namely, the kind of theory of medicine that one uses to frame experience can have a huge impact – both constructively and destructively – on how one engages the idea of pathology and, therefore, how patients are treated.

To whatever extent one wishes to frame the world of microorganisms through the monomorphic lenses of Pasteur's theory of germs, one is introducing frames of obfuscation that are hiding, if not distorting, information which alters what one sees and how one sees that which one is permitted to see. To whatever extent one wishes to engage the world of microorganisms through the pleomorphic

lenses of Béchamp, Enderlein, Rife, and Naessens, one is being introduced to forms of framing that disclose a great deal more accurate information than is available through the lenses of a monomorphic approach to microbiology.

I remember watching a video featuring Dr. Barre Lando in which he was discussing different facets of his medical training background. He indicated that at one point during his development as a would-be healer he had gone to Canada to study with Naessens and that, from time to time, symposia of one kind or another would be organized by Naessens and his associates for purposes of, among other things, providing interested or curious individuals with an opportunity to be exposed to, in a hands-on manner, concerning the power and capabilities of the Somatoscope, as well as to offer them a chance to explore the world of somatids, the somatid cycle, and other facets of pleomorphism,

On such occasions, Dr. Lando indicated that a variety of people with medical backgrounds from Canada and/or the United States would attend those gatherings. They would be instructed in the use of the Somatoscope and be shown, among other possibilities, some of the dynamics of pleomorphic transformations that could be observed with that instrument. However, even though, invariably, those individuals would marvel at what they, via the Somatoscope, were seeing and, therefore, were unable to deny what their eyes and minds were showing them to be real phenomena, nonetheless, they also indicated that they would never be able to divulge what they were seeing when they returned to their respective practices because they would be running the risk of promoting a perspective that countermanded medical orthodoxy and, as a result, this would likely open themselves up to the possibility of being sanctioned or penalized in one way or another by members of that orthodoxy.

A transducer is a process, dynamic, or device which translates one kind of energy into another kind of energy. The energy which is to be translated is referred to as ‘input energy’, while the energy which gives expression to the translated form of the input energy is known as ‘output energy’.

The process, dynamic or device which turns input energy into output energy can serve a variety of functions. For example, a transducer can detect the presence of various kinds of energy (say pressure or thermal) and, then, convert what is detected into an output form of energy (say, electromagnetic) that gives expression to a measurement or sensory signal.

In addition, transducers can be used to capture certain properties or features of the input energy and convert those features into data packets which can be used during subsequent processing or transference dynamics. Alternatively, input energy can be transduced to forms of actuation that impact, move, affect, orient or modulate some phenomenon that lies beyond the boundaries of the transduction process.

Some transducers give expression to only a single kind of process in which one kind of input energy is translated into a certain kind of output energy. Other, more complex transducers are able to combine conversion processes, and, as a result, they can both detect as well as act on what is detected.

Some forms of transducers generate their own energy in order to subsidize the transduction processes which occur within them. Other forms of transducers need to become coupled with external sources of energy in order to be able to run transduction dynamics.

Any number of examples could be given of transducers with which most people, in one way or another, have come into contact. Thus, microphones, tape recorders, photoelectric cells, and various kinds of pressure gauges all constitute transduction devices.

Within the human body, piezoelectric dynamics involve transduction processes in which mechanical pressure, often involving crystalline-like structures in various kinds of tissue systems, can be transduced into electrical currents, Furthermore, when the foregoing sorts of structures are exposed to electromagnetic fields, those fields can be transduced into various kinds of mechanical energy.

Toward the latter part of a previous chapter that touched upon a few themes of Chinese medicine, the notion of ‘Qi’ was introduced and described as making reference to a form of intelligent organization that is believed by practitioners of Chinese medicine to flow through

the body. During the course of the foregoing discussion, the invented term: "prana-nur-qi" also was advanced as a way of acknowledging how different cultural and spiritual traditions all allude to the presence of the same, or a very similar, form of intelligent organization which helps to direct, among other things, what transpires during different facets of life functioning.

Questions were raised during the aforementioned chapter on Chinese medicine concerning the nature of the relationship between Qi or prana-nur-qi and the human body. For instance, is Qi (prana-nur-qi) a form of energy, and, if so, what kind of energy is it, and if it is not any form of energy with which we are familiar (e.g., electromagnetic, strong and weak forces, gravitational), then, how does that form of energy interact with, say, electromagnetic, phenomena?

One possible approach to some of the foregoing questions is to suppose that there might be some sort of transduction process taking place between Qi (prana-nur-qi) and biological processes which enable the intelligent organization of Qi to modulate the manner in which biological dynamics take place. If such transducers existed in the human body, they might take on the form of a separate kind of process or dynamic in which Qi (prana-nur-qi) flows through such a transducer that converts whatever Qi (prana-nur-qi) is into some epigenetic series of communications which would not only organize different metabolic pathways to occur: At the right time, at the right rate, in the right place, in the right amounts, in the right sequence, and for the right length of time, but, as well, would co-ordinate the collective set of those pathways into a functioning, coherent, viable form of living organism.

An alternative to the foregoing possibility that various kinds of separate transducers might exist in, for example, the human body which convert Qi (prana-nur-qi) into different epigenetic forms of molecular and electromagnetic communication would be the possibility that Qi (prana-nur-qi) itself might serve as a transducing, actuating medium that directly modulates epigenetic processes in the body as that intelligent organization flows through the body. If this possibility were the case, currently, we have no idea of how Qi (prana-nur-qi) is capable of modulating that which might be other than Qi (prana-nur-qi).

A further possibility might be that the organizing intelligence of Qi (prana-nur-qi) both acts on biological organisms directly as well as works in co-operation with the presence of separate transducing structures that exist within the body. In other words, there might be some sort of complex relationship involving Qi (prana-nur-qi) and transducing structures within an organism in which, sometimes, Qi (prana-nur-qi) would serve as the transducing medium in some direct fashion, and, on other occasions, Qi (prana-nur-qi) might operate through structures which are geared to transduce Qi (prana-nur-qi) in specific ways within biological organisms.

Leaving aside, at least for now, considerations concerning the possibility that Qi (prana-nur-qi) might serve as its own medium for transducing whatever that medium might encounter during its journey through any given organism, let's consider the idea mentioned earlier that there are separate transduction structures within the human body that convert or translate Qi (prana-nur-qi) into an array of epigenetic forms of communication that underwrite biological metabolism. More specifically, let's consider the possibility that somatids are such transducers.

Naessens has indicated that all manner of remarkable properties are associated with somatids. For example, they are capable of withstanding different extremes (involving temperature, acidic conditions, radiological conditions, and seem to be almost impenetrable), and, one might anticipate that transduction structures would need to be able withstand a variety of conditions if they were to have fundamental, reliable roles to play within different life forms in an assortment of conditions.

Moreover, somatids are pleiomorphic in character. In other words, when appropriately induced to do so by conditions in the surrounding biological terrain, somatids are capable of giving rise to a complex series of both apathogenic and pathogenic forms of microorganisms, and, therefore, they are capable of taking on a multiplicity of functional roles within any given cell, tissue structure, organ, or organism – capacities which seem consonant with the possible existence of a form of intelligent organization (i.e., Qi – prana-nur-qi) which might interact with life forms in a diverse number of ways that would be reflected in the diverse forms which can be assumed by somatids.

In addition, according to the research carried out by Naessens over nearly 70 years, every kind of cell and organism has somatids which are peculiar to those sorts of cells and organisms. Furthermore, somatids – which exist on the nanoscale -- seem to be more basic and fundamental than cells, and one example of its fundamental nature is that when the life of an organism disappears, the somatids in such life forms continue on.

Qi (prana-nur-qi) is considered to be a fundamental form of intelligent organization. If Qi (prana-nur-qi) is transduced by structures within life forms, one might anticipate that the latter structures would have to be able to operate on the sorts of basic levels which Naessens claims might be the case with respect to somatids in order to be able to interact with the intelligent organizing capabilities of Qi (prana-nur-qi).

Naessens maintained that somatids exhibit electrical properties. For instance, there appears to be a positive charge associated with the inner dimension of the particle, while there is a negative charge associated with the exterior portion a somatid.

Furthermore, Naessens notes that the charges associated with somatids tend to be considerably larger than what one finds in cells. For this reason, he suggests that somatids could serve as energy condensers which might have the capacity to underwrite different forms of energy dynamics.

While the nature of that which makes possible the aforementioned charge properties in somatids is unknown – somatids are, after all, pretty much of a black box – nevertheless, the charge properties of somatids some intriguing possibilities. For instance, maybe the foregoing charge properties are an indication that some form of transduction dynamic is taking place within somatids in which each kind of somatid interacts with the flow of Qi (prana-nur-qi) in a somatid's own unique way and translates, or is induced by Qi (prana-nur-qi) to translate, the flow of Qi (prana-nur-qi) through the transducing structure into whatever epigenetic direction is needed by the cells or tissues within which such somatids reside.

Naessens contends that although somatids seem to be able to exist quite independently of life, nonetheless, he does not feel that life without somatids is possible. However, whatever the precise nature of

the relationship, if any, among life, somatids, and Qi (prana-nur-qi) might be, at the present time, that possible relationship is shrouded in mystery.

One might sum up the foregoing set of possibilities as: The Somatid Transduction Hypothesis. This refers to the idea that somatids have a transducing relationship with the fundamental organizing intelligence of Qi (prana-nur-qi) and that such transduction dynamics play fundamental roles in organizing epigenetic dynamics within different life forms.

The microzymas of Béchamp, and the endobionts of Enderlein, and the bions of Reich might all be part of the pleiomorphic life-cycle of somatids which become manifest when the conditions of a given biological terrain are conducive to their manifestation. Furthermore, the nano-protoplasm units which Gilbert Ling explored could play some sort of role in somatid dynamics.

The foregoing hypothesis is rooted in some known things about the nature of somatids as well as some of the properties of Qi (prana-nur-qi). While that hypothesis stands in need of additional evidence beyond what has been given here, nonetheless, it will serve as a working hypothesis that has relevance to the discussions which will occur in subsequent chapters.

If somatids do not serve as transducers for the intelligent organizational capacities of Qi (prana-nur-qi) or some other unknown dimension of reality, then, one is faced with, yet, another mystery. More specifically, if somatids are not performing some sort of transducing dynamics involving Qi (prana-nur-qi) that enables epigenetic dynamics to take place in a viable manner within various life forms, then, what are somatids doing in those life forms, and why do somatids have the properties that they do, and how did somatids come to acquire those properties?

Chapter 15: Energetic Potentials

Dr. Jerry Tennant went through medical school and, eventually trained as an ophthalmologist. At a certain point in his adult life, while practicing as a doctor, he developed encephalitis.

His particular case was extremely serious. He started to experience significant memory problems, as well as had uncontrollable spastic movements, and, for a while, had a bleeding disorder.

In addition, he lost, for the most part, about seven years of his life (1995-2002) when he began to sleep for 16 hours a day. During the remaining eight hours of his day, he had difficulty focusing on much of anything, but he did have approximately a three hour window within the aforementioned 8-hour daily period when he had sufficient cognitive faculties at his command to be able to read a newspaper.

He sought the assistance of medical experts at Harvard and the National Institute of Health. However, they were baffled by his condition.

Dr. Tennant is of the opinion that he contracted encephalitis from one of his patients on whom he was performing Lasik surgery and who was also suffering from leukemia. He believes that a virus, of some sort, escaped from his patient's eye, made its way through his mask, and, then, entered his brain after travelling through the nasal canal.

There is no reliable way to confirm how Dr. Tenant actually became ill. His viral account is, in the absence of any supporting evidence, nothing more than a narrative.

Given that a number of medical experts were puzzled by his condition, one might entertain the possibility that, perhaps, the etiology of his illness could have been something other than what he supposed had been the cause of his condition. In fact, in certain ways, his illness had many of the earmarks of someone who had undergone an encounter with some form -- or forms – of EMF toxicity that either was (were) acute in nature or were chronic and had accumulated over a period of time.

At some point his biological terrain might have reached some sort of a tipping point with respect to the presence of such EMF toxicity. As

a result, his body broke down, and he began to suffer an array of neurological and blood-related problems.

Whatever the etiology of his illness might have been and in the absence of any kind of medical expertise that might have helped him to deal with his difficulties, he started to reflect on how to escape from the pathology that had consumed so much of his life in such fundamental ways. Yet, as noted earlier, he only had about three hours a day in which his brain seemed to work well enough for him to be in a position to try to figure out what to do.

One of his first thoughts was that he believed that all cells of the body worked in a similar fashion. If he could find a way to heal one cell, then, he might have found a way to heal all of his cells.

With that possibility in mind, he purchased some 10-15 books on cellular biology. Apparently, Dr. Tenant was working on the assumption that the basic unit of life is the cell, but as Béchamp, Enderlein, Rife, Ling, Naessens and other proponents of the pleiomorphic/pleomorphic theory of microorganisms indicate, the cell is not necessarily the basic unit of life, and if this is the case, then, Dr. Tenant might have begun his inquiry based on a problematic assumption.

Notwithstanding the foregoing considerations, one of the principles that emerged from the research of Dr. Tenant into cell biology is that all cells appear to be designed to operate within a pH range of 7.35 to 7.45. In effect, he felt that pH describes a form of voltage in liquid form in which electrons had the opportunity, depending on circumstances, to either donate or receive electrons.

The movement of electrons gives expression to physics. From such physics, chemical transactions arose, and so, for Dr. Tenant, physics seemed, possibly, to have a role to play with respect to resolving his physical problems.

According to Dr. Tennant, a pH reader really serves as a voltage meter. Thus, a pH of 7.35 translates into a voltage of -20 millivolts involving the movements of electrons that are being donated, whereas a pH of 7.45 gives expression to a voltage of -25 millivolts that are generated through the process of electrons moving as they are being donated to, or received by, one or another atom or molecule.

By convention, if a particular solution tends to receive electrons, a plus sign is placed before the voltage that is being generated. On the other hand, if such a solution tends to donate electrons, then, a minus sign is placed before the voltage.

Voltage can be converted via a logarithmic scale that will produce results ranging from 1-14. And, as indicated previously, cells operate optimally when the pH of those cells stays between a pH of 7.35 (-20 millivolts) and a pH of 7.45 (-25 millivolts).

In order to maintain the foregoing sorts of cell voltage, cells need energy. -25 millivolts are needed for cells to be able to operate properly, and -50 millivolts of energy are needed for the formation of new cells.

Different cells within the body tend to wear out at different rates. When such cells wear out, they have to be replaced.

For example, cells in the nervous system tend to turn over every 8 months. Liver cells need to be replaced every 8 weeks, while skin cells go through replacement cycles that take place every 6 weeks, or so.

Obviously, energy is needed in order for the foregoing sorts of replacement processes to be able go forward. Moreover, prior to their replacement, in order for cells to be able to last until they are replaced, energy is also required to keep the day-to-day functioning of those cells operational.

For Dr. Tennant, all chronic disease involves, in one way or another, the presence of an inadequate voltage to be able to underwrite or accommodate cellular energy needs. Consequently, whatever the ultimate cause of Dr. Tennant's disease might have been, the bottom line is that according to his perspective, his disease condition emerged as a result of – somehow -- inadequate voltage being present in certain cells, tissues, organs, and so on within his body.

In addition to the energy that is required to maintain cells and to help subsidize the replacement process, energy is also needed to tend to the problems that are caused by environmental toxins such as the glyphosates that come from certain pesticides, or the heavy metals that are present in many products or which are by-products of different manufacturing or industrial processes (for example, the

mercury that is given off as an emission when certain kinds of coal are burned).

Such toxins constitute constant sources of stress on biological systems. As a physician friend of mine pointed out to me with respect to a bout of illness that had befallen me nearly four years ago, most Americans suffer from adrenal insufficiency because their biological systems or terrains are constantly under stress from all the toxins that are being dumped into the environment – including EMF-based environmental toxins.

According to Dr. Tennant, the human body is a movable electronic module. Therefore, it needs access to battery packs that can supply it with the energy it needs to, among other things, move about in the world.

He identifies four such battery packs in the human body. To begin with, the muscles in our bodies serve as rechargeable battery packs.

The fascia -- or band of connective tissue (usually consisting of collagen) that surrounds muscles -- gives expression to an extensive wiring system that runs throughout the body. Piezoelectricity – which arises when mechanical stresses are placed on a given substance and generate a flow of electrons – plays a major role in the energy dynamics of the muscles. (Both of the foregoing issues were explored -- albeit from a different perspective -- during an earlier chapter on Chinese medicine).

Each organ has its own battery pack as a result of the system of muscles that run from our toes to our head. In effect, according to Dr. Tennat, the fascia that surround muscles form semi-conductors.

A semi-conductor is an arrangement of molecules which conduct a flow of electrons in only one direction at the speed of light. These semi-conductors are at the heart of the battery pack recharging system that helps serve the energy needs of the organs with which those semi-conductors are associated.

There are six loops of circuitry involving the system of battery packs that are entailed by the networks of muscles, and surrounding fascia that are found throughout the body. The nature of such circuitry is fairly complex, and every stack of battery batteries can be associated with an acupuncture meridian.

For instance, the Stomach-Spleen battery pack supplies the energy that underwrites the activities of the endocrine system. In addition, the aforementioned battery pack supplies the energy for the reproductive systems in both females and males, as well as supplies energy for the macula of the eye and various kinds of cognitive processes in the brain.

Notwithstanding the complexity of the foregoing sorts of circuitry, there is a process akin to the sort of differential diagnosis process that a car mechanic might go through to figure out where voltage is not being maintained within a computerized vehicle. For instance, one might have to check the levels of the thyroid hormone T3 because this hormone plays a key role in regulating the voltage of every cell membrane in the body.

Or, maybe one will have to check the levels of the T2 thyroid hormone. This hormone has an intimate relationship with what transpires in the mitochondria, and there are many other such checks that can be performed.

According to Dr. Tenant, a second rechargeable battery pack system is located in cell membranes. These battery packs exist in the form of a network of capacitors. Capacitors are able to store energy.

According to some traditional theories, membranes of cells consist, among other things, of two opposing layers of fat cells or phospholipids. The phospholipids are made up from constituents that form two conductors separated by an insulator. By definition, this constitutes a capacitor which is capable of storing electrons.

Research by Herbert Hillman indicates -- during the last fifty years of the 1900s and the first, ten, or so, years of the twentieth century – that the traditional way of characterizing the cell membrane as a tri-laminar structure (consisting of two opposing layers of fat cells or phospholipids) might be an artifact of the methodological procedures used when trying to obtain a micrograph of a cell membrane rather than being a reflection of the actual structure of a cell membrane. A different kind of research conducted by Gilbert Ling also calls the traditional notion of a cell membrane into question.

If the tri-laminar character of cell membranes turns out to be an artifact that is generated by the methods that are used to produce a micrograph of some kind, then, the cell membrane does not consist of

two conductors separated by an insulator. Moreover, if the cell membrane does not consist of two conductors (the phospholipids) separated by an insulator, then, the traditional idea of how cells serve as capacitors for storing electrons is problematic and some other form of capacitor must be found for what takes place within various kinds of tissue (e.g., the liquid dimensions of the body involving structured water which will be discussed a little bit further on in this chapter).

Jerry Tennant maintains that there is a third battery pack system which exists within the mitochondria organelles which populate cells. This battery pack system supposedly uses a complex process of electron transfer involving the formation of ATP (adenosine triphosphate), as well as energy expenditure when ATP is converted to ADP (adenosinediphosphate).

When this battery is charged, reference is being made to the presence of ATP. When the battery stands in need of recharging, then, reference is being made to the fact that ADP has resulted from the donation of an electron to some cellular process and, therefore, needs to undertake a journey back to ATP (i.e., its recharged state).

The recharging process is known as the Citric-Acid or Krebs cycle. For the most part, this metabolic pathway involves taking fatty acids through a series of transitions that generate and transfer electrons in conjunction with the molecular components that make up the cycle, and if oxygen is present during the various steps of the cycle, then, for each unit of fatty acid that is processed by the Krebs cycle, 38 ADP batteries are recharged.

With respect to the foregoing ATP-ADP battery pack, one might wish to keep in mind the research of Gilbert Ling that was explored in an earlier chapter. Among other things, Dr. Ling felt that ATP served a different role in organisms other than acting as an energy source -- a biological role which had to do with protein folding.

According to Dr. Tennant, a fourth form of battery recharging comes through DNA. This involves the dynamics of scalar forces (which, in turn, seem to be connected to the golden mean -- 1.618 – as a function of distance between units that are make up the structure of the helix) that are used by DNA to complete its various tasks of replication, transport, and assembly.

Dr. Tennant contends that chronic disease arises when there is one, or more, failures in any of the foregoing systems of rechargeable battery packs. In other words, such systems cannot sustain an electric charge of the requisite sort (i.e., -20 to -25 millivolts) within the cells of those organ systems.

However, is there any reason to suppose that various kinds of acute diseases – and not just the sort of chronic diseases to which Dr. Tennat refers -- could not also arise as a result of, for whatever reason, some sort of loss of voltage in one, or more, of the four battery pack systems within the human body. Both chronic and acute diseases might arise as a result of the presence of some kind of environmental toxin – such as tend to be generated through EMF-based forms of technology that spill dirty or jagged, pulsed forms of electricity into the environment on a constant basis.

Dr. Tennant notes that the energy recharging stations of the body are wired up like many circuit boards in computers. Many of the latter circuit boards make use of Tesla resonating circuits.

A Tesla resonating circuit consists of a capacitor (energy storage) and a coil (conductor), and each is wired in parallel. When the foregoing kind of an arrangement exists, the circuit has the capacity to communicate (in the language of electro-magnetic interactions) with other kinds of Tesla circuits, irrespective of whether such circuits are part of some sort of external form of wiring, or they are part of the circuitry involved in the purported energy recharging stations of the body.

Consequently, resonance interactions that occur between what is transpiring electronically outside the body and what is taking place electromagnetically within the body could be taking place. These sorts of resonance interactions might play a role in undermining the way the energy recharging systems in the body operate and could be part of the reason why voltage might be lost as such systems are engaged by environmentally toxic systems of EMF-based technology in problematic and destabilizing ways.

There is a great deal of quality work that has been done concerning the biological toxicity which is being generated through EMF-based forms of technology by, among others: Arthur Firstenberg (and all the many individuals about whom he writes in *The Invisible*

Rainbow who have made fundamental contributions to this work); Elana Freeland (*Under and Ionized Sky* and *Geoengineered Transhumanism*); Robert Becker and Andrew Marino (e.g., *Electromagnetism and Life*); Daniel T. DeBaun and Ryan DeBaun (*Radiation Nation*); Samuel Milham (Dirty Electricity); Dr. Devra Davis (*Disconnect: The Truth About Cell Phone Radiation, What the Industry is Doing to Hide It*), as well as the work of Olle Johansson, Dr. Martin L. Pall (who has shown how EMF adversely affects human and animal biology by interfering with voltage gated calcium channels) and many, many others.

However, just as certain forms of electricity are harmful to, and destructive of, biological processes, there also are forms of electricity that can have constructive impacts on helping the body to repair whatever might be causing a loss in voltage within various battery packs. The research of Dr. Carolyn McMakin (*The Resonance Effect*) is just one example of how to go about restoring the health of someone's biological terrain through the administration of appropriate electrical frequencies.

Dr. Tennant has invented what is known as a BioModulator which is capable of recharging the ATP-ADP battery pack process. He also indicates that different muscle battery recharging packs can be treated by using various kinds of patches on the bio-terminals of what is known as a BioModulator.

When the cells in tissue are damaged by, for example, some form of EMF-based toxicity, the tissue goes to -50 millivolts which is well outside the parameters of optimal cell functioning. This in turn causes the arterials running through such tissues to dilate, which, in turn, gives rise to the symptoms of inflammation (such as temperature heat, swelling, redness, and pain).

If the battery charging system associated with adversely affected tissue cannot provide the necessary voltage which is capable of underwriting the energy costs of repairing damaged tissue, then, a person might transition from some sort of acute condition of disease to a more chronic form of that disease as a result of a continued absence of the voltage which is necessary for healthy cell, tissue, and organ functioning.

As voltage is dropping, oxygen levels also will begin to lower. To a large extent, the efficiency with which metabolism takes place is controlled by the relative presence, or absence, of oxygen.

The amount of oxygen that might be available is controlled by the degree of voltage that is present. As a result, this can have problematic consequences for the amount of ATP which is available for subsidizing the biological activity that takes place with the cells of tissues and organs.

When the body is healthy, oxygen levels help to suppress the tendency of the bacteria within us to generate digestive enzymes that will dissolve cellular material in order for the bacteria to be able derive the nutrients that such bacteria need. As voltage and oxygen levels drop, bacteria tend to lose their cell membranes and become cell-wall deficient organisms – or stealth pathogens (a form of pleiomorphism) – which begin to generate various kinds of toxins that are capable of damaging the cells and tissues with which those toxins come in contact.

Such toxins can produce a variety of symptoms. These symptoms range from: Headaches, and a fever, to: Vomiting, diarrhea, as well as different kinds of joint pain, depending on the tissues being affected by the presence of such toxins.

If the voltage becomes sufficiently low –- say in the vicinity of +30 millivolts) other entities begin to show up. For instance, this might involve the emergence of cell-wall deficient fungi which present their own problems for a struggling biological terrain.

The foregoing findings are consistent with the research of Gaston Naessens that were touched upon in the previous chapter. In addition, such findings are also consistent with the research findings of Béchamp, Enderlein, Rife and Reich which have been explored in previous chapters.

What starts out, for instance, as some kind of EMF-based form of environmental toxicity, could, in time – as a function of the loss of voltage, along with the emergence of toxins that bacteria or fungi might produce -- lead to a whole host of other problems that are capable of affecting different systems within one's body -- neurological, respiratory, blood processes, metabolism,

energy/voltage levels, and so on. All of the foregoing issues start – whether acutely or chronically – with a loss of voltage which EMF-based technologies (and other kinds of environmental toxins) are capable of bringing about under the right set of circumstances.

The foregoing seven or eight pages provide an overview of Dr. Tenant's perspective concerning the energy of life. It gives expression to a theoretical model that seeks to organize an array of data involving energy dynamics within the human body.

There are several alternative ways of engaging the data which Dr. Tenant is trying to organize that might resonate with certain facets of his perspective and, yet, go about the process of energy dynamics in a different manner. For example, one might try to account for the energy of life by looking at the dynamics of water within living organisms.

Pursuing alternative kinds of critical reflection concerning the issue of energy within the body, need not necessarily negate what Dr. Tenant is advancing. Instead, looking at the dynamics of water within living organisms – human or otherwise – might complement what Dr. Tenant is claiming as well as introduce some ideas concerning the energies of life that might even be more fundamental than the principles which were advanced during the foregoing overview involving the theoretical perspective of Dr. Tenant.

During the early part of his book: *The Fourth Phase of Water: Beyond Solid, Liquid, and Vapor*, Gerald Pollack mentions the name of Gilbert Ling a number of times. For example, on the book's dedication page Dr. Pollack acknowledges how Gilbert Ling introduced the author to the idea that the behavior of water within the biological terrain is quite unlike the way in which water behaves in a cup.

A short while later in his book, Dr. Pollack notes how Gilbert Ling invented the glass microelectrode which was an invaluable tool in electrophysiological research. Among other things, the glass microelectrode helped to generate evidence which indicated that -- contrary to existing models and theories concerning the cell -- water operated in accordance with various principles of structuring that conventional theory had not only missed.

If Ling's research in this area were accepted, then, the manner in which biologists might view what went on within a cell would become altered substantially. They would be induced to shift their focus from the dynamics of molecules within a liquid medium to the dynamics of water and how the latter dynamics affected molecular transactions that took place within that medium (Recall, if you will, the importance which water played in the structuring of nano-protoplasm units – Gilbert Ling's fundamental unit of life – that was explored somewhat during the previous chapter on Ling.

Within a few more pages, Gilbert Ling is mentioned for a third time in the aforementioned book when Dr. Pollack points out how many, if not most, scientists of that time did not embrace the innovative research of Dr. Ling. Instead, they tended to reject him and sought to persuade people like Dr. Pollack that becoming associated with Dr. Ling or his research was not a good career move and was likely to sully one's professional reputation.

Thus, Dr. Ling inspired Dr. Pollack in two important ways. On the one hand, the focus of Dr. Ling's research substantially influenced various facets Dr. Pollack's own, subsequent, research, and, on the other hand, Dr. Pollack's perspective also was shaped by the courage and integrity displayed by Dr. Ling while challenging some of the scientific theocracy that was observed during the times in which the latter individual lived.

As a result of the foregoing sorts of inspiration, Dr. Pollack believes that like the notion of epicycles that was employed in an attempt to save the appearance of Ptolemaic theory when the latter offered explanations that were inconsistent with what was indicated through direct observation of the heavens, Dr. Pollack believes that theories of water have become too burdened by epicycle-like dynamics which have become bogged down in a collection of ad hoc beliefs that have been assembled into a theoretical edifice which is at odds with what can be observed when water is studied directly. Therefore, rather than merely becoming entangled in processes which did little but add ever more epicycle-like ideas which distort one's attempt to understand the nature of water, Dr. Pollack wanted to simplify the study of water by moving away from uncorroborated, ad

hoc, theory-driven notions of water and, instead, move toward an empirically or observationally-driven investigation of water.

Although most everyone knows that the chemical formula for water is H_2O, the actual structure of water has been the subject of a considerable amount of debate. Dr. Pollack begins his foray into that debate by distinguishing between two kinds of water, namely: bulk water and structured water.

Bulk water is what one might encounter when one fills up a cup from the tap. Structured water, on the other hand, entails a variety of characteristics that tend to remain hidden in ordinary tap water.

For example, when water is juxtaposed next to some material that has hydrophilic properties – that is, the material is water-loving – then, an Exclusion Zone (the term was introduced by John Watterson, an Australian) emerges in such water. This zone – as the associated term indicates – excludes almost everything from that sector of water, and in the process of doing so, generates a separation of charge in which the exclusion zone is shaped by the presence of negatively charged electrons, while positive charges (to be discussed shortly) are pushed away or repelled from the place where the negatively charged exclusion zone is adjacent to the aforementioned hydrophilic surface.

Technically speaking, Exclusion Zones are never completely free of contaminants. However, experiments have been done by Dr. Pollack and others which indicate that there is an inverse relationship between the size of the Exclusion Zone and the extent to which contaminants are present, and, therefore, the fewer contaminants that are present, then, the larger the Exclusion Zone tends to be, while the greater the relative degree of contamination that is present, then, the smaller the associated Exclusion Zone tends to be.

Another factor which affects the size or robustness of a given Exclusion Zone involves the character of the hydrophilic surface that serves as the nucleation site for the emergence of such an Exclusion Zone. Hydrophilic templates that are robust tend to give rise to exclusion zones which reflect that robustness, but there are a number of factors -- such as the structural character of that template or the extent to which contaminants are present -- which also can affect the properties of an Exclusion Zone.

In bulk water, exclusion zones do not form. Moreover, there is a relative absence of charge in bulk water, or, said in a slightly different way, the molecules in bulk water have a neutral charge in which the two atoms of hydrogen cancel out the charge of the single atom of oxygen.

When water becomes structured, then, the protons within water tend to become organized in certain ways that are in response to the way in which the Exclusion Zone forms and becomes negatively charged. This results in the formation of positively-charged hydronium ions (H_3O^+).

Furthermore, just as negative charges have degrees of freedom that govern their movement within the Exclusion Zone, so too, hydronium ions (H_3O^+) have the capacity to move about to varying degrees within their own region of activity. The respective movements of the two kinds of charges can affect both the size of the Exclusion Zone as well various kinds of dynamics that might occur along the boundaries which demarcate the Exclusion Zone and the adjacent region of positively charged hydronium ions.

In effect, the hydrophilic surface, plus the negatively charged exclusion zone, plus the presence of hydronium ions creates a battery. The Exclusion Zone is populated with negatively charged electrons, and it is book-ended by a hydrophilic surface on one side and a zone of hydronium ions (H_3O^+) on the other side, and the foregoing separation of charge (the battery) can be maintained if it is suitably charged.

For instance, when radiant energy (e.g., from the sun or some other source) engages the foregoing battery, the battery becomes charged. Part of the foregoing radiant energy helps to maintain the separation of charge that constitutes the battery.

The negatively charged Exclusion Zone has the capacity to form a series of layers. Each of these layers consists of a repeating sequence of honeycombed-shaped structures made up of oxygen and hydrogen molecules that lend a crystalline-like character to those layers.

The aforementioned honeycombed layers stack one on top of another in parallel fashion relative to the hydrophilic surface that serves to nucleate the structuring process within water. The negative charge which characterizes the Exclusion Zone is a function of the way

the honeycombed sequences come together as various layers of those sequences are formed.

More specifically the honeycombed, hexagonal character of the foregoing layers was due to a conclusion that was drawn on the basis of an array of different kinds of physiochemical data. This data consisted of measures involving freezing points, density considerations, diffraction patterns, boiling points, as well as spectral analysis of the frequency properties that are present in structured water. When considered as a whole, the foregoing data was consistent with, and seemed to point in the direction of, the idea that a latticework of hexagonal structures seemed to characterize the Exclusion Zone.

The lattice that is formed by the repeated hexagonal units which make up any given layer of the Exclusion Zone consists of a ratio of three molecules of hydrogen to two molecules of oxygen, and, therefore, every hexagonal unit carries a negative charge. This is why, collectively speaking, the Exclusion Zone as a whole is negatively charged.

Another one of the properties that is associated with the foregoing sort of hexagonal or honeycomb lattice structures is that those layers have the capacity to slide by one another in different conditions or circumstances. This means that the interactive dynamics between layers tends to entail a low degree of friction which could affect the sorts of dynamics that might occur within structured water.

For instance, when a given latticed layer within the Exclusion Zone interacts with the layers above and below it, there are a variety of ways in which those layers can be stacked one on top of the other. These variations are due to the way in which areas of negative and positive charge on one layer align with negative and positive regions of adjacent layers as they slide by one another, and such variations can lead to an array of different kinds of localized dynamics within such water depending on prevailing circumstances.

When the bond angles that are present in structured water have been examined, they have been shown to differ from the bond angles that are present in water when it is in a liquid, gaseous, or solid phase. This issue of bond angles is one of the reasons why structured water is considered to be the fourth phase of water.

In addition, when electrons are able to move through a latticework fairly freely, they usually exhibit the property of being able to absorb ultraviolet wavelengths in the order of 270 nm. This property shows up in different kinds of materials that consist of hexagonal arrangements, and, consequently, when the Exclusion Zone in water was experimentally demonstrated to absorb ultraviolet wavelengths at 270 nm, this was another indication that the structure of the latticework appeared to be hexagonal in nature.

One might also note in passing that some individuals might question whether appreciable amounts of hexagonal-shaped layers of a crystalline-like latticework would be able to form given the existence of different kinds of thermal agitation which might be present within cells or tissue. Dr. Pollack points out that the more that such layers accumulate, then, the less likely will the dissipating force of thermal agitation tend to arise because those layers actually have a dampening down-like effect on the activity of those sorts of forces.

Before moving on, one might also note that the layers of hexagonal-shaped latticework that arise within structured water play a fundamental role in helping the Exclusion Zone to develop and expand. More specifically, on the one hand, the hexagonal-shaped structures which make up the latticework are quite narrow and, therefore, tend to exclude most solutes from entering into the Zone, and, on the other hand, the different layers tend to not be lined up with the layers to either side of them, and, as a result, this also tends to keep most solutes – including hydronium ions -- from being able to enter into the Exclusion Zone.

Although most of Dr. Pollack's book explores the Exclusion Zone as a region that is characterized by a negative charge, he also points out that positively charged Exclusion Zones are not only theoretically possible but have been empirically demonstrated to exist. Such zones were discovered to have occurred in conjunction with the presence of certain kinds of metals and polymers.

Although positively charged Exclusion Zones appear to be less common than negatively charged Exclusion Zones, nonetheless, the reality of such a possibility tends to induce one to ask certain kinds of questions. For example, is it possible (given the right nucleating surface within any given biological terrain – say, in conjunction with

various metals which occur naturally or which have entered a given biological terrain via some sort of medical injection or environmental poisoning) that positively charged Exclusion Zones might form which could have various kinds of impact (either constructive or problematic) on that terrain?

The properties of positively-charged Exclusion Zones appear to be the inverse of what is observed in conjunction with negatively-charged Exclusion Zones. However, experiments also have demonstrated that due to the relative absence of oxygen in positive Exclusion Zones, those zones tend to be more susceptible to breaking down or dissipating than negatively charged Exclusion Zones.

Nevertheless, given the right set of circumstances, if positively-charged Exclusion Zones were to occur in biological terrains, and if those zones were inclined to dissipate more readily than is true in relation to negatively-charged Exclusion Zones, then, one wonders about whether, or not, the presence of those sorts of fragile systems still might have the capacity to destabilize some facet of the biological terrain in which they form and, in the process, induce certain elements within the microbiome to transition away from a normal symbiotic relationship with that terrain and, in the process, give rise to some kind of pathological condition.

The foregoing consideration seems especially relevant topics for critical reflection given the extent to which environmental pollution has been occurring for quite some time in different parts of the world. Increasingly, various kinds of heavy metals have been finding their way into the bodies of all manner of living organisms, and, consequently, given the presence of those metals – along with an array of different synthetic polymer compounds that have been permitted to be dumped into the environment without any sort of adequate safety tests taking place – one wonders if such metals and synthetic polymer compounds might be involved in the emergence (even if only for relatively short periods of time) of potentially problematic positively-charged Exclusion Zones within living organisms.

On the other hand, one might also reflect on the possibility that positively-charged Exclusion Zones could arise in conjunction with (that is, be nucleated by) naturally occurring metals that are in the body, or Exclusion Zones might arise in conjunction with molecules

(for example, proteins) that contain some sort of metallic ionic component, such as zinc, which are known as metalloproteins, and these sorts of molecules occur fairly frequently in living organisms. The bioelectric and biomagnetic currents which occur in different aspects of the biological terrain might not just be generated through the formation of the batteries that are entailed by the sort of structured water which is characterized by a negatively charged Exclusion Zones, but, as well, such bioelectric and biomagnetic currents might be generated through the formation of batteries that arise in conjunction with positively-charged Exclusion Zones.

There could be a multiplicity of possibilities involving the kinds of constructive electrical circuitry that are possible within the context of any given cell, tissue, or organ. While the majority of the localized batteries that give expression to such circuitry might be a function of negatively-charged Exclusion Zones, and even though positively-charged Exclusion Zones might have a tendency to dissipate more easily than their negatively-charged counterpart, nevertheless, positively-charged Exclusion Zones could have a role to play within the dynamics of bioelectric and biomagnetic phenomena as a result of the batteries that come into play within the biological terrain.

At one point early on in his delineation of the properties of structured water, Dr. Pollack introduces terms such as “droplets” of water, “bubbles”, as well as “vesicles” and, then, differentiates the use of those terms. Thus, whereas (1) a droplet consists of a positively charged interior surrounded by a negatively charged Exclusion Zone, (2) a bubble has, with one exception, the same structural properties as a droplet and that exception is that its interior consists of some sort of gas, usually in the form of water vapor, and (3) the term “vesicle” is a generic way of referring to both droplets and bubbles with the proviso that when a sufficient amount of energy is transferred to a droplet, the latter becomes a bubble because the interior is transformed into some sort of gas, usually in the form of water vapor.

Starting with hydrophilic surfaces to which water is adjacent, and proceeding on through: (a) The creation of negatively charged Exclusion Zones that become structured into crystalline-like layers of honeycombed sequences made up of two oxygen and three hydrogen molecules that preferentially absorb ultraviolet wavelengths of 270

nm and which can be stacked in a variety of ways involving forces of attraction and repulsion that can lead to different kinds of localized dynamics; (b) the simultaneous formation of a zone of hydronium ions (H_3O^+); (c) the separation of charge that exists between the Exclusion Zone and the zone of hydronium ions that possesses battery-like properties; (d) the maintaining of that separation of charge through the influx of some source of radiant charge; (e) the possibility of there being both negatively-charged and positively charged Exclusion Zone-based battery systems that occur in cells as well as tissues, and, finally, (f) the notions of droplets of water, bubbles, and vesicles, then, Dr. Pollack has introduced a network of ideas that can be used to explain an array of water-related phenomena which have mystified many observers for decades. For example, the foregoing ideas can be used to account for why gelatin preparations, which consist mostly of water, don't leak water, or why tsunami waves are able to sustain themselves over long distances whereas ocean waves tend to dissipate within relatively short distances.

The foregoing ideas also can be organized to account for how warm water can be used to induce an ice cream mix to freeze more quickly than would be the case if one were to use cold water. Alternatively, when properly understood, the foregoing ideas are able to plausibly explain why some of the water in a person's body's rushes to a destabilized area of the biological terrain during the process of inflammation, as well as account for the forces that enable water to reach the top of a 300-foot Redwood tree without breaking the capillaries that transport that water, as well as provide a possible explanation for how certain lizards are able to walk – or run – on water.

Different chapters of *The Fourth Phase of Water* by Gerald Pollack are devoted to not only generating answers to the foregoing issues, but, as well, various chapters of that book also explore other equally interesting phenomena involving water that some people might have thought were understood on the basis of previously developed theories concerning the nature of water but which, with the right kind of critical examination, can be seen to involve principles other than the ones which had been presumed to be true with respect to those kinds of phenomena. By critically reflecting on a series of problems such as

those noted above and which can be understood through the appropriate use of the aforementioned itemized list of ideas or principles [see entries (a) through (f) on page 498] that are present in structured water, Dr. Pollack assists readers to develop a deeper insight into how water might be operating in the context of everyday life – including the biological events that give expression to that life.

While the foregoing comments allude to an array of interesting phenomena involving water, none of those topics will be pursued in what follows. Dr. Pollack addresses all of the those issues, as well as many more, in his aforementioned book, and there is a lot on which to reflect if one takes the conceptual journey that is being mapped out in his work.

Instead, the plan for this chapter has been to introduce enough information about the dynamics of structured water to lend plausibility to two principles that I believe are actively present in the biological terrain … principles which are consistent with everything that has been said up to this point in my book. The two principles that are being alluded to are: (1) the dynamics of structured water constitute a primary source for the energy that either helps subsidize or takes the place of the different kinds of battery packs that were outlined when providing an overview of the work of Dr. Jerry Tennant in the first part of this chapter; (2) the dynamics of structured water within living organisms are organized by the epigenetic capacities that have been hypothesized to be present in microzymas, endobionts, or somatids (The Somatid Transduction Hypothesis). Or, said in another way, epigenetic processes (according to the blueprint of order that is inherent in, for example, somatids) are initiated or triggered by introducing various kinds of hydrophilic molecules (such as proteins) into different facets of cellular and tissue functioning in order to generate the energy-producing batteries that are present in structured water.

The foregoing dynamics enable metabolic transactions to take place in a manner that is directed toward engendering a condition of detoxified stability within any given biological terrain. In other words, the foregoing processes maintain or re-establish symbiotic relationships within a given biological terrain as well as in conjunction with the microbiome which occupies, or interacts with, that terrain.

Part of the foregoing process of generating detoxified stability involves the manufacture and distribution of energy in a way that helps maintain the basic voltage necessary for cells to function properly that was stressed by the Jerry Tennant material. As indicated previously, in human beings, this voltage value runs from between -20 to -25 millivolts (and is associated with a pH of, respectively, 7.35 (-20 millivolts) and a pH of 7.45 (-25 millivolts).

The foregoing voltage and pH values are part of the blueprint through which the specialized somatids, endobionts, or microzymas which (according to Béchamp, Enderlein, Rife, Reich, and Naessens) populate the cells and tissues of different organs and which govern the dynamics that take place in those sectors of a given region of biological terrain. Those dynamics give expression to an array of adaptive learning processes that are regulated by the epigenetic programs and algorithms which are present in the hypothesized blueprint with somatids, endobionts, or microzymas that set the voltage of life values which Jerry Tennat maintained were crucial to properly functioning cells.

Dr. Tennant also indicates that the electrical dynamics involved in the circuits of life could have semi-conductor like properties associated with some of those circuits. Interestingly, Dr. Pollack notes that the existence of various kinds of contaminants (which he believes can never be entirely removed) which are present in and around the Exclusion Zone could give expression to the activity of an n-type semiconductor under the right conditions.

A semiconductor exists when certain kinds of electrical conductivity are present within a crystalline-like structure. An n-type semiconductor is created when an impurity (contaminant) of some kind is added to a semiconductor which affects the manner in which that latter structure conducts electricity.

Earlier, mention had been made concerning the possibility that positively-charged Exclusion Zones might occur within the biological terrain and how both constructive and problematic properties could be associated with those sorts of Exclusion Zone-based batteries. During that discussion, the notion of metalloproteins was introduced in passing, and, conceivably, those sorts of metalloproteins, along with

other kinds of metallic molecules, could form n-type semiconductor-like dynamics within cells.

In addition, while previously exploring some of the dynamics associated with the cell-membrane battery-packs that have been proposed by Dr. Tennant, a possibility was mentioned in which the tri-laminar character of cell membranes might not be correct and, instead, such a structure might actually constitute an artifact that is generated by the methods which are used to produce a micrograph of some kind. If this is true, then, contrary to what is claimed by Dr. Tennant concerning the issue of cell-membrane related battery packs, those membranes might not consist of two conductors separated by an insulator, and, consequently, if cell membranes do not consist of two conductors (the phospholipids) separated by an insulator, then, according to the model of Dr. Tennant, no capacitor would be available to store electrons.

However, Dr. Pollack's notion of a battery pack that is formed through the emergence of the separation of charge [between, say, a negatively charged Exclusion Zone and a zone populated largely by positively-charged hydronium ions (H_3O^+)] does exhibit properties which might entail a capacity to conduct currents as well as to store electrical charge. Therefore, there are elements present in structured water which might have capacitor-like qualities capable of conducting and storing electrical charges within cells and tissues that are quite independent of whatever dynamics might, or might not, occur in relation to cell membranes.

Dr. Thomas Cowan mentions something similar in his book: *Cancer and the New Biology of Water*, when he indicates how Gilbert Ling critiqued the traditional notion of a sodium-potassium pump. Dr. Ling claimed that such a pump was actually a function of the properties inherent in structured water rather than being a function of the dynamics of proteins that, supposedly, are located on, or which extend through (as transmembranes) any given cellular membrane.

When discussing the kind of sodium-potassium pump which has been proposed by Gilbert Ling, Dr. Cowan suggests that such a process does not require energy in order for the formation of structured water to be able to take place. If, by the foregoing suggestion, Dr. Cowan is

indicating that no extra energy is required for those dynamics to occur, then, I would agree, but, perhaps, a certain clarification is needed.

For example, in order for an Exclusion Zone to be generated, some sort of hydrophilic surface must be present which one cannot assume just materializes ex nihilo but, presumably, that surface is present through the expenditure of some kind of energy. Furthermore, the force of attraction which is present in the phenomenon that makes something hydrophilic also gives expression to a form of energy which is being expended as water and that surface interact.

In addition, the forces of repulsion which come into play during the creation of the Exclusion Zone and which maintain a separation of charge also give expression to a process of energy transactions that are taking place. Moreover, the formation of the hexagonal latticework that characterizes the Exclusion Zone, together with the formation of hydronium ions along the periphery of that zone, also involves energy transactions.

If the foregoing arrangement of energy transactions is induced to dissipate, then the dynamics of structured water will disappear. Therefore, while no extra energy is needed to induce those dynamics to take place once the right set of conditions are present, nonetheless, those conditions and the dynamics to which they give rise are all different modalities of energy transactions.

According to Dr. Cowan (and also see Chapter 10 in the present book), Gilbert Ling proposed that there are certain molecules known as “cardinal absorbents” which are capable of triggering or inducing phase changes in various aspects of cellular water. As noted previously in this chapter, such phase-changes tend to lead to the formation of negatively charged (usually) Exclusion Zones in which positive charges (i.e., hydronium ions), are relatively absent or separated (excluded) from the foregoing zones. This separation of charge establishes the conditions necessary for the emergence of a battery that can bring about the removal of sodium from a given cell while, simultaneously, potassium becomes concentrated in that cell.

Although Dr. Cowan discusses how trigger molecules can alter the phase properties of water within cells, he doesn’t appear to indicate what regulates the presence or absence of those sorts of molecules. One might suppose, however, that the dynamics of those kinds of

triggering molecules are regulated by the epigenetic instructions that are being issued through the presence of somatids, endobionts, or microzymas within cells and tissues, and, as a result, different facets of cells or tissues can be induced to change the localized phase character of water in a given region by introducing the appropriate triggering molecule at the right place and at right time which would set in motion whatever kind of structured water dynamics were needed to carry out a given biological operation or set of operations in that region or locale.

According to Dr. Tennant, there is an additional battery pack system that exists within the body that is associated with the mitochondria which populate the cytoplasm of cells. As previously noted, this battery pack utilizes a complex process of electron transfer, known as the Citric-Acid or Krebs cycle.

For the most part, the foregoing cyclical, metabolic pathway involves taking fatty acids through a series of transitions that generate and transfer electrons in conjunction with the molecular components that make up the cycle. If oxygen is present during the various steps of the cycle, then, for each unit of fatty acid that is processed by the Krebs cycle, 38 ADP (Adenosinediphosphate) batteries are recharged into Adenosine triphosphate (ATP), and, the latter molecule, is used to subsidize various kinds of energy requirements within cellular, tissue, and organ dynamics.

However, in the aforementioned book by Thomas Cowan – i.e., *Cancer and the New Biology of Water* – the author indicates how Gilbert Ling contends that the traditional understanding of the Krebs cycle as the power plant of a cell is misguided. According to Ling, and contrary to the opinion of many scientists, the Krebs cycle does not generate ATP (adenosine triphosphate) as a means of providing energy to run various metabolic pathways within the cell.

Instead, Ling proposes that the function of ATP is to help proteins to unfold in ways that enable those proteins to bind with, or interact with, different regions of structured water within the cell. The energy that actually makes biological processes possible is a function of the batteries that are generated when the appropriate sort of triggering mechanism induces Exclusion Zones to form, which, in turn, lead to a separation of charge (i.e., battery formation) between the negatively

charged (usually) Exclusion Zone and the adjacent regions that have become populated with positively-charged hydronium ions.

In order to provide a sort of proof of concept notion concerning the idea that the role of ATP in the cell involves unfolding proteins rather than offering a source of energy that, supposedly, operates biological functions within the cell, Dr. Cowan refers to the way in which the making of Jell-O utilizes heat to unfold gelatin proteins so that the latter molecules will bind with water in order to help create a viscous gel-like condition which will form when that mixture is subsequently cooled. For Ling, and Dr. Cowan, ATP serves the same function in cells as heat does in the making of Jell-O, and, therefore, ATP helps proteins to unfold so that they can bind with water and help shape the dynamics that will occur in and around the gel-like conditions that emerge in conjunction with structured water.

Although Dr. Cowan does not directly address the following issue (however, he does speak of "the life force of the organism"), one might suppose that just as earlier the idea had been introduced which suggested that the epigenetic dynamics inherent in somatids, endobionts, or microzymas (which, Naessens, Reich, Enderlein, and Béchamp did consider to be the life force of organisms) are responsible for regulating the triggering dynamics involving what Ling referred to as cardinal absorbents, so too, the epigenetic dynamics that are inherent in somatids, endobionts, or microzymas, might also control how, where, and when the ATP that is produced by the Krebs cycle will be used within any given aspect of the biological terrain. Presumably, a certain degree of efficiency would be introduced if one were to suppose that the same epigenetic center of command and control which is responsible for regulating the activities of triggering molecules also would be responsible for the dynamics of the ATP production that provide the mechanism through which different proteins are able to unfold so that such proteins can interact in appropriate or necessary ways with the structured water that has been triggered to arise in different localized areas of cells, tissues, or organs.

Another proposal which formed part of Dr. Tennant's battery pack theories concerned sources of energy that might be available to the body for purposes of maintaining the voltage of life (outlined in the

first part of the present chapter) has to do with the notion of scalar forces which Dr. Tennant indicates are generated in conjunction with DNA. Supposedly, these sorts of forces lead to, or, are somehow associated with, the emergence of battery packs that are used by DNA to complete various tasks of replication, transport, assembly, and so on.

One issue connected to the foregoing has to do with whether, or not, the foregoing kinds of scalar forces are actually capable of generating the requisite batteries, circuitry, and storage capacities that might be necessary be able to fully subsidize the genome's capacity to underwrite an array of tasks involving transcription, transportation, translation, as well as the epigenetic processes that shape the way in which the DNA code is to be parsed. Another issue present in the foregoing scenario involves asking the following question: Why not just suppose that structured water is able to occur in the regions where the genome resides and, if this were to occur, then, that water would be fully capable of providing the localized sorts of battery-generated currents, circuits, and electrical storage properties that are needed for whatever sorts of DNA-related activity takes place, and, therefore, if the foregoing were the case, there would be no need to posit a scalar-oriented set of forces that regulates various functions associated with the expression of genes?

The comments in the previous paragraph are not intended to indicate that such scalar forces do not exist in relation to molecules of DNA. Rather, the intent is to suggest that acknowledging the possible presence of those sorts of scalar forces is not the same thing as demonstrating how those forces would not only be able to generate or become associated with a system which would be capable of providing the energy that subsidizes genome-related activities but, as well, would take place within a system that was capable of regulating the use of such energy during processes of transcription, translation, transportation, assembly, and so on.

As noted earlier in the chapter, Dr. Tennant maintains that, in one way or another, all chronic disease involves the presence of an inadequate voltage (i.e., something other than being maintained between the -20 and -25 millivolts that are needed to underwrite or accommodate the sorts of cellular dynamics which generate health).

Consequently, whatever the ultimate cause of a given form of chronic disease might be, nevertheless, according to Dr. Tennant, somewhere during the course of life that condition emerged as a result of the presence of an inadequate voltage in various cells, tissues, or organs.

The perspective being put forth by Dr. Pollack is not inconsistent with the foregoing general position that is being proposed by Dr. Tennant. However, Dr. Pollack – along with Gilbert Ling, Thomas Cowan, and others – are proposing that, among other things, the problems associated with the existence of an inadequate voltage might be a function of various kinds of pathological dynamics that are undermining conditions which are conducive to the formation of structured water within cells, tissues, or organs.

If one were to add some of the considerations that are to be advanced during the next chapter on epigenetics to the foregoing perspective concerning structured water, then, one might suggest that both acute and chronic diseases occur when the process of forming regions of properly functioning structured water within cells, tissues, and organs becomes dysfunctional due to way in which the epigenetic communication between, on the one hand, somatids, endobionts, or microzymas and, on the other hand, water within the biological terrain is being interfered with or undermined in some fashion. In other words, in order for a condition of detoxified stability to exist in which the biological terrain of an organism is in symbiotic balance with the microbiome that occupies that terrain, then, a healthy form of communication must be maintained between the 70% of cells that consists of water and the epigenetic system that might be being transduced through somatids, endobionts, or microzymas that are being hypothesized to be responsible (via the intelligent organization of Qi – prana-nur-qi) for regulating the formation of regions of structured water within cells through processes of "frequency following response".

As noted previously in the present chapter – Dr. Tennant believes that the four proposed energy recharging stations of the body are wired together like many circuit boards in computers. He believes that those kinds of circuit boards establish conditions which constitute Tesla resonating circuits.

According to Dr. Tennant, a Tesla resonating circuit consists of a capacitor (energy storage) and a coil (conductor) being wired in parallel. Consequently, there appears to be nothing that is required to form a Tesla resonating circuit which, at least in principle, might not also be found in the way in which different regions of structured water within a cell could be linked or "wired" together to form parallel circuits that involve both the property of conduction (i.e., a coil) and the property of energy storage (i.e., a capacitor) and, therefore, constitute a Tesla resonating circuit.

Dr. Tennant maintains that those resonating circuits have the capacity to communicate (via frequencies) with other kinds of Tesla circuits. These resonating circuits could be part of some sort of external form of electronic circuitry in, say, a weapon (which was seeking to induce "frequency following responses" in targeted individuals) or those Tesla resonating circuits might be part of the energy dynamics that exist within the body both in the form of epigenetically linked regions of structured water, as well as in the form of the transduction dynamics that might be taking place within somatids, endobionts, or microzymas and which epigenetically communicate with or regulate (via frequencies) the formation of regions of structured water within cells, tissues, and organs that carry out an array of biological functions or give expression to various kinds of metabolic pathways.

The notion of structured water seems to be immersed in the dynamics of frequency following responses. For instance, this seems to be taking place when (through, for instance, the release of triggering molecules) the dynamics of phase changes that give rise to structured water are set in motion by means of the epigenetic processes (which, among other things, govern the activity of triggering molecules) that are organized through the transduction dynamics of somatids, endobionts, or microzymas, thereby, creating conditions within the biological terrain which will entrain an array of biological molecules within cells, tissues, and organs to respond to the epigenetic programming that is regulating cell, tissue and organ dynamics at the behest of fundamental units of life – namely, somatids, endobionts, or microzymas – in accordance with the organizing intelligence to which Qi (prana-nur-qi) gives expression.

Moreover, given Naessens' report (noted earlier in the last chapter) that the exterior portion of somatids could not be penetrated even when a diamond-tipped drill was employed, then, the shell or membrane which encloses such an entity is not likely to be characterized by various kinds of receptor or transmembrane dynamics. Instead, the means through which somatids, endobionts, or microzymas communicate with the world beyond the interior of those entities would seem to be in terms of frequencies, resonances, or other forms of communication.

All of the foregoing considerations are not meant to be definitive treatments concerning the dynamics of energy potentials within the biological terrain, but, rather, they only are intended to provide an overview of possibilities. Dr. Pollack and others have explored the details of those kinds of dynamics much more intently than what is being presented here, but, nonetheless, the general perspective that is being advanced in the present book has been enriched by virtue of the ideas concerning energy sources that have been critically reflected upon in the present chapter.

Chapter 16: Epigenetic Algorithms

In 1974, the Sloan-Kettering Institute, as well as the medical/scientific world, was rocked by a major scandal that took place within that organization. Some people might say that the scandal was precipitated by the unethical activities – masquerading as science – of a person by the name of William Summerlin who not only had been appointed to oversee a clinical department at the hospital (Memorial) which is associated with the Institute, but as well, Summerlin had been made a full member of the Sloan-Kettering Institute.

Full membership at the Institute was, and is, something that is difficult to achieve and usually involves a long period of apprenticeship of sorts before it can be realized. However, Summerlin seemed to be something of a 35-year old wunderkind and, somehow, he had acquired his lofty status fairly quickly.

Earlier, an indication was given that some people might wish to claim that Summerlin was solely responsible for the scandal that occurred in 1974, but this is only true to a certain extent. The reason for putting forth such a qualifier is that what Summerlin did was done while being supervised – allegedly -- by a senior member of Sloan-Kettering, namely, Dr. Robert Good who had been brought in the year before from the University of Minnesota to serve as head of the Sloan-Kettering Institute.

Summerlin had been able to ascend through the ranks of the Institute as a result of various innovations that he had introduced to the methodology of tissue culturing. His work had potentially fundamental implications for the entire field of transplantation which involved taking some biological component (tissues, organs, etc.) from one person and transferring that component to another person without the latter individual rejecting what was being transferred.

The standard way of describing the foregoing process is that Summerlin seemed to have discovered a way to assist a transplant recipient to avoid the so-called immune response in which the body of the person who is receiving, say, new skin tissue from another human being tends to treat the new tissue as non-self and, therefore, would initiate processes that were intended to reject that tissue as foreign or other. On the other hand, one also could understand such a rejection

phenomenon as being part of a detoxification process that was not necessarily immunological in character but, instead, might give expression to the manner in which the body of a transplant recipient was attempting to re-establish some sort of detoxified stability amidst the set of biological traumatic events entailed by the foregoing sorts of procedures that had de-stabilized the biological terrain of the recipient. As a result, various symbiotic relationships which the individual's biological terrain had with different facets of the microbiome occupying that terrain have been altered or destabilized, in one way or another, and, in the process, various elements of the person's microbiome were induced to enter into stages of their pleiomorphic/pleomorphic life cycle that are no longer symbiotic with the surrounding biological terrain and which, as a result, are capable of leading to a multiplicity of inflammation processes that need to be resolved.

The foregoing dynamics of inflammation are not necessarily signs of an immune response of rejection between self and non-self. Rather, perhaps, the network of inflammation processers that are occurring in connection with a given instance of transplantation constitute signs that different parts of a person's microbiome have become non-symbiotic as a result of being induced to transition out of a normal state of symbiosis with the surrounding biological terrain and, consequently, different non-symbiotic stages of the pleiomorphic/pleiomorphic life cycle of such endogenous microorganisms have begun to create detoxification issues that an individual's body might not be able to properly address on its own or might not be able to resolve even with clinical intervention of some kind.

Summerlin had begun his research on tissue culturing techniques in 1970 when he was a teaching fellow at Stanford. He claimed to have developed a special solution of some sort which, supposedly, would enable tissue taken from one body to be transplanted to another without any rejection phenomenon taking place provided that the tissue which is to be transplanted was immersed in Summerlin's allegedly innovative medium for a period of between 4 and 6 weeks.

Mice were used to demonstrate the alleged effectiveness of his culturing technique. More specifically, he took mice that were

genetically unrelated to one another and obtained skin tissue from black mice and transplanted that tissue to white mice which would, continue to be white with the exception of the black skin tissue that had been transferred from the black mice to the white mice, and all of this would occur without, apparently, any rejection phenomenon arising.

If the alleged principles inherent in Summerlin's tissue culturing technique could be applied to organ transplants, then, among other things, doctors would be able to avoid giving all of the anti-rejection drugs that tend to be administered to transplant recipients. Such drugs have a potential, all on their own, for generating medical problems in the transplant recipients (such as an increased likelihood of cancer as well as leaving the biological terrains of the recipients vulnerable to other kinds of destabilizing pathologies).

Dr. Good, the new head of Sloan-Kettering, took on the responsibility of supervising and supporting Summerlin's research. They wrote papers together on the topic of the tissue culturing technique which supposedly had been developed by Summerlin. However, beginning in 1973, Good had been receiving communications from researchers outside the Institute who indicated that they were having difficulty replicating the results which had been published by Summerlin and Good.

Summerlin was asked by Dr. Good to reproduce the aforementioned results by means of another demonstration involving white and black mice. Subsequently, Summerlin brought forth the requested donor and recipient research subjects (i.e., black and white mice) to confirm what, supposedly, Summerlin had demonstrated previously.

He showed the foregoing results to Dr. Good. Unfortunately, Dr. Good failed to exercise any sort of due diligence with respect to what he was being shown.

Shortly thereafter, when a technician who handles the experimental animals was in the process of returning the mice to their cages, he noticed something peculiar concerning the white mouse. In order to more closely examine the anomaly he was sensing, the technician took a cotton ball which had been dipped in alcohol and proceeded to wipe the black area of the transplant recipient with the

cotton swab, and, lo and behold, the black area began to disappear because it had been created with ink rather than with skin tissue that had been miraculously transformed by means of Summerlin's special medium.

As many institutions are inclined to do, when word of the foregoing scientific fraud was revealed to the people in charge of the Sloan-Kettering Institute (including Dr. Good), the latter individuals did not immediately denounce the research as fraudulent, unethical, and unacceptable, but, instead, they sought to cover it up. The fraud was only made known to the public when approximately three weeks later, Barbara Yuncker, a reporter for the *New York Post*, received a tip from a whistleblower that such an incident had taken place at the Sloan-Kettering Institute.

Once the fraud became public knowledge, Dr. Good assembled a committee of five individuals who had been working at Sloan-Kettering for quite some time and tasked them with writing a report on Summerlin's research. When that report finally was issued, Summerlin was identified as being solely responsible for the fraud, and although Dr. Good was chastised for his hasty promotion of Summerlin, Dr. Good was cleared of any wrong doing in the actual fraud.

While, technically, it might have been true that Dr. Good did not actively and knowingly participate in such a fraud, that sort of scientific fraud was only able to be perpetrated because Dr. Good had failed to exercise any kind of rigorous oversight with respect to Summerlin's "research." When Dr. Good began to receive communiqués from other researchers that they could not replicate Summerlin's results, he did not exercise due diligence and conduct his own investigation of the matter, and, moreover, even when shown the living participants (i.e., the mice) that were being used to serve as confirmation that the original experiments were capable of being replicated, Dr. Good failed to detect what a technician, using only observation and some alcohol, was able to uncover.

Summerlin's time at Sloan-Kettering was terminated, but he received a severance package that amounted to one year's salary. He was described as being mentally unbalanced by members of the Institute, and, yet subsequently, he was able to practice as a

dermatologist for 35 years without any apparent signs manifesting themselves in relation to the mentally unstable behavior with which he had been labeled by various individuals at the Sloan-Kettering Institute.

The foregoing saga has been narrated for a variety of reasons. One of those reasons has to do with research that was discussed previously during an earlier chapter of the present book which explored, at least to a degree, the work of Gaston Naessens.

More specifically, Naessens, apparently, had been able to actually accomplish what Summerlin only fraudulently had led other people to believe had been accomplished. However, Naessens worked with rabbits rather mice.

Like Summerlin, Naessens was interested in whether one could conduct a skin graft without encountering the phenomenon of rejection. In contrast with Summerlin's research, Naessens wanted to see if he could induce a patch of fur and skin from a white-furred rabbit to take root, so to speak, in a genetically unrelated black-furred rabbit.

Naessens was not just engaging in the foregoing research arbitrarily. There was a certain theoretical understanding which led to his experiments.

As outlined earlier present book, Naessens believed that somatids, not cells, were the basic units of life and that, in fact, he was of the opinion that while life was not possible without the presence of somatids, nonetheless, those entities, like Béchamp's microzymas and Enderlein's endobionts, had the capacity to exist independently of living organisms. Naessens stipulated that somatids were viral-like in size and, therefore, were measured in nanometers that were toward the lower end of that scale.

Naessens also was of the opinion that somatids were pleiomorphic/pleomorphic in character, and, therefore, under the appropriate circumstances, he claimed that they could transmogrify functionally as well as structurally and also indicated that his claims in this respect could be verified if one were to examine somatids with his Somatoscope which was capable of capturing the living nano-dynamics of those entities. In addition, while acknowledging that

further research was needed, he maintained that the species of somatids varied with the nature of the tissues and organs one might be examining and, consequently, that not only did different kinds or species of somatids uniquely regulate what was transpiring in given organs or tissues, those different species of somatids could be found throughout the extensive networks entailed by the circulatory systems of both blood lymph.

Finally, he felt that genetic activity of some kind went on within the different species of somatids. However, because somatids seem to be virtually indestructible (e.g., they have been exposed to acids, 50,000 rems of nuclear radiation, temperatures as high as 200 degrees Centigrade, and diamond-tipped drills without any of this seeming to affect, or be able to penetrate, their physical structure), discovering what, precisely, might be taking place within somatids tends to be shrouded in mystery.

Nonetheless, on the basis of his experiments with rabbits, he believed that somatids were capable of some sort of genomic activity. In other words, when Naessens isolated and purified the somatids which were present in the skin tissue out of which fur grew, and, then, he transferred those somatids (at the rate of one cubic centimeter per day for two successive weeks into the bloodstream of the transplant recipient), he found that when skin from a white-furred rabbit subsequently was transplanted to the area of a black-furred rabbit from which black fur had been removed and to which the appropriate sort of skin somatids had been transferred earlier, then a white patch of fur grew in the area from which black-fur had been removed and did so without any kind of rejection phenomenon taking place.

Apparently, the transplanted skin from the white-furred donor rabbit was able to survive without rejection because of the presence of the somatids from the skin of the white-furred donor rabbits that previously had been transferred to the black-furred rabbit. Thus, on the basis of the results of the foregoing experiments, Naessens was led to entertain the possibility that somatids seemed to have a genetic role to play which involved some kind of capacity to organize what transpired in the skin of the transplant recipient.

In another work (*Follow the What?*), evidential considerations were advanced which indicated that there might not be any immune

system, per se, but, instead, the body has an array of different ways through which it defends itself against various kinds of destabilizations involving the biological terrain as well as the latter's normally symbiotic relationship with the microbiome that occupies that terrain through a network of various kinds of cells (e.g., macrophages, neutrophils, dendritic cells, T-cells and B-cells), and molecules (e.g., cytokines, 30-plus members of the complement system) that do not have immunological functions so much as they have detoxification functions. The foregoing perspective was buttressed by an overview concerning the notion of antibodies and some relevant evidence indicating that antibodies might not actually exist, or if they do exist, they do not necessarily have immunological functions.

The theory of antibodies is what, supposedly, provides the body with a system of adaptive learning which allows the biological terrain to match up an indefinite number of possible antigen receptor shapes with the structural properties of this or that antibody. Aside from raising questions in passing -- such as what is the precise nature of the dynamics that enable a particular antibody structure to be identified from among an indefinitely large number of such antibodies so that an appropriate match can be made with a given antigen structure (and how long would this take?) -- one might wish to argue that while there is an adaptive learning system within the biological terrain that enables that terrain to improve -- within certain limits -- the speed and efficiency through which detoxification takes place as well as to find ways to deal with an environment that is often changing, nonetheless, the nature of this adaptive learning system is not immunological in character but is epigenetic in character.

Furthermore, one might advance a hypothesis at this point (i.e., The Somatid Transduction Hypothesis introduced in an earlier chapter) which suggests that what organizes and regulates the aforementioned epigenetic set of dynamics is connected to the different species of somatids which reside in various kinds of tissues and organs and that are constantly circulating throughout the blood and lymph systems. While I don't intend to prove such a hypothesis during the course of the present chapter, I do wish to put forth a

variety of considerations that might help to place such a hypothesis in a context that could lend credence to it.

Although Susumu Ohno popularized the notion of "junk DNA" in 1972, the term actually had been kicking around since, at least, the 1960s. However, the phrase did not actually come into wide-spread use until the Human Genome Project indicated that only a relatively small portion of the DNA (2%) that was present in the genome seemed to code for identifiable proteins and, at the time, no one seemed to understand why the other 98% of the DNA was present.

I first came into contact with the idea of "junk DNA" during the 1980's when I was involved in exploring a variety of sciences that might have some sort of applicability to my dissertation topic. Moreover, without trying to claim that, at the time, I had any understanding of what junk DNA actually entailed, I intuitively felt that it had some sort of organizational role to play in various organisms, and, therefore, was not really junk or non-functional in nature.

Unfortunately, all too many individuals were using that term because they were projecting their ignorance on to something that as far as they could see (which turned out not to be very far) didn't appear to serve any known function. Furthermore, in the process of using that sort of ignorance to frame part of their existential world, and rather than actually scientifically studying the phenomenon, many of those "scientists" just proceeded to prematurely generate a number of theories (usually of an evolutionary nature) about why junk DNA might be present in the genome.

Inexplicably, there were life forms (e.g., worms) that were much simpler than human beings which actually had roughly the same number of coding genes as humans did. In addition, there was even a considerable overlap in the kinds of genes that showed up in the two species that were quite similar to one another despite the considerable morphological and functional differences that differentiated or separated those two life forms.

If two such different species had roughly the same number of genes and seemed to hold many genes in common, then, how could one explain the obvious structural and functional differences between

them? An early clue that might help scientists address the foregoing question actually had to do with the so-called "junk DNA."

More specifically, researchers discovered that the complexity of an organism often ran in parallel with the amount of non-coding or junk DNA which was present. In other words, organisms that were categorized as being more complex, in some sense, tended to have a greater amount of junk DNA than organisms that were considered to be less complex in some sense.

Over a period of time, there were a number of different functions which were discovered that appeared to be regulated by so-called junk DNA. For example some of that DNA seemed to have what might be termed a structural support role which helped DNA to not unravel, while other sections of the mysterious DNA appeared to help to structurally anchor chromosomes during the process of cell division.

Notwithstanding the foregoing sorts of structural roles, researchers also began to discover that a considerable amount of the DNA that had been written off as not having any function actually coded for RNA, and such RNA turned out to give expression to an array of different functions, including the transporting of materials that are needed to be able to generate proteins (transfer-RNA) as well as part of the dynamic platforms (ribosomes) where amino acids are strung together to make proteins.

More recently, scientists have found that so-called non-functional DNA – i.e., junk DNA – also can serve different kinds of regulatory functions. In other words, this sort of DNA has the capacity to, among other things, turn genes on and off, and, in fact, various kinds of diseases tend to arise when the foregoing sorts of regulatory responsibilities are rendered dysfunctional through the occurrence of one or another kind of mutation such that genes are turned on or off in problematic ways.

For example, there is genetic disorder known as myotonic dystrophy which entails a form of atrophying or wasting away that takes place across three generations within a family. Usually, a grandparent might have cataracts, and one, or more, of the children of that grandparent might experience regular bouts of muscle stiffness as well as cardiac problems, while one, or more, of the grandchildren that

are affected by the disorder tend to exhibit various kinds of learning disabilities and muscle floppiness.

Both males and females run a risk of incurring such a genetic disorder from an affected parent. Although only one of the two copies of the relevant gene that is passed on might be problematic, nonetheless, the disorder is said to be dominant because the gene that is associated with the mutation is able to nullify or prevent the normal gene from being expressed.

Usually speaking, dominant disorders tend to be fairly stable with respect to whatever dysfunctional property is being passed on to a child. Thus, if the affected parent has problem 'x,' then the affected child will have the same problem 'x.'

This is not the case in myotonic dystrophy. As one goes from grandparent to their child to grandchild, the disease becomes progressively worse and is manifested earlier in each generation -- from cataracts, to muscle stiffness and cardiac problems, to learning disabilities and floppy muscles. However, the severest form of the disorder that occurs in affected grandchildren tends to be passed on by the mother of those children.

Affected individuals are found to have multiple copies of a sequence of three DNA molecules – namely, cytosine, thymine, and guanine. Multiple copies (ranging from 5 to 30) of this sequence are also found in individuals without the disorder, but the number of copies of the foregoing DNA sequence occur more than 35 times in affected individuals, and under certain circumstances when the sequence repeats 50 times or more, then a parent – who normally passes on the same number of sequence repeats to a child as the parent has – might pass on a set of sequences which are greater than the number of such sequences that are present in the parent.

What is anomalous about myotonic dystrophy is that the gene which is involved in the disorder has not mutated. What has mutated is the number of the DNA sequences (C, G, and T) of "junk DNA" which are associated with that gene.

Myotonic dystrophy is not the only kind of genetic disorder in which a given gene associated with the disorder is left intact (i.e., is passed on without any mutation). Instead, what changes in these

different kinds of genetic disorder (e.g., Fragile X syndrome, which gives expression to learning disabilities) are the character of the sequences of so-called junk DNA that are associated with the non-mutated gene (cytosine, cytosine, and guanine in the case of Fragile X syndrome) and/or the number of multiple copies of that seemingly superfluous DNA that are associated with the gene that has not undergone any sort of change in the sequence of amino acids that give expression to the protein for which the latter gene codes.

Another genetic disorder – known as FSHD ("facioscapulohumeral muscular dystrophy" if you wish to either punish yourself or impress/annoy people on the subway) -- entails a wasting away of muscles that help operate one's upper body and face. However, what differentiates this particular disorder from the two maladies which were touched upon earlier is that while people who do not have this disorder exhibit multiple sequences (between 11 and 100) of a block of DNA which consists of more than 3,000 letters (A, C, T, G), those who suffer from the disorder tend to have ten or fewer blocks of the foregoing set of 3,000 genetic letters.

More than ten years of research were required to put the foregoing information together. One of the primary reasons why such a lengthy period of research was needed to accomplish that task is because the blocks or sets of repeats of the 3,000 DNA sequence do not occur anywhere near the gene that it affects.

Somewhere around 40% of the human genome consists of what are known as "interspersed repetitive elements.' There are believed to be four primary classes of those sorts of repetitive elements – namely, (1) LINEs (long interspersed elements); (2) DNA transposons; (3) SINEs (short interspersed elements; and (4) LTRs (elements with long terminal repeats).

Some individuals have advanced various kinds of evolutionary hypotheses to account for why they believe the foregoing classes of repeating sequences exist. However, what the actual function, if any, of the aforementioned classes of repeating sequences might be seems to remain something of a mystery.

Furthermore, not all repeating sequences necessarily involve large sets of genetic letters like the foregoing genetic disorder known as FSHD. There are many repetitive sequences which consist of only a

couple of genetic letters that tend to be quite characteristic of a given individual's genetic material, and, therefore, vary from person to person in ways that enable one to differentiate whether such a pattern of sequences comes from one person rather than another.

The foregoing property functions like a genetic fingerprint. That property can be used to establish paternity, rule out someone as having committed certain crimes, or help facilitate various kinds of research projects which are seeking to understand how different parts of the genome might operate.

Enough has been said over the last several pages to begin to ask some questions. For instance, one might ask about how the foregoing sorts of short sequences come to be so uniquely tied to individuals.

Alternatively, in the case of FSHD, someone might be interested in discovering why most people who possess anywhere between 11 and 100 blocks of a set of 3,000 letters do not seem to have any dysfunctional features associated with such an arrangement, whereas individuals who have ten or fewer of those blocks incur a disease? After all, other than the number one, what is the difference between having 11 such blocks versus having 10 such blocks?

One might also be interested in learning how the foregoing sorts of lengthy blocks -- which appear to be quite distant from the gene they influence -- communicate with, or alter the functioning of, their target genes? Are there any functional differences in allegedly "normal people who possess, say, 11 or 15 of the aforementioned set of 3,000 genetic letters, and those individuals who have 90 or 95 of those sets, and, in addition, what determines how many of those sets of 3,000 letters will be produced?

Given that most mutations consist of just a single letter difference in the DNA code, what sort of change is necessary to prevent a human being from developing eleven or more blocks of the 3,000 genetic letters? What determines how many of those blocks are produced, and what, exactly, are those sets of 3,000 letters communicating?

Similar sorts of questions could be raised in conjunction with the repeat of certain sequences of "junk" genetic material in relation to myotonic dystrophy (5 to 30 copies in "normal" human beings versus 35 or more such repeated sequences in genetically affected

individuals). Why does the genetic disorder seem to become worse as it goes from grandparent to grandchild, and why do different systems appear to be affected as the disease progresses in severity across generations? What is the difference between someone with 30-34 copies of the repeated sequence and someone with 35, or more, such copies? What is the nature of the mutation which leads to such differences in functionality? When the norm is for parents to pass on to their children the same set of repeated sequences as they themselves have, why does this change in the more severe cases, and why are such departures from the "norm" usually passed on only by the mother?

All of the foregoing sorts of questions could be summarized by asking just one question. What is the source (sources) that regulates or (regulate) the foregoing events?

This is a question that will continue to be asked throughout the following discussion. Something appears to have regulatory oversight concerning so-called "junk DNA" which is not only independent of the 20,000, or so genes that normally are thought of as constituting the genome of a human being, but, in addition, that sort of regulatory functionality seems to be directing "junk" genetic material to regulate – at least to a degree -- what does or does not transpire in relation to the 20,000 genes that were uncovered during the Human Genome Project.

One could, of course, argue that the 98% of the genetic material that is found in human beings -- and which does not code for the 20,000, or so, genes that comprise the basic human genome -- is somehow self-regulating and, therefore, there is no need to posit the existence of some sort of regulatory system that oversees what is transpiring in the allegedly "junk" sector of genetic material. However, there seems to be quite a lot of evidence (some of which will be covered in the present as well as subsequent chapters of the present book) to suggest that the 98% portion of genetic material that, previously, was considered to be non-functional -- and, therefore, something of a genetic junk yard – actually might be receiving its marching orders (concerning when, for example, to turn certain genes on or off) from something other than the aforementioned 98% of

genetic material … such as Naessens somatids, or Reich's bions, or Enderlein's endobionts, or Béchamp's microzymas.

Initially, the DNA which exists in the nucleus of a eukaryotic cell is transcribed via a process that translates DNA into a form of RNA known as mRNA. The latter leaves the nucleus and makes the journey to ribosomes where the genetic message inherent in mRNA gets converted, with the help of tRNA -- or transfer RNA -- into amino acids at ribosome factories in the cytoplasm.

The genome of a human being consists of two sets of 3 billion base pairs. A base pair consists of either cytosine connected to guanine (both of which constitute nucleic acids), or thymine connected to adenine (both of which are nucleic acids).

One of the foregoing sets of 3 billion base pairs is from the mother, while another set is from the father. If one were to straighten out either set of the foregoing string of base pairs as well as take into consideration that any given base pair is separated from the base pairs on either side by a distance of 25 centimeters, then, the length of each set of base pairs would extend to more than 46 million miles.

The nucleus is the largest organelle in a cell. It takes up about 10% of a cell's volume and has a diameter of about 6 microns or micrometers. Yet, it contains 2 times 46 million miles worth of data.

While the size of any given instance of mRNA varies with the nature of the message that has been transcribed, nonetheless, such molecules are relatively miniscule compared to the aforementioned sets of 3 billion base pairs. When reflecting on the foregoing considerations, I've often wondered what induces mRNA to leave, rather than stay, in the nucleus.

Moreover, one wonders how the mRNA "knows" where to go. The size of the nucleus is much larger than any of the messenger molecules (which run about 50 nanometers but become somewhat larger when certain modifications are made), and the size of the cytoplasm into which mRNA molecules venture is larger still since the cytoplasm contains 90% of the cell's overall volume, and, consequently, finding ribosomes – which vary in size, depending on the organism, but generally run between 20 and 30 nanometers – is, seemingly, not necessarily all that easy.

Given the foregoing considerations, one can't help but ask how a given instance of mRNA "finds" its way to a given ribosome. Moreover, one – at least this is true for the 'one' represented by me -- has a hard time believing that all of the foregoing dynamics is just a matter of a random series of events involving processes of trial and error that, somehow – eventually – gives expression to an organism that can quickly adjust to both changing environmental conditions as well as resolve the variable biological needs that those sorts of changing conditions engender.

Perhaps, there is some sort of guidance system which regulates what mRNA molecules do and how they get to where they need to go in order to be able to deliver their message. The basic genome of 20,000 genes codes only for proteins, and those genes are turned on and off by different facets of the remaining 98% of the genetic material (previously known as junk DNA) that constitutes the full genome, and the activity of that 98% of the genome seems to be induced into action by something other than itself. Just as the basic genome of 20,000 proteins doesn't turn itself on and off, so too, the remaining 98% of the genetic material doesn't necessarily activate itself but might be activated by something other the remaining 98% of the genetic material.

There also seems to be various evidential indications which allude to the possibility of some sort of independent system of regulation that might be related to the foregoing processes of activation. This involves the capacity of mRNA, with the help of tRNA and ribosomes, to generate sequential strings of some 20 amino acids whose molecular structures are nothing like the molecular structures of DNA, RNA, mRNA, or tRNA, and, thus, this sort of disconnect raises the question of how did a genetic coding system arise which enables nucleic acids, of one kind or another, to generate totally dissimilar amino acids.

How did certain kinds of nucleic acids come to mean or stand for various amino acids? How did different sequences of three nucleic acids come to mean one amino acid rather than another? How did some sequences, rather than others, come to serve as start and stop signals during the process of gene expression?

Genetic dynamics seem to give expression to a language-like process in which certain combinations and sequences of letters give

expression to words known as amino acids, which, in turn, can be arranged in ways that constitute different kinds of functionalities like nouns, verbs, prepositions, adverbs, and so on that, when organized in the right sequences, give expression to sentences which constitute complete thoughts in the form of metabolic processes of one kind or another. What are the woof and warp or syntax and semantics of such a language-like system, and does the latter set of arrangements suggest the existence of some sort of regulatory system that is responsible for keeping the biological terrain in a condition of detoxified stability with the microbiome that occupies that terrain?

One can introduce further complicating factors into the foregoing scenario by noting that genes rarely, if ever, come in a form in which they contain nothing but the sequences that will code for various proteins. Sprinkled throughout a gene are bits and pieces of genetic material that don't seem to have anything to do with the final protein that is to be put together via ribosomal, mRNA, and tRNA activity.

Such interstitial genetic entities are known as introns. Those introns are removed so that nothing but the genetic sequences that are needed to code for a given protein will be taken out of the nucleus via mRNA.

Again, one would like to know what it is that performs this sort of editing process. What determines whether certain sequences are essential or are unessential components for any given mRNA message, and are there functional reasons why such introns exist at all?

Again, such questions seem to raise the possibility that there is some regulatory system that might not be under the operational control of either the basic genome of 20,000 genes in human being (and this also would seem to be true in other organisms as well) or under the operational control of the other 98% of the genetic material as well. If this is the case, then, such questions would seem to allude to the existence of some sort of regulatory operating system that is present which might be responsible for making those kinds of determinations and, thereby, be responsible for overseeing various kinds of regulatory dynamics.

Of course, being able to ask such questions or, as a result of trying to resolve those mysteries, proceeding to posit the aforementioned sort of regulatory system which is not a function of either the basic

genome of (in humans) of 20,000 genes or the 98% of the extra genetic material that seems to be present, does not really prove anything. However, rather than trying to prove something, all I am trying to do is induce readers to begin to critically reflect on such possibilities.

In one sense, introns do seem to have a functional significance, at least in a negative manner. The repeated sequences of genetic letters which are associated with genetic disorders such as myotonic dystrophy and Fragile X syndrome are to be found among the interstitial sequences within a gene that are known as introns.

For example, in Fragile X syndrome there are a series of repeats (consisting of the nucleic letters CCG) that occur before the initial coding area that constitutes what will be the first of a series of amino acids that will make up a fully functional protein. So-called "normal" people will have anywhere between 15 and 65 copies of the foregoing three-letter sequence, whereas the gene of the individual who has the Fragile X defect will have anywhere from 200 to several thousand repeating sequences.

What sort of mutation might cause such sequences to go from between 15 and 65 repetitions up to between two hundred and several thousand repeats of that three letter sequence? What, if anything, is keeping track of how many of the repeated sequences are present, and what terminates the set of repeats at one number – say 200 – rather than some other number such as one or two thousand?

When the number of repeated sequences becomes very large, production of mRNA is discontinued. What determines what constitutes a sufficiently large number of repeated sequences to discontinue production of mRNA and what is responsible for the shut down directive?

If repeated sequences of the three-letter nucleic sequence that are sufficiently large are problematic, what function, if any, is served by the presence of between 15 and 65 repeated sequences, and why are the "normal" set of repetitions so variable, and in any given "normal" individual what is responsible for determining what the number of repeated sequences will be? One has difficulty reconciling the idea that while 200 to several thousand repeated sequences means trouble, nonetheless, the presence of 15 to 65 repeated sequences has no

"meaning" and simply needs to be excised from the gene that is coding for a particular protein.

Researchers have discovered that the "normal" range of repeated sequences (15 to 65) apparently has remained fairly stable for a considerable period of so-called evolutionary time. This suggests to those who are inclined toward evolution, that such a set of sequences must have some kind of function – and, therefore, is not just nonsense genetic material -- but what the nature of the function of such a range of repeated sequences might be in so-called normal individuals is not entirely clear.

One might note in passing that the way in which some evolutionists travel about in their conceptual domain resonates with a travel technique that is, sometimes, used in a Muppets movie. More specifically, given that such movies tend to be about an hour and a half long, should the need arise in those movies to make a lengthy journey that normally would – in the real world -- take a great deal of time, then, a "travel by map" device is introduced in which one can traverse great distances between different cities on Earth by simply drawing a line between one's starting point and the desired end point of the trip, and, without having traversed actual distances (other than the distances on the map), one arrives at one's destination.

Many evolutionists do something which is very similar. One might call their technique "travel by conjecture" during which a person is able to arrive at the desired conceptual destination without having to actually slog through any intervening empirical miles at all.

In any event, given the fact that the aforementioned set of "normal," repeated sequences has remained quite stable across thousands of years, this does not necessarily demonstrate that such stability has evolutionary significance. What is important is that the range of repeated sequences which is considered normal has remained stable, and this remains so irrespective of whether, or not, researchers can identify which set of forces (evolutionary or something else) is served by this sort of a conserved condition.

The conservation of such regions of interstitial genetic materials does seem to indicate that normal regions of repeated sequences do have some role in shaping or modulating the manner in which mRNA is used. If so, this would suggest, in, yet, another way, that there might

be some sort of regulatory dynamics taking place that is not necessarily a function of either the basic genome of 20,000 proteins or the more extended genome which involves the remaining 98% of genetic material.

More specifically, the function of the gene with which Fragile X syndrome is associated not only serves as a sort of shuttle system for an array of RNA molecules that enables the latter molecules to be delivered to various locations within the biological terrain, but, as well, the gene which is associated with the Fragile X syndrome also plays a role in shaping how the RNA molecules that are being transported will be involved in the process of protein construction. So, if, as result of the presence of a sufficiently large number of repeats of the CCG base sequence, mRNA production is discontinued, and, therefore, the gene does not become properly functional, then a series of important biological tools will not be built.

Neurons appear to become impaired as a result of the absence of the protein that is coded by the foregoing gene. The specific nature of how neurons are adversely affected by the absence of the protein at issue is not, yet, known.

However, the bottom line is that the learning capacity of a person with such a disorder becomes dysfunctional in various ways. Therefore, one of the differences between a properly functioning system of neurons and a dysfunctional system of neurons has to do with whether the “junk” regions that are present as introns within the DNA sequence that constitutes the gene associated with Fragile X syndrome are, or are not, normal in character with respect to the number of repeats that are contained in those introns.

If one compares certain genes -- in, say, a worm -- that are fairly similar to genes in human beings and which serve similar functions, the genes in the simpler organism tend to be fairly straightforward sequences of DNA that can be transcribed into mRNA which, in turn, will be translated into a string of amino acids when processed by a ribosome which, in turn, leads to the expression of a specific protein. However, comparable genes in human beings tend to be much longer than their counterparts in simpler species, and the factor of length is a function of the introns that are present in human genes but which are not present in the simpler organisms.

This feature of greater length that is tied to the presence of introns actually entails the possibility of arranging genetic information in a multiplicity of ways that are capable of leading to the production of proteins that are other than what a given gene normally codes for if all – or most -- of the introns were removed or edited out. Although the set of 20,000, or so, genes which constitute the basic complement of genes with which all human beings start their lives – notwithstanding, of course, certain variations in the character of those genes as one goes from one person to the next – some of the introns that are contained within any given gene actually provide those genes – which usually code for specific proteins – with the degrees of freedom that allow the genetic material in a given gene to be edited and assembled in any number of ways, depending on what introns are retained and what introns are removed.

Some researchers have indicated that 60% of the fixed genes in the human genome have the capacity to generate multiple kinds of proteins depending on how they are edited. This means that 12,000 standard, fixed genes in the basic genome (60% of 20,000 genes) have the capacity for giving rise to a multiplicity of genes other than what such genes normally would code for if all, or most, of the introns in such a gene were edited out.

The 98% of the genetic material that previously had been thought to be non-functional in character (i.e., junk) seems to be responsible for the **mechanics** of gene editing that takes place as the DNA sequences for one kind of protein, rather than another. Thus, selections are made from the genetic material in a gene, and this consists of both introns as well as the sequences that entail the coding for the protein that normally is associated with a given gene -- say, the same protein that serves a similar function in simpler organisms.

Nonetheless, even given the foregoing considerations, one cannot necessarily argue that the regulatory directives that determine which kind of protein will be assembled in conjunction with a given gene is a function of the editing process per se. Conceivably, such dynamics might be a function of an independent system of operational regulatory activity that is calling for one kind of protein rather than another to be generated in response to changing environmental conditions to which a given biological terrain must respond.

The human genome in any given cell (consisting of both the sequences for the 20,000, or so, genes that make up the basic genetic package of the genome as well as the remaining genetic material that makes up 98% of the overall total of the genome) is not necessarily aware of what is transpiring in either the surrounding biological terrain considered as a whole or aware of how that terrain is being affected by changing conditions within the environment in which such a biological terrain resides. On the other hand, presumably, there might well be some sort of capacity for awareness which is present in a given organism or biological terrain that is engaging, as well as being engaged by, the surrounding environment … a complex, dialectical dynamic which generates the need for different kinds of directives or communications to be sent to various cells that induce the latter to start producing or stop producing various kinds of proteins, or to start (or stop) assembling one kind of protein rather than another modality of protein (depending on how the introns in a given gene are edited or parsed).

There are almost 1,300 gene families that exist in the human genome which are comparable to gene families that exist across most branches of biological life. However, in vertebrates, there are about 100 gene families that are engaged in an array of intricate sorts of dynamics that have responsibility for, among other things, helping to maintain a condition of detoxified stability in the biological terrains of such vertebrates.

To be sure, having a system of operational oversight concerning the aforementioned 1,500 gene families (which are largely held in common by most species of life) would be important in order that dynamics governing those biological systems would start and stop the production of the proteins associated with the foregoing sorts of gene families in ways that are conducive to the continued well-being of different kinds of biological terrain. Nevertheless, there also appear to be other gene families that seem to need to be even more responsive to what is transpiring throughout the biological terrain of a given species of vertebrate and its interaction with the surrounding ecological environment and, as a result, such a need also could suggest the possibility of the existence or presence of some sort of sophisticated system of operational oversight.

This is because the aforementioned smaller set of 100 gene families involves complex operations of detoxification and stabilization that are crucial for, among other things, helping to maintain or, when necessary, attempt to re-establish a condition of detoxified stability in the biological terrain that gives expression to a given kind of organisms. This sort of operational control would be able to regulate, among other things, the relationship between the biological terrain and the microbiome that inhabits that terrain to remain in a state of symbiosis and try to prevent that relationship from becoming destabilized to the point where different microorganisms within the microbiome are induced to enter into non-symbiotic stages of their pleiomorphic/pleomorphic life cycles which have the capacity to further destabilize the biological terrain and, in the process, give rise to different kinds of diseases depending on the nature of the destabilization that takes place and depending on what sorts of transitions are induced to take place in different segments of the microbiome which constitute a retreat from symbiotic behavior in conjunction with the surrounding biological terrain.

Among the sorts of functions to which the foregoing set of 100 gene families might give expression could involve many kinds of detoxification and re-stabilization dynamics. More specifically, biological dynamics involving such components as: Macrophages, neutrophils, dendritic cells, T-cells, B-cells, the complement system, cytokines, and the lymph system might all be connected with the aforementioned set of 100 gene families which are capable – when properly regulated – of helping to contribute to the detoxified stability of a given biological terrain or organism.

With each passing year, more and more of the 98% of the genome which previously had been considered to be non-functional, and, therefore, junk, is being shown to have the capacity to influence the manner in which the basic complement of 20,000 genes in the human genome can be expressed. Nonetheless, what seems to be missing from the developing biological portrait that is being drawn is the presence of some sort of oversight capacity which communicates with that 98% of the genome concerning how the 2% of the genome that constitutes the basic set of 20,000 proteins will be turned on, off, parsed, or edited, and my candidate for part of this command and control center resides

within the somatids of Naessens, or the endobionts of Enderlein, or the frequencies with which Rife dealt, or the microzyma of Béchamp.

More specifically, the Somatid Transduction Hypothesis might be at play here. In other words, the somatids in different kinds of tissue serve as transduction centers for the organizing intelligence of Qi (prana-nur-qi) which permeates those centers and results in the sorts of epigenetic dynamics that will regulate how the basic genome is to be expressed under certain circumstances, as well as how the somatid transduction process is to regulate the way in which so-called "junk"-DNA and "junk"-RNA are to be used to parse and edit genomic material.

In essence, what is being referred to in the foregoing paragraph has to do with the epigenetic dynamics that occur in a given biological terrain. Such dynamics constitute a system of adaptive learning which is set in motion when the human genome (consisting of both the 98% and the 2% of genetic material) is directed to stop, start, be parsed, or be edited by some sort of operational control center that is capable of interacting with the entire biological terrain as well as the surrounding environmental ecology with the speed, efficiency, and finesse that is necessary to maintain or -- when necessary -- help a given biological terrain to re-establish a condition of detoxified stability that preserves the symbiotic relationships that exist between such a biological terrain and the microbiome that occupies it.

Epigenetics entails the biological dynamics that are needed to help a system to maintain or recover, if necessary, a condition of stability without altering the nature of the genetic material that makes up the genome. Epigenetics is about processes that control and affect how genetic information is used in conjunction with changing circumstances both within a given biological terrain as well changes in the surrounding environment that pose both opportunities for, and challenges to, the capacity of an organism to be able to maintain, or recover, stability or well-being.

Epigenetics entails various degrees of freedom as well as degrees of constraint concerning the capacity of a biological system to engage in different forms of adaptive learning that are geared toward helping a given biological terrain to be able to deal with changing conditions. However, the system of adaptive learning that is being expressed here

is different from the system of adaptive learning that is proposed by those who believe in the existence of antibodies and an immune system.

All of the components (e.g., macrophages, neutrophils, dendritic cells, complement system, cytokines, and so on) which are being mentioned by immunologists (and those who are influenced by those individuals) do not necessarily serve any sort of immunological function that provides continuous or semi-continuous forms of automatic protection that is mediated, to a large extent, by the presence of antibodies. Instead, the focus of the epigenetic adaptive learning system being proposed here has entirely to do with the dynamics of detoxification and stabilization which need to be performed, in whole or in part, on each occasion that a given biological terrain is destabilized in some fashion and, as such, there is no sort of on-going immunological memory associated with the kind of epigenetic dynamics that are being suggested in the present chapter.

The sort of epigenetic adaptive learning system which is presently being proposed concerns creative uses of existing genetic tools to counter any given set of changing conditions that destabilizes or threatens to destabilize the well-being of an organism. Well-being is a condition of detoxified stability which preserves the set of symbiotic relationships that exist between a given biological terrain and the microbiome which occupies that terrain.

The foregoing sense of adaptive learning is not rooted in a monomorphic theory that entails relatively fixed and static forms of antibody-mediated responses to hostile pathogens (e.g., various kinds of microorganisms including viruses) that are “remembered” (in some collective sense) by a set of antibodies. Instead, the aforementioned epigenetic adaptive learning system is rooted in a pleiomorphic/pleomorphic understanding concerning the capacity of microorganisms to change their morphological and functional capabilities in response to an ever-changing set of environmental conditions that impinge on the capacity of a given biological terrain or organism to be able to respond to such changes in unique ways while seeking to maintain – or recover – a condition of detoxified stability through which a condition of well-being is established.

There is a set of genes known as the HOX group which plays an array of crucial roles during the process of development. That group of genes needs to be turned on and off in a particular order of expression if development is to unfold in a fully functional matter.

The margin of error for the successful, sequential expression of the HOX genes is pretty-much zero. Consequently, one might expect that the epigenetic system of adaptive learning that is being suggested here would be fairly silent when it comes to potentially creative ways to parse the genes that make up the HOX group of genes.

Yet, at the same time, something is turning the genes in that group on and off in a very precise sequence. Therefore, one might propose that the same system that is responsible for the epigenetic regulation of the sort of gene parsing that offers creative ways for handling certain existential challenges also has the capacity to oversee forms of gene expression that are governed by few, if any, degrees of freedom while simultaneously being restrained through various dynamics of necessary constraint.

Both kinds of epigenetic adaptive learning (relatively free and relatively constrained) serve the overarching process of maintaining, or recovering, the sort of condition of detoxified stability which gives expression to well-being. In other words, both of the foregoing kinds of epigenetic dynamics that are being suggested here would seem to allude to, or give expression to, the existence of a system of command and control that oversees what transpires within a given biological terrain or organism.

Such a system of epigenetic command and control seems to operate in accordance with an endogenous gyroscope-like dynamic that "knows" what constitutes a condition of detoxified stability and continuously measures and balances what is transpiring within the given biological terrain that it oversees against an internal dynamic or model of well-being and makes adaptive adjustments according to what is needed to maintain a condition of well-being or detoxified stability or what is needed in order to try to recover a condition of well-being that might have become destabilized in some fashion. Conceivably, and as suggested previously, such an epigenetic system of oversight and adaptive learning is linked to the somatids of Naessens,

or the endobionts of Enderlein, or the frequencies of Rife, or the microzymas of Béchamp.

Somatids or endobionts or microzymas constitute transducers. They have the capacity to convert one kind of energy (a field energy of some kind – such as Qi – prana-nur-qi) into another kind of energy or set of energies and makes possible the epigenetic regulation of what transpires in a given biological terrain or organism.

There are a number of components which are involved in the process of editing genes to generate various kinds of proteins other than the one which normally would be produced if the introns present in such a gene were removed. There also are a number of components involved in the starting and stopping of any given version of a given gene that is to be expressed.

For example, whether, or not, a given gene can be turned on depends on a sequence of so-called "junk DNA" that is known as a "**promoter**". The promoter sequence needs to be located prior to the first string of DNA that, together with many subsequent strings of DNA, will collectively constitute the genetic message that is present in such a gene and which will be converted into mRNA

If the promoter sequence is absent, then, the gene cannot be turned on. Moreover, if that promoter sequence were to somehow become reversed, then even though it might occupy a space at the beginning of the gene sequences that are to be transcribed into a mRNA molecule, nonetheless, the gene could not be turned on.

There are, however, other kinds of components that need to be active in addition to the foregoing sequence of promoter "junk" DNA if a given gene is to be expressed. For instance, there are a number of molecules known as "**transcription factors**" which need to be present in order that a certain kind of enzyme which is crucial to the process of generating an mRNA copy of a given gene can be bound to, or bound by, the aforementioned transcription factors.

Furthermore, promoter sequences can be influenced by various kinds of molecules that have modulating properties. These properties often determine whether a given gene will be expressed or suppressed and, as well, will determine the extent to which a given gene will be expressed or suppressed.

The molecules that can have a profound effect upon whether, or not, a given gene is expressed can be quite small. For instance, methyl groups – which consist of just one carbon atom and three hydrogen atoms – are at the center of a range of modulating forces that operate in conjunction with many genes.

More specifically, when a methyl group is juxtaposed next to a cytosine base and the foregoing two molecules are followed by a guanine base, then such a sequence is able to serve as a locus of modification when enzymes of one kind or another are added to the complex. What makes such an arrangement especially interesting is that the process of adding of a methyl group (known as methylation) does not appear to be a function of either DNA or RNA activity, and, yet, methylation can have a considerable impact on what happens genetically.

For example, identical twins each have precisely the same set of genes. Nonetheless, over time, and, sometimes even beginning when the twins are in the womb, subtle differences might begin to emerge that are a function of processes like methylation that will alter the way in which certain genes function. For whatever reason, some of the genes that are found in each and every cell of the bodies of the twins begin to be used in slightly different ways, and methyl groups are one of the non-DNA and non-RNA molecules which are involved in the mediation of those sorts of differences.

Whereas methyl groups tend to be involved in shutting off or dampening down the expression of a gene, there are other molecules that have the capacity to help certain genes to be turned back on or which can help to dial up the extent to which, given various circumstances, those genes can be expressed. Histones – which are proteins, and there are many kinds of histones – are often involved in the foregoing sorts of genetic transactions, and given that there are more than 60 kinds of chemical groups that can be brought into modulate histones via one, or another, of the amino acid components that make up a histone, there are a huge number of combinations which are possible when one, or more, of the foregoing sorts of chemical groups interact with different kinds of histones and, when acting in concert with one another, can affect the expression of genes.

Among other things, histone protein molecules can not only determine the extent to which a gene might be expressed, but some of those proteins can determine the state of readiness with which a given gene might be processed in the future. As a result, the presence of histone proteins can help enhance the efficiency and speed with which a given gene operates under different circumstances.

A wrinkle, or two, of complexity can be introduced into the foregoing scenario by keeping in mind that certain histones can do more than just dial up the extent to which a given gene is expressed or, alternatively, prepare a given gene to be ready to be expressed given the right sort of circumstances. Some histones interact with certain kinds of enzymes (known as "**major repressors**") that, in turn, interact with long segments of so-called "junk" or non-coding segments of RNA (non-coding in the sense of not being a part of the genetic material that codes for the standard set of fixed proteins which, in humans, consist of some 20,000 genes).

The foregoing kind of interaction will result in suppressing certain modalities of gene expression. There are many degrees of freedom which exist with respect to how histones, major repressors and the aforementioned long segments of non-coding RNA can interact and affect which genes are expressed and how they are expressed.

Finally, promoters are not necessarily assigned to a specific gene. They tend to be involved in turning on whichever gene happens to be sufficiently close and only if, relative to the gene being turned on, such promoter sequences have the right sequential relationship in conjunction with that gene (in other words, a gene might be sufficiently close to a given promoter sequence to be a candidate for being turned on, but if the promoter sequence has a reverse sequence orientation relative to that gene, then the gene will not be turned on).

So, in order for a gene to not only be turned on but in order for a needed gene to be turned on at a given time, a number of conditions have to be satisfied. Thus, a promoter gene with the appropriate sequential orientation must be found at the beginning of the gene that needs to be transcribed according to the needs of the biological terrain that exist at that time, and, in addition, the right sort of transcription factors must arrive ahead of, in order to be able to be ready to bind, the enzyme that is to generate a given sequence of mRNA, and, finally,

the appropriate sorts of methylation, histone proteins, major repressors, and long segments of non-coding must be present to ensure that the gene is either not expressed in a certain way or that it is expressed in one way or another.

Different kinds of promoter sequences require certain kinds of transcription factors. Usually speaking, different cell types will tend to express the sorts of transcription factors that are needed by a given promoter sequence which operates within such a cell type.

To further complicate matters, there is another set of allegedly junk DNA sequences that are known as "**enhancers**". Enhancers tend to be several hundred base pairs long, but they are highly variable in the nature of their sequences.

Unlike promoters, they do not have to possess any particular sequential orientation relative to a given gene in order to be operational. However, there are forms of enhancers which are referred to as "**latent enhancers**" which are variable in whether, or not, they are active at any given time. Such latent enhancers have to be activated in order to begin to influence or modulate what is transpiring within any given gene.

Enhancers, themselves, seem to be functionally dependent on the presence of another kind of so-called junk DNA. As previously indicated, there is a class of sequences involving "junk RNA" that is known as "long non-coding RNA."

Sequences of long non-coding RNA interact with a group of proteins that interact with one another and, collectively, are referred to as a "**Mediator**." This dynamic between the Mediator and the long non-coding RNA sequence has the capacity to modulate what happens in a given proximate gene that codes for a particular protein.

The aforementioned Mediator complex of proteins also plays a role in the nature of the activity that takes place in conjunction with a collection of enhancers. This collectivity of enhancers is known as a "**super-enhancer**" which can be many times the size of regular enhancers that usually consist of a few hundred sequences of "junk" DNA.

The Mediator and super-enhancer dynamic appears to play a key role in the manner in which embryonic stem cells manifest themselves.

In other words, whether a given kind of embryonic cell stays embryonic, and, therefore, pluripotent (i.e., has the capacity to become any kind of cell), or become specialized (and, therefore, moves away from pluripotency) can be affected by how the Mediator protein complex and super-enhancer region of so-called junk DNA interact with one another.

In connection with the foregoing considerations, there also are a group of proteins known as "**master regulators**." This concerns four proteins that when they are highly expressed, the pluripotency of embryonic cells seems to be retained but when the foregoing proteins are not highly expressed, specialized cells of one kind or another come into being, and which outcome will occur in any given instance will depend on the activity of the super-enhancers that are present.

Promoters, transcription factors, enhancers, latent enhancers, super enhancers, the Mediator complex, and the master regulators are all involved in a dance of exquisite timing, precision and varying degrees of freedom. In addition, components such as methyl groups, histones, various kinds of enzymes, and long segments of non-coding RNA also are present which expand the complexity of how all of the foregoing components will interact with one another.

Moreover, to add to the cauldron of complexity that presently is being stirred, there are certain genes that operate with anywhere up to 20 separate so-called "junk DNA/RNA" regions. In addition, there are certain regions of such "junk DNA/RNA which are able to engage anywhere from one to ten different genes.

While the term "epigenetics" is often restricted to the way in which, say, histone molecules and methyl groups turn different genes on and off or modulate the way in which they are expressed, a case might be made for considerably expanding the notion of what constitutes epigenetic activity. More specifically, epigenetics seems to involve processes of adaptive learning that are a function of a great many modalities of biological activity which determine how, when and where different genes are expressed in various cells of the body.

As such, epigenetics should not be limited to just the non-DNA and non-RNA molecules (such as methyl groups or histones which are modified in different ways) that are involved in affecting the way in which the genome is expressed. Epigenetics seems to encompass all of

the forms of adaptive learning that take place during the process of gene expression or suppression.

Consequently, the notion of epigenetics, when considered in an expanded sense of the term, seems to point in the direction of some kind of over-arching system of control that is independent of both the 2% of the genome that generates a set of fixed proteins, as well as the 98% of the genome which involves the activity of an array of DNA and RNA sequences that constitute the surface of the dynamics which are being regulated by some sort of underlying or overarching system of operational control concerning what takes place in the biological terrain under different circumstances of contingency. As such, the operational system that regulates how, and when, and where the 98% and the 2% of the genome interact with one another would seem to reside in something beyond those two segments of the genome, and, as stated previously, my candidate for the location of such a operational control system is in the guise of the transduction dynamics of somatids, endobionts, or microzyma that seem to be essential to life and, yet, as Béchamp, Enderlein, Rife, and Naessens all maintained, are, simultaneously, independent of those same life-forms.

The nature of the epigenetic control that somatids, endobionts, or microzymas have with respect to the way in which the 98% of the genome interacts with the 2% of the genome is not captured by the specific dynamics that are entailed by, among other components: Promoters, transcription factors, enhancers, latent enhancers, super enhancers, the Mediator complex, the master regulators, methyl groups, histone proteins, long sequences of non-coding RNA, and so on. The aforementioned set of components are the workers that serve as the means through which certain kinds of biological tasks are carried out, but the heart or essence of epigenetics resides in the operational control center that instructs those, and other, molecular workers how, when, and where to perform their functions.

As such, the scope of epigenetics goes beyond whatever sorts of nuances (such as methylation) that are being introduced to modulate the dynamics that are being carried out by the foregoing set of components. Epigenetics really refers to the processes of operational control that govern when things are to be done, or in what order they are to be done, or in what combinations they are to be done, or where

they are to be done, or how such processes are to be modified so that the biological terrain can effectively respond in a timely and appropriately adaptive manner to the changing conditions of life.

Epigenetics doesn't change the nature of the tools which are to be used to carry out various functions. Epigenetics changes how those tools will be used in response to changing conditions, and such operational capabilities appear to go to the very heart of what constitutes adaptive learning.

Moreover, the foregoing sort of adaptive learning would seem to be present in the Naessens transplant experiment which was discussed toward the beginning of the present chapter. In those transplant experiments, rabbit-skin from a white-furred rabbit was observed to give rise to a certain amount of white fur in a black-furred counterpart without encountering any sort of rejection phenomenon -- provided that somatids from the white-furred donor were first transferred to the black-furred recipient prior to the process of transplantation. The donor somatids seem to have responsibility for the kinds of adaptive learning that had to occur in the recipient rabbit in order for the subsequent transplantation to be able to occur without initiating a rejection phenomenon.

If the foregoing is true, then, the issue of rejection is not a self versus non-self issue. The rejection occurs if the recipient organism is not provided with the sorts of epigenetic operational controls that are present in the donor organism, and, as such, rejection is really a matter of the epigenetic process breaking down due to the absence, for whatever reason, of the right kinds of operational control capabilities.

As a result, the necessary sorts of adaptive learning cannot take place. These adaptive learning dynamics normally enable the biological terrain to detoxify the poisons or toxins that give expression to the sorts of strong allergic reactions that emerge when transplantation takes place without the appropriate capacity for adaptive learning being present.

Earlier, mention was made about how histones can affect the manner in which genes are expressed, including the sorts of modifications to genes that enhances or enables the readiness of those genes to be expressed under certain kinds of circumstances. Given that histones seem to be involved in many kinds of allergic responses, it is

not that much of a reach to suppose that something has gone wrong with those aspects of epigenetic control which are responsible for certain kinds of histone dynamics, including a readiness to respond (problematically) to the presence of certain kinds of molecules (poisons or toxins) to which the individual has become sensitized as a result of a breakdown in epigenetic functioning.

Conceivably, many of the diseases that are considered to be autoimmune in character might be, instead, what results when the operational control capacity of the system of epigenetics is poisoned in some fashion. As a result, various aspects of metabolism (whether anabolic or catabolic) become dysfunctional.

One might even say that all of the foregoing sorts of dysfunctional dynamics are variations on one theme – allergic reactions of one kind or another. More specifically, the body develops allergies – which are processes of inflammation or destabilization – in response to the presence of poisoned or dysfunctional chemical pathways that are occurring in different parts of the body.

As indicated earlier, allergies are a form of inflammation within some aspect of the biological terrain. Such inflammation appears to have the capacity to induce various aspects of the microbiome to transition away from symbiotic relationships with the terrain.

Consequently, allergies, of whatever kind, give expression to a breakdown in the dynamics of epigenetics in which poisoned or dysfunctional processes of one kind or another cannot be properly detoxified. As a result, the biological terrain cannot be returned to a condition of detoxified stability in which that terrain continues to have an on-going symbiotic relationship with the pleiomorphic/pleiomorphic microbiome that occupies the terrain.

Unless the underling process of epigenetic poisoning or dysfunction can be detoxified, then, allergies tend to become chronic in nature. This is the case irrespective of whether such maladies occur in the guise of normal allergies, or they occur in the guise of more complex forms of dysfunction such as so-called autoimmune diseases.

Therefore, the condition of being chronic is a symptom of the way in which the epigenetic system of operational control continues to be poisoned or rendered dysfunctional. Just as the adaptive learning that

occurs in conjunction with epigenetic processes had become stagnant or static or fixed in a constructive fashion when, for instance methylation takes place in relation to the suppression of certain genes, to too, there is a negative counterpart to the foregoing in which the adaptive learning process becomes stagnant or static in a problematic way, and, this results in the emergence of one, or another, kind of pathology.

Consequently, so-called autoimmune diseases might not necessarily have anything to do with issues of immunity in which parts of the self supposedly attack other parts of the self because the latter components are, somehow, perceived to be operating in ways that are not consistent with what is considered to be the self's way of conducting genetic business. Instead, so-called autoimmune diseases might be just another set of symptoms that arise when the epigenetic system is poisoned in one fashion or another, and, as a result, some portion of operational control is lost or becomes dysfunctional because what is normally a process of adaptive learning is being prevented (through absence or dysfunction) from properly governing the manner in which the 98% of the genome which encompasses a high degree of non-coding DNA and RNA modulating capacity will interact with the other 2% of the genome that codes for fixed proteins.

The essential dynamics that are being outlined in this chapter are as follows. To begin with, the organizing intelligence of Qi (prana-nur-qi) flows through somatids, and the latter components are unique to each kind of tissue, organ, and organism.

Next, somatids transduce the organizing intelligence of Qi into the energies and epigenetic dynamics that are necessary to either maintain biological stability or to activate processes of detoxification and recovery concerning various forms of biological destabilization. Epigenetic dynamics regulate how the genome of any form of tissue, organ, or organism is to be parsed, edited, sequenced, modulated, started (turned on), or stopped (turned off).

On the one hand, pathology arises when the transduction dynamics of somatids are undermined in some fashion. On the other hand, pathology also arises when the epigenetic dynamics which are set in motion through the transduction process are destabilized in some fashion involving, among other things, the problematic manner

in which the genomes of tissues, organs, or organisms are parsed, edited, modulated, sequenced, turned on, and/or turned off.

<u>Chapter 17:</u> Endosome Linguistics

A recent book (2023) by Dr. Ed Park entitled – *Exosomes: Songs of Healing* – proclaims that exosomes can be generated through stem cells and that such exosomes are part of the human body's natural process for healing and repairing the body. The foregoing perspective gives rise to a variety of questions which will be explored to varying degrees during the course of the present chapter.

For example, what is the nature of the communication dynamic which links an aspect of the biological terrain that is in need of repair with that part, or parts, of the body which is, or are, being tasked with attending to the repair process? How does the latter process "know" what kind of endosomes/exosome package should be put together in order to effect a certain kind of repair? What, if anything, is responsible for regulating the process of overseeing different facets of the endosomes/exosome phenomena?

Moreover, before proceeding on with taking a look at various issues which have relevance to the foregoing questions, one should keep in mind something which is, in a sense, fairly obvious, and, yet, is, for various reasons, often forgotten. More specifically, developing a medical technology which leverages a certain amount of understanding concerning some of the behavioral functionality of various aspects of biological dynamics is not at all necessarily the same as being able to understand how the system one is exploiting is able to do what it does.

For instance, suppose one knows a genius – someone who is talented in a number of ways, yet, one has no idea how that individual does what that individual does. However, one has some money and, as a result, one decides to offer the talented genius a job to come up with solutions for a medical problem in which one is invested to varying degrees.

For whatever reason, the genius accepts the offer and begins to work on the assigned problem. After a period of time, the individual comes to the individual who is bankrolling the project and says that based on the research, observation, and testing which has been completed, a set of processes in the body have been discovered which produce molecular structures that have certain kinds of properties

which could be used to help resolve the medical problem which initially led to the foregoing research being pursued.

The person funding the research begins to ask a variety of questions concerning the biological dynamics which occur in the body and which make such molecular structures possible. The researcher indicates that the research hasn't gotten that far yet.

The latter individual indicates that what is understood is the following: A way has been found to identify and gather certain kinds of molecular structures which are produced by the body. Furthermore, research also indicates that when those structures are employed according to certain methodological protocols, then, determinate kinds of constructive, clinical results often have been observed to occur.

There are two different kinds of regulatory systems which are present in the foregoing scenario. The first sort of regulatory system has to do with the way in which the body goes about its business, while the second kind of regulatory system has to do with the manner in which a researcher has parsed the aforementioned, natural biological system and, then, excerpted various features of that latter system in order to leverage such an understanding for clinical and/or commercial purposes.

The second kind of regulatory system is a function of how human beings wish to exploit certain aspects of a natural system according to the interests of various human beings. Such an artificial regulatory system need not have much, or anything, in common with the natural regulatory system which the former artificial or synthetic regulatory system is seeking to leverage or exploit.

Regulating the use of a discovery concerning a certain aspect of biological functioning is one thing. Discovering the regulatory character of how a given biological system makes the foregoing sort of functioning possible might be another thing altogether.

People often confuse, if not conflate, the foregoing two kinds of regulatory systems. Such people seem to assume that if researchers have found a way to exploit a small facet of a natural system of biological functioning, then, this necessarily means that those researchers understand, and have insight into, the entire set of

dynamics which govern the natural system which is being parsed and leveraged in some possibly arbitrary, artificial, or synthetic fashion.

Over a number of decades, things have been discovered in conjunction with the phenomena of endosomes/exosomes. What has been discovered with respect to those phenomena might not be able to shed much light on how endosomes or exosomes are actually regulated in the human body and much of the remainder of this chapter will be directed toward examining the nature of the features which are central to, but seem to be missing from, issues concerning endosomes and exosomes.

In other words, just as we might not understand how a talented genius does what such an individual does and, very likely, just as a talented genius does not necessarily know how what is done within, or through, that individual is able to take place, perhaps the same might be true with respect to the dynamics of endosomes and exosomes. Any number of properties concerning those dynamics might have been discovered through various kinds of research, but none of those discoveries necessarily has much to do with the regulatory processes which govern the dynamics of endosomes and exosomes in the human body, and, if so, this might point toward one more instance of something being more deeply hidden in the phenomena within which we live our lives.

Discoveries concerning certain aspects of endosomes/exosome dynamics have been relatively recent. One of these relatively recent discoveries has to do with the manner in which endosomes and exosomes serve as integral parts of a system of communication within the human body.

Prior to the uncovering of the communicative function of endosomes/exosomes, most biologists maintained that proteins were the primary form of communication which was used in the body. For example, according to the old way of thinking about molecular communication, certain genes might be expressed, and as a result, proteins for which those genes coded would be generated, and, then, these proteins would be released into the system to attend to whatever biological, communicative process required the generation of such a protein.

For the most part, endosomes and exosomes are the same. They merely refer to different phases of their life cycles.

During the process of being generated within an organelle known as the "Golgi Apparatus", the foregoing entities are called endosomes. Once those entities have been generated and packaged within a Golgi body and, then, transported out of that organelle, they are referred to as exosomes.

While the existence of the "Golgi Apparatus" has been known by biologists for quite some time, there were different ideas about exactly what that apparatus did. Whatever such differing ideas might involve, one of the functions of the Golgi apparatus which tended to be held in common by various perspectives is that the foregoing organelle packaged things, although what was being packaged was often at the center of the aforementioned differences of opinion.

Many theorists believed that proteins, of one kind or another, were being packaged, and, then, released from any given Golgi organelle. According to current theory, endosomes might contain: Proteins, micro-RNA (which has the capacity to prevent certain kinds of protein translation from taking place), as well as messenger RNA to be used in the construction of proteins.

Consequently, given the multifaceted set of content possibilities, the packages being released from Golgi bodies came to be known as MVEs or Multivesicular Endosomes. The contents of those packages would be transported to the cell surface for release at which point they would become exosomes.

Without going into any sort of depth, one might note in passing that enough has been said in previous chapters to indicate that the notion of cells might be an artifact of theory and methodology rather than a function of actual biology. For example, the research of Herbert Hillman, Gilbert Ling, Gerald Pollack (all of whom have been mentioned previously), as well as other individuals (e.g., Vladimir Voeikov, Konstantin Korotkov, And Tom Cowan) suggests the possibility that while compartments within a body's tissues and organs might form or dissipate as a function of changing conditions involving the dynamics of water undergoing transitions from bulk water to structured water according to the folding and unfolding of various kinds of proteins via the dynamics of ATP as well as due to the

dynamics of nano-protoplasm units, nonetheless, these temporary forms of compartmentalization are not the same as permanent cells.

Consequently, while Golgi bodies might release MVEs and while these MVE's might eventually transport their contents to some other part of an organism's system of transitory protoplasm compartments at which point endosomes (which arose within a compartmentalized region) become exosomes (packages which have become exteriorized relative to where they arose within a given compartmentalized region of biological terrain), nonetheless, none of the foregoing dynamics have to be understood in cellular terms. Endosomes and exosomes can be understood as phases of a communication process that takes place at different points in an organism's or organ's or tissue's system of protoplasm involving compartmentalized regions which form and dissipate according to the ways in which water becomes structured and unstructured.

Irrespective of whether one thinks of Golgi bodies as packaging proteins or as packaging some other kind of contents, there are similar sorts of questions which arise. For example, what induced, and, then, regulated the set of dynamics through which, at a given time, the Golgi body identifies and secures a specific something or set of "somethings" (content), packages those contents, and, then, is induced to release those contents in the form of an MVE from the Golgi body at a certain time in order to be transported, presumably, in a specific sequence and to a specific destination of some kind?

Endosomes/exosomes are believed to be packaged in phospholipid bilayers. One of those two phospholipids bilayers supposedly faces the surrounding cytoplasm through polar or hydrophilic (water-loving) components which are part of the exterior compartmentalization of the MVE and, as such, can interact with the water-containing cytoplasm which surrounds the MVE, while the second of those two bilayers has polar or hydrophilic components of its phospholipid layer facing inward toward the interior of the MVE which also contains water.

As indicated in the earlier chapter on the work of Gilbert Ling, if he were still alive, then, he might speak about MVE's as a function of nano-protoplasm units which are formed at a particular time due to the forces that are brought to bear on the region of biological terrain in

which such units are formed. According to the perspective being given expression through the preset book, Qi (prana-nur-qi) is what regulates the dynamics that intelligently organizes the formation of nano-protoplasm units that would lead to the manifestation or emergence of such MVEs, and such intelligent organization is being transduced through the presence of somatids which are present in, and specific for, any given kind of tissue, organ, or organism.

Endosomes/exosomes are said to have a diameter which is about 100-nanometers in size. Prevailing theories concerning the foregoing nano-packaged entities contend that since they are surrounded by phospholipid bilayers, this membrane-like structure enables them to become absorbed, in some way, by the phospholipid materials which surround whatever cells to which the MVEs are being transported.

An alternative possibility to the foregoing considerations is that whatever surrounds MVEs becomes assembled and disassembled as a result of the dynamics which are taking place in the structured or bulk water surrounding the contents of MVEs, and, if this is the case, then, there is no need to suppose that a process of absorption of one set of phospholipid layers by another set of phospholipids is taking place. Instead, one could suppose that MVEs are a transitory form of compartmentalized contents – like everything else taking part in tissues, organs, or organisms -- which is responsive to the surrounding conditions of bulk and structured water ("responsive" in terms of being inherently receptive to the formation of relatively closed or open/permeable compartmentalized regions or MVEs which are transitory in nature).

Endosomes/Exosomes are the smallest of three structures that are known as extracellular vesicles. Another, larger form (100 to 1000 nanometers) involving the general category of extracellular vesicles is referred to as "microvesicles."

Microvesicles arise in conjunction with two processes. One of these processes is known as: "exocytosis," which involves a 'budding-out' dynamic which, supposedly, takes place in conjunction with the phospholipid surfaces of cells, and the second of the aforementioned two processes is termed: "endocytosis," which, allegedly, consists of a 'pinching-in' dynamic that takes place with respect to the phospholipid bilayers of a cell surface.

Whether one is talking about endocytosis or exocytosis, the same question bubbles to the surface. What regulates when, where, or how those two processes or dynamics take place?

A still larger species of the aforementioned extracellular vesicles are called “apoptotic bodies” (they vary in size and the largest of them run about 5000 nanometers in size). As the foregoing name suggests, these kinds of extracellular vesicles contain remnants of cells which have self-destructed as part of an ongoing process of renewal and detoxification which takes place in various parts of the body.

For many years, the presence of different kinds of extracellular vesicles was known through electron microscopy. However, the various roles played by those different kinds of vesicles were not understood, and this is especially the case in relation to the dynamics of communication with respect to which endosomes/exosomes were discovered to be giving expression.

‘Something’ in -- or associated with -- a Golgi body is able to decode incoming signals concerning the contents which are to be packaged during the construction of various endosomes. Furthermore, ‘something’ is responsible for knowing when, where, and how to transport those endosomes/exosomes.

Knowing that endosomes are put together in a Golgi body doesn’t necessarily tell one anything about the dynamics of the process through which the contents of those endosomes are determined, identified, gathered, and packaged. In addition, knowing that endosomes become exosomes as the former are released from Golgi bodies and, then, those entities are transported to this or that region of the biological terrain doesn’t necessarily tell one anything about what regulates this process of quite specific transportation dynamic, and, moreover, knowing what regions of the biological terrain are being targeted by exosomes does not necessarily provide one with any insight concerning how the contents of the exosome become communicated to, or understood by, the receiving end of such a process of communication.

According to current understanding concerning the nature of biological dynamics (and, therefore, putting aside alternative views concerning whether cells in a traditional sense actually exist), cells function differently from one another as a result of processes involving

sequences of gene promotion and gene silencing. In other words, despite the fact that every cell in a given organism which contains a nucleus has the same, full complement of genes as do all the other cells in that organism which contain a nucleus, nonetheless, something regulates the way in which different genes are promoted and silenced so that a given cell will produce various proteins at certain times, in determinate amounts, and in particular sequences while simultaneously silencing the expression of other genes.

Some people refer to the complement of 23 paternal chromosomes and 23 maternal chromosomes in human beings as a sort of cookbook which contains recipes for every kind of protein. Strictly speaking, such a description is incorrect because the recipes for any given protein in a given cell come from something other than those 46 chromosomes.

For instance, epigenetic transcription factors in the form of, among other possibilities, methyl (CH_3) and acetyl ($-COCH_3$) groups are sent by 'something' to latch on to certain facets of the part of a genome which is undergoing transcription. The place where such groups attach themselves makes a difference in what happens next, and, consequently, the presence of those transcription factors is not enough.

In short, transcription factors become attached to specific components within the genome. As a result, 'something' not only has to call for a specific kind of transcription factor, but, as well, 'something' has to indicate where that transcription factor must attach itself and for how long.

There is no evidence indicating that the genome is telling itself what to do or when and how to do what it does. Instead, the genome is being parsed by something independent of the genome, and the determinations concerning the expression or silencing of different genes is shaped by, among other things, the presence and dynamics of transcription factors for which, again, there is no evidence that the identity and dynamics of those transcription factors are being regulated by the genome, but, rather, the available evidence appears to indicate that those transcription factors dance to the tune of a pied piper which plies its trade from beyond the horizons of the genome.

Endosomes/exosomes may be among the notes which are played by a mysterious pied piper phenomenon when the genome is induced to dance about doing the genetic jig as genes are being expressed and silenced. However, which notes are to be played, and when those notes are to be played, and where silences are to appear in order to separate notes, as well as the sequence in which those notes are to be played are specified by something other than those endosomes/exosomes.

Endosomes/exosomes give expression to the notes of a musical score. They are not whatever writes the score, nor are they that which plays the score (thought they are among the notes of the score which are played), nor are they that which hears the score, nor are they that which responds to the score, nor are they that which assigns significance to the notes which are being communicated.

Epigenetics is the genomic orchestra that is full of different kinds of biological instruments which plays the score that has been written and which is being conducted by 'something' else. Previously, this conductor has been identified as being the somatids that populate any given kind of tissue (each tissue has its own conductor) and which transduce the organizing intelligence of Qi (prana-nur-qi), and, therefore, Qi (prana-nur-qi) is that which writes the score and induces the somatids to transduce what is being communicated through the orchestral dynamics of epigenetic processes.

One is free to reject the foregoing somatid transduction hypothesis, but if one does this, then, one is faced with a number of puzzles which will need to be solved. More specifically, if somatids are not responsible for transducing the organizing intelligence of Qi (prana-nur-qi) into forms of energy, processes, and dynamics which are capable of regulating all aspects of epigenetic functioning, then what is regulating that epigenetic functioning (and how does this other possibility do what it does)? Furthermore, if somatids are not responsible for transducing the organizing intelligence of Qi (prana-nur-qi), then, what are the different kinds of somatids doing in various sorts of cells, tissues, organs, and organisms as such somatids (based on a great deal of evidence) run through their pleiomorphic cycles as a function of the character of the biological terrain in which they reside?

Notwithstanding the foregoing considerations, let's consider different aspects of mesenchymal stem cells and the exosomes to

which they give rise. Such exosomes have come to play a central role in an array of therapies which are directed toward reducing various kinds of inflammation as well as helping to induce the regeneration of various kinds of cellular/tissue dynamics.

Before getting to the topic of mesenchymal stem cells (and these types of cells are not the only kind of cells which are capable of releasing exosomes), one should backtrack a bit in order to place the forthcoming discussion in something of an intelligible, biological context. For instance, the term "embryogenesis" refers to the collective set of dynamics through which biological development takes place.

The first seven, or so, steps of the foregoing process are: "Fertilized egg, 2-cell structure, 4-cell structure, 8-cell structure, morula (a 16-cell structure in which certain kinds of morphological changes can be detected), blastula (a fluid-filled cavity surrounded by a covering or epithelial), gastrula (an invaginated structure consisting of three layers. These three layers are termed: The "ectoderm", "mesoderm", and "endoderm".

Although various facts are known concerning the foregoing seven stages of embryogenesis, that which is responsible for regulating all of the dynamics to which those stages gives expression is unknown. Thus, although 'something' is inducing the gastrula to differentiate into three different layers of activity, each of which has its own characteristic properties.

What is regulating the foregoing process of differentiation is not known. This is because despite having discovered many aspects of what is happening during certain aspects of embryogenesis, the nature of the regulatory process governing processes of differentiation (that is, whatever is determining which genes are to be expressed and silenced -- and when, as well as in what order and to what extent) remains to be discovered.

Mesenchymal cells are not actually full-blown pluripotent stem cells, as much as they are stem-cell like in certain respects. The name for these kinds of cells was due to certain similarities which mesenchymal cells had to stem cells that arise relatively early during the process of embryogenesis and which are linked to certain kinds of connective tissue that is part of the mesodermal layer which is known as "the mesenchyme".

"Epithelial" is a term that is used to refer to cells which have been brought together in sheet-like arrangements. When any of those cells become separated from, or operate independently of, those sheet-like arrangements and, therefore, are free to travel about in an amoeba-like fashion, they are termed "mesenchymal".

Mesenchymal cells are a function of pericytes. These latter cells form sheet-like linings within many of the smaller blood vessels which can be found throughout the body, and, as well, pericytes line the still smaller blood-transporting capillaries that run throughout body tissues and organs.

There is a biological dynamic that enables certain cells in the aforementioned pericytes (that are lining smaller blood vessels and capillaries) to become mesenchymal in nature. What regulates various facets of the foregoing transition process is not known.

Once the aforementioned transition takes place, mesenchymal cells exhibit an array of properties. Among other things, they: Are mobile rather than being fixed; lack polarity (i.e., charge), and do not adhere to cell surfaces.

However, what is of most relevance for present purposes is the way in which mesenchymal cells are also capable of transforming into different cells through a process which is termed "mesengenic". In this respect, they are somewhat pleiomorphic-like in nature, and, consequently, one can't help but wonder if there are some commonalities in the dynamics which make mesengenic transformations possible and the dynamics which are present in pleiomorphic transformations such as those which take place in the 16-plus stages established by Gaston Naessens.

Stem cell biologists know how to prod mesenchymal cells to become different kinds of cells by introducing various molecules into a culture containing those cells and inducing specific kinds of transformations. Nevertheless, knowing how to do the foregoing does not mean one necessarily also understands how regulatory processes in the wild, so to speak – that is naturally -- set in motion one kind of mesenchymal transformation (e.g., muscle cells) rather than some other kind of mesenchymal transformation (e.g., bone or cartilage) at one time rather than another.

Notwithstanding the foregoing considerations concerning the capacity of mesenchymal cells to be able to transform into different cells, the individual (namely, Arnold Caplan) who gave the former cells their moniker believes that the actual function of mesenchymal cells in the body is not about the aforementioned capacity to transform into other kinds of cells. Instead, Caplan maintains that mesenchymal cells are not only occupied with decreasing inflammation, but, as well, they are actively engaged in ensuring that the right kinds of exosomes are being released into an injured aspect of a given biological terrain so that the contents of those exosomes will: (a) induce a certain amount of growth in local, damaged tissue through the initiation of cell division that can help to replace damaged tissue, as well as: (b) inducing certain processes of de-differentiation among local stem cells in order to regenerate various facets of a damaged area, and the specific nature of the contents of those exosomes is what makes such structures "right" for a given set of circumstances.

Given the foregoing perspective, some individuals have offered the opinion that the sorts of cell transformations which researchers have been able to induce in lab cultures by introducing various molecules into those cultures is nothing more than an artifact of experimental conditions. In other words, although intriguing, the foregoing kinds of lab experiments are misleading because they seem to obfuscate what appears to be the natural functions to which Arnold Caplan had been attempting to draw our attention (i.e., the capacity to reduce inflammation as well as to promote cell-division and tissue regeneration).

There is, however, a possible way (this is only a conjecture) to link the lab experiments concerning cell transformation with that which Arnold Caplan contends is the actual nature of the functions of mesenchymal cells (cell-division, regeneration, decrease in inflammation). More specifically, if – as lab experiments have shown – mesenchymal cells have the capacity to transform into a number of other kinds of cells, then, this would tend to indicate that – based on capabilities which can produce different cells for different purposes -- those cells might also have the capacity to determine what specific exosome contents would need to be called into a given form of terrain destabilization in order to best induce the sorts of decrease in

inflammation, cell-division, and tissue regeneration that are needed in the species of cells and tissues which populate a damaged area.

Irrespective of whether one accepts the foregoing conjecture or rejects it in favor of some other alternative, an underlying issue concerning regulatory oversight remains. In other words, irrespective of how the aforementioned biological "sleight-of-hand" is performed, mesenchymal cells need to decode signals of some kind which seek to induce certain kinds of exosomes (that is, exosomes with a certain set of proteins, micro-RNA, and mRNA) to be released into the areas that are in need of that assistance, and, therefore, not just any kind of exosome will serve the immediate needs of the part of the biological terrain which has been destabilized.

According to current models, mesenchymal cells are either inclined toward journeying to injured areas of the biological terrain or those cells simply emerge from various pericytes that line small blood vessels and capillaries during a process which transitions pericytes from epithelial to mesenchymal cells. Moreover, these transformed cells release many exosomes, and those exosomes begin to engage and act on injured tissue.

On the one hand, the foregoing exosomes are described as modulating different kinds of inflammatory agents which have been sent to, and are present in, the injured tissue. On the other hand, the exosomes released by the mesenchymal cells engage stem cells which are present in, or around, the injured area, in order to either induce the stem cells to undergo division and/or to induce the latter sorts of cells to undergo some degree of de-differentiation through which those cells regain a certain capacity to produce species of cells that had been discontinued during certain stages of embryogenesis but which, as a result of those de-differentiation dynamics, can now be used to help regenerate injured tissue.

The foregoing several paragraphs provide a synoptic overview of what is known about the dynamics of mesenchymal cells and exosomes. However, there is much which is absent from the previous account because much which remains unknown.

For instance, irrespective of whether mesenchymal cells are inclined to journey to injured areas or, alternatively, happen upon injury sites as those cells journey about the body and, subsequently,

become engaged with attending to injury issues, how do mesenchymal cells "know" that an injury of some kind has occurred? What induces those cells to begin putting together packages of proteins, mRNA, micro-RNA and whatever else is placed in those packages?

Furthermore, what kinds of mRNA are to be included in the exosome packages in order to help activate certain kinds of gene expression? What sorts of micro-RNA messages are selected to silence the expression of certain other kinds of genes?

Different sequences of mRNA will induce the expression of different aspects of the genome. Different sequences of micro-RNA will silence different genes.

Presumably, different kinds of injuries to different kinds of tissues will require the exosomes which are being released to be ready to induce the right kind of cell-divisions and the right kinds of de-differentiation in local stem cells. Therefore, questions necessarily arise as to how mesenchymal cells acquire 'knowledge' with respect to the nature of the contents that are to be selected for packaging as endosomes/exosomes.

How do mesenchymal cells identify the inflammatory agents that might be present at an injury site? How do mesenchymal cells "know" what elements to include in an endosome package in order to be able to modulate those inflammatory agents?

What proteins are selected for such exosome packages? From where do those proteins originate?

How many exosomes are to be released? What initiates the process of packaging and what terminates that process?

Is there any order to the sequence in which they are released? Do mesenchymal cells release different kinds of exosomes depending on an "assessment" (conducted how) of a given area of injury, or are there different kinds of mesenchymal cells which have various, specialist capabilities, and irrespective of which of the foregoing possibilities might be the case, how are the activities of different mesenchymal cells coordinated?

Endosomes don't put themselves together? Golgi bodies might be in charge of the packaging process, but do Golgi bodies necessarily have regulatory oversight with respect to determining what goes in

such packages, and regardless of what has regulatory oversight, how does it work?

What initiates the epithelial-mesenchymal transformation in pericytes? What regulates that transformational process?

If one is unhappy with the previously noted "somatid transduction hypothesis" which proposes that the organizing intelligence of Qi (prana-nur-qi) is transduced by the internal dynamics of somatids (which Naessens considered to be fundamental to the possibility of life) to become a form of regulatory control which can be expressed through the sequential biological, metabolic processes that are entailed by epigenetic dynamics, then, one will have to come up with an alternative account for how mesenchymal cells do what they do.

Of course, even if one were to accept the somatid transduction hypothesis, there are still a number of outstanding issues haunting that hypothesis. One of these specters concerns the nature of Qi (prana-nur-qi) itself and its capacity to manifest a form of organizing intelligence.

Providing even a provisional response to the foregoing sorts of issues will have to await discussions which are slated for later chapters. Moreover, notwithstanding to whatever extent those issues might be addressed in subsequent chapters, nonetheless, there are likely to be an array of indications which emerge during those discussions that point to something more deeply hidden still.

Despite having to wait for a fuller development of such issues, nonetheless, by way of a teaser, one might consider the following possibility. Perhaps, organizing intelligence (such as Qi – prana-nur-qi) is not a force or form of energy in the traditional sense of physics but, rather, is a dimension (remember the discussion which took place in Chapter 2) that, like time, has the capacity to become interspersed with the spatial dimension in which we operate.

Just as time modulates aspects of reality with which it comes into "contact" (the nature of this contact remains elusive and somewhat mysterious), so too, the dimension of Qi (prana-nur-qi) modulates (according to its capacity to do so) various kinds of dynamics taking place in the Venn diagram-like or Euler diagram-like overlapping of different dimensions (including space) which are interacting with, and

co-operating with, one another. Somatids might serve as circuit board-like structures that transduce certain aspects of Qi (prana-nur-qi) dimensional logic into a logic which can be operationalized within a biological setting.

Endosomes/exosomes are part of the semantics of the transduced dimensional language of Qi (prana-nur-qi). Mesenchymal dynamics are part of the syntax of that dimensional language.

Somatids translate or transduce the syntax and semantics of such dimensional language into an epigenetic language which can be used to regulate biological dynamics through metabolic pathways or programming. Somatids are the operational means through which biological dominos (e.g., Gilbert Ling's nano-protoplasm units or Gerald Pollack's structured water dynamics) are put in place so that they will have certain effects when they are triggered to begin "falling" (i.e., metabolism).

Because the somatids which are present in different cellular species are unique to each type of cell (cf. Gaston Naessens), then, the sorts of dynamics (including the types of exosomes which might be released through the Golgi bodies of different cell types) that happen in the somatids of, for example, neurons will be different from what happens in the somatids of mesenchymal cells. Yet, the dynamics of neuronal and mesenchymal cells – along with all of the several hundred-plus other kinds of cells in the human body -- will be coordinated through the one who is speaking (namely Qi – prana-nur-qi) because the latter is that which is directing/conducting all of the different somatids of the body into a coherent form of dimensional language which makes biological sense.

Chapter 18: Bacterial Symbiosis

In a relatively recent book (2015) by Alanna Collen entitled: *10% Human: How Your Body's Microbes Hold the Key to Health and Happiness*, a statement is made which reflects some of the perspective which is inherent in the foregoing title. More specifically, the author indicates that we are only 10% human because for every cell that is identified as being human in nature, there are nine other cells which are bacterial in nature simultaneously populating our bodies as well.

Given the foregoing ratio of microorganisms to human cells, there is a question which can be raised which, perhaps, is apropos to nothing, but Collen does not address the issue. More specifically, why is the ratio of microbes to human cells what it is, rather than being a smaller or greater ratio?

Presumably, there are ecological forces which maintain such a ratio. However, one might also wonder whether, or not, the foregoing ratio – and, maybe, various relevant ecological conditions – is a function of some sort of regulatory dynamic which shapes the way in which the microbiome and the human body interact with one another.

If there were a regulatory dynamic that had some degree of oversight concerning the way in which the microbiome and the human body interacted with one another, an obvious question would arise. What is the nature of that regulatory dynamic?

Undoubtedly, teasing out the details of such a possible dynamic would constitute a considerable challenge. On the other hand, providing various considerations (in the form of data, questions, and critical reflection) that might lend support to the possible existence of such a regulatory system could serve as a prolegomenon for the more difficult challenge noted above.

According to Collen, there are approximately 4,000 different species of bacteria residing within, and on, a human being. In passing, one might ask about why – given the millions, and perhaps trillions, of species of bacteria (both discovered and waiting to be discovered) that are believed to exist in the world – only 4000 species of bacteria appear to be present in the microbiome of humans, and, in addition, whether the foregoing number represents sort of regulated limit of an unknown nature.

Perhaps, as a way of injecting a degree of dramatic hyperbole into her presentation, Collen introduces the notion that we are colonized by an array of alien life forms. She follows up on the foregoing idea by raising a seemingly rhetorical question concerning the apparently disgusting nature of such a state of affairs.

The foregoing considerations tend to lead to questions about what it means to be a human being. There are some individuals who might wish to argue that the essence of being human is a function of something more than our bodies and that those bodies are just the vehicles which are used to journey through life, and, therefore, the idea that human beings are 'occupied' by nine bacterial cellular forms for every human kind of cell which is present might merely mean that the nature of the human body might be far more complex, strange, and nuanced than many people have supposed or been conditioned to believe.

For example, as indicated during the last chapter, when certain cells are aligned in a layered fashion, they are called epithelial, but when those same cells become separate from the epithelial layer, they are called mesenchymal cells and exhibit other kinds of functions. Consequently, perhaps something similar might be operating in conjunction with respect to bacteria which start out in the form of somatids but, as biological conditions manifest changes, then, those forms also undergo various kinds of transition (somewhat akin to the epithelial-mesenchymal transition discussed in the last chapter) and, in the process, acquire new morphologies and functions.

More than 50 years ago, I remember listening to a double-record set by a former Harvard professor -- Richard Alpert (aka Baba Ram Dass) -- in which a point was made (although I might be conflating the alleged source of this idea with the ideas of someone else) that just as a person should not suppose that one is the car in which one is riding, so too, one should not suppose that one is the body by means of which one moves through physical life. One could further develop the foregoing idea by indicating that just as cars come equipped with all manner of accessories that have different uses for the enjoyment and use of a passenger in that car, then, one also might consider the 4000 species of bacteria which are present in, on and around (remember the bioplasma clouds of Chapter 13) the average human being to be so

many added accessories associated with the basic body model and which have various functions to enhance the quality of the body-driving experience.

To consider the presence of bacterial cells to be, somehow, more disgusting than the presence of non-bacterial, human cells seems somewhat arbitrary. Moreover, there are many human beings who are as squeamish in relation to human cellular biology as they might be with respect to the way in which bacterial cells seem to have such an intimate relationship with human cells, and, in addition, one might also consider the possibility that having to deal with human beings might not always be a picnic for the 4000, or so, bacterial species which are sharing space with human cells.

When Gaston Naessens studied the blood of human beings using the near-nano-scale power of his ingenious and highly innovative Somatoscope optical technology, he discovered that the somatid entities which are present in the blood (and, actually, are present in other cells of our bodies as well) exhibited a 17-18 stage cycle of pleiomorphic forms (some of which are bacterial in nature) that arose as conditions changed in which those somatids resided. Moreover, while the microzymas which Béchamp studied in the blood of different organisms (see Chapter 8 of the present book) might not be exactly the same as Naessens' somatids, nonetheless, both microzymas and somatids shared many similar characteristics, including the property of being pleiomorphic in nature, and, therefore, they were able to transform into different morphological and functional forms as conditions in the biological terrain in which they resided underwent various kinds of transitions in character.

Enderlein and Rife (see Chapter 14) also had research findings which coincided and resonated with some of the foregoing discoveries of Naessens and Béchamp. Enderlein referred to the fundamental pleiomorphic entities which he discovered in organisms -- including human beings -- as endobionts.

Naessens indicated that only the first three stages of the aforementioned cycle were associated with conditions of health and that the other thirteen-plus pleiomorphic forms which occurred at various points during the somatid cycle appeared to arise during pathological conditions. However, just because these other

pleiomorphic forms emerged in conjunction with pathological conditions does not necessarily mean that those forms are responsible for whatever form of pathology might be present, any more than the presence of fire fighters at blaze or inferno necessarily means that those individuals started the fire.

Naessens also indicated that different kinds of cells in the body have somatids within them and that the somatids which exist in any given type of cell are unique to that cell type. Given that there are some 214-plus species of cells in the human body, perhaps the somatid cycles which take place in those cells might generate the 4000, or so, species of microorganisms which are estimated in exist in human beings.

In the light of the foregoing considerations, a number of questions begin to bubble to the surface of consciousness. For instance, is the somatid cycle the same in every type of cell (that is, the same as Naessens discovered in the case of blood), and, if not, then what are the differences – both morphologically and functionally?

Another question which might be asked is the following one. Are the bacteria which exist in human beings (at a ratio of 9 or 10 to 1) descendents of the somatid cycles taking place in different cells of the body as conditions in the biological terrain of the body change?

Is it possible that the bacteria which reside on, within, and around us (i.e., the latter option is the bioplasma cloud which envelops human beings) have not colonized us as Alanna Collen indicates in her previously mentioned book but, instead, those bacteria have been brought into being in humans through the pleiomorphic activity of the somatids/microzymas/endobionts within us? Perhaps, under the appropriate set of circumstances, one of the functions of the somatid cycle is a matter of generating various forms of microorganisms that help to establish conditions in various parts of the body that are conducive to maintaining health

In other words, when the relationships among different species of bacteria are destabilized further problems might arise as a result of such destabilization dynamics among the relationships of different bacterial species in the body. Such destabilization could occur as a result of the presence of various environmental toxins or the use of different kinds of antibiotics and pharmaceuticals.

Alanna Collen refers to herself as an evolutionary biologist. She goes on to point out that by engaging biology through the filters and lenses of evolutionary theory, she is inclined to look for whether, or not, a given arrangement involving the biochemistry, anatomy, or behavior of a given organism is conducive to the continued survival of that species and/or the population to which it belongs, and, therefore, entails some sort of evolutionary advantage.

She goes on to raise a question about such evolutionary advantage in the case of the microbiome. More specifically, given that the alleged focus of the immune system is to protect an organism against microorganisms as well as fight off infections which are caused by representatives of the microbiome, then, why would an organism – for example, a human being – permit the presence of (as a function of evolution) all manner of bacteria?

In *Follow the What?* (an earlier book of mine) considerable discussion was devoted to exploring the possibility that the systems which often are referred to as components of an immune system might be better described and characterized as systems whose primary task is an on-going process of detoxification and re-stabilization rather than some sort of permanent or semi- permanent form of immunity. Among others, Béchamp, Enderlein, and Naessens, have all argued (based on experiment rather than theory) that the presence of certain kinds of bacteria during a given form of illness does not necessarily prove that those bacteria cause a given form of illness but, rather, those bacteria might be part of a detoxification and re-stabilization process.

If the foregoing consideration turns out to be true, then, irrespective of whether one wishes to look at biological processes through an evolutionary lens or through some other kind of theoretical kind of lens, then, one might wish to consider the possibility that the bacteria and other microorganisms which are present in the body are not necessarily inherently dangerous (although this is often the connotation which surrounds and permeates the term “microorganism”). Therefore, those entities are not necessarily something against which the body needs to defend itself or which need to be eliminated but, actually, they might be part of a set of detoxifying and re-stabilizing dynamics that are trying to

help the body overcome a given condition of pathology which has beset the biological terrain of a human being.

In words, there need not be any puzzle – evolutionary or otherwise – which is necessarily entailed by the existence of microorganisms within, on, and around us. The vast majority of the trillions of microorganisms within human beings have a symbiotic relationship with the cells of the human body, and it is only when something disturbs such a condition of symbiosis that problems might arise

During her aforementioned book, Alanna Collen probes many kinds of illnesses (e.g., allergies, obesity, various kinds of autoimmune diseases, and an array of problematic gastrointestinal conditions) which can be traced to the dynamics of destabilization in the relationships among different types of microorganism within the body. Alternatively, many illnesses also can be traced to destabilizations in the relationships among, on the one hand, various kinds of microorganisms which have established long-standing, healthy, ecological niches on, within, and around the body and, on the other hand, various epigenetic pathways within that same body.

As Claude Bernard proclaimed in the mid-1800s, the initiating keys for illness in many cases have to do with changes (or forms of destabilization) which are induced in the condition of the biological terrain in which both microorganisms and so-called human cells reside. Consequently, while pathological conditions might arise in the context of microbial dynamics taking place in the body, that pathology is only possible because changes of a certain kind previously have taken place in the biological terrain in which those microorganisms exist and not because those microbes have initiated an infection of some kind.

The presence of infection is often a sign that something has gone awry with respect to the way in which the different vectors in a given part of the biological terrain of an individual are no longer in dynamic balance with one another. In other words, the organism's terrain has become destabilized in some way and inflammation or infection is a symptom of that sort of imbalance.

As an evolutionary biologist, Alanna Collen had a professional interest in what happens in our bodies when the human microbiome

becomes destabilized in various ways. However, she also had a personal interest in the topic because she had gone through some difficult health issues in which her microbiome was involved and, as a result, she began to research the nature of the relationship between the properties of the human microbiome and health.

For example, at one point during her research, she provided samples of her microbiome to the American Gut Project (to which anyone from around the world can donate samples). This organization takes the foregoing sorts of samples and sequences their genome as part of a research program which is attempting to build up a more comprehensive understanding of the microbes within human beings and how changes in the microbiome are related to health issues.

One of the things which she found out through the sequencing of her microbiome is that her microbiome was less diverse than were the microbiomes of many other people who had donated samples to the American Gut Project. As a result, one of the questions that she began to pursue had to do with whether some of the antibiotics and other chemicals she had been given to counter her illness had contributed to lowering the diversity of her microbiome.

She also was interested in trying to find out if the lesser diversity of her microbiome might contribute in some way to the constant infections which she was experiencing during her attempt to recover from her underlying pathological condition. A further question about which she wondered was whether, or not, there might be some way through which she would be able to recover the diversity in her microbiome which seemed to have been lowered or lost.

Although the vast majority of the 100 trillion organisms which constitute the human microbiome are bacterial in nature, nonetheless, one also can find other kinds of microorganisms – such as fungi -- in that collection. Given that both Enderlein and Naessens had shown that both bacterial and fungal forms are among the pleiomorphic stages of, respectively, the endobiont cycle and somatid cycle, one should not necessarily be surprised that one can find such microorganisms in the microbiome, and, consequently, one does not necessarily have to assume that those organisms enter us from without but could be indigenous to the human body and naturally arise within us when conditions are conducive to their emergence.

If one adds up the genes in the microbiome, that figure tends to dwarf the size of the human genome that was uncovered during the Human Genome Project. More specifically, the number of genes which was essentially settled on in conjunction with the latter project was 21,000, whereas the genes which are collectively present in the microbiome have been estimated to be in the vicinity of nearly 4.4 million genes.

Of course, when one takes into consideration the way so-called "junk" DNA and RNA actually plays a significant role in enabling human beings to generate nearly 90,000 proteins rather than the 21,000 proteins which are coded in the so-called standard complement of genes (the ones which were sequenced in the Human Genome Project), then, the difference in size between the human genome and the collective genome of the microbiome becomes lessened to a degree. Nonetheless, the difference between the two remains considerable nonetheless.

Alanna Collen contends that the human body operates as a function of the way in which the genes of the human genome and the collective set of genes of the microbiome co-operate with one another. While in one sense, the foregoing contention is true – that is, the human body requires cooperation between what takes place with respect to the human genome (in its larger context of approximately 90,000 genes rather than just 21,000 genes) and what takes place in the roughly 4.4 million genes to which the human microbiome gives expression – nevertheless, the epigenetics which occur in the foregoing two sets of genes are actually being regulated by something more deeply hidden beyond those respective sets of genes, and, hopefully, this aspect of things will become clearer as the relationship between the human genome and the human microbiome is probed a little more closely.

The author of *10% Human* maintains that human beings, along with many other organisms, have been co-evolving with microorganisms for millions of years. For instance, she uses the Hawaiian bobtail squid to help illustrate aspects of the foregoing contention concerning co-evolution.

More specifically, Collen indicates there is a particular kind of bacteria – namely, Aliivibrio fischeri -- which resides in an organ

located in the underside of the Hawaiian bobtail squid. This species of bacteria has the capacity to translate food into light energy.

As a result, when the foregoing squid is viewed from below, the squid glows. According to Collen this provides a certain amount of camouflage when the squid is viewed from below by a potential predator due to the way the glowing squid will appear to blend into moonlit water.

Of course, the foregoing account doesn't explain how the glowing bottom portion of the squid protects the squid from predators that attack the squid from behind or above. Nor does the previous scenario indicate what happens when there is no moon on a given night or what happens when the squid is propelling itself through a portion of ocean in which the moon is covered by clouds or a storm is taking place.

Notwithstanding either the foregoing considerations or whatever truth might be present in claims concerning the protection which the squid's association with a bioluminescent bacterium might provide, no evidence is actually provided concerning how Aliivibrio fischeri developed its capacity for bioluminescence or how it came to reside in a specialized organ within the Hawaiian bobtail squid that could make use of such bioluminescence. Nor is any evidence offered concerning how the species of squid developed the aforementioned specialized organ or how the bioluminescent bacterium and the Hawaiian bobtail squid came to develop a symbiotic relationship.

Alanna Collen contends that Aliivibrio fischeri somehow got invited into the Hawaiian bobtail squid. She never considers the possibility that the bacterial species might have arisen from within the squid as a result of somatid/microzyma/endobiont activity or as a result of the way in which Qi (prana-nur-qi) intelligently organizes dynamics within the squid to give rise to such a species of bacteria.

Consequently, although Collen clearly suggests in her book that co-evolution has taken place between the Hawaiian bobtail squid and the Aliivibrio fischeri species of bacteria, there is no evidence offered in support of such a suggestion. In effect, and as is true in much, if not most, of evolutionary discussions, narration has taken the place of evidence.

Having finished her brief examination of bioluminescence and Hawaiian bobtail squids, Alanna Collen proceeds to use cows as a way of introducing another alleged illustration of co-evolution. She points out that on their own, cows are able to derive very little nutrition from the fibrous materials (such as grass) that they eat, and this is because the genome of the cow has no means to breakdown the fibrous molecules in the cell walls of the plants they eat and, consequently, are not able to access much of the nutrients which are surrounded by those fibrous molecules.

In addition, she argues that if cows were to try to resolve the aforementioned nutrition problem through the evolution of DNA programs that could underwrite the genetic code for producing the enzyme or enzymes that are needed for disassembling the molecules which are present in the cell walls that surround the nutrients in grass, then, such a evolutionary project would take millions of years because the coding for the necessary enzymes could only take place at a rate of a small number of random mutations per generation of cows.

However, Collen proposes that microorganisms tend to provide a ready solution to the foregoing problem. In other words, there is an array of bacterial populations occupying the four stomachs of a cow that are dedicated to breaking down the molecules in the cell walls of plants such as grass and, thereby, enable the cow to access the nutrients which are present beyond the molecular obstacles that are present in the cell walls of grass.

Furthermore, she notes that cows even have a cud – which is a structure consisting of plant fibers – that assists in the foregoing dynamics. The cud journeys from, on the one hand, the mechanical grinding process that takes place in the cow's mouth, to, on the other hand, locations in the stomach where enzymes are busily engaged in breaking down the grass to access nutrients housed in the plant material.

According to Collen, the foregoing arrangement which involves various populations of bacteria that provide enzymes capable of solving a problem which the genetic cows on their own could not resolve is -- evolutionarily speaking -- a much speedier process than would happen in the genome of cows over a period of numerous generations. She claims that because the genes in bacteria mutate at a

much higher rate than is the case in cows and because the length of a bacterial generation is so much shorter than a cow generation, then, bacteria easily are able to come up with the genetic coding that is needed to produce enzymes capable of solving the cell wall problem presented by fibrous plant materials.

Once again, narration fills in for actual evidence. How did cows acquire their genetic capacity to generate four stomachs, and how did the operational dynamics arise in cows which enable cuds to do what they do?

Collen provides no detailed account in her book which is capable of answering the foregoing kinds of questions. Furthermore, although she stipulates that the genomes of bacteria mutate at a faster rate than the genomes of cows do, and she indicates, as well, that the generational turnover of bacteria is so much faster than the generational turnover of cows, why should one suppose that a faster mutation rate and a faster generational turnover will lead, necessarily, to functional epigenetic coding for the sorts of enzymes which are needed to break down the cell walls of fibrous materials – especially given that she considers mutations, whether in bacteria or cows, to be a random affair and, therefore, there is no rhyme nor reason why one should expect or predict that just the right set of DNA sequences will result from mutations in the genome of bacteria irrespective of how quickly a bacterial generation turns over and irrespective of the rate at which mutations take place in bacteria?

Moreover, just as was the case with the previously discussed case of the Hawaiian bobtail squid and the Aliivibrio fischeri species of bacteria, Collen never discusses the possibility that the cell wall disassembling bacteria might arise within cows as a result of the interaction between the organizing intelligence of Qi (prana-nur-qi) and the possible transducing dynamics of somatids. While there are a lot of questions swirling about: The nature of Qi (prana-nur-qi), the properties of somatids, and the relationship between the two, nonetheless, somatids don't necessarily have to undergo some process of random mutation in order to generate bacteria capable of giving expression to enzymes that are able to breakdown the cell walls of plants.

Béchamp, Enderlein, Rife, Naessens and others already have empirically and experimentally demonstrated that microzymas, endobionts, and somatids are capable of pleiomorphic transformations in which different kinds of morphology and functionality emerge during those transformations. The only questions are: (a) Whether any of the pleiomorphic transformations that occur in the somatid cycles of cows might have the capacity to breakdown the molecules in the fibrous cell walls of plants, or (b) whether there might be some sort of interactional dynamic between the organizing intelligence of Qi (prana-nur-qi) and the somatids present in the cells of the stomachs of cows which might give rise to bacteria with such enzymatic capabilities.

Hypotheses based on random mutations cannot be tested. Hypotheses rooted in data which has been gathered for more than 170 years in conjunction with microzymas, endobionts, bions, somatids, or Qi (prana-nur-qi) can be tested.

Having provided several illustrations (i.e., Hawaiian bobtail squids and cows) that, allegedly, show how bacteria and various kinds of other organisms have co-evolved, Alanna Collen turns her attention to human beings and the microbiome. Before proceeding further, however, one point needs to be made clearly.

More specifically, one can be fully in accord with the tenor of Collen's general perspective which seeks to explore the ways in which our microbiomes interact with non-microbiome aspects of human beings, and the implications which such interactions carry for health and illness. Nonetheless, such a discussion can take place quite independently of issues of co-evolution or evolution in general and, instead, just explore the aforementioned sorts of dynamics between the microbiome and the rest of human biology and what might make those dynamics possible.

For instance, there is a relatively small, pouch-like structure located on the lower right side of the human torso which is near to the beginning of the large intestine – and, therefore, below, or following, the small intestine. This structure is known as the caecum, and attached to it is an organ of some controversy – namely, the appendix.

Not everyone has an appendix. Furthermore, a relatively rare number of individuals have several of these structures.

The morphology of appendices is not uniform. They can range in length from two centimeters, on the small side, to twelve times that size on the lengthier end of things, but with an average length of about eight centimeters.

According to Collen, Darwin considered the appendix in human beings to be an increasingly diminishing vestige of much larger editions of that organ that were present in various kinds of non-human animals. Influenced by Darwin's foregoing perspective as well as ignorant of what might be taking place in the appendix, many doctors from the middle of the twentieth century onward routinely began to surgically remove the appendix even though it might not be causing any problems.

Between 5-10% of human beings will experience appendicitis during their lives, usually early on in their lives. If untreated, roughly half of those individuals will die.

I had a 13-14 year-old cousin who passed away back in the 1950s as a result of a burst appendix. My older brother had his appendix removed at a young age, and the 8-year old son of my niece recently had a bout of appendicitis which led to an appendectomy.

Some scientists, medical doctors, and researchers have begun to reflect on the appendix from a conceptual direction which diverges from Darwin's notion which considers that structure to be a shrinking vestige of an organ which, supposedly, played some sort of role in earlier forms of animal life but, currently, has no function. According to this new perspective, the appendix interacts (e.g., communicating, detoxifying, and/or restabilizing) with the microbiome, and the fact that the appendix is attached to the previously mentioned caecum which is a central processing region for a great deal microbiome activity that takes place in, for example, the large intestine, and, consequently, this close association between the appendix and the caecum tends to lend support to the idea that the appendix might have a significant role to play in the way in which the microbiome interacts with the rest of the human body

One of the functions that are being newly attributed to the appendix has to do with its serving as a repository, of sorts, for different strains of bacteria. The theory underlying the foregoing claim proposes that following various kinds of illnesses that have adversely

affected the viable presence of certain kinds of microorganisms in the human body, then, such depleted populations of microorganisms might be replenished or reseeded through microorganisms which have been kept as a backup in the appendix for precisely such a set of contingencies.

There is a certain amount of correlation between individuals who manage to keep their appendix and the state of their health. More specifically, individuals who have lost their appendix have a higher likelihood of encountering autoimmune diseases, gastrointestinal disorders, blood cancers, and heart attacks than is the case in relation to individuals who have an intact appendix, but correlation reveals nothing about what causal factors, if any, might link the presence of a functional appendix and resistance to certain kinds of disease.

If one goes along with, or accepts, the idea that the appendix serves as a sort of repository for backup bacterial forms, the reader is provided with no indication by Collen (and this might be because no one actually knows) about whether, or not, all 4,000 species of microorganisms which, supposedly, are present in human beings are also present in the appendix as potential spares should a need arise. Consequently, if the repository theory concerning the appendix is true, one can't help but wonder about how the microbial contents of the appendix come to be present in that organ.

Is there some sort of selection process that determines what does, and does not, get transported into the appendix? If there is a selection process, what regulates that process?

How are candidates identified? How are they transported or induced to enter the appendix?

When does the foregoing set of microbial repository stocking processes begin? What initiates it?

Irrespective of what kinds of microorganisms might be included in the appendix, how does this organ avoid becoming overrun by bacterial growth? In addition, what induces an appendix to become inflamed and, then, have its contents released into the surrounding biological terrain, and why does the incidence of this sort of event only extend to 5-10 % of the human population?

If, among other possibilities, the appendix does serve as a repository for backup bacteria, then, what regulates the process of releasing specific bacteria which might be needed as a source of replenishment or reseeding for certain aspects of the microbiome? How does the appendix "know" when to release bacterial backups and how does it "know" which bacteria are to be released?

What regulates the foregoing processes? One cannot say that such processes are set in motion by the genome of the cells in the appendix because before genes can be expressed, 'something' has to oversee: Which genes in the appendix are to be expressed, and when those genes are to be expressed and in what order they are to be expressed, and to what extent they are to be expressed.

To whatever extent transcription factors (such as methyl groups and acetyl groups) are shaping the epigenetic processes of gene expression that are taking place within such an organ, those groups do not regulate themselves (i.e., they don't organize the timing of their own generation and journey to specific aspects of the genome), but, instead, those transcription factors are being regulated by something else? What is this 'something' else?

Epigenetics is a description concerning which genes are being given expression in a particular metabolic pathway or set of such pathways, as well as a description of the way in which transcription factors are used to structure or shape those pathways. However, epigenetics does not explain what is regulating the sequential timing of gene expression in the appendix because the transcription factors which are used to shape that sequential timing are, themselves, in need of explanation as to why their dynamics are the way they are and what is regulating those dynamics.

If one thinks of transcription factors as being domino-like, then, there is 'something' which is setting up those dominos to fall in particular ways at particular times. Furthermore, there is 'something' that is responsible for initiating the process of determining which dominos are to fall when, and where those dominos are to fall and for how long, as well as in what sequence.

To indicate, as Alanna Collen does in her aforementioned book, that the microbiome and the human body interact in symbiotic ways is one thing. To indicate the nature of what ultimately regulates such

symbiotic dynamics is quite another – although obviously closely related – issue.

While transcription factors are part of the foregoing symbiotic dynamics, those factors are not the 'something' which ultimately regulates what is transpiring. Such transcription factors – along with, perhaps, exosomes, phages and frequencies -- might be part of a system through which the microbiome and the rest of the human body communicate with one another, but the system or network which employs the foregoing sorts of biological tools was put together or organized by 'something' else, and whatever this 'something' else is, it determines the rules of engagement for different aspects of the symbiotic dynamics which govern the manner in which the microbiome and the rest of the human body interact with each other.

One of the ways in which researchers seek to probe the possible relationships between microorganisms and the animals in which they exist is through mice that have been bred, raised, and cared for in ways that are intended to keep those mice free of microorganisms of any kind. Such germ-free mice are, then, used for purposes of comparison with mice which have been bred, raised, and cared for in ways that result in microbiomes arising in the latter kinds of mice.

Through the foregoing sorts of comparisons, researchers are able to obtain empirical data which might lead to as a better understanding concerning the possible function of various kinds of microbes in the bodies of mice. Furthermore, germ-free mice can be introduced to single species of microorganisms in order to see what impact such a bacterial species might have on the biological functioning of mice.

These latter kinds of experimental mice are referred to as being "gnotobiotic". This term is used because these mice involve known life forms –- both with respect to the microorganism which is being introduced to the experimental mice as well as in relation to the mouse biology of organisms which previously had been germ free.

Notwithstanding whatever objections might be raised concerning the use of animals for experimental purposes, there is another kind of problem which tends to haunt those experiments. More specifically, the way in which mice and microorganisms interact with one another does not necessarily reflect the way in which human beings and microorganisms interact with one another.

While acknowledging the foregoing points, many researchers indicate that without mice studies, scientific understanding would be slowed down considerably. However, to what extent such studies actually help us to better understand the nature of the relationship between our microbiomes and the rest of our biological functioning is uncertain.

Alanna Collen indicates that one of the things which has been discovered through mice studies is that bacteria in mice are able to induce the cells which are lining the gut wall of a mouse to release a molecule that serves as a nutrient and, as a result, whatever is released appears to entice microorganisms to take up residence and, presumably, enter into some sort of symbiotic relationship with the mouse. According to Collen, this suggests the possibility that the relationship between the microorganisms and the animals which they inhabit might be more than one of being tolerated but involves, as well, some sort of active enticement.

An alternative possibility to the foregoing perspective is that microorganisms might induce the lining of gut cells to release certain kinds of molecules to determine if there is an ecological fit between the two kinds of organism. If an overture is made by the microorganism to the lining of a gut cells, and there is either no response or the response is not to the "liking" of the microorganism, then, the microorganism might move on to other, possibly, more receptive regions of terrain.

Beyond the foregoing considerations, one might also inquire about the nature of the dynamics in a microorganism which would induce it to release something at a given time and place. What is regulating that releasing dynamic in a given species of bacteria, and what is regulating the subsequent release response, if any, of the cell in the lining of the guts which might be responding to what a microbe has released?

What is the form of communication which is taking place? How do the microorganisms and the cells lining the gut "understand" what to release and when to do it and where to do it and how much to do it?

Why does the foregoing dynamic appear to begin with the bacterial side of things rather than the animal side of things? Is it possible that the animal side of things might have first contacted the microbial side of things by means of frequencies, biophotons, phages,

and/or exosomes (all of which might have been difficult to detect, let along to be understood, through available methods) that are regulated through the animal side of things and which induced the microbe to release a signal in return that indicated the nature of its presence?

Are the foregoing dynamics just random sorts of events that happen to elicit a response of some kind? Or, is there some sort of systematic communication taking place, and, if so, what is the nature of that communication?

The Human Microbiome Project is conducted under the auspices of the National Institute of Health, an agency within the federal bureaucracy of American government. The aforementioned Project, along with many other research bodies around the world, ha established that there is an intimate relationship between the condition of our microbiome and the state of our health.

For instance, the Human Microbiome Project discovered that the types and distribution of microorganisms which are present in human beings seem to be unique like a fingerprint. This finding is consonant with the studies by James Meadow et. al. ("*Humans differ in their personal microbial cloud*") that were explored in an earlier chapter and which described how the bioplasma clouds of microorganisms that envelop human beings are sufficiently unique to each individual that those clouds can be used to accurately reveal the identities of the individuals associated with a given kind of bioplasma cloud.

The foregoing findings also are consonant with the research of Gaston Naessens. More specifically, based on decades of research, he concluded that the somatids which are present in different species and cell types are unique to those species and cell types.

Moreover, in response to the way in which changing conditions take place within biological terrains, Naessens discovered that the somatids which are present in those terrains give rise to pleiomorphic cycles of various kinds of microorganisms, including bacterial forms. The combinatorics which are possible as a function of the changing conditions of biological terrain within individuals which induce different stages of the somatid cycle in ways that are unique to: (a) Those individuals, (b) their life conditions, and (c) the different kinds of somatids which are present in the more than two hundred different types of cells present in human beings, would appear to be indefinitely

large and, consequently, those combinatorics are very likely to result in unique relationships between microbiomes and the human beings in which they reside – a conclusion that resonates with the findings of the aforementioned Human Microbiome Project.

The latter Project took bacterial samples from hundreds of volunteers. These samples came from 18 regions – some external and some internal – that were drawn from the biological terrains of those volunteers.

Many of the microorganisms discovered in those samples were either unique to individuals or were only found in a couple of volunteers. On the one hand, very few of the microorganisms discovered during that Project were common to all of the volunteers.

Nonetheless, the kinds of microorganisms that were found in each of the 18 areas sampled in any given volunteer tended to be more similar to the kinds of microorganisms which are found in the same sampling area of the other volunteers than such microbes are similar to microorganisms that are found in the other sampling sites across their biological terrains. For example, the microorganisms which might show up in the same sampled area of two different volunteers could be closely related to one another (i.e., similar), but they might constitute two different species of some given genus.

Each of the aforementioned 18 sampling sites constituted unique ecological niches, and, as a result, different ecological terrains were more conducive to some microorganisms rather than others. Thus, as Collen points out in her book, areas of the body that are moist – such as the groin and underarms – tend to be inhabited by various species of Staphylococcus and Corynebacterium microbes because those bacteria thrive in niches that are humid and exhibit higher nitrogen contents as a result of the sweat which is present in such areas.

Presumably, the foregoing principle is active throughout the body. In other words, the viability of various kinds of microorganism is functionally related to the presence or absence of certain sorts of ecological properties, which is why one is likely to find similar sorts of microorganisms to be present in similar kinds of ecological niches that are present in the human body.

However, those ecological niches might be very restricted in scope. For example, the Human Microbiome Project took samples from different parts of the mouth and discovered more than 800 species of bacteria that had established viable populations, sometimes in very close proximity to one another, whereas the nose was home to some 900 species of bacteria.

Despite whatever differences that might exist in the microorganisms which exist in the same sampling region of different individuals, nevertheless, the microorganisms which are present tended to perform the same kind of functions. In other words, for one individual, a particular biological function in a given region of the body might be associated with a particular strain of microorganism, whereas in another individual the same function might be associated with another kind of microorganism.

The foregoing finding suggests something of potential interest. Conceivably, whatever might be regulating the interaction between the microbiome and the rest of the human body might have the capacity to work with a number of different microbial candidates and still bring about a certain kind of biological function, much like a master craftsman might be able to use a variety of different tools to generate the same kind of effect.

If the foregoing possibility is operative in human beings, then, while the kinds of microorganisms which are present in an individual have their significance, nevertheless, what might be more important is the nature of the regulatory dynamics that select which microorganisms are to be used to bring about a given function at a given point in time. One might even suppose that if the appendix were a repository of bacterial tools, then, under a particular set of contingent circumstances, different bacterial tools within that repository might be called upon by a regulatory system in order to perform specific tasks in response to changing conditions.

Alternatively, one might suppose that whatever regulates the interaction between the microbiome and the rest of the body could modulate what goes on in a particular ecological niche of the body. This could be done through the selection of specific species of bacteria to seed that niche and, thereby, influence or shape the way in which

one, or more, of the other bacterial species which inhabit that niche go about their business.

The foregoing microbial seeding possibility might operate in conjunction with the appendix. Or, such a seeding possibility might be mediated through other systems of communication -- involving, for example, exosomes, phages, and frequencies -- that are under the purview of whatever is regulating the way in which the microbiome and the human body symbiotically interact with one another.

As one moves from the stomach to the small intestine to the large intestine, the kinds and numbers of microorganisms change. The highly acidic nature of the stomach is inhospitable to most kinds of microorganisms, although one species – namely, Helicobacter pylori – has been found to be present in the stomachs of some people.

The small intestine supports 10,000 microorganisms for every milliliter of its 7 meter length. Microbial density increases to 10,000,000 microbes per milliliter near the junction where the small and large intestines meet.

The foregoing junction is proximate to the aforementioned caecum to which the appendix is attached. The caecum sports some 4,000 different species of microorganisms that give expression to trillions of microbes.

Continuing on down the intestinal tract, the colon constitutes much of the large intestine. The density of microbial life in the colon runs about one trillion microorganisms per milliliter.

The mouth, stomach, and small intestines all play their roles in breaking down what is consumed by a human being. The microorganisms which are present in each of the foregoing regions participate in that process.

As indicated above, microbial density changes as one proceeds down the intestinal tract. One goes from 10,000 microbes per milliliter in the small intestine to 10,000,000 microbes per milliliter as the small intestine transitions into the large intestine, and, then, the density jumps to one trillion microbes per milliliter in the colon. Given the foregoing considerations, one might well ask whether there was some sort of regulatory dynamics taking place which generated those kinds

of transitions in microbial density, and, if this were the case, what might be providing the oversight for those transitions?

Furthermore, given that there are thousands of different species of microorganisms which are present in the intestinal tract, then, one might also wonder if the manner in which those species were distributed in the intestinal tract might be ordered in some fashion as well. Perhaps, distribution of species in the intestinal tract might be regulated just as the density of microorganism appears to be regulated as one travels down the intestinal tract.

If it were not for the microorganisms that inhabit the gut, the cells that line the interior of the colon would die. The latter cells live off the waste materials which are generated by those microorganisms.

The waste materials that remain following different stages of the digestive process and which will become part of the stool that is subsequently expelled from the body consists mostly of microorganisms (approximately 75%). The different kinds and amounts of microorganisms which are found in the stools of people provide a great many clues concerning the health of those individuals.

The bacteria which are present in the gut reflect our diets. Different kinds of bacteria have predilections for different kinds of nutrients, and different kinds of nutrients are a function of the types of food that we eat, and, therefore, when our diets change, so too do the kinds of bacteria that will emerge in different aspects of our biological terrain.

However, as Alanna Collen indicated toward the beginning of her book, the biological terrain within human beings that forms the ecology in which microorganisms reside can be destabilized through the use of drugs such as antibiotics. That terrain can also be impacted by other factors such as nuclear radiation, electromagnetic radiation, environmental toxins, and a wide variety of vaccines and pharmaceuticals.

Just as diet can affect the composition of the microbiome within us, there are other factors -- such as the ones noted in the previous paragraph -- which can problematically affect the way in which different species, degrees of density, and distribution of microorganisms within the body can change. Such transitions can

impact how the rest of the body functions or how microorganisms in other parts of the body behave.

As indicated earlier, the properties of our stools reflect various aspects of what is transpiring in our bodies, especially as this pertains to the dynamics taking place without our microbiome. Similarly, the waste products of microorganisms reflect what is transpiring in those microbes, and while such waste products can provide a beneficial function (as is the case in the colon), those waste products can also create problems for the human body.

The human body serves as an ecological terrain for the microbiome. At the same time, the microbiome constitutes an ecological terrain for the human body.

That which takes place in the human body has ramifications – both good and bad – for what transpires in the microbiome. That which occurs in the microbiome has ramifications – both good and bad – for what happens in the human body.

In other words, the symbiosis between the human body and the microbiome is a two-way street. Moreover, the inverse of the foregoing symbiosis is also a two way street.

Dysbiosis is a term which refers to a condition in which some aspect of the microbiome – often involving one, or another, part of the gut -- has given rise to a problematic distribution of microorganisms. Such a destabilization of microbial balance can take place in a variety of ways -- including through: Diet, exposure to certain kinds of medical treatment (e.g., antibiotics, chemotherapy), environmental toxins, and different sorts of infection.

Before proceeding with the issue of dysbiosis, one might want to ask oneself a question – a question that will not be answered in what follows but, nonetheless, a line of inquiry which helps to create a somewhat elusive context for the ensuing discussion. More specifically, given that the absence of microbial balance within a human being can give rise to a variety of illnesses, how does a balanced microbiome come into existence?

Leaving the foregoing question aside – or letting it move about in the background, along the horizons of one's consciousness – the discussion of dysbiosis can begin by noting that differences between

health and unhealthy individuals can be studied through DNA sequencing of the bacteria – some living and some dead – that are present in the stools of people. For example, if one compares the properties of microbes in individuals suffering from Irritable Bowel Syndrome with the microbial contents of those who do not suffer from IBS, there are identifiable differences between the two groups of individuals, leading one to conclude that IBS might have something to do with the kinds of microbes that make up different aspects of the gut microbiome.

On the other hand, there are individuals suffering from IBS that have a microbiome which -- at least in general terms -- does not appear to be appreciably different from the gut microbiomes of healthy people. The one thing which seems to be held in common by this sub-group of IBS sufferers whose gut microbiomes seem to be relatively normal is that such individuals often report being depressed.

The foregoing finding raises a question. If being depressed is highly correlated with the presence of IBS in some people whose gut microbiotas do not seem to be appreciably different from the gut microbiomes of healthy people, how does – if it does – the phenomenon of depression lead to the symptoms of IBS?

Is it possible that the physiological impact of depression is causally affecting the microbiota of the gut in some fashion? In other words, while the gut microbiota of such IBS individuals might be – in gross terms (no pun intended) – not all that different from the gut microbiota of people without IBS, perhaps, depression has physiological ramifications which might adversely affect the way in which gut microbiota function.

On the one hand, changing the composition of gut microbiota is associated with the onset of IBS. Nonetheless, changing the way in which gut microbiota function -- or are prevented from functioning – also might lead to the emergence of IBS as well.

The foregoing considerations can be made more complicated. After all, there are many people who are depressed, and, yet, they do not exhibit any of the symptoms of IBS, and, consequently, if the physiological ramifications of depression can lead to IBS in some people, why doesn't this happen in all cases?

Those who suffer from IBS tend to undergo sudden bouts of diarrhea, and/or pain, and/or constipation? How do either changes in the diversity of the gut microbiota or the presence of depression cause such symptoms?

People who suffer from "inflammatory bowel disease" have colons that are replete with ulcers. However, the colons of those who have been diagnosed with IBS have colons which are as smooth as are the colons of healthy individuals.

Conceivably, whether one develops inflammatory bowel disease or irritable bowel syndrome (two different illnesses) might be a matter of the character of the composition of the gut microbiome. IN other words, one kind of microbial gut profile might lead in the direction of inflammatory bowel disease, whereas another sort of microbial gut profile might lead in the direction of irritable bowel syndrome.

If so, the foregoing possibility still leaves a question to be answered. Namely, what induces an individual's microbial gut profile to move in one direction rather than another?

Beginning in May of 2000, half of the 5,000 people in the town of Walkerton, Ontario came down with various forms of gastroenteritis that often featured bloody bouts of diarrhea. Eventually, the outbreak of illness was allegedly traced to a species of E. coli bacteria that was problematic for human beings and whose presence was said to be due to a breakdown in the chlorination system associated with the town's water supply – a breakdown which the water company had known about for a number of weeks and had been actively taking steps to try to ensure that no one discovered what had been occurring.

Leaving aside the fact that half of the people in the relatively small town of Walkerton didn't get sick and, consequently, leaving aside the questions which the foregoing fact tends to generate (i.e., why did only half the people became ill rather than everyone in a town which is likely to be serviced by only one water supply), there are other questions which can be raised. For instance, several years after the water supply problem finally had been resolved and the water was properly treated once again, nearly one-third of the people who had become ill during the initial outbreak continued to be ill with what is referred to as "post-infectious irritable bowel syndrome," so why did a

third of the people continue to be ill and, yet, the other two thirds of the people had who, initially, had become ill apparently were able to recover?

Apparently, no stool study of bacterial DNA sequences was conducted in conjunction with the people of Walkerton, and, therefore, it might not have been possible to either compare the microbial composition of gut microbiota in relation to healthy and unhealthy people or to have been able to establish a baseline for exploring possible differences in the composition of the gut microbiota of people who recovered from the initial illness and those who did not recover. Moreover, whether, or not, any of the individuals who continued to suffer from IBS also suffered from depression remains unknown.

Another possibility to consider has to do with the role which the appendix might, or might not, play with respect to helping the gut microbiota to recover from an illness which had destabilized the balance of the gut microbiota. In other words, if – as some researchers have begun to suspect – the appendix serves as a repository for backup forms of bacteria that might be used to re-seed absent or diminished forms of gut microbiota, then, why did the appendix seem to do its job in some cases but not others?

How many of the people who remained ill with IBS had had appendectomies at some point in their lives? Moreover, with respect to those cases in which people still had their appendix but continued to be ill for at least eight years following the May 2000 outbreak, then, what implications, if any, does the foregoing possibility have for the theory that the appendix has functional value with respect to the dynamics of the gut microbiome?

Independently of the Walkerton incident, studies have been conducted in conjunction with IBS sufferers who exhibit different kinds of symptoms. Such individuals have been divided into three categories as a function whether their symptoms primarily involve: Pain, constipation, or a physical sensation of feeling bloated and full.

Based on the DNA sequencing of the bacteria in the stools of the foregoing three categories of patients, certain findings have been established. For instance, in the case of those subjects whose primary symptom was that of pain, their gut microbiota tended to show greater numbers of the Proteobacteria microbe, whereas subjects who were

found to have higher amounts of Cyanobacteria microbes in the gut microbiota tended to report a sense of bloating and becoming filled.

Furthermore, with respect to individuals whose primary symptom was constipation, there were 17 bacterial groups that tended to show up in greater numbers than was the case in other subject categories. However, those 17 groups have only been shown to be correlated with the constipation category, and, therefore, whether one, or more, of those bacterial groups is causally responsible for the symptom of constipation is unknown.

In addition, while the finding that Cyanobacteria tend to show up in greater numbers among subjects whose primary symptom is a sense of bloating and feeling full when eating, while Proteobacteria tend to be present in greater numbers in those subjects whose primary symptom is pain, this fact in and of itself doesn't necessarily indicate that the greater presence of those microbes in different conditions of symptomology is the cause of those symptoms. At the same time, such considerations do lead to further questions.

For example, on the one hand, if the greater presence of certain microbes is the cause of a given symptom, then, what is the nature of the dynamic which links the relatively greater numbers of those microbes to a particular symptom? On the other hand, if the higher numbers of those microbes does not directly cause a given kind of symptom, then, what is the significance of the imbalances in the composition of the microbiota in different conditions of symptomology, and, moreover, what is actually causing the different symptoms?

According to Alanna Collen, the answer to the foregoing puzzles might be connected, in some fashion, with the way in which microorganisms are distributed in the microbiota. In other words, problems do not necessarily arise due to the presence of a particular microbe, but, rather, destabilization of the gut microbiome is a function of changes in the relative quantities of different groups of bacteria within that gut microbiome.

If the foregoing is the case, then, this returns us to an issue which was introduced earlier in this chapter. How does a microbiome become established in a manner that is balanced and not susceptible to dysbiosis?

Is this process of establishing microbial balance something that the microbiome does on its own (and, if so, then how), or is the balancing process a result of a symbiotic interactional dynamic between the microbiome and the rest of a human's biological terrain? If the latter option is the case, then, what is the nature of that sort of symbiotic balancing dynamic?

Related to the latter question, is another issue – namely, what, if anything, sets the relative numbers of microbe groups that are present in any given aspect of the gut microbiome? For instance, in the case of IBS, why did the gut microbiota of some people tend to show greater numbers of the Proteobacteria microbe relative to other groups of bacteria, whereas subjects who were found to have higher amounts of Cyanobacteria microbes in their gut microbiota tended to report a sense of bloating and becoming filled?

Furthermore, if the relative numbers of different microbial groups play a fundamental role in the health of an individual, is there anything which is keeping track with respect to those relative numbers of different microbial groups in relation to one another? Moreover, if the relative numbers of certain microbial groups is not responsible for the symptoms which occur, then, what is the significance of those relative numbers of microbial groups?

In the Walkerton, Ontario May/2000 outbreak of gastroenteritis that was said to be due to contaminated water, one-third of the 2,500 people who became ill continued to experience symptoms of IBS for years after the foregoing incident while the other two-thirds of the 2,500 ill people regained their health. If the relative numbers of microbial groups plays some sort of central role in the foregoing illness, then, why (or how) did the microbiomes of some people (the ones who got healthy) become re-balanced, while the microbiomes of others (the ones who stayed ill in some way) remained in a condition of dysbiosis or imbalance?

There is a considerable amount of research concerning obesity and diet which indicates that the so-called human part of our bodies is not the only thing which might have the capacity to turn the genes in our genomes on and off. Alanna Collen indicates that the microbiome might also be able to communicate with our genomes through an array

of messaging media which brings about the expression or suppression of certain genes.

For example, when energy is produced, it can be used to subsidize different kinds of dynamics (e.g., muscle movement) or it can be stored in fat cells. Experimental evidence exists which suggests the possibility that the fate of the foregoing energy within the body can be influenced by the manner in which aspects of the microbiome turn genes on or off in the human genome.

Given the foregoing considerations, such findings lead to various questions. For instance, what aspect of the microbiome is communicating with the human genome to turn genes on and off? How does that aspect of the microbiome "know:" What kind of message to send, when to send such a message, where to send the message, and when to stop the communication process?

Alternatively, is it possible that some aspect of the microbiome is not what is regulating the foregoing dynamics of turning genes on and off? In other words, perhaps some other form of regulatory oversight (such as the intelligent organization of Qi as transduced by somatids) is taking input from the microbiome and the rest of the body and blending that data together to set up the epigenetic dominos in one way rather than another as a holistic function of the condition of the biological terrain, both with respect to the condition of its microbiome as well as in relation to the condition of the rest of the biological terrain of a human being.

The presence of Qi (prana-nur-qi) doesn't necessarily guarantee that the biological terrain will always work in a perfect state of health. Rather, Qi (prana-nur-qi) works with the conditions that are present, and, sometimes inducing epigenetic dynamics to generate symptoms that provide clues which can be used to constructively address the form of destabilization or imbalance that is present might be the best that can be done.

Chapter 19: Cellular Theory

In a section entitled "The Cell and the Gene" which appears toward the beginning of his book: *The Master Builder: How the New Science of Life is Rewriting the Story of Life*, Alfonso Martinez Arias offers several quotations prior to launching into a discussion concerning the way in which study of the cell is inducing scientists to break free from a long-held paradigm that considers the genome to be the master and director of the biological universe. More specifically, Arias first draws upon the words of E.B. Wilson to introduce readers to the idea that there is a form of organization which is present in the egg that regulates what happens from one generation of cell division to the next, but the nature of this process of regulation is unknown.

The second quotation provided by Arias gives expression to a Twitter (now X) comment by Pavel Tomancak in response to the aforementioned book. Tomancak is a research group leader at the Max Planck Institute of Molecular Biology, and in his Twitter comment, he observes how there is an oddly liberating force present in the idea – which is developed in the book by Arias – that the genome and the process of emergent cellular dynamics are independent of one another and, yet, find ways to interact to bring about functional biology.

While one can agree with E.B. Wilson that there is a specter of the unknown which tends to haunt issues concerning the nature of cellular regulation which governs biological processes, nonetheless, one might question to what extent such regulatory oversight is a function of something that is internal to cellular behavior rather than being a function – at least, to some degree – of something (e.g., Qi or 'prana-nur-qi') that is external to that behavior. Moreover, while one might agree with Tomancak that there is something present in the complex interaction of genomic and cellular dynamics which has a form of heuristic value that induces one to entertain many exciting possibilities, nevertheless, to tie, at least in part, such considerations to the notion of emergent behavior might be more obfuscating than liberating.

A theme that will 'emerge' from time to time during this chapter has to do with the idea that the notion of "emergent behavior" seems to be little more than code for 'we don't actually don't know what is going on but we'll use the term "emergent behavior" in order to

pretend that we do understand the way things work. The idea of emergent behavior seems comparable to a situation in which one person sets up an elaborate arrangement of dominos, some of which are concealed from sight, and, then, another person comes along who notes as the dominos are falling that the way in which they are falling is an emergent property of the system, as if the process of emergence was giving expression to a dynamic which is other than the fact that someone or something already had set up the dominos to fall in one way rather than some other way.

The idea of 'emergence' gives expression to the manner in which dynamics are observed to occur in one way rather than another. As such, emergence has nothing to do with the nature of the processes which make possible the phenomena to which the notion of "emergence" is alluding.

To resort to the idea of 'emergence' is to admit that one does not understand how what is transpiring is able to take place. 'Emergence' is a descriptive placeholder which is intended to connote epistemological insight in conjunction with a dynamic about which nothing more is known than that under certain circumstances, something occurs in a way that can be described but is not currently understood.

Cellular research might be helping to rewrite our understanding of how cellular dynamics serve as tools in the building of life. However, perhaps a case can be made to suggest that cells are not the masters of that building process, but, instead, might just be servants of something that is more deeply hidden.

Alfonso Arias initiates his foray into the world of cellular dynamics by pointing out that fingerprints are not, strictly speaking, functions of our genes. In other words, although research has indicated that hundreds of genes have roles to play in shaping different facets of a fingerprint, nonetheless, what makes a fingerprint unique has more to do with the cellular dynamics through which genes are expressed and that this process of cellular filtering modulates the ways in which the products of genes (i.e., proteins) operate in a given biological context.

Identical twins have precisely the same genomes. Yet, their fingerprints are different from one another because their respective cellular dynamics differ in various ways from each other and, as a

result, the manner in which their respective genes are expressed and the manner in which the products of their respective forms of gene expression will interact with other products of such gene expression and, thereby, those forms of gene expression will be differentially affected by an array of differences (both subtle as well as more substantial) that are likely to be present in the cellular dynamics through which their identical genomes are being expressed and that will show up according to the different ways in which the ridges and swirls of the fingertips are constructed while in the embryo.

The author of *The Master Builder* cites another example to demonstrate how genes are not necessarily the determinate force which establishes how different aspects of the biological terrain acquire their properties. For example, while the color of our eyes might be a function of the genes which are received from one, or the other, parent, nonetheless, there are all manner of biomarkers running through our irises that cannot be accounted for by inherited genes per se but are, instead, a function of the manner in which, and the conditions in which, the expressed products (i.e., proteins) of genes are brought together into metabolic pathways by cellular functioning, which is reflected in the manner in which iris scans reveal something uniquely complex about an individual.

For much of the twentieth century, DNA has been described as if it constituted a book of recipes or an instruction manual which makes life possible. Yet, DNA does not contain the regulatory details or directions which are present in cooking recipes or instruction manuals that render the latter set of directions intelligible or useful.

In other words, a cooking recipe or instruction manual itemizes the products that are to be used, how much of each product is to be used, in what sequence they are to be used, as well as how they are to be combined and the circumstances under which they are to be combined. However, the genome which was uncovered through the Human Genome Project doesn't indicate how to do any of the foregoing procedures.

In fact, there are often a number of sequential hurdles to overcome during the dynamics of genetic expression before one can even put a gene together from a given set of DNA molecules that supposedly make up a gene. Indeed, not all of the DNA sequences

which are initially singled out for gene processing will necessarily end up being components in the gene that is subsequently expressed.

From a certain perspective, a gene is a construct and not a pre-packaged set of DNA sequences. A gene is like having to go to a cupboard and, then, somehow, locate a box marked gene 157 (amidst thousands of other gene boxes). Once that box has been selected, one must open the box, unpack the different packages present in that box, discard certain specified contents in some of those packets, and, then, bring together the remaining contents of different packets in that gene box according to how the contents of another package labeled "transcription sprinkles or factors" (which come from another non-gene cupboard) are – in unknown ways – induced to attach themselves to the contents of the remaining packages in the gene box.

Thus, there is a considerable difference of opinion concerning what constitutes a gene. Some people might identify the initial "box" of DNA sequence packets as being the gene, while other individuals might only consider something to be a gene if the set of DNA molecules which are present have undergone a series of processes (including being removed from the initial box) that render the processed sequences ready to be translated into a protein via the interaction of messenger RNA and a ribosome.

Between 1 and 3 percent of the genome of any given species gives rise to inherited traits. The rest of the genome of such a species gives expression to traits and properties which cannot be tied directly to specific genes that have been inherited from one's parents.

Consequently, even in the case of directly inherited traits, the available evidence indicates that genes tend to be complex constructs which need to be assembled before being translated into a particular kind of protein and, therefore, such genes are not pre-packaged structures that can be easily activated – batteries included and no assembly required. The complexity of genetic transcription increases when one considers the other 97 to 99 percent of the genome of a species that are not directly inherited.

The need to go through a process of genetic assembly both with respect to traits that are directly inherited as well as with respect to traits which are not directly inherited raises some fundamental questions. For instance, what is regulating, or has oversight

concerning, the nature of the genetic assembly process either in the case of traits which are not directly inherited from parents as well as in the case of traits that are directly inherited from parents?

No one has been able to demonstrate how genes – without any assistance beyond the presence of DNA – might be able to regulate the process of turning themselves on and off. Something beyond such genetic material seems to be needed to flip the genetic on/off switch.

No one has been able to demonstrate how genes, on their own, are able to regulate the pre-transcription process during which sequences of DNA are parsed such that -- metaphorically speaking -- genetic wheat is separated from genetic chaff as some DNA sequences are retained while other DNA sequences are discarded. Something beyond DNA appears to be required to regulate this pre-transcription parsing process.

No one has been able to demonstrate how parsed genes on their own are able to call for the right kinds of messenger RNA to sequentially transcribe sections of DNA that are being uncoiled or have been able to demonstrate that mRNA is sequentially regulating its own journey to the right sections of uncoiling DNA. Something beyond DNA and mRNA seem to be implicated.

No one has been able to demonstrate that messenger RNA and transfer RNA are, respectively, responsible for regulating the journey from the nucleus to the ribosomes in the cytoplasm, as well as responsible for regulating the transfer of certain amino acids to a growing peptide chain which takes place through the mediation of ribosomal dynamics involving mRNA and tRNA. Something beyond mRNA, tRNA, and ribosomes appears to be needed to regulate the foregoing set of dynamics.

No one has been able to demonstrate that DNA, mRNA, tRNA, ribosomes, or amino acids – individually or collectively -- are responsible, on their own, for the triplet coding system which links the aforementioned different forms of genetic material to a series of 20 particular amino acids, or, on their own, are responsible for some amino acids having more than one entry in the foregoing triplet coding system, or are responsible for the triplet system having the codon ATG (Adenine, Thymine, Guanine) as a signal for beginning a particular genetic process of transcription/translation, or are responsible for the

triplet system having three stop or termination signals (TAA, TAG, and TGA) for the translation process. Something beyond DNA, mRNA, tRNA, ribosomes, and amino acids appears to be the source of the regulatory dynamics which established and govern the foregoing triplet coding system.

Some individuals might like to say that the triplet coding system which links, on the one hand, DNA, mRNA, tRNA, and ribosomes, and, on the other hand, 20 different amino acids is an emergent property of cellular functioning. Other individuals might like to suggest that those who claim that the aforementioned triplet coding system is an emergent property of cellular functioning merely might be attempting to give the impression that something has been explained when this is not the case.

Even if one would like to maintain that the cell is entirely responsible for establishing and regulating the foregoing two-sided triplet coding system, there should be dynamics to which one can point that specify how the triplet coding system came to be in the first place. In addition, someone who makes the foregoing sorts of claims should be able to put forth particulars concerning how the system which is entailed by that coding system regulates the process of gene expression.

If one cannot do the foregoing from beginning to end, then, one has not shown that the triplet coding system is an emergent property of cellular functioning. Instead, all that one might have been able to do is to show how cellular functioning contributes to (that is, serves as tool box for implementing) such transcription and translation processes.

Evolutionarily speaking, the fact that the same genetic code is at the heart of life on Earth – from: Chemotrophic to photosynthetic forms; from: Anaerobic to aerobic forms; from: Prokaryotic to eukaryotic forms; from: Mono-cellular to multi-cellular forms; from Invertebrate to vertebrate forms; from: Bacteria, to: Fungi, archaea, plants, fish, insects, reptiles, birds, mammals, and so on – seemed to constitute persuasive data that all life was connected in some essential way. Indeed, the biological metaphor for the creative breakthrough that was comparable to the invention of the wheel (or sliced bread) was the invention of the genetic coding system.

Yet, as indicated previously, no one has been able to demonstrate how the foregoing invention took place. Consequently, to contend that the origin of life is necessarily evolutionary in nature is more a narrative than anything else.

Such a narrative is a story that some people tell themselves to quiet their anxieties. Like other kinds of narrative myths, the evolutionary story helps to provide a sense of meaning concerning certain aspects of existence, but whether, or not, that meaning reflects the truth of such phenomena is another matter altogether.

Some of the initial research that sought to establish the way evolution might work in individual organisms had to do with showing how various kinds of biological disorders displayed Mendelian forms of inheritability. For example, a given protein might have the capacity to break down a particular molecule in the body, and if the latter molecule began to accumulate because it was not being broken down, then, the idea began to gain currency that the missing or dysfunctional protein/enzyme was due to a gene which had mutated in a problematic way.

Whether the foregoing gene was dominant or recessive could be worked out by studying the people who exhibited the sorts of symptoms that arose when a particular enzyme was missing or malfunctioning and, then, complementing the foregoing research by examining family histories to see what similar sorts of symptomology might have been present in the family tree. However, there are many kinds of diseases in which there is not necessarily any sort of direct connection between phenotype and Mendelian inheritance principles that can be tied to a specific gene.

Determining what role is played by proteins that are enzymes is often easier than trying to discover the nature of the role which is played by proteins that are not enzymes. The function of the latter sorts of proteins (i.e., those that are non-enzymatic in nature) is often very subtle and difficult to detect.

For example, in the 1920s, various scientists (Nadine Dobrovolskaya-Zavadskaya among others) were exploring the possible relationship between radiation exposure and genetic mutations. At one point, a species of mouse was produced which

exhibited a trait -- shortened tail – that could be passed on to subsequent generations.

The trait was considered to be dominant. However, the trait was not due to the presence of something, but, instead, it appeared to be due to the relative absence of something.

More specifically, when one of the genes connected to the trait of shortened tail had been destroyed by radiation, then, the short-tail property would be present. Yet, when both of the genes connected to the foregoing trait were destroyed by radiation, the mouse did not survive the embryonic stage.

When the latter mice were autopsied, researchers discovered that there were an array of malformed properties such as the absence of a tail, a shortened spinal column, and disorganized muscles in the chest area. The gene associated with the foregoing mice came to be known as Brachyury ('short-tail,' cf. Greek).

Researchers concluded that what happened in any given mouse inheriting the foregoing gene appeared to give expression to a spectrum of possibilities. More specifically, the greater the extent of dysfunctional dynamics in such mice that became manifest during development was a reflection of the degree of damage to the Brachyury gene.

The Brachyury gene seemed to be connected to a variety of developmental issues. However, the nature of that connection was obscure.

Since a certain quantity of time is needed to produce new generations of mice and because mice take up a lot of laboratory space, as well as require a lot of food, alternative forms of research subjects with a different kind of cost-benefit profile were desirable. Enter the fruit fly (Drosophila melanogaster, 'lover of dew').

Fruit flies don't require much lab space or food and, in addition, they are able to produce hundreds of offspring just ten days after first arriving in the world. An added bonus is that they only have four chromosomes, and this makes mapping the relationship between genes and mutations easier to track.

"Homeosis" refers to the way organisms are structurally put together. "Homeotic" mutants are organisms that exhibit various kinds of structural problems.

Drosophila research was rooted in homeotic experimentation. Thomas Hunt Morgan (beginning in 1910 and extending into the 1940s), Edward Lewis (especially during the 1950s-1960s), and Thomas Kaufman (from the 1970s through to the present) were among the individuals that made discoveries concerning the way in which different modalities of mutation affected various aspects of body structure while the genome of fruit flies was undergoing development following conception .

Toward the latter part of the 1970s, two European researchers – Erick Wieschaus and Christiane Nüsslein-Volhard – discovered that during the development of Drosophila, one could observe the emergence of 11 segments between the head and the tail of the fruit fly. Each of these segments were found to give expression to their own form of development, and, moreover, not only did the induced mutations appear to give rise to an array of distinct mutational classes which differentially impacted the way various regions of the fruit fly developed, but, as well, the two researchers confirmed what previously had been suspected – namely, that certain genes seemed to be able to have more than one kind of function.

In the early 1980s, researchers discovered a stretch of DNA -- some 180 molecules in length -- which coded for 60 amino acids that were found in a number of the genes which were present in several mutated regions of the Drosophila known as the bithorax and Antennapedia complexes. The foregoing stretch of 180 DNA molecules came to be referred to as a "homeobox" due to the presence of homeotic genes (that is, genes containing mutations affecting structural development) that had been duplicated.

Soon, the foregoing homeobox of 180 DNA molecules was discovered in all kinds of organisms, from: Flies, to: Frogs and vertebrates. This finding led to the discovery of the Hox genes which code for different aspects of the dynamic that leads to the emergence of the developmental body plan – especially in conjunction with the relative positioning of various facets of that body plan -- which is manifested or emerges along the head-tail axis of animals.

The Hox genes were discovered to be located in chromosomes according to the order in which those genes are needed during the developmental process of a given organism. However, what was not discovered was how such an arrangement came into being.

All organisms contain Hox genes. Furthermore, they are highly conserved across species.

Putting aside questions about why random mutations -- which, supposedly, are the bread and butter of the evolutionary process – should be involved in the conservation or preservation of any set of genetic features, discoveries were made which indicated that, among other possibilities, Hox genes coded for protein transcription factors rather than enzymes of one kind or another. Transcription factors attach to certain aspects of DNA in order to help activate the genes that are to be expressed through those DNA sequences.

As such, Hox genes are specifically involved in controlling how genes are expressed. This process of regulation shapes how the proteins which are expressed through genes will be used to demarcate and organize different aspects of an organism's body plan.

In short, Hox genes are a set of tools. Some of the tools serve as transcription factors, but other Hox genes give expression to building materials (e.g., cytoskeletal components) or connective materials (e.g., adhesive proteins), and so on.

One can find Hox genes in a diverse array of organisms, and those genes play similar roles in each of those organisms. For instance, there is a gene that is present in fruit flies, fish, mice, and humans that is involved in the fashioning of tubular structures that help in advancing the construction of the respective hearts of those organisms.

In fact, one might say that there is a general principle present in the development of the body plan across organisms. More specifically, organs which exhibit shared degrees of similarity in different species of organisms (such as the case of the heart noted above) can be traced to a set of genes in each species of organism which play similar roles in the development of those organs.

In other words, not only do DNA sequences (e.g., the Hox genes) seem to be conserved, but, as well, the functions of various gene groups also are preserved. This means that despite whatever

differences might exist within certain gene groups that are present in various species of organisms, nonetheless, the functionality of those genes appear to be retained across various species and, as a result, those genes – despite their genetic differences – tend to bring about, or fashion, similar results in their respective species of organisms.

Irrespective of whatever degree of sameness or similarity might exist in the genes and/or their functions that are present in different organisms, there also are degrees of differences among those species of organisms. Thus, whatever the similarities are among, say, the hearts of fruit flies, fish, mice, and humans, there also are differences in the cytology, physiology, morphology, anatomy, and metabolic processes that take place in the hearts of those organisms.

The discussion concerning fingerprints and iris biomarkers which occurred earlier in this chapter indicated that even in identical twins who start out with precisely the same set of genes, nonetheless, there are a host of differences in the biological processing of their respective lived lives which, for example, lead to fingerprint ridges and swirls or iris biomarkers that are constructed in slightly different ways. Similarly, there are differences in the hearts of fruit flies, fish, mice, and humans, and these differences are not a function of random events but appear to be regulated in nature.

While one might hypothesize that the differences in the fingerprints and iris biomarkers of identical twins are due to chance factors, nonetheless, one could never prove this was, in fact, the case. Moreover, the foregoing sort of hypothesis becomes even murkier in the case of the differences which are present in the hearts of different species.

If the differences involved in the construction of the hearts of various species were the result of random events, then, the consistency of functionality which is present in the hearts of fruit flies, fish, mice, and humans becomes difficult to explain in a plausible manner. This is because notwithstanding the existence of significant differences in the way such hearts function, the operative word here is "function," and, consequently, the collective set of differences in the structure and dynamics of the heart in each kind of species gives expression to functioning hearts … something that is not likely to be

the case if those collective differences were expressions of random events.

Such differences are expressions of processes which take even those genes that are the same and proceed to use those genes in different ways. If the same proteins across such species were not used in different ways, then, the hearts of the aforementioned species would be the same – which they are not.

Different artists will take precisely the same kind of paint and use it in different ways, and different potters can work with precisely the same kind of clay and produce different structural outcomes. Similarly, the same sorts of genes can be used in a multiplicity of different ways by various species of organisms.

Moreover, just as various medical doctors might use different tools and techniques to generate a cure (and, therefore, those different forms of treatments effectively have the same sort of functionality), so too, different genes might be used to effect biological functions of a similar kind across a set of quite different species. In other words, the genes which are used to perform the same or similar function in various species do so as a result of dynamics which involve the use of different genes that give expression to a function that is homologous with a function that is expressed by a set of different genes in different organisms.

What induces the product (i.e., protein) of the same gene in different organisms to be used differently in those organisms? What induces one set of genes in one kind of species of organism to bring about a function that is the same as, or similar to, the function that is due to a different set of genes in another species of organism?

What is responsible for the conservation of the same or similar genes in different species of organisms? What is responsible for the conservation of functionality in different species of organism?

Natural selection might help to account for why organisms with the same or similar genes get to live to procreate another day. Nonetheless, ‘something” else seems to be needed to provide an explanation for what is responsible for the origin of the foregoing kind of conservation principle.

Natural selection doesn't appear to explain how the foregoing sorts of similar genes or similar functions came into existence in the first place. In addition, natural selection doesn't explain the functionality of those genes as much as natural selection tends to offer odds (say in the form of population genetics) concerning whether that sort of functionality is likely to continue or disappear in a given set of ecological circumstances.

On the other hand, to try to treat the foregoing sorts of conservation dynamics as being entangled with, if not a function of, random phenomena seems inherently contradictory. How does one reconcile processes which are essentially ephemeral, unstable, and unpredictable with a dynamic (i.e. principle of conservation) which shares none of those characteristics? As a result, one seems to need some sort of account that is not tied to allegedly random phenomena to account for why certain genes, or the functions served by various genes, are conserved across different species of organisms.

Of course, someone might wish to argue that the principle of conservation is a phenomenon that emerges from the bowels of random dynamics. However, doing so, leads to a lot of questions about the nature of the set of events that instantiates a principle which is stable and determinate from dynamics that are inherently unstable and indeterminate.

In his book, *The Master Builder*, Alfonso Arias engages in a discussion concerning the expression of genes involved in the development of eyes. First he talks about a mutant gene in fruit flies which is known as "eyeless," and as the name suggests, fruit flies that carry this gene have eyes which do not possess the usual number of visual receptors.

Rather strangely, however, when the RNA edition of that eyeless gene is relocated to regions that code for some other body part of the fruit fly and, then, the eyeless RNA is induced to express itself, an eye appears. The foregoing dynamic occurs quite apart from whatever body part is being coded by the genetic sequence to which the eyeless RNA has been relocated.

Under "normal" circumstances, the eyeless mutant leads to an eyeless fruit fly. Yet, when the RNA for that mutant gene is relocated to another part of the fly's body, an eye emerges.

Researchers at a laboratory in Switzerland conducted a different set of experiments that were connected to the development of eyes in fruit flies. Instead of using the mutant eyeless gene, they used a similar sort of gene that exists in human beings.

This latter gene is known as "PAX6." When mutations occur in this gene, the iris either doesn't develop at all or it does so in a dysfunctional manner.

The PAX6 gene was transferred to a fruit fly. Irrespective of where the foregoing gene is relocated in a fruit fly, an eye emerges.

Yet, the eye which is formed during that experiment is the sort of eye which normally forms in fruit flies. In other words, the eye which is expressed contains a full complement of fruit fly visual receptors (around seven hundred) rather than the single visual receptor which occurs in the human eye.

If genes are the dominant force in development, then, why did the mutant eyeless gene in fruit flies form a normal eye in some other part of the body plan? If genes are the dominant force in development, then, why did the relocated human PAX6 eye gene give expression to a fruit fly eye rather than a human eye?

The regulatory dynamics surrounding such phenomena do not seem to be tied to genetics. Those dynamics appear to be a function of something beyond DNA.

According to Alfonso Arias, the "something beyond DNA" is a function of cellular dynamics. He uses the allegedly synthetic form of life that was "invented" by Craig Venter in 2010 to help introduce the topic of how cellular dynamics is the source of regulation in living organisms rather than DNA.

Venter and his research colleagues replaced the DNA of a Mycoplasma (a particular kind of small bacteria) with a minimalist set of genes that had been artificially constructed and which Venter believed would be sufficient to sustain the life of the bacterium being experimented upon. However, Arias points out that Venter did not do anything to the cytoplasm in which the artificial genes were placed, and, consequently, Venter did not take into consideration the contribution that cellular cytoplasm, and its contents, made to enabling artificial genes to be functional.

Arias likened DNA to software and the cell surrounding that DNA to a computer which is responsible for enabling such software to be expressed. Consequently, Arias felt that Venter hadn't created a synthetic life form as the latter individual had claimed but, instead, Venter merely had substituted one kind of software (artificially constructed) for another kind of software (the DNA which is normally indigenous to Mycoplasma bacteria) and in the process retooled the computer with different software.

The foregoing experiment reminds me of experiments which have been conducted in conjunction with cancer research. More specifically, when replaces the nucleus of a healthy cell with the nucleus from a cancerous cell, the cell remains healthy, yet, when one replaces the nucleus of cancerous cell with the nucleus from a healthy cell, the cell remains cancerous.

Given the foregoing considerations, cancer would seem to have something to do with the cytoplasmic functioning of a cell rather than its nuclear functioning. Nonetheless, identifying what the dynamics are in such cytoplasmic functioning that might be responsible for cancer has proven to be quite elusive.

One could raise similar sorts of reservations in relation to Arias' notion that it is the cell which regulates what is going on in the cell. How does the cell go about reading and implementing the retooled artificial genes which have been inserted into the cytoplasm of the Mycoplasma bacterium?

How do the cytoplasm and its contents "know" when to express a given artificial gene? How do the cytoplasm and its contents "know" in what sequence artificial genes should be activated or to what extent they should be expressed or when those artificial genes should be shut down or when they should be replicated?

Despite more than 150 years of extensive research concerning issues which are relevant to cellular dynamics, there is no mention in the aforementioned book by Alfonso Arias of: Béchamp, Enderlein, Rife, Reich, and Naessens, nor is there any mention of: Microzymas, endobionts, bions, and somatids in that same publication. Conceivably, the regulatory oversight involving both cytoplasmic and genetic dynamics could be a function of the foregoing pleiomorphic entities or could be a function of that which such entities are transducing (i.e., the

intelligent organizing dynamics of Qi, prana-nur-qi) rather than either DNA/RNA or the cytoplasm, and, yet, such possibilities are never pursued in *The Master Builder*.

One can agree with Alfonso Arias when he contends that DNA/RNA needs something to translate the former into a functioning system. However, whether that "something" is the cytoplasm and its non-DNA/RNA contents is problematic because I am having trouble understanding just what capabilities the cytoplasm possesses which, in an intelligently organized fashion, could regulate: The parsing, the timing, the initiating, the sequencing, the determining of quantities, the replicating, and the terminating processes that make possible the translation of DNA/RNA into active, concrete dynamics that give expression to a functioning organism.

Alfonso Arias refers to genes as being tools. Are the cytoplasm and its non-DNA/RNA contents (e.g., organelles) any less tool-like?

Just what is the regulatory character of the cytoplasm and its non-DNA/RNA contents? How does the cytoplasm tell itself what to do anymore than DNA/RNA tells itself what to do?

What about the previously discussed research of Gilbert Ling? His experimental and theoretical work led to the formation of a hypothesis which suggested that the cell might not be the smallest unit of life and, instead, he indicated that much of what went on in the cell could be understood to be functions of nano-protoplasm units that interacted with one another.

While one might be willing to consider the possibility that Ling's nano-protoplasm units could be responsible for the way in which cells actually function in some fundamental sense, nonetheless, there still remains an array of problems. For example, Ling never actually indicated what was responsible for organizing different kinds of nano-protoplasm units and bringing them together at any given time and place, or in any given sequence, or in any given amounts, or for any given length of time.

Alfonso Arias refers to cells as the "Master Builders." In one sense, one might agree with him because the cytoplasm and its contents provide the mechanisms (e.g., organelles) through which different proteins are assembled, constructed, transported and so on.

However, being a builder is not the same thing as being the supervisor that plans the time, manner, order, and extent to which builders are to go about their constructive dynamics. In order to demonstrate that builders do not just put things together but, as well, are responsible for the planning of such assembly/building processes, one has to demonstrate how the builders actually are able to accomplish the task of regulating dynamics and, in the process, show that such builders are not restricted just to serving as the medium or means through which dynamics are being carried on behalf of a source of regulatory oversight which comes from beyond the cell.

There are over 200 different kinds of cells in the human body, many of which have sub-varieties. These 200-plus types of cells are distributed across the approximately 37 trillion cells that comprise the human body.

The largest of the foregoing cells are motor neurons which can run a meter, or so, while having a diameter of about 0.1 millimeters. The smallest kind of cell is known as “granule cells.”

The latter type of cell is also the most numerous kind of neuron in the brain. They tend to be active in the cerebellum of vertebrates, including human beings.

The outer part of our bodies consists of cells which are packed together to form an epithelium structure that protects the interior of our bodies. Within us is another epithelium structure which runs from the mouth to the anus and is dedicated to breaking down food so that what is useful is retained and what is not useful is eliminated.

The lungs contain an array of cells which, among other things, give expression to elaborate branching networks. The heart consists of specialized muscle cells which, on average and depending on the person, expand as well as contract between 80 and 100 thousand times a day.

One could continue providing a sketch of other kinds of cells that perform specialized functions in various organs of the body such as the: Liver, kidneys, spleen, gall bladder, muscles, pancreas, and the adrenal glands. Nevertheless, while such sketches might provide one with an overview of biological functioning in the body, those sketches will not provide one with any insight into whether, or not, Alfonso

Arias is correct when he claims that cells are the master builders which are responsible for organizing the way in which the genome of an organism is expressed so that such an organism constitutes a functional life form.

As indicated previously, one can agree with Arias that cells are master builders in the sense that they provide the machinery or dynamic processes which generate and make use of the proteins that are encoded within an organism's genome. Nonetheless, being able to provide a descriptive account of cellular dynamics does not necessarily offer any insight into what is organizing those dynamics.

That such dynamics occur is one thing. However, what organizes those dynamics in terms of their: Timing, initiation, construction, sequencing, interaction, communication, replication, repair, detoxification, and cessation seems to entail another set of issues because how cells, on their own, organize the foregoing sorts of functions is not at all clear.

At this juncture, many people resort to notions of: Self-assembly, self-organization, and emergent behavior in an attempt to give the impression that once one reaches a certain level of complexity, then, everything looks after itself in lock-step, automatic fashion. Such a perspective seems to resonate with the alleged explanatory efforts of someone who might insist that the patterns which are manifested by a large collection of intricately aligned, falling dominos is all a matter of self-assembling, self-organizing, and emergent dynamics.

At best, such accounts appear to be missing important evidential features which would be able to show that all aspects of biological functioning, across all species of life, are due to specifiable sets of properties that necessarily and demonstrably lead to the phenomena which are being observed. To the best of my understanding, no one has successfully met the foregoing challenges – although attempts to do so have been advanced continuously for several hundred years.

At worst, the notions of self-assembly, self-organization, and emergent behavior are just terms of obfuscation. Such notions provide the illusion of an explanation while actually providing a conceptual means to avoid having to deal with considerable evidence (some of which has been documented and explored in the several volumes of the present work) which appear to indicate that something more

deeply hidden might be responsible for what is taking place in, and through, life forms.

According to Alfonso Arias, what differentiates living organisms from non-living phenomena is a function of the capacity of life forms to be able to replicate and multiply. When cells attain a particular size, they divide and increase in numbers.

Replication is a complex process, consisting of a number of very precise, sequential steps. As a result, one might argue that what differentiates living organisms from non-living phenomena is not replication per se, but, rather, the sought-for differentiating feature is the system dynamics which are responsible for, among other things, mapping out, and, then, executing, the program which makes replication possible.

For instance, what sets the size of the cell that triggers replication? What monitors this dimension of size, and what recognizes that the right cellular size has been reached and, then, initiates and organizes the many steps to which the dynamics of mitosis give expression?

Furthermore, what directs the organism to stop replicating? After all, one of the characteristics of certain kinds of cancer is unbridled replication, and, therefore, how does the organism differentiate between healthy forms of replication and pathological forms of replication?

What organizes all of the different kinds of materials which go into the replication process? For example, many kinds of proteins are needed to underwrite the dynamics of replication, so what is regulating the construction and coordination of all those proteins in order to ensure that they are present at the right times, and in the right places, and in the right amounts, and in the right sequences?

To say that a distinguishing feature of life forms is their capacity to replicate and multiply seems rather limited in its scope to explain how life forms are different from non-life forms. Trying to figure out what makes replication possible would seem to be a much more fundamental issue as far as identifying that which distinguishes life forms from non-life forms is concerned.

Furthermore, replication is only possible because a great many other biological processes are taking place which enable a life form to

be able to live long enough to be in a position to replicate. Replication might be an important part of that life process, but without a capacity for: Sensation, movement, eating, digestion, energy production, defense, and a series of anabolic and catabolic processes that provide cells with the many biological components which they need to survive between junctures of replication, then, replication, in and of itself, will not take an organism very far.

Consequently, what appears to distinguish life forms from non-life forms is a capacity for organizing the former phenomenon's internal dynamics in a way that enables the aforementioned organizing capacity to be reproduced in daughter cells. As such, replication is important, but it is a function of something much more fundamental – namely, the capacity for organizing dynamics in a way that can sustain those dynamics through multiple instances of replication.

During the process of mitosis, there are short, tubular formations which are oriented at right angles and operate in close association with one another amidst a plethora of different kinds of proteins. These tubular structures play a significant role in the process of mitosis and are known as centrioles.

What calls for the expression of the proteins that go into the making of the centrioles? What governs how many of those proteins will be produced?

What sets the number of centrioles which are to be generated? What regulates the assembly of the centrioles?

What calls for the different kinds of proteins which surround the centrioles? What regulates the right-angle orientation of centrioles to one another?

One of the functions of centrioles is to help establish a network of microtubules that can be used to transport different components to various parts of the cell. Given the foregoing considerations, what organizes the way in which such microtubules are laid down, and what regulates which components are to be transported where and when by means of such microtubules?

When mitosis begins, centrioles disengage from whatever functions they are performing. Next those structures separate and move to opposite or polar sides of a cell, where they become active in

the process of laying down parallel tracks of microtubules across the cell.

What regulates the disengagement of centrioles from their on-going functions and organizes the subsequent transition of those centrioles into a mitotic dynamic? What organizes the separation of centrioles and their movement to opposite sides of the cell?

What regulates the way in which centrioles lay down parallel tacks of microtubules? What regulates how long those tracks are and how far apart those tracks are from one another?

The foregoing structural/dynamic arrangement is termed a "spindle." Upon completion of the spindle network, proteins (known as dyneins) appear on the scene and proceed to move chromosomes to the two polar-regions so that each polar region will receive half of the original cell's DNA from which the whole chromosome can be re-constructed.

What "knows" that the spindle structure has been completed? What calls for the dynein proteins to be called in at the right time and in the right amounts?

How do the dynein proteins "know" where to move the chromosomes? What regulates the process which ensures that each polar region will receive half of the original set of chromosomes?

After different chromosomes have been moved to particular polar-regions, the spindle array is disassembled. More or less simultaneously with the foregoing disassembling process, the cell is cut in two, with each side getting the full complement of what is needed to continue on as a functioning cell, and, as well, membranes are formed to partition the two sides of the replication process.

What "knows" that the chromosome moving project has been completed? What regulates the spindle disassembly process?

What regulates the process of cutting the cell in two and ensuring that each side has a full complement of all of the components which are needed for functional cells? What regulates the process of new membrane formation?

Once the mitotic process has been completed, the centrioles which played such a key role in that process return to their previous modalities of activity. What regulates this return to the original set of

programs in which centrioles had been involved before being called up to active mitotic duty?

Although Alfonso Arias indicates in his aforementioned book that there is much still to learn about the dynamics of mitosis, nonetheless, he contends that the cell determines all aspects of those dynamics. He notes that some of those cellular activities are known, while he also acknowledges that some of their dynamics and properties have, yet, to be discovered.

Among the cellular activities which have been uncovered, Arias mentions the mTOR protein. According to him, the mTOR protein gathers and assesses data on the cell concerning: Volume; the presence of various kinds of stress factors; nutrient status, as well as the character of the interaction which is taking place in relation to neighboring cells.

The foregoing data is used to "decide" whether, or not, the time is right for replication dynamics to be initiated. Or, if replication is not deemed to be an appropriate sort of dynamic to undertake at a given time, then, alternatively, mTOR determines whether, or not, some other kind of dynamic should be pursued (one such possibility being apoptosis or self-induced death).

Alfonso Arias indicates that no one currently understands how mTOR does what it does. Yet, if no one knows how mTOR does what it does, then, how do we know that mTOR is what is actually gathering, assessing, and making decisions about what course of action should be pursued?

The presence of the protein mTOR might be correlated with the foregoing sorts of sensing, assessment and decision processes. However, correlation is not causation.

How does one determine that mTOR is responsible for various sorts of sensing, assessing, and deciding dynamics rather than being merely a tool which is directed by some other sort of organizing dynamic to engage in various kinds of activity within the cell? Can one necessarily assume that the hammer which is on a work bench is what is responsible for the sensing, assessing, and deciding that takes place with respect to how that hammer is to be used?

According to Arias, mTOR's activities are a function of the sum total of that protein's interactions with other components of its cellular environment as well as with the ecological character of that which surrounds such a cellular environment. However, this is just another way of describing one's ignorance concerning what mTOR actually is, and is not, doing.

What is the nature of the interaction between mTOR and the rest of its immediate and more general environments? Is it just a matter of the electrical properties of that protein, and, if this is the case, then, how is such electrical data sensed, assessed, or used, and what is it within mTOR which makes those sorts of processes possible?

Are electrical properties and their interactions enough to organize and regulate what transpires in a cell? Or, are electrical properties just tools that need to be directed, organized, and regulated by something else, just as the presence of electricity in a house is not enough, in and of itself, to turn the lights on or off in that house, or to turn the heat on or off in that residence, or to heat the building's water for a shower/bath, or to turn any number of appliances and gadgets in that home on or off.

Supposedly, cells call upon genes as the latter are needed. What senses that need, and what assesses how that need is to be met, and what organizes and regulates the sequential dynamics which are directed toward responding to such a need?

One of the tools cited by Alfonso Arias which supposedly addresses some of the foregoing issues is known as a "transcription factor." Transcription factors come in small (e.g., methyl groups and acetyl groups) and – relative to such smallness – large sizes (various kinds of proteins).

Transcription factors shape the activation process of gene expression. When activated, the products of gene expression generate additional tools that can be used to establish various pathways of cellular metabolism.

According to Arias, DNA encodes a potential which is waiting to be used. He maintains that the user for which DNA is waiting (unbeknownst to the DNA) is the cell.

The cell might use such DNA, and the cell has the machinery to make use of that DNA. However, there is no indication that the cell is what has arranged for certain kinds of transcription factors to be sent to a particular set of DNA sequences in order for the latter to be activated for a particular time, place, amount, degree, and sequence.

The cell might have needs. In addition, there are potentials encoded in DNA which have the capacity to help address all, or part, of those needs.

What dimension of a cell senses, assesses, and responds to those needs by inducing a given gene or set of genes (via transcription factors of different kinds) to become active? How does that which is activated in the foregoing manner know where to go to address the need of a cell, and what organizes the transportation of the protein which has been activated?

One might suppose that there is some manner of molecular communication which is taking place to inform or shape the foregoing dynamics. However, communication requires that: (a) something "knows" what to communicate and (b) something "knows how to understand" what is being communicated and, in addition, "how to act" on what has been "understood."

There is plenty of evidence to support the idea that such communication is taking place within and between cells. We just don't have much insight into how cells are able to "speak" and "understand" that language.

To contend that cells automatically know how to deal with such molecular communication is akin to saying that human beings automatically know what to feel, think, believe, say, or do when the word "syzygy" is spoken. After all, on the one hand, syzygy could be referring to an approximately straight-line alignment of three celestial bodies located within a gravitational field, while, on the other hand, syzygy could also refer an idea of Jung's concerning the union of opposites – such as animus and anima.

A further possibility is that a person either does not know that "syzygy" is a word or does not know the various meanings which can be assigned to that term. An additional possibility might be that someone believes that one knows what the word means but is wrong.

In human language, some of the foregoing problems might be resolved through considering how a given context relates to a given word, but contexts often have to be understood or interpreted. Consequently, in the case of molecular communication, what might be regulating the process of understanding or interpreting the nature of the relationship between the presence of a certain kind of molecule and a given biological context?

While much has been discovered, there still are many things which are not understood about what makes communication possible in human beings. Furthermore, although one might be tempted to assume that molecular communication in cells is, somehow, much simpler and much more automatic than is the case in human communication, nevertheless as is true in relation to human language, there is much about molecular communication which is not known.

Are cells solely responsible for the communication dynamics which are transpiring in them? Or, are cells merely the networks through which such molecular communication is being channeled or transmitted?

What establishes or sets the semantics and syntax of molecular communication? What codes and decodes the molecular communication which is being transmitted according to those principles of semantics and syntax?

What determines the significance of what is being transmitted? What generates the response to such significance?

No one has shown that the cell, and the cell alone, is able to answer all of the questions above or any of the other questions in this chapter which preceded those questions. If researchers cannot show in precise detail how the cell is causally responsible for all processes of sensing, assessing, communicating, and determining what transpires in the cell, then, one cannot automatically disregard the possibility that something more deeply hidden might be responsible for the organizing and regulation of cellular dynamics.

According to Alfonso Arias, a cell cannot be reduced down to a set of component parts. He maintains that the interaction of those parts gives rise to dynamics which could not be anticipated on the basis of just examining the nature of those parts.

The foregoing unanticipated behavior of a system of interacting parts is referred to as emergence. Alfonso Arias -- along with many other individuals -- believes that the notion of 'emergence' is essential to understanding the nature of cellular dynamics.

Dr. Arias proposes that the first principle of emergent systems requires one to acknowledge that the components of such systems must interact with one another. By this, he means that those processes of interaction exchange information with one another concerning their respective statuses.

To assert that the components of an emergent system interact with one another is one thing. To say that those components have the capacity to sense, assess, communicate about, and determine how to proceed with respect to such interactional dynamics is, potentially, quite another thing.

The components of a biological system each have capacities to interact and not interact with other components. Those components often find themselves in situations not of their own creation but, instead, are a function of processes that bring different components together at certain times, places, and amounts, combinations, and sequences which were not determined by those components.

Once a component has been positioned in a biological setting by something other than that component, then, that component will likely behave according to its capabilities as it interacts with the way in which the properties of the situation in which it exists either engage, reject, or modulate those capabilities. Nevertheless, just as DNA does not get to determine if and when it will be used, so too, the components of cells do not get to determine if and when they will be generated, or, once expressed, those components do not get to determine where they will be stationed and for how long, nor do those components of gene expression get to determine the sort of company in which they will find themselves or determine what kinds of forces will be acting on them.

What is the property or capacity of a cell which brings the foregoing sorts of components together according to a given time, place, amount, sequence, and in the context of a set of conditions that such components did not choose? Once assembled, different components will interact with various aspects of their immediate

environment, but those assembled components had nothing to do with the nature of the context to which they are being brought within the cell, and the context in which those cells find themselves did not generate itself but was constructed.

Constructed by what … by random processes? How do random processes keep churning out precisely the same kinds of dynamics over an extended period of time in a manner that ensures the functional stability of a given life form?

As discussed in various preceding chapters, Béchamp, Enderlein, Rife, Reich, Ling, Pollack, and Naessens all made significant contributions concerning what they considered to be part of the foregoing construction process. However, while there are still many unanswered questions concerning the extent to which the contributions of the aforementioned individuals might be capable of explaining what takes place in a cell, nonetheless, not only did randomness not play a central or even peripheral role in the dynamics proposed by those individuals, but there were non-cellular forces at play (e.g., microzymas, somatids, nano-protoplasm units, Qi or prana-nur-qi) which appeared to impact the way in which different cellular components were brought together to interact with one another.

In addition to the aforementioned principle of interaction among cellular components which Alfonso Arias contends characterizes emergent systems in biology, he also indicates that a second feature which is present in emergent systems concerns the way in which they operate according to a set of simple rules.

For example, adding components together can lead to properties which might not have been foreseen if one limited one's considerations just to the properties of individual components prior to being combined with one another. For instance, to take a very simple example, if one examines sodium and chloride as individual elements, then, one can note that they each have properties which are characteristic of their respective atomic structures and seem far removed from the properties of salt.

Sodium is a highly reactive alkali metal. Chloride is a negatively charged form of the chlorine atom, and the latter is a gas that has toxic properties.

However, when one joins sodium and chloride together, the combination of the two elements generates a molecule with properties that one might not have been able to predict based on what one knows about those two elements when considered individually. Some people might consider the properties of salt (i.e., sodium-chloride) to constitute an emergent feature that arises unpredictably when two elements are combined together in certain ways.

Is emergence something other than an expression concerning one's ignorance about the potential of the components present in a given system? However unpredictable or unforeseen the nature of salt might be in the light of what one knows about sodium and chloride considered individually, nonetheless, salt is a function of what is possible when sodium and chloride are brought together.

Does the fact that different components of a cell can interact with one another in various, unpredictable ways explain how those components were brought together in the first place? If different components of a cell are able to interact with one another and, as a result, produce a dynamic or phenomenon which could not have been predicted if one were restricted to considering what those components are like apart from one another, does such an unexpected event say anything about the dynamics which enabled those components to come together?

Observing what happens when various components are brought together is one thing. Accounting for what brings those components together at certain times, in certain places, in certain amounts, in certain sequences, and under certain conditions involves a separate set of issues.

There are at least two kinds of 'emergence' which are being alluded to in the previous paragraph. One kind of emergence has to do with what happens – however unanticipated it might be -- when two components are brought together in a cell, while the other kind of emergence – which is not just unanticipated but is not necessarily understood at all -- has to do with what enables those two components to be brought together at certain times, in certain places, in certain amounts, in certain sequences, and under certain biological conditions.

The second of the two foregoing forms of emergence is much more fundamental than the first kind of emergence because rather than just

describing what happens when two components are brought together, the second form of emergence is alluding to something which is necessary for enabling the first kind of emergence to be able to occur. The first kind of emergence noted above is totally dependent on the second kind of emergence noted previously because without that second kind of emergence dynamic, then, the first kind of emergence phenomenon would never have taken place.

Is the second kind of emergence – i.e., that which accounts for how different components are brought together at certain times, places, amounts, sequences, and under certain conditions – a function of cellular dynamics? Or, alternatively, are cellular dynamics merely the tools that are used to give expression to a form of organization and regulation which is not due to those cellular dynamics but, instead, makes use of those dynamics in order to cause components to be brought together that give expression to the first kind of emergence noted above (i.e., salt-like phenomena)?

Alfonso Arias believes that the second kind of emergence noted above is a function of cellular dynamics and nothing more. The problem with that sort of perspective seems to be its failure to account for how cellular dynamics "know": What to do, and when to do it, and under what circumstances it is to be done.

In other words, a dimension of intelligent organization seems to be absent from cellular dynamics as described by Alfonso Arias. While one can understand how cellular dynamics are able to carry out different kinds of regulatory processes (such as mitosis or gene expression), nevertheless, one has difficulty understanding the source and nature of a cell's capacity to organize the processes it carries out so that various components will come together at a particular time, place amount, sequence, and under certain conditions.

The capacity of a cell to serve as a set of tools does not explain the emergence of the uses to which such tools are put. Tools do not explain their uses, but, rather, tools simply comply with the uses to which they are applied, and the source and nature of such usages appears to come from something other than those tools.

DNA sequences do not explain how they become expressed, nor do such sequences explain the nature of the functions for which they are expressed. Similarly, cellular dynamics do not explain the tools which

exist in the cell, and moreover, cellular dynamics do not account for why those tools are used in one way rather than another at any given time.

DNA is just one of the tools that are present in a cell. Cellular dynamics refer to the entire spectrum of tools (including DNA) which are used during the implementation of whatever series of metabolic pathways are needed for a cell to be able to remain functional (i.e., living).

One can agree with Alfonso Arias that cells are themselves emergent phenomena. However, they are emergent phenomena which depend on a source of organization and regulation which is more deeply hidden and which also gives expression to a more fundamental form of emergent dynamics than is entailed by tool-chest of cellular dynamics.

<u>Chapter 20:</u> Transcending Cells

Various aspects of Gerald Pollack's concept-breaking work: *The Fourth Phase of Water: Beyond Solid, Liquid, and Vapor* were discussed in a previous chapter (15) of the present book entitled: "*Potentials*". Pollack's aforementioned book explored the physics and chemistry of water both within a biological context as well as in situations not necessarily initially connected with biology but which, nonetheless, often carried ramifications for providing a framework through which to better understand the phenomena associated with the dynamics of water within life forms as a result of what happens with water when it is subjected to different kinds of biological conditions.

Twelve years prior to publishing the foregoing book, Pollack released another work: *Cells, Gels, and the Engines of Life*. During the course of that work, he sought to lay out principles of physics and chemistry which indicated how biological systems might operate in ways that departed from standard, traditional theories concerning the cell.

For example, he notes in the Preface to that book that he had come across several passages in a well-known textbook on biology that – perhaps unintentionally -- raised some important questions. More specifically, the foregoing textbook described a set of circumstances in which a simple species of organism was crawling along when a part of its underside somehow became hung-up on the surface across which it was crawling.

The front part of the crawling organism continued on with its journey. Unfortunately, as the front part of the organism moved forward, an aft-part of that organism was torn away and was left behind.

One question which surfaces in conjunction with the above incident is the following one. Namely, once the membrane structure surrounding that organism's inner features was breached – and the membrane of a structure allegedly protects the integrity of such an organism – why didn't the inner contents of the organism pour out and lead to its demise?

Of course, one possible way of trying to resolve such a conundrum is to suppose that, somehow, the breach was quickly resealed. The

problem with such a proffering is that one has difficulty understanding the nature of the biological dynamics which might demonstrate how such a resealing process would be able to take place and do so sufficiently quickly that the crawling organism would not die.

Pollack goes on to indicate that the foregoing sort of incident is not an isolated incident in biology. Nevertheless, cells and life forms often manage to go on ticking despite taking the sort of licking which decimates many parts of their membranes.

Furthermore, despite years of research, Pollack stipulates that evidence is decidedly lacking which might be able to prove that a resealing process of some kind takes place in the foregoing sorts of cases. However, he suggests – as a way of alluding to future topics that will be discussed in his book – that if one were to consider the internal contents of a cell or organism as being gel-like rather than aqueous in nature, then, one might be able to provide a plausible account concerning what is happening in those cases since gels (think of a substance like Jell-O) don't release liquid materials when they are cut.

The reason why gels exhibit the foregoing property is because the structural properties of a gel are different than an aqueous solution. While water might be present in a gel, the conditions in a gel are such that water and different ions within the gel are induced to adhere to various kinds of polymers which are also present in that gel, and, as a result, when the gel is breached in some fashion, the water continues to adhere to the surfaces of those polymers and, therefore, the water is not free to flow when the gel has been breached or cut.

The difference between a gel and an aqueous solution is that the conditions within the gel are conducive to various forms of phase transitions in which the electrical properties of the materials in the gel induce water and ions to adhere to the surface of polymers which are present in the gel. Once a certain threshold point has been reached due to the nature of existing conditions, then, phase transitions take place which are a function of the charge dynamics which are induced to take place in an aqueous solution and, as a result, a gel forms.

Under the right set of conditions, liquid water will become either ice or water vapor, and when this happens, a phase transition has occurred. Similarly, under the right set of conditions, an aqueous

solution will assume gel-like properties, and when this occurs, a phase transition will have taken place.

A central theme which runs through Pollack's book – *Cells, Gels, and the Engines of Life* – is that when one considers cytoplasm to be a gel-like phenomena rather than a watery solution, then, a great many aspects of biological life and cellular life can be explained which, otherwise, tend to be elude our understanding. In a sense, life is a series of phase-transitions which are induced in the cytoplasm that is present in an organism or cell.

For Pollack, the idea of phase-transition is a unifying theme in biology. However, as the ensuing discussion will seek to suggest, that which makes those phase transitions possible might be a more fundamental principle.

In other words, the perspective that many of the events which take place in a cell or life form might be a function of various kinds of gel-like phase transitions gives expression to some important ideas concerning the possible dynamics of biological life forms. Nevertheless, showing that such gel-like phase transitions might constitute a very plausible way of describing many aspects of biological functioning doesn't necessarily explain what organizes and regulates those sorts of phase transitions into a sequence of events which are capable of generating a functioning organism.

Following the Preface of *Cells, Gels, and the Engines of Life*, Pollack quotes something once said by Albert Szent-Györgyi, some of whose work was discussed earlier in the present book. According to the latter individual: "Science is built on the premise that Nature answers intelligent questions intelligently; so if no answer exists, there must be something wrong with the question."

The appropriateness of a question depends on the topic which is being addressed. If no answer has been found concerning a given topic, then, perhaps, it is not just that something is wrong with the questions which are being asked but that the right sorts of questions are not being asked at all, and trying to understand what makes certain kinds of questions be the right ones to ask is not always easy to grasp.

By raising questions concerning the nature of the dynamics within an organism or cell and coming-up with answers that point in the

direction of gel-like phase transitions suggest that, perhaps, the questions being asked are intelligent and, as a result, they are being answered intelligently by Nature in the form of experimental results that lend credibility to the idea that the dynamics of gel-like phase transitions might be a central principle in biology. Notwithstanding the foregoing considerations, asking questions about the dynamics of particular kinds of gel-like phase-transitions within biological contexts often leaves out, or avoids, questions concerning the character of the regulatory forces that organize those phase transitions into functioning wholes

In short, questions concerning the nature of the dynamics which are present in biological contexts are one thing. Nonetheless, despite whatever questions might be answered by Nature in conjunction with the queries which are made that are pursued and lead to the foregoing sorts of descriptions, being able to describe the foregoing kinds of dynamics (as Pollack does in his aforementioned books) is not necessarily the same thing as providing an account of how those dynamics are organized to give expression to life.

Something more deeply hidden seems to lie beyond the surface descriptions concerning the way in which phase transitions generate gel-like phenomena within cells and other biological life forms. This something more appears to be a function of the nature of the source of regulatory control which brings the foregoing sorts of phase transition into a functional network or system of dynamics.

To simplify matters – and, perhaps, to oversimplify if not distort things – Pollack appears to be trying to understand the nature of certain aspects of the dynamics which are present in a very complex arrangement of biological dominos. He seems to be focusing on phenomena which are linked to the way in which those dominos are observed to fall and, then, set in motion various other kinds of falling-dominos dynamics, but eventually, the questions that need to be asked have to do with what is responsible for the dominos being set up with the potential for dynamics that they have in the first place – not only individually but collectively as well.

Describing whatever phase transitions that biological dominos go through as they play their role in the overall network or system of biological dominos does not necessarily account for the properties of

the overall system in which those dominos reside. In various ways, regulatory capacities and organizational principles are present in the network of biological dominos which cannot necessarily be explained by the phase transitions that individual dominos are induced to manifest at given points in time.

Instead, those regulatory principles are responsible for inducing sequences of phase transitions and regulating when and how those transitions are manifested. Therefore, what stands in need of intelligent questions has to do with the nature of the regulatory dynamics which have organizational oversight concerning the patterns through which individual biological dominos play their respective roles.

Aside from the foregoing issue concerning the extent to which cytoplasm is aqueous or gel-like in nature, there are other challenges which can be directed toward some traditional theories concerning the dynamics of cells. For example, two such challenges have to do with the notions of "membrane channels" and "membrane pumps."

Pumps are believed to be biological mechanisms (often in form of proteins) that enable solutes (such as sodium or potassium) to pass through the membranes of a cell against the concentration gradients which normally prevent those solutes from being able to traverse across those membranes. Channels, on the other hand, are openings (again, often created by the morphological dynamics of certain kinds of proteins) which enable solutes to leak out of a cell.

The dynamics of membrane channels and pumps enable a cell to maintain a balance between what needs to be in a cell and what needs to be outside of a cell. Thus, for instance, as a result of the dynamics of pumps and channels, the concentration of potassium inside a cell is maintained at a higher level than the concentration of potassium which is present outside the cell, while the concentration of sodium outside of a cell is maintained at a higher level that the concentrations of that solute inside the cell.

There are several questions which arise in conjunction with the foregoing considerations. For instance, how did cells come to "know" which concentrations of different solutes should be relatively higher inside cells than outside of those cells? In addition, one might ask about how cells came to "discover" the nature of the regulatory

processes that determine, for best results, what relative concentrations of various solutes are permitted inside and outside a given cell.

Pollack points out how proteins which possess pump-like and channel-like properties have been proven to exist. Nevertheless, he believes that one of the hopefully intelligent questions which needs asking is whether, or not, pumps and channels are actually the means through which solutes and ions are partitioned within cytoplasm.

Being able to show that proteins are able to exhibit such properties under certain kinds of experimental – and often artificial – circumstances is one thing. Whether, or not, the foregoing sorts of experiments reflect what takes place in a cell is quite another consideration.

In other words, can one acknowledge that proteins exist which have pump-like and channel-like properties without requiring one to commit to the idea that this is how cells function? After all, there are experiments which have demonstrated how certain kinds of proteins can be inserted into artificial membranes and the presence of those proteins enables ions to be transported from one side of that membrane to the other side of the membrane, but does the existence of the foregoing sorts of experiments prove that this is how things are done in the case of actual cells?

Gerald Pollack indicates that the concept of a cell membrane arose before microscopes were sufficiently powerful to be able to resolve whether, or not, the presence of those kinds of structures was actually present in a cell. In 1665, when Robert Hooke gave the term “cells” to the box-like structures that he observed in cork, he was describing a space that could have been as easily formed by a gelatinous-like material as it might have been formed by an aqueous solution that was enveloped by a membrane.

The foregoing possibility is not necessarily as far-fetched as it, initially, might seem to be. As early as 1835, biologists -- such as Dujardin -- were describing cytoplasm as a gelatinous-like material which did not mix with its surrounding environment, and the reason why that cytoplasm did not mix with, or leak into, the surrounding environment could have been due to precisely its gelatinous-like

nature rather than because there was some membrane present which prevented the cytoplasm mixing with the surrounding environment.

For whatever reason, the idea which seemed to capture the imagination of many researchers was rooted in the belief that there was some sort of membrane surrounding cells which prevented it from mixing with, or leaking into, the surrounding environment. Differences arose, however, concerning the precise nature of that membrane.

Some individuals maintained membranes consisted of some sort of protein structure. Other individuals felt that membranes might be the result of a condensed form of cytoplasm.

Initially, the membrane was considered to be impermeable. When evidence surfaced that water could be introduced into cytoplasm, the nature of the membrane was re-constituted and, subsequently, was considered to be semi-permeable.

Nonetheless, scientists maintained that such permeability applied mostly to water and little else. However, in the 1920s and 1930s experiments were conducted indicating that some solutes – such as potassium – had the capacity to enter into the cell as well as leak out of the cell, and, as a result, the membrane underwent a major overhaul.

One of the first proposals to try to resolve how potassium ions might be able to find their way into a cell's interior was to conceptualize the membrane as a sieve-like structure in which the channels were large enough to permit potassium ions through but small enough to prevent larger sodium ions from entering the cell. Yet, subsequent experiments which radioactively tagged sodium ions were able to demonstrate that sodium also could enter the cell, and, as a result, researchers proposed that there were a number of different kinds of channels in membranes, some of which had to do with potassium and some which had to do with sodium.

The foregoing suggestion tended to be countered to some degree by experimental findings indicating that the amount of sodium ions inside cells was less than it should be if sodium channels allowed sodium ions to flow freely as seemed to be the case given the amount of potassium ions which were found inside of cells. Consequently, in the early 1940s, the idea of a pump was proposed to resolve the

disparities in the amounts of sodium ions and potassium ions which were present inside cells.

Membrane pumps removed sodium ions which had found their way into a cell's interior via sodium channels. However, if sodium ions had to be removed from the interior of cells, then, one might ask why there were sodium channels at all that allowed sodium ions to enter the cell.

Moreover, despite the presence of a sodium pump, some sodium ions still remained in the interior of a cell. What determined how many sodium ions were to be removed from the interior of the cell by the proposed pumps?

Like the notion of membranes, the idea of pumps was theoretically intriguing to various researchers. Soon, all manner of pumps were being proposed, including: Chloride pumps, hydrogen-ion pumps, calcium pumps, as well as pumps for a variety of other solutes.

Proposing the possibility that such pumps existed in cells was easy. Explaining how those pumps worked seemed to be a more elusive consideration.

Over time, numerous specialized solute channels (numbering more than 100) and an array of pumps were proposed. These channels and pumps were used to model how cells supposedly interacted with their environments.

Beginning in 1989 and extending through 1993, an array of experiments were performed which brought the idea of specialized, single-channel structures into question. More specifically, a variety of mediums were used (including silicon rubber patches, polyethylene terephthalate filters, and pure lipid bilayers) which were capable of generating many of the same phenomena (e.g., ion selectivity, gating, and changes in conductivity) that were normally being attributed to the presence of channels.

The foregoing experiments didn't disprove the existence of membrane channels. Rather, those experiments indicated that channels were not necessarily the only way in which certain kinds of biological phenomena might be possible, and, therefore, what was being attributed to channels might actually be a function of some other kind of dynamic.

All of the foregoing mediums – from channels to lipid bilayers – shared one feature in common. No one understood what enabled those mediums to generate similar kinds of cellular phenomena.

There also were questions about how different channels were considered to be dedicated to specific solutes. For example, why didn't smaller solutes (say, a hydrogen ion which is about 0.5 angstroms in diameter) diffuse down channels which were meant to accommodate larger-sized solutes (say, a sodium ion which has a diameter that is between 3-5 angstroms)?

In addition, various modern models proposed membrane solute channels that were fairly complex in their hypothesized way of functioning. The notion of transition states was introduced to enable a given solute to make the journey from one side of the alleged membrane to the other side of that membrane.

Those transition states would have to take place within a timeframe of 100, or so, pico seconds. Since the number of transition states associated with a given channel often was somewhat extensive in nature (involving as many as 27 such states), trying to figure out how the foregoing set of transitional dynamics work has proven to be fairly problematic.

In short, contending that membrane channels are simple structures – like tubes through the membrane -- is contraindicated, or brought into question, by an array of evidential considerations. Moreover, the more complex the dynamics of those channels became, the more difficulty one encountered when one tried to explain how they work in ways that make sense biologically or when trying to account for how such complex sorts of channels arose originally.

While more than 100 different kinds of channels were proposed over the years to account for how solutes gained entry to, and leaked out of, cells, more than 50 models of membrane pumps also surfaced as well. The notion of a pump was introduced because a way was needed to account for how cells tended to be characterized by solute concentrations that exhibited non-equilibrium conditions between the inside and the outside of those cells, and the idea of membrane pumps appeared to explain such experimental observations.

A primary consideration confronting the pump idea has to do with energy. More specifically, how much energy is required to run those pumps?

The disequilibrium relationships between the inside and outside of a cell that characterize the concentrations of various solutes are important to the healthy functioning of those cells as well as the functional health of organisms in which such cells reside. Therefore, one could suppose that a constant supply of energy might be necessary to maintain such conditions of disequilibrium.

As long ago as 1962, Gilbert Ling (who was first encountered during chapter 10 of Volume 1) conducted a series of experiments which were designed to explore various aspects of the membrane pump idea. For instance, if one maintained that pumps were fueled by ATP to ADP transitions with the freeing of electrons (which was the accepted model at that time), then a good line of inquiry might be investigate what would happen if one were to deprive cells the oxygen that was necessary to generate ATP.

To answer the foregoing question, Ling introduced a number of poisons (such as cyanide) into a cell to see what, if anything, happened in conjunction with sodium pumps. If those proposed pumps actually derived their energy from ATP, then, the foregoing sorts of poisoning dynamics which impacted cellular oxygen supplies should effectively disconnect the sodium pumps from their energy supply and render those pumps dysfunctional.

However, Ling discovered that notwithstanding the presence of poisons which disrupted ATP dynamics, the alleged sodium pumps continued to remove sodium from the interior of cells. Therefore, whatever might be fueling such a pump was being energetically subsidized, apparently, through some other means.

The next question addressed by Ling had to do with the amount of energy that might be necessary to run a pump continuously in order to maintain a constant disequilibrium in the concentration of sodium ions within a cell (low) relative to the concentration of sodium ions outside of the cell (high). Ling determined that such a continuous process of pumping would require, at a minimum, some 15 to 30 times the amount of energy which would have been actually available to a cell following the aforementioned process of poisoning.

The foregoing experiment was only run in connection with the so-called sodium pump. If one calculated the total amount of energy which would be necessary to continuously subsidize the energy required for 50, or more, other pumps that were hypothesized to exist in cells, then, based on the results of Ling's experiments which focused on sodium ions, one could be facing an energy shortage that was hundreds, if not thousands, of times less than what would be available to a cell that had been poisoned, and, consequently, the means, mechanism, or dynamic through which such solutes might be displaced from the interior of a cell seemed to continue to elude the understanding of researchers.

Furthermore, the above considerations only address cells. There are organelles (such as mitochondria) within some cells which have surface areas that are greater than the cells within which they reside (e.g., the mitochondria of liver cells or the sarcoplasmic reticulum of muscle cells), and, consequently, the pumps which are necessary for these larger surface areas will require quantities of energy that are above and beyond what is needed by the alleged pumps which supposedly populate the membranes of cells containing those kinds of organelles.

Leaving considerations of poisoning aside, current estimates (based on oxygen consumption measurements) concerning how much of a cell's energy is believed to be directed toward running just sodium pumps runs between 30-35%. If one throws 50 other kinds of alleged membrane pumps into the mix, then, one would seem to have to scramble quite a bit to find the energy that would be necessary for the continuous running of all those pumps.

Several scientists (Christopher Miller and Jeffrey Freedman) challenged Ling's findings, and their ideas ended up in a 1976 article written by Gina Kolata (14 years after Ling's experiments had been completed). Miller and Freedman had been former students and research colleagues of Ling but had had a falling out with their mentor when their careers were threatened by prevailing power structures in the scientific community since the research being conducted by Ling ran counter to mainstream views in biology.

Furthermore, an experiment had been referenced by Miller and Freedman in the aforementioned article which, supposedly, showed

that Ling's experimental results were questionable. Ling sought to track down the findings of the experiment mentioned in the Kolata article, but what he found, instead, was that the experiment to which reference was being made in that article had never actually been conducted.

Some 21 years later in 1997, Ling wrote an article that rebutted the criticisms of his work which had appeared in the Kolata article. During his 1997 article, Ling indicated, among other things, that although over the years there had been several review articles which had been written concerning the membrane pump hypothesis, those review articles only mentioned research that allegedly lent support to such a hypothesis but never mentioned or discussed the considerable research that ran contrary to the membrane pump issue.

As noted previously in this chapter, proteins do exist which have been shown experimentally to have channel-like and pump-like dynamics associated with them. However, one question which might be asked in conjunction with those kinds of proteins is whether the channel-like or pump-like dynamics which, under certain circumstances, are present in those proteins are of a secondary or incidental nature or constitute a primary function of such proteins.

For example, due to the introduction of electrical charges in a given cellular environment, conformational changes can be induced to occur in proteins. Given the right set of circumstances, those conformational changes might have channel-like or pump-like properties quite independently of whether, or not, any sort of channeling or pumping dynamics are taking place through those proteins.

Alternatively, some degree of channel-like or pump-like dynamics could be occurring. Nonetheless, if these dynamics are not sufficiently extensive or continuous enough to subsidize the channeling and pumping activities which are hypothesized to occur in conjunction with membranes, then, whatever channel-like or pump-like dynamics are occurring will be incidental or secondary to what would be required to run a fully functioning set of membrane channels and membrane pumps.

If either of the previous possibilities turns out to be the case, then, the occurrence of the foregoing sorts of conformational changes in

proteins is not necessarily proof that membrane channels and membrane pumps exist. Rather, those conformational changes were being interpreted as if they are proof of the existence of membrane channels and membrane pumps when, in actuality, those sorts of conformational changes in proteins might be serving other kinds of functionality in which channel-like and pump-like conformational dynamics are taking place but which have nothing necessarily to do with underwriting the activities of hypothesized membrane channels and membrane pumps.

Membrane channels and pumps were initially introduced into biological discussions because of a need to account for how solutes might be able to enter into the interior of cells or to explain how other solutes might be able to be removed from the interior of cells despite – due to theoretical considerations and not experimental evidence – the presence of what was believed to be a relatively impenetrable, continuous membrane exterior. But, if whatever membrane structure was present in cells was not continuous, then, one might need to find ways of explaining the movements of solutes into and out of cells through dynamics that did not involve membrane channels and pumps.

Presumably, if impenetrable, continuous membrane structures are integral to the functioning of cells, then, poking holes or disrupting those structures in various ways should lead to the demise of cells protected by such membranes. Gerald Pollack discusses an array of experiments in his book – *Cells, Gels, and the Engines of Life* – which explore the foregoing possibilities.

Pollack describes experiments that were conducted in which all kinds of holes were poked in cells to see what might happen. For example, electroporation techniques were used in some experiments through which a bevy of holes were created in the exterior of a cell by directing a series of high-voltage pulses toward those cells, and such puncture wounds were large enough to permit all manner of molecules – from DNA to proteins to other macromolecules – to exit the cell.

Another method used in the experiments involving micropipettes. The size of the point on such instruments is 1 micrometer in diameter, and, therefore, given that the size of many cells often runs 10

micrometers, then, relatively speaking, quite a sizable hole is being poked into a cell.

A third method employed in the foregoing sorts of experiments involved patch-clamps. When patch-clamps are removed from a cell, then, like the micropipette, a micrometer-sized hole is created which is approximately a million times greater than a potassium ion and hundreds of thousands times the size of a sodium ion as well as the size of many other kinds of solutes.

During experiments involving the foregoing three methods, cells keep on ticking for extended periods of time. The continuing functioning occurs despite the fact that the holes created might persist for hours.

If large holes are poked in the exterior of a cell, and if those holes remain open for a time, then, if a continuous, impenetrable membrane were integral to cell functioning, one might anticipate that cells with such large-sized puncture wounds should not be able to last very long. However, considerable experimental evidence indicates that these kinds of anticipations are routinely thwarted.

One might hypothesize with respect to the foregoing experiments that some process of re-sealing might take place in relation to the cells being punctured, thereby, enabling cells to continue functioning. Nonetheless, electron micrographs of punctured cells indicate that no such resealing seems to take place.

When micropipettes are used to section cells (for example, nerve, muscle, or epithelial cells), the latter entities continue to survive for different periods of time, depending on the nature of the sectioned remnant one is observing. Thus, if the sectioned portion retained a nucleus (and, therefore, possessed a full complement of chromosomes), then, that portion could be observed to continue to live on indefinitely and, in addition, could be observed to engage in mitosis (cell division), while if the sectioned portion is non-nucleated (and, therefore, contained no chromosomes), then, those sectioned remnants were observed to survive for between one to two days.

Pollack indicates that although the standard understanding of membranes generally involves the idea that the latter structures are largely made of lipids that are peppered, here and there, with a few

embedded proteins. However, he points out that, with considerable justification, one also could describe membranes as consisting largely of proteins with portions of lipids peppered here and there because when one compares the ratio of proteins to lipids according to their weight, then, in the inner membrane of chloroplasts and mitochondria, the ratio is 3 to 1, and, moreover, the ratio of proteins to lipids according to weight has been determined to be as much as 5 to 1 in the membranes of certain bacteria.

Although light microscopes and electron micrographs seem to capture a continuous membrane structure, how lipids and proteins fit together is not certain. This is especially the case given that proteins constitute as much as between 50 to 80% protein of a membrane structure, and the morphology of proteins which fold back on themselves in intricate ways can be quite complex with various kinds of electrical dynamics taking place within them and in conjunction with neighboring proteins – dynamics which might facilitate the transport of at least some solutes into and out of a cell.

In other words, to whatever extent membranes might exist along the exterior of a cell or organelle, there is not necessarily any guarantee that such membranes are continuous in nature. In fact, epigenetic processes might lead to the expression of an array of genes that lead to a constant modulating of the conditions present in and around membranes … gene expressions which induce various aspects of the membrane to alter according to the forces and electrical charges which are brought to bear on those membranes.

Therefore, rather than have to hypothesize the existence of permanent channels and pumps in a membrane that is considered to be continuous in nature, the topology of a cell's surface might be able to undergo constant transitions as a means of mediating the way a given cell interacts with its environment. The foregoing dynamics would sort of be like the way the internal structure of office space might be organized to enable walls to be moved about and modulated to accommodate the dynamics which transpire in that space.

In the foregoing perspective, proteins and lipids along the exterior of a cell or organelle are merely tools which are capable of being positioned in a variety of ways -- like so many biological dominos -- in order to be able to establish conditions which are conducive to

different kinds of biological processes being able to take place. Epigenetic dynamics could determine how those tools will be induced to be moved about to facilitate this or that transaction between a cell and its environment or between an organelle and its cellular environment.

Gerald Pollack indicates that during acute osmotic challenge events, the membrane surface areas of cells often have been observed to double in size. Yet, he also points out that there is no obvious way in which a continuous, fixed lipid-protein membrane structure would be able to accommodate or adapt to such cellular stresses.

He suggests that one way of resolving the foregoing issue might have to do with the capacity of proteins that are present in the membrane to be able to undergo the sorts of conformational changes which would permit increases in surface area due to acute osmotic challenges to be accommodated. Another way to resolve the aforementioned problem would be to suppose that epigenetic dynamics had the capacity to respond to acute osmotic challenges by regulating the conditions that were established along the exterior of a cell or organelle in ways that would induce proteins and lipids to interact with one another to meet those sorts of challenges.

If the latter possibility were the case, then, one would have to make inquiries concerning what might enable epigenetic dynamics to bring about the sorts of modulation of conditions in the exterior of a cell or organelle that could effectively respond to the aforementioned kinds of challenges. As has been suggested in other chapters of these two volumes, the intelligent organizing capacity of Qi (prana-nur-qi) might be able to underwrite those sorts of regulatory dynamics.

For a variety of reasons, proving the existence of an intelligent organizing capacity like Qi (prana-nur-qi) is difficult. Such difficulty is especially apparent if Qi (prana-nur-qi) is a phenomenon which is not a function of any known force (such as electromagnetic dynamics, the strong force, the weak force, or – if it exists – the gravitational force), and, therefore, currently, we don't possess any methodology that is capable of accessing or disclosing its essential nature.

Karl Popper once indicated that if a proposal or hypothesis cannot be subjected to a process which could show how to falsify such a proposal, then, that hypothesis is not scientific. However, if our

ignorance concerning the nature of reality is such that we don't know how to go about falsifying a given proposal or hypothesis, then, perhaps, what is not scientific is our way of understanding science.

When one is confronted, again and again, with evidence (some of which has been put forth in the two volumes of this book) that seems to point toward the idea that something more deeply hidden might be present which is responsible for, among other things, the regulatory character of many aspects of biological dynamics, then, we are confronted with a difficulty of another kind. More specifically, we are faced with running the risk of rejecting a hypothesis as being false that might turn out to be true (this is known as a Type 1 error) … if only we were intelligent enough and sufficiently insightful to understand how to go about demonstrating that there might be truths of some kind which are present in such a hypothesis.

Toward the beginning of this chapter, a quote of Albert Szent-Györgyi was given in which the suggestion was made that if one is not getting answers, then, perhaps there is something wrong with the questions being asked. However, there is a further problem involving cases in which we don't even know what questions to ask because we are so adrift in our ignorance concerning the nature of reality.

To restrict science only to what one wishes to acknowledge as being compatible with the limits of one's methodology, seems a little ideologically self-serving as well as, appears to be somewhat overly restrictive epistemologically. To be sure, one has to establish a set of methodological and conceptual filters which prevent just anything and everything from being considered as scientific, and, yet, nonetheless, there are unfortunate tendencies in much of so-called science that are excessively authoritarian (as opposed to being authoritative) with respect to determining what should constitute legitimate and illegitimate research pursuits, and anyone who supposes otherwise knows nothing about the histories of so-called 'sciences' (and as has been discussed in the two volumes of this book, the work of: Béchamp, Enderlein, Rife, Reich, Ling, and Naessens constitute case studies concerning the considerable deficiencies which often govern many aspects of so-called 'science').

In light of the foregoing considerations, let's return to the issue of membranes. Pollack stipulates in *Cells, Gels, and the Engines of Life* that

the reason why the idea of membranes was hypothesized in the 19th century was to provide, at least at that time, what was considered to constitute a plausible account that would explain why cells did not leak their internal contents … contents which were presumed to consist of a watery form of cytoplasm containing various kinds of solutes and macromolecules.

After citing an array of evidence indicating how many aspects of the membrane hypothesis (as well as the associated notions of pumps and channels) appear to have questionable credibility, Pollack provides an alternative way of approaching the question of why the contents of a cell don't leak into the environment. More specifically, he proposes that, perhaps, the interior contents of a cell do not consist of watery cytoplasm but, instead, such contents might exist in the form of a gel-like medium in which the contents of that material medium are not free to diffuse into the environment, any more than the contents of prepared Jell-O are initially free to diffuse into the environment.

Expanding on the research of Gilbert Ling (discussed in Chapter 10 of Volume 1), Pollack maintained that the presence of proteins in cytoplasm could have charge properties which induced water molecules to adhere to those proteins. As a result, the foregoing dynamics tend to create conditions that lead to the formation of "structured water" (involving the separation of charges) which has gel-like properties that are quite different from the properties that tend to be exhibited by what is called "bulk water" which is more aqueous-like and not gel-like in nature.

For example, structured water has properties and potentials which can be quite diverse in relation to the sorts of dynamics that it helps make possible under different circumstances. The capacity of different life forms to be able to resist the crystallization of water is one such possibility.

Pollack indicates that the force of water crystallization is considerable. In this regard, he notes that when people in the area where he lives know that the weather is about to turn freezing cold, they often put a few pieces of wood in backyard ponds so that the wood can absorb the force of water as the latter crystallizes during the freezing process and, thereby, the presence of the wood helps to prevent the concrete pond walls from having to absorb, by themselves,

the impact of expanding crystals during ice formation and, therefore, run the risk of cracking.

Moreover, although the presence of solutes in the cytoplasm of an organism can lower the temperature at which water will freeze by a few degrees and, thereby, provide some degree of protection for life forms when the latter are experiencing temperatures which are approaching freezing conditions, Pollack indicates that life forms, including many species of plants – as well as various other kinds of organisms -- are actually able to withstand much lower temperatures as a result of another consideration. More specifically, he indicates that some of the dynamics which occur in structured water under certain conditions enable plant cells to resist the formation of crystals when conditions fall well below freezing.

Pollack also indicates that structured water has the capacity to affect the diffusion of ions within cells. In his aforementioned book he provides an overview concerning a number of experiments which describe how localized concentration gradients can be established for -- among other solutes -- calcium, sodium, and potassium by inducing structured water to establish conditions that are able to restrain how those ions move about.

While the notion of structured water is intriguing, can one necessarily suppose that the entire interior of a cell consists of a gel-like medium? After all, in his 2013 book: *The Fourth Phase of Water*, Pollack does seem to indicate that bulk water and structured water exist in proximity to one another, but unlike bulk water, structured water has undergone a separation of charge due to the presence of certain kinds of surfaces (e.g., proteins) to which various bulk water molecules have begun to adhere and through the process of adherence, that water undergoes certain transitions in its physical and chemical properties which give rise to gel-like materials.

Perhaps, however, rather than cytoplasm being either aqueous or gel-like, it might exhibit both properties. Moreover, given the speed (often in pico-seconds or faster) with which many dynamics in the cytoplasm take place, one might wish to entertain the possibility that the interior of a cell is a constantly shifting set of events which are governed by different tipping points, and when appropriately triggered, will induce the formation of structured water with

specialized forms of dynamics, which, are, then, followed by the dissipation of those structures as surrounding conditions change due to other kinds of protein and ion seeds which are transported to that locale.

The time when those structured water units would form (recall Gilbert Ling's notion of nano-protoplasm units), and where they would form, and in what quantities they would form, as well as in what sequences they would form, and for how long they would remain in such a dynamic arrangement would be a function of the kinds of protein surfaces which are being introduced into the cytoplasm at any given point in time and space. Epigenetics describes aspects of the foregoing issues, but the hypothesis which has been advanced in this book is that epigenetics is a function of the way in which somatids transduce the organizing intelligence of Qi (prana-nur-qi).

Through gene expression, conditions can be created within cells which are conducive to the formation of structured water with varied sorts of properties due to the nature of the accompanying separation of electrical charge phenomenon which takes places during the formation of structured water. In addition, through gene expression, conditions can be created within cells which are conducive to the dissipation of the foregoing sorts of structured water dynamics, only to be followed, or replaced, by the formation of new instances of structured water accompanied by a form of charge separation which has different dynamic properties than the previous structured water dynamic might have exhibited.

Moreover, although the interior of cells might consist of constantly shifting transitions between bulk water and structured water, the situation near the exterior of a cell's surface could be different. For example, the cytoskeleton is present near the exterior of a cell, and it consists of a dynamic system of interacting proteins that are present in all cells (from bacteria and archaea to human beings) which not only provide cells with their shapes and provide instruments for mobility, but, as well, the cytoskeleton creates an environment which could be conducive to the emergence of both standing forms of structured water as well as be conducive to epigenetically induced conformational changes that might accommodate the formation of temporary channel-like passageways or pump-like dynamics within

the cytoskeleton and, perhaps, in conjunction with the exterior of the cell.

In other words, rather than positing the existence of more than a hundred different kinds of permanent channels or more than 50 varieties of permanently placed membrane pumps, the foregoing considerations offer what appears to be a simpler possibility. More specifically, epigenetic regulation of the proteins which are released into the region of the cytoskeleton and near to the exterior of the cell could induce various proteins in that region to either undergo different kinds of conformational changes, or, alternatively, could induce the assembly of an array of systems of structured water which punctuate different facets of the cytoskeleton – both of which might (individually or together) create channel-like formations and/or pump-like formations, which, subsequently become disassembled when induced to do so.

As Harold Hillman indicated in his research, the alleged tri-laminar character of the membrane might be an artifact of the methods which are used to create electron micrographs of cells. Alternatively, given that -- when living -- the nature of a cell seems to give expression to a constantly shifting set of phenomena, the tri-laminar-like structure that, traditionally, has been associated with cells might only constitute a static snap-shot of a dead entity that is unable to take into account the possibility that in a living cell such a tri-laminar-like structure is, at best, only one possibility among an array of possibilities in a constant sea of cytoplasmic change and, therefore, such a static depiction is misleading in the way it tends to give expression to the idea that the membrane matrix constitutes a specific kind of permanent structure (i.e., a tri-laminar one) and, consequently, would not reflect the continuously shifting dynamics involved in the assembly and disassembly of structures and shifting conformational forms which have been transpiring either along the exterior of a cell or in connection with the cytoskeleton which exists just inside that exterior when the cell is alive.

In short, there might be only certain conditions in which the exterior of a cell or organelle takes on a tri-laminar structure. For example, the foregoing sort of a structure might be typical for what tends to be manifested in cells at death, or in the throes of death, or

shortly following death -- sort of like a cellular counterpart to the condition of rigor mortis in human beings.

However, while living, cells are dynamic networks. Structured water is constantly emerging and dissipating according to the nature of the proteins which are being fed into the bulk water aspects of a cell, and the sorts of charge separation to which that structured water gives rise will shape the quantum dynamics which will characterize such structured water.

The exterior dynamics of a cell, as well as the, dynamics taking place in the cytoskeleton which exists just inside that exterior, also are undergoing a constant series of transactions taking place in time-frames which are pico-seconds or faster. All of the problems concerning various theories involving: Membranes, pumps, channels, ion separation, and cell integrity which have been explored by Gerald Pollack in *Cells, Gels, and the Engines of Life* can be addressed by the notion of a cellular dynamic that can be induced to shape-shift (internally and externally) according to life circumstances by means of the phenomena that are entailed by the formation of structured water dynamics in conjunction with the conformational changes which can be induced in proteins under different cellular conditions.

Among other possibilities, the foregoing dynamics give rise to the nano-protoplasm units and associated phenomena that were developed by Gilbert Ling. However, as intimated previously, both the work of Ling and Pollack seem to be missing a regulatory dimension.

More specifically, while both Ling and Pollack go into great – and, I believe, very important -- details concerning the physics and chemistry of what takes place in connection with the emergence of specific instances of structured water or the formation of particular kinds of nano-protoplasm units, nonetheless, there seems to be an absence of any understanding concerning whatever is responsible for regulating the sequential assembly and disassembly of structured water networks or the assembly and disassembly of various systems of nano-protoplasm units that collectively give expression to a functional organelle, cell, organ, or organism.

Epigenetics describes the dynamics of gene expression that provide the proteins which form the seeds for the formation of structured water or nano-protoplasm units. However, something more

deeply hidden seems to direct epigenetics to generate one kind of metabolic pathway rather than another kind of pathway in a given location at a given time and in a given sequence so that the properties of the structured water and conditions out of which nano-protoplasm units emerge in those conditions will have the right set of physical and chemical properties to underwrite functional, biological dynamics.

Structured water and nano-protoplasm units are modulated by epigenetic dynamics (as a result of the coherent, organizing intelligence of Qi, prana-nur-qi) which create conditions that not only direct the flow of energy in ways that counteract or resist or transcend the disorganized forces of thermal agitation within the cell but, also, are organized to run coherently (e.g., via the meridian system) throughout the organism. In addition, structured water and nano-protoplasm units are organized and regulated (again, as a result of the coherent, organizing intelligence of Qi, prana-nur-qi) to establish conditions which will be co-operatively receptive to the protein seeds which are provided by epigenetic dynamics, and, in the process, give expression to functional processes in different cell types or different tissue types or different organs.

According to Gerald Pollack, the phenomenon which is at the heart of all of the foregoing considerations is the notion of "phase transitions." This phenomenon can be described as a process in which cytoplasmic dynamics are shaped and modulated in response to different kinds of triggering, induction, or seeding processes.

Thus, changes in cellular: Temperature, the presence of different kinds of biochemical molecules, pH, electrical fields, ionic composition, and mechanical forms of stress, can lead to an array of transitions in a cell's cytoplasm. These changes don't necessarily have to be substantial in order to be consequential.

The foregoing sorts of changes can lead to transitions in the properties and dynamics in the region of cytoplasm where the aforementioned sorts of triggering, seeding, or induction processes take place. As a result of those triggering events: Chemical processes can be facilitated or retarded; charge separation among water molecules can take place; permeability properties can be affected; surfaces which are hydrophobic can be replaced by surfaces which are hydrophilic (or vice versa); conformational properties can be altered;

the flow of electrons can be shifted; solute dynamics can undergo changes; stability can transform into receptivity to change; some biological structures can be built or disassembled; molecules can interact with one another in different ways under the influence of whatever triggering or seeding process might be taking place.

Epigenetics is the process of seeding different regions of the cytoplasm with proteins which will induce or trigger phase transitions involving various biological properties in a given region. Those phase transitions are directed toward establishing functional metabolic pathways (both anabolic and catabolic) which will attend to the needs of the cell, or the needs of the tissue that is made from such cells, or the organs which are a function of cell-modulated tissue dynamics, or the organism which requires co-ordination among all the different types of cells, tissues, and organs.

Qi (prana-nur-qi) provides the organizing intelligence which sets in motion the precise epigenetic dynamics that are needed to control the way in which different cells will be seeded according to the conditions which exist in the region being seeded. Qi (prana-nur-qi) regulates the: When, where, what, how, length of time amounts, and sequences to which epigenetic dynamics give expression.

Chapter 21: Developmental Dynamics

Once researchers began to grasp that one hadn't necessarily garnered any insight into the actual way in which life worked despite knowing the identity of the proteins for which standard genes in the basic genome of an organism might code and once researchers began to understand that so-called "junk DNA" could be genetically parsed in an array of unpredictable ways which was capable of generating a litany of non-standard genes, some individuals started to consider the possibility that one's understanding of life might be improved if one could establish a better sense of how genes – both standard and non-standard – might be linked with one another. After all, genes seemed to give expression to nodes which were wired to one another in systematic ways, and if one could establish the nature of that connectivity or circuitry, then, one might acquire a greater insight into the nature of life.

Early on, one of the problems that were encountered when trying to pursue the foregoing kind of system or network approach to biology had to do with the realization that DNA did not always seem to be organized in a coherent fashion. In other words, rather than being aligned in sequences of DNA that were sequestered together in order to efficiently serve, when called upon, a common biological function in which each genetic component could, as needed, be read off in linear fashion from just one region of DNA, researchers discovered that various DNA elements that were needed to generate a given protein often were scattered about the biological system or network, and, so, one the questions which arose with respect to the dynamics of living organisms had to do with how do such entities manage to bring together the genetic elements which are needed to give expression to a particular protein.

For example, the promoter region of a gene which helps to initiate the transcription of a gene was often found near to the gene which was to be transcribed. Yet, there were enhancer elements necessary for the regulation of the transcription for such a gene that might be located thousands of base pairs distant from the either the gene that such elements were supposed to regulate as well as the promoter regions that were involved in the initiation of that gene's transcription.

The problems which pervaded the regulatory dynamics of gene expression often involved complexities that went beyond the separation of enhancer elements and promoter regions for a given gene to be able to be transcribed. Frequently, many different proteins might have to be brought together in a certain spatial and sequential arrangement within the context of a very small temporal window in order to make the transcription of a given gene possible.

For example, methyltransferase is an enzyme which has the capacity to connect a methyl group to different regions of DNA sequences. The location where a methyl group is attached to DNA can make a difference in the identity of the protein that will be expressed or how that protein will be expressed.

However, while methyltransferase might have the capacity to attach methyl groups to a region of DNA, it doesn't necessarily do so in a selective fashion. Consequently, the foregoing enzyme often needs assistance from other biological components to ensure that a methyl group is attached to the right section of DNA so that one kind of protein, rather than another, will be transcribed, or to ensure that a given protein will be expressed in one way rather than in another manner.

The foregoing sorts of dynamical complexity would appear to suggest that some kind of signaling or molecular communication is taking place in order to bring together the specific elements which are needed for the transcription of a gene: When those elements are needed, and where those elements are needed, and in what sequence they are needed, and in what amounts those elements are needed, and for what length of time they are needed. Nonetheless, even if one were able to figure out the identity of the signals or forms of molecular communication which are being used to co-ordinate transcription dynamics, one is still faced with the problem of determining what is triggering or regulating the release of those signals or different forms of molecular communication in such a tightly programmed fashion.

The aforementioned issues of communication become quite significant when one considers the degrees of freedom that often characterize the way in which macromolecules can interact with one another. For instance, many macromolecules might have no inherent selective preference for engaging other proteins or regions of DNA.

Yet, biological functioning tends to demand precision. Consequently, the natural promiscuity of many macromolecules has to be restrained in specific ways, and, therefore, those macromolecules need regulatory assistance to realize their constructive potential in any given set of biological transactions.

The degrees of freedom which tend to characterize the dynamics of many macromolecules actually have a heuristic dimension rather than necessarily being problematic in nature. More specifically, such degrees of freedom mean that provided the right sorts of regulatory considerations are in place, then, a given macromolecule can have an array of functional uses under a variety of conditions.

Of course, another side of the foregoing set of possibilities is also present. In other words, if something goes wrong with the regulatory dynamics which are needed to constrain the promiscuous dynamics of those macromolecules, then, biological problems of one kind or another could emerge because given their multi-directional dynamic inclinations, then, such macromolecules might begin to become involved in biological transactions with which they are not necessarily compatible.

Chromatin is a complex of proteins and DNA which constitutes dense, compact, and coiled structures. It is the biological form that gives expression to the different elements of an organism's genome prior to the time when the process of transcription takes place.

When chromatin is induced to begin to unravel, it is known as euchromatin. As it unravels, it becomes a mass of material which can bend and fold in a variety of directions.

Those bends and folds often assume the form of loops in which the promoter region for a given gene might be brought into proximity with enhancer elements for such a gene. These are enhancer elements which – as previously indicated -- might be located thousands of base pairs away from the promoter sequences when the two sets of sequences are packed within the yet-to-be unraveled chromatin.

Currently, researchers do not understand what factors are involved in inducing unraveled euchromatin to bend and loop in certain directions -- rather than in other possible directions -- so that promoter and enhancer regions match up together. Moreover, if a

given enhancer element regulates more than one gene, then, those genes – despite whatever base pair distances might separate them in chromatin – are often brought in close proximity to one another as well through the loops that form during the unraveling of chromatin.

Loops are established when two sections of chromatin are pinched together by means of a circular-like hoop known as cohesin. Cohesin consists of four proteins which can slide along an unraveled strand of DNA to make the loop smaller or larger.

The size of the foregoing loop functionally relies, at least to a degree, on the presence of another protein known as CCCTC-binding factor. As the foregoing name might tend to suggest, the named protein has a facility for linking to sections of DNA that have a CCCTC sequence of nucleic acids.

The aforementioned binding factor serves as a marker which signals that the protein hoop structure which is moving along a pinched stretch of unraveled euchromatin should stop at the indicated DNA designated sequence of CCCTC. In effect, it marks the place where an enhancer unit in the unraveled euchromatin will be exposed so that such a sequence will be in proximity to the promoter sequence in another part of the unraveled euchromatin that is involved with initiating the transcription of a given gene, and there are tens of thousands of these sorts of stop signs which populate an organism's chromatin sequences.

The foregoing process is sometimes more nuanced in the nature of its dynamics. More specifically, sometimes the CCCTC-binding factor is associated with the activation, rather than, suppression, of other enhancers which might be present.

In addition, the CCCTC-binding factor can be displaced from a given point of unraveling chromatin, and, once that factor has been removed, then, the unraveled euchromatin is able to re-configure itself in the form of other kinds of loops. The foregoing displacement process is induced by a bit of non-coding RNA known as "Jpx RNA."

Displacing CCCTC-binding factor through the presence of Jpx RNA is part of a process that activates a gene referred to as "Xist RNA." The activation of the latter gene plays a role in inactivating or silencing an X chromosome and its, roughly, 900 genes.

Furthermore, even when enhancers are placed in the proximity of given promoter sequences through the dynamics of, say, CCCTC-binding factors, there is no guarantee that subsequent steps will proceed without a hitch. Loops involve a certain amount of floppiness, and, therefore, there might be various co-factors or insulators which are required to help stabilize that floppiness or lend further precision to on-going dynamics.

In 2014 Erez Aiden, along with a number of colleagues, discovered that chromatin structures in human beings consisted of six sections or compartments. This structural arrangement seemed to be the same irrespective of the kind of cell one was studying.

Each of the foregoing sections shared a number of features. For instance, each section appeared to be characterized by a unique set of connective circuits, and, in addition, each compartment had its own way of epigenetically marking its DNA sequences for subsequent disposition.

Furthermore, within each of the six sections, there were a number of regions which consisted of DNA clusters mixed together with various other kinds of molecules. The DNA clusters contained approximately a million base pairs each.

The foregoing structures were termed TADs or topologically associating domains. The "topological association" component of the previous term just means that the densely packed DNA clusters and other kinds of molecules were contiguous to one another and, consequently, constituted a shared form of topological space.

Let's pause at this juncture and reflect a little on the foregoing descriptions concerning some of what happens when chromatin begins to be unraveled to form euchromatin whose DNA sequences form various kinds of loops. For example, let's consider what needs to happen in order for the foregoing set of dynamics to be able to unfold.

First, "something" has to induce chromatin to become unraveled into euchromatin loops. Then, "something" has to signal for the cohesin gene to be expressed.

Moreover, cohesin will have to be induced by "something" to pinch together specific parts of the looping sequences of unraveled euchromatin. As well, "something" has to direct the movement of

cohesin until it reaches the appropriate CCCTC stop sequence, and, then, whatever co-factors or insulators that are needed will have to be brought into play by "something" in order to provide additional specificity to the matching of enhancer sites with promoter sites.

If needed, "something" has to induce the CCCTC-binding factor to be able to disengage from its attachment to the foregoing DNA sequence. Furthermore, "something" has to induce unraveled loops of DNA to re-configure themselves in a manner that, when properly modulated, will bring certain enhancers and promoters in proximity to one another.

On occasion, "something" will have to call for the activation of the Xist RNA gene. "Something" also will have to induce that gene to displace a given CCCTC-binding factor.

What is the nature of the "something" that is presupposed by each of the foregoing sorts of dynamics? What is regulating those different kinds of dynamics to take place: At particular times, in particular places, in particular amounts, in particular sequences, for particular lengths of time, in conjunction – when necessary -- with particular co-factors or insulators, as well as with occasional displacements and reconfigurations?

What arranges for chromatin to be divisible into six compartments? What organizes the unique circuitry that operates within each of those compartments, and what regulates the unique set of epigenetic markers that are used to activate different genes within those compartments, and what arranges for a specific set of densely packed DNA clusters (consisting of around a million base pairs) and accompanying molecules to form different topologically associating domains (TADs) that are used for different biological functions?

What regulates the activities in each of those six compartments? What regulates the way, or extent to which, those six compartments interact with or co-operate with one another?

All of the foregoing regulated dynamics are transpiring in unique ways in the more than 200 cell types which exist in human beings. What is regulating all that uniqueness in those more than 200 types of cells, and what is regulating the way in which such differentiated

uniqueness is coordinated to give expression to a functioning biological organism?

Moreover, let us keep in mind that notwithstanding the considerable complexity which is entailed by all of the foregoing theaters of activity, together with the regulatory dynamics which govern such activity, nonetheless, only a few kinds of genes and proteins and dynamics have been mentioned in the descriptions that preceded the current set of reflections on those descriptions. Some 80 to 90 thousand proteins have been identified in human beings, and, therefore, different kinds of regulatory activities will be required to govern the activation and activities of each of those 80-90 thousand proteins.

A fair amount is known that can be used to describe various aspects of the character of different kinds of dynamics that take place in human beings or other organisms. Yet, almost nothing is known about the "something" that regulates those dynamics.

Epigenetics doesn't regulate those dynamics. Rather, epigenetics is a description which ensues from, and is made possible by, such regulatory dynamics.

Although transcription factors are often known as epigenetic transcription factors, nevertheless, the epigenetic dimension of those transcription factors refers to what might be considered to be a biological version of an "after action report." In other words, epigenetics describes the forms which regulatory action takes, but epigenetics does not explain why particular forms of regulatory action were taken or made possible at given times, places, amounts, and sequences.

DNA does not account for such regulatory activity. Furthermore, based on the exploratory discussions pursued in previous chapters of the present book, cellular dynamics do not seem to account for such regulatory activity either.

Moreover, various kinds of biological networks – such as compartmentalized chromatin sections – do not seem to be able to explain the regulatory dynamics which govern those networks. Instead, the forces and entities that are used to describe those sorts of networks appear to be, themselves, in need of explanation.

Biological development is a staged-process through which increasingly specialized capabilities replace more generalized capacities that have degrees of freedom which tend to be absent from their more specialized descendents. How these degrees of freedom tend to become lost over the course of development is a fairly complex mystery.

During the late 1930s, early 1940s, Conrad Waddington was seeking to find a way to add nuance to neo-Darwinian biology by trying to integrate elements of developmental dynamics to the standard theory of that time. He introduced the term: "epigenetic landscape" to refer to the manner in which cell differentiation branched out from a common starting point.

In addition, he also used the term: "canalization." The idea to which this latter term gave expression concerned the manner in which species-specific phenotypes (the physical instantiation of genotypic possibilities) managed to exhibit a set of similar features despite having had to journey through variations that were entailed by environmental and genetic dynamics.

The epigenetic landscape gives expression to a chaotic attractor in which modalities of canalization become the species-specific manifestations that eventually surfaced. Dynamics which, initially, seemed chaotic always seemed to lead to the emergence of determinate, somewhat predictable results that were self-similar (rather than self-same) in nature.

Thus, a zygote, or fertilized egg, appears at the top of a mountain of life which has been formed by a cataclysmic-like biological event that has merged remnants of two other mountains of life. The foregoing, combinatoric potential is said to be totipotent, which means that such a cell has the capacity to develop into a mature, species-specific adult organism by means of a sub-set of cellular capacities that are able to give rise to every type of cell which characterizes and goes into the formation of such a mature adult.

Totipotency has been described as giving expression to a state of symmetry. In other words, a biological condition exists which has the capacity to travel in what seem to be like equally-probable developmental directions but has not, yet, showed an inclination to move in one developmental direction rather than another.

At a given point in time, however, “something” breaks the foregoing symmetry. What the nature of this “something” might be is currently unknown.

The foregoing process of symmetry-breaking leads to the formation of a structure that is pluripotent and, therefore, not only capable of giving rise to all of the different types of cellular tissue which will constitute an adult form of human being but, as well, such a pluripotent cell is able to give rise to whatever is needed to support the differentiated unpacking of cell types. To some extent, pluripotency is a slightly narrowed-down form of totipotency.

Pluripotency has its own form of symmetry-like qualities. Yet, once again, “something” of an unknown nature intervenes and breaks that symmetry-like condition by pushing development (through an unknown regulatory dynamic) toward the formation of: (a) the trophoblast (formerly known as the blastocyst which is a precursor to the formation of the placenta that, among other things, connects the developing life form to the uterus of the mother); (b) the hypoblast (from which the yolk sac will arise), and (c) the epiblast (out of which the endoderm, mesoderm, and ectoderm will assume differentiated form).

In turn, the endoderm will differentially transition into cell lines that will form the lungs and gut, while cell lines that will underwrite the formation of the heart, muscles, and kidneys will be induced to emerge from the mesoderm, and, finally, neuronal and epidermal cell lines will differentially issue forth from the ectoderm. “Something” of an unknown nature regulates the dynamics of differentiation that take place in the endoderm, mesoderm, and ectoderm which pushes cell lines in determinate directions.

The developmental process starts with a specific collection of genetic materials. With each step of differentiation, the foregoing collection of genetic materials remains the same, and, yet, “something” is inducing an array of cellular differentiations to take place at certain times by initiating processes that parse the genetic materials in ways which give expression to cell lines in which much of the genetic material has been silenced while other aspects of that same genetic material has been selected for expression.

In a sense, each juncture of specialized differentiation represents a form of canalization within the general epigenetic landscape. Over the course of development, there is a successive unfolding of specialized expressions of canalizations … canalizations emerging out of canalizations.

Indeterminate events and environmental variables will uniquely tag and demarcate the foregoing processes of canalization. Yet, setting aside pathogenic considerations of various kinds, none of the aforementioned events or variables can prevent successive forms of canalization from taking place and which, subsequently, will characterize the overt epigenetic landscape of an individual's developmental life process.

Many facets of the foregoing developmental process can be described in considerable detail. Nevertheless, almost nothing is known about the nature of the mysterious "something" which initiates and regulates the various stages of differentiation that can be described.

What, if anything, do the previously discussed somatids of Naessens or the bions of Reich, or the endobionts of Enderlein, or the microzymas of Béchamp have to do with the processes of developmental differentiation? Naessens was quite clear that each kind of cell and life form had its own, unique set of somatids, so how – or does – that uniqueness fit into the process of cell line differentiation in various organisms?

What, if anything, does the organizing intelligence of Qi (prana-nur-qi) have to do with the process of cellular differentiation? Is Qi (prana-nur-qi) the mysterious "something" which is responsible for regulating the dynamics of differentiation?

While there might be theoretical aspects which are woven through notions such as: microzymas, endobionts, bions, somatids, and Qi (prana-nur-qi), nonetheless, all of the foregoing notions are rooted in a great deal of empirical evidence and experimental research. To fail to sincerely consider, rigorously explore, and critically reflect on those historically rooted possibilities seems to resonate rather strongly with the resistance that the church bishops were alleged to have exhibited when invited to look at aspects of reality through use of the telescope that was being offered to them by Galileo.

For many years, researchers believed that once cells differentiated into, or committed to, a specific cell type (for example, kidney, heart, or liver), then, those cell types could not re-acquire the pluripotency which had been present at an earlier stage of development. Those sorts of beliefs began to change somewhat during the 1960s when experimental work showed how cells that contained genes which had been shut down previously during a given stage of differentiation could be induced to, once again, become active.

Some 40 years later, toward the beginning of the 21st century, two biologists – Kazutoshi Takahashi and Shinya Yamanaka – discovered that if one inserted certain genes into cells that had undergone some degree of differentiation, then, those differentiated cells could be induced to revert to a former pluripotent state. The genes used in the foregoing transformation came from active stem cells, and while there are different modalities of genes which have relevancy to the condition of pluripotency, nevertheless, the two aforementioned Japanese researchers found that could affect a reversion from differentiated specialization back to a state of pluripotency by using only four genes.

The four genes that the two biologists discovered had been assigned the monikers of: Sox2, Oct4, Klf4, and c-Myc. Each of the foregoing genes encodes molecules that serve as transcription factors, and by adding those four genes to a cell, the transcriptional dynamics of a cell could be reset to a previous state of pluripotency.

Despite the sophistication present in the foregoing methodological considerations, nevertheless, none of what the two previously noted Japanese biological researchers had discovered actually disclosed the identity of whatever it is that induces certain genes (along with other components) to be selected for transcription at a particular stage of developmental dynamics. In effect, what those two scientists were doing was to serve as stand-ins for an otherwise mysterious "something" which -- under natural, non-experimental circumstances – brought about the expression of transcription factors that helped to establish a condition of pluripotency.

Presumably, those two individuals had to carefully control various aspects of their experimental process. More specifically, they had to discover and select the right kinds of genes to be used in their experiment, and they had to induce those genes to be expressed in

certain ways, and they had to conduct such an induction process according to a given set of conditions, and they had to ensure that the timing, amounts, and sequences that were needed for the genes to complete their tasks were properly established.

For example, Kunihiko Kaneko, a specialist in complex systems, has shown that if reprogramming techniques are to work, then, they must abide by certain principles. More specifically, he -- along with several other researchers – have indicated that expression levels of Yamanaka factors (i.e., Sox2, Oct4, Klf4, and c-Myc) affect the oscillatory dynamics of such reprogramming ventures, and unless those dynamics are managed properly, then, the reprogramming process might not be able to prevent certain kinds of epigenetic events from taking place that incline a system toward differentiation rather than pluripotency.

In effect, Takahashi and Yamanaka have been engaging in a bit of reverse engineering. In other words, based on their study of that which could be observed in relation to what happens in natural processes of cellular differentiation, they were able to discover a recipe which, when properly followed, gave expression to the requisite steps that induced a condition of pluripotency.

However, if one removes the two, foregoing scientists from the picture, then, what is the identity of that which would be setting in motion the necessary dynamics for the emergence of a condition of pluripotency in actual life that the two researchers were doing in their experiment? Something else other than the two scientists would have to be exercising the regulatory oversight which is needed to make the phenomenon of pluripotency possible.

The two aforementioned individuals were not inventing pluripotency. They were, in a sense, plagiarizing, or borrowing from, the original work of “something” else, and by saying things in this way, I am not trying to minimize their scientific accomplishment.

The foregoing combination of four genes that are linked to transcription factors -- which, initially, were added to fibroblast cells from mice and, then, subsequently, to human somatic cells -- became part of pre-programmed packages known as: iPSCs, or “induced pluripotent stem cells”. Various kinds of cells can now be grown in cultures that contain “Yamanaka factors” (such as: Sox2, Oct4, Klf4,

and c-Myc) which have the capacity to induce those cultured cells to become transformed into iPSCs, and, then, by modulating the latter cells in various ways, those cultured cells can be differentiated or specialized in whatever direction one likes.

Nevertheless, notwithstanding all of the substantial scientific accomplishment which is present in the foregoing research, perhaps, once again, we need to remind ourselves that a fundamental dynamic concerning pluripotency and differentiation continues to remain a steadfast mystery. In other words, we still don't know what the nature of the "something" is which establishes pluripotency in natural cells to begin with, and – absent the presence of scientists -- we don't know what regulates the processes which shut down some lines of gene expression while opening up other lines of gene expression during any given stage of cellular differentiation or specialization.

In time, certain aspects of the methodological procedures employed by Takahashi and Yamanaka were updated. Currently, microRNAs are used to reprogram differentiated cells to return to being pluripotent stem cells.

MicroRNA structures usually are between 21-23 nucleotides in length. They are non-coding (i.e., they don't code for proteins), single-stranded molecules that can be found in animals and plants and which are involved in the post-transcriptional regulation of gene expression.

The foregoing sorts of short nucleotides have been discovered to be capable of directly reprogramming cells so that one cell-type can be transitioned into another cell-type. Such capabilities have been applied to various modalities of regenerative medicine as well as aspects of synthetic biology.

While microRNAs can be used to reprogram differentiated cells and transition the latter to conditions of pluripotency, such short, single-stranded sequences of nucleotides might not necessarily have anything to do with how cells naturally go about establishing pluripotency. However, even if microRNAs were to have such roles within natural (non-experimental) circumstances, once again, we do not know the nature of the "something" that calls upon those molecules to be activated in the wild, so to speak.

Some researchers (e.g., Richard Watson, a computer scientist from England) have spoken of the computer-like computational power of cells. Such individuals indicate that cells have a primitive sort of awareness concerning various aspects of their own internal environments as well as properties which characterize the environments in which they reside, and, as a result, they have a certain minimal capacity to engage in continuous processes directed toward: Sensing, identifying, assessing, and responding to events which are taking place within and without the cell – activities that, allegedly, require computational skills of one kind or another.

The foregoing overview gives expression to a theory or model concerning what some people maintain is taking place within cells. However, just as DNA cannot be shown to have any capacity to direct itself, so too, whether cells have any of the self-directing or self-organizing computational properties that some individuals have been attributing to them is far from having been confirmed.

For example, while some individuals might suppose that, on the basis of observed biological dynamics, cells seem to be exhibiting capacities involving "decisions" of some kind concerning the institution of cellular differentiation processes in response to environmental conditions, nevertheless, no one has been able to identify the nature of the specific dynamics which would be needed to make those sorts of alleged computational capabilities possible in a cell. Cellular activity is being engaged through the lenses and filters of a theoretical framework that might be projecting the properties of such theories onto that which is being observed.

"Something" associated with cells might be engaging in dynamics that are computational-like. However, the appearance of computational-like processes does not necessarily make those dynamics computational in nature because there might be other ways of reaching the same sort of answer which is non-computational in nature (for instance, is "insight" necessarily a function of computations?).

Moreover, "something" associated with cells might have sensitivity to, and awareness of, changes in the internal and external environments of cells, and, in addition, "something" associated with

cells might be engaged in inducing various processes of differentiation. Nonetheless, whatever that "something" is, the cells with which that "something" is associated might just constitute biological tool-chests through which that "something" operates -- just as DNA might serve as a biological tool chest through which that "something" might operate – and, if this is the case, then, "something" other than cells might be regulating what is transpiring within, and through, cells.

Somatids have been experimentally demonstrated to be associated with cells of many – perhaps every -- type. Whether, or not, the regulatory dynamics concerning cellular functioning that are being alluded to by the term "something" turn out to be a function of somatid dynamics (which might, or might not, transduce the organizational intelligence of Qi = prana-nur-qi = into the functionality of cells) remains an open question, and this will continue to remain an open question until the research that was started by Béchamp, Enderlein, Rife, Reich, Naessens and various other individuals begins to be rigorously and sincerely pursued further than already has been the case.

Putting aside the foregoing considerations, let's return to some embryological considerations. As indicated earlier in this chapter, during one of the earliest stages of development, a blastocyst (in mammals) is constructed from a single layer of trophoblast cells which assumes the form of a hollow sphere.

The foregoing hollow cell will soon become home to a community of pluripotent cells. This assembly of pluripotency is referred to as the "inner cell mass."

The ICM is sandwiched between two compartmental structures. On one side of the ICM is a cavity waiting to become the yolk sac, while, on the other side of the ICM, is the trophoblast.

At a certain juncture, the ICM transitions into two sets of cellular potentials. One set of cells will become the hypoblast, and those cells will be dispersed to form a cavity in which the yolk sack will become realized, and the second set of ICM cells will go on to form the epiblast which will serve as the seed for the formation of the fetus, beginning with the compartmentalization process that, first, generates the endoderm, mesoderm, and ectoderm, which, then, each branch out into different organ systems.

The formation of the epiblast takes place in a way that opens up space in the embryo above the epiblast, and this spatial opening will lead to the formation of a compartment that will become the amniotic sac. At this stage of things, the epiblast and hypoblast assume the shape of a disk which is positioned between the amniotic sac, above that disk, while the yolk sac is below that disk.

Part of the foregoing increase in complexity involves the first inklings of a future body plan that is manifested in the form of a body axis structure known as the primitive streak. This takes place at around the two week mark.

The primitive streak begins its journey as seemingly nothing more than a fold in the tissue which is forming in the epiblast. Eventually, the aforementioned primitive streak will transition into a system out of which, on the one hand, structures such as the mouth, gut, and anus will emerge, and, on the other hand, an orienting axis for the future spinal column and central nervous system also will form.

Gastrulation takes place in the third week of human development. During this embryological phase, the embryo transitions from a single layer of cells to a multilayered complex of cells in which the blastocyst is transformed into a much more complex structure known as the "gastrula."

Due to the central importance of the gastrulation process in human development, medical/ethical/legal limits have been placed on how deep into the gastrulation process research can be conducted in conjunction with human beings. Currently, the aspects of the human developmental period which can be researched in invasive ways is limited to approximately fourteen days, and, consequently, much of what is known about the dynamics of gastrulation is based on animal studies – especially mice – and, consequently, assumptions have to be made which presume there are likely to be many similarities between the nature of gastrulation events in mice and the characteristics of such development in human beings.

While some of the foregoing assumptions concerning possible similarities in developmental dynamics between other forms of life and human beings might turn out to be correct, some of those assumptions will be wrong. If this were not the case, then, human beings should develop into mice or chickens, and since they don't, one

realizes that whatever similarities might exist between experimental animals and human being, nevertheless, there are likely to be an array of substantial differences as well.

Based on experimental and clinical data which has been drawn from a variety of sources, the epiblast-hypoblast disk must undergo a process of differentiation if the primitive streak is to emerge. As I result, certain cells toward the center of the disk begin to transform.

The Hex gene is induced to be expressed during this stage of things. Once differentiated, the foregoing cells begin to move (crawl?) across other cells which, previously, had been neighbors and the former cells travel toward the edge of the disk (and, apparently, which edge of the disk will serve as the terminal point for such a journey is irrelevant as long as all of the Hex-affiliated cells stay together.).

The collective movement of the foregoing cells will eventually end up along the edge of one side of the disc. Once those cells arrive at the edge of the disk, epiblast cells on the other side of the disk will begin to construct the primitive streak which will be extended along a line toward the center of the epiblast.

A number of "usual suspects" genes – such as Wnt and Nodal – begin to be expressed during this stage of the developmental process. These genes produce components which have various kinds of regulatory roles.

When the foregoing sort of developmental dust has settled, a form of polarity has emerged in the embryo. Anterior and posterior regions have been established.

As the primitive streak grows, a deformation in the disk emerges (possibly from the weight of the growth process, but the node might be due to some other kind of dynamic). As the deformation or node develops, genes are expressed, some of which constitute transcription factors of one kind or another.

Some of the foregoing transcription factors are involved in the silencing of a gene which expresses a protein known as "E-cadherin." This latter molecule plays a role in helping cells to adhere to one another, and, consequently, one can regulate whether, or not, cells will stick to one another or be free to go their own way by, respectively, switching this gene on or off.

The process of going from sticky to non-sticky cellular forms of interaction was discussed earlier in this book. It is known as the epithelial-mesenchymal transition.

When the gene expressing E-cadherin is silenced, cells are able to disengage from their neighbors. At certain points during the formation of the primitive streak, that gene is turned off, and, as a result, certain cells begin to emigrate from the epiblast and, subsequently, form other communities or layers of cells such as the ectoderm, mesoderm, and endoderm.

The foregoing several pages provide a fairly detailed description of some of the early stages of embryological development. Yet, a great deal is missing from that description.

For instance, what has induced the trophoblast cells to assume the form of a hollow structure that is lined with a single-layer of cells? How did the cells which form the Inner Cell Mass acquire their pluripotency and why did they become assembled between the trophoblast and the yolk sac?

What induced one set of cells in the Inner Cell Mass to form the hypoblast that will become the yolk sac, while the other set of ICMs differentiated into the epiblast from which the fetus will arise? What determines which set of cells is selected for each kind of differentiation process?

What induces he Hex gene to be expressed at a certain time, place, and in certain amounts? What inclines Hex-expressing-cells to stay together?

What induces the foregoing epiblast cells to form in such a way that a cavity or compartment is created that will house the amniotic sac above the epiblast disk? Presumably, the foregoing cavity-making events cannot be attributed to random factors since the formation of the amniotic sac occurs in the same way again and again, and, consequently, one might infer that whatever is inducing the epiblast cells to aggregate in the way they do also might be advancing a set of modulating forces which simultaneously are helping to shape the amniotic sac.

What initiates and regulates the formation of the gastrula? What initiates and regulates the formation of the primitive streak along with

the formation of an axial structure that will help to orient the spinal column and central nervous system?

What induces certain hypoblast cells to begin moving toward the edge of the epiblast-hypoblast disk? How do those cells "know" where they are going and what induces such cellular activity?

How do the epiblast cells on the other side of the aforementioned disk "know" that one component of a polarity has been established on the opposite side, and, therefore, begin to construct the primitive streak. Why is the primitive streak constructed in the direction of the center of the disk?

What determines whether, or not, the gene expressing E-cadherin (which helps to regulate the way cells adhere to one another) will be silenced in any given set of circumstances? What "knows" when such a gene should be turned on or off in particular cells?

How do the cells which have undergone the epithelial-mesenchymal transition -- and, therefore, have been set free to disengage from one another -- "know" when to differentiate and where they are going to form endoderm, mesoderm, and ectoderm layers of cells?

What determines that endoderm cells should differentiate into lung and gut systems rather than the muscle, heart, kidney organ branches of the mesoderm or the skin and neuron systems of the ectoderm? How are cells selected within the endoderm, the mesoderm and the ectoderm for differentiating into one kind of organ system rather than another?

"Something" is regulating all of the foregoing: Dynamics; compartmentalization processes; sequences of gene expression or silencing; releases of transcription factors; specializations; constructions, and movements. "Something" is initiating and regulating the expression of various kinds of relevant genes and transcription factors at the right time, in the right place, in the right amounts, and in the right sequences.

However, the foregoing descriptions that concerns the formation of the primitive streak/spinal column or which deals with the transition from the blastocyst to the gastrula do not really explain much of anything in terms of what is actually regulating those

developmental transitions and transformations. That which results or emerges from such regulatory activity is described, and, yet, the nature of the regulatory "something" which communicates, initiates, shapes, positions, moves, and terminates the results that are being described is absent from the description and, consequently, alludes to something more deeply hidden.

Transcription factors and the proteins which arise from the activation of genes can all be named. Nonetheless, that which has initiating and regulatory oversight in relation to those factors, proteins, and genes remains unknown.

To claim – as many researchers do – that the foregoing dynamics and phenomena are a function of the collective efforts of many cells interacting with one another and communicating with each other in order to be able to create the conditions which naturally lead, in a self-organizing fashion, to the next stage of development is not really an explanation. It is a narrative from which critical dimensions are missing … missing dimensions which are tantamount to saying that cellular and developmental activities -- like dominos – organize themselves to fall in particular patterns of emerging dynamics.

Nothing to see here folks! Just move along!

One can peruse any aspect of embryological development one cares to consider, and the same sort of bifurcation exists. In short, there is a polarity which runs from, on the one hand, a variety of surface features that can be described in considerable detail and, on the other hand, a more deeply hidden "something" which is responsible for the existence of what is being described and is responsible for those described components and processes having the properties and characteristics that they do but whatever that "something" is, its nature appears to fall beyond the horizons of current descriptive capabilities and understandings.

<u>Chapter 22:</u> Chronobiological Considerations

Jeremy Campbell indicates (*Winston Churchill's Afternoon Nap*) that Einstein wanted to remove time and space from their traditional metaphysical pedestal of unchanging absoluteness. As a result, one effect of the theory of general relativity was to try to physicalize space and time, and, consequently, time and space became fluctuating components of physical reality which, supposedly, enabled the dimensions of space and time to enter into material-like interactions with other material facets of the universe.

Moreover, just as time was allegedly physicalized through the relativistic efforts of Einstein, Campbell contends time has been "biologized and psychologized" due to research that has been conducted throughout the twentieth century. According to Campbell, biologists have been discovering data which suggests that biological clocks seem to be affected by the conditions of life which surround those clocks.

When Einstein sought to physicalize space and, especially, time, he was continuing, as well as transforming, a process that had been popularized by Galileo (though this process did not begin with the latter individual). More specifically, Galileo treated time as a continuous and uniform entity that could be represented by a straight line. Thus, time was construed in a spatialized manner within a mathematical framework.

As such, time came to be treated as if it were a fourth spatial direction that is continuous in the same way that space is supposed to be continuous. Thus, both space and time were alleged to consist of an infinite number of points, all of which could be mapped on to the real number line.

Consequently, the modern conception of time has departed rather substantially from the idea of time that had prevailed for nearly 2000 years. In the traditional view, time – whatever it might be -- was used to serve as some sort of absolute master clock that was independent from all of physical/material reality, but, today, time has become, for many individuals, just another component of the physical world that is capable of fluctuating under a variety of conditions.

However, all of these changes in the way in which time is, and has been, conceived could be more of a reflection in the way through which time is methodologically engaged than those changes in understanding are necessarily an accurate reflection of the structural character, or actual ontology, of time. In other words, what really might have changed during the last 500, or so, years is the way in which time has been methodologically engaged, represented, and described.

These transitions in representational methodology have led to comparable transformations in the way that time is conceptualized. As indicated previously, however, none of those changes necessarily has much capacity to provide us with any insight into the actual ontological nature of time.

Organisms are not only oriented in space, they also are oriented in time. Chronobiology is the science that studies the role which the dimension of time has in biological functioning.

A great deal of experimental research over the past century suggests that virtually all species – if not all species – have the capacity to give expression to a variety of temporal rhythms. These rhythms regulate different facets of biological processes in those species, including how frequently different types of cells undergo turnover or replacement as well as how a given species interacts with its ecological surroundings.

For example, consider animals that live in burrows. Such animals have an internal, biological clock that is entrained by the temporal rhythm of alternating patterns of night and day.

Entrainment is a form of frequency-following behavior. In other words, certain biological dynamics in an organism begin to operate in accordance with the cyclical rhythms of day and night.

Each day, the internal, biological clocks of the aforementioned animals are reset to reflect the changing relationship of the ratio of daylight hours relative to nighttime hours. Some of these burrow animals are nocturnal in behavior, and some of them are not, but in either case, the process of waking up involves a number of factors which interact to initiate such a process.

There is considerable uncertainty surrounding how much of the foregoing sort of entrainment process is (1) a function of some sort of learned behavior and how much of that process is (2) a function of the inherent inclination of an organism's biological dynamics to be sensitive to, and receptive to being shaped by, such rhythms. We know that entrainment takes place, but we do not necessarily have a clear understanding of what regulates such an entrainment process.

Franz Halberg introduced the term circadian rhythm to describe instances of temporal entrainment -- such as in the case of the burrow animals mentioned above -- which are rooted in a period lasting roughly one day. Alternating cycles of day and night act as a zeitgeber or 'time giver' that is connected, in yet-to-be-determined ways, to biological processes in an organism which interact with the temporal aspects of such an external set of conditions to set their circadian biological clock.

When an organism becomes disentrained -- that is, when an organism is unable to make contact with the temporal frame of reference provided by the relevant zeitgeber (in this case, the alternating cycle of day and night), such a disentrained organism will operate on the basis of processes which are inherent in its internal capacity to create temporal frames of reference. This clock -- left on its own without any external standard through which it can be assisted to recalibrate -- will run either somewhat longer than a 24-hour period, or somewhat shorter than a 24-hour period.

What the nature of the dynamics are which are inherent in an organism's capacity to create a temporal frame of reference independent of external cues is, if at all, poorly understood. What regulates the processes which determine whether those cycles will be slightly more than, or slightly less than, a 24 hour period is not known.

Organisms entrained by various kinds of temporal rhythms, of which circadian rhythms are but one example, do more than just reset their internal clocks to synchronize with various rhythms of the external world. Entrainment means virtually every biological process that goes on in a given organism will have determinate phase relationships with events occurring both in other parts of the body, as well as in various aspects of the external world.

The foregoing sorts of phase relationships give expression to the aspects of a given cycle (in this case a biological cycle) which is being manifested at a given point in time in its relationship with other kinds of physical (e.g., the sun rising and setting) and biological cycles (e.g., separate dynamics that are taking place simultaneously with, or in conjunction with, such circadian rhythms). Behavior can be a complex function of an interacting set of such cyclical phase relationships that come together to help shape (although not necessarily completely) the nature of such behavior

The phenomenon of diapause is an example of how the behavior of an organism can be governed by the phase relationships that are established through the manner in which such biological clocks establish cyclical modalities of dynamics involving various properties of the external world. Diapause refers to a period of inactivity or quiescence which is exhibited by many organisms (e.g., insects) during periods of detrimental weather conditions, such as drought or winter weather.

However, the preliminary stages of diapause occur much in advance of the forthcoming, adverse weather conditions. Activities such as the storing of food or the building of shelters are steps that are preparatory in nature and seem to take place independently of any overt, specific stimuli of drought or cold or snow.

The foregoing preparatory activity is an expression of the phase relationships that exist among: (a) certain biological clocks of an organism; (b) various motor systems in that organism; (c) the changing ratio of sunlight to nighttime, and (d) the degree of awareness or understanding in an organism concerning changing circumstances, both internal as well as external. As the character of these phase relationships changes, behavioral patterns emerge that are preparatory to a later set of phase relationships which constitute diapause proper -- that is, an actual period of quiescence.

Since bad weather is not necessarily a cyclical process, one cannot suppose that preparing for bad weather and the onset of diapause is something which is entirely innate. Presumably, elements of learning are involved, but not much is known about how, for example, an insect becomes sufficiently sensitive to indications that bad weather is on the

way so that behavioral dynamics can be activated which lead to preparations for the onset of a forthcoming episode of diapause.

Therefore, biological clocks are part of a system that enables an organism to grasp (although not necessarily on a conscious level or in a self-reflexive manner) the character of a changing set of phase relationships in the dialectic between organism and environment. In a sense, there is an entrainment process in which certain properties of temporality are internalized and/or activated, and these internalized and/or activated features have the effect of inducing an organism to act within a framework which is shaped, to varying degrees, by such an entrainment process.

In effect, an organism possesses a spectrum of ratios of constraints and degrees of freedom of various kinds which govern biological dynamics as well as the behavior which is a function of those dynamics. This spectrum establishes -- under appropriate circumstances -- a set of parameters within which, and through which an organism is capable of responding by means of a complex set of dialectical modalities of interaction with the environment.

Data concerning phase properties might be exchanged between the organism and the environment during the foregoing sorts of zeitgeber entrainment processes. Moreover, the effect of this exchange of phase properties might bring about transitions in different aspects of an organism's spectrum of ratios involving degrees of freedom and constraints that might be manifested in certain kinds of entrainment behavior.

The foregoing transitions might be principle-governed rather than rule-governed. Biological principles and biological rules are ways of referring to the character of the ratios of biological constraints and degrees of freedom that help to govern behavior, as well as that help to govern what makes a given ratio of constraints and degrees of freedom, or set of such ratios possible.

Possible behavioral rules and principles are both associated with what are known as “attractor basins”. Attractor basins give expression to the tendency of a dynamic system or network to be inclined toward one kind of activity rather than another kind of activity as a function of the way that system’s ratio of biological degrees of freedom and degrees of constraint interact with a given set of conditions.

Such attractor basins could be either linear or chaotic in nature. Behavioral rules, when they are manifested, tend to be associated with linear attractors, and, as a result, these sorts of dynamics are fairly, narrowly defined and do not permit much, if any, deviation from the scope of the behavioral parameters that describe such a biological rule (i.e.,, they tend to be self-same – repetitive -- in their manifested properties).

Biological principles, on the other hand, establish a dynamic context which allows for a far more sweeping range of possibilities that -- while determinate in character (and, therefore, not random) -- are not always predictable. Many of these sorts of possibilities are self-similar (in Wittgenstein's sense of bearing a family resemblance to one another), rather than being self-same (i.e., repetitive) in character.

Consequently, biological principles are capable of being receptive to, as well as capable of responding to, nuances and variations that fall beyond the largely linear horizons of a biological rule. Thus, the self-similar possibilities of biological principles are complex functions of the structural parameters of the chaotic attractors to which they give expression.

The biological principle(s) inherent in a given biological clock form an attractor basin that is sensitive to, and shaped by, certain kinds of phase properties being relayed to the basin(s) as a result of the organism's engagement of, and engagement by, different aspects of the environment. In other words, the presence of certain kinds of phase relationships induces shifts or transitions in the way the attractor basin/principle gives expression to itself in the form of certain kinds of cyclical behavior.

Subsequent behavior that is generated in, or that is colored by, such an attractor basin, will conform to the parameters of biological constraints and degrees of freedom that have been established by means of the entrainment process which helps to activate such a principle/attractor basin. Moreover, since the activated attractor basin/principle is sensitive to, and shaped by, the changing character of the phase relationships in the dialectic between organism and the environment, those behavioral patterns that are influenced by such an attractor basin dynamic will reflect the shifts in those phase relationship properties.

In short, certain aspects of an organism's behavior become entrained by transitions in the way the phase relationships between environment and organism interact with one another. Depending on the nature of those phase relationships, biological rules or biological principles will be established and set in motion. As a result, behavior will be affected according to the nature of the dialectical engagement that is taking place between organism and environment.

The foregoing attractor basins – irrespective of whether they are connected to biological rules or biological principles as well as irrespective of the linear or chaotic dynamics to which those attractor basins give expression -- can often be described by means of molecular communication of one kind or another (and a few examples will be discussed shortly). However, such descriptions do not necessarily provide an account which explains why various kinds of temporal entrainment are regulated in the way they are.

Consequently, while the molecules which are present in the dynamics of biological communication can be used to describe some of what is taking place in an organism, nevertheless, mentioning those molecules and showing some of the ways in which they work together doesn't necessarily explain what is regulating their dynamics. In a sense, one might have some degree of semantics concerning molecular communication without any syntax which can enable one to understand how such semantics is being generated.

A number of questions arise in conjunction with the foregoing considerations. For example, why are some frequencies followed by an organism and not others? What sensitizes an organism to some frequencies and not others? What enables an organism to recognize and be sensitized to certain entrainment dynamics? How are these entrainment dynamics integrated with the rest of an organism's biological terrain?

In the early 1970s, a certain amount of excitement was generated when a number of biologists believed they had discovered a master biological clock. Such a clock is supposed to be autonomous as well as independent of all external, temporal cues, and, in addition, a master biological clock is theorized to be responsible for generating all the different rhythms of the body.

The would-be master clock discovered in the 1970s is located in the frontal portion of the hypothalamus. It consists of several clusters of cell groups that have become linked during the course of development, and the technical term for these coupled cell clusters is suprachiasmatic nucleus -- or, SCN, for short.

Two properties, in particular, of the SCN seemed to enhance its attractiveness as a candidate for the master clock. First of all, the coupled cells of the SCN displayed a great deal of oscillatory activity, and oscillatory behavior is something one would expect to observe in any candidate for a master clock since the clock is responsible for regulating a wide variety of rhythmic patterns.

Secondly, the suprachiasmatic cells are connected, via a nerve tract, to the retina in each eye. One obvious implication of this link is that the SCN would be able to receive important data concerning temporal rhythms in the external world, and especially important in this regard would involve those rhythms which are being expressed through the changing pattern of the ratio of daylight to nighttime as one progressed through the year.

Subsequent experiments, in which the SCN were removed, indicated the master clock had not been found. These experiments showed that although the temporal identity of an organism is significantly altered when the SCN are removed, nevertheless, temporal identity was not destroyed.

In other words, while the SCN seemed to play a fundamental role in synchronizing various biological rhythms, they were not responsible for generating those other rhythms. Consequently, there must be other biological sources that are underwriting temporal identity.

Although the suprachiasmatic nuclei do not constitute 'the' master biological clock, they are believed to be the locus within which one of two master clocks can be found. Together, these two clocks are considered, by many chronobiologists to be responsible for regulating the vast majority, if not all, of the biological rhythms in the human body, and these rhythms range from: The secretion of growth hormone, to cycles of activity and inactivity, to establishing the point in the sleep cycle when vivid dreams are considered by some to be the

most likely to occur, to the rise and fall of core body temperature, and so on.

The location of the second master clock has not yet been established (and, technicality, the so-called first master clock might not be the sort of master it was originally believed to be). However, this second clock is thought to be the more stable, as well as to be the more powerful, of the two clocks.

Nevertheless, this second, more stable and powerful, master clock – if it exists -- is believed not to have any direct contact with the changing patterns of light to darkness ratios. Therefore, this second clock might be entrained by the so-called master clock thought to be located in the suprachiasmatic nucleus, since this latter "master" clock is in contact, via nerve tracts extending to the retina, with external data concerning the changing ratio of light to darkness.

There are some chronobiologists who do not accept the 'two master-clock hypothesis.' They believe there might be a number of other "master" clocks in addition to the two already mentioned.

For example, there is considerable evidence pointing toward the adrenal gland as the locus for, yet, another clock of sorts. More specifically, one of the hormones secreted from the outer cortex of the adrenal glands is cortisol.

Cortisol plays a fundamental role in the way the body responds to stressful situations. Fluctuations in the level of cortisol secretion appear to follow cyclical rhythms during the course of the day.

The adrenal-clock, however, is not necessarily a master clock. Quite frequently, a given biological system will have an intrinsic periodicity that characterizes its biological activity. This innate periodicity is not, in and of itself, a master clock. Such inherently periodic systems are known as a "tau".

The structural character of a tau gives expression to certain aspects of an underlying genetic potential. Although a tau's general structural character is species specific, the individual members of a species will display a tau that is similar to, but not precisely the same as, the average value for the species with respect to that tau.

Human beings, along with a variety of other species, are capable of being entrained, simultaneously, to a variety of different biological

clocks. On the other hand, human beings are also capable of having some of their biological rhythms synchronized with others with whom they live in close contact over a period of time (for example, research has shown that women of menstruating age who live together will exhibit a certain amount of synchrony with respect to their menstrual cycles).

Some hormones play a role in communicating, to various systems in the body, information concerning the temporal phase of external rhythms. These hormones are referred to as "temporally active hormones."

These sorts of hormones are believed to keep different circadian systems in touch with the fluctuations occurring in various rhythmic patterns in the external world that are relevant to the body's circadian rhythms. In human beings, there are a variety of temporally active hormones providing humans with a number of different sources of temporal-related events.

As a result, such hormones help establish a spectrum of ratios of biological constraints and degrees of freedom with respect to the way a human being can engage the environment in the form of a temporal dialectic. Furthermore, although the general number and structure of biological clocks is pretty much the same from one human being to the next, there can be a great deal of variance in how these different clocks are linked together in different individuals, and, therefore, various individuals will exhibit different patterns of synchronization with respect to how their clocks will be linked to one another.

Sometimes these differences are a result of genetic inheritances. Sometimes the differences in patterns of synchronization are due to the impact which the kind of life the individual leads has on that person's biological system. Finally, sometimes a combination of the two foregoing factors will lead to differences in patterns of synchronization from individual to individual.

Modern high-speed computers have taken on a function, with respect to biological rhythms, somewhat similar to the role that a prism played with respect to the study of light waves. Just as a prism is able to show visible light to be an aggregate of a number of different

wavelengths of light, so too, modern computers have been able to show there is a spectrum of biological rhythms underlying an organism's activity.

Through the application of computer and inferential statistical techniques, approximately seven to eight basic types of rhythms have been discovered so far. They are: (a) ultradian (less than 20 hours); (b) circadian (between 20-28 hours); (c) circasemiseptan (3 ½ days); (d) circaseptan (7 days, plus or minus 3); (e) circadiseptan (14 days, plus or minus 3); (f) circavigintan (21 days, plus or minus 3); (g) circannual (1 year, plus or minus 2 months), and (h) the term infradian is used to refer to cycles lasting longer than 24 hours.

Before moving on, one might reflect on an important question concerning the foregoing eight types of rhythms which have been detected in various species, including human beings. What regulates their dynamics, since -- as will be indicated subsequently -- mentioning various kinds of molecules that have been correlated with those rhythms doesn't necessarily have much explanatory power since those molecules appear to be nothing more than tools which are organized by a system of regulation which operates above the pay grade of those sorts of molecules.

Circaseptan rhythms (which have a period of approximately 7 days) are showing up in a variety of biological processes. Generally speaking, these rhythms are of low amplitude and, therefore, are hard to detect amidst the higher amplitude, more prevalent circadian rhythms. However, although, on an individual basis, the circaseptan rhythms are weaker than the circadian rhythms, over the course of a week, the aggregate collection of circaseptan rhythms can be fairly substantial.

While circaseptan and circasemiseptan rhythms do not appear to reflect any external temporal rhythm, these rhythms are not arbitrary. They have a harmonic relationship with such external rhythms as the cycle of day and night, as well as the lunar cycle.

Thus, the rhythms associated with various biological functions (such as growth, maturation, cell maintenance, reproduction, immune responses, and so on) will be a complex harmonic function of the way entrainment properties of external rhythms dialectically interact with the vectoring properties of innate biological currents such as the

circaseptan and circasemiseptan rhythms. However, nobody in the field of chronobiology knows, yet, what the structural character of this dialectic is or what the harmonic laws are which govern those dialectic dynamics.

One can differentiate between music and noise by noting how the former consists of a set of sound waves that have an ordered, structured relationship with one another. In the case of noise, the aspect of orderly relationship is missing.

In music, a given complex sound is a function of a set of simple waves that are whole-number multiples of some fundamental, lowest frequency, wave component inherent in the given complex sound. This lowest frequency wave component is known as the first harmonic. Depending on the sort of whole-number multiple a given wave component has relative to the frequency of the first harmonic, the other wave components of a complex musical sound will be referred to as harmonics of the second, third, fourth, etc. order.

Some of the more complex temporal rhythms (e.g., circannual or circavigintan, etc.) might be whole-number multiples of some of the simpler rhythms such as the ultradian or the circadian. Thus, the more complex biological rhythms could be seen to be higher order harmonics of the basic temporal units.

Just as light plays a fundamental role in Einstein's special theory of relativity, light also plays a fundamental role in chronobiology. Light is the standard to which the body refers in order to re-gauge its biological rhythms so they can be synchronized with, among other things, the primary circadian rhythms generated by the alternating cycle of night and day.

Although most of the light impinging on the individual's eye is transduced into visual signals, a certain amount of the light serves as a source of temporal data concerning the external rhythm of the cycle of day and night. This data is passed on to the suprachiasmatic nucleus in the hypothalamus. These nuclei are linked with a variety of other biological clocks and taus. The end result of this dialectic is to permit the organism to get into an appropriate phase relationship with external rhythms.

The pineal gland is known as a neuroendocrine transducer. This means it is capable of converting or translating the action potentials of the nervous system into the secretion of various kinds of hormones. One of the hormones transduced by the pineal gland in this fashion is melatonin.

The suprachiasmatic nuclei are connected to the pineal gland by means of a nerve tract. By sending certain messages along this nerve tract to the pineal gland, the SCN is able to control the quantities, and, therefore, activity, of a particular enzyme in the pineal gland.

The enzyme regulated by the SCN plays a role in synthesizing melatonin. The precursor neurotransmitter from which melatonin is synthesized is serotonin.

Although the precise role of melatonin is not presently known, it is deeply implicated in the body's circadian system that is hooked into external rhythms of night and day. The levels of melatonin secretion are highest between the hours of 11 at night and 7 in the morning, whereas the levels of melatonin secretion are lowest during the hours of waking activity.

Apparently, light serves as a signal for the suppression of melatonin secretion, whereas nighttime acts as a stimulus leading to the synthesis of melatonin. The rhythmic rise and fall of melatonin levels is a waveform that is propagated throughout the body.

Notwithstanding the foregoing considerations, while, on the one hand, light might serve as a signal that suppresses melatonin secretion, whereas, on the other hand, nighttime acts as stimulus which leads to the synthesis of melatonin, one still would like to know what is regulating the precise nature of the suppression and synthesizing dynamics which are described as being a function of, respectively, the presence or absence of light. What regulates such processes of suppression and synthesis?

Does the SCN regulate the synthesizing of melatonin? Or, is the SCN merely the location where melatonin is synthesized from a precursor molecule, serotonin – a process which is regulated by "something" apart from the SCN and which initiates the call-up for serotonin to be transported to, or generated through, the SCN in order to serve as a precursor for the subsequent synthesis of melatonin?

This cyclical waveform plays a role in the synchronization and harmonious interaction of a variety of biological rhythms. Furthermore, while the amplitude, frequency and phase of this wave can be affected by altering the timing and/or intensity of the organism's engagement with light stimuli, each species has its own characteristic way of responding to those sorts of alterations in the character of light stimuli.

Most, if not all, vertebrates come equipped with a pineal gland. Although the function and the size of the pineal gland varies from species to species, generally speaking, the more critical the role (s) that is (are) played by temporal rhythms in a given vertebrate species, the larger will be the size of that species pineal gland. In addition, in many of -- if not most of these vertebrate species -- fluctuations in the level of melatonin synthesis and suppression in the pineal gland are linked to the way the organism establishes phase relationships with external cyclical patterns such as day and night, as well as summer and winter.

In the latter case, the nervous system might have some sort of mechanism for both: (a) keeping running totals of the ratio of melatonin synthesis to melatonin suppression and, then, (b) coupling (a) with a process that compares the latter ratio against some innate or learned (such as through critical periods) standard. This mechanism allows the organism to make fairly complex preparations for forthcoming seasonal changes.

Given the foregoing considerations, one wonders what regulates the suppression or expression of the pineal gland’s capacity for neuroendocrine transduction. What determines or regulates which neurotransmitters are called for so that they can be transduced into one kind of hormonal signal rather than another sort of signal?

The suprachiasmatic nuclei are also linked with the lateral geniculate nucleus. The primary neurotransmitter propagated along the nerve tract connecting the SCN and the LGN is known as neuropeptide Y.

In experiments in which neuropeptide Y has been introduced directly into the SCN, this neurotransmitter appears to have the effect of resetting the circadian clock of the suprachiasmatic nuclei in the same manner as if the organism had encountered the darkness of

night. One of the implications of this kind of experiment is as follows: Just as there are biochemical components that act as carriers of the temporal data concerning light, there also might be systems responsible for the generation and regulation of carriers of the temporal data concerning darkness.

The foregoing considerations tend to lead to various kinds of questions. For example, what regulates: When, how much, and for how long, neuropeptide Y will be introduced into the SCN (suprachiasmatic nuclei)?

Moreover, exactly how does neuropeptide Y reset the circadian clock of the suprachiasmatic nuclei? In addition, if neuropeptide Y supposedly resets the circadian clock of the suprachiasmatic nuclei in the same manner as if the organism had encountered the darkness of night, then, under normal circumstances, what is regulating the way a human being will biologically respond to darkness so that neuropeptide Y will be released?

All species exhibit a mixture of constraints and degrees of freedom in relation to temporal phenomena. In other words, for every species there are some aspects of functioning in which temporal relationships are central or critical, whereas there will be other aspects of functioning in which temporal relationships play only a very minor, or even non-existent, role.

The ratio between these two possibilities (i.e., instances in which temporality is important and instances when temporality is relatively unimportant) establishes a given species' temporal identity. Temporal identity sets the tone, orientation and so on with which a given organism will interact with different patterns of external rhythms under various circumstances.

The phenomenon of critical periods is one of the modes through which the temporal identity of a given species or individual is given expression More specifically, for a large number of species, there seem to be temporal phase windows, of varying lengths of time, within which the learning of various kinds of behavior or the development of certain kinds of capabilities must take place.

Vision in kittens, social behavior in monkeys, the singing of songs in different species of birds, identification of the mothering-one in geese, and language in human beings, are all examples of learned behaviors that appear to share a common feature. More specifically, they are all shaped by the structural character of the temporal windows that seem to form integral aspects of the temporal identity of the aforementioned species.

Other kinds of learning also exhibit a rootedness in the ratio of temporal constraints and temporal degrees of freedom. Honeybees, for example, are able to learn certain information concerning the scent, color, location, and distance of a source of nectar. However, each segment of information can be learned only at certain phase states during the bee's interaction with the nectar source.

More specifically, the honeybee only seems to be able to learn the color of a flower in the two second period just prior to landing on the flower. Secondly, the honeybee only appears to be able to learn the scent of a flower when it has actually landed on the plant. Thirdly, the honeybee, apparently, is able to learn the location of the nectar source only as it leaves the flower on which it has landed. Finally, the honeybee seems to be able to learn the location of the hive entrance only when it leaves the hive as it goes in search of food sources.

In all of these cases, the temporal phases linking the honeybee to the learning cycle assumes a fundamental importance. If anything disrupts the temporal window within which, and through which, certain kinds of data must be stored in the honeybee's memory, then, learning of the requisite sort does appear to be able to take place.

The fact that in some species there are critical temporal windows or critical phase relationships that must exist in order for certain kinds of learning to occur raises the question of whether there are similar sorts of temporal windows of learning in human beings. This is an issue of some importance.

For example, the network of phase relationships that arises as a result of the dialectic between a given individual's temporal identity and the way in which a given curriculum program allows a topic to unfold over time might play a fundamental role in determining the way in which the individual engages, and is engaged by, the subject matter. The structural character of such an engagement process might

affect, in turn, both the quality and quantity of learning that occurs in relation to a given subject matter.

Some curriculum programs might enhance an individual's likelihood of learning because such a program is conducive to the individual's mode of temporal identity. As a result, a resonance process arises that permits heuristic transitions in some of the ratios of constraints and degrees of freedom governing an individual's understanding.

On the other hand, other curriculum programs might diminish an individual's likelihood of learning since such a program is not compatible with the structural character of the individual's temporal identity. In other words, in such circumstances, the dialectic between individual and curriculum does not permit a resonance process to be established that is conducive to heuristic transitions in the ratios of constraints and degrees of freedom governing that individual's understanding.

Sometimes a curriculum program might need to expand the character and quantity of constraints surrounding the unfolding of a given subject matter in relation to an individual of a given temporal identity. At other times, one might need to decrease the character and quantity of such constraints for a given individual.

Similarly, sometimes one might need to expand the character and quantity of the degrees of freedom surrounding the unfolding of a given subject in relation to an individual of a certain temporal identity. At other times, such degrees of freedom might need to be decreased.

During experiments in which all time cues were removed from the experimental situation and people were allowed to set their own routine with respect to sleeping, eating, working, and so on, scientists found a number of themes that, on average, seemed to be characteristic of human sleep. Apparently, sleep patterns are shaped by several distinct components.

One of the components shaping the sleep cycle is innate. The other component shaping the sleep cycle is a function of the way an individual interacts with, experiences, and learns from on-going

environmental contingencies involving work, recreation, social relationships, and so on.

Part of the innate component of sleep has to do with how long, in general, any given period of sleep lasts. This component is strongly influenced by a biological clock intrinsic to the genetic components that are used to lay down the spectrum of ratios of constraints and degrees of freedom that shape biological patterns.

Moreover, the onset of sleep is also affected by an innate biological clock since, generally speaking, people tend to seek out sleep a short time after the core temperature of the body has reached its lowest level. As indicated previously, the cyclical character of deep body temperature is regulated by a biological clock.

The structural character of the sleep cycle has four or five fundamental stages that run in sequence throughout a 'normal' period of sleep. These stages are differentiated from one another by, among other things, the frequency signature of the brain waves (e.g., beta, alpha, delta, gamma, or theta) that occur during a given stage of sleep, as well as, at least in some stages of sleep, the level of synthesis activity of certain neurotransmitters (namely, acetylcholine, norepinephrine and serotonin).

One might note in passing that the presence or absence of various kinds of neurotransmitters could be engaged through a variety of hermeneutical lenses. The presence or absence of such neurotransmitters could be: In some way causative of (or helping to cause) a given physical state; non-causative (and, currently, unexplained) correlates of those states, and, finally, functions of (that is, generated by or made possible by) such a state.

At various, relatively regular, intervals (approximately every 90 minutes) during the running of the sleep sequence, the REM phenomenon usually occurs. REM sleep is characterized by a paralysis of the muscles of the body, a heightened level of activity of the nervous system, and vivid dreaming. Usually, REM sleep occurs after, or in conjunction with, stage-2 sleep, once the sleep sequence has completed the following sequence of stages: 1, 2, 3, 4, 3, 2 (usually going through this sequence of stages takes about 90 minutes).

With the exception of stage 1, this pattern is repeated a number of times throughout the period of sleep. Finally, the amount of time that any given individual spends in REM sleep tends to be both characteristic of the individual, as well as relatively stable over the course of the individual's life.

Notwithstanding the foregoing considerations, for more than 25 years (and, therefore, what follows is based on a good sample size), I have interacted with, observed, and talked with my wife – both when she is awake and, as well as, when she, apparently, was asleep. As a result, I have become aware of considerable evidence to indicate that things don't necessarily work in accordance with the foregoing "standard" description of the sleep cycle.

For example, within minutes of falling asleep – and not 90 minutes later -- she often is dreaming. These episodes do not appear to be the sorts of hypnagogic states that occur sometimes during an individual's transition period from waking to sleeping when various kinds of images might become manifest through a person's phenomenological screening process, but, instead such events appear to be full-fledged, detailed dreams which, on occasion get told to me when, for some reason, something disturbs her sleep ten or fifteen minutes later (and on some occasions this disturbance is a function of the nature of the content of the dream itself).

Allan Hobson and Robert McCarley have studied the aminergic and cholinergic components of the biological clocks that help regulate and shape not only the waking-sleep cycle, but the sleep-dream cycle as well. The aminergic component, which is located in a specialized group of cells in the brainstem, gives expression to the so-called amine force. This 'force' is responsible for the synthesis and release of the neurotransmitters, serotonin and norepinephrine.

There is second group of specialized cells in the pons that gives expression to the cholinergic force. This 'force' controls the synthesis and release of acetylcholine.

According to Hobson and McCarley, the aminergic system plays a fundamental role in bringing about and sustaining the waking portion of the wake-sleep cycle. All throughout the waking state, serotonin and norepinephrine are synthesized and released in a regular, clock-like fashion. The effect of these manifestations of the aminergic force is,

among other things, to inhibit the activity of the giant pons cells that are the locus of synthesis of acetylcholine.

During the sleep segment of the wake-sleep cycle, the activity of the aminergic system is suppressed. This results in the disinhibition of the cholinergic system, and once disinhibited, this system proceeds to synthesize and release acetylcholine.

The combined effect of the gradual suppression of the activity of the aminergic system, together with the disinhibition of the cholinergic system, permits a variety of systems of the nervous system to become activated. One of the systems activated in this manner begins synthesizing a neurotransmitter that is conveyed to the voluntary muscle system.

When this neurotransmitter arrives at the site of the voluntary muscle motor plates, it takes on the function of a blocking agent with respect to motor nerve impulses, thereby, preventing movement of arms, legs and so on. In addition, Hobson and McCarley believe the combined effect of the suppression of the aminergic system, along with the disinhibition of the cholinergic system, leads to the increased level of activity of the nervous system out of which REM sleep arises.

Even if one were to accept the idea that REM sleep activity is, in some fashion, specifically stimulated by the presence of acetylcholine, this idea doesn't provide much of an explanatory framework for understanding what regulates: When, where, how much, and for how long acetylcholine is to be released into cells related to the REM sleep activity. Furthermore, being able to tie acetylcholine to REM sleep activity doesn't really clarify what role such acetylcholine plays or whether, or not, it has any role to play in conjunction with the nature of the dream content or an individual's awareness of such content

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In broad, general terms, one can categorize brain circuitry in two ways. On the one hand, there are circuits that are dominated by fast-acting but short-lived neurotransmitters such as acetylcholine (which excites cellular activity in the nervous system) and GABA (gamma amine butyric acid) (which inhibits cellular activity in the nervous system). These neurotransmitters are generally found in motor and sensory circuits where speed of response is important.

On the other hand, there are brain circuits that are dominated by relatively slow-acting but long-lived neurotransmitters like serotonin and norepinephrine. These neurotransmitters are generally associated with activities of learning and attention.

Although the roles of acetylcholine and GABA have been mapped out fairly precisely in relation to sensory and motor activity, such is not the case with respect to the roles of serotonin and norepinephrine as far as learning and attention activities are concerned. In other words, although serotonin and norepinephrine might be implicated in conscious, intelligent activities, just how they bring about such activities, or how they sustain them, or how they underwrite a system that permits differential attention is not known.

Surely, any attempt to reduce the extremely diverse and complicated possibilities surrounding learning/intentional activity to being a function of biogenic amine neurotransmitters, will encounter theoretical difficulties. For example, even if there were 25 or 30 of these sorts of neurotransmitters (i.e., enough for a complex alphabet of sorts), one still would be faced with the following problem: Biogenic amine neurotransmitters, such as serotonin and norepinephrine, do not control their own levels or rates of synthesis. Nor do they control where in the nervous system they will be sent or when they will be released for propagation, or in what sequence any of this will be done.

One could suppose that learning and attention are somehow reducible to being a function of various combinations of biogenic amine neurotransmitters. Nevertheless, one still needs to uncover the structural character of the system that is responsible for organizing, shaping, regulating and directing the components of the biogenic amine code to form the complex, diverse structural properties characteristic of both learning and intentional activity.

In a sense, the problem facing the biogenic amine neurotransmitter theory of learning and attention is, at best, like that of a person who is trying to decode an alien language. When a language is radically dissimilar from any with which one is familiar, one might not be able to apply the normal mathematical rules of decryption which can be used for breaking human codes or coming to understand human languages.

If the problems facing the biogenic amine neurotransmitter theory of learning and attention are comparable to those facing the decryption of an alien language, then, all that the biological cryptologist has to go on is, at most, a few letters of the alien alphabet (i.e., the known neurotransmitters). Knowledge of these letters, however, is not necessarily accompanied by any understanding of how the letters are organized to give expression to the sort of syntactical or semantic processes that are capable of giving expression to learning and attention.

There are further problems that arise if the biogenic amine neurotransmitter system of learning and attention does not operate like a language. If this is the case, then, biogenic amines such as serotonin and norepinephrine are not analogs for letters or words and have some entirely different functional role that they fulfill, and what this role – or these roles -- might be, is not currently known by anyone.

However, irrespective of what their role, or roles, might be, the underlying problem that needs to be solved remains the same. In each case, one needs to discover the identity of the structural character of the processes or mechanisms which are responsible for regulating the organizational capacities that establish the spectrum of ratios of biological constraints and degrees of freedom that give expression to both the phenomenological and functional properties of learning and attention.

These properties could be described in terms of waveforms of synthesis activity that have varying frequencies, amplitudes and wavelengths involving different biogenic amines or different combinations of such amines. On the other hand, various biogenic amine neurotransmitters might be just a medium of transmission for some underlying source of regulatory dynamics, and if this were the case, then perhaps, one should be paying more attention to what is shaping the wave being propagated through the biogenic amine medium than one is paying attention to the character of the wave that is being propagated by, or through, that medium.

The latter sort of method is the one which tends to be pursued by many investigators. As a result, they often reduce the idea of explanation down to a process of description, as if describing a wave

form is the same thing as understanding the nature of that which makes such a wave form possible.

If the foregoing were the case, then, the idea of wavelength is tied in some way to what is regulating the duration of the burst of synthesis activity of a particular biogenic amine, whereas frequency might have something to do with what is inducing a given wavelength to be generated at a certain rate per unit of time. Furthermore, amplitude might be a function of what is responsible for regulating the level of intensity of the synthesis activity surrounding a given biogenic amine dynamic.

Once a person developed some facility with the foregoing considerations, one, then, would have to work out the nature of the functional relation between different waveform properties and various kinds of learning and phenomenological phenomena. In addition, an extra dimension of vectored shaping might be introduced if one were to assume that the same waveform propagated through different biogenic amine mediums might mean quite different things or have quite different functions in different circumstances.

Throughout the aforementioned sort of waveform activity, the property of phase relationships would play an extremely important role of shaping and communicating various aspects of understanding concerning such dynamics. Indeed, in light of the fact that more and more aspects of biological functioning are being construed in terms of periodic, cyclical, or rhythmic patterns of activity, the need to map out what is regulating those phase relationships within, and among, such cyclical patterns of activity, as well as to map out what is regulating the character of phase transitions under various circumstances of learning and attention becomes increasingly pressing.

From the foregoing perspective, the brain or nervous system would become like an amalgamation of dialectically interacting phase states. Such states might be extremely receptive or sensitive to sympathetic vibrations (i.e., the phenomenon of resonance) from a variety of other dimensions that are in a compatible or synchronous phase state.

The foregoing suggests the temporal dimension might serve as an ideal medium through which data concerning phase state, phase relationship and phase quanta could be exchanged among a variety of

quite different (in terms of the spectrum of ratios of constraints and degrees of freedom that characterize them) dimensional mediums. In other words, given that the temporal dimension can be conceived of as sharing a common boundary (in the form of a set of phase relationships) with virtually every other dimensional structure, one easily could suppose that a great deal of data concerning the phase states of different dimensions might be transmitted via, or transduced through, the temporal dimension. One could further suppose that such transmitted or transduced phase data might become entangled with whatever dimensional dialectic activity exhibited a similar organizational, structural or ordered resonance.

If the foregoing suppositions are true, then, one of the common currencies of data communication in the universe might be phase relationships and phase states. All of these phase modes are manifestations of the sort of constraints and degrees of freedom to which the temporal dimension helps give regulatory expression during its dialectic with other dimensions.

Daniel Kripke and David Sonnenschein have run a series of studies indicating that many people seem to go through waking cycles, lasting approximately 90 minutes, in which they have reverie or fantasy experiences of a spontaneous nature at the beginning and/or end of such cycles. While these reverie episodes exhibited some degree of resemblance to REM-stage dreaming, they were not accompanied by the characteristic rapid eye movements of REM-sleep. Therefore, these reverie rhythms are not considered to be waking counterparts to REM-stage dreaming.

Both REM-stage dreaming as well as the waking reverie cycles are examples of ultradian rhythms. These are rhythms lasting less than the 24 hour period of the more easily detectable circadian rhythms.

A number of chronobiologists believe there are a number of ultradian rhythms occurring in human beings. Moreover, these chronobiologists believe such ultradian phenomena might form a number of related and interacting, rhythmic families.

Another example of an ultradian rhythm involves the idea of ‘sleepability.’ Sleepability refers to the ability of a person to go to sleep

at a given time. Researchers have discovered there are temporal windows opening up on a regular basis.

An individual can go to sleep more easily when these windows are open than when they are closed. Generally speaking, these temporal windows emerge approximately every 90 minutes

This temporal window of 90 minutes shows up in a number of phenomena experienced by human beings. These include the reverie or fantasy experiences of a spontaneous nature that occur at the beginning and/or end of waking cycles studied by Daniel Kripke and David Sonnenschein, as well as the "sleepability" temporal windows, and REM-dream cycles).

One can't help but wonder about the nature of the foregoing ultradian cycles. Does the same biological clock or tau govern those phenomena, or do separate clocks or taus regulate those phenomena, and if the latter should be the case, then, why are the temporal frameworks for these phenomena so similar?

There also appear to be temporal windows of wakeability. These are periods of time during the sleep cycle when the individual can awaken more easily relative to other periods of the sleep cycle.

One example of a wakeability window occurs during the REM-stage of sleep. Wakeability appears to be another example of an ultradian rhythm.

Despite the fact the foregoing examples of ultradian rhythms, along with a number of other instances of such rhythms, have cycles lasting approximately 90 minutes, there does not seem to be any master biological clock synchronizing all of these oscillating systems. In other words, the similarity of cycle length notwithstanding, all of these ultradian rhythms appear to be independent of one another, and, therefore, might be examples of taus (phenomena which are periodic in nature but do not appear to be a function of biological clocks).

Another example of how ultradian rhythms might play an important role in shaping the structural character of human behavior concerns evidence that suggests there are significant differences in the storage-efficiency of short-term and long-term memory. This evidence indicates memory storage-efficiency is dependent on the time of day one is given certain kinds of memory tasks.

Apparently, short-term memory reaches a peak of efficiency somewhere between 10-11 am. Long-term memory, on the other hand, seems to reach a peak of efficiency later in the day.

For instance, children who were read a story at 9:00 A.M. were able to recall fewer details of that story than were children who were read the same story at 3:00 pm. The data seems to indicate there is a 15 % difference in storage-efficiency.

If the foregoing finding holds across the board, then, it might have substantial implications for how one structures the school day. For example, although teachers obviously would like students to remember everything being taught, some material might be more essential or critical than other kinds of course material. The experimental data alluded to above indicate that the more essential course material might be saved for the latter portion of the afternoon when that data has a better chance of staying in long-term memory.

The foregoing considerations concerning memory storage-efficiency, however, might have to be modulated somewhat by other kinds of experimental findings. For instance, a certain amount of evidence has been uncovered which points to potential differences between two broad categories of temporal identity in human beings.

The members of one group have been labeled "owls". The individuals in the other group are referred to as "larks".

As the respective names suggest, owls tend to have their period of peak activity late in the day (even at night). Larks manifest a period of peak activity during the early part of the day.

Interestingly enough, a major biochemical difference between the two groups has to do with the amount of epinephrine secreted by individuals in each group during the morning hours. Epinephrine, that is associated with biological stimulation, is secreted in greater quantities, during the morning hours, by the larks, and, of course, this leads to questions about what regulates the amount of epinephrine which is dumped into the biological terrain at any given time.

One wonders if there is a way for the two experimental results outlined above to be combined so that all categories of individuals could gain the greatest benefit from the effect such rhythms have on the potential for learning, alertness and so on? For instance, should

one assign students to classes according to the character of their temporal identity?

One also wonders if larks will learn more efficiently in the afternoon as the first study cited above suggests, or whether their temporal identity will overshadow the apparent enhancement of memory efficiency associated with mid-afternoon learning. Or, could one explain the apparent enhancement of memory efficiency in mid-afternoon learning by the presence of a larger number of owls, relative to larks, in the sample subjects? Whatever the answer to these questions might be, biological rhythms, together with their complex expression in the form of temporal identity, would seem to be important areas to explore in relation to the educational process.

The biological rhythms occurring in humans are, to some extent, a function of dynamics which are rooted in inherent or innate systems. Nonetheless, the structural character of those rhythms is not instinctual in any narrow sense. There is some degree of flexibility inherent in the manner in which those rhythms are expressed.

Therefore, although dynamics which are somewhat innate play a significant role in shaping various aspects of behavior, they do not necessarily control behavior in a rigid fashion. Quite frequently, the manner in which biological rhythms manifest themselves is itself susceptible to being shaped, to a certain extent, by directed awareness, and, the presence of this sort of dynamic raises questions about what is the nature of the phenomena which regulates such directed awareness.

For example, experimental work has established that when human beings undertake a task requiring some degree of concentration for an extended period of time, they go through a cycle of, first, enhanced efficiency, which is, then, followed by a deterioration of efficient engagement of the given task. Then, this cycle repeats itself.

The length of each cycle is approximately 90 minutes (once, again – as was manifested in REM cycles and sleepability phenomena -- a 90-minute period is present). Thus, such a cycle is an ultradian rhythm.

Apparently, the cycle is set in motion by an individual's decision to engage some task requiring conscious attention. Possibly, within

certain limits, each new decision to change one's focus might reset the ultradian efficiency clock so that another cycle is initiated.

Obviously, if a change in the direction of conscious attention is made too frequently (and this is a characteristic of ADHD), this, presumably, would have a dampening effect on the efficiency cycle. In other words, one would never be able to get far enough into the task in order to make the heightened awareness payoff. Consequently, there would seem to be some minimal amount of time that would have to be spent in the cycle to get the most out of it.

Furthermore, under some circumstances, there might be other sorts of forces shaping the ultradian cycle of efficiency. For instance, there are cases in which one becomes deeply engrossed in what one is doing because one finds a given issue or task extremely intriguing, interesting, challenging, stimulating, rewarding, and so on.

Under these sorts of circumstances, the 90-minute cycle might not be in effect. In other words, there might be thresholds involving interest/reward/challenge that, in being exceeded, lead to the shutting down of the aforementioned ultradian cycles which, normally, govern mental alertness.

Alternatively, if the ultradian rhythm concerning mental alertness is in effect (i.e., not shut down or switched off), the down aspect of the cycle might be greatly attenuated as it is swamped by other, more powerful or competing cycles. As a result, there might not be much deterioration of mental alertness during those sorts of circumstances.

A further possibility is the following consideration. Within the context of a given task, challenge, or issue which is being engaged, there might be a number of new, interesting twists and turns, each of which resets the efficiency cycle.

However, because all of the twists and turns are bound together within the framework of a thematically directed latticework of interest/reward/challenge, the change in focus does not become disruptive to, or interfere with, or act as a suppressor of, efficient engagement as would be the case if the twists and turns were unrelated to one another. Indeed, such a latticework might operate as a strange or chaotic attractor in which the various re-settings of the

ultradian mental alertness cycle give expression to a self-similar (and, therefore, linked) series of rhythms.

This latter point concerning the possibility of the synergetic effect of introducing twists and turns within a given task framework has some potentially interesting implications for educational theory and the planning of classes, homework, assignments and so on. Possibly, if one can find the right kind of twists and turns within the context of a certain task framework, one might be able to provide the individual with a means to reset the ultradian efficiency clock on a regular basis, and, thereby, within certain limits, keep the individual at peak efficiency for a longer period of time.

The foregoing considerations seem to suggest that not only are there biological rhythms, but there also are what might be referred to as epistemological and/or hermeneutical rhythms. Furthermore, these biological rhythms and epistemological/hermeneutical rhythms dialectically interact with one another in a process of mutual vectoring or tensoring dynamics.

Consequently, when something is learned might be as important as what is learned. The phase orientation one has as one begins to engage a given topic, issue, or task might significantly affect the structural character of the outcome of such an engagement.

In other words, certain phase relationships, which play central roles in shaping learning and understanding, might be more amenable to heuristically valuable phase shifts or transitions during some phase states than during other phase states. The foregoing concept is somewhat abstract could be made more concrete and specific with further critical reflection and research.

Each individual might be shaped by a variety of temporal windows affecting the efficiency with which, and way in which, learning and understanding occur. These temporal windows are a function of the dialectic among a variety of biological and epistemological or hermeneutical rhythms, and if course material were engaged by an individual when a propitious ratio of such temporal windows is open, then, what transpires might be more conducive to learning and understanding.

Similarly, before one can understand certain aspects of an issue, one might have to acquire the right sort of phase orientation with respect to such an issue. That is, one might have to get into, or be brought into, phase with the material as well as the educational setting through which the material is being introduced. Consequently, an important part of the educational process might be to assist the individual in constructing the right sort of phase state or phase orientation through which a constructive exchange of phase quanta (i.e., learning, understanding, etc.) is more likely to occur.

In short, an individual's temporal identity gives expression to both biological rhythms, as well as, hermeneutical rhythms. Indeed, temporal identity is a manifestation of the structural character that is generated, in part, by the dialectic of biological and hermeneutical rhythms. In addition, temporal identity consists of oscillating ratios of constraints and degrees of freedom. These oscillating ratios are generated by the different levels of scale of dimensional dialectics that give expression to a human being.

One of the interesting things about an oscillator is the way it, simultaneously, can serve as both a clock as well as a source of systematic signals, communications, or data. In this respect, there might be a sense in which both biological and epistemological/hermeneutical rhythms form oscillating systems that are reminiscent of, or resonate with, clocks that operate in accordance with the requirements of Einstein's special theory of relativity.

In other words, biological and hermeneutical clocks and/or taus often give measured versions of rhythms, time, synchronization, signals and so on which are influenced by local conditions instead of being reflections of temporal absolutes that are unaffected by methodological considerations. At the same time, just as is the case in special relativity, there are elements of universal laws (involving rhythmic structures in the present case) which are conserved or preserved during the process of methodological engagement, and therefore, aspects of both variability and invariance can be manifested in the biological and hermeneutical oscillating systems (whether in the form of clocks or taus) that characterize human beings.

Although chemical clocks or chemical oscillators were first discovered in 1921 by William Bray, they were not systematically studied until the late 1950s and early 1960s when A. M. Zhabotinsky and B. P. Belousov of the Soviet Union took an interest in such phenomena. Essentially, a chemical oscillator (sometimes referred to as a Belousov-Zhabotinsky reaction) will -- if left to itself – shift, spontaneously, between several states in a periodic fashion. Usually, the periodicity of a chemical clock is noticeable because that periodicity is visually manifested as a color transition in the chemical system that is oscillating.

As is the case for any oscillating system, a chemical clock is sustained by a process of energy flow which can be: (a) Stored, at least temporarily, as potential energy; and, then, (b) become converted from a potential form to an active or kinetic form of energy. One of the ways in which this process of energy flow occurs in chemical systems is by means of a series of cyclical transitions between the oxidized and reduced states of certain molecules that oscillate between those two possibilities.

Chemical oscillators are capable of producing a wide range of effects, including complex phenomena of communication. In other words, some networks of chemical/biochemical processes exhibiting various sorts of oscillating properties are capable of giving rise to a variety of systems that generate, store and transfer data.

For example, the Acrasiales fungi or slime mold is -- relative to human beings -- a simple example of a chemical/biochemical clock that, under the right sort of circumstances, manifests many of the characteristics of a system of communication. Under environmentally favorable conditions, the slime mold exists as a single-celled amoeba, but when environmental contingencies become problematic (such as when food becomes scarce), the formerly independent slime molds begin to draw together and become transformed into a stalk.

In time, this stalk yields spores that, eventually, break off and are dispersed by wind currents to (hopefully) more favorable environmental circumstances. If, and when, more favorable conditions are reached, the spores undergo reproduction which results in a new colony of slime molds being established.

The series of transformations and transitions undergone by slime molds is driven by a chemical oscillatory system in which cyclic adenosine monophosphate (cyclic-AMP) plays a leading role. One of the slime molds in the colony begins to secrete cyclic-AMP in rhythmic pulses.

These pulses have the effect of entraining the other slime molds' production and secretion of cyclic AMP so that all of the members of the colony begin to secrete cyclic AMP in unison. Neither the process which regulates the initial release of cyclic-AMP, nor the process which gives expression to the process of entrainment of other members of the colony is well understood.

The over-all effect of the community production of cyclic-AMP is to lead all of the individual cells to congregate around the initial cyclic-AMP-secreting-amoeba cell. The congregated colony, then, undergoes the series of transformations outlined previously in which there is a sequential expression of the base, stalk and spores stages of the slime mold.

What regulates the foregoing process of congregation is not known. Furthermore, what regulates the aforementioned series of subsequent transformations is not understood either.

Cyclic-AMP is referred to as the 'second messenger'. It has this label because of its role of interacting with neurotransmitters that are considered to be the first-line messengers.

While such neurotransmitters might be considered first-line messengers, the operative word here is “messengers.” Those neurotransmitters might serve as messengers, but “something” else is responsible for when, where, how, and in what sequence they are being sent.

Generally speaking, when a given neurotransmitter is ‘alleged’ to attach to a receptor site (the term “alleged” is used here because there are theories that propose forms of communication which are not dependent on receptor site dynamics), one of the effects ensuing from this attachment is the synthesis of cyclic-AMP inside of the target cell. Cyclic-AMP is, then, distributed throughout the cell.

Apparently, the presence of cyclic-AMP helps to communicate some of the message that has come to the cell in the form of a given

neurotransmitter. More specifically, among other things, cyclic-AMP seems to help amplify -- by an order of quite a few magnitudes -- the relatively weak signal of the first messenger neurotransmitter.

In addition, cyclic-AMP tends to extend the period of duration during which the message conveyed by the first messenger is actively propagated. In other words, even though a neurotransmitter might have departed from the receptor site which, allegedly, initiated the synthesis of cyclic-AMP, nonetheless, the cyclic AMP continues to serve as a sort of proxy for the message/signal carried by the neurotransmitter.

The second messenger, cyclic-AMP, operates more slowly, relative to the pace at which many other neural processes take place. Consequently, the activity rate of cyclic-AMP might lend itself to helping to maintain those mental states that are more enduring such as memory, learning and consciousness, but what induces and regulates the temporal properties of cyclic-AMP and which enable it to be maintained over a period of time remains an open question.

In 1955, M. Calvin and A. T. Wilson detected, for the first time, an instance of a biochemical oscillator. The oscillator forms part of the process of photosynthesis. More specifically, the oscillator is located in the portion of the cycle known as the dark reactions.

Approximately ten years later, another example of a biochemical oscillator was discovered. More specifically, during the process of glycolysis, the primary means by which cells in many different organisms catabolically degrade glycogen, there are several enzymes involved in the breakdown of glucose that form an oscillating system.

Cyclic-AMP and its associated catabolic enzyme, phosphodiesterase, could, conceivably, form an oscillating system somewhat comparable to the systems existing in glycolysis and the dark reaction of photosynthesis. Moreover, cyclic-AMP might play a fundamental role in entraining a variety of biological rhythms of the body and mind.

The foregoing possible roles emerge for cyclic-AMP in the light of its pervasive, almost ubiquitous, rhythmic activity in so many parts of the body. On the other hand, even if the foregoing possibility were true, one has difficulty understanding how cyclic-AMP, in and of itself,

has the capacity to regulate biological rhythms to serve different kinds of functions related to biological rhythm.

Cyclic-AMP seems to be more of a tool. In other words, while cyclic-AMP might be used during the regulation of some aspect of biological functioning, nonetheless, cyclic-AMP doesn't seem to be the source of those regulatory dynamics.

Evoked potentials refer to specific kinds of electrical activity in the brain that arise in response to the presentation of certain stimuli. Evoked potentials can be distinguished from background electrical activity by means of various techniques of analysis involving computers and mathematics.

Different waveforms of evoked potential have been associated with different contexts of stimulation. For example, an evoked potential waveform known as P300 occurs whenever an individual is surprised by one of the events in a sequence of stimuli.

Another evoked potential is known as a "contingent negative variation." In less technical terms, this is known as an "expectancy wave".

As the latter expression suggests, such an evoked potential occurs when an individual is led to believe that a certain kind of stimulus will occur at a given point in time or at a given point in a series of events. As the time approaches for the stimulus to appear, the contingent negative variation waveform increases in amplitude.

The size of the amplitude increase will be a function of various factors. Such factors include: The personality, past history and current circumstances of the individual in whom the expectancy wave potential is being evoked.

An individual's perception of internal time consciousness can be affected by the structural character of the contingent negative variation waveform that is present. Generally speaking, the larger the amplitude of this wave -- that is, the greater the individual's expectations concerning the time of occurrence of a given event -- then, an individual's perception of the alleged duration during which such events take place within internal time consciousness (i.e., the experienced phenomenology of that event), relative to some external

measurement of the temporal duration of that event, will seem to take place more rapidly.

The experimental work of Robert Hicks, a psychologist, seems to indicate that the appearance of the expectancy wave can be traced to the activity of certain cells that are located in the frontal lobes of the cerebral cortex. Apparently, these cells either: (a) are responsible for the synthesis and release of the neurotransmitter dopamine (when activated by the action potential); or, (b) such cells are sensitive to the presence of dopamine (i.e., they have receptor sites on their membranes that, allegedly, are dopamine-specific and which, supposedly, modulate a cell's activity when dopamine occupies those receptor sites).

Hicks and other researchers have found that the perception of events in internal time consciousness can be affected by giving the individual drugs that either: Increase the synthesis and release of dopamine or which prevent dopamine from occupying the relevant receptor sites on the membranes of dopamine sensitive cells. Thus, for example, amphetamines -- which lead to increased synthesis and release of dopamine -- have the effect of speeding up the experienced perception of events in internal time consciousness relative to some external mode of temporal measurement concerning those events.

On the other hand, Haldol, which is a neuroleptic (i.e., a class of drugs used in the treatment of certain psychotic conditions), blocks the action of dopamine through competitive inhibition. As a result, the individual's perception of events, as measured by internal time consciousness, slows down relative to some external mode of temporal measurement with respect to those events.

Jeremy Campbell ties the expectancy wave phenomenon to the biological clock in the frontal lobes of the cerebral cortex. In other words, he believes that the cells which, supposedly, are responsible for generating the sense of the passing moment of the present are the cells giving expression to the individual's perception of internal time consciousness, and, therefore, according to Campbell, such cells are responsible for the individual's experience of the present as having a certain kind of structural character of duration.

Even if one were to accept the proposal that increases or decreases in the levels of dopamine in the receptor sites of the

membranes of certain cells in the frontal lobes are associated with the modulation of the individual's perception of internal time consciousness, this does not explain what is responsible for the processes that lead to the increase of dopamine production, or to the increase of substances that will block the action or synthesis of dopamine. In other words, the presence or absence of dopamine might be only a step in the causal sequence resulting in the modulation of an individual's perception of internal time consciousness.

In other words, dopamine does not necessarily initiate this causal sequence. It might only be one of the effects of such an initiatory process.

Consequently, in order to say that one understands what sets an expectancy wave in motion, or why a given expectancy wave has the amplitude it does, then, one is going to have to fill in quite a few missing facts. Moreover, these facts that are missing are not a matter of insignificant details because they go to the very heart of what is really going on in the case of the emergence of a contingent negative variation waveform of a given structural character.

For example, in the previously mentioned experiments conducted by Robert Hicks, the experimenters are the ones who are introducing amphetamines or Haldol into a given subject's biological system, and, when one forgets this aspect of things, then, amphetamines and Haldol assume a place in the causal scheme of things which tends to be misleading. More specifically, while amphetamines and Haldol might have a modulating role in relation to one's internal sense of temporal perception, neither of those molecules is necessarily what led to their being released into an individual's biological system.

In the aforementioned experiment by Hicks, the experimenters are the ones with regulatory oversight with respect to the entry of such molecules into a given's subject's biological terrain. However, when there is no experiment taking place, then, "something" else (other than the experimenters) must be regulating what takes place in the cells of a person's biological terrain.

In other words, irrespective of whether, not, there are (as Jeremy Campbell believes) cells in the frontal lobes of the cerebral cortex which are able to tie together, in some fashion, the expectancy wave phenomenon with some sort of biological clock, and irrespective of

whether those cells in the frontal lobes of the cerebral cortex are: (a) Responsible for the synthesis and release of the neurotransmitter dopamine (when activated by the action potential); or, (b) such cells are sensitive to the presence of dopamine, such a theory provides no account for how dopamine causes individuals to become conscious -- on some level -- of the presence and significance of such an evoked potential waveform.

All that has been shown, at best, is that there is an association, or correlation, between the presence of such a wave and the character of the individual's perception of internal time consciousness. The actual nature of the relationship, if any, between the wave and the individual's awareness of the wave is unknown.

The foregoing series of brief discussions concerning various chronobiological phenomena give expression to many of the buzzwords which are entangled with such phenomena. Many terms of relevance appear in those discussions.

The reader has been introduced to such notions as: Entrainment, frequency following behavior, circadian rhythms, attractor basins, self-same or self-similar dynamics, chaotic and linear attractors, phase relationships, diapause, master biological clocks, taus, oscillatory systems, light/dark activation, suprachiasmatic nucleus, temporal identity, temporally active hormones, ultradian cycles, harmonic properties of biological cycles, the pineal gland as a neuroendocrine transducer, molecular communication, neuropeptide Y, serotonin, dopamine, acetylcholine, norepinephrine, adrenal clocks, cyclic-AMP, secondary messengers, melatonin, aminergic/amine force, brainstem, cholinergic force, pons, REM cycles, sleepability windows, wakeability windows, critical periods, larks, owls, long-term and short-term memory, Belousov-Zhabotinsky reactions, evoked potentials, and expectancy waves. The foregoing terms can be strung together in a variety of combinations, and those strings can be used – as has been done throughout the present chapter -- to accurately describe a great deal of the phenomena which are being explored by chronobiologists, and, yet, almost nowhere amidst the foregoing terminology is one ever likely to arrive at any understanding which will explain what is

responsible for regulating the phenomena to which the foregoing terms are alluding.

Relatively recently, I read most of an interesting book entitled: *The Body Clock in Traditional Medicine: Understanding Our Energy Cycles for Health and Healing* by Lothar Ursinus. The author indicates that every organ of the body is characterized by daily cycles which exhibit both a zenith and nadir of activity.

For instance, the kidneys tend to display their greatest level activity between the hours of 5pm and 7pm. On the other hand, their lowest level of activity in the kidneys occurs between the hours of 5am to 7am.

Lungs, on the other hand, tend to exhibit their most intense period of activity between 3am and 5 am, whereas the low point of lung activity tends to occur between 3pm and 5pm. Perhaps somewhat ironically, the period of highest activity for the lungs is also the time frame within which many ill and old people will take their last breath – perhaps due to the challenge of having to operate at a heightened level of, among other things, lung functioning.

The zenith of colon activity is between 5 am and 7am, whereas the nadir of colon activity tends to take place within the two-hour window of 5pm and 7pm. According to Traditional Chinese Medicine, the relationship between the lungs and colon is somewhat polar in nature, and, consequently, pathological conditions sometimes are diagnosed as being due to some sort of problem involving the way these two, somewhat polar opposites get along with one another.

The height of stomach activity is manifested between 7am and 9am, while the low point of stomach activity takes place roughly ten hours later between 7pm and 9pm (which also is the case in conjunction with the kidneys, the lungs and the colon). Moreover, as is true with respect to kidney, lung, and colon activity, cycles, the windows for high and low level functioning in the stomach come in increments that are roughly two hours long.

The high tide for heart activity runs between 11am to 1pm. The heart's low tide of activity tends to occur between 11pm and 1am. The heart transmits more electromagnetic energy than any other organ.

That field is generating waves which are detectable a number of feet distant from the person whose heart is pumping them out.

In addition, the heart has been discovered to contain a nervous system which is more complex than the one which exists in the brain. Measurements have been made which indicate that the magnetic component of the electromagnetic field generated by the heart is 5,000 times more powerful than the magnetic component of the electromagnetic field which is generated by the brain, and the electrical component of the heart's electromagnetic field is a 100 times greater than what is generated through the brain.

Just as Jerry Tennant pointed out in his book: *Healing Is Voltage*, that there is a relationship between the teeth and different organs of the body, so too, Traditional Chinese Medicine indicates that certain teeth have a relationship with certain organs or organ systems. For example, if one identifies teeth according to the dental numbering system, then, upper teeth 14 and 15 on the right side as well as upper teeth 24 and 25 on the left side are linked to both the colon and lungs, whereas the teeth numbered 16, 17, 26, and 27 in the upper jaw, as well as teeth 34, 35, 44, and 45 in the lower jaw have links to the stomach. The teeth which are identified with heart activity are 18, 28 38, and 48 – the wisdom teeth.

The small intestine, bladder, pericardium, gall bladder, liver, spleen/pancreas, and large intestine, all have their characteristic two hour periods of high and low activity levels that are separated by an interim period of approximately ten hours. In addition, all of the foregoing organs have their individual relationships with teeth that are located in different parts of the mouth.

The foregoing activity levels are a function of the ways in which the dynamics of different organs interact with Qi (prana-nur-qi) by means of twelve principle meridians of energy flow. Each of those twelve meridians is responsible for a particular organ or organ system.

As indicated in Volume 1 of the present book, Qi (prana-nur-qi) is identified in Traditional Chinese Medicine as the organizing intelligence which arranges for the ways in which energy is coupled with organ activity and helps to shape the dynamics which take place during such activity, in terms of both the zenith and nadir of such organ activity. However, what does not seem to be explained in the

source of the organizing intelligence which is running through the system of 12 principle meridians (along with some more minor meridians) and, in the process, has regulatory oversight concerning the activities of different organs and organ systems.

Traditional Chinese Medicine is concerned with understanding what holistic, synchronized functioning should look like with respect to how different organs or organ systems should operate in conjunction with the principle meridians. Such an understanding can be used as a sort of reference template against which to assess the symptoms which might arise when organ, organ systems and the flow of Qi is prevented from giving expression to holistic, synchronized, healthy functioning.

Consequently, to be an effective form of medicine, Traditional Chinese Medicine does not necessarily have to understand the source of the organizing intelligence which is manifested through the presence of Qi (prana-nur-qi). Nonetheless, the presence of Qi (prana-nur-qi) can be understood through its fruits.

With a bit of reverse engineering -- which has taken place over a period of some 5,000 years -- the physicians who practice Traditional Chinese Medicine have become familiar with what Qi (prana-nur-qi) can do when it is permitted to run properly within the body. Those physicians also have become familiar with what happens when the relationship between Qi (prana-nur-qi) and organs becomes destabilized, and how to proceed in order to address the best forms of treatment through which such destabilized biology might be best returned to a healthy, stable, holistic, synchronistic form of functionality.

Notwithstanding the foregoing considerations, questions concerning the source of the organizing intelligence to which Qi (prana-nur-qi) gives expression continue to persist. One thing, however, which is clear, seemingly, is that whatever makes Qi (prana-nur-qi) possible does not seem to be a function of biology, but, rather, biology appears to constitute a complexly structured medium whose dynamics are being regulated by “something” more deeply hidden.

Chapter 23: Entangled Phenomena

Erwin Schrödinger introduced the term "entanglement" in an article that appeared in the *Proceedings of the Cambridge Philosophical Society*. It refers to a phenomenon in which quantum entities that once were engaged in a dynamic of some kind are able to continue to be sensitive to certain modalities of change taking place with respect to one another despite having become separated from each other by considerable spatial distances.

One of the reasons – but not the only one – that stood in the way of Einstein being able to whole-heartedly endorse quantum theory (despite his acknowledgement of its heuristic value) involved the issue of spooky actions at a distance that seemed to be entailed by quantum dynamics. He wanted physical events to take place within a framework of time and space that wasn't haunted by ghostly interactions among quantum particles that apparently were able to operate contrary to the way in which Einstein believed reality worked.

More specifically, Einstein maintained that events are constrained by the condition of locality. He believed that in order for one object to affect another, there had to be some form of direct contact involving those objects and through which they were causally affected.

Furthermore, Einstein believed that any mode of contact that acted upon some object took time to occur. Therefore, according to Einstein, one object could only affect another object if the two objects were linked through conditions of locality involving time and space that could account for how an effect arose out of a cause when two objects were contiguously connected, in some dynamic fashion, via time and space.

Entanglement, however, appeared to violate the condition of locality. The interaction between two objects said to be entangled seemed to be instantaneous and, therefore, of a nonlocal character.

In other words, the phenomenon of entanglement did not appear to require any traversing of a distance in space that took some period of time to complete. This idea of nonlocality was the spooky and ghostly action at a distance to which Einstein was referring in, among other places, the position developed by him as well as Podolsky and Rosen in 1935.

The action at a distance problem had previously raised its mysterious head in 1688 when Newton stated in his work, Principia *Mathematica* that while the power of gravity was: Real, observable, capable of being quantified, and law-like in its behavior, nonetheless, he didn't have any idea how gravity was propagated between objects. He stipulated in his book that he would not frame any hypothesis ("hypotheses non fingo") concerning how gravity did what it did, but however gravity worked Newton assumed that the phenomenon operated instantaneously.

In his general theory of relativity, Einstein removed the spooky action at a distance dimension of Newton's theory that was implicit in the notion of instantaneousness. Instead, Einstein believed that gravity traveled at the speed of light, and, therefore, gravity like everything else in the universe was subject to the condition of locality.

Although Einstein's assumption concerning the speed with which gravity propagated its effects was subsequently proven to be true, mysteries concerning the nature of gravity continue to this day. Einstein's general theory of relativity described gravitational phenomena in terms of geometry, and, indeed, he said that gravitation is geometry, but nonetheless, the actual nature of gravity continues to elude the scientists of today as much as its nature eluded Newton in his day and Einstein in his time.

The issue of nonlocality was not the only problem Einstein had with quantum theory. He also took exception with the way many physicists apparently were willing to doom reality to being nothing more than a function of statistics and probabilities that were independent of any kind of an underlying reality – sometimes referred to as hidden variables – that were responsible for generating and shaping the physical dynamics that were being described through the statistics and probabilities that came to be associated with quantum events.

Einstein was perfectly willing to use the mathematical techniques of statistical mechanics and quantum probabilities to describe various physical phenomena – such as in relation to Brownian movement. However, Einstein believed there was some sort of underlying physical dynamic which was taking place that was being described, within limits, through those mathematical techniques.

For example, initially, Max Planck treated his notion of quanta as being merely a sort of arbitrary mathematical construction that could help reconcile mathematical descriptions of various forms of radiation with experimentally determined results. Initially, he didn't consider quanta to be real, and he was critical of Einstein when the latter individual claimed that light was a function of Planck's imaginary quanta and could be used to account for why a small current of electricity would be produced when light was directed toward certain metals and, in the process, gave expression to the photoelectric effect.

Not only did Einstein's account of the photoelectric effect treat Planck's mathematical artifact as real, but, as well, Einstein was throwing down the gauntlet with respect to a long-standing understanding – established through the interference experiments run by Thomas Young in 1801 -- that light was presumed to propagate as a wave. According to Einstein, light propagated in the form of discrete packages of energy or quanta.

In 1924, Louis de Broglie appeared to re-introduce the relevance of wave descriptions with respect to quantum phenomena. De Broglie hypothesized that there is a wavelength, λ, which can be linked with any particle or object that is related to the latter's momentum, p, via the Planck constant, h.

Conceivably, Planck, Einstein, and de Broglie might have been both correct and incorrect at the same time. Perhaps, one needs to make a distinction between the mathematics that is used to describe some given phenomenon and the reality to which such mathematics alludes.

For instance, are quantum phenomena wave-like or particle-like? Many experiments over the years have demonstrated that under various conditions quantum events give expression to phenomena that have properties that can be reliably described through the mathematics of waves as well as through the mathematics of quanta.

Some scientists have referred to the presence of the foregoing sort of duality as an indication that quantum phenomena are both wave-like and particle-like. The term "wavicles" is sometimes used to refer to that sort of duality.

However, one also might argue that reality is not necessarily either wave-like or particle-like, but, instead, gives expression to something more fundamental than quantum events … something that has the capacity to manifest wave-like and particle-like properties under the right conditions. As such, quantum events constitute an intermediate medium of sorts that operates in accordance with a set of principles that, depending on circumstances, has the capacity to generate either wave-like or particle-like phenomena even as those principles are neither necessarily wave-like nor particle-like in character.

If this is the case, then, maybe, one should be careful to distinguish between, on the one hand, the inherent nature of reality, and on the other hand, the quantum properties (which are being described mathematically) which are a function of an underlying dynamic. If the reality being alluded to through the mathematics of quantum mechanics is treated as that which makes a given set of properties possible and which can be accurately described, under different circumstances, through both wave-like (e.g., de Broglie and Schrödinger) and particle-like treatments (e.g., Einstein and Compton), then, the mathematics does not necessarily fix or determine what such events actually are. Rather, the mathematics merely describes some of the phenomena to which the underlying reality – whatever it might be -- gives rise.

In other words, perhaps, quantum events are neither a function of waves nor a function of particles. The reality underlying quantum events is something that can give rise to phenomena that are both particle-like and wave-like in character but that "something" cannot be reduced to being either wave-like or particle-like in nature.

If one were to adopt the perspective that has been outlined in the last several paragraphs, then, one might come to understand how Planck, Einstein, and de Broglie could be considered to be simultaneously both correct and incorrect. For example, Planck might have been correct to consider the notion of quanta as merely being a mathematical construction that helped solve some problems involving certain problems in thermodynamics, but, at the same time, Planck also might have been wrong to want to claim that quanta were not tied, in a rather complex manner, to an underlying reality that

constrained the value of Planck's quantum of action to be a constant of a given kind (i.e., $6.62606957 \times 10^{-34}$ m^2 kg/s) … in other words, quanta were not real in any fundamental sense, but the nature of that which constrained the phenomena to which the term "quanta" alluded was real and not an arbitrary artifact of his mathematical calculations.

Similarly, Einstein might have been correct to indicate that when light is directed toward certain kinds of metals, then, one will observe a small electric current that can best be described as a particle-like phenomenon. On the other hand, Einstein also might have been wrong to suppose that the underlying reality that was making such a particle-like phenomena possible was, strictly speaking, a function of quanta … but, instead, dynamics were being constrained by "something" as well as organized in such a way that made reality appear to be particle-like in nature.

In other words, the quantum aspect of Einstein's mathematical description concerned only the properties of the phenomenon that were being manifested in the photoelectric effect but did not necessarily capture the nature of what gave quanta their properties under such conditions (e.g., what is the origin of the particular constant value of any given quantum package?). As such, Einstein's quanta were a surface phenomenon that were functionally dependent on an underlying set of hidden variables that gave rise to a phenomenon (the photoelectric effect) whose surface or manifested features could be accurately captured through Einstein's particulate approach to the photoelectric effect.

Finally, applying the same sort of analytical perspective that has been used in conjunction with Planck and Einstein, one also might come to the conclusion that Louis de Broglie could be considered to have been both correct and incorrect when he said there is a wavelength that is associated with every material object or particle that is related to the momentum of that particle by means of Planck's constant. De Broglie is correct because the mathematical relationship he is alluding to in his hypothesis does accurately describe certain facets of the phenomena that arise in conjunction with quantum dynamics, but the wavelength that is associated with a particle is part of the mathematical description of a phenomenon which is manifested in a wave form but which is a function of something which is neither a

wave or particle in any essential sense, and, therefore, the aforementioned wavelength does not necessarily capture the nature of what it is that gives rise to the properties being described by de Broglie through the language of waves.

Manifestation is one thing. That which makes such a manifestation possible is another thing.

Einstein objected to the idea of considering statistics and probabilities as being the final word concerning the nature of reality. He believed in the reality of a set of hidden variables or underlying processes and/or entities and/or forces that could account for why the statistics and probabilities used in quantum descriptions had the properties they did.

There is a similar sort of argument that might be directed toward those who wish to claim that wave-like and/or particle-like descriptions are the final word concerning the nature of the reality to which such descriptions refer. The wave-like and particle-like terms are similar to the statistical and probabilistic terms that are generated through quantum calculations in the sense that both sets of terms could be considered to be functions of a deeper or hidden dimension of reality that gives rise to phenomena that can be described in terms of particles, waves, statistics, and probabilities but, in fact, cannot be reduced to such terms because those terms are restricted to the surface level of manifestation and do not necessarily accurately represent that which makes such surface level phenomenal manifestation possible.

Einstein believed in the idea of a realm of hidden variables – that is, some sort of fundamental bedrock of reality -- that existed independently of the statistical and probabilistic mathematical language used to describe various phenomenal events that arose through such underlying dynamics. The problem is, however, there could be more than one level of hidden variables and, therefore, when Einstein accounted for the photoelectric effect by treating light in terms of particle-like quanta, then, in his own way, Einstein might have been committing a similar sort of mistake as those (e.g., Bohr, Heisenberg, Born, and others) with whom he disagreed when they tried to limit the nature of reality to statistical and probabilistic descriptions, and, consequently, Einstein's notion of hidden variables

notwithstanding, there might be at least one more level of hidden variables that existed beneath the surface phenomena of light and that constrained light to behave as if it were particle-like even as that level of hidden variables is not necessarily particle-like in character but can, under the right circumstances, give rise to phenomena that can be described effectively through mathematical descriptions that treat such phenomena as if they constitute a reality that is particle-like in nature.

There is a story (possibly apocryphal) associated with Richard Feynman, one of the architects of the modern Standard Model of quantum theory that resonates, to a degree, with the foregoing perspective. Various sources have reported that a graduate student came to Feynman one day after the student had gone through a period of study and reflection that nearly drove the student crazy as he tried to understand what the actual nature of reality was that was being parsed by various kinds of mathematical equations, techniques, and so on. After listening to the student talk about his feelings of perplexity and despair concerning such matters, Feynman is reported (by some) to have said: "Just do the calculations … no one understands what is going on."

Planck, Einstein, de Broglie and many others found ways to mathematically treat observed phenomena that enabled them to generate calculations that solved an array of problems. However, in doing so, they came up with solutions that were vulnerable to conflicting interpretations concerning the nature or meaning of the sort of 'reality' to which their calculations were alluding or attempting to describe.

Feynman was a pragmatist. He was in favor of proceeding in ways that led to generating reliable and effective solutions with respect to various physical problems and, as a result, he was prepared, within certain limits, to put aside questions concerning the ultimate nature of reality … especially if such questions got in the way of being able to discover methods for solving certain kinds of problems.

Einstein was a realist. While he was quite prepared to just do calculations that were rooted in statistical and probabilistic models without necessarily being able to understand what was transpiring beneath the surface phenomena being described by various

mathematical techniques, nonetheless, he fervently believed that beyond the calculations there existed some ultimate realm of physical law consisting of hidden variables – at least they were hidden until they could be identified and properly understood -- that were generating phenomenal properties that could be described through the language of statistics and probabilities.

Although the early theory of quantum mechanics had generated many successes, nonetheless, by the early-to-mid 1920s a variety of problems began to emerge that could not be handled adequately by the initial set of methodological and mathematical approximations that had been devised for describing how certain facets of the physical world operated. These problems included the issue of whether light was particle-like or wave-like in nature but also involved difficulties that arose in conjunction with developing an adequate account of how light was absorbed and emitted by atoms under different conditions.

Consequently, many physicists felt that a new approach of some kind was required … an approach that would be able to build upon what already had been achieved but a perspective that also could help lead exploration in a different direction that might be able to solve some of the problems that were beginning to accumulate. Over a period of several months in 1925, Werner Heisenberg decided to try his hand at making a constructive contribution to the aforementioned crisis of understanding.

He started out with the intention of attempting to find some workaround in relation to the notion of an electron's orbit. Niels Bohr introduced the idea that an electron might move in an orbit around the nucleus of an atom … somewhat like the way in which planets travel in a fixed orbit around a sun.

Bohr's model of the atom was an attempt to improve on the earlier 'plum pudding' model of atoms (proposed by J.J. Thompson in 1904) in which negatively charged electrons were described as being distributed throughout some sort of positively charged, homogenous medium. While Bohr's planetary-like refashioning of the model of the atom initially attracted a lot of interest (especially with the general public), it had at least one fatal flaw.

If electrons traveled in an orbit like planets around the sun, then electrons should exhibit angular acceleration. That is, electrons would

be constantly changing their direction of movement as they sped about their orbit at some constant rate.

Generally speaking, electrons emit light during the process of acceleration (that is, changing directions during the process of moving through an orbit). As a result, electrons would lose energy as they circled about the nucleus, and, eventually, this would mean that electrons were likely to spiral inward toward the nucleus – eventually crashing into the nucleus -- and, in the process, destabilize the atom.

Bohr came up with a solution to the foregoing problem by re-conceptualizing the notion of an orbit. Instead of conceiving of orbits as paths that circled around the nucleus (and, therefore, were vulnerable to losing energy through emitted packets of light), Bohr treated an orbital as a stationary state that, somehow, permitted electrons to avoid constantly losing energy while occupying that state.

Although electrons could move from one orbital state to another through processes of absorbing or emitting packages of energy of a discrete nature, electrons were otherwise constrained … especially with respect to any sort of movements that might result in a spiral of destruction that ended with a crash-landing into the nucleus. However, Bohr's proposed solution was relatively arbitrary because there was no concrete evidence demonstrating what electrons actually did when present in an atom.

To be sure, the behavior of electrons was consistent with the conditions that Bohr imposed on the hypothetical stationary state orbital. However, how any of this actually took place -– in an ontological sense -- was unknown because no one could directly observe the manner in which an electron occupied its alleged orbital state or how an electron moved from one such 'orbital' state to another.

Heisenberg wanted to eliminate the notion of an atomic orbit precisely because no one could see the actual dynamics of electrons within Bohr's hypothetical stationary state orbital. Consequently, Heisenberg decided to focus on what could be observed – namely, the packages of energy that were absorbed or emitted by atoms.

In order to accomplish his aim, Heisenberg came up with a mathematical way to calculate answers capable of describing some of

what was transpiring during the process of an atom's absorbing or emitting energy. Not entirely sure about the viability of his mathematical construction, Heisenberg left his work with his mentor, Max Born, and Born eventually came to realize that Heisenberg had developed a way of solving certain problems concerning the atom that was connected to the mathematics of matrices.

Heisenberg's breakthrough led to what became known as matrix mechanics … the use of matrices to represent and make calculations concerning certain aspects of the behavior and properties of electrons in transition. However, the development of matrix mechanics was not solely due to Heisenberg's initial breakthrough since the method was further refined through the collective efforts of Heisenberg, Max Born, and Pascual Jordan.

Without understanding the actual dynamics of electrons within an atom any better than Bohr did, Heisenberg had devised a method of calculating answers that was capable of generating usable and reliable results concerning the behavior of electrons within an atom. Heisenberg's mathematical invention didn't clarify the ontological nature of the underlying reality concerning how electrons did what they did within an atom, but, instead, his perspective served to help scientists to be able to run with Bohr's idea of stationary state orbital and, in the process, solve problems even though no one really knew what was going on as far as the dynamics were concerned with respect to how an electron actually occupied an orbital (if they did) or were able to move about in an orbital – if that is what they did – or how electrons made the transition between orbital states.

During 1925, and carrying over into 1926, Erwin Schrödinger constructed an equation that he hoped would be able to replace the matrix mechanical model. Although the Heisenberg/Born/Jordan method did offer a mathematical means through which to solve certain problems, that model also was very abstract in character because it did not permit one to have any sort of working image of what was taking place in an atom.

The matrix mechanical model was like a black box. Empirical values could be entered into that computational device, and output values based on such input data could be calculated by running them through a set of matrices that were provided by the model, but one

had no understanding of the actual dynamics that were taking place while the model was grinding out its solutions.

Schrödinger's differential equation was intended to serve as a means through which to model how de Broglie's wave function -- that supposedly was associated with each particle -- unfolded over time. Consequently, it became known as a wave equation.

However, there were some difficulties surrounding the meaning of Schrödinger's equation. If one understood Schrödinger's equation to be a description of particles as a waveform, then the equation indicated that such a wave should continue to expand in all directions becoming improbably large in the process, and as the purported wave did so, that description becoming increasingly at odds with an array of empirical data.

There were a few other problems as well that were caught up in the wave equation. For example, when that equation was used in calculations involving several particles, more than three dimensions were needed to solve problems, but no one really knew how to reconcile those extra dimensions with what was believed to be a three-dimensional reality.

In addition, the equation involved the use of imaginary numbers. How was one supposed to reconcile the imaginary with the real?

As far as trying to get a picture is concerned with respect to the way reality worked, physicists seemed to be no better off with Schrödinger's wave equation than they were with matrix mechanics. In other words, trying to figure out how: (a) Imaginary numbers, (b) expanding wave functions, and (c) more than three dimensions might fit together to give a coherent picture of the dynamics involved in quantum interactions was as problematic as it was to try to understand what the abstract character of matrix mechanics meant with respect to the actual, ontological nature of those dynamics.

Max Born – who had worked with Heisenberg and Jordan in the development of matrix mechanics – found a way to re-fashion Schrödinger's wave equation so that it would be able to generate reliable answers, but his idea came with a price. More specifically, contrary to Schrödinger's initial intention to put forth a mathematical model through which one could obtain a concrete image or sense of

wave phenomena from a quantum perspective, Born's interpretive reconstruction of Schrödinger's equation jettisoned the notion that the equation described the nature and/or behavior of an electron and, instead, contended that the equation (when properly reworked) described a set of probabilities for locating where an electron might show up in a given set of physical circumstances.

In short, Born was treating Schrödinger's equation as a black box just as matrix mechanics gave expression to a mathematical black box. In each instance, one lost contact -- to some extent – with reality in order to be able to establish a method for generating calculations that gave rise to workable solutions for various problems in quantum dynamics.

Schrödinger's equation didn't describe the dynamics of a particle. It constituted a way of descriptively capturing the possible outcomes of those dynamics.

What were electrons doing prior to such calculations? No one knew!

How did electrons give rise to such probabilities? No one knew!

Why should Schrödinger's equation be able to describe where one might find a given particle or why that particle could be associated with such a probability distribution? No one knew!

How and why did electrons pop up in one location rather than another? No one knew!

Did Schrödinger's equation actually describe reality? To some extent it did, and to some extent, it did not.

The equation made precise predictions that usually reflected certain aspects of ensuing reality. However, no one understood what made those predictions turn out correctly in the way they did.

Unfortunately, somewhere along the line, quantum physicists reified methodology and began to treat probability distributions as ontological in character rather than merely being descriptive of certain kinds of outcomes. Niels Bohr was one of the chief architects of this approach to quantum phenomena … an approach that came to be known as the Copenhagen interpretation of quantum mechanics (although this was not Bohr's choice of words).

For instance, consider Heisenberg's uncertainty principle. As originally conceived, the uncertainty principle was about how one's ability to simultaneously determine precise values for certain pairs of variables -- such as momentum and position – was methodologically limited.

The more accurately one sought to determine the momentum for a given particle, the more such an attempt would interfere with one's ability to accurately determine the position of that particle. The reverse also was true.

The formal expression of the uncertainty principle is: $\sigma_x\sigma_p \geq \hbar/2$ (developed by Earle Kennard and Hermann Weyl during the period 1927-1928). This inequality states that the standard deviation of position and the standard deviation of momentum, when considered together, are greater than or equal to the reduced form of Planck's constant (that is, $h/2\pi$).

When Heisenberg made the idea of the uncertainty principle public in 1927 through the pages of a paper on that topic, he used the example of a microscope. More specifically, if one were to use light to determine the precise position of a particle, then, the extent to which that position could be accurately resolved would depend on the wavelength of the light being used to measure position.

The smaller the wavelength of light employed, then the more energy will be contained in that light. While such a wavelength can help one to narrow down the measured position of a particle, that same light energy also will impact the momentum of the particle being measured.

The very methodological process of trying to simultaneously measure position and momentum would affect the accuracy with which one could determine values for the conjugate properties of that particle (such as position and momentum). If one attempted to pin down the position of the particle, this attempt to establish greater precision would affect the precise measurement of momentum, and if one simultaneously tried to determine the momentum of a particle using light energy, then such a measurement would adversely affect the precision with which one could determine the position of that same particle.

When Heisenberg discussed his microscope example with Bohr, Bohr accepted – to a degree -- the uncertainty principle that was being illustrated through the microscope scenario, but Bohr maintained that Heisenberg's microscope example carried unwanted implications because it suggested not only that there was a definite path being followed by a particle that could be impacted by the light energy being used to measure things, but, as well, Heisenberg's microscope example suggested that during instances when nothing was being measured, then, particles would have some determinate ontological position and momentum that was on-going independently of the measuring process.

Bohr believed that Born's probabilistic version of Schrödinger's equation indicated that all one could talk about were the probabilities associated with different possible paths of a particle. One could not talk about the paths themselves.

As a result, Bohr insisted that particles did not move along a specific path. In doing so, he confused and conflated mathematical description with ontology.

Bohr did not possess any evidence indicating that particles could not or did not follow specific paths. All he had were the methods of matrix mechanics and Born's reworking of Schrödinger's equation.

Each of those computational techniques entailed a hermeneutical variation on Heisenberg's uncertainty principle. In other words, the more one focused on determining the character of the behavioral outcomes of quantum processes, the less one understood how such outcomes were possible in the first place.

Bohr was correct when he maintained that being able to calculate a probability for where a particle might appear did not necessarily imply that such a particle had to follow a particular path in order to be able to arrive at the point of manifestation predicted by such a calculation. However, Bohr was wrong to suppose that Born's reworking of Schrödinger's equation necessarily implied that particles did not, and could not, follow a particular path to the point where the particle was predicted as having a certain probability of showing up.

The fact of the matter is, physicists didn't know why matrix mechanics or Schrödinger's equation worked. They just knew that they did.

Rather than admit that Schrödinger and Born had stumbled on to something that worked but did so for unknown reasons, some individuals – such as Bohr – decided to invest the mysteries surrounding the functionality of the wave equation with ontological value. Probability distributions did not just have descriptive value, but, as well, they reflected the nature of reality itself.

Bohr maintained that a particle didn't have momentum, position, or any other quantum property until the act of measurement generated a specific value. Somehow (and Bohr never explained how), the process of measurement transformed a dimension of the probable into a real world value.

Yet, one wonders about the nature of such a transformation process. If particles have no ontological value until a measurement is made, then, how does a probability get turned into a reality?

In addition, what sort of reality is a probability? A probability is a description of a certain facet of reality so, at the very least, probability refers to certain behavioral properties of that which is being described.

Yet, beyond such a descriptive quality, what reality did probabilities have? What made that to which probabilities referred have the properties being alluded to through probabilities?

What is the nature of the dynamic that allegedly takes place on the quantum level involving the manner in which the process of measurement somehow engages probability to produce an ontological entity with concrete values? How does a measurement generate something real out of – seemingly – a non-ontological entity (i.e., probability)?

Between 1927 and 1930, Einstein attempted, informally, to poke holes in Bohr's belief about the manner in which uncertainty allegedly permeated reality. Bohr maintained that the issue of uncertainty was inherent in the nature of things and was not just a function of being unable to come up with a methodological means for detecting the presence of hidden variables and/or an inability to demonstrate that

there might be experimental ways to uncover more information concerning a situation than the uncertainty principle said was possible.

While attending several Solvay Congresses (one of the primary scientific venues during the 1920s and 1930s – and which began in 1911 -- through which scientists discussed their ideas and discoveries with one another), Einstein devised a number of thought experiments that were intended to challenge Bohr's aforementioned position concerning uncertainty. On each occasion, Bohr was able to point out difficulties with one or another aspect of Einstein's thought experiments.

However, in repelling Einstein's various challenges, Bohr wasn't proving that his own perspective was correct. Bohr was demonstrating that there were problems with Einstein's way of engaging the uncertainty issue.

Einstein was trying to show that reality was not inherently uncertain in nature. However, even if Einstein had only been trying to demonstrate that uncertainty was a purely methodological issue and not an ontological one, Bohr's counterarguments would have succeeded because there were, in fact, conceptual problems with each of Einstein's thought experiments … details and considerations involving the issue of uncertainty that Einstein had not taken into account when devising his theoretical challenges to Bohr's position.

For instance, consider Einstein's initial challenge to Bohr's perspective. Einstein described an experiment in which a beam of electrons is fired toward a narrow slit, and after passing through the slit, the electrons begin to behave in a wave-like fashion and fan out instead of acting as if they were particle-like in nature and, thus, continuing to move in a straight line.

Einstein's thought experiment specifies that on the other side of the slit area, there is, at some arbitrary distance from that slit, a semicircular shaped film. According to the Copenhagen interpretation of quantum theory, one cannot know where the electron is or in what state it is in until it strikes the film at some point, thereby blackening the film and, in the process, generating a measurement event.

Einstein found such a description troubling. More specifically, if all quantum theory could do was to compute a probability distribution that described where the electron might engage the film, then Einstein argued that this was tantamount to saying that every portion of film had some random probability that could be assigned to it and which would indicate the likelihood of that portion of the screen being impacted by the electron.

However, if the Copenhagen interpretation of quantum theory were correct, then Einstein believed that the foregoing sort of description would seem to mean that every other portion of the film that was not impacted by the electron when the latter entity engaged the film would – in a mysterious fashion -- have to be able to receive communication of some kind informing it not to turn black. According to Einstein, such communication would have to be instantaneous – meaning that all points in the semicircular film were connected in some way.

Bohr's response to Einstein's thought experiment was one of confusion. He didn't seem to grasp the thrust of Einstein's argument.

If someone claims confusion, trying to figure out the nature of the confusion becomes a rather difficult – and, perhaps, somewhat fruitless --exercise … at least as far as Bohr is concerned. Nevertheless, there is a certain amount of confusion inherent in Einstein's thought experiment, and bringing the nature of that confusion to light could be a productive exercise.

In Einstein's thought experiment, once an electron is shot in the direction of the narrow slit arrow, no one knows what is going on. This is not necessarily because there is some kind of uncertainty that is inherent in the nature of reality but because there are no empirical eyes on the electron prior to the time it shows up at the slit … and, perhaps, not even then.

At the slit, Einstein indicates that the electron appears to undergo a transition due to diffraction and, as a result, the electron begins to spread out as it moves toward the film. Diffraction is inferred to have occurred because of subsequent results that manifest themselves in conjunction with the film, but no one has actually seen what happens when the electron passes through the slit, and, therefore, the precise character of quantum dynamics taking place at the slit are unknown.

At one point, the electron appears to behave in a particle-like fashion (as it is sent toward the slit area). At another point, the electron seems to behave in a wave-like fashion (apparently due to the process of diffraction as the electron engages the narrow slit area).

Quantum theory predicts how an electron behaves in a certain set of circumstances (such as Einstein's thought experiment). That theory can't explain how an electron is able to manifest particle-like properties at some points while manifesting wave-like properties at other points.

Quantum theory computes a probability distribution to describe what will happen once a beam of electrons is sent toward the slit. No one knows what the electron is doing (or not doing) once it has been released, and no one knows what the precise nature of the dynamic is that takes place at the slit area, and no knows where the electron will engage the film, but the computed probability distribution descriptively encompasses all possibilities involving such an impact event.

Probabilities do not necessarily determine where an electron will blacken the film. Rather, electrons act in a way that gives expression to some aspect of the probability distribution used to describe that behavior.

The probability distribution profile is useful because it accurately describes the manifested behavior of an electron under a given set of circumstances. Nonetheless, the probability distribution gives expression to only one kind of understanding … namely, the likelihood that an electron will blacken the film at one point rather than another and has no insight into the actual nature of the dynamic through which the film becomes blackened.

Nothing else about the behavior or state of the electron is known from the time the electron is released until to the time when a point on the film becomes darkened. Everything that is said -- about the behavior or state of the electron between: The moment of release, until: The time when the film is reached – are inferences based on observed behaviors (the darkening of the film).

The probability distribution can't tell anyone why electrons behave in the manner described by such a distribution. The distribution only indicates that this is the way things seem to turn out.

Statisticians and probability theorists are very good at coming up with figures to assign probabilities for what proportion of a given population is likely to commit suicide or develop cancer or die in a traffic accident or get divorced over the course of, say, a year. However, those statisticians cannot tell one when, why, where, or how any of the foregoing possibilities will happen … only that such events are likely to take place in the way that is indicated by various probability functions.

To a fair degree, the foregoing considerations also hold in relation to quantum mechanics. Physicists can generate computations concerning the probability that a certain kind of quantum event will take place in a given set of circumstances, but they can't always say when, why, where, or how such events will take place.

Probability distributions don't cause suicide, cancer, traffic accidents, or divorce. Similarly, probability distributions don't cause quantum events, but as is true in conjunction with suicide and so on, what goes on in quantum dynamics does tend to reflect the probability distributions that have been drawn up to describe certain facets of those dynamics.

Einstein devised his foregoing thought-experiment because he thought that the Copenhagen interpretation of quantum mechanics committed its proponents to maintaining that quantum events were random occurrences that could manifest themselves on any portion of the film and, consequently, the probability distribution appeared to be playing some sort of a causal role with respect to where electrons actually showed up … after all, if there were nothing beyond the probability distributions (i.e., no hidden variables determining why one thing rather than another took place), then, what else could account for why one part of the film was blackened rather than a different point on the film -- except uncertain, random events.

As a result, Einstein was concerned that if quantum events were really a random phenomenon and if probability distributions were somehow playing a causal role in determining where the film would become blackened, then, presumably, all of the other points on the

screen would have to be informed – in some instantaneous fashion -- not to become blackened.

What is really meant by the idea that something is random? Whenever one uses the term "random", one is either stating a position of ignorance concerning why a given dynamic occurs in the way it does or one is putting forth an ontological theory about how the universe operates on its most fundamental level.

Bohr was doing both in the Copenhagen theory of interpretation concerning quantum events. According to Bohr, reality was inherently uncertain and random in character and, as a result, he turned the uncertainty principle from a methodological problem (the limits of precision) into an ontological statement about the nature of reality – and reportedly reduced Heisenberg to tears while doing so.

However, statements involving probability distributions had an ambiguity about them that helps to lend confusion to the Einstein-Bohr dust-up. Such statements could be used in conjunction with mathematical computations that generated descriptions about certain aspects of quantum behavior, or they could be used to give expression to a theory concerning the inherent nature of reality … and whether, or not, reality is uncertain, random, and probabilistic in nature.

There was no evidence to demonstrate that reality could be reduced to being nothing more than uncertain, random evens as the Copenhagen theory of interpretation claimed. However, the precision and heuristic properties of probabilistic descriptions were leveraged to make unfounded ontological claims concerning the nature of reality.

If reality were merely a function of random, probabilistic events, then, how – Einstein wanted to know -- did any given point on the film in the thought experiment "know" when, or when not, to become blackened? How did the different points that constituted the film become "informed" about what should happen?

How – Einstein wanted to know -- could one suppose that such communication would be able to take place in any other manner than an instantaneous one? In other words, how did all points on the film become informed at the same time about which point would become blackened?

Einstein was trying to visualize how things worked. He wanted to understand the nature of the dynamic that was taking place when the electron engaged the film, and a probability distribution couldn't provide him with the sort of explanation he was seeking.

Einstein didn't have a problem with the idea that probability distributions could be used to describe the behavior of events, and he had used those sorts of tools in his own work. Nonetheless, he did have a problem with the idea that the Copenhagen school of interpretation was using probability distributions as the basis for an ontological account of why quantum events occurred in the way they did.

On the one hand, Bohr was enlisting probability distributions as a means of giving expression to his ontological theory concerning the random, uncertain, nature of reality. On the other hand, Einstein was trying to figure out how one went from the descriptive, methodological properties of probability distributions to an ontological understanding of those same probability distributions.

Einstein was asking very straightforward questions: What is the nature of the dynamic that is taking place at the surface of the film? How does one point within a given probability distribution become or transition into a particular reality at a certain point on the film?

From Bohr's perspective, such questions were ignoring the "fact" (according to Bohr) that reality was inherently uncertain and random, and, therefore, Einstein's question couldn't be answered. Things happened and, as well, certain probabilistic descriptions of what took place were possible, but that was the end of the matter.

For Bohr, probability distributions could describe – within limits – what might happen when an electron was sent toward a narrow slit with a semicircular film on the far side. However, those probability distributions -- when considered through the filters of the Heisenberg uncertainty principle (at least as interpreted by Bohr) – went as far as one could take things ontologically because such probability distributions supposedly gave expression to the fundamental nature of reality … there was nothing of a hidden nature that was happening beneath those random, uncertain, probabilistic events

So, as far as Bohr was concerned, to ask how the film "knew" which point would become blackened and how such data would be

communicated to all of the other points on the film was to introduce confusion into the matter. The point on the film that became blackened was a random event, and, consequently, there was no need for anything to be communicated to the other points on the film because random events are self-selecting as far as where they show up is concerned.

Bohr was able to fend off Einstein's attacks because, in one way or another, he could point out problems with Einstein's thought experiments. Bohr never had to prove that his own ontological position was true, but, rather, he only had to point out the shortcomings of Einstein's challenges.

Perhaps instead of attacking Bohr's theoretical position, Einstein should have demanded that Bohr defend his own position and prove that the inherent nature of reality was uncertain and random. If Einstein had changed his tactics to something along the foregoing lines, Bohr very likely would have floundered as badly as Einstein's thought experiments did since it is often easier to point out the flaws in someone else's way of trying to account for observed phenomena than it is to put forth a viable argument of one's own concerning the nature of reality.

Bohr didn't actually demonstrate what the nature of reality is. He pretty much evaded that issue altogether.

Using probability distributions as a methodological technique through which to describe certain facets of reality can be defended because those techniques are capable of producing reliable, heuristically valuable descriptions. Nevertheless, trying to prove that such descriptions also account for the inherent nature of reality is a very different matter … a proof that Bohr never successfully accomplished – rather, he merely assumed that his position was correct and proceeded from there.

Bohr's interests were assisted by the fact that the methodological/descriptive side of his hermeneutical position worked. Einstein couldn't argue with scientific success.

Indeed, since Einstein's thought experiments were unable to penetrate Bohr's theoretical defenses concerning the issues of uncertainty and randomness, Einstein was made to appear as if he

were arguing for the wrong side of the issue. Therefore, many individuals seemed to miss the fact that Bohr never demonstrated that reality was inherently uncertain and random but, rather, Bohr had shown only that the particular thought experiments brought forth by Einstein were flawed in one way or another.

Like a magician, Bohr made use of a form of misdirection during his point-counterpoint with Einstein. That is, Bohr kept everyone's focus – including Einstein's -- on the problems with the thought experiments being devised by Einstein.

This tactic led many people to presume that Bohr had won the debate concerning the nature of reality when, in truth, the debate between Bohr and Einstein was never about the tenability of Bohr's beliefs concerning the nature of reality (although Einstein tried his best to push the discussion in that direction). Instead, the debates that occurred between Einstein and Bohr during several of the Solvay Congresses always tended to gravitate back toward the problems that afflicted Einstein's thought experiments and, therefore, discussion moved away from the rather glaring fact that Bohr really didn't have any proof that the so-called Copenhagen theory of interpreting quantum dynamics was a correct account of, or explanation for, the nature of reality.

To be sure, the Copenhagen interpretation of quantum mechanics was – within certain limits -- a coherent, meaningful description of reality, and it was internally consistent. Furthermore, the probability distributions that arose in conjunction with Schrödinger's equation were compatible with – but not necessarily proof of, or evidence for -- the idea that reality was inherently uncertain, random and probabilistic.

Nonetheless, at no point did Bohr do anything to show that such probabilistic descriptions were anything more than methodological tools that yielded useful solutions in relation to certain physical problems. Bohr interpreted those descriptions in an ontological manner, but he never demonstrated that he was justified in doing so.

Einstein's thought experiments might not have proven that hidden variables existed. However, Bohr never demonstrated that such hidden variables didn't exist … only that there were flaws with

Einstein's attempt to find fault with Bohr's interpretive perspective concerning the nature of reality.

Einstein took one more kick at the can bearing the label of the Copenhagen theory of quantum mechanics. The kick did not assume the form of an informal point-counterpoint with Bohr during one, or another, of the Solvay Congresses, but, instead, the kick assumed a more formal expression in the form of a May 15, 1935 paper entitled: "*Can Quantum Mechanical Descriptions of Physical Reality Be Considered Complete*" that was published in the *Physical Review* and authored by Einstein, Boris Podolsky and Nathan Rosen.

The paper placed the Einstein-Bohr debate in an either-or context. Either the Copenhagen theory of quantum interpretation was wrong in denying the existence of hidden variables, or the principle of locality (which is at the heart of Einstein's realism) was false and, as a result, two objects that are separated by distance can, in fact, influence one another without anything being communicated across the distance that separates the two objects.

Of course, Einstein, Podolsky, and Rosen were firmly of the opinion that the principle of locality was inviolable. Their paper was an attempt to point out – or, at least, allude to – the existence of problems with the position of those – such as Bohr -- who believed that nature was inherently uncertain, random, and probabilistic and, therefore, individuals who believed that, among other things, the principle of locality did not necessarily hold.

The EPR paper puts forth an argument that is a variation on Einstein's previously discussed initial challenge to Bohr's theoretical position concerning the nature of reality. To briefly summarize: The latter argument involved questions about how the different parts of a semicircular film "knew" which point on the film should turn black and which points should not turn black if probability distributions somehow led to an electron ending up at one point rather than another on the surface of the semicircular film that was set up, hypothetically, beyond the slit through which an electron traveled and that, supposedly, led to the diffraction of the electron and an ensuing spreading out of a wave of some kind that moved toward the semicircular film.

In the 1935 EPR thought experiment, Einstein, Podolsky and Rosen imagine that a particle of some kind decays and in the process yields two further particles that speed off in opposite directions from one another. According to the Copenhagen theory of quantum interpretation, there are no set quantum properties that exist in either of the foregoing particles, but, instead, only probabilities involving possible values can be associated with such particles, and when a measurement is made, we come to know which of the predicted probabilities have been manifested into existence.

The two particles supposedly are related in such a way that when data becomes known about one of the particles, then, immediately, something about the other particle is also known. For example, if one makes a measurement involving momentum with respect to either of the two particles, then one immediately knows the momentum of the other, unmeasured particle.

However, as far as EPR are concerned, this is precisely the problem. If – according to the Copenhagen school of thought – quantum properties don't exist until a measurement is made, then how does the particle that is unmeasured nevertheless instantaneously "know" what momentum to manifest given that the two particles are separated by a distance across which there has been no communication – as far as anyone knows -- concerning the issue of momentum?

EPR state that given the distance which separates the two particles, there is no way that one particle (the unmeasured one) could know what has transpired with the other particle (the measured one). Consequently, by process of elimination, then, seemingly, the only possibility that plausibly can account for the hypothetical situation being described by EPR is to conclude that the unmeasured particle always had a fixed momentum that is independent of the process of measurement.

The EPR paper continues on to make the same sort of point with respect to the issue of position. After doing so, the thrust of the EPR argument is that one is faced with having to choose between, on the one hand, the incompleteness of quantum theory or, on the other hand, the idea that the principle of locality has been violated in some way, and since there no evidence to indicate that the principle of

locality has been violated, then, it has been demonstrated that quantum properties are real and independent of measurement, and, therefore, quantum theory is incomplete because it can't account for the existence of such on-going, real, quantum properties.

Of course, in principle, there is nothing to prevent Bohr, or anyone else, from arguing that, in point of fact, we don't know what the momentum or position of the unmeasured particle is because it hasn't been measured. Such an argument might maintain that EPR are assuming that the two particles will have identical momentums but, perhaps, there is some small probability that the two particles will have different momentums under certain conditions, but this can't be determined until the second particle is measured.

If and when the second particle is measured for the property of momentum and that property turns out to be identical with the value for the previously measured particle, then, this is only because – or, so, it might be argued -- the probability distribution gives expression to that value at the time of measurement and not because the particles have fixed quantum properties existing between measurements. The foregoing argument is somewhat tautological in character – and a touch sophomoric -- but it could be a possible response to the EPR paper.

However, a different approach subsequently was taken by a number of experimental physicists. The result of those experiments tended to bring the principle of locality into question rather than to demonstrate that quantum theory is incomplete.

Before a claim can be experimentally probed to determine whether, or not, that claim might be true or false, one needs to be able to state things in a manner that could be empirically tractable or amenable to testing. John Bell, an Irish physicist, was the individual who first helped to clarify some of the issues in this regard.

Instead of focusing on the momentum or position of a particle, Bell decided to make spin the quantum property that is to be measured. The nature of spin is somewhat obscure.

Spin comes in two varieties – up and down. However, the issue of spin is not a straightforward matter, and, consequently, there is a lack

of clarity concerning what actually is going on when the property of spin is mentioned.

The idea of spin arose in a context that described electrons moving about the nucleus much as a planet moves about a sun (Bohr's idea). According to such a model, electrons operated within the parameters of an orbital, and spin was likened to the manner in which planets spin on their own axis while also traveling about the sun.

The problem with the foregoing image is that – as previously indicated – one runs into problems by supposing that electrons travel about a nucleus as planets move about a sun because under those conditions electrons would lose energy during such a process of orbiting and, as a result, those particles eventually will spiral into the nucleus. As noted earlier, Bohr solved the foregoing idea by re-conceptualizing the notion of an orbit and transforming it into some sort of stationary state of fixed energy … although Bohr was never very clear about what any of this meant – or how it was possible -- other than to indicate that doing so permitted one to avoid the 'electron-spiraling-into-the-nucleus' problem.

Electrons occupied orbitals. Nonetheless, what, if anything, electrons did in those orbitals was unknown.

Similarly, electrons possessed the property of spin, and experimental results indicated, as previously noted, that such a property came in two varieties that arbitrarily were dubbed: "up" and "down". However, just as no one knew what went on within such orbitals, no one really knew what spin actually entailed.

Some individuals referred to spin as being a kind of angular momentum associated with an electron while it did whatever it did within an orbit. However, since no one really knew what electrons were doing while in "orbit" – the orbit-term is potentially misleading because no one knows whether, or not, an electron actually circles or orbits about a nucleus – and, therefore, one can't be sure that the electron spins about an axis while in orbit.

Moreover, in a sense, introducing the notion of spin – at least if this term is understood in any traditional sense of "spin" -- into the conversation appears to undo what Bohr had been trying to do when he claimed that electrons do not run in orbits around the nucleus

because if they did, then, such an orbiting motion will be manifesting angular momentum and, as a result, energy will be expended, and, consequently, sooner or later, this will lead to the electron spiraling into the nucleus due to the loss of energy.

Yet, if "spin" is understood in any sort of traditional sense, then, this would seem to have to involve some sort of angular momentum as well, and, therefore, whatever spin is, it can't involve 'spin' in the usual sense of the word. If the electron's spin involved the spinning of the electron about an axis, then, presumably angular momentum would be present which would seemingly lead to the expending of energy that would eventually lead to the spiraling of the electron into the nucleus.

The energy state of an electron can be measured, and, as well, the spin state of an electron can be determined – that is, one can determine whether the state of the electron is 'up' or 'down'. Yet, none of these designations can tell one what it means for an electron to have spin while occupying a given orbit.

The notion of spin is useful because it permits one to be able to distinguish between particles that possess that property even though we don't quite know what spin actually is. In fact, the capacity of certain particles to exhibit different conditions of spin (i.e., 'up' or 'down') plays a crucial role in experiments involving the issue of entanglement.

Bell imagined a variant of the EPR thought experiment in which a particle gives rise to two further particles that take off in opposite directions. At some distance in both directions, a detector is set up to capture the state of spin of the particles.

However, the detectors are not set up in the same way. They are calibrated for different angles to determine whether the state of the particle was up or down at those two angles.

If the detectors are aligned with one another, Bell believed that one could come up with a hidden variable theory that was capable of accounting for what is observed at the two detectors. But, if the detectors were not aligned with one another – that is, if they were set at different angles – then, a hidden variable theory might have difficulty accounting for certain kinds of results.

More specifically, Bell gave a quantitative face to his thought experiment. If one measured the spin of the two particles over a range of angles that were independent of one another (i.e., not aligned), a set of conditions would have been established through which one could differentiate between what a quantum theory would predict and what a hidden variable theory would predict that operated in accordance with the principle of locality.

According to Bell, if a series of experiments were run and if the statistical treatment of the collective results from those experiments fell outside a given set of parameters, then, the principle of locality would have been demonstrated to be incorrect. The statistical parameters came to be known as Bell's inequality or Bell's theorem.

Bell was not trying to prove that either Einstein's notion of locality was correct or that quantum theory was correct. Instead, he was trying to devise a way that would be able to empirically distinguish between the two perspectives, and Bell's theorem -- Bells' inequality -- gave expression to a prediction that, under the right set of circumstances, could be tested with respect to those differences.

Since Bell developed his inequality or theorem, a number of experimentalists have tested his prediction. For example, John Clauser and Stuart Freedman did so in 1972, as did Alain Aspect, along with several other individuals, in 1981.

While different experimental techniques were used in the foregoing empirical tests, the results all seemed to show that – statistically speaking – the modes of detection employed in the respective experiments indicated that the separated particles seemed to be sensitive to their respective conditions in ways that could not be explained in terms of hidden variable theories or that could not be understood if the principle of locality were in force. Since the running of the aforementioned experiments, various criticisms have arisen as to whether, or not, the different experiments were as loophole free as would be needed to definitively demonstrate that Einstein was wrong – as far as hidden variable and the principle of locality were concerned – or that quantum theory was correct.

The foregoing criticisms tend to revolve around issues of experimental design (such as whether, or not, the detectors employed in the experiment are engaged in a process of fair sampling, or,

alternatively, whether, or not, there might have been some way in which particles were transmitting their quantum states to one another without necessarily violating the principle of locality). In addition, some of the criticisms explored the possibility that the aforementioned experimental results still might be capable of being explained through some kind of hidden variable theory.

In what follows, I am going to accept as given – with certain qualifications to be noted subsequently -- that the phenomenon of entanglement has been experimentally demonstrated. In other words, I am accepting the idea that experiments have shown that Bell's inequality has been exceeded in ways that cannot be accounted for in a plausible fashion when approached from traditional notions of locality which require that in order for two objects to affect one another, there must be some form of spatial and temporal connection between those two objects that permits a communication of information across the distance that separates them in a manner that does not entail violating the speed of light.

To date, no one knows what the phenomenon of entanglement actually involves. Like spin, the phenomenon of entanglement can be detected, but what, exactly, is being detected is unknown.

Have any of the experiments that were alluded to earlier demonstrated that entanglement is a purely random, uncertain, probabilistic phenomenon? Or, have those experiments only shown that such experimental results are consistent with the capacity of quantum theory to be able to accurately predict certain kinds of outcomes?

No one disputes the ability of quantum theory to be very good at what it does – namely, describing and predicting the behavioral dynamics of various kinds of particles under different physical circumstances. On the other hand, that which has been at issue -- almost from the very beginning -- is the following: What exactly is the nature of <u>that</u> which quantum dynamics does such a good job of describing … at least in terms of some of its behavioral feature? What, if anything, makes the phenomena possible that are being so precisely described?

Bells' inequality states that if one collects enough data in relation to what occurs when two detectors have their angles set in a non-

aligned fashion with respect to two particles that have separated themselves from one another, then, statistically speaking, sufficient evidence can be compiled that might enable one to be able to determine whether probabilistic quantum theory or Einstein's realism better reflects that data. According to a number of experiments, quantum theory handles predicting the outcomes of such experiments better than any known theory of hidden variables which stipulates that an Einsteinian-like principle of locality is necessary such that whatever communications or signaling takes place between the foregoing two separated particles must be done through a means which does not travel faster than the speed of light.

Nonetheless, despite the foregoing results, one continues to be confronted with the same question that bothered Einstein. How do probability distributions get turned into the real events that are statistically compiled over the course of a series of experiments? What is the nature of the transition that takes one from a theoretical prediction to an actual event if there are no concrete quantum properties – only probabilities -- present in the particles that are about to be measured? Why do quantum probabilities have the quantitative properties that they do?

When – according to Bohr-like interpretations of quantum mechanics -- random, uncertain probabilities engage the process of measurement, something happens? Isn't this process of engagement – whatever the specific character of its dynamics might be -- an expression of the principle of locality at work?

Perhaps, such an expression of locality – if that is what it is -- does not operate in quite the way that Einstein envisioned. Nevertheless, "something" appears to be affecting that which at one point, supposedly, has no inherent, fixed quantum properties by inducing those blank slates to begin exhibiting specific quantum values at some subsequent point, and, if so, then, isn't the issue of causality (being able to affect or induce dynamics) at the heart of the principle of locality?

Does the measurement process cause a particle -- which, supposedly, possesses no fixed quantum properties -- to suddenly acquire certain, concrete values, and, if so, how does this take place? Or, do random, uncertain, probabilities cause a measurement to take

on certain, concrete values, and, if so, how does this latter dynamic take place?

The entanglement experiments might indicate that Einstein's notion of – or, way of engaging the issue of -- locality is problematic. However, notwithstanding a concession that the phenomenon of entanglement doesn't seem to involve the principle of locality when that idea is construed in terms of signals being communicated across the spatial distance separating two particles, nevertheless, such a concession does not necessarily force one to abandon the principle of locality.

For example, maybe there are non-spatial dimensions involved in the phenomenon of locality. If so, then, perhaps, such non-spatial dimensions contiguously link particles in ways that fall outside the normal way of thinking about reality as a function of relationships that take place "within" – as opposed to of relationships which happen "in conjunction with" --- three spatial dimensions or even x-spatial dimensions.

Time is a possible example of a non-spatial dimension. Unfortunately, the nature of time has become hermeneutically distorted through its spatialization (conceptually speaking) over a number of centuries by scientists so that (at least in behavioral terms) the idea of time becomes treatable via mathematically-based descriptions and representations of reality that often carry a geometric bias that requires dimensions to be spatial in character (at least descriptively speaking) rather than being non-spatial and, possibly, resistant to being reduced to any sort of metric that can be spatially represented.

Does time occupy space, or does space occupy time? Or, perhaps, neither of the foregoing two ways of hermeneutically engaging reality is correct.

What is the nature of the interactional dynamic when space and time interact with one another? What is the nature of the dynamic resonances that make phenomenological bridges between those dimensions possible?

Maybe space is just one type of dimension -- among many possibilities -- but a dimension which is characterized by, at least,

three degrees of spatial, directional freedom. Conceivably, there might be other kinds of non-spatial dimensions – other than time – that are capable of causally linking two particles that do not exhibit the sort of locality which Einstein considered to be a necessary component of any link between two particles operating in time and space that were considered to be causally related.

For example, consciousness might be a form of non-spatial dimensionality. Perhaps, the dimension of consciousness and the dimension of space interact with one another such that space serves as a screen, manifold, or topological surface onto which, or into which, or through which, consciousness is able to project its phenomenology.

If the dimensions of space and consciousness interact with one another, and if consciousness is non-spatial in nature, then distance is irrelevant to the nature of their relationship. The sort of "locality" which is manifested through the interaction of those two dimensions is a function of something other than spatial contiguity or proximity.

To be sure, we might not understand the nature of the dynamics which are entailed by the way in which two such dissimilar dimensions as consciousness and space might interact with one another. On the other hand, the ontology of the dimension of time doesn't seem to have much in common with the ontology of space, and, yet, quite obviously, we have on-going phenomenological experiences which indicate that those two dimensions do have some sort of contiguity, proximity, or locality with respect to one another that is not necessarily a function of distance in any spatial sense.

Perhaps, the dimension of time pervades the dimension of space. Or, alternatively, maybe the dimension of space pervades the dimension of time.

Each dimension might have its own characteristic set of dynamics. Conceivably, the dynamics of the pervading process involving two, or more, dimensions, could be a matter of some sort of dimensional resonance which establishes temporary links of causal transaction, like a bridge, between the dimensions or through which some form of dimensional tunneling or transduction takes place.

Something called "tunneling" has been shown to exist in quantum dynamics in which particles occasionally exhibit a capacity to go from

one side of a barrier of some kind to the other side of that barrier. Yet, although the tunneling phenomena has been shown to be possible, no one actually knows how it works, and, consequently, to suggest hypothetical possibilities in which dissimilar dimensions (e.g., time and space or consciousness and space or time) might, somehow, be able to establish tunneling resonances of various kinds with one another does not seem to be all that anomalous.

For instance, rather than considering intelligence to be a function of living brain dynamics, maybe life – to which brain functioning gives partial expression -- is a dimension that is capable of transducing the presence of a dimension of organizing intelligence (e.g., as previously suggested, somatids might have a role in such a transduction process). As such, the nervous system might serve as a receiver or transducer of the presence of certain kinds of dimensional dynamics on behalf of the dimension of life.

However, as the research of John Lorber seems to suggest (and this was explored in Volume 1), there might be circumstances in which such a form of organizing intelligence establishes links independently of the normal means (i.e. the nervous system). For example, perhaps Qi (prana-nur-qi) is a special kind of dimensional intelligence which has the capacity to interact with the dimension of life -- apart from brain functioning -- and, among other possibilities, help to regulate and organize various aspects of epigenetic dynamics.

Conceivably, the déjà vu dimensionality of the reincarnation phenomenon is not necessarily a function of individuals going through cycles of birth and rebirth. Perhaps, the dimensions of time, space, consciousness, life and intelligence have become entangled in some fashion, and, as a result, the interpenetration of these dimensions with one another have given rise to a phenomenology in which a "remembered" past in one soul is actually the result of a passing, resonant contact, or leakage, with a historical past that actually is associated with the life of another soul, and, souls, themselves might give expression to another kind of dimensional phenomenon as well.

There has been a tendency in science for quite some time to want to reduce material phenomena to being functions of a set of particles which can be broken down into subsets: (a) Leptons (electron, muon, tau, and their three neutrinos); (b) gauge bosons (photons – carriers

of, or transmitters of, the electromagnetic force; z-bosons and w-bosons - carriers or, or transmitters of, the weak nuclear force; (c) gluons – carriers of, or transmitters of the strong nuclear force); (d) scalar bosons (Higgs – related to issue of mass), and (e) quarks (up, down, charm, strange, top, and bottom). Nonetheless, only one the foregoing generations of quarks and leptons (referred to as fermions) seems to have much of a role in the structure and dynamics of material phenomena in the aspects of the universe with which we are currently familiar (namely, up and down quarks along with the electron and electron neutrino).

Consequently, many physicists have wondered why three generations of those particles exist if only one of them seems to do the heavy lifting that, purportedly, makes physical events possible. Perhaps, the foregoing particles are manifestations of the dynamics and properties of an underlying set of dimensions.

More specifically, when one mixes, on the one hand, the potential of such a "particle or material dimension" with other dimensions that give expression to, for example: Time, space, gravity (considered as a dimension rather than a force generated or carried by a particle – such as the graviton), and, on the other hand, organizing intelligence (Qi, prana-nur-qi), then, physical reality might turn out not be a function of the quantum properties of the particles that make up the standard model, but, rather, quantum phenomena (and, therefore, the particles of the standard model) are functions of the interaction of an underlying set of dimensions … that is, an underlying set of hidden variables in the form of an array of dimensions.

If so, then, one doesn't have to try to figure out, for instance, how something can be both a wave and a particle. Given the foregoing considerations, waves and particles are merely structural forms which give manifested expression to the way in which different dimensions (including time and space) interact with one another.

Mathematics can be used to describe phenomena in particle terminology, and mathematics can be used to describe the same sort of phenomena in wave terminology. Waves and particles are multiple manifestations being described through the unifying properties of an underlying mathematics, and, perhaps, something similar is taking place in the "real world" in which when one speaks of "waves" and

"particles," this does not mean that one thing is operating in two different ways, but, rather, that there is some sort of underlying dynamic which is capable of giving expression to two kinds of manifestation depending on the nature of methodological engagement which is being pursued.

Waves and particles could, at least in part, be a function of, or be giving expression to, dimensional entanglement dynamics. In other words, entanglement might take place whenever different manifestations or phenomena become linked with one another through dimensional resonances (e.g., quantum spin) which have become a shared feature of those kinds of manifestations or phenomena, just as the so-called phenomenon of 'reincarnation' -- as well as other kinds of déjà vu experiences -- might be a function of certain aspects of temporal-phenomenological dynamics that are being shared with people, places, or events and, therefore, constitute cases of entanglement.

If one doesn't know what entanglement is, how can one make any definitive statement about what it does, or does not, involve? If one doesn't know what entanglement is or what makes it possible, then, from a certain perspective, one cannot automatically rule out the possibility that entanglement is itself a function of hidden variables … although, in some respects, such hidden variables – if they are present -- might operate quite differently than in the way that Einstein originally felt that hidden variables would behave in terms of the issue of locality.

The fact that no one has been able to figure out what such a hidden variable theory might look like does not constitute evidence that such a hidden variable theory does not, or cannot, exist. Just as the LHC experiments that yielded evidence for the existence of the Higgs field in 2011 eliminated some versions of Supersymmetry from consideration but did not eliminate all forms of Supersymmetry as possible explanations for what was observed in those experiments, so too, the entanglement experiments might have eliminated some versions of hidden variables from consideration – such as those that are rooted in an Einsteinian notion of spatial locality which required signaling events to comply with the time needed by the speed of light to convey such signals across a given distance.

Nonetheless, those entanglement experiments have not necessarily shut the door on the possibility that some other version of hidden variable theory might be able to successfully account for the results of those experiments. Perhaps, if we actually knew what dimensions were and how they worked, then, we might find it easier to conceive of forms of locality which were independent of considerations involving spatial contiguity or proximity (and to one might wish to revisit the chapter on dimensionality in Volume 1 for some possible issues on which to critically reflect in this respect).

One cannot use ignorance about the nature of reality as proof of anything. Indeed, if one is going to use one's inability to imagine how to solve a problem in a given way at a given time (e.g., through a hidden variable theory) as a legitimate reason for concluding that such a current inability must mean no such solution exists, then, the pursuit of understanding concerning the nature of reality would have come to a screeching halt thousands of years ago.

The entanglement experiments have not demonstrated that there are no hidden variables present in those experiments. Rather, those experiments have shown that if hidden variables are operating beneath the surface of the observed results, then, those variables will have to have a set of properties that is different from anything that is currently known or understood about, among other things, the issue of locality.

In addition, the entanglement experiments have not demonstrated that the Copenhagen interpretation of quantum mechanics is correct. Instead, what has been shown by those experiments is that quantum methodology does a much better job of predicting the outcome of those experiments than does any known theory of hidden variables.

By restricting itself to predicting behavioral properties of particles and, for the most, simultaneously jettisoning any considerations about what makes such behavior possible, quantum methodology has managed to accumulate a variety of algorithms that permit scientists to be able to accurately predict the likely behavioral properties of particles under different conditions. However, unless one is totally spellbound by a Pythagorean-like obsession with the idea that reality is a function of mathematical entities and that, therefore, mathematical expressions necessarily reflect the essence of reality, one can't help

but notice that, thus far, there is a complete absence of any plausible account in quantum theory with respect to how reality came to have the capacity to manifest the properties that are being described through the application of quantum methods, and, as well, there is a complete absence of any plausible account in quantum theory with respect to being able to explain how probability distributions are turned into real events.

To reiterate, entanglement experiments have not shown that reality is inherently, random, uncertain, and probabilistic … in other words that the Copenhagen theory of quantum interpretation concerning the nature of reality is correct. Such experiments only have demonstrated that quantum methodology does a better job of predicting the outcomes of certain kinds of experiments than does any other kind of theory currently known.

Now, someone might wish to argue that if something looks like a duck, walks like a duck, and sounds like a duck, then, what one is seeing must be a duck. In other words, if quantum descriptions make reality look, walk, and sound like something that is random, uncertain, and probabilistic, then, surely, reality must be random, uncertain, and probabilistic.

On the other hand, one also could argue that when one views reality through a certain kind of filter, then, one should not be surprised if what is being viewed through that kind of filter appears to assume some of the properties that are inherent in the nature of such a filter but are not necessarily a reflection of the nature of reality. As someone once said: "To a hammer, everything seems like a nail," and, yet, while a hammer might have a great deal of heuristic value, nevertheless, to suppose that no other instruments other than a hammer can be used and should be used when engaging reality seems to be a rather blinkered way of interacting with phenomena.

Quantum methodology constitutes a set of filters through which to engage reality. Therefore, one cannot necessarily conclude that if such a set of filters makes reality look, walk, and sound like a random, uncertain, and probabilistic phenomenon, then this is an accurate reflection of the character of reality.

Entanglement experiments have not shown that reality looks, walks, and sounds like quantum theory. Rather, those experiments

have shown that quantum methodology constitutes a means of filtering certain kinds of experimental data in a manner that is capable of yielding accurate results involving the prediction of certain kinds of particle behavior during those experiments.

When a tox-screen is run, that procedure can only detect the features that the procedure is set up to detect. Whatever toxins fall outside the parameters of the capacity of that kind of pre-established methodology to detect or capture will appear to be non-existent, but one cannot, then, subsequently declare, that whatever toxins are missed through the application of that methodology do not, or cannot, exist or that reality is necessarily a function of the way that the tox screen filters things.

One must distinguish between the process of filtering data concerning reality and the nature of reality itself. One cannot automatically suppose that any given filter provides a fully complete or accurate representation of that which is being filtered.

Quantum methodology consists of a set of interrelated filters. Those filters are pre-set to engage reality through random, uncertain, probabilistic descriptions.

Does this mean that reality is random, uncertain, and probabilistic? Not necessarily.

Quantum theory looks for, and organizes data according to, the properties inherent in its methodological protocols. Experiments are set up to generate data that can be run through the filters of those protocols and to be interpreted in terms of how those filters engage the experimental set-up.

In summary, the entanglement experiments – as ingenious as they are – have only established one fact. Under certain conditions, particles appear to have a strange form of behavioral interconnectedness that can be accurately predicted – to a degree -- through quantum methods, while, at the same time, the observed form of behavioral interconnectedness seems to fall beyond the capacity of current theories involving hidden variable or the principle of locality, as understood by Einstein, to be able to explain.

Nonetheless, a whole host of other issues remain in play. For example, and as previously indicated, those experiments have not

eliminated all notions of locality from consideration … only certain versions of locality, such as the one championed by Einstein.

Moreover, the entanglement experiments have not established what entanglement is. All that they have demonstrated is that, within certain limits, the phenomenon is real.

One of the truly amazing things about quantum theory is that a tremendous quantity of precision is so intimately woven together with an incredible amount of ignorance. For example, at the present time, no one knows what the structure of an electron is, and no one knows how an electron occupies an "orbit", and no one knows what spin is, and no one knows what entanglement is, and no one can tell – in the vernacular of the *Invasion of the Body Snatchers* – how the allegedly blank quantum pod of a particle takes on specific, concrete quantum properties, and, yet, certain aspects of the behavior of the foregoing sorts of unknowns can, nevertheless, be determined with considerable accuracy.

Chapter 24: Quantum Framing

In 1980, John Searle released an article entitled: "The Chinese Room." The focus of the foregoing essay involved putting forth a series of considerations which purported to counter the perspective known as 'strong AI' – which claims that computers and/or their programs are capable of generating computational systems that have properties of consciousness, intelligence, understanding, and agency (i.e., constitute a mind).

The core of Searle's foregoing argument was illustrated through a thought experiment. To begin with, he asks his readers to suppose that he had been put in a room and, from to time, he would be given a considerable amount of visual/written material in both Chinese and English.

The material in English constituted a set of rules which explained what to do in order to put Chinese characters together in a manner that would make syntactic and semantic sense to a natural speaker of the latter language if the latter individual were to ask questions in Chinese and wanted Searle to provide the answer to those questions in the form of written Chinese characters. However, Searle stipulates that he knows no Chinese and, as a result, Chinese characters appear to him as just a series of squiggles of various shapes.

Searle further asks his readers to suppose that one other set of conditions holds true in his thought experiment. More specifically, he indicates that (a) the quality of the instructions which he receives in English becomes so good with respect to how to put strings of Chinese characters together in ways that make syntactic and semantic sense and, as well, (b) his ability to follow those instructions becomes so proficient that (c) he is able to generate strings of Chinese characters in response to questions written in Chinese that a natural speaker of Chinese would not be a able to tell that Searle's responses to the questions being asked in written Chinese had been put together by someone who did not know any Chinese.

Having stated his thought experiment, Searle goes on to draw a few conclusions concerning the parallels he believes might exist between the Chinese Room experiment and artificial intelligence. For example, despite not knowing any Chinese, Searle is able to have his actions programmed by the English rule book which instructs him on

how to write an answer using Chinese characters to questions which are written in Chinese characters.

Consequently, Searle argues that just as he, supposedly, has no awareness, understanding, or insight into the nature of what he has been instructed to put together in the form of Chinese characters that are to serve as responses to questions that have been asked through written Chinese characters, so too, neither does a computer, nor its programs, have any awareness, understanding, or insight into the nature of what the computer/program is doing as a function of what its construction and programming enable that computer and program to do. In short, just as Searle has no awareness or understanding of what he is doing, so too, neither a computer nor its programs have any awareness or understanding of what is being done through them.

Following the explication of his thought experiment, Searle proceeds to outline, and, then, address, various possible objections which might be raised concerning the manner in which he has used his thought experiment to demonstrate why he maintains that various proposals concerning strong AI are not tenable. After quickly running through his critical reflections concerning several possible objections to his perspective, he goes on to assert that mind is a function of biological processes which have the chemical and physical capacity to cause the sort of intentional dynamics which give rise to awareness, perception, learning, and understanding.

As will be shortly evident, the purpose of providing an overview of the Chinese Room thought experiment is not to establish a position, one way or the other, concerning whether, or not, strong AI is a tenable perspective. However, before moving on try to fry some other fish, one might note in passing that there are several issues which are not discussed in Searle's article.

First of all, while it might be a consensus view of many scientists in 1980s (when the Searle article was released) as well as today, 45 years later, that mind is a function of biological activity, nonetheless, if one wishes to be technically correct, then, there are really a whole bevy of lacunae (some of which have been referenced at various points in the current book) which infest the idea that mind is a function of biological activity and, therefore, which prevent one from justifiably asserting that there is evidential proof demonstrating that mind is

necessarily a function of biology, and only biology. Nonetheless, one should keep in mind that Searle has asked his readers to suppose or assume many things in conjunction with his thought experiment, and given that nowhere in his article does he put forth evidence demonstrating that the mind is a function of the brain, then, apparently, such a claim is just one more item which his readers are to suppose is true.

Secondly, Searle stipulates in his essay that he has been able to gain such proficiency with understanding the rule book written in English, and, furthermore, he claims that the forgoing rule book has been compiled so adeptly, then, as a result, he has developed a capacity to construct written sequences of Chinese characters which are capable of providing answers to questions written in Chinese characters in such a way that someone with native facility in written Chinese would not be able to identify the characters put together by Searle as having been done by someone who had no knowledge or understanding of Chinese. In short, Searle has passed a Turing-like test in conjunction with the Chinese language.

However, Searle doesn't indicate how much time had been required to acquire the foregoing sorts of facility. In addition, he doesn't consider issues concerning what he might have learned about writing Chinese during the time spent that had been needed to gain facility with the rule book with which he has been provided.

How language is learned is not understood. Whether, or not, Searle would have been able – consciously or unconsciously – to pick up certain aspects of written Chinese is not known, and, therefore, the conceptual waters are muddied somewhat as to whether, or not, Searle could accurately say that he knew nothing about written Chinese by the time his experiment ended.

In addition, nothing has been said by Searle in his article about how long would be needed for him to be able to take questions written in Chinese characters and provide syntactically and semantically viable responses based on his access to a rule book. More specifically, in the light of the linguistic research of Noam Chomsky, we know that language – whatever else it is – has been shown to be a function of grammars that are transformational-generative in nature.

Consequently, languages are capable of generating questions which give expression to an indefinitely large number of grammatical possibilities. As a result, one might question how Searle would go about parsing the transformational-generative possibilities which might be present in the questions which are given to him in a way that would enable him to proceed with answers because such possibilities – both with respect to questions as well as answers -- could not be listed in a rule book.

In other words, transformational-generative dynamics are not rule governed. Instead, they operate as a function of principles which are multifaceted and multi-dimensional in their possibilities, and, therefore, there are limits to what a rule book could do for someone is Searle's position.

Moreover, something else not mentioned by Searle in his Chinese Room article has to do with what might have been taking place within him phenomenologically while he was gaining facility with the rule book. What was he thinking, feeling, understanding, concluding, questioning, and reflecting upon during the whole process of consulting and developing facility with the rule book which provided instructions on how to put Chinese characters together under different circumstances, and could one legitimately infer that the same sort of thing is going on in computers when they are running through the programs which have been written for them?

Finally, there is a considerable amount of sloppiness present on various sides of the 'strong' AI issue involving language. For instance, what is meant by: Thinking, intelligence, understanding, agency, referring, and intentionality?

A computer program is provided with a variety of heuristic principles which shape how that program -- without further assistance from a programmer -- can not only grow over time but, as well, how such growth can give expression to improved, more accurate, more efficient functioning that leads to a more proficient treatment in conjunction with new tasks. Is the computer exhibiting learning and thinking if there is no phenomenological component associated with such growth and improved functioning?

Alternatively, when a human being engages a given context and that mode of engaging such contexts undergoes a certain kind of

growth (an ambiguous term as it stands) over time and, as a result, enables the individual to develop more accurate, more efficient functioning that leads to a more proficient way of engaging new tasks. Is such a human being exhibiting learning and thinking if that person has no idea how something was learned or what makes that person's newly acquired facilities possible?

Quite frequently, human beings have no idea where the ideas come from which bubble to the surface of awareness. Moreover, quite frequently, we have no idea how language works or what we will say next.

In *The Coming Wave* (and one might say that what is claimed to be coming is already here, and, actually has been here for awhile) Mustafa Suleyman describes how AlphaGo -- a program which was equipped with the capacity to generate new moves in the game of Go (that is, specific moves which had not been programmed into it) -- specified that a stone should be placed on a particular square on the game board. The foregoing move came in the second match between AlphaGo and Lee Sedol, a world-champion-caliber Go player, during an exhibition challenge which had been arranged in 2016, and the foregoing move has come to be known as 'move 37,'

By all accounts – at least, according to those who know something about the game of Go – move 37 appeared to constitute a component in an, apparently, undeniably losing strategy. The individuals that had: Designed, programmed, and trained AlphaGo did not understand the nature of the move, and, yet, it proved to be the turning point that would eventually lead to victory.

Was the foregoing incident like that which takes place in human beings when ideas, with unknown provenance, pop into awareness? Was the AlphaGo move 37 anything more than a function of combinatoric heuristics?

What actually goes on in conjunction with a human being when ideas pop into consciousness? What goes on in a program like AlphaGo when an action like 'move 37' occurs?

Given that there are many factors (such as emotions, motivations, beliefs, desires, attitudes, biases, physical conditions, and values) which can modulate human action, how does one assign the issue of

agency to human beings? Given that there are many factors (such as voltages, semi-conductors, physical conditions, heuristics, rules, scripts, and principles) which can modulate a programs output, how does one assign agency to such programs?

Let's replace the Chinese language with quantum mechanics in Searle's aforementioned thought experiment. Let's assume that Searle knows nothing about quantum mechanics and, therefore, he is provided with a book of rules which shows how to string mathematical symbols together in a way that is capable of providing answers which an expert in quantum mechanics would not be able to determine whether such answers came from someone who had been trained in the mathematics and physics of quantum mechanics or came from someone who had been provided with, and became facile with, the right kind of rule book.

As a result, Searle, presumably, is able to pass the quantum-version of the Turing Test. After all, we are assuming that he can generate the same correct answers that quantum physicists are able to do when using Heisenberg's S-matrix mechanics, or Schrödinger's wave equation, or Born's wave function, or Dirac's relativistic equation, or Feynman's sum over histories-path integral approach.

Moreover, one might be prepared to maintain that the understanding which Searle has concerning the nature of the relationship between quantum mechanics and reality is pretty much the same as someone who has been trained in the arcane details of quantum mechanics since as Richard Feynman once said during a lecture on quantum mechanics: "I think I can safely say that nobody really understands quantum mechanics." The Turing Test – no matter what its form – doesn't say whether something is understood or true but only that on the basis of answers given, one cannot determine whether the answers come from a source that understands the nature of the answer being given or comes from a source that doesn't necessarily understand the nature of the answer which is being given.

In quantum mechanics, accurate answers can be given that physicists don't necessarily understand what make those answers so determinately accurate. Consequently, the fact that Searle might not understand the mathematical symbols which he is stringing together -- per rule book instructions -- in response to questions from physicists

who are seeking answers to quantum queries, and the fact that he does not understand what those symbols have to do with having insight into the nature of reality, would seem to qualify him as something of a colleague of many quantum physicists.

Are quantum physicists doing anything more than stringing together mathematical symbols that they have acquired from the text rule books which were used during their undergraduate and graduate days of education? How many quantum physicists are capable of proving that the symbols they use are mathematically valid as opposed to being heuristically valuable in solving certain kinds of problems?

What is the nature of the relationship between mathematics and reality? This is a question that leads to the sorts of critical reflection which continue to yield heuristically valuable results.

Eugene Wigner once wrote an article entitled: *The Unreasonable Effectiveness of Mathematics in the Natural Sciences*. The use of the word "unreasonable" in the above title seems, well, 'unreasonable'.

A choice of other descriptors – such as "unexpected" – might have been a more congenial-like consideration to include in that article's title. Ed Whitten, when -- during an interview – responded to a question about the title of Wigner's article, used the word "uncanny" as a way of trying to capture something of the relationship between mathematics and reality – at least, certain aspects of reality – and the use of the term "uncanny" suggests there is something elusive and mysterious concerning the way in which mathematics seems to exhibit so much heuristic value when addressing various kinds of phenomena.

Wigner's aforementioned essay begins with a quote from *Study of Mathematics* by Bertrand Russell. Russell maintained that "Mathematics, rightly viewed, possesses not only truth, but supreme beauty …" Of course, such a claim not only raises questions about what might be meant by the notion of a "rightly viewed" notion of mathematics, but it raises questions about whether, or not, mathematics actually possesses any truth (as opposed to having a potential for describing various kinds of possible truths) or what might be the nature of whatever beauty mathematics supposedly possesses. As far as the 'beauty' aspect of things is concerned, Russell indicates that the sort of beauty he has in mind is one that is "sublimely pure," with a "stern perfection."

Ironically, there appears to be a certain degree of imprecision in the words which Russell uses to describe the beauty of mathematics. One wonders why he couldn't come up with a set of mathematical symbols to capture the truth concerning the sort of 'purity' and 'stern perfection' to which he was alluding when mentioning the idea of beauty in mathematics.

There are those individuals who believe that reality is inherently mathematical because of its capacity to reflect what appear to be the patterns, logical relationships, and quantitative dimensions which appear to be present in, or are given expression through, certain aspects of reality. So, what is one to do when one comes across the translated words of Lao Tzu which stipulate that: "The Tao that can be told is not the true Tao," or "the unnamable is the eternally real," and one wonders if mathematics – despite all its marvels and rigors – is anything more than a way to take snap-shots of some low-lying fruit that has fallen to the ground and begun to decay.

Poetry, literature, art, music, and love "rightly viewed" seem to be more intimately connected to truth and beauty than mathematics does. Moreover, the way in which the right kind of poetry, literature, art, music, and/or love can seemingly reflect something more deeply hidden in the nature of reality is often 'unexpected,' 'uncanny,' and, as well, often has a decidedly "unreasonably effectiveness" in their capacity to attune one to existence in substantive, heuristically valuable ways.

Mathematics is a linguistic-like system which has qualities of syntax and semantics which can be used to describe certain features of experience. However, other kinds of languages also have qualities of syntax and semantics which can be used to describe certain features of experience and do so in a manner that often appears to fall beyond the horizons of mathematical capabilities … for example, what is the mathematical expression for: "… it is a far, far better thing that I do, than I have ever done; it is a far, far better rest I go to than I have ever known;" or: "Do not go gentle into that good night;" or: "Hell is other people;" or: "We shall not cease exploration, and the end of all our exploring will be to arrive where we started and know the place for the first time."

One should respect mathematics for what it has the capacity to describe. Nonetheless, one also should exercise a certain amount of caution in relation to mathematics for what it does not seem to have the capacity to describe.

If one were faced with having to choose between engaging life through the truths and beauty of mathematics or through the truths and beauty of character, then, many people might choose the latter possibility. There is a syntax and semantics inherent in character which, when properly employed, enables one to navigate many an existential sea that lies in mathematically uncharted waters.

On the other hand, the foregoing considerations need not be reduced to an either/or affair. There is nothing inconsistent – either mathematically or morally – to be a mathematician with character or someone who has character who knows a bit of mathematics.

As translated by Stephen Mitchell, Lao Tzu says:

"Free from desire, you realize the mystery.

Caught in desire, you see only the manifestations."

Mathematics could be conceived as giving expression to desires which seek to capture the beauty and truth of manifestations while being largely ill-equipped to engage the idea that there might be something more deeply hidden that makes such manifestations possible, and, as a result, mathematics becomes trapped or caught in the realm of manifestation.

Does mathematics give expression to reality? Or, does reality give rise to manifestation, some of which are describable through mathematics.

Lao Tzu goes on to say:

"Yet mystery and manifestations arise from the same source.

This source is called darkness.

Darkness within darkness.

The gateway to all understanding."

Manifestation is a function of darkness. Mathematics can describe some of the dynamics of manifestation, but it can never explain what makes such manifestation possible because its linguistic qualities distort the nature of the darkness out of which manifestation arises by

trying to say that which cannot be said since "The Tao that can be told is not the true Tao."

Defenders of mathematics might wish to respond to the foregoing considerations by suggesting that the Tao is instituting an unfair set of rules upon communication because it seeks to allude to the existence of issues that fall beyond the purview of the syntax and semantics of mathematics. On the other hand, by responding in such a manner, such defenders of mathematics might be introducing a certain unfairness of their own by trying to insist that discussions be kept within the boundaries in which mathematics excels.

Someone seems to be demanding that thoughts become a function of some sort of "newspeak." But, who is the one that is calling human beings to a form of understanding which requires them to comply with the limits of language?

Mathematics tends to deal with description. Nevertheless, reliable explanations that can be shown to be true concerning the essential nature of that which is being described are often absent or very difficult to come by in mathematics.

People sometimes confuse description with explanation. To be sure, some of those descriptions contain elements of causality in them in the sense that one can show how one set of relationships or dynamics that is being described might be associated with the emergence or presence of other kinds of relationships or dynamics.

However, while entertaining the foregoing sorts of possibilities, one should critically reflect on some of the complexities which were explored in an earlier discussion concerning the work of Morton White involving the issue of causality. If one engages in the foregoing sorts of critical reflection, one might be able to better appreciate: How the striking of a match that is followed by the lighting of the match doesn't really take into account all of the other conditions which are necessary for the match to light, and, therefore, descriptions don't necessarily lead to, or entail, an explanation of what is being described.

Therefore, mathematical descriptions which capture the relationship between the striking of a match and the lighting of the match do not necessarily constitute a full explanation of the physical dynamics involved in the match lighting. Furthermore, one could

complicate the foregoing issue by noting that a full explanation might not only have to reference all relevant physical conditions but, as well, would have to take into account all of the psychological, social, cultural, economic, and historical factors which might have relevance to the fact that a given match became lit at a particular time.

The more variables that are needed to describe a given set of circumstances, the less tractable or amenable such a set of circumstances is to mathematical treatment. This is probably part of the reason why life, with all of its millions – if not trillions (or more) -- of variables, has not, yet, been plausibly described through mathematical forms of treatment.

Notwithstanding the foregoing sorts of considerations, one experiences a certain degree of perplexity when Wigner refers to the unreasonable effectiveness of mathematics in his aforementioned article. Most of mathematics is, through and through, a rationalistic enterprise – leaving aside, of course, the way in which many of the heuristic concepts in math often arise in mysterious ways because we don't have much understanding about how ideas come into existence or what makes the intuitions and insights possible that give flight to mathematical ideas which have wings with which to soar.

What makes the logical, logical? Logic seems to exhibit a certain kind of 'je ne sais quoi.' In other words, what makes something logical is often indescribable and associated with properties that are hard to identify or are quite elusive in the manner in which they affect what is transpiring.

If one grasps the nature of a mathematical relationship, then, the logic inherent in that relationship is discernible, if not palpable. Moreover, if one is fortunate, then, the foregoing logic becomes expressible to the extent that symbols can be strung together that make sense in the context of the syntactic and semantic properties that regulate mathematical speech or dynamics, and proofs are the way in which one makes sure that what is being expressed is consistent with the principles which govern mathematical syntax and semantics.

Mathematics is a way of giving expression to a network of logical properties that are capable of being used to reliably describe various kinds of relationships and dynamics. Mathematics might give expression to ways of describing things which lead to very unexpected

outcomes, but there is nothing unreasonable about such effectiveness, because more than 2000 years have been spent developing the system of proofs which characterize the nature of the logic which is present in the syntax and semantics of mathematical forms of linguistic description.

The mathematics of circles is present in electromagnetic descriptions, because cyclical phenomena have logical resonances with circles. The mathematics of imaginary numbers is present in wave equations because quantum phenomena have logical resonances with the way in which, among other things, imaginary numbers are able to map dynamic relationships involving different properties (e.g., potential and kinetic energy). Matrices are involved in Heisenberg's way of solving various problems in quantum mechanics because the logic of matrices lends itself to some of the logical properties and relationships existing in particle dynamics. Topology is present in general relativity because there are logical resonances between principles of topology and the dynamics of gravity. The mathematics of groups is present in particle physics because, on the one hand, there are logical resonances in the way that groups describe issues of conservation across certain kinds of transformation and, on the other hand, the sorts of symmetries which are observed in various aspects of particle dynamics. Mathematics is involved in the descriptions which are present in any kind of science to the degree that there are logical resonances which exist between a given form of mathematics and a given kind of physical/material phenomenon that is being explored through a given science.

In her book: *Lost in Math: How Beauty Leads Physics Astray, Sabine Hossenfelder* – a researcher in particle physics – explores the possibility that physics has, increasingly, come under the influence of a form of methodological framing in which certain alleged qualities of mathematics appear to have become more important to theorists than the phenomena to which physics, as a discipline, ought to be attending. More specifically, many researchers (some of them quite prominent) appear to believe that the principles of physics should be given expression through equations, formulas, models, and the like which are beautiful, elegant, and characterized by simplicity.

However, the foregoing perspective is plagued with a variety of problems. One of those difficulties is that no one has been able to define or explain what is meant by the notion of mathematical beauty, elegance, or simplicity.

On the one hand, most, if not all, of the individuals to whom allusion is being made seem convinced that the presence of beauty, elegance, and simplicity in a mathematical structure, relation, equation, or formula would be readily discernible. On the other hand, being able to provide a mathematical analysis of the sorts of properties and qualities which might characterize such mathematical beauty, elegance, or simplicity has proven to be a rigorously elusive challenge.

Mathematical beauty, elegance, and simplicity form a symmetry group with the lost chord in which ignorance is conserved across all transformations. The unproven Riemann Hypothesis concerning the distribution of prime numbers might, or might not, be, a distant cousin.

According to Sabine Hossenfelder, if one wants to know what makes the world possible, one must follow the empirical breadcrumbs that have been left behind by previous explorers and which lead down into the basement of science where “facts” cannot be shown to be a function of anything more fundamental or simpler. In the basement one will find space, time, and twenty-five particles, but one will find no explanation of what makes any of what one finds to be possible, and, moreover, even if there were some such explanation, there is no guarantee that what might be more fundamental is necessarily, somehow, simpler.

We live in an age in which phenomena are considered to be a function of the way that the foregoing sorts of particles move about in space and time. Yet, what if such particles, space, and time, are just phenomena that are a function of something that is more deeply hidden?

Gluons are the carriers of the strong force. W^+, W^-, and Z bosons are the carriers of the weak force, while photons are the carriers of electromagnetic force, and the Higgs boson is the active component (that has no quantum spin) in a scalar field through which mass is distributed to elementary particles. No one knows whether, or not, the graviton -- the alleged carrier of gravitational force – exists.

Presumably, a fundamental question to ask about the foregoing bosons is: How do such particles carry the forces that are being attributed to them? Approached in a slightly different way, one might ask: Do bosons actually carry the aforementioned forces or do bosons just serve as loci of transmission, and, if so, where do those forces come from and what lends to them their properties, and how do those forces and their loci of transmission come together, or are bosons merely the point where a given force is manifested, and, as such, there is no actual boson – just a dynamic of manifested force of some kind?

Sabine Hossenfelder indicates in her book that theories are "made of math." What the nature of that "made" aspect of things might involve is not necessarily clear – especially when one tries to reflect on the possible way in which the components of 'beauty,' 'elegance,' and 'simplicity' should be participating -- at least according to some -- in the making of a physical theory.

Are 'beauty,' 'elegance,' and 'simplicity' different qualities? Or, are they the same quality which is being references by three different terms?

Math seems to give expression to a network of logical dynamics that can be used to describe phenomena. If mathematics is something other than this, then, what this 'otherness' might involve has never been made clear in anything which I have read, heard, or seen … and, in this respect, perhaps I have lived an overly impoverished life.

When one makes a theory out of math, then, presumably, one would like the math to describe phenomena in a way that can be checked, in some fashion, in order to be able to determine whether the description can be shown to be accurately reflective, reliable, and heuristically valuable with respect to whatever phenomenon is being engaged. If one cannot demonstrate that the theory one has made out of math is accurately reflective, reliable, and heuristically valuable, then, one has used math in a way that has led to the making of a bad or problematic theory.

Subsequently, Sabine Hossenfelder indicates that physics is not math. She goes on to indicate that in addition to being internally consistent (that is, the logical features of the math being used must be able to hold together and, therefore, not entail contradictions of one kind or another), physics must be able to give expression to a

framework which accurately reflects whatever phenomenon is being observed.

Yet, the nature of such accurate reflection is usually written in the language of mathematics. So, physics is math, but it just isn't only math.

Physics entails forms of math that can establish certain kinds of dependable, descriptive relationship with actual aspects of reality – that is, the math used in such physical descriptions must be capable of being tied to experience (observables, evidence, and/or experiment) in a demonstrably acceptable fashion. Consequently, a theory of physics which is written in mathematical terms that have no dependable, descriptive relationship with actual dimensions of lived experience is likely to give expression to a bad theory of physics concerning a given phenomenon that has been encountered during such lived experience.

At this juncture, Sabine Hossenfelder indicates that the real problem in physics is not mathematics per se. Instead, according to her, the real problem is entangled with the challenge of finding the right kind of math.

So, when someone claims that the 'right kind of math' must have beauty, elegance, and/or simplicity what might be meant? Moreover, what do such beauty, elegance, and simplicity contribute to the way in which mathematics describes some given phenomenon, or, stated somewhat differently, what do beauty, elegance, or simplicity give one that is not provided by a mathematical description which is accurately reflective, reliable, and heuristically valuable concerning the phenomenon or phenomena to which one is attending?

Sabine Hossenfelder believes that notions of beauty, elegance, and simplicity seem to be empty concepts that obfuscate the process of doing physics. She believes that preoccupation with those concepts tends to lead one away from arriving at mathematical descriptions which are scientifically viable rather than assist to make progress toward such viable descriptions.

Interestingly, in one *Manifold* podcast to which I listened, Sabine Hossenfelder makes a point that I have often tried to make to individuals who have been inclined to confuse simplicity with

Ockham's razor. Many such people want to argue that Ockham's razor stipulates that the simpler of two relatively evenly matched theories is likely to be the right one.

However, Ockham didn't actually make such an argument. Rather, he indicated that one should not generate assumptions beyond necessity – that is, beyond what is needed to provide a defensible account of a given phenomenon.

There is nothing to which one can point in nature which plausibly demonstrates that nature must be a function of dynamics that are rooted in qualities of simplicity – assuming, of course, one could even specify what was meant by the idea that the properties which make existence or ontology possible are necessarily "simple" in nature. What we might want, or expect, nature to do is quite different from what nature might actually do.

In order to do justice to the truth concerning nature, one must give truth that which is its due. To give nature's truth what it is due involves removing everything – to borrow, somewhat loosely, from the perspective of Michelangelo -- which does not belong to nature's actual structure or set of qualities.

This is something which tends to be more easily said than done. In fact, the challenge of transposing Michelangelo's advice into the discipline of physics leads to, among other possibilities, the aesthetically-tinged issue of "naturalness."

In 1936, as Isidor I. Rabi was reflecting upon the discovery of a sub-atomic particle termed the "muon," he is reported to have asked, sort of rhetorically: "Who ordered that?" His question in response to the discovery of the muon was due to the way in which that particle was completely unexpected and didn't seem to fit in with the other particles which had been discovered.

The muon is like an electron. However, the former particle has a mass which is 207 times heavier than the electron.

The muon is part of a second generation of fermions. The members of the second generation of fermions are like their counterparts in the first generation of fermions, but the members of the latter set of fermions have heavier masses than the members belonging to the first generation of fermions, and the third generation

of fermions are similar to the other two generations but have even heavier masses than the first two generations.

Unlike the electron, the muon doesn't seem to show up much except in the context of the high energy physics at CERN and in cosmic rays. Consequently, the first generation of fermions (the electron, the electron neutrino, as well as the up and down quarks) is involved in the sorts of physics that operate in what is considered to give expression to 'usual' or 'standard' forms of dynamics.

As a result, there is a sense of "naturalness" in the way the properties of the particles in the first generation of fermions conform to expected or anticipated forms of dynamic manifestation. The fact that there are second and third generations of fermions which exist and, with the exception of mass, exhibit the same or similar properties except mass had been unexpected and, therefore, are referred to as being somewhat: 'unnatural'.

That which is 'unnatural' in the foregoing sense seems to beg for an explanation as to why there is such a departure from the way in which other known phenomena usually seem to operate. The existence of such an anomaly suggests that there must be some deeper explanation for why unnatural phenomena, in the foregoing sense, are possible.

No one knows why there are three generations of fermions. It is one of the great unsolved puzzles which are present in the Standard model of particle physics.

Ironically, the three generation issue is only the tip of the iceberg when it comes to the issues of 'unnaturalness' that exist in relation to the Standard model. In fact, there would seem to be more themes of unnaturalness than there are themes of naturalness which are present in that model.

When the entire edifice of the Standard model of particle physics is coupled with Einstein's general theory of relativity, that partnership is fraught with 'unnaturalness'. For example, why do any of the 25 particles that have been discovered have the values they do? Why does the scalar Higgs boson have a mass of about 125-126 GeV which is much lighter or smaller than had been expected, and what sets that value? Why is there such an exceedingly large disparity between the

strength of the force of gravity and the strength of the other three forces (electromagnetic, weak force, and strong force)? Why is the calculated value of dark energy so much smaller than what might be expected on the basis of other considerations in cosmology?

All of the foregoing factors tend to suggest that there might be something more deeply hidden than is indicated by the Standard model. All of the foregoing considerations tend to raise the question of why do we live in what appears to be such an unnatural universe in which values seem to need to be "just so."

None of the foregoing values could have been anticipated to be what they are. Yet, nonetheless, despite the presence of so much unnaturalness, the universe has been able to motor on for billions of years and does not appear to be about to change the way in which it will conduct its existential business in the foreseeable future.

Our models of the universe cannot be derived from first principles. Given all the possible universes that might have come into being, the universe in which we reside seems to depend on a lot of apparent coincidences which involve large and small dimensionless numbers that require a certain amount of fine-tuning to be brought into alignment with the available data.

Some physicists believe that the "natural/unnatural" distinction can be, and should be, used as guide for conducting research. It is as if such individuals were trying to adapt *Animal Farm* to the world of physics by saying something to the effect that: 'all phenomena are equally natural/unnatural, but some are more natural/unnatural than others' and, therefore, they deserve special consideration – as if looking for an explanation as to why such a specific condition or form of naturalness/unnaturalness exists, and, therefore, how it might be a key to unlocking an array of mysteries … as if science weren't already supposed to be preoccupied with doing precisely this independently of considerations of naturalness or unnaturalness.

Considerable amounts of time, resources, finances, journal space, and careers have been tied to decisions about what sorts of 'natural' and 'unnatural' research should be pursued. Investments of various kinds have been, and are being, made about what kind of a theory is considered to be most likely to provide solutions to unsolved problems in physics, and, yet, the metric for selecting such theories

often appears to be rooted in considerations of aesthetics involving beauty, elegance, simplicity, symmetry, and naturalness rather than being firmly rooted in rigorous forms of observation, testing, and, various rounds of probing questions concerning the reliability of physical evidence followed by a series of critical reflections concerning the possible significance of accumulated data and, then, repeat that same set of processes (in a self-similar way) as many times as needed in order to arrive at an understanding concerning the nature of whatever phenomenon or phenomena is being engaged that assists one to develop a more heuristically valuable orientation concerning the nature of one's relationship with a universe that seems to help make such a phenomenon or set of phenomena possible.

Sabine Hossenfelder contends that trying to use the notion of naturalness as a guideline for conducting research seems to be a variation on the idea that mathematics necessarily contains beauty or elegance as part of its fundamental value to physics. She maintains that giving such a central role to the natural-unnatural divide in conjunction with the development of physical theory places an additional set of assumptions -- and, consequently, introduces an unnecessary set of conceptual, methodological, and financial stresses -- on the process of theory building and, as such, might serve to derail physics because one would be introducing biases into the scientific processes that frame research by expecting reality to operate in ways that comply with a researcher's sense of what is natural and what is unnatural and, therefore, will tend to dictate or determine what kinds of projects will be considered to most likely to lead to the resolution of problems in physics – sort of like choosing some horse in the third because of the way the creature conducted itself in the paddock area prior to the race.

Hossenfelder is not trying to suggest that researchers should try to avoid the pursuit of deeper, more fundamental accounts for why things are the way they are. Instead, she is trying to indicate that what someone (even a possible consensus of individuals) considers to be natural and unnatural revolves about a rather ill-defined and arbitrary criterion – like beauty and elegance – and, therefore, might not be a reliable methodological criterion to use for the development of theory because such criteria run the risk of inducing researchers to think

about problems or possibilities in physics through aesthetic lenses instead of through more substantive methodological lenses which are not subject to the optical flaws which tend to emerge as a result of such arbitrary considerations.

Issues of naturalness and unnaturalness often tend to be entangled in arcane forms of mathematics. Such forms of mathematics might involve a system of axioms and so on which are consistent within their own frames of reference but which, nonetheless, often have difficulty finding physical phenomena to fit into the conceptual system that is being generated through those kinds of exotic frameworks, and, as such, those kinds of mathematical constructions often tend to become all dressed up with no place to go in the real world.

Having done undergraduate work in psychology as well as having worked in several mental health-oriented institutions, I am familiar with the notion of delusional thinking. While Sabine Hossenfelder might be too polite – or too politically astute -- to say as much, there seems to be a very treacherous stretch of phenomenological territory which exists between physicists who are delusional in their way of going about physics and those researchers who make creative use of the constructive possibilities in mathematics to establish important bridges between mathematical forms of description and aspects of reality which are reflective of, or have some logical resonance with, those forms of description.

Consider the issue of supersymmetry. This theory maintains that fermions (particles which are characterized by half-integer values of intrinsic angular momentum or spin) and bosons (particles which are characterized by integer values of intrinsic angular momentum or spin) can be transformed into one another ... or, in other words, fermions and bosons constitute different editions of one another.

Moreover, the foregoing transformations involving spin can involve changes in space-time. When such mathematical transformations are considered in terms of local symmetries, a particle with spin 2 emerges that gives expression to properties that are like the hypothetical graviton, the alleged carrier of the force of gravity.

Supersymmetry also entails another perk. More specifically, by accepting the framework of supersymmetry, the set of particles that is

theorized to be associated with the 25 particles of the standard model enables theorists to avoid the infinities which often plague calculations concerning high-energy physics as well as to side-step the infinities that often emerge in conjunction with attempts to unify the four fundamental forces.

While, on the liability side of the theoretical ledger, the number of particles in supersymmetry doubles (plus a few), on the credit side of that ledger, the number of radically different kinds of particles goes from two to one (from: fermions and bosons, to: supersymmetric partners which can be transformed into one another). So, on the one hand, things become more complicated because more particles are presumed to be present, nonetheless, on the other hand, things become less complicated because one only has to deal with a single, fundamental category of particles which, under the right circumstances, has the capacity to show up in either of two spin modes.

In addition, supersymmetry provides one with a way to incorporate gravity into the folds of particle physics and quantum mechanics. Moreover, supersymmetry also provides a method for eliminating infinities from supersymmetric processes which are geared toward unifying the four fundamental forces.

The new supersymmetric particles have been provided with names. For instance, the supersymmetric partner of the electron is known as a "selectron," and the supersymmetric partner of a quark is known as a "squark," while, on the other hand, the supersymmetric partner of a photon is termed a "photino," and the counterpart to a gluon is called a 'gluino."

If supersymmetry were true, then, it might be able to resolve a number of outstanding problems in physics. Unfortunately, not one of the supersymmetric theorized partners for the 25 fundamental particles of the Standard model has been found amidst the debris of high-energy physics.

Furthermore, when the Higgs boson was discovered in 2012, the energies being reached in the Large Hadron Collider were considered by many researchers to have been sufficiently high that some sort of evidence should have shown up which was capable of confirming at

least a few of the proposed supersymmetric particles, and, yet, no such evidence emerged then, or subsequently.

One possibility for the absence of evidence concerning the existence of the sought for supersymmetric particles is that those proposed particles are much heavier than initially predicted, and, therefore, detecting their presence would require even more powerful forms of high-energy physics than is presently possible because heavier particles require greater amounts of energy to subsidize their existence. On the other hand, an alternative possibility concerning the absence of the kind of evidence which might lend support to the possible existence of the proposed supersymmetric particles is that they just don't exist and, consequently, supersymmetry is not a tenable theory.

The Large Hadron Collider operates at energies that run up to 13.6 TeV (teraelectron volts, a trillion electron volts). Nima Arkani-Hamed believes that a collider needs to be built to test, among other things, issues of "naturalness" in conjunction with supersymmetry, and the size of collider which he has in mind is one that generates energies of 100 TeV, nearly 8 times the size of energies which are currently produced at CERN.

There has been, and continues to be, much talk about the beauty, elegance, and simplicity of supersymmetry. Yet, none of that beauty, elegance, or simplicity seems to be capable of being translated into real world physics.

One of the features about supersymmetry that some people found attractive was its apparent property of "naturalness." Yet, despite its alleged naturalness, that naturalness did not enable supersymmetry to become real.

The mathematics of supersymmetry might be beautiful and elegant in some sort of amorphous fashion, as well as be shimmering with simplicity of some kind or fully natural in some sense. However, to date, as far as real world physics seems to be concerned, the mathematics of supersymmetry appears to constitute a 'bridge to nowhere' in the physical world.

There are several other issues to consider in conjunction with supersymmetry. Let's suppose that the sought for new particles that

are predicted by supersymmetry all exist and that the only reason why they have not been discovered is that – as intimated earlier -- they are heavier than anticipated and, consequently, require a much more powerful collider to be able to generate the energies which are necessary for their appearance.

Notwithstanding the foregoing concession, supersymmetry still doesn't provide much of an explanation concerning fundamental issues. Instead, the theory just seems to provide a more nuanced sort of description concerning various aspects of particle dynamics.

More specifically, the mathematics of supersymmetry offers a way to descriptively represent the idea that fermions and bosons can transition into one another. Yet, the foregoing sort of supersymmetric operator says nothing about what the actual nature of that kind of a transition dynamic might actually involve – just that <u>if</u> it exists – then, certain other theoretical considerations become mathematically possible.

Such a transition dynamic has not been derived from first principles. The dynamic has been proposed because it is a form of fine-tuning based on assumptions which help make the mathematics of the theory provide a consistent way of thinking about various possibilities in particles physics.

Nonetheless, there is nothing which has actually been shown to exist except a system of mathematics which suggests that such a transition dynamic might exist. Furthermore, even if such a transition process were conceded to be real, the mathematics does not provide an account which would justify claiming that such a transition process (i.e., fermions into bosons, and vice versa) might work according to one kind of specific dynamic rather than according to some other sort of specific dynamic.

In addition to the lack of details concerning the nature of the transition dynamic which enables fermions and bosons to be able to exhibit the properties of one another under the right set of conditions, there are other problems surrounding the issue of symmetries in supersymmetry theories. Symmetry groups encompass all of the transformations which can take place within a system without altering the fundamental nature of that system.

There are three different symmetry groups that are present in the standard model of physics. These are, on the one hand, U(1) and SU(2) which govern permissible transformations involving the electroweak theory, and, on the other hand, SU(3) which has to do with permissible transformations involving the strong force.

In order to incorporate the Standard model into supersymmetric theory, there must be a way for the aforementioned symmetries to emerge out of the dynamics of supersymmetry. The term which is used in conjunction with the foregoing process of emergence is known as "symmetry breaking."

Supposedly, if and when such a 'breaking" phenomenon occurs, that process leads to a supersymmetric system giving expression to a subset of symmetries, among which are the three symmetries of the Standard model that were mentioned previously. One of the favorite means of accomplishing the foregoing form of symmetry breaking is 'The Big Bang' simply because nothing is actually known about that event (it is pretty much a black box phenomenon), and, as a result, one is able to make all manner of assumptions concerning what took place in the black box known as the Big Bang, and consequently, all manner of degrees of freedom exist for making assumptions about what might happen next.

Of course, nearly 50 years ago, Steven Weinberg came out with a narrative (dressed in scientific language) concerning the supposed first three minutes of the Big Bang, which was followed by an updated version in 1993. Nonetheless, if one does a bit of "fact checking" concerning one, or another, of the editions of the Weinberg book in the light of: (1) The work of Halton Arp; (2) the development of the 'Electric Universe" approach to explaining various aspects of the structure and dynamics of the observable universe; (3) together with some problems which exist in relation to the distribution of lithium in the universe, (4) along with a plethora of apparent revelations made possible by the Webb telescope, (5) in addition to an array of problems which require arbitrary forms of fine-tuning in relation to alleged early episodes of expansion (not the least of which is whether space is something that is capable of inflating in the way that the dynamics of expansion require), then, one might question whether the first three

minutes happened in the way that Weinberg claimed they did or whether the Big Bang happened at all.

If the Big Bang didn't occur, then, one wonders what might have caused some form of symmetry breaking to occur. Even if a Big Bang event did occur, one still wonders about the specific properties of that dynamic and what might have given expression to the process of symmetry breaking.

Mathematically speaking, supersymmetry has postulated the existence of various larger symmetries which contain within them the seeds of the smaller symmetries that comprise the Standard model, and which, presumably, would unfold or become manifest once the larger symmetry had been broken. One larger symmetry group which had been proposed by supersymmetry theorists is known as: SU(5), and it was offered as a possible way of unifying various aspects of physics.

The mathematics of SU(5) indicated that certain kinds of particle interactions might be possible, and one of these possibilities involved the decay of the proton. Yet, available evidence also existed which suggested the lifetime of a proton could be as much as 10^{31} years, and this is multiple orders of magnitude greater than some of the present estimates concerning the age of the universe.

Rather than waiting in a laboratory which is located in some corner of the Earth in order to see if a given proton might decay prior to 10^{31} years, a work around was devised. Every molecule of water contains 10 protons, and there are an estimated 10^{25} molecules in every liter of water.

Consequently, if one were to pour enough water into a holding tank and, then, shielded that tank from high-energy collisions which might lead to the decay of a proton, one might stand a chance of determining whether, or not, the lifetime of a proton actually was 10^{31} years. The foregoing sorts of experiments have been run in various parts of the world since the 1980s, but, to date, no one has observed evidence indicating that protons decay as a result of their own internal dynamics.

Current estimates suggest that the lifetime of a proton is 10^{33} years or higher. As a result, the symmetry group SU(5) had to be

discarded because it predicted that protons would decay – relatively speaking – more quickly than evidence actually indicated.

Other symmetry groups have been devised which allow for a proton lifetime that lasts for up to 10^{36} years. Given current technology, experiments cannot be conducted that would be capable of confirming or rejecting such a lifetime length.

The foregoing considerations are merely forms of fine-tuning a theory to try to force-fit it into the compartments generated by observed data – hardly an argument in favor of naturalness as a guiding principle for future experimentation. Moreover, even if someone could conduct an experiment in which protons appear to decay, nevertheless, all that would have been demonstrated is how a given symmetry group which permits such a decay process is consistent with the lifetime data concerning the proton.

Yet, the foregoing considerations would do nothing to confirm whether, or not, there was, or could have been, any symmetry breaking event (such as the Big Bang) which would have given rise to the three symmetry groups of the Standard model. Nor would such experiments determine whether, or not, such a symmetry breaking event entailed a real world dynamic which enabled fermions and bosons to transition into one another or actually gave rise to a spin 2 particle, such as the graviton.

Since no supersymmetry particles have been detected in high-energy physics, the only thing one can surmise is that if symmetry-breaking is energy dependent, then, symmetry breaking dynamics must take place at energies above what is possible to generate in current colliders. On the other hand, there is no actual proof indicating that to whatever extent symmetry breaking occurs, it is necessarily energy dependent, but making symmetry breaking a function of energy means that one can use the unknown nature of the energies which envelop the Big Bang in a cloud of obfuscation and, thereby, serves as a source of lending cover for whatever sorts of degrees of freedom are needed to make one's mathematical systems seem like they are describing something other than their own inner workings.

A theoretical cousin to the lifetime of the proton is the notion of dimensionality. Since its inception in 1968-1970, string theory has

gone through various editions, and over the years, those versions have been characterized by different numbers of dimensions.

Dimensions tend to be a function of the mathematics in which those dimensions are rooted. Once theory proposed the existence of such dimensions, some researchers went in search of evidence that those sorts of dimensions actually existed.

No evidence was forthcoming indicating that those purported dimensions existed, and to account for why various dimensions that are claimed to be necessary for the unification of physics have not been observed, theorists introduced the notion of compactification. Compactification involves a process in which dimensions supposedly are curled into tiny, compact forms that are not readily visible.

However, the general concept of compactification does not actually provide an account for the physical dynamics that would be needed for such a process to be possible. Moreover, compactification assumes -- but not does have much to say about whether, or not -- dimensions are necessarily the sort of phenomena which can be compactified.

In the closing years of the 20th century, Nina Arkani-Hamed, together with Gia Davis and Savas Dimopoulos, wrote a paper that proposed the existence of dimensions which were compactified, and, yet, were compactified in such a way that they were sufficiently large enough that they might be detectable in forthcoming high-energy experiments. The notion of "naturalness" played an important role in the foregoing proposal because that notion was cited as the reason why one would expect extra dimensions to migrate around the TeV scale of energies.

Experiments conducted at the Large Hadron Collider have provided no indication that such large compactified forms of extra dimensions exist. In addition, no one has provided evidence that dimensions are capable of being compactified in any context other than a mathematical one, and, perhaps, this is the reason why experimental evidence of compactified extra dimensions have not been detected and, indeed, cannot be detected.

If one is bored with the limited possibilities inherent in the 10-11 dimensions which have been proposed in conjunction with string

theory, one might wish to consider a proposal for a form of unified theory by Alain Connes, a previous winner of the Fields Prize which is the mathematical counterpart to Nobel Prize and an award which is associated with considerable amount of community esteem concerning the mathematical skills and insights of those who have received that aware. At one point, Connes had proposed a 384 by 384 dimensional matrix which could might be used to tract the vibrations of space-time as a way of quantizing the positions of particles and, therefore, be able to better understand certain aspects of particle dynamics.

By constructing the foregoing edifice, Connes was able to incorporate the sorts of gauge interactions which are entailed by the Standard model and, thereby, introduce an element of unification into his theoretical considerations. Nonetheless, for a variety of reasons, people – including, apparently, Connes himself – lost interest in the foregoing proposal

Maybe, one of the reasons for the loss of interest that is being alluded to in the foregoing paragraph might have something to do with the way in which something can make sense mathematically and, yet, nevertheless, a way cannot be discovered which enables such mathematics to gain significant traction with respect to being able to accurately reflect the properties of some facet of actual existence. In addition, one could raise questions about how to understand the notion of "dimensionality" that is being referenced in the aforementioned proposed 384-square matrix and whether the reason why such notions tend to be geometrized is because geometries – even exotic ones – fit in with mathematics as presently understood, whereas notions of dimensions which cannot be geometrized tend to be mathematically elusive, if not baffling in fundamental ways.

Early on in his book: *Something Deeply Hidden*, Sean Carroll makes a distinction between epistemic and ontological perspectives. He contends that epistemic considerations have to do with descriptions concerning someone's state of, or belief about their state of, knowledge, whereas ontological considerations allegedly describe so-called 'objective' aspects of the universe or reality.

He uses the notion of a probability distribution in statistical mechanics as a way of illustrating the foregoing distinction. Statistical

mechanics seeks to characterize the nature of some substantial system of molecules, atoms, or particles by using various mathematical methods and techniques that provide one with a sense of the dynamics and characteristics which govern the entire set of foregoing objects on the basis of what is understood about sub-sets of that system and, then, scale up.

If one can develop a probability distribution concerning the contributions which are being made by different components of a system, then, one can use that probability distribution to make certain kinds of predictions concerning what the system as a whole might do under different circumstances. The aforementioned probability distribution doesn't necessarily constitute a complete understanding of the actual nature of the system (i.e., its ontology) which one's distribution is being used to characterize, but the probability distribution does give expression to the nature of the relationship between one's understanding of how one believes things might work (one's epistemic orientation) and the phenomenon or phenomena which is being engaged through one's probability distribution.

Understandings concerning the components of a given system can be accurate or inaccurate. The better one understands those features and the more accurately one's understanding reflects the properties of those features, then, notwithstanding the presence of other sources of modulation which have not been taken into consideration, the more closely, in general, one's understanding approaches a form of knowledge about whatever aspect of experience on which one might be focusing.

Associated with every edition of quantum mechanics is a wave function. The wave function gives expression to a probability distribution which is said to characterize the weighted possibilities that are present in the system which the wave function is being used to describe in the form of a distributed potential.

In statistical mechanics, the probability distribution describes the relative contributions which different components (e.g., atoms, molecules, and so on) of a system are believed to make in order to generate dynamics that will give expression to the contributions of those components in shaping the overall behavior of the system being

considered. What does the probability distribution of a wave function describe?

The most straightforward answer which can be given to the foregoing question is that we don't actually know what the probability distribution of a wave function describes. In most cases, the wave function and Schrödinger's wave equation are in synch with one another, but why such a condition of synchronization should exist is not necessarily known because the wave equation and the wave function intersect at just one point in an ontological game of pin the tail on the quantum structure and, then, write down data concerning the place where the pin lands.

Sean Carroll sets out to fashion a minimalist rendition of quantum mechanics and insists that one of the fundamental principles of such a process requires one to treat the wave function as an ontological statement rather than as an epistemological statement. In other words, he wants his readers to consider the wave function to be an accurate representation of reality.

On what basis can one claim that the wave function is an accurate representation of reality? It provides a set of possibilities, only one of which will turn out to be correct.

Therefore, while reality might be represented somewhere in such a probability distribution, nonetheless, prior to performing a measurement, we don't immediately know what the identity of such a reflective point is in conjunction with a given set of circumstances. As a result, one could equally well say that the wave function is filled with an array of wrong representations concerning the nature of a given aspect of reality.

In order to bracket, in a sort of Husserlian fashion, an array of complicating factors in quantum mechanistic, Carroll next asks his readers to set aside all the problems surrounding the issue of measurement in quantum mechanics. He proposes that we assume that the wave function unfurls smoothly in tandem with the Schrödinger equation and that the nature of that unfurling dynamic is deterministic in character.

In what sense is the wave function which is being described by Carroll deterministic in nature? To be sure, the aspect of the wave

function which will turn out to reflect some aspect of reality might provide evidence that something deterministic is taking place, but this is not because of the wave function.

Rather, an aspect of reality happens to be among the many possibilities which are being described in the wave function. The description is one thing, and the reality being described is something else.

We still don't know why that aspect of the wave function's probability distribution is the one alluding to an actual aspect of reality which is present amidst an array of representational pretenders. We still don't know what determines why a given possibility in the probability distribution is the one which becomes manifested reality.

Suppose I take a snap shot of all of the participants in a race and based on what I understand about past performances and present circumstances involving those participants, I assign a likelihood that a given participant will win the race. Has either the snap shot or the assigning of probabilities determined the outcome of the race even if the person selected to win the race does, in fact, win it ?

Past performances do shape what a given contestant might be able to do, and present circumstances do shape what a given contestant might be able to do. Nevertheless, what happens on the day of the race – not only with respect to the winner but in relation to the other participants as well – also will shape what transpires.

We have come face-to-face with the sort of situation that was encountered during Volume 1's discussion that explored a few of Morton White's about causality and the lighting of a match. What actually determines or causes something is a function of many considerations.

However, one can acknowledge the foregoing point without feeling forced to also maintain that a snap shot which is taken of a number of race participants whose chances of winning a race have been handicapped and attached to the photo constitutes one of the causes of the race's outcome. There is nothing deterministic about the snap shot or the handicapping process even as both considerations

inform a person's understanding in relation to various possibilities concerning the upcoming race.

Subsequently, Carroll somewhat modifies his position – which he calls "austere quantum mechanics" (AQM). He indicates that the wave function is a precise replica of a quantum system.

Nevertheless, such a representation seems more like a snap shot than it constitutes a look at the actual dynamics of a given phenomenon. It reflects possibilities and does not determine anything real.

A quantum system is a snap shot that incorporates our understanding of the different components of that system and how they might interact with one another under a given set of circumstances. Such a system – like the previously discussed snap shot – has elements of possible reality in its composition because the character of that composition is drawn from events which were real in the past.

Yet, that which selects what will become manifest after the other possible components have been eliminated by the unfolding of actual events is not present in the snap shot. Similarly, what determines why a quantum system manifests itself in one way rather than another at a given point in time is not present in the snap shot, even though the possibility of such an outcome might be represented in the snap shot.

The wave function doesn't explain the Schrödinger wave equation. The wave function describes a set of possibilities, and the wave equation identifies which of those possibilities reflects an aspect of reality.

The wave function portrays the potential of different possibilities. The wave equation identifies what has been actualized into reality from amidst a set of potentials and possibilities.

Carroll contends that the world, or the universe, or reality, is nothing but a wave function. However, the world is a process that is continually engaged in actualizing potentials at a rate with which wave functions cannot keep pace … descriptions always lag behind actualities.

Moreover, to refer to wave functions as a form of wave seems somewhat misleading. Such functions seem more like distribution patterns rather than waves.

To be sure, there is some kind of amplitude associated with such functions. Yet, while differences in amplitudes across a series of possibilities can be presented as a wave-like form that reflects the manner in which such possibilities or probabilities are distributed (and, as such, can be characterized in terms of undulations of a sort, nonetheless, the probabilities which are present in such a function don't seem to exhibit any sort of internal dynamic which actually seems wave-like.

Perhaps, quantum wave functions constitute a standing wave of sorts. But, if this is the case, one still would like to know what caused such a standing wave to have the properties it does because although wave functions might have descriptive value, their properties and characteristics don't appear to be self-explanatory.

According to Carroll the electron has no actual position. Instead, the electron is a function of all of the positions that an electron could have.

The foregoing property of being able to encompass many quantum possibilities at the same time is known as superposition. For instance, according to such a perspective, there is no electron in the sense of an isolated thing traveling about in space.

For Carroll, an electron consists of all of its potentials and possibilities held together (somehow) in a state of superposition. When a measurement or observation takes place, the superposition bubble bursts, and a specific possibility becomes realized.

The notion of superposition is a description that Carroll wants to pass off as a kind of ontology. Nonetheless, just as he indicated earlier in his book that no one actually see's a wave function – we see measurements, observations, and experimental outcomes – so too, no one actually sees a state of superposition.

Superposition gives expression to an assumption that is being made by quantum physicists. It constitutes a belief concerning the structural character of quantum phenomena.

The notion of "superposition" has heuristic value (that is, it provides a productive or useful way of thinking about certain kinds of phenomena but is not necessarily true in any substantive, ontological sense). Yet, Carroll has no way to prove (ontologically speaking rather than hermeneutically speaking) that electrons – or any other kind of quantum entity -- are the ontological, superpositional complexes that he supposes them to be.

For the sake of discussion, let us suppose that Carroll's foregoing description of electrons as being nothing more than a superposition of possibilities were true. What determines which aspect of the electron's superpositional potential will be the one toward which the electron will be inclined in a given set of circumstances?

In other words, what causes the electron to be inclined toward one facet of its potential rather than another? What is the actual nature of the dynamics which give causal expression to the transition from a superpositional entity to an actualized electron?

What happens to all of the other facets of superposition when potential or possibility becomes actuality? Are those facets carried along like so much unused luggage, awaiting their chance for subsequent activation?

Perhaps, there is a chain of superpositional supermarkets spread across the universe. Maybe, different modalities of superposition show up in cosmic bins from which particles can be randomly drawn to replenish their superpositional state for the next kind of dynamic in which they become entangled?

To say that a particle is in a state of superposition sounds like there is an ontological complex or structure somewhere that is waiting for its potential to be activated in some manner. But, if electrons – and other particles -- can have no actual position until measurement establishes it, then, why should one suppose that packets of superpositional possibilities should have any ontological status while they are waiting to decohere, and if they have no determinate ontological character, then, how – exactly -- do superpositional packets work and how do they become incorporated into some on-going dynamic?

Setting aside issues of superposition for which there is no actual evidence but which seems to offer a sense of comfort -- as many rituals do – to those who have use for them, let's move on to the notion of "decoherence" (the term was introduced in 1970 by Hans Dieter Zeh). The foregoing idea is used to refer to the dynamics of transition from possibility to realized possibility.

Decoherence is a black box. Outcomes are ground into existence in conjunction with that dynamic, but no one knows how the sausage is made.

Wave functions supposedly collapse or undergo decoherence when a measurement is made or an observation is conducted. Nevertheless, notwithstanding the incredible precision concerning the nature of what emerges from such a collapse or process of decoherence, no one know how observation or measurement interacts with quantum phenomena to yield a specific result or outcome.

Some people have suggested that it is the observation or measurement itself which collapses the wave function, and, as a result, we, in a sense, determine the nature of the universe by collapsing things in one way rather than another. However, given that no one knows how the process of decoherence operates, one has difficulty understanding in what way observation is determining the nature of the universe.

Alternatively, maybe human beings are not responsible for the collapse of the wave function (assuming this even occurs in any ontological sense). Perhaps, the universe discloses aspects of its nature according to its own manner of doing so, and, if this is the case, then, maybe, decoherence (to whatever extent it might occur) is brought about by the universe and, consequently, observation and measurement are a function of what the universe discloses to various processes of observation and measurement.

We see what we are shown according to the lenses, filter, and frames which are used to engage what is being shown. Being ready, or open, to see what is actually present is another issue.

We often believe that we choose the experiment. Only infrequently do we consider the possibility that the experiment, is, in a sense choosing us.

We don't even know how ideas come into our consciousness (although we have many theories concerning this process). Why should we automatically suppose that we understand how experiments, of one kind or another, come into our lives?

In some ways, quantum physicists seem a bit like those human calculators who are able to generate correct answers to complex problems in arithmetic but don't necessarily know how they (i.e., the number magicians) do what they do or what they do is done to them. Perhaps, terms such as: Decoherence, superposition, and wave function serve as a bit of misdirection to take people's attention away from the mysteries which seem to make quantum mechanics work but which no one understands – not even the practitioners of that craft … mysteries which suggest that there is something more deeply hidden.

Much of Sean Carroll's book – *Something Deeply Hidden* -- is directed toward providing the sort of scientific, historical, and philosophical context that might help readers understand the Many-Worlds perspective of Hugh Everett, III. While Carroll's foregoing exposition goes through many twists and turns that are interesting and well-written, that process can be short-circuited somewhat by critically reflecting on a basic premise which appears in Carroll's account of Everett's position

More specifically, Carroll points out that Everett maintains there is a wave function associated with every aspect, object, or dynamic of the universe. Collectively, all of those wave functions are part of what Everett calls the "universal wave function."

According to Carroll, Everett contends that everything is quantum in nature. Consequently, Everett believes that the universe can be described by the foregoing universal wave function.

Moreover, for Everett, the state of superposition for the universal wave function does not refer just to the probability distribution which characterizes such a wave function. The state of superposition for the universal wave function entails all possible worlds that such a universal state of superposition encompasses.

Therefore, probabilities have become instantiated as 'worlds'. Everett insists that those worlds are always present, but particular aspects of those 'worlds' can be actualized through solving

Schrödinger's wave equation – one problem, experiment, measurement, and calculation at a time.

While the general logic of the Many-World's perspective is fairly clear, whether one is willing to buy into that logic is another matter. In other words, to be willing to accept such logic, then, seemingly, one must suppose that the probabilities of the universal wave function represent ontological entities which on the macro level of the universal wave function can be considered to be possible worlds which can be transitioned into actual, real, objective, ontological worlds.

However, to begin with, we don't actually know what the probability distribution is for the universal wave function. Furthermore, even if we were knowledgeable about such a distribution, we don't know what gives that distribution the probabilistic character it has.

Therefore, we don't necessarily know whether, or not, the universe is entirely quantum in nature. That is, we don't necessarily know whether, or not, there might be some set of hidden variables – say, Qi, prana-nur-qi -- which could be responsible for organizing, and actualizing, the universal wave function in one way rather than another.

Furthermore, there is a problem with the apparent act of conceptual or theoretical prestidigitation which has sought to transform a probability distribution for the universal wave function into a set of ontological worlds that are omnipresent and waiting to be activated through applications of Schrödinger's wave equation. More specifically, the wave equation is tied to particular contexts.

That equation is a partial description of an aspect of a given particularized context. Therefore, it carries no necessary, long-term predictions for what the rest of the universe must be like or even what makes the solution to such an equation what it is.

In addition, there is no universal wave function which can be shown to be constraining or determining the ontology concerning what a specific application of the wave equation will discover on any given occasion. In fact, until one knows (and not just believes) whether, or not, the entire universe is quantum in nature -- and

nothing but quantum in nature -- and until one can prove that there are no phenomena, or forces, or processes, or dynamics which are present in the universe, or operating through the universe, that are responsible for organizing the quantum dimensions of physical phenomena to manifest in the way they do, then, one is in no position to talk about what might be meant by the notion of Many-Worlds or what those Many-Worlds might be a function of.

To claim otherwise is equivalent to whistling past the cemetery of buried, unknown things. The whistling indicates that one strongly suspects that there is something more deeply hidden beneath that which we refer to as objective knowledge but the latter – tattered and torn though it might be -- is all we have to hang onto amidst the mysteries past which we are walking in our whistling way.

Chapter 25: Bohmian Perspectives

Before actually taking a look at some of the perspectives of David Bohm, there is a backstory. That story goes through a few twists and turns but merges relatively seamlessly with a weekend during which I had an opportunity to interact with Bohm in a limited fashion approximately a year before he passed away in October 1992.

The backstory begins with my attempt to obtain a doctorate from the University of Toronto. I was encountering a lot of difficulty with getting any traction with my thesis committee, especial my alleged advisor.

There were a variety of reasons for the aforementioned problems. One difficulty revolved about my unwillingness to accept ideas just because they had been uttered by individuals who might have had some degree of academic reputation swirling about them, sort of like Charles Schultz's cartoon character Pig-Pen – although what is swirling about Pig-Pen is more endearing and easier to deal with than what often transpires in academia.

I had been taking critical exception with some of the ideas of a well-known English philosopher. My thesis advisor thought that instances in which a mere graduate student presumed to voice criticisms of such esteemed figures were acts of impertinence.

I must admit to a certain amount of confusion concerning the emergence of the brouhaha that developed in conjunction with the philosopher in question. I had been working under the impression that such issues were what graduate school was about … Silly me!

The foregoing sort of situation is not a isolated incident in my academic life. I had encountered some of this sort of problem when I was an undergraduate at Harvard.

For instance, to take but one example, when I was engaged in an oral defense of my undergraduate honors thesis, one of the members of the orals committee complained that he didn't see much of traditional psychology in my thesis. This made me wonder what the point of a thesis was if not to develop new ideas in a rigorous way which were capable of being defended in, say, an oral examination by individuals who had developed some degree of competency with

respect to the process of conceptual give and take during an academic exercise.

I should point out in passing that my thesis advisor for my undergraduate honors thesis was Robert White, author of a number of well-regarded books and articles. My thesis project began when I read his book on abnormal psychology and started to critically reflect on his ideas about the notion of anxiety.

I approached him with some of my ideas concerning that topic. He couldn't have been more encouraging with what I wanted to do, and actually spent a fair amount of time just listening and, over time, raising questions here and there concerning aspects which either weren't clear or which he felt needed shoring up.

I should indicate that the theory of anxiety which I wanted to advance in my honors thesis was diametrically opposed to what he had said in his textbook. He took the opposition in stride and simply tried to help me develop my perspective.

Notwithstanding the foregoing considerations and returning to the topic of my doctoral program, after a few cycles of being at logger-heads with respect to various philosophical issues which my doctoral thesis considered sacrosanct, my thesis advisor began to avoid me. Meetings would be arranged for a particular day, and at the last moment he would cancel the meeting, or, alternatively, I would show up at his office at the appointed time to be informed by the departmental secretary that the professor had to go to another appointment.

From time to time, I would submit something in writing about my thesis for his consideration. Initially, he might make some comments concerning what had been written, but when there was pushback from my side in relation to what he had said, he got upset and said he wasn't prepared to take the time to go through what I had written because, among other things, what I had written in response to his comments was too long.

I also had come in contact with the foregoing sort of process when I was an undergraduate at Harvard. During my first year of university, I was taking a course in psychology – but it was called "social relations."

I had written a paper on nature and nurture. The woman who read the paper said it had been too long, and if it had not been so good, she would have marked me down just because of its length, but, then, she warned me that if the length-issue happened again, I would be penalized irrespective of how good the paper might be.

A year, or so, later, I took another course in psychology. I wrote a fairly long paper – about 30 pages – and the comment on the paper was "An excellent review of the topic, but it is 300 % of the suggested length."

One can appreciate that the people who read the term papers of their students are under a great deal of temporal pressure to: Teach, do research, live their lives, and, then, find time to read 30 or 40 papers in a relatively short period of time. However, I thought the purpose of university was to help students to develop competency and, consequently, I never was able to reconcile why my papers often came back to me with a grade (often good ones) but with very few comments.

Those few comments didn't really provide me with the kind of feed-back that is necessary to be in a position to critically reflect on what is being said and lead, possibly, to further learning -- especially if they were in the form of a question mark or were written somewhere in the margins of a given page as a one or two word observation that was often difficult to decipher either as words or as what might be meant. Unfortunately, the people who read my papers often had a way of closing the door on the sort of conversation that I had tried to start via my essay.

There were other problems which affected making any constructive process with my dissertation. Some of these difficulties had to do with a student group and a community group with which I was associated.

The foregoing difficulties were of sufficient severity that one day my thesis advisor saw me in the departmental hallway and asked me, rather pointedly: 'what in the heck was I up to'? Apparently, he had been contacted by the director of the graduate institute in which I was enrolled, and the director, in turn, had been contacted by someone high up in the Ministry of Education for the Province of Ontario wanting to know why I was still a student.

Without much help, I managed to write a doctoral thesis. I submitted it to the department, but my thesis advisor refused to read it.

The casual observer might wonder why I didn't complain to someone in academic officialdom about what was going on, or why didn't I just change my thesis advisor. I had tried to re-configure my thesis committee, but that went nowhere.

In addition, I had been a member of a student group which had sought to bring to light a case of plagiarism which had been committed by a professor in the University of Toronto. Although the evidence that plagiarism had been committed was substantial – something which a number of professors from other universities acknowledged in writing – nonetheless, the university refused to pursue the matter and, instead, appointed the professor to head up the university body that was in charge of violations concerning the student honor code, including the issue of plagiarism.

Consequently, I understood, at least to a degree, how university administration works. I could complain about the matter, but many people in academic administrative positions are not only cowards, but they are bullies, and, as a result, I decided to follow the advice of Br'er Fox and just lay low for awhile until I could come up with some sort of plan that might work.

I wasn't about to quit, but the powers that be had managed to run out the clock on my doctoral program. As a result, I was placed in what is known as 'lapsed candidacy status."

This meant that I was not permitted to use any of the resources of the university or have any access to faculty assistance. If and when I submitted a thesis, I would be considered for re-admission and, if successful, I would be able to have an oral defense of my thesis.

There was a doctoral candidate from Africa with whom I had taken a class or two and with whom I would talk from time to time. Office space in the department was very limited and there was hardly any space for graduate students to use, but a few graduate students in my department did manage to obtain some office space, and the aforementioned young man from Africa was one of them.

After he received his doctorate, he arranged for me to receive the key to his office. For the next five-plus years, or so, I took up residence in that office and was a familiar sight within the department because I used the office all the time even though I was not supposed to be permitted into, or onto, university property.

The dislike which various people in my academic department had for the situation was often palpable. Yet, despite office space being at a premium and despite the fact that my lapsed candidacy status purportedly denied me access to university resources, nevertheless, over a five-to-six year period, no one in an official capacity ever approached me and said that I needed to give back the key to the office or that I needed to leave the premises.

One might suppose that the foregoing state of affairs was an indication of the liberality and compassion of academia. It wasn't … cowardice is a common trait amongst many – but not all – people in academia.

I suppose the thinking might have been something to the effect that, sooner or later, I would realize that I had been firmly checkmated and, then, eventually would slowly sink into the existential shadows and disappear.

On the one hand, I didn't have a leg – legal or otherwise – to stand upon to buttress what I did for five-plus years. On the other hand, my academic department held all the cards, and, yet, they were all derelict in their duty because, apparently, they didn't want to have to deal with any possible fallout which might arise if they tried to remove me from making use of premium office space.

In the five-plus years that I spent in that space, no one ever came into the office. The office contained space for two students, and, yet, no other student was ever assigned to that office.

There was even one occasion when I was between apartments around Christmas time. Although the university building in which the office was located had closed down for the holidays, I managed to find ways to avoid security when necessary and, as well, slept on the floor of the office for a few days.

The foregoing saga constitutes act one of my passion play. In the second act, plans for an escape from my academic gulag are set in motion … and, yes, I am working my way toward David Bohm.

While using the aforementioned office, I had actually been writing a second doctoral dissertation. This effort explored areas quite different from my previous attempt and was sort of a hermeneutical field theory concerning the nature of understanding.

While working a job, trying to carry on some semblance of a normal life, as well as writing the new dissertation, I was travelling, from time to time, to Ottawa in order to give a lecture on this or that topic at the University of Ottawa or Carleton University. These occasions had been arranged by a friend of mine who lived in Ottawa and knew some people in both of the aforementioned universities who were connected with programs in adult education.

During one such trip, I gave a talk on mysticism and science to a fairly good-sized audience (50-60 people). After the talk, a gentleman came up to me, said that he enjoyed my talk and indicated that he was surprised with some aspects of the talk because I was mentioning some ideas involving the work of Roger Penrose -- a physicist -- that not all that many people knew about.

I had been talking with someone else at the time, and the gentleman realized that he had sort of unintentionally stumbled into another conversation. He apologized for interrupting, but before disengaging the situation, he handed me a couple of papers and indicated that I might find them interesting.

I thanked him for the material. He left, and I returned to the other conversation that had been taking place.

When I returned to the home of my friend and retired to the guest room for the night, I took a look at the papers I had been given. They were written by Dr. F David Peat, and the name rang a bell.

After thinking about his name for a moment, I realized that I had read several of his books. He was a physicist who had grown tired of pursuing the usual suspects in the realm of quantum physics and had gone to England to see if he could find a way to engage in a different kind of exploratory process.

One of the first people with whom David Peat had begun to explore different topics was Roger Penrose, a well-known and well-thought of scientist from England. During my previously noted talk at the university in Ottawa, I had mentioned some of the ideas of Penrose, and I believe this was what David Peat was referring to when he said that I had touched upon some topics in science with which a lot of people are not familiar

At some point while in England, he also became involved with David Bohm -- someone who had written a book on the fundamental aspects of quantum mechanics which, along with a book by John von Neumann, was considered by many to be one of the two premiere works on the theory of quantum mechanics that had been written. von Neumann's work had been written in German and was later translated into English, but Bohm's book had been written into English and, then, translated into other languages.

Subsequently, David Peat developed a friendship with Bohm. Bohm was someone with whom Einstein was so impressed that the Einstein thought that Bohm might be Einstein's successor in the world of physics.

David Peat went on to collaborate with Bohm on a number of publications. In addition, Peat later became Bohm's biographer.

Unbeknownst to me at the time, the two Davids had been getting together for a fair amount of time to talk about Bohm's life and ideas. This was being done in preparation for the writing of the biography which, as it turned out, would not be released until after Bohm had passed away.

After realizing that I had read several of David Peat's books and after reading the papers which he had left with me, I was hit with an epiphany – a plan for escaping my academic prison. Maybe, just maybe, David Peat might be willing to become involved in my dissertation dilemma in some constructive fashion.

I returned to Toronto, but because I had no phone, I arranged with my friend in Ottawa to try and contact David Peat and see if he would receive me for a brief talk concerning my situation. David Peat agreed to the meeting, and when I returned to Ottawa, I took a copy of my

finished dissertation -- number 2 – with me just in case things went well.

At this point, the thesis was probably 700 or more pages long (I never learn my lessons). It delved into all manner of areas including: Morphogenesis, chronobiology, field theory, quantum mechanics, mathematics, holography, dissipative structures, and a few other topics.

David Peat and I met. I explained the situation to him and what I had in mind.

After making my pitch, I asked him if I could leave a copy of my thesis with him. He could look through it and decide whether, or not, he wanted to pursue the matter further, and he agreed to do this.

A few weeks later, my friend in Ottawa was able to notify me that David had decided to come on board with my dissertation project. Subsequently, I met with him and a friend of his who was a professor of linguistics in Quebec, and the latter individual also agreed to be a member of the oral defense examination.

I, then, began to approach various people at the University of Toronto in order to try to establish a nominal thesis committee, as well as to complete the remaining slots that were needed for the oral defense examination committee.

One of the people I contacted was a Nobel Prize recipient. However, he was not interested and didn't even want to talk to me about such a possibility, asking his secretary to pass on his regrets instead.

When all was said and done, the oral examination committee consisted of: A quantum physicist; a biophysicist; two other individuals with rigorous backgrounds in science; a linguist; someone who was a specialist in adult education, and someone who was not selected by me but was provided by the university as a sort of watch-dog concerning the process but who also was someone who had a vote with respect to whether I passed or failed my oral exam.

I applied for my lapsed candidacy status to be rescinded and to be readmitted to the university. My application was accepted, and a date for the orals was set.

The oral defense examination went my way, 7-0. Upon completing the process, my new thesis advisor said to me that what had been accomplished by the thesis committee over the past several months had taken a lot of guts, mostly mine.

Following the receipt of my doctoral degree, I was involved in a lot of different things, as was David Peat. However a year, or so, later, he contacted me and said that he wanted to invite me to a symposium at the Fetzer Institute in Michigan which was being held in conjunction with western scientists and indigenous counterparts to those scientists.

David Peat was sort of a bridge between the two communities. This is because not only was he a western scientist but, as well, he had been working with different members of the indigenous communities in Canada on a variety of projects, including their epistemological perspectives concerning the nature of reality.

When voicing the invitation to me, David Peat said that David Bohm -- who, at the time, was a resident scientist at the Fetzer Institute -- would be attending the symposium. I couldn't figure out why I was being invited to the gathering because I was neither a western scientist nor someone from the indigenous community.

Despite confusion concerning my status, I accepted. When I arrived at the airport – and I was one of the last people to arrive -- I was met by David Bohm and his wife, Saral/Sarah. The thought which I had then was that, perhaps, David was just being a good host and had been receiving everyone that was attending the three day event.

I kept a pretty low profile throughout most of the symposium, although I did manage to speak up on a few occasions. The discussions and activities which took place during the symposium were thought-provoking, but I noted that although, from time to time, David Bohm might comment on some aspect concerning presentations which were given by one, or another, of the individuals from the indigenous peoples side of things, he was very much given over to listening to, and thinking about, what they had to say.

When he did talk, his comments often gave emphasis to the way indigenous approaches to engaging the universe epistemologically tended to resonate considerably with some of his own thoughts

concerning the issues being discussed. The foregoing resonance was especially strong in relation to his ideas that the fundamental nature of the universe was not a function of things – e.g., particles – but a function of a constant process of transformation and flowing of existential events in which, like a vortex in a set of rapids, an apparent structure would form which appeared substantial but really only gave expression to the illusion of permanence as a result of the dynamics which underwrote the apparent, substantial existence of the vortex form.

On the last day of the symposium, David Bohn's wife, Saral/Sarah, came to me and indicated that David wanted to go for a walk with me. I was kind of nonplused about the invitation, but, naturally, I accepted.

We started our walk, but we had not gone very far before word came that there was a phone call which required David's presence. David apologized but indicated that the call was important and left to attend to that which was beckoning for his attention.

A few hours later the proceedings at the symposium came to an end. People – including me – went our separate ways.

Some months passed before David Peat and I got together again. During our session, he mentioned -- sort of in a seeming nonchalant sort of manner -- that David Bohm thought I was "very clever".

I didn't say anything. I reflected briefly on why David Bohm would think that – and at the time I took the comment as, possibly, a bit of criticism which might be said of someone who was trying to pass themselves off as something they were not and needed to try to be clever, in some way, in order to try to succeed in getting away with such a pretense.

Other than meeting David Bohm at the airport and not saying much, if anything, on that occasion except, perhaps, "Hello," or other than starting to go on a walk with him and his wife in which mostly pleasantries were being spoken before the conversation had a chance to get going when he was called away, or other than saying a few brief comments during one of the plenary sessions of the symposium (one of which had to do with a short anecdote concerning the life of Saint Augustine), there was nothing that I could would constitute grounds

for why David Bohm would think that I was a "very clever" individual, however that phrased might be parsed.

Something else which David Peat mentioned to me during one of our conversations was that he thought I should submit something that was based on my dissertation research to the *Physical Review*. Given that the *Physical Review* had to do with articles which were written by, and for, physicists, and given that I was not a physicist – just a guy who thought about things, some of which had to do with physics – I couldn't figure out why he would make such a suggestion, but as is my nature, I didn't ask David why he was making such a suggestion.

David Peat had read through various aspects of my dissertation. After doing so, he had agreed to become part of the oral defense examination process as an external examiner.

Subsequently, he had invited me to participate in the previously mentioned Fetzer Institute symposium. However, we never actually had an opportunity to sit down and discuss the dissertation in any way beyond the questions which he asked during the oral defense examination process, so, I didn't have much of an insight into what he might have thought about what I said in the dissertation except, perhaps, that he thought it was good enough for a doctoral degree and that he didn't approve of the way that the University of Toronto had handled my situation.

So, his suggestion that I write something and submit it to the *Physical Review* kind of came out of left field as far as I was concerned. Nevertheless, rather than query him about why he felt that I – someone who was not a physicist and never done any physics -- should write an article and send it off to such a prestigious journal, I let it go and moved on to other issues.

A few years later, David Peat released his biography of David Bohm. At some point, he left Canada to set up as facility in Italy that assumed the form of the 'Pari Center for New Learning.'

We continued to correspond via e-mail. Later on, he invited my wife and I to come to the Pari Center and stay as long as we liked.

The invitation was intriguing, but there were some practical problems which tended to block the undertaking of such a venture. First, I had no money to get to Italy, and, in addition, even if I had the

money, I thought that because of various events in my past and present life I might be on a no-flight list (and who knows what non-serious considerations will land people on such a list).

My Canadian passport had expired, and I had returned to the United States. If I was going to travel, I would have to get a U.S. passport, and I thought there might be some problems in securing one.

There was also the fact that my wife was currently employed in the court system in Maine and couldn't leave – except, for perhaps, a limited time. Moreover, and, maybe, the most important problem was that neither my wife nor I eat like normal people, and I couldn't imagine how we would survive for very long living among individuals who ate vegetables and other healthy foods that were served up in recipes that my wife and I – who are not all that venturesome when it comes to food -- were not likely to be able to consume.

I politely declined David's offer, citing various vagaries in the process. David later asked me to write an article for a book of readings which was being prepared in conjunction with the Pari Center, and I acceded to this request, writing about symmetry and the Sufi path.

When engaged in the research for the present book, I finally got around to reading David Peat's biography on David Bohm – *Infinite Potential*. On page 126, I came across a revelation.

The topic had to do with David Bohm's friendship with Richard Feynman. David described Feynman as being "a very clever fellow." This was followed by David Peat's observation that such a description was David Bohm's way of paying his "highest compliment" to whomever it was directed.

David Peat had passed away in 2017. I hadn't gotten around to reading the aforementioned biography until 2024.

Now, I number of mental tumblers began to fall in place. There was a reason why David Bohm had wanted to receive me at the airport, and there was a reason why he wanted to go for a walk with me during the symposium being held at the Fetzer Institute to have a chance of becoming engaged in a discussion of some kind, and there was a reason why David Peat wanted me to write an article and submit it to the *Physical Review*, and there was a reason why David Peat had invited me to the Pari Center.

The problem was that until reading the material on page 126 of the biography, none of the foregoing considerations made a lot of sense to me. I thought the two Davids were just being nice and wanting to be inclusive toward me.

Apparently, somewhere along the line prior to the symposium at the Fetzer Institute, David Peat had either discussed, or showed, David Bohm parts of my dissertation, or, perhaps, a bit of both. There would have been no other basis for David Bohm referring to me as being "very clever," and wanting to go on a walk with me (a very common activity among many European scientists … at least at the time in which Bohm was coming up through the ranks of physicists) and the tragedy for me is that I have no idea what he thought might have been "very clever" with respect to what I had written in the dissertation.

Moreover, if I had accepted David Peat's invitation to come to Pari and stay as long as I liked, I might have found out what David Peat thought about my ideas because we would have had plenty of time for discussions. I've since seen a number of videos which were done in conjunction with the Pari Center, and I feel badly because he talked about many ideas in those videos about which I also have reflected upon, and our not-to-be discussions might have proven to be very fruitful … c'est la vie.

On the other hand, if I had gone to Pari, Italy, maybe, after discussing things with me, David might have wondered why he had ever offered the invitation in the first place. Similarly, if David Bohm and I had continued our walk and had been able to discuss different issues, he also might have wondered why he ever thought I was "very clever."

My situation vis-à-vis the two Davids is sort of a variation on the "Lady and the Tiger" story. I'm just not certain through which door I walked.

If David Bohm and I had ever had a chance to engage in an extended discussion, there are a number of things which I might have said, not knowing, of course, how he might have replied. For example, consider the issue of "active information" which, toward the latter years of his life, David Bohm had come to think of as being every bit as elemental and foundational as energy and matter.

However, in various writings and talks David also maintained that all aspects of reality – at their most fundamental level – were a function of on-going transformational dynamics. Things, per se, didn't exist, and, instead, such "things" were like vortices in a set of rapids which only seemed to have a substantial sort of existence because of the underlying dynamics that were creating the illusion of a permanent structure of some kind.

In the chapter on 'information' in Volume 1 of *Something More Deeply Hidden*, the idea was introduced that despite all of the hype surrounding that buzzword, nonetheless, "information" is nothing more than a technology of transmission. Even Claude Shannon had stipulated that information was not about meaning but, rather, was about a way of encoding and decoding whatever one wanted to transmit, and because of this orientation, Shannon felt that Norbert Wiener had not understood what Shannon was getting at since Wiener appeared to contend that meaning had a role to play in the dynamics of information.

Consequently, when David Bohm talks about the idea of "active information," some potential problems begin to arise. To begin with, if one takes seriously his ideas concerning what he seems to believe is the basic nature of reality – namely, on-going transformational dynamics – then, whatever that transformational dynamic might be, it is not information, per se, but those dynamics allude, instead, to phenomena which are pre-informational.

In other words, although the transformational dynamics which Bohm believes are fundamental in nature might have the capacity to generate a set of structural properties which, subsequently, might be representationally encoded in some sort of informational format, nonetheless the aforementioned fundamental transformational activities are not, themselves, a form of information. Information is a process of encoding data for purposes of transmission, whereas the nature of the foregoing sorts of fundamental transformational dynamics brings into existence a set of characteristics which collectively assume the form, properties, and capabilities of some sort of existential structure, object, or thing -- from: Particles, to: Atoms, molecules, compounds, and so on.

I recall that in the previously mentioned Fetzer Institute symposium bringing together western scientists and their indigenous counterparts, different individuals from various indigenous communities in Canada and the United States indicated that native languages tended to be oriented toward expressing reality in terms of flows, transformations, and relational dynamics rather than as being a function of things or objects. Alan Ford – who was attending the symposium and who had been the linguist on the committee that examined me during my oral defense of my dissertation – had been researching a number of native languages and provided some examples of the foregoing principle as well.

In response to the foregoing observations concerning the way in which indigenous languages tended to be rooted in verb-like processes rather than being ensconced in thing-like or noun-like considerations, David Bohm indicated that such a perspective resonated with his own orientation toward physics. He indicated that the hidden variables which underlay quantum phenomena and made the latter phenomena possible were transformational dynamics of some kind rather than particles, objects, or things … objects were a function of those underlying transformational processes.

In the light of the foregoing possibilities, the notion of "active information" would appear to be somewhat misleading or obfuscating. In fact, rather than consider active information to be as fundamental as energy and matter – a position which Bohm tended to champion toward the latter part of his life – one might suppose that energy and matter were both functions of the sorts of transformational dynamics to which the term "active information" seemed to be alluding.

This more fundamental dimension of reality – that is, an on-going flow of transformational dynamics – gave expression to the sorts of processes which Bohm's ideas about the fundamentals of physics alluded to and to which the languages of indigenous peoples often tried to draw the attention of its speakers. As such, active information is a problematic – possibly misleading -- way of trying to refer to a set of dynamics which shape and generate the structural features of existence, while the latter 'products' which arise as a function of the foregoing sorts of transformational dynamics would be the sorts of things in conjunction with which some people might try to engage in

processes of encoding and decoding that led to the formation of informational packets concerning those things.

The 'active' part of the foregoing term references the dimensions of process, flow, and transformational dynamics. Moreover, the 'information" aspect of that phrase seeks to allude to the way in which transformational dynamics give rise to structures, features, properties, and capabilities that are manifested in the objects that populate the world.

As such, the transformational dynamics do not constitute "active information." Instead, those dynamics generate the properties which Bohm is designating as 'information,' even though such dynamics are not actually information, active or otherwise.

David Bohm introduced the notion of "active information" as a way of trying to account for the nature of the quantum potential. According to Bohm, the quantum potential served to guide particles in non-mechanical ways.

However, the precise nature of this guiding process remained elusive. In effect, the notions of 'active information' and 'quantum potential' were attempts to acknowledge the existence of something more deeply hidden than had been captured by either the notion of the wave functions which were part of standard quantum mechanics or even Bohm's and de Broglie's own notion of the pilot wave, and this something more deeply hidden is that which is actually responsible for giving expression to that which actualized the possibilities to which the wave function gave expression and which enabled the pilot wave to guide particles.

Wave functions came out of nowhere. No one could explain why they exhibited the properties they did even as those properties helped physicists to describe aspects of reality quite accurately.

Pilot-waves resolved various kinds of problems – such as the issue of causality. Nonetheless, no one understand the nature of the dynamics which gave rise to the process of guiding particles to function in one way rather another.

Something more fundamental was needed to explain the existence of the wave function or the pilot-wave. 'Active information,' 'quantum potential,' 'the pilot wave,' and 'hidden variables,' were all ways

through which David Bohm sought to work toward establishing the nature of some more fundamental aspect of reality.

The mystery surrounding the idea of a 'quantum potential' is somewhat akin to the mystery surrounding the 'vector potential.' More specifically, although the interrelatedness of electricity and magnetism had been known for some time before Maxwell arrived on the scene, Maxwell was able to describe how the dynamics in those fields were governed by means of the set of field equations which he introduced.

The notion of a 'vector potential' was used to link those two fields. That concept was not considered to have any counterpart in reality but was used, instead, as a mathematical technique for relating electrical and magnetic fields.

Yakir Aharonov, a student of Bohm, believed that there was something more to the 'vector potential' than being just a mathematical technique. Aharonov's questioning of the nature of the 'vector potential' was somewhat similar to the way in which Einstein saw something more in the notion of a quantum than just serving as a mathematical device for resolving certain problems in thermodynamics and which, supposedly, had no real-world significance.

In any event, in the late 1950s, Aharonov and Bohm put forth considerations indicating that even when a magnetic field is completely shielded from an electrical field, nonetheless, something akin to the vector potential might be present. If present, this effect could impact the sort of interference pattern which might be observed in a double-slit experiment, and the effect appeared to be a function of the quantity of flux which was trapped in the magnetic field even though the electron had not passed through the magnetic field because the latter field had been completely shielded from electrical contamination.

Classical physics claimed that irrespective of whether, or not, the magnetic and electrical fields were shielded from one another, there should be no difference in the interference pattern that would be displayed in either case. Aharonov and Bohm suggested that this was not necessarily the case, and, in the process, indicated that the vector potential might not be just a mathematical device.

Later on, David Bohm discovered that someone else – an individual by the name of Rory Siday – had hypothesized the same sort of effect while working with Werner Ehrenberg in the 1940s, and the latter two individuals had released a paper which quickly disappeared into obscurity. However, when Bohm found out about the work of Siday and Ehrenberg, he changed the name of the Aharonov-Bohm effect to the ESAB effect in recognition of all of the individuals who had explored and contributed to the issue.

Over the years, a number of experiments – starting with the work of Robert Chambers – were conducted which seemed to confirm the reality of the ESAB effect. No one, however, has been able to explain how the effect actually works, and, as a result, the foregoing work points in the direction of something more deeply hidden, as is also the case with the notion of a quantum potential which is hypothesized to have a role in guiding dynamics on the quantum level and, yet, exactly how such guidance works is not known.

Bohm gradually came to see the world of material phenomena as an expression of the explicate order. This is the realm where everyday sorts of macroscopic objects are separated from one another and operate in accordance with the principles which governed mechanical forces of causality within a context of space and time.

However, Bohm also believed that the explicate order was a function of an underlying implicate order, and Bohm's hermeneutical journey along the conceptual road which, eventually, took him to the realm of the implicate order was characterized by a variety of twists and turns. For instance, early on, when working with Oppenheimer, he entertained the possibility that electrons (and, possibly, other particles) were engaged in on-going cycles of expansion and collapse.

Subsequently, while he was in political exile in Brazil (beginning in 1951), he played around with the notion that reality gave expression to a series of levels in which different kinds of phenomena occurred on different levels. In 1952, Bohm undertook a research project that sought to rework de Broglie's 1927 pilot-wave theory (and, currently, this revamped theory is known as the de Broglie-Bohm theory) which, among other things: Was deterministic, and not probabilistic; avoided all of the problems associated with the wave function; but made the foregoing accomplishments possible at the cost of losing locality (i.e., it

wasn't relativistic), and, as well, some unknowns concerning how the fundamental dynamics of the pilot-wave actually worked remained unresolved.

A little later, when conducting research in Israel (mid 1950s), he had begun to think about nature as being a continuous process of transformational dynamics. During this time, he also started to suspect that reality might not be as reducible to a rational framework as he once had believed was the case and which seemed to suggest that there was something more deeply hidden than quantum phenomena – namely, that which regulated, shaped, or helped make those phenomena possible.

Prior to being hired to become part of Birkbeck College at the University of London, David Bohm gave a talk at University College in London. In the audience was a young John Bell who was trying to find a way to reconcile causality with the standard model of quantum physics which was probabilistic and, therefore, seemed hold no conceptual place in its model within which, and through which, the issue of causality might be able to assert itself.

Bell was inspired by Bohm's talk at the University of London concerning the paper written by Einstein, Rosen, and Podolsky indicating that quantum theory's description of reality was incomplete and, as a result, Bell decided to take a closer look at Bohm's 1952 reworking of de Broglie's hidden variable theory involving the pilot-wave. Bell was intrigued by the way in which the de Broglie-Bohm model of quantum mechanics returned causality to quantum dynamics, but he also was intrigued by way in which the de Broglie-Bohm theory was inherently non-local in nature.

One of the criticisms that Bohr had leveled against Einstein entailed the idea that even when particles are separated, the universe is a whole. Bohr's criticism was alluding to the idea that, in some way, the universe was not necessarily local in nature (as Einstein's special theory of relativity indicated). In other words, Bohr believed that separated elements could still be in contact with, and be affected by, one another because they were part of an indivisible whole, but Bohr never seemed to be able to spell out the details of the foregoing perspective in any way that made sense.

Bell devised a hypothesis (Bells' inequality) that was inspired by the de Broglie-Bohm model of quantum mechanics. Bell's inequality offered a standard for testing (i.e., via mathematical limits concerning the degree of correlation between particles that one would expect under certain conditions) as to whether, or not, Bohr's notion of non-locality might be true, while also providing a way to confirm Einstein's belief that causality (and not probability) was a foundational element of reality. Or, said in another way, Bell had advanced a proposal which showed how one might be able to provide data that would shed some light on the issues of causality and locality.

In effect, Bell was proposing an experiment which, in its own manner, could resolve at least part of the conceptual dispute which had separated Bohr and Einstein with respect to their respective views concerning the nature of reality. This could be done by showing how Bohr and Einstein might be both right and wrong in their respective views with respect to the issues of causality and locality, and, as was pointed out in the earlier chapter on 'entanglement,' a number of experiments have subsequently demonstrated that quantum events (at least to some degree) were both causal and non-local in nature – something which also is consistent with the de Broglie-Bohm theory of quantum dynamics.

After moving on to Birkbeck College at the University of London in the late 1950s, David Bohm developed his theory concerning the implicate order, and his book: *Wholeness and the Implicate Order* was published in 1980. Toward the latter part of the 1980s he also added the notion of 'active information' which was briefly explored earlier in this chapter.

As indicated previously, while David Bohm seemed to indicate that the quantum realm operated through, or in, what he referred to as an enfolded or implicate order, nonetheless, on other occasions, he appeared to propose that the situation might be a little more complicated than making the implicate order a function of quantum dynamics. In other words, even if one were to suppose that the quantum world did take place within the implicate order, there might be deeper realms of the latter order which governed the way in which quantum phenomena took place because, presumably, there is some form of transformational dynamics which regulated and gave

expression to why quantum phenomena occurred in the way they did, and the notion of 'active information' sought to explore those kinds of possibilities.

In the early 1960s, David Bohm began to wonder if the realm of consciousness might have some role to play in phenomena such as the vector potential and the quantum potential. As a result, he began to investigate a wide variety of mystical and philosophical traditions – from: Buddhism and yoga, to: The works of two Russians by the name of G. I. Gurdjieff and P.D. Ouspensky.

Had my walk on the grounds of the Fetzer Institute with David Bohm not been interrupted, some mention probably would have been made during the discussion that I had read all of the works of the two individuals with whom, for a time, David Bohm had become intrigued. In addition, mention probably would have been made that I also had spent some time with a group in Toronto that was associated with the Gurdjieff work through the medium of Madame Walsh (who, at one juncture, I met) who had been one of his students in France.

Like David Bohm, at some point I had come to the conclusion that whatever it was for which I was searching, Gurdjieff and Ouspensky were not it. So, like Bohm, I moved in another direction, but also like David, I felt that the research which had been conducted by those two individuals, as well as others whom they had influenced, raised some important issues concerning the nature of one's relationship with the universe and how conditioned consciousness can lead to problematic ways of understanding that relationship … both with respect to one's own sense of human reality as well as in conjunction with the nature of physical reality.

As a result of my reflections, I moved in the direction of the Sufis, some of whom were said to have been teachers of Gurdjieff. David, on the other hand, moved in the direction of Jiddu Krishnamurti who talked about the importance of transforming consciousness by escaping from the forces of unconscious conditioning and, thereby, becoming open to the potential of true intelligence in which the mind, allegedly, no longer operated through various forms of logical thinking and, instead, the individual might be able to gain direct access to processes of acquiring understanding that are not tied to discursive thought processes.

Conceivably, if one could gain access to forms of awareness and consciousness which transcended normal thought processes, then, perhaps, one might also be able to gain insight into how fundamental transformational dynamics shaped particle dynamics through the activities of the quantum potential. The foregoing might, or might not, be true, but the more David read about, and talked with, Krishnamurti, the more he seemed to feel there might be something constructive in Krishnamurti's perspective which might be of assistance to him in his search for basic truths concerning physics as well as truths concerning his own relationship with the nature of reality.

A lot could be said about David Bohm's interaction with Krishnamurti which engages a variety of issues such as: Language, consciousness, epistemology, identity, morality, life's purpose, awakening, education, learning, self-realization, methodology, the nature of reality, and so on. Although David devoted a great deal of time, resources, money, and attention to the Krishnamurti perspective, in the end, Bohm parted company with the teacher.

On the one hand, David Bohm felt that he had learned a great deal from Krishnamurti. On the other hand, Bohm had a great many doubts concerning Krishnamurti and whether the latter individual actually was who and what he claimed to be.

David was very given to the idea of dialogue. In many ways, Krishnamurti did not seem all that interested in dialogue but, instead, only seemed to be devoted to a one-way form of transmission – from him to whoever was in his presence.

Krishnamurti was very rigorous in pointing out the elements of ego that were present in other people. However, he seemed extremely resistant to the possibility that there was any ego present in his own being … sort of like the 'Wizard of Oz' who kept trying to indicate that one should pay no attention to the man behind the curtain even after substantial evidence had been forthcoming that things were other than he claimed.

David Bohm felt that on many occasions, Krishnamurti could be quite spiritually abusive and lacking in compassion toward others. Had David Bohm and I been able to complete our walk together on the grounds of the Fetzer Institute, I might have related some of my own experience in this regard.

I have had involvement with two individuals who were said to be Sufi guides. One of the two I found to be genuine and was someone who had helped me to turn my life around in a more constructive fashion, and while I learned a lot about myself, life, and the Sufi path from the other individual, the latter person turned out to be a charlatan and given to various forms of spiritual abuse which were not readily visible because that person was a master in manipulating people – including me at times.

David Bohm and I were both searching for something more deeply hidden – something that our respective experiences had confirmed, again and again, was discernible in a variety of circumstances and issues. Yet, that which is more deeply hidden is very difficult to clearly resolve in a way about which one can feel confident that the nature of one's epistemological or hermeneutical relationship with reality is, and has been, properly understood,

Reality often seems to be ready to remind us in any number of ways that we don't necessarily understand things as well as we might suppose. On the one hand, reality seems to be continuously engaging various dimensions of the individual via many different kinds of dialogue (scientifically, biologically, emotionally, psychologically, socially, morally, spiritually, physically), but, on the other hand, oftentimes we shy away from truly open dialogue with reality and tend to be interested only in a one-way form of transmission that extends from us to reality.

Toward the end of Wittgenstein's *Tractatus Logico-Philosphicus*, one is confronted with a proposal. More specifically, Wittgenstein recommends that one should consider the propositions put forth in his treatise as, ultimately, senseless.

Consequently, after one has used those series of propositions as so many exercises in critical reflection which are intended as steps that assist one to become open to certain possibilities, then, one should transcend those propositions. In short, one should discard the ladder which one has used to climb to a certain level of understanding, and when one has done this, one will see the world properly.

Wittgenstein uses language to induce readers to reflect on the limits of language. David Bohm used language – dialogical, mathematical, logical, political, educational, theoretical, emotional, and

rational – all of his life. Yet, there was a persistent element in his life's work which alluded to the existence of a realm that was beyond language and which made possible everything about which language sought to explore.

The words of the *Tao Te Ching* resonate with me – namely, "The Tao that can be told is not the true Tao.' Wittgenstein's recommendation at the end of the Tractatus also resonates with me that one should use language to reach a certain level of understanding and, then, throw the ladder away, but whether one will, at that point, be in a position to see the nature of the Tao aright is unclear.

David Bohm's tendency -- after all is said and done -- to return to the theme of a realm of transformational dynamics which transcends our physics and, therefore, renders the latter incomplete also resonates with me. Everything we do in life seems little more than a prolegomena – that is, a set of activities which are intended to serve as an introduction to something that is larger – something more deeply hidden.

One dimension of that something more deeply hidden seems to be rooted in the intelligent organization that appears to be given expression through the dynamics of Qi (prana-nur-qi). Perhaps, if David and I had had the opportunity to finish our walk, this too, might have been explored.

Chapter 26: Field Manifestations

Although the concept of a field has been used by individuals such as Faraday, Maxwell, and Einstein, the term often means different things to different people. However, one quality that is often present in all such uses is the absence of any sort of understanding which offers an explanation of why the field has the properties and/or dynamics that it has.

The latter features are often described by, or through, conceptual systems that capture aspects of how a given field manifests itself or behaves over a period of time. Nonetheless, that which makes such manifestations possible often escapes both detection and understanding, and, as a result, we have descriptions that often are unaccompanied by explanations.

As will be discussed a little later on, Maxwell indicated by means of his 'method of analogies' that the methodological techniques a person employs while seeking to gain insight certain phenomena – such as fields -- do not necessarily have to be an accurate reflection of the way ontology or reality works in order for those techniques to be able to uncover principles of significance that have heuristic value in one's epistemological and hermeneutical pursuits. So, while the discussion that follows might provide an account which outlines some of the hermeneutical, methodological, and descriptive value which a given modality of field might have, nonetheless, such an account tends to be tinged with indications that something more deeply hidden seems to underlie what makes a field of any kind possible.

Up until the time that Michael Faraday introduced his concept of the field into nineteenth century thinking, physicists believed the most fundamental description of physical/material phenomena would be, in no small part, a function of the manner in which discrete substances or pieces of matter were arranged as separate entities. However, Faraday argued that a more fundamental description of physical or material events should be rooted in continuous rather than discrete processes, and this argument was rooted in certain observations which had been made by a Danish physicist.

More specifically, in 1820, H. C. Øersted had made an interesting discovery. He found that the moving charges of an electrical current were capable of deflecting the needle of a compass that had been placed in a position which was perpendicular to the direction of motion to which the moving electric charge was giving expression.

The foregoing finding was noteworthy for two reasons. (1) It suggested there was a connection of some sort between electrical and magnetic phenomena. (2) Unlike the cases of gravitational and electrostatic forces -- in which forces were transmitted between interacting objects along lines that linked the centers of those objects -- moving electrical charges generated forces that were perpendicular to the usual direction of the transmission of forces.

Faraday believed Øersted observations meant electricity and magnetism might be different manifestations of one and the same force. The illusion of the existence of separate forces was more an artifact of the experimental situation in which relative motion was being used to induce the underlying, single force to be expressed primarily as an electrical or magnetic kind of phenomenon.

This linking of electricity with magnetism was the staging area from which Faraday launched his revolutionary concept of the field. He jettisoned the traditional idea of discrete bodies acting on one another in accordance with the Newtonian notion of 'action-at-a-distance'.

Faraday replaced the foregoing idea with the notion of a potential field of force. In other words, he believed objects were linked by means of a field of force that continuously manifested itself in the space that permeated and surrounded the objects being linked by a given field.

Later on in his career, Faraday proposed that the idea of a potential field of force should be extended to cover the manifestation of all modalities of physical force … and not just those of electricity and magnetism. By suggesting such an extension or generalization of the field concept, Faraday became the first physicist to advocate using a unified field theory approach to account for all physical or material phenomena.

When Faraday used the term 'continuous field of force', he had something particular in mind. He believed a sphere of influence surrounded every charge.

The properties of this sphere of influence were a function of the character of the charge that generated it. However, irrespective of the particular properties of the sphere of influence that were generated by a given kind of force, he maintained that all such spheres of influence would manifest themselves in a continuous fashion.

The continuous aspect of a field can be illustrated by imagining the use of a test charge, of some sort, which engages the sphere of influence at some point 'p'. According to Faraday, one should be able to anticipate that the properties of a given sphere of influence should have the potential to affect the test charge in a determinate way at the point of engagement.

When considered as a whole, the sphere of influence of a given electrical charge will give expression to a field whose strength of intensity of electrical charge will vary from point to point in that field in a way that reflects the character of the electrical charge that generates the field in question. Thus, if one were to consider some other point ('x') at some distance ('d') from the point 'p' through which that field had, initially, been engaged by means of a test charge, then according to Faraday, one would find that the sphere of influence of the field generated by the electrical charge would affect the test probe with a strength of electrical field intensity that was characteristic of the field at that point of engagement.

In fact, such fields were described as being continuous. This is because one should be able to select any point in a given interval between 'p' and 'x' -- or between any other points that might be selected -- and determine the strength of electrical intensity with which the sphere of influence of an electrical charge's field will affect a test probe that is introduced at such intermediate points.

The idea of a continuous field requires that there can be no point within the sphere of influence of a given electrical charge that does not have the potential to affect a test probe -- via some degree of electrical intensity -- which engages such a field at that point. In short, the potential capability of a field to exert a force of variable strength of

electrical intensity at each and every point of the field renders the field continuous.

Certain ramifications follow from the foregoing considerations. For example, the idea of atomism is rejected since such an idea necessarily carries with it a discrete perspective in which the phenomena of the physical universe are expressions of interacting particles that are distinct and separate from one another in certain ways.

Instead, from the perspective of the field concept, the atomistic properties that various phenomena seem to possess are only apparent and are not real. Underlying these discrete-appearing surface features is a smooth or continuous distribution of field variables manifesting themselves in ways that are sometimes intense and concentrated (or localized).

At other times, those field variables are dispersed and not localized. The combination of concentrated as well as dispersed manifestations of a continuously varying set of field variables gives rise to the illusion there are discrete events which are separated from one another.

Thus, from Faraday's perspective, there are no fundamental entities such as elementary particles or atoms. Everything is an expression of a single unified field that manifests itself on a continuous basis by means of transitions in the way various field variables are given expression through the field.

These field variables are not individual, distinct, discrete features. They are, in a sense, abstractions or samples that have been drawn from one of the smooth distributions of values that characterize a given field’s manner of manifesting itself.

Although all of the experimental evidence available to physicists in the 1800s supported Faraday's idea of a field, Faraday's position was not unassailable. For example, on some exceedingly small level of scale, there might be one, or more, points that fall within the sphere of influence of an electrical charge and, yet, do not manifest the sort of strength in electrical intensity that is capable of affecting a test probe inserted at that point.

In this case, the variable distribution of the strength of electrical intensity that characterizes the field at such points would fall off to zero. As a result, the field would be manifesting discontinuous properties. However, the level of sophistication of available experimental methodology in the 1800s were not able to detect the presence of such possible points of discontinuity and, consequently, such limited methodology would produce experimental results that indicated that the field in question seemed to be continuous.

One could approach the test charge issue from a perspective that is somewhat similar to Weierstrass' epsilon/delta format. In other words, to use a mathematical concept, the “neighborhood” of these points can be explored on varying levels of scale.

Within the limits of one's instrumentality and methodology one could challenge the assumption of continuity in such neighborhoods as much as one likes. The idea of continuity stands as long as one can meet any test challenges that are made in a neighborhood whose outer boundaries are marked by the two points, 'p' and 'x', and that fall within the parameters of the sphere of influence of an electrical charge.

An alternative to the foregoing is to get entirely away from approaches requiring one to construe continuity in terms of a series of inexhaustible points that occupy the space within a certain set of parameters. For example, continuity might be construed as an expression of the integrity of phase relationships

For now, one might characterize phase relationships as expressions of the way different aspects of phenomena interact with one another while in certain states, conditions, and cycles of manifestation. These states, conditions, and cycles constitute the phases of objects or processes during particular modes of being that give expression to various dimensions of possibility inherent in an object’s or process’ manner of being, and if such phase relationships are preserved among the neighborhoods that constitute the 'point-structures' of a field latticework being probed by a test charge or force of some sort, then, the field might considered to be continuous in a way that depended on phase relationships and not on an infinite set of points.

From the perspective of phase relationships, a field is not infinite. It is finite.

What makes such a field continuous is the network of phase relationships that link one neighborhood with another, or that link the different, internal aspects of a neighborhood with one another. As long as there is some minimal set of phase relationships that permit a latticework -- or a given neighborhood -- to manifest one or more of the ratios of constraints and degrees of freedom that are encompassed by the spectrum of ratios that constitute the structural character of the latticework, or neighborhood, then, continuity has been maintained.

Given the foregoing considerations, if one found 'holes' (that is, non-active areas that were not manifesting field properties) in the vicinity of a neighborhood, or somewhere within a latticework of phenomena, these 'holes' would not necessarily represent disruptions in the continuous character of the neighborhood or latticework. For example, conceivably, the character of a field could involve a complex structure such that the field is defined as being wherever it manifests itself and that the field is linked through those manifestations.

If one finds a 'hole', in the foregoing sense, one has merely located one of the parameters or boundary markers of the field. The more holes of this sort there might be, then, the more complex the boundary structure of the field becomes. As such, the field becomes a topological object comparable to a very complex torus or set of such tori.

Thus, a field manifests itself continuously, but not necessarily in the sense that every point of a given space is under the sphere of influence of that field. The field is continuous because one, or more, of the ratios of constraint and degrees of freedom that characterize that field is (are) being manifested at any given instance of time.

Continuity would become a function of phase relationships that took place over time which do not require a given force to express itself at each, and every, spatial point, and, consequently, continuity would not be a function of spatially contiguous relationships. Nevertheless, if a given field were capable of withstanding any sort of epsilon/delta-like challenge that might be thrown at it, this would be a special case that does not violate the more fundamental property of continuity as characterized in terms of ordered arrangement as opposed to being characterized in terms of spatial points.

The capacity to successfully meet an epsilon/delta challenge would simply mean that a given area of space is being shaped by whatever force is operative in such a location. As such, space becomes part of the sphere of influence of such a force field.

In other words, a field might have a dialectical relationship with the dimension of space through which it is manifested, but the field is not reducible to space. Other dimensions must interact with space to generate a field, and when the field is generated, that field need not occupy all of space to be continuous, but, instead, the field is continuous by virtue of the set of phase relationships to which the latticework that constitutes the field gives expression.

If one characterizes entropy in terms of the ratio of constraints to degrees of freedom in a given context, then one can speak of the entropy spectrum for a structure. Such a spectrum constitutes the envelope of ratio values that are possible for that structure under a variety of circumstances ... whether induced or spontaneously manifested.

In general terms, if there is a change in the ratio of constraints to degrees of freedom for a given structure, then there has been a change in the entropy character of that structure. Or, said slightly differently, another aspect or facet of the structure's entropy spectrum has been manifested.

If the nature of the ratio change is to shift the manifestation of a structure's entropy spectrum in the direction of more constraints, relative to degrees of freedom, then such a change is said to constitute an increase in the entropy of the structure. This is the case since -- relative to the entropy state prior to the change in question -- the structure is less able to give expression to its degrees of freedom.

Neither an increase in entropy nor a decrease in entropy, affects the quality of order in the structure or system undergoing a transition in the way the entropy spectrum is being manifested. ‘Order’ is a reflection of the fact there is some kind of ratio of constraints to degrees of freedom being given expression though a set of phase relationships that are bound together to form a particular point, neighborhood, or latticework.

Very rarely, if ever (at least in the material/physical realm) would one find cases of pure constraint, without degrees of freedom. For example, even at, or near, Absolute Zero, there are a variety of strange phenomena that have been observed to occur and, therefore, this state does not constitute a realm of pure constraint as once was thought), or pure degrees of freedom without constraint.

Usually, constraints and degrees of freedom pair off to form a source of tension of a dialectical nature. Therefore, as far as the issue of 'order' or ordered structure is concerned, what the character of the associated ratio is doesn't make any difference.

As long as a ratio involving some combination of degrees of freedom and constraints is present, then the degree of order doesn't fluctuate even if the character of the foregoing sort of ratio does change. This is in direct contrast to the way modern thermodynamics and many interpretations of information theory tie order to the idea of entropy because in terms of the foregoing point of view, entropy is not the loss of order but, instead, gives expression to the re-arrangement of the degrees of freedom and constraints which characterize a given modality of order.

Approached from the foregoing perspective, the idea of a smooth distribution can be construed in terms of an envelope of values or a set of parameters. This set describes how the entropy spectrum manifests itself through an overlapping sequence of transitions in the ratio of constraints and degrees of freedom governing the dialectic of two or more points, neighborhoods, or latticeworks of coherent phase relationships.

Any individual expression of a given ratio of constraints to degrees of freedom is, in point of fact, a phase state. Consequently, the envelope of values that gives expression to the set of ratios that make up the entropy spectrum governing the dialectical interaction between two or more point-structures, latticeworks, or neighborhoods constitutes the bundle of phase relationships that mark the different facets of the way the neighborhoods, etc., are, or can be, linked with one another.

If there is a disruption in the phase relationships connecting, for example, different neighborhoods, such that the ratio of constraints to degrees of freedom that gives expression to that connectivity drops to

zero, then there is no longer any connection between the neighborhoods. Continuity has been broken.

When the a ratio of degrees of freedom and constraints is zero, then, in effect, this means that none of the neighborhoods, latticeworks, and so on which previously had been linked are capable of constraining one another. Furthermore, they are not capable of entering into dialectical engagement with one another in accordance with some range of modulating degrees of freedom or constraints.

In short, the phase relationships that had connected the neighborhoods or latticeworks and that had been given expression in the form of shifting ratios of constraints and degrees of freedom of dialectical interaction, no longer exist. The minimal condition for continuity -- namely, that the neighborhoods or latticeworks in question be linked through some on-going manifestation of an entropy spectrum -- is no longer capable of being satisfied.

In the context of hermeneutics (and one could self-reflexively speak about the attempt of hermeneutical field theory to understand the notion of "fields"), one of the ways that shifts in the character of the entropy spectrum manifest themselves is the manner in which such shifts affect the activity of the hermeneutical operator (which, briefly speaking, can be characterized as a set of operations consisting of: (1) identifying reference, (2) reflexive awareness, (3) characterization, (4) the interrogative imperative, (5) inferential mapping, and (6) congruence functions) as it (the hermeneutical operator) engages various considerations and works toward some sort of an orientation in understanding concerning a given issue (say "fields"). Any increase or decrease in the constraints that are placed on the activity of the foregoing notion of a hermeneutical operator that is not congruent with the structural character of that aspect of ontology phenomenon or experience to which identifying reference is being made is, generally speaking, construed as an increase in the entropy of the hermeneutical system. Similarly, any increase or decrease in the degrees of freedom that occur with respect to the activity of the hermeneutical operator and that are incongruent with the structural character of the aspect of ontology, phenomenon, or experience to which identifying reference is being made is, generally speaking, to be construed as an increase in the entropy of the hermeneutical system.

Thus, increases in entropy are a function of what brings distortion, deviation, or error into the activity of any given hermeneutical activity. Consequently, the hermeneutical analog for high entropy concerns those instances of hermeneutical operator activity in which there is either: (a) an insufficient number of constraints or degrees of freedom of the 'right' character (capable of reflecting the properties of a given phenomenon) available, or (b) there is an excess of constraints and/or degrees of freedom of the wrong character (capable of reflecting the properties of a given phenomenon) . The 'rightness' and 'wrongness' of character alluded to in the foregoing depends on whether or not a given instance of hermeneutical operator activity is capable of being used in a constructive, positive, heuristically valuable fashion so that progress toward establishing full analogical congruence can be achieved (i.e., one approaches the truth of something as a limit).

There appear to be a variety of inferences one might make with respect to educational issues on the basis of the foregoing discussion which link entropy and the activity of the hermeneutical operator. Perhaps, the most fundamental of the points that might be made in this regard, however, concerns the following consideration. The educational process should provide the individual with a means of learning how to go about constructing, generating, acquiring and/or searching for an entropy ratio that will maximize the heuristic value of one's dialectical engagement of experience and/or reality.

For Faraday, a line of force is inherently characterized by two polarized ends of opposite charge. That is to say, he believed one could not have either kind of polarity (positive or negative) in isolation. From the perspective of this chapter, a line of force could be characterized as a manifestation of the phase relationship that arises between polar ends.

Faraday demonstrated that if one had a wire which exhibited a certain amount of conductivity, then the total current that could be induced in that wire was entirely dependent on the number of lines of force that were cut. This was the basic rule of electromagnetic induction.

Faraday did not commit himself to any particular view as to the specific identity of a line of force. They could be lines of vibration, or

they could be lines of ether flow, or they could give expression to some other mode of transmission. However, Faraday did feel that whatever their actual character might be, they stood for the physical means by which, or through which, force was transmitted in nature.

Unfortunately, Faraday was never able to demonstrate that lines of force had a physical reality of their own. Nevertheless, he did believe his notion of lines of force had a heuristic value since the idea of 'lines of force' helped lend the sort of concreteness and form to a theory that would help one to develop ways of: Testing the theory, making deductions with respect to the theory, and so on.

For Faraday, the fundamental -- indeed, the only -- physical substance responsible for natural phenomena is force. Thus, a field is, from Faraday's perspective, an expression of the presence of force. Another way of stating the same thing is to say that forces generate fields that can be described in terms of lines of force.

According to Faraday, force acts exclusively on the contiguous points with which it comes into contact as it manifests itself. This concept of force was quite different from the kind of force that was operative in Newton's theories.

For Newton, force was something that any given particle exerted on other particles that were at a distance from the particle exerting the force (and, one might keep in mind that before the advent of electricity, the only sort of force which many people considered had to do with gravitational issues). As such, forces did not manifest themselves through a field -- whether this was a field of force or some other kind of field.

Newtonian forces manifested themselves directly on the other body in an instantaneous fashion. However, no one – including Newton – knew the details of such an 'action at a distance.'

Within the context of Newtonian theory, one might speak of measuring field intensities in terms of force per unit of mass. Moreover, in such a context, one might speak of the force exerted on a body that encounters a region of given field intensity as being equal to the product of the mass of that body and the level of field intensity that it encounters. However, the role played by the use of field terminology in Newton's theories amounted to little more than a mathematical

means for arriving at an answer in relation to questions concerning the amount of force that was being exerted on a particular body in a given set of circumstances.

One of the major stumbling blocks one encounters in attempting to construct a testable theory built around Faraday's concept of a field -- as expressed in terms of lines of force -- is to establish the laws that govern the way forces interact. Without such laws, one is in no position to attempt to account for how material phenomena can be construed as expressions of an underlying set of interacting forces.

Faraday had proposed only one such law: The conservation of force. Essentially, this law indicated there is no change in the total amount of force in the universe, but, unfortunately, this law was not clearly stated.

In other words, Faraday never clearly spelled out how the field of force giving expression to one body exerts its effect on the field of force that gives expression to some other body being acted upon. Consequently, one does not know how the changes in force occurring in one region are to be compensated for by changes in force in contiguous areas, and such knowledge is essential for any proposed law of the conservation of force.

Whatever specific content one decides to introduce into the laws that govern the interaction of forces, that content must retain three features inherent in Faraday's notion of force if such laws are to be consistent with what Faraday might have had in mind. To begin with, forces have a definite location.

Secondly, Faraday's idea of force has an element of directionality to it. Finally, the rate at which a force is transmitted through a field is not only finite, but this rate also is dependent on the character of the contiguous forces that it encounters during the process of being transmitted through the field with which the force is associated.

The idea of lines of force might fit in nicely with the mathematical idea of a latticework as an expression of the set of constraints and degrees of freedom giving expression to the dynamics of phase relationships that arise as a result of the dialectic of dimensions that have been set in motion by the underlying order-field. On the other hand, in the context of phenomenology and hermeneutics (and, again,

reminding us that issues of force and fields need not be restricted to the realm of physical forces and fields), these lines of force are not necessarily linear in character, nor do they need to be limited to dimensions of just time and space.

These 'lines', instead, could be complex, multi-dimensional manifolds that are shaped by a variety of chaotic attractors (i.e., dimensional dynamics). Nonetheless, like their counterparts in the physical world, hermeneutical and phenomenological lines of force have a capacity to affect, alter, shape, orient, transform or operate on 'objects' that come within, and are receptive to, the sphere of influence of the field that makes possible lines of force of such structural character.

For example, one can speak of the lines of force that are established phenomenologically and hermeneutically between focus and horizon/ground. These components can be considered as two polarized ends of opposite 'charge'.

Obviously, however, the nature of a hermeneutical or phenomenological charge is something quite different than an electrical charge. However, the important consideration here is the aspect of polarity that exists between focus and horizon or ground since there is a dynamic tension between them (i.e. between focus and ground) that generates conceptual phase relationships or lines of force.

The structural character of any given pair of focal/horizonal phase relationships will be a function of the intensity, orientation, and so on, of the 'charge' character that arises whenever one brings a focus and a horizon of determinate natures into dialectical engagement with one another. Moreover, as is the case with electrical charge, one cannot treat either focus or horizon/ground in isolation from one another. Where one is, one also will find the other.

One measures the continuous mapping of the lines of force between oppositely charged poles in an electrical field by inserting a test probe into the field, thereby deriving an indication of the electrical potential that has been created at the point of insertion. One also can sample something of the flavor or character of the continuous mapping of the lines of force that have been generated between a given focus and horizon by inserting a test probe into a given

hermeneutical or phenomenological field. A common test probe in hermeneutics and phenomenology comes in the form of the interrogative imperative – that is, questions which probe either of the two poles – i.e., focus and horizon – or their relationship with one another.

However, the nature of such a test probe need not be in the form of questions. Anything (emotions, sensations, thoughts, motivations, and so on) that is capable of eliciting, evoking or inducing various kinds of phenomenological response is capable of serving as a hermeneutical probe.

Certain aspects of Faraday's ideas concerning the notion of a field were given considerable mathematical precision and rigor through the efforts of James Clerk Maxwell. More specifically, the field equations that were developed in his work *Treatise on Electricity and Magnetism* provided a means of describing the rate at which electrical and magnetic fields changed in relation to time as well as the three axes of space.

The character of the relationship of the rates of change of the electrical and magnetic fields along the temporal and spatial dimensions was captured by Maxwell in the form of partial differential equations. Partial differential equations were more complex and sophisticated versions of the ordinary differential equations that were employed by Newton to describe the rates of change of distance between objects.

The latter kind of equations revolved around just one independent variable. This concerned the rates of change with respect, say, to the distance between objects when calculating gravitational effects.

However, when one was trying to determine the rates of change of electrical and magnetic fields, one had to treat each of the spatial coordinates separately from one another. This is required because the orientation or direction of a magnetic field is different from the orientation or direction of the electrical current that is the source of that magnetic field.

In addition, the partial differential equations devised by Maxwell had to take into consideration the fact that a magnetic field was

actually equivalent to a moving electrical field, just as an electrical field was equivalent to a moving magnetic field. This meant his equations needed to keep track of the rate at which the position of a body changed in relation to time since this reflected the property of motion that played such an important role in linking magnetic and electrical phenomena.

Maxwell's equations gave expression to certain aspects of the idea of a field that had been introduced by Faraday. More specifically, Maxwell's equations described fields that were manifestations of continuously distributed densities of electrical or magnetic charge that constitute the field of force that is generated by a given material source. The way in which variations in charge density manifest themselves as a continuous function of changes in time and position within a given field is dependent on the character of the source material with which the field is associated.

Maxwell's concept of a field differed from Faraday's idea of a field of force. Although Maxwell based his mathematical formulations on the experimental findings of Faraday, Maxwell did not adopt the theoretical framework in which Faraday had embedded his empirical observations.

Faraday had maintained that matter is but a manifestation of a more fundamental field of force and, therefore, believed there was an equivalency between matter and the field with which it was associated. Maxwell treated matter and its associated field as separate entities.

Maxwell did retain something of Faraday's field concept in as much as Maxwell believed that bodies did not act directly on other bodies. Thus, he agreed with Faraday that the action of bodies on other bodies was mediated through a field.

On the other hand, Maxwell retained a Newtonian flavor in his thinking by treating force as something that was to be distinguished from matter. Moreover, like Newton, he didn't conceive of, say, an electrical field as being a field of force as Faraday had done, but, instead, Maxwell thought in terms of mathematical formulations that allowed one to calculate the quantity of force per unit charge that was present in a given field.

Yet, Maxwell also differed from both Newton and Faraday. He believed a field -- in this case an electrical one -- occupies, in some unspecified sense, the same space as does the charge on which the field acts, despite believing that matter and the field were two different things.

Maxwell chose to reinterpret issues surrounding the field concept in terms of the idea of the ether. More specifically, he believed the electromagnetic field could be construed in terms of a form of ether that conformed to the laws of Newtonian mechanics. Consequently, Maxwell assumed the ether possessed, among other things, mechanical properties such as mass and elasticity.

Because the ether was assumed to have a variety of mechanical properties, Maxwell believed phenomena such as electromagnetism would be propagated through the ether field at a finite velocity. Thus, he agreed with Faraday about the finite character of the propagation in the electromagnetic field, but he differed with Faraday concerning the reasons why this was the case.

Maxwell's theoretical task became a matter of constructing a model of electromagnetic phenomena in terms of a sort of mechanical ether. He had to show how the mechanical ether was able to induce phenomena to not only propagate at a finite velocity, but to propagate in a way that was in agreement with what was already known about electrical and magnetic phenomena.

One of the primary reasons for Maxwell's shift in perspective away from Faraday's field concept is because the idea of the ether lent itself to exploitation by means of mechanical analogs in a way that Faraday's fields of force did not. In other words, the idea of the ether had heuristic value for Maxwell.

In other words, the ether’s somewhat amorphous character allowed Maxwell to build a variety of mechanical properties into it that collectively were capable of reflecting many of the structural characteristics of electrical and magnetic phenomena. Indeed, Maxwell's mechanical model of the ether permitted him to provide a unified means of describing phenomena such as: Electrical currents, static electricity, magnetism, as well as the inductive effects resulting from the interaction of electrical and magnetic properties.

As indicated in the opening pages of this chapter, the method of analogies played a fundamental role in helping Maxwell to develop his theory of the electromagnetic field. Maxwell, of course, realized the mechanical analogs he was using to represent electrical and magnetic phenomena did not necessarily accurately reveal how such phenomena actually worked.

That is, he did not feel the electromagnetic field possessed the sort of mechanical structures in which his model was rooted. Yet, at the same time, he believed models that were false in certain ways still could help uncover various aspects of the truth.

Thus, even if, ultimately, his mechanical model did not accurately reflect the structural character of the electromagnetic field as far as showing how certain effects and properties actually (i.e., ontologically) were generated in that field, nonetheless, the model allowed him to develop a clear grasp of the behavioral properties and relationships that existed in the field. As a result, he would be in a position to transform his understanding into a mathematical description that would accurately reflect the behavioral properties and relationships that characterized the electromagnetic field.

When all is said and done, Maxwell derived a set of equations that conformed to the laws of Newtonian mechanics and which also permitted one to accurately reflect many aspects of the structural character of electromagnetic fields. However, his model left open -- if not entirely unanswered -- the identity of the ontological "mechanism" that was responsible for the phenomena of electromagnetic fields.

Among the mechanical analogs that Maxwell developed was the idea of vortices or eddies in the ether medium. These gave representation to magnetic phenomena.

Vortices were conceived of as being like flexible bars with a rough surface. He theorized that in any given locality of the field such vortices revolved in the same direction about axes that were roughly parallel with one another. However, as one moved from one locality in the field to other localities of the field, the properties of the vortices could change such that the rotational velocity of the vortex, or the

direction of movement of the vortex about its axis, could vary due to differences in conditions prevailing in different localities of the field.

In addition, Maxwell proposed that the vortices were separated from one another by a medium made up of small electrical balls. These balls revolved about their own axes in a direction opposite to the direction of rotation of the vortices.

Movement of these balls constituted an electrical current. Moreover, by linking the mechanics of vortex behavior with the mechanics of the behavior of the electrical balls, Maxwell was able to bring electrical and magnetic phenomena in contact with one another within the context of the field concept.

The notion of a displacement current assumed a role of central importance to Maxwell's theory of the electromagnetic field. According to Maxwell, when a displacement current occurred at a particular point in the field, this was due to a change in position of a given electrical charge.

Such a transition in electrical displacement would have, associated with it, a magnetic field that would spread out at right angles from the path of the displacement current. Since the magnetic field would be mirroring changes in the displacement current, the changes in the magnetic field would bring about further electrical displacements as a result of the moving magnetic field's capacity to generate electromotive forces of induction.

This dialectic of electrical displacements, leading, in turn, to the emergence of a magnetic field, that would lead to further electrical displacements, and so on, would go on for an indefinite period of time and would spread throughout the field. However, neither Maxwell, nor anyone since him, has been able to provide a tenable account of why displacement currents should be able to generate the ensuing complex of interacting fields and waves.

Around the turn of the twentieth century, scientists could make predictions about the character of the relationship between the temperature of a given body and the kind of wavelength of light it gives off when radiating at that temperature. The means used to make such predictions involved marrying the principles of statistical

mechanics to Maxwell's electromagnetic equations. Unfortunately, the theoretical predictions that were made on the basis of such a methodological union frequently did not agree with empirical measurements.

Max Planck had suggested in 1900 that one might be able to resolve the foregoing sorts of problems if one were to suppose that energy were emitted from thermodynamic systems only in certain amounts. These energy packets would be multiples of a value 'h', derived by Planck, and known, henceforth, as the Planck constant.

Einstein made use of Planck's proposal in the former's 1905 paper on the photoelectric effect, the phenomenon in which electrons were observe to be emitted from various solid, liquid, or gaseous materials when exposed to radiation of certain wavelengths. Essentially, Einstein argued that the photoelectric effect could be understood as a function of the absorption and emission of discrete bundles of energy.

While the work of Planck and Einstein helped resolve some of the issues in thermodynamics, it also helped give rise to a further problem that had far-reaching implications. For example, the idea of a discrete, particle-like, bundle of energy was difficult to reconcile with Maxwell's theory of electromagnetic fields in which light, as one form of electromagnetic radiation, supposedly was propagated in the form of a wave.

Einstein began to look for principles he hoped would be capable of withstanding whatever theoretical and methodological reconstruction might have to take place with respect to the "classical" mechanics of Newton and Maxwell that were under assault by the changes taking place in physics around the turn of the century. Thus, in another of his famous three revolutionary papers written early in the twentieth century, Einstein advanced his theory of special relativity as a way of, hopefully, helping to bridge the scientific transformations which were taking place.

In 1905 Albert Einstein put forth his ideas on special relativity. The "special" aspect of his first paper on relativity reflects his focus on the relation of different frames of reference that were traveling with a constant, rectilinear (either in straight lines or at right angles) motion relative to one another.

One might think of a frame of reference as the vantage point from which one methodologically engages or measures a given phenomenon of physics. Frames of reference that traveled with a constant, rectilinear relative to one another were known as "inertial frames of reference". Consequently, because there were many other kinds of non-linear motion possible for a given frame of reference, Einstein was initially interested only in the special case of rectilinear relative motion.

According to Einstein, the principle of special relativity was intimately connected with all physical phenomena. In effect, this principle stipulates that irrespective of the motion of a given observer relative to any other observer, the laws of nature will be the same for all observers. Another way of stating the same idea is to say that the laws of nature are independent of the kinds of motion that different observers have with respect to one another.

In other words, the special theory of relativity is, at heart, about the invariance of physical laws and, therefore, about that which transcends the relative motion of observers within different frames of reference. Unfortunately, many people have remembered the "relative" part of the theory but entirely have forgotten (or never, actually, knew) the real significance underlying Einstein's seminal 1905 paper.

Ironically, the popular misconception of the theory of relativity as being mainly about how reality tends to appear, or look, differently, relative to one's point of view was aided and abetted by Einstein himself. More specifically, apparently (and, perhaps, apocryphally), Einstein was once reported to have glibly explained the theory of relativity as somewhat akin to how sitting on a hot stove for a minute seems like an hour and sitting next to a beautiful girl for a minute seems like an hour.

He might have had his tongue firmly in his cheek when he supposedly made the foregoing comments. However, many people have been misled by the imagery ever since that time.

In any event, earlier, in the late 1500s, Galileo also had put forth a principle of relativity. He maintained that various laws of motion which he had been exploring retained their invariant form as laws even if the coordinate framework of an observer was subjected to

different transformations such as rotation, translation (motion in which all the parts of an object move in the same direction), and so on. In other words, physical laws of motion were independent of the sorts of geometric transformations that might be performed on any given coordinate system being used by an observer to represent the motion in question.

Nevertheless, there is a major difference between Galileo's principle of relativity and the principle of relativity advocated by Einstein. This difference concerned the role that time played in the two theoretical frameworks.

Galileo believed the laws of motion were the same independent of the frame of reference being considered. However, the transformations in Galileo's theory (which showed how one frame of reference was the equivalent of other frames of reference vis–à–vis, say, a particular law of motion) were performed only on the "spatial" coordinates of the frames of reference being considered.

Galileo considered the time coordinate to be absolute. That is, the time coordinate was the same for all observers in all inertial frames of reference. Consequently, according to Galileo, there was no need to translate the time component from one frame of reference to another as had been done in relation to the spatial component.

For Galileo, spatial coordinates could be moved, rotated and twisted. Time, however, was inviolate and not subject to change.

One of the revolutionary facets of Einstein's special theory of relativity was the manner in which it departed from the classical treatment of, or approach to, time as an absolute. Indeed, Einstein argued there was, at least, one law of nature -- namely, the Maxwell equations for electromagnetic phenomena -- in which time could not be treated as an absolute.

Einstein contended that if one treated time as an absolute, then Maxwell's equations altered their character in certain ways as one moved from one frame of reference to another. Therefore, when time was treated as an absolute, the laws of physics that were given expression through Maxwell's equations became dependent on, and were a function of, the character of the state of motion of a given observational frame of reference.

As indicated previously, Einstein believed the laws of nature were invariant and independent of any given observational frame of reference. Consequently, in order to maintain this view, Einstein argued that as one moved from one inertial framework to another, there was a need not only for the spatial coordinates of one framework to be translated into their equivalent counterpart in the new frame of reference, but there also was a need for one to translate the temporal coordinates of one frame of reference into their temporal "equivalents" in a new frame of reference that had rectilinear motion relative to the first framework.

In short, Einstein agreed with Galileo concerning the invariance of the "laws" of nature and that such laws were independent of the frames of reference through which these laws were experienced or engaged. At the same time, he disagreed with Galileo concerning the role that time played since, for Einstein, time was part of the fabric of a frame of reference and not part of the fabric of the invariant laws of nature.

However, Einstein did not believe that a principle of relativity that emphasized the invariance of physical laws was sufficient, in and of itself, to withstand the challenges to classical mechanics (in the form of Newtonian and Maxwellian theories) which were in the air at the turn of the century. Some additional factor was necessary.

This extra factor turned out to be the constancy of the speed of light. More specifically, Einstein assumed that, in 'empty' space, light would always be propagated at a constant velocity "c". Furthermore, he maintained the velocity of light is independent of the motion of the body that is emitting light, and, therefore, the speed of light would have the same value for all frameworks that were in uniform, rectilinear motion relative to one another.

The foregoing position led to the problem of how to account for the constancy of the speed of light. After all, one might expect that the velocity of light should be subject to the same variability as were other spatial and temporal features of inertial frameworks.

Lorentz, prior to Einstein, had suggested that one would have to assign variable times and distances to different frameworks that were in uniform, constant motion relative to one another. In addition, one would have to use a set of transformation equations to show how the

measured values in one framework could be related to the comparable variables being measured in other frameworks moving in constant, uniform motion relative to the first framework.

Lorentz believed one would have different values for the observables -- such as: length, time, and so on -- being measured in inertial frameworks as a result of the effect that the ether imparted to systems traveling through it. 'The ether' was a hypothetical idea adopted by many physicists of the 19th and early twentieth century and was believed to be a function of the spatial medium through which all bodies were assumed to move.

This facet of Lorentz' perspective was unacceptable to Einstein. Einstein was interested in developing a position that would be independent of considerations of 'the ether' -- a problematic theoretical entity.

Although the relativistic transformation equations derived by Einstein -- in order to preserve the constancy of the speed of light in all frameworks -- had precisely the same form as Lorentz's transformations equations (which had been constructed with the idea of taking into account the effect that movement through the ether was assumed to have on physical/material objects), Einstein understood the same equations in a very different way than did Lorentz. Einstein had been led to the Lorentz transformation equations by rethinking the ideas of length, time, and simultaneity and not through the causal effects of the ether.

In Einstein's relativistic theory, measurements involving time, length, and so on, could have different values in different inertial frameworks despite being tied to one-and-the-same observed event. Variability of such measurements relative to a given event was permitted in order to be able to preserve the velocity of light as a constant, and the constancy of the velocity of light is a fundamental building block in the invariant character of the laws of classical physics involving the basic equations of Maxwell and Newton.

By reworking the mathematics of the Lorentz equations (which are still known as Lorentz transformations despite the differences in the manner in which they were generated and understood), Einstein showed that the inverse of a Lorentz transformation is itself a Lorentz transformation. This meant that in systems that were in uniform

relative motion with respect to one another, differences in measurements for length, time, and mass taken for a given event within one inertial framework would be reflected reciprocally -- through the Lorentz transformation equations -- in other inertial frameworks conducting their own set of measurements involving the same event.

Thus, despite differences in the values for length, time, mass, and so on, that might be obtained in inertial frameworks linked to one and-the-same event, each of the inertial frameworks observed the same laws of physics in operation. In other words, when one looked at an event through Einstein-filtered glasses involving the Lorentz transformations, then, one could "see" that the cement that bound together the different measurement values of various inertial frameworks linked to a common event was the fact that the general character of physical laws remained intact when one translated the results of measurement in one inertial framework with the results of measurement in other inertial frameworks observing the same event. In short, measurement across inertial frameworks could be shown to be relative, but the laws of physics manifested in these same inertial frameworks remained invariant.

For Einstein, the fact that the inverse of a Lorentz transformation could be shown to be a Lorentz transformation, as well, had another significant meaning. It meant there was no inertial framework that could be demonstrated to have a preferred stationary position relative to the ether, and, therefore, there was no framework that could be used as a sort of ontological ground zero through which one could calibrate the relationship of all other frameworks vis–à–vis some given physical event.

Another way of saying the same thing is to maintain that the ether -- if it existed at all -- could not be shown to have any causal effect on variables such as length, time, or mass within inertial frameworks that were in uniform, constant motion relative to one another. For, in order to be able to demonstrate that the ether did have such a causal impact, one would have to be able to identify some framework as being stationary relative to the ether and, therefore, capable of being used to establish a baseline against which the impact of the ether on non-stationary frameworks could be measured.

Absolute motion could not be detected. Only relative motion was measurable.

Only the relative motion of inertial frameworks that were tied to a given event would affect the measurements made in such linked systems. Yet, irrespective of whatever differences in measurement might arise from one inertial framework to another relative to some given event, each of the frameworks would be able to show, via the Lorentz transformation equations, that the same laws of physics governed the event being observed irrespective of the framework of measurement and relative motion that one selected.

When conceptual push comes to theoretical shove, Einstein's special theory of relativity is largely a theory about methodological issues. However, there are, as well, certain ontological overtones which exist in Einstein's special theory of relativity.

For example, one such overtone is his assumption that the speed of light is independent of the state of motion of the body from which it is emitted. This sort of ontological overtone aside, however, most of his paper on the electrodynamics of moving bodies involves a methodological reworking of concepts such as time, length, mass, synchronization, and so on.

More specifically, the reworking is done, on the one hand, in terms of the manner in which the process of measurement shapes one's understanding with respect to the character of various aspects of experience. In other words, the way in which one makes an idea operational tends to shape the way one engages and understands ontology.

For instance, when Einstein says time is what a clock measures, he colors his understanding of the ontology of time. The coloring comes from the character of the means he uses to operationalize the ontology of time for purposes of quantifying and measuring (i.e., the means through which he proposes to keep track of time).

There also is another aspect to consider with respect to Einstein's methodological reworking of the meaning of some of the basic concepts of physics. This aspect concerns the manner in which one goes about translating the measured values obtained in another

framework that has relative uniform motion with respect to one's own framework and, therefore, revolves about the methodology of translation between, or among, different frameworks.

Each of the foregoing aspects of the methodological reworking of basic ideas of physics doesn't really say much about the structural character of ontology ... except indirectly. In effect, Einstein is exploring some of the constraints and degrees of freedom of ontology as far as how one can methodologically interact with that ontology in the context of doing comparative studies with observers in other frameworks who have relative uniform motion with respect to one.

The principle that: The inverse of a Lorentz transformation is, itself, a Lorentz transformation, says absolutely nothing about the structural character of ontology. What it does say is: (a) the methodologies of systems involved in relative uniform motion are tied together in certain ways (both methodologically and ontologically); (b) our perceptions and interpretations of how such methodologies are employed in other observational frameworks is rooted in, and shaped by, methodological considerations; and, (c) our understanding of what goes on in our own observational framework is rooted in, and shaped by the manner in which we operationalize terms in that framework in order to be able to quantify and measure events that occur in that framework.

The idea of relativistic effects is often given an ontological flavor such that, for example, time paradoxes are permitted to have ontological implications. Thus, supposedly, one and the same clock can, in an ontological sense, run both faster and slower at the same time, just as a Lorentz transformation and its inverse -- which are mathematical structures -- can exist simultaneously.

Herbert Dingle, in his book *Science at the Crossroads*, seems to be taking issue with just this aspect of the special theory of relativity. He is commenting on, and criticizing, the tendency of people to interpret the special theory as an ontological theory that provides an accurate description of certain aspects of reality. Indeed, if one were to suppose that the special theory of relativity is primarily about ontology, then one does end up with a number of paradoxes, some of which are pointed out by Dingle in his aforementioned book.

On the other hand, if one likens the special theory of relativity to the invention of a better calibrated ruler or measuring device, then although the new measuring device does not, in and of itself, say anything concerning the nature of ontology, it does alter the structural character of the way one goes about engaging ontology. As a result, the measuring device could help to improve certain aspects of one's understanding of ontology (or one's relationship with ontology) because the process of measurement provides a means of compensating to some degree for certain factors that are capable of distorting the way in which one's mode of methodology engages ontology during the measurement process.

The special theory of relativity leaves the laws of nature unchanged. The special theory of relativity is intended to show that the laws of nature are invariant despite the fact that the measurements for different variables such as time, mass, length, and so on, might vary from one framework to another in relation to the observation of one-and-the-same event.

Apparently, the best way Einstein could think to demonstrate invariance among a variety of frameworks that have uniform relative motion with respect to one another, was to re-calibrate the methodology. He did this by using the constancy of the speed of light as the value that is to guide the re-calibration process as one goes from one locality to another. This re-calibration is accomplished through the transformation equations that are themselves rooted in a reworking of the meaning of such basic concepts as time, simultaneity, length and so on.

In a sense, what Einstein has done in the special theory of relativity is somewhat analogous to what Maxwell has done in arriving at his electromagnetic field theory. Maxwell used a method (namely, the method of analogies) which generated implausible mechanisms in order to make certain relationships visible and certain calculations possible.

Despite such implausibilities, Maxwell's method yielded results that not only were in agreement with empirical results, but also tied together, in a unified way, a wide variety of electrical and magnetic phenomena. So, even though the mechanisms utilized by Maxwell did not appear to be likely candidates to accurately reflect how (in an

ontological sense) things happened in the context of electromagnetic field, nonetheless, use of those sorts of devices or mechanisms (analogies) led to results that were able to accurately reflect, to some extent, the invariant character of the effects that ensued from the unknown how's of such fields.

Einstein, too, has employed a method (namely, the special theory of relativity) which generated implausible mechanisms (e.g., time should simultaneously run both faster and slower) in order to make certain relationships visible and certain calculations possible. Despite such implausibilities, Einstein's method, yielded results that were not only in closer agreement to empirical findings than were the results derived from the methods of Newtonian mechanics, but his methods also tied together, in a unified way, a wide variety of physical phenomena. Therefore, even though the relativity methodology did not appear to be a likely candidate to accurately reflect how (in an ontological sense) things actually happened in the context of, say, the electromagnetic field, it led to results that were able to accurately reflect, to a degree, the invariant character that was inherent in the unknown dynamics to which such fields gave behavioral expression – expressions which could be described analogically.

In short, Einstein's special theory of relativity didn't get one any closer to understanding the 'how' of things, but it did bring one closer to a more accurate representation of what that unknown 'how' made possible. His method accomplished this by sensitizing one to the way methodological engagement affected processes of observation, measurement, interpretation and translation.

The foregoing considerations leave open the possibility that just as Einstein found his way to a methodological improvement concerning Newtonian mechanics, someone also might be able to discover a means of improving on the methodology of Einstein's special theory of relativity in a way that would not entail problems such as the twin paradox, or having one and the same clock running both faster and slower at the same time, and so on. Such a possibility points in the direction of something more deeply hidden.

What is essential in all of this is not so much Einstein's methodology in particular, but the effect of that methodology in allowing one to generate a more accurate description of certain

aspects of the way in which we go about engaging ontology, while preserving the invariance of the laws of nature as one moves from one observational framework to another. If one could come up with an alternative means of accomplishing what Einstein's methodology accomplishes, yet, a method which is free from some of the problem's of Einstein's special theory of relativity, then, this new approach to things would constitute an improvement, once again, in the heuristic value that might assist us to have deeper insight into some of the nuances concerning the way in which we methodologically engage certain aspects of reality.

However, one might not be able to eliminate, or by-pass, the problems inherent in Einstein's methodology, for such problems might give expression to certain limits in the character of rational methodology itself. More specifically, there is a sense in which the problems that occur in Einstein's special theory of relativity might serve as something akin to Heisenberg's uncertainty principle.

Heisenberg indicated that the very process we use to observe phenomena can disturb, if not distort, the character of what is observed and, thereby, place limits on the extent to which reality can be known. So too, one of the effects of Einstein's special theory of relativity might be to indicate that the very methodology that is used to preserve the invariance of the physical laws of the universe interferes with our ability to establish certain facts about the universe. For example, one might not be able to determine the actual structural identity of a given event independent of its being embedded in a network of assumptions and methodological considerations concerning measurement and relative motion.

Einstein's methodology permits one to see that a given event is law-governed. His methodology also permits one to see how the structural forms of the laws that are operative, manifest themselves according to the manner in which different observational systems engage a given event.

However, Einstein's methodology obscures one's vision of the actual ontological character of that which underlies the event being measured. One sees relative mass, velocity, length, and time, but one does not see the actual mass, velocity, length or time of an event.

One sees only what one's methodology permits one to see. In a sense, the methodology becomes like a modern heir to the Kantian categories.

Consequently, Einstein's methodology introduces an element of uncertainty concerning the nature of reality. As is the case with quantum phenomena, one can approach the actual structural character of reality only up to a point.

Beyond that point of closest methodological approach, the methodology itself prevents one from getting any closer. Indeed, the attempt to get closer only leads to problems, paradoxes and distortions.

In other words, within certain limits, the methodologies of both quantum physics as well as relativistic physics help one to grasp the structural character of certain aspects of one’s relationship to ontology. However, if the boundaries of these methodological limits are ruptured or exceeded, an increasing element of indeterminacy and/or uncertainty is introduced into the proceedings, and, as a result, one's vision of certain aspects of ontology becomes obscured.

Maxwell's equations were accepted by scientists as reflections or embodiments of certain aspects of the invariance inherent in the character of the laws governing natural phenomena. If one treated time as an absolute, Maxwell's equations produced variable results as one moved from one frame of reference to another.

Thus, if one wanted to retain those equations, then, one had to make adjustments in the manner in which one methodologically approached the issue of time. Einstein did this by requiring the temporal component of a coordinate system to be subject to the same translation process as the three spatial components of that same coordinate system.

One of the mistakes that might have been made in classical mechanics is that the measurement of time was considered to be absolute in the same way that time itself was considered an absolute. Measurement is affected by a variety of forces operative in a given framework (and time is but one such dimensional force), whereas time's ontology is not necessarily affected by such things at all.

In other words, the structural character of the ontology of time might be such that it permits a range of possible dialectics between itself and various modes of measurement which might engage it. While the mode of measurement will be sensitive to a variety of forces that will affect its capacity to get an accurate reading of the character of time, the dimension of time is not affected by any of these forces.

As such, although time acts upon, and shapes, whatever engages it, time might not, in turn, be affected by the activity or character of any of the entities or forces that it engages. In this sense, ontological time (as opposed to measured time) could be said to have perfect elasticity, since no matter how it is engaged or by what it is engaged, ontological time retains its original structure without displacement affects ensuing from such engagement.

In any event, part of Einstein's revolution was to draw our attention to the extent to which the measurement of time is extremely sensitive, under certain circumstances, to the effects of velocity, gravitational fields, and so on. Nonetheless, as indicated earlier, nothing that Einstein said could be considered to carry any necessary entailments with respect to the ontology of time itself.

The scientists from Galileo onward -- up to the time of Einstein -- made a mistake when they assumed that because the ontology of time is everywhere the same, therefore, the measurement of time must everywhere be the same. They failed to properly understand the complex nature of the relationship between methodology and ontology.

For instance, they failed to understand that the hermeneutical engagement of time, as expressed in terms of some mode of measurement, constitutes a process of making operational the temporal dimension which comes to be used as an index for such hermeneutical engagement. This index of measurement is dependent on the state of motion, or on the state of the conditions of gravitation, in which the measurement index is embedded.

In other words, the scientists from Galileo up to the time of Einstein failed to understand that the measurement of time is relative to the frame of reference in which the measurement takes place. This is because the latter is affected by the conditions and forces that prevail locally within that frame of reference.

Since the time of Einstein, there also has been an erroneous assumption that has been made. This faulty assumption is the reverse of the mistake by Galileo, Newton and others.

Whereas Galileo, et al, had mistakenly assumed that because the ontology of time is everywhere the same, then therefore, the measurement of time must everywhere be the same, Einstein, and subsequent generations, have mistakenly assumed that because the measurement of time will vary from framework to framework, therefore, the structural character or the ontology of time also will vary from framework to framework. This need not be the case.

The ontology of time might be independent of one's mode of measurement. However, the mode of measurement is not independent of the structural character of the ontology of time since the latter establishes the parameters within which any given mode of temporal measurement must operate.

The confusion between the measurement of time and the ontology of time carries over into another issue of some importance to the theory of relativity -- namely, the problem of simultaneity. In a sense, this problem is really only a variation on the measurement issue discussed previously, and, as a result, there is a failure to maintain a clear distinction between the measurement of simultaneity and the idea of absolute simultaneity as an expression of the actual nature of ontology.

When one says the word "now", the instant required to say that word exists simultaneously everywhere in the universe. This is an intuitive example of absolute simultaneity, but once one undertakes to measure the instant in question and to attempt to compare the measurements taken, then one encounters all the problems of simultaneity about which Einstein talked and wrote.

If – following comments made earlier in this chapter -- one treats changes in the ratio of constraints and degrees of freedom as evidence of the presence of one or more forces, then several questions need to be asked. First, how does a force bring about a change in the ratio of constraints and degrees of freedom, and, secondly, what is the relationship between a force and a field?

These questions will not be answered in their entirety within the context of the present chapter. What is being offered here is more like pointing in a certain direction and identifying a few of the components, and, as such, it is an unfinished sketch to which an increasing amount of detail could be added over time as new data and understandings become available.

Part of the answer to the foregoing questions concerns the idea of an order-field. An order-field is generated through the dialectic of a set of dimensions.

The structural character of the foregoing dimensions is an expression of a spectrum of various ratios of constraints and degrees of freedom that have been established by the underlying order-field. This underlying order-field induces and/or permits different aspects of the foregoing spectrum of ratios to engage one another.

The ensuing engagement generates a further spectrum of ratios that give expression to the character of the dialectic between, or among, different dimensions (which involve more than space and time). This dialectic of dimensions generates, in turn, a further spectrum of ratios of constraints and degrees of freedom that give expression to point-structures, in neighborhoods, and latticeworks on different levels of scale.

At the heart of any field theory -- whether that field theory is rooted in Faraday's idea of a force, or in Maxwell's model of an ether that was ‘mechanical’ in some sense, or in the geometry of Einstein's general theory of relativity – there is a certain degree of antagonism toward the concept of Newton's idea of action-at-a distance. Field theories are all predicated on the principle that the dynamics of the field – that is, the dialectical character of field dynamics -- is a function of events which are related in some sort of continuous function, and field theories differ from one another in the manner in which they attempt to account for the structural character or nature of the continuous relationships among various aspects of the field and how effects are propagated through the field by means of those relationships.

Consequently, an order-field constitutes a field due to the way that the underlying order has some sort of dimensional contact with, or has some sort of phased-based dynamical relationship with, each aspect of

the order-field that is present. The order-field also gives expression to properties in the way it has contact in the form of relationships with the dialectic that induces these basic dimensions from which emerge various point-structures, neighborhoods, and latticeworks. All of these relationships are accomplished through the spectrum of ratios of constraints and degrees of freedom out of which dimensionality and dialectical activity initially arise by means of the order-field.

Thus, an order-field encompasses each and every point of these spectrums on whatever level of scale one cares to consider ... from the microcosmic to the macrocosmic. This presence manifests itself as a field that organizes, arranges, shapes, directs, orients and generates all structures and structuring activity.

These structures and structuring activities are structural manifestations of the way the order-field gives expression to itself as a result of operating on itself. So, the nature of the order-field being considered here is more akin to the contiguous character of Faraday's notion of a force field, than it is to either the action-at-a-distance field concept of Newton or the bifurcated matter/field concept of Maxwell.

Nevertheless, the order-field being proposed here is different from Faraday's notion of a force field. From the perspective of the theory being put forth in this chapter, the idea of a force is itself an index of the presence of an order-field, manifesting itself in a form that results in a change in a given ration of constraints and degrees of freedom which characterizes the way such a field is manifested at a given point in time.

Consequently, as such, the notion of force being alluded to in this essay is not the basic constituent of the universe as it is for Faraday. Force is, instead, itself a manifestation of something more fundamental -- namely, the structural character of the order-field which makes any given kind of a force possible.

The structural character of any given force is a function of the ratio, or set of ratios, of constraints and degrees of freedom that have been arranged through the presence of the ontological or dimensional structure to which an order-field gives expression. As such, force is the way that an order-field is manifested at a given point of intersection of different dimensional components (and, again, the notion of “dimension” should not be limited to space and time).

The range of a force is described by the series of point-structures, neighborhoods, or latticeworks whose altered character can be traced to the presence of a capability for bringing about a transformation in the ratio(s) of constraints and degrees of freedom of the observed kind. The path of a force is described by the vectored or tensored series of point-structures, neighborhoods, or latticeworks whose alteration in ratio character can be traced to the primary epicenter(s) of intensity of a force's presence, as opposed to secondary, aftershock effects that occur away from the primary points of field intensity.

The structural character of either the range of a dimensional force or the path of a dimensional force can be varied in character. In other words the character of a given force's range or path need not be simple or linear in nature but could be chaotic in character, and such chaotic properties need not be restricted to just the dimensions of space and time and, therefore, could involve the contributions of a variety of dimensional dynamics beyond space and time.

The notion of an order-field provides a potential means for any given point of time/space to be in "contact" with any other point of time/space by means of the dialectic of phase relationships through which those ratios of constraints and degrees of freedom are given expression. However, these junctures of contact are not necessarily physical in any generally understood sense of "contact" since the latter might have various kinds of dimensional capacity to modulate, different aspects of the physical/material world.

Furthermore, the dialectic connecting various neighborhoods does not need to be construed in terms that require the transmission of physical signals between points that are spatially separated. The points of contact are manifestations of the dialectic of dimensions that have been set in motion by the underlying order-field. Thus, 'points' might be in non-physical contact on the level of the order-field in the form of phase relationships, and this contact might manifest itself on the level of scale of physical events as simultaneous events between, or among, physical points separated by spatial distances (i.e., dimensional entanglement dynamics).

Methodologically, one might not be able to demonstrate the simultaneity of such events because of the sorts of problems pointed out by Einstein concerning the measurement of simultaneity in

relation to points that are physically separated. Nonetheless, ontologically, the events might be simultaneous expressions of certain facets of an underlying ontological and/or metaphysical order-field, and, therefore, viewed from such a perspective, the ontological character of an order-field underwrites the simultaneity of events, not the mode of measurement.

On a given level of scale, a particular ratio of constraints and degrees of freedom expresses itself as a point-structure. A group of related ratios manifest themselves as a structural neighborhood.

In the hermeneutical context, neighborhoods tend to build-up (e.g. through learning and memory) around points of phenomenological engagement to which attention is directed and identifying reference is made. Indeed, attention and identifying reference mark the beachhead landing of the hermeneutical operator (defined previously as a function of five interacting dynamics) with respect to various aspects of the phenomenology of the experiential field. Whether -- and, if so, to what extent -- a given experiential or phenomenological neighborhood will bind the hermeneutical operator or whether the hermeneutical operator will remain relatively unbound will be a function of the dialectical engagement between (or among) the hermeneutical operator and a given experiential neighborhood or series of such neighborhoods.

Hermeneutical point-structures are not geometric points. In other words, they are not necessarily 'spatial' or internally simple in character. Consequently, unlike geometric points, hermeneutical point-structures cannot necessarily be construed as lacking an internal structure.

A point-structure is a ratio of constraints and degrees of freedom that, when taken all together, give expression to a dimensional form or structure or complex that can have multiple facets and themes. This suggests a potential for complexity of structural character.

A further flavor of complexity comes from the fact that what is a point-structure on one level of scale, might, on another level of scale, give rise to a neighborhood of point-structures or even a variety of latticeworks. As such, point-structures have the capacity to manifest fractal-like properties when engaged on different levels of scale.

Latticeworks are the result of a collection of phenomenological neighborhoods that are held together by a set of phase relationships. These phase relationships establish identifiable patterns of focal activity, as well as identifiable patterns of horizonal boundaries, within which the collection of experiential neighborhoods interact with one another.

Ratios of constraints and degrees of freedom are related to one another by means of phase relationships. More precisely, ratios are linked to one another by a spectrum of constraints and degrees of freedom that establish parameters within which phase quanta are exchanged between interacting ratios. Phase quanta are discrete arrangements of constraints and degrees of freedom that are drawn from the spectrum of arrangements that are possible in a given context of interacting phenomenological point-structures, neighborhoods, and/or latticeworks established through a given order-field.

At any given time, if two dimensional point-structures or neighborhoods or latticeworks are linked to one another, the structural character of the link is an expression of one aspect of the spectrum of ratios that is generated by the underlying dialectic of dimensions. When such a link manifests itself, this is known as a phase quanta exchange, and this exchange gives expression to a state known as a phase relationship.

Thus, the phase relationship state encompasses the following sequence of activities. (a) It begins with an experiential engagement of a specific set of ratios that give rise to the character of the engagement; (b) proceeds through phase quanta exchanges (which are not necessarily physical in nature – quanta in this case being the smallest 'packet' of structural or dimensional character that can be manifested without altering the nature of what is being expressed; (c) includes the alteration of the ratio character of the point structures, neighborhoods and/or latticeworks involved in the engagement process as a result of the presence of forces of one kind or another; and, (d) ends with the experiential or phenomenological disengagement of previously interacting ratios.

Both the process of phase quanta exchange, as well as the state of phase relationship in which that exchange is embedded, are subject to the influence of differential, vectored components of force. Sometimes

the structural character of the way these vectored pressure components interact is complex and multi-dimensional, and use of the foregoing term – namely, "multi-dimensional" -- is intended to allude to the possibility of an array of different kinds of dimensions beyond space and time that are interacting to give rise to, or being expressed through, such an order-field.

When this is the case, the dialectic of components gives expression to tensor components that constitute a source of stresses capable of simultaneously modulating any given phase quanta exchange or phase relationship state. This is comparable to the manner in which Faraday's lines of force could be subjected to a variety of stresses and pressures within the electromagnetic field except the forces being alluded to here are not necessarily electromagnetic in character and, consequently, such forces might be forms of dimensional dynamics interacting with one another according to the manner in which their respective degrees of freedom and constraints permit.

The order-field is continuous in the sense that a relay race is continuous. In other words, despite the presence of discrete elements (i.e., the runners for the different teams competing in the race), these elements are organized or arranged in such a way that one or more of the runners is always running throughout the race, although not all the runners will be running at any given instant during the course of the race.

The integrity of the continuity of the race is preserved because of the way the runners, taken as discrete elements, are ordered within the context of the rules and/or principles that govern the running of the race. The primary characteristic of this ordering is that there should be an overlapping of one discrete element with another discrete element at different points of the race. This is the region within which the baton is passed on from one runner to the next.

Similarly, an order-field is continuous because the spectrum of ratios on any given level of scale will always be giving expression to one or more aspects of the phase relationships which give expression to particular instances of the ratios of degrees of freedom and constraints that form such an order-field. Moreover, there is an overlapping of events that occurs between the expression of one ratio

and a subsequent expression of another ratio drawn from the same set of dimensional possibilities.

This region of overlap is contained either in the phase relationship that links the two ratios that are being expressed, or it is contained in the mere dimensional contiguity of the events. Space and time could be dimensionally contiguous with one another through various kinds of phase relationships and, consequently, without that contact necessarily being a function of an infinite set of geometric points.

In either of the foregoing cases, as one ratio -- for whatever reason -- ceases manifesting itself, other ratios spontaneously (as a function of phase relationships in the order-field) will manifest themselves, or be induced to do so, even though there might be no causal link between or among such contiguous events. All of the foregoing considerations are traceable to the modes of manifestation being expressed through the phase relationships which are made possible by the underlying order-field.

From the perspective of field theory, the laws describing the fundamental character of physical phenomena will be expressed in terms of a set of field variables, f_v. Each observer will map these field variables in a continuous fashion by means of a dimensional coordinate system (which might involve more than space and time) that gives representational expression to: Three spatial components, one temporal component, and however many other dimensions are involved in the manifestations to which the order-field is giving expression at a given juncture. However, each observer might use a different set of words or hermeneutical functions (of which mathematics is but one modality) to describe such a multi-dimensional coordinate systems.

Irrespective of whatever labels might be assigned to the dimensional coordinate system in each frame of reference, the principle of relativity suggests that the physical laws that are derived by various observers in relative dimensional motion with respect to one another should, nonetheless, be in one-to-one correspondence with each other. However, until one has devised a means of translating from the coordinate language of one experiential-dimensional frame of reference to the coordinate language of another experiential-dimensional frame of reference, then, one is not in any position to

establish whether or not the natural laws deduced in the different frameworks which are in relative, dimensional motion to one another are capable of being placed in one-to-one correspondence.

On the other hand, if one is successful in generating a set of translations that: (a) allow one to move from one experiential-dimensional framework to another such experiential-dimensional framework in a way that conforms to the invariant structural character of the dimensional dynamics which govern the underlying order-field, and (b) are independent of the state of dimensional dynamics of any given observer relative to the state of dimensional dynamics of any other observer, then, such a set of translations is known as a "continuous transformation group". Moreover, if one has a set of homeomorphic, analog, mapping latticeworks of dimensional dynamics (forming a non-spatial form of dimensional topology or manifold) that preserve the invariance or symmetry of the laws of understanding independently of the state of dialectical engagement of any given hermeneutical observer with respect to some given event or phenomenon, then, such a set constitutes a "continuous hermeneutical group".

Given the foregoing considerations, the methodology of special relativity theory could be considered to constitute a special limiting case of a more general principle of hermeneutical relativity that is directed toward establishing invariance of structural character in the context of the dialectical engagement of ontology by a number of different observational frameworks and their concomitant systems of dimensional measurement. In other words, Einstein's theory of special relativity gives expression to a set of hermeneutical activities concerning the nature of the relationship of a given frame of reference to that which makes such a frame of reference possible, and, therefore, while the focus of the special relativity might be ontological, such ontology is being framed through the hermeneutical lenses of the methodology of special relativity.

One encounters the social community of alleged 'knowers' and interpreters in the context of continuous hermeneutical transformation groups. This occurs in the following way.

In order for the invariance or symmetry of a given law of understanding to be preserved in relation to the nature of the dimensional order-field which makes phenomenology or experience possible, one must establish congruence with – or merge horizons with -- that which makes phenomena of such structural character possible. To acknowledge that various hermeneutical latticeworks of different observers are analogs of one another is not sufficient.

They must all preserve symmetry through generating congruence functions in relation to the structural character of the phenomenon to which all observers are making identifying reference. Only in this context of each hermeneutical framework having established defensible congruence functions with respect to some aspect of the structural character of reality would there be significance in being able to demonstrate that these different frameworks are analogs for one another.

At the same time, by means of the dialectic between, or among, different hermeneutical frameworks, members of the community can work toward uncovering facets of invariance in different aspects of the structural character of reality or ontology or the order-field that makes such hermeneutical frameworks possible. In this sense, the hermeneutical activity of the community considered as a whole takes on the form of a hermeneutical operator (outlined earlier in this chapter) that engages the point-structure products that are generated by individuals through the activity of their own hermeneutical operator … the community becomes horizon to the individual, and the individual becomes horizon to the community.

In other words, the hermeneutical activity of the community as a whole forms a latticework in which the hermeneutical activity of individuals forms complex point-structures or neighborhoods (in the case of a number of people whose hermeneutical positions are similar but not entirely the same) within that community latticework. Thus, the hermeneutical activity of the community is an expression of the hermeneutical operator considered from a different level of scale than that of the individual.

Consequently, many – but not necessarily all -- of the basic components that are inherent in the individual's hermeneutical operator also are inherent in the community run hermeneutical

operator. Furthermore, just as one finds different kinds of dimensional attractors on the individual level of scale, one also finds various kinds of dimensional attractors on the community level of scale.

When one speaks of the invariance or symmetry of a law of understanding, it is important to understand that one is not talking about an abstract structure that is divorced from a concrete context. While invariant laws must be independent of the idiosyncrasies that might characterize the hermeneutical framework of any particular observer, such laws are not independent from the structural character of the aspect of ontology that is giving expression to this sort of invariance. Indeed, only when the hermeneutical framework of a given observer merges horizons with a certain aspect of ontology by means of congruence functions, could one say that the individual has grasped something -- on a given level of scale -- of the invariant structural character of that to which identifying reference is being made.

In the classical tradition of physics, the idea of a physical material or substance was something that could be assigned a determinate -- usually unique -- location in space and time. Moreover, this idea usually included an array of properties -- the array varying with different substances -- which gave expression to various facets of the character of the substance in question.

In addition, whatever array of properties might be associated with a given substance, the traditional view held that, in general (although there were exceptions to this) such properties would be conserved as the substance is exposed to, or moves through, a variety of changes across time and space. Finally, by following the transitions undergone by a given substance or set of substances, classical scientists believed the character of causal relationships could be detected from which one could deduce universal laws, such as the laws of motion governing physical substances or materials.

Einstein rejected an essential portion of the classical idea of substance that has been outlined above. For example, Einstein argued that one cannot make any unique assignment of properties -- such as mass, length, velocity, time, causality or simultaneity -- to any aspect of a field.

Instead, in accordance with the transformation equations that Einstein applied, not only will one be required to assign different values to such properties in different frameworks, one also will not be able to identify any of these assignments as being the 'true' or 'real' one. Indeed, according to Einstein, one's methodology does not permit one to do anything but treat all of the values as being equally real or true in the sense that they all preserve the invariance of physical law, but each frame of reference does so in its own idiosyncratic fashion as a function of their system of measurement.

While Einstein did not accept the idea of substance in the traditional sense, neither did he believe that the assignment of values could be made arbitrarily. In fact, once one makes an assignment of a value in some given frame of reference, all of the other values for that frame of reference can be determined by means of the transformation equations.

Because, as indicated previously, none of these assignments or determinations really can be said to be rooted in some substance in the field, what was being described was an event. This event could be observed to be characterized by a different set of property values in different frames of reference.

Consequently, Einstein had substituted the idea of events with variable properties -- which, nonetheless, conformed to invariant laws of nature -- for the classical idea of: A substance whose properties were conserved across time and space and that was subject to laws of causality. In short, Einstein's special theory of relativity required physics to become an exploration into the realm of invariance, which had no room for the notion of a physics rooted in the fixed identity of some conserved substance.

From the perspective of Einstein’s theory of special relativity, events are a function of the dimensional dynamics which make frames of reference possible. As such, ‘events’ are manifestations of a field.

There is a difference, however, between: Our methodological incapacity to establish the uniqueness of the properties of matter and the field, and saying that there is no uniqueness of the ontological properties of matter and the field. In a sense, the relativity principle sacrificed the issue of uniqueness of property value on the altar of invariance.

In other words, apparently, Einstein had to pay a price for having a methodological means of establishing invariance in the laws of nature amongst a group of referential frames exhibiting differential values of time, mass, length, simultaneity, and so on, with respect to one-and-the-same event. That price was to lose any chance of determining an ontologically unique set of property values in relation to that event.

As far as Einstein's special theory of relativity is concerned, it's field aspects seem to be more a reflection of the field properties of the methodology that is central to the special theory than they are a reflection of any field properties of ontology. Said in another way, the special theory of relativity is a field theory only in the sense that it provides an account of how the measured properties of time, length, mass, velocity, and simultaneity can be shown to be a function of the conditions that prevail at a given locality of space, and, as a result, the descriptions given at those localities are not dependent on any notion of action-at-a-distance since the general idea of a field concept requires that any given description of phenomena which is made with respect to bodies that are in uniform motion relative to one another will be entirely dependent on local conditions only.

More specifically, local conditions include the way one's methodology engages the universal laws that are given expression through the manner in which physical phenomena unfold under a particular set of circumstances in a given locality of space time. Thus, such issues as causality, force, energy distribution, substance, and so on, will manifest themselves as a function of the manner in which the field properties of the methodology of special relativity theory engage localized aspects of ontology.

The field properties of the methodology of special relativity theory also are given expression in the so-called Lorentz transformations that permit one to take the values that have been measured in the context of a given inertial framework and translate those values into the context of some other inertial frame of reference. In essence, the transformation equations represent nothing more than a transfer of the field properties of the methodology of the special theory of relativity from one inertial framework to another. In fact, such transformation equations ensure that the special theory of relativity

remains a field theory in as much as the values that are to be assigned to the various physical properties of a given inertial framework will always be a continuous reflection of the local ontological conditions that prevail with respect to that inertial framework.

In a sense, the methodological flavor that characterizes Einstein's special theory of relativity serves to lay the groundwork for the kind of field theory that is encompassed by Einstein's later, general theory of relativity. In other words, the field concept of the general theory of relativity also is rooted in methodological considerations -- namely, the geometry of "space-time". This means the phenomenon of gravitation is reduced to being a function of the methodological means (i.e., geometry) which Einstein chose to use in order to give operational expression to certain universal laws of relationship among different bodies of the physical universe.

Moreover, as required by the general idea of the field concept, one can measure the gravitational effect on any given point of space by taking into consideration the geometric properties that manifest themselves in the local region of the point. Consequently, gravitation, when expressed as a function of the geometric properties that prevail with respect to a given set of conditions in a given region of space-time, transmits its 'influence' in accordance with the characteristics of field theory -- namely, on a localized, point-by-point basis of phase relationships.

Although there are obvious differences between the methodological character of the field properties of Einstein's special theory of relativity and the field properties of his general theory of relativity, there is an underlying, thematic sameness to them. Essentially, this commonality or unity lies in the fact that Einstein's idea of a field in each case is solidly embedded in the properties of the methodology used to operationalize and give representational expression to certain aspects of ontology. Said in another way, the underlying thematic sameness of the two theories of relativity lies in the way Einstein makes field properties in each theory a function of methodology rather than ontology even as those field properties are made possible by the presence of an underlying dimensional order-field.

One is able to describe what occurs from one point to the next of space-time in the special theory of relativity, by taking into account the effects of relative motion on measurement and/or using an appropriate set of transformation equations that permit one to translate the values generated by the measurement process in one framework into the values that will be generated by the measurement process in another framework. In the general theory of relativity, one is able to describe what occurs from one point to another in space-time by taking into account the effects of the structural character of the geometry that manifests itself in the context of a methodological engagement of gravitational phenomena in a given locality.

In the special theory of relativity, one is not able to establish, or know, the nature of reality in and of itself. One only can interact with reality through the frames of the methodological glasses one uses to engage that reality.

Therefore, although the character of the relativistic lenses of the special theory permits one to see the universality of physical laws in all frameworks, they prevent one from seeing just what it is that is being governed in such a law-like way. From Einstein's perspective, all that one sees are the values generated by the methodology of special relativity.

Similarly, in the general theory of relativity, one is not able to make contact with reality in and of itself. Again, one's vision is limited to the structural character of the frames of the methodological glasses one uses to engage reality.

The character of the relativistic lenses of the general theory of relativity permits one to see that the law of gravitation is universally applicable in all frameworks. Nonetheless, one does not know why space-time has the geometry it does, or what has the capacity to warp space to generate geometric characteristics of the kind that are observed in various cases.

One sees there is a correlation among geometry, mass and gravitational phenomena, but one does not know what it is that sustains this correlation. To say that gravitation is geometry, does not account for how space comes to have the geometry it does, nor does such a hermeneutical orientation account for why mass should be proportional to geometric properties.

Consequently, the methodological strategy that Einstein used in the special theory of relativity to develop his notion of a field laid the groundwork for his doing the same sort of thing when it came to the development of the field concept in the context of the general theory of relativity. Moreover, by rooting the field concept in methodology, each theory of relativity was able to permit one to describe certain universal properties and behaviors that are manifested in the context of localized frameworks, while, simultaneously, limiting one's understanding of the underlying reality that made universal properties and behaviors of such structural character possible.

The mechanistic theory of life holds that all properties of living organisms can be completely accounted for in terms of physical and chemical laws. On the other hand, what might be termed "vitalist" approaches propose that one must posit the existence of some non-mechanical causal principle (or set of such principles) -- in addition to the mechanical principles of physics and chemistry -- in order to explicate the various facets of the phenomenon of life. Finally, there are holistic or organic theories of life that attempt to explain the phenomenon of life as a function of emergent properties.

Emergent properties are believed to manifest themselves at certain levels of hierarchical complexity. Their appearance cannot be anticipated – at least from the orientation of certain methodological perspectives -- on the basis of the principles that are operative in lower levels of complexity.

In effect, emergent properties are said to manifest themselves when certain kinds of hierarchical complexity reach a sort of critical mass and begin to generate phenomena as an expression of the way the whole system interacts together. Consequently, emergent properties are considered to be by-products of the complexity of a given system taken as a whole, rather than the result of some subsystem of mechanistic principles.

Rupert Sheldrake considers the idea of morphogenetic fields to be an example of the organic approach to theories of life. In general terms, morphogenetic fields are believed to be the agencies that are

the source of various kinds of structure, form, shape and organization that are manifested in living systems.

According to Sheldrake, morphogenetic fields transmit their structuring influences across both space and time such that there is a cumulative structuring effect from one point in time to another, as well as from one point in space to another. However, these influences are only passed on to, or affect, systems that are "similar" in some sense.

The hypothesis of formative causation plays an important role in Sheldrake's model. Essentially, this hypothesis says that the degree of repetition that is associated with a given morphogenetic field will affect the intensity of the influence of that field on similar fields with which it comes into contact.

On the basis of the “hypothesis of formative causation”, Sheldrake says one could expect or predict that something of the following sort will occur. When a given species of animal learns a new form of behavior, then, subsequent members of that species will exhibit -- if raised under conditions that are similar to the original group -- a tendency to learn such a behavioral form more quickly than when the new behavioral form was first introduced into that species. Furthermore, within certain limits and up to a certain point, the learning curve will accelerate with each successive generation of the species that is taught the behavioral form at issue.

In addition, Sheldrake maintains that the acceleration of the learning curve will be affected by the quantities of species members that are involved in the original, and subsequent, learning experiences. In other words, if one uses only a few members in the original, and subsequent, learning trials, then, the influence of the morphogenetic field that is set in motion will be relatively weak compared to the strength of the morphogenetic field that will be generated if one had used thousands of members in the original, and subsequent, learning trials.

There are a number of questions that arise in relation to the foregoing considerations. For example, if what Sheldrake says is true, then, why don't the subsequent generations of adherents of a given religion learn their religious tradition more quickly, more deeply and more completely than do the early adherents of that tradition?

After all, it is almost universally acknowledged that the early adherents of a religious tradition are often the best exemplars of that tradition -- best in the sense of having most completely and most deeply mastered the various aspects of the tradition. One might even argue the earlier adherents also pick up the tradition more quickly than subsequent generations of adherents because they have direct access to the individual who is the prophet or avatar or saint who introduced the tradition.

In order for Sheldrake to put forth a tenable position, he is going to have to be able to offer a plausible way of resolving the foregoing problem. For instance, one way of addressing the aforementioned difficulty might be to suppose there are other morphogenetic fields in existence that are antagonistic to the spiritual morphogenetic fields being generated through a prophet and his followers. As a result, the influence of the spiritual morphogenetic field might be dampered, modulated or curtailed by the existence of other kinds of morphogenetic fields that are antagonistic to the first kind of field.

However, if one were to adopt the foregoing position, one would be faced with a further question. Given the presence of antagonistic morphogenetic fields, how does one account for the emergence of a morphogenetic field that runs counter to the already existing fields? One might suppose that the inertial character of the already existing, antagonistic systems would be too much to overcome for a fledgling morphogenetic field.

One also would like to know whether, or not, the rate or intensity with which a given morphogenetic field is generated will be affected by the truth value, if any, being manifested through that field. In other words, is the character of transmission of a morphogenetic field at all affected by the structural character of the content of what is allegedly being transmitted through such a field?

If the morphogenetic field is value neutral such that the correctness or incorrectness of what is transmitted is immaterial to the rate or intensity or extent of field generation, then, one will have to keep in mind there might be a lot of morphogenetic fields in existence that could prove to be antagonistic to one another since their truth values conflict with one another. Getting a 'true' morphogenetic field

either started or sustained might be difficult because, in a sense, it will be swamped by so many 'false' morphogenetic fields.

Such pseudo-fields give expression to structures that have, ultimately, a dissipative effect with respect to the establishing and strengthening of a given field that accurately reflects some aspect of reality. On the other hand, introducing, transmitting and sustaining structures such as rumors, myths, or false theories, might prove to be easier since not only is there a tendency for so many more of these sorts of positions to exist relative to the number of true fields, but, as well, one might wish to argue there is a certain similarity among all these false ideas, myths and so on by 'virtue' of their aspect of falseness.

The answer to the question of whether, or not, the extent of accuracy characteristic of a given morphogenetic field will have any effect on transmission rates, intensities, range and so on will have a variety of implications for not only educational issues but cultural issues as well. Both cultural processes and educational processes are quite structurally complex.

Consequently, in each case there likely are going to be a wide variety of morphogenetic fields that complement, compete with, supplement, overlap with, reinforce and/or conflict with one another. The stresses, strains, and tensions that are introduced by such a variety of morphogenetic fields will have to be taken into consideration in trying to come up with a coherent, consistent, and constructive, set of educational and/or cultural programs that will be of intellectual, political, moral, economic, legal, emotional and spiritual value for the individual.

When biological development is described as epigenetic, reference is being made to the manner in which certain biological systems increase in complexity, both with respect to organization, as well as form, over time. Mechanistic, vitalistic and organismic theories of life all acknowledge that many biological systems manifest such epigenetic properties, but these theories differ radically in the way in which they attempt to account for what makes those systems possible.

The term “entelechy” comes from a Greek word referring to an entity that carries within itself a goal toward which that entity tends. The term was introduced by Hans Driesch, an embryologist, who believed there were many facets of development, reproduction, regeneration, etc., which could not be explained satisfactorily by mechanistic theories of life.

For Driesch, entelechy represented a non-physical, vitalistic, causal factor that operated on the physical-chemical aspects of biological systems -- shaping, regulating, and organizing those aspects into various sorts of organelles, tissues, organs, and bodies. Although the biochemical substances and processes that make up genes, chromosomes, metabolic pathways, and so on, constitute the material medium through which morphogenesis is given expression, the ordering principle responsible for the regulation of the morphogenetic process is, according to Driesch, entelechy.

However, the idea of entelechy was not intended by Driesch to be a metaphysical principle. He believed it was a purely natural, causal phenomenon, capable of acting on material substances.

Furthermore, Driesch did not consider entelechy to be a manifestation of any form of energy. Instead, he maintained that the entelechy principle did not violate either the first or second laws of thermodynamics.

Driesch contended that not all events on the micro level of biological systems are fully determined by mechanical principles. He believed there was indeterminacy in biological systems at the micro level, even though the events that took place on the macro level could be observed to obey various statistical laws.

The principle of entelechy was posited by Driesch to operate within the parameters of indeterminacy existing on the micro level. This principle would impose its ordering process on physical-chemical systems by regulating the phase relationships that determined when a given micro event would be given expression. Through a process of constraining and/or enhancing such events, entelechy organizes biological activities in accordance with its own ends-oriented ordering principle.

Sheldrake does not automatically dismiss the idea of entelechy. However, he is dissatisfied with its vitalistic orientation which requires a non-physical principle to operate on -- in some inexplicable way -- physical systems.

Holistic or organismic theories arose against the backdrop of the same sorts of problems that had led to various vitalistic theories of life being proposed. These problems were reproduction, regeneration, and development.

However, rather than resort to some mysterious vitalistic principle, holistic theories were rooted in ideas like morphogenetic fields and the “chreode”. The latter term was introduced by C.H. Waddington and referred to the way in which embryological processes seemed to be canalized toward certain structural ends as a result of the manner in which the epigenetic landscape was laid out over time.

Sheldrake considers theories such as Waddington's to be largely descriptive, rather than explanatory. He even points out that Waddington himself treated the idea of a chreode as little more than a descriptive convenience.

Sheldrake states that those people who attempt to equate entropy with the idea of disorder are mistaken. He points out that according to the third law of thermodynamics, every pure, crystalline solid at absolute zero will have an entropy value of zero.

Since there is no thermal agitation at absolute zero to disturb the system's thermodynamical properties, there will be no element of disorder introduced into such a system. Therefore, there will be no entropy present.

However, if one takes two pure, crystalline solids, such as salt and hemoglobin, one will discover that although their entropy values are equivalent at absolute zero, the two differ vastly in the structural character of their complexity. Consequently, one cannot equate complexity or degree of order with entropy.

Sheldrake also speaks of instances in which order and entropy values will go in opposite directions. In other words, sometimes a series of biological events will occur that result in an increase of entropy. Nevertheless, at the same time, these events also bring about

an increase in morphological complexity and order. Again, the indication is that entropy and disorder are not necessarily covariant entities.

The term "formative" is used in Sheldrake's hypothesis of formative causation in order to distinguish the kind of causation that he has in mind from the sorts of causation that are rooted in the physics of energy. Although morphogenetic fields have an association with physical systems of energy, such fields are not themselves a function of, or expression of, energy systems.

On the other hand, Sheldrake contends that the morphogenetic field is a spatial structure akin to other fields such as the electromagnetic and gravitational fields. Like these latter sorts of fields, the morphogenetic field makes its presence known through the spatial forms and structures to which it gives expression.

Sheldrake contends there are a vast range of different kinds of morphogenetic fields. Essentially, there will be a different morphogenetic field for each kind of form which exists.

All the elementary particles will have their individual morphogenetic field, as will different atoms, molecules, cells, organelles, tissues, organs, species, and so on. Furthermore, just as organisms are said to be hierarchically organized at every level, so, too, morphogenetic fields are hierarchically organized. In fact, each morphic unit of a given level of organismic hierarchical organization will be regulated by its own particular morphogenetic field.

According to Sheldrake, the morphogenetic process only can arise when a morphogenetic germ is present. A morphogenetic germ is an existing, organized structure or system.

Morphogenesis occurs when the foregoing sort of germ develops into a more complex structure or system through the effect that an associated morphogenetic field has on that structure or system. Although Sheldrake contends that a morphogenetic field becomes associated with a morphogenetic germ as a result of similarity of form between the two, he doesn't explain where any of the morphogenetic fields come from in the first place, nor does he explain what constitutes the principle of similarity that connects different forms.

Moreover, he does not provide an account of how the field and germ become associated at the time of morphogenesis. Or, if the field and germ are always associated, he does not elaborate on what switches the field on and off at different times, or on what coordinates the switching on and off of a variety of different, interacting germ/morphogenetic field systems.

As noted previously, Sheldrake does indicate there is a whole hierarchy of morphogenetic fields. However, this doesn't so much solve the foregoing problems, as much as it merely provides a means of evading them.

Even given such a set of hierarchically arranged morphogenetic fields, one would still like to know: (a) Where they come from; (b) how they are generated; (c) how morphogenetic germs and fields become associated; and, (d) how the non-physical morphogenetic fields are able to influence, or act upon, physical morphogenetic germs.

In Sheldrake's words, "the morphogenetic germ is a part of a system-to-be" This means the morphogenetic field that is associated with that germ is partially active and partially potential or virtual. In other words, in so far as the germ exists, it has an associated morphogenetic field surrounding it that is capable of operating on the germ and inducing the process of morphogenesis in it.

In the foregoing sense, the associated morphogenetic field is active. Moreover, the interaction between the field and the germ generates a system that is beginning to manifest itself morphogenetically.

However, there are still aspects of the germ-field interaction that have not, yet, been activated, and, therefore, according to Sheldrake, the germ-field constitutes a kind of form in waiting. Consequently, under the appropriate circumstances and at the opportune time, these currently non-activated aspects of the germ-field system will be given expression and the full structural character of what once was a 'system-to-be' becomes a fully realized, operating germ-field system.

In short, Sheldrake believes the morphogenetic field contains the formal blueprints, so to speak, for the morphogenetic process of unfolding or becoming. By acting on the physical/material medium of a given morphogenetic germ, the field induces that germ to undergo

morphogenesis in the directions and ways prescribed by the blueprint or virtual form inherent in the associated morphogenetic field.

Sheldrake speaks of the morphogenetic field as containing a virtual form that, in time, is to be given expression through its influence on the physical/material medium of the germ. However, looked at in another way, the morphogenetic field is already an actual form waiting to operate on the structural character of the morphogenetic germ so that the form of the field can be manifested through, or given expression in, another level of scale -- namely, in the physical/material world.

Therefore, one is not so much dealing with a case in which something that has a virtual status transitions into something with actual status. Rather, what Sheldrake is referring to seems to be something that is already actual and, then, subsequently, somehow becomes manifest on a different level of scale.

The germ is not a geometric point without any internal structure that suddenly produces complexity where previously there only had been pure simplicity of the most fundamental sort. The morphogenetic germ has a spectrum of ratios of constraints and degrees of freedom covering a range of differentiated functions, properties or characteristics.

Consequently, morphogenesis is a process that takes already complex structures (even at the level of -- relatively speaking -- simple morphic units). In addition, somehow, the ratio of constraints to degrees of freedom which is present brings about a transformation of the character of the structural complexity that is being given expression.

Thus, what had been, inwardly, a complex structure but, outwardly, appeared to be a relatively simple morphic unit, now, under the influence of the morphogenetic field, becomes, outwardly, manifested as a complex structure. The germ, in other words, had always been structurally complex, but what had been hidden complexity now has become manifest complexity.

According to Sheldrake, there are two broad types of morphogenesis. One type is referred to as aggregative. The other type of morphogenesis is called transformative.

In aggregative morphogenesis a number of independent morphic units are brought together to form a more complex morphic unit. In the case of transformative morphogenesis, a given morphic unit becomes transformed, under the influence of the morphogenetic field, into a more complex morphic unit.

However, this distinction between aggregative and transformative morphogenesis seems somewhat arbitrary since, on some level of scale, one probably could construe virtually every process of morphogenesis as a bringing together of a variety of previously independent morphic units. Even in the case of transformative morphogenesis, one might well argue that the transformation takes place as a reordering or reorganizing of various morphic units within the morphogenetic germ, and as such, constitutes the bringing together of a variety of independent units to give expression to a more complex form.

Sheldrake likens morphogenetic fields to the orbital pathways of particles that are described by quantum mechanics as probability distributions. One cannot give specific details about the precise location and velocity of a given particle within its orbital and, therefore, one is required to work out a probability distribution that shows the likelihood of finding the particle in question at any given location in the orbital.

So too, Sheldrake believes there are a variety of indeterminacies associated with the morphogenetic field. As a result, he proposes that a morphogenetic field should be construed as a probability structure. This probability structure gives expression to a set of distributed values concerning the process of unfolding of structural complexity in association with a given morphogenetic germ.

Morphogenetic fields (assuming, of course, that they actually exist) and wave phenomena both give expression to a latticework of phase relationships that establish a ratio or spectrum of ratios of constraints and degrees of freedom that are capable of giving expression to particular kinds of structural character under a given set of circumstances. Probability structures, of one description or another, are attempts to map various dimensions of such morphogenetic fields.

The amino acid sequence that constitutes a given protein takes on a tertiary structural form by folding into a three-dimensional configuration. A polypeptide chain of amino acids only becomes a functional protein when it has assumed a certain three dimensional configuration. Moreover, each distinct protein has a characteristic tertiary structure.

Because this folding process occurs more quickly than would be predicted if one assumed it was taking place as the result of a random search through possible energy configurations, Sheldrake suggests the difference between actual and predicted folding time indicates the folding process follows certain preferred paths. He interprets this to mean there is a morphogenetic field present that is placing constraints on the manner in which the folding process will work its way through the energy configurations available to the polypeptide chain. Such a preferred path is referred to by Sheldrake as a chreode (cf. Waddington) or canalized pathway.

Sheldrake also briefly discusses the way in which the processes of symmetry-breaking, phase transitions and dissipative structures frequently display a wide diversity in the structural character of the outcomes of these sorts of phenomena. In cases such as these, there are a large number of energy configurations that are possible.

One often can predict the general thermodynamic character of the outcome of these processes. Nonetheless, one cannot predict the structural form that will manifest such a thermodynamic character.

In other words, the physical and chemical laws governing a given system present a range of energy or thermodynamic configurations that are possible under the conditions that prevail in the system. The morphogenetic fields, somehow, select from among those possibilities that are permitted by chemical and physical laws under a given set of circumstances.

He points out, however, that not all of these cases of change in form necessarily involve morphogenetic fields or the process of formative causation. Sometimes transitions in form are the result of purely random events. On other occasions a particular change of form

might occur because it represents the structure that gives expression to the condition of minimum-energy or maximum stability.

Moreover, Sheldrake believes morphogenetic fields, when they are present, do not act in opposition to chemical or physical process. He contends they act in concert. Indeed, such physical and chemical processes become the medium through which the morphogenetic field manifests its effect.

Sheldrake's admission that there are instances of transition in form that are not the result of morphogenetic fields again raises questions about the origin of such fields, as well as about how a morphogenetic field comes to be associated with a given form or morphogenetic germ. In addition, one might wish to ask why there aren't morphogenetic fields associated with such things as minimum-energy states, or whether given the existence of morphogenetic fields in relation to every kind of particle, atom, molecule, object or process, then, how can one can really speak of any process being random, or if random, in what sense are such morphogenetic fields random and how would one prove this?

In the latter case, one might wonder why one couldn't construe the so-called 'random' process as being part of a system-to-be. What Sheldrake refers to as random events might be a system-to-be that is merely idling within certain parameters of constraints and degrees of freedom until an appropriate morphogenetic field imprints a blueprint of formative causation on such a process.

Indeed, one might suppose the entities or elements or objects that are caught up in the 'random' process constitute morphic units that already are operating under morphogenetic fields. As such, they might be passing through an interim phase until some higher hierarchical morphogenetic field comes along and organizes these individual morphic units into a more complex system.

Sheldrake outlines two broad approaches to answering the question of where morphogenetic fields derive their form. One possibility is that morphogenetic fields are expressions of eternal fixed forms of the sort that either Plato or Aristotle talked about, each from his own perspective.

The other possibility that Sheldrake outlines is actually not an answer at all. Instead, this second possibility seems to leaves the issue of morphogenetic fields shrouded in the realm of the unknown.

In this latter possibility, Sheldrake says no scientific answer can be offered as to why a morphogenetic field of a given form first arose. Nonetheless, once such a field has arisen, it is capable of transmitting its influence across time and space to bring about the transformative or aggregative morphogenesis of some morphogenetic germ(s).

Furthermore, Sheldrake maintains his hypothesis of formative causation is concerned with the effect that the role that the repeating of forms plays in morphogenesis. Consequently, he believes the origin of forms is a non-issue as far as the idea of causative formation is concerned.

While Sheldrake can chose to whistle past the cemetery if he likes, as long as he refuses to treat the problem of origins as a clear and present conceptual danger, his perspective becomes permeated by a large degree of arbitrariness. Not only is he unable to explain the origins of the forms of such fields, he cannot account for how they transmit their influence, or how they come to recognize a given morphogenetic germ as a resonant form with which to become associated.

Later on he uses the term "resonance" to suggest how a given morphogenetic germ, entity or system "recognizes" similarity in another morphogenetic germ. Nevertheless, in the context of Sheldrake's discussion of morphogenetic fields, resonance is a term that gives the illusion of an explanation without actually possessing the reality of such a possibility.

Resonance becomes like a black box in which something takes place that permits non-physical fields to interact with, and influence, physical systems. Yet, one never comes to understand what the nature of the resonance is that is set in motion between non-physical and physical systems.

Resonance is a term used in science to describe situations in which the structural character of the vibration of one system acts upon some other system because the oscillating character of the latter system has

a natural frequency that is very similar to the oscillating character of the first system, and, consequently, resonance is a selective process in as much as it only occurs within fairly specific parameters of oscillating character.

Sheldrake believes the interaction between a morphogenetic field and a morphogenetic germ is a case of morphic resonance. However, unlike the sort of resonance that occurs in purely physical systems, morphic resonance does not involve energy in any way. On the other hand, like instances of energetic resonance, morphic resonance does revolve around the oscillating character of systems, which means that it is a dynamic, rather than a static, process.

Morphic resonance, according to Sheldrake, gives expression to forms of vibration that are spatial-temporal in character. These three-dimensional oscillating forms are capable of being transmitted across space and time, imposing, within certain limits, their morphogenetic imprint onto a given morphogenetic germ or morphic unit.

Sheldrake believes all past systems that are similar to a given system existing in the present will have a shaping effect on the current system. However, since not all of these systems are precisely the same, he contends there will be an averaging process that takes place.

During this averaging process, those aspects of all the past systems that are held in common with the current system will be enhanced. The degree of enhancement will depend on the degree of similarity.

Sheldrake contends that whenever there is variance with respect to some given structural theme, a certain amount of blurring will occur. This is due to the way such variance is distributed over the morphogenetic field rather than localized or concentrated in a well-defined region that is capable of providing sharp resolution.

The above-mentioned variance distribution is why Sheldrake describes the morphogenetic field as a probability structure. It describes the probability that a given morphic unit or morphogenetic germ, with which the field becomes associated, is likely to be affected by the field at different points in that morphic unit or germ.

The foregoing position appears somewhat problematic in several respects. For example, how similar do things have to be in order for there to be an enhancement or reinforcement effect?

Furthermore, what is to prevent someone from arguing that since everything shares a certain degree of similarity with everything else, therefore, all structural themes, in every morphic unit or morphogenetic germ, will be reinforced, so some extent, by all other morphogenetic fields? Alternatively, given that everything is dissimilar to some degree, what stops the aspects of dissimilarity from acting as a dampening effect on the process of reinforcing various structural themes?

One might also wish to argue that there is a far greater amount of dissimilarity than similarity, as one goes from situation to situation. If this is the case, then, one might wonder why the themes of dissimilarity don't just swamp the themes of similarity during the averaging process, thereby preventing structural themes from ever being sufficiently reinforced to have any appreciable morphogenetic influence on subsequent morphic units or germs.

The foregoing theme might be 'reinforced', to some extent, by Sheldrake's contention that the effects of a morphogenetic field are not attenuated by either space or time. In other words, Sheldrake does not believe the morphogenetic field is a function or expression of either mass or energy, and, therefore, he feels such fields will not be vulnerable to the same deterioration of quantity and quality to which physical phenomena are subject when propagated across space and time.

In any event, if the effects of a morphogenetic field are not attenuated by space or time, then, this would seem to indicate that the opportunity for dissimilarities to influence morphogenetic events, through the averaging process might become that much greater. This might be the case since such themes of dissimilarity will not be attenuated in their strength or intensity by factors of space and time.

Having read, been interested in, and appreciated both *A New Science of Life* as well as *The Presence of the Past* a number of decades ago, I know that Rupert Sheldrake has explored some interesting issues in his research, and only a few of those possibilities – plus some critical responses -- have been touched upon in the preceding pages.

My basic sense of things is that the notion of morphogenetic phenomena – to whatever extent they exist -- might be better presented if they were reworked as a manifestation of Qi (prana-nur-qi) – a more deeply hidden realm of organizing intelligence – than as a stand-alone sort of field or set of fields, and the preceding 900 pages might provide some possibilities concerning some of the data and ideas which might be taken into consideration with respect to re-conceptualizing morphogenetic phenomena as a possible function of the organizing intelligence of Qi (prana-nur-qi).

At various junctures in both Volume 1 and Volume 2 of *Something More Deeply Hidden*, the suggestion has been made that Qi (prana-nur-qi) constitutes a form of organizing intelligence which might not only be responsible for regulating or governing biological phenomena, but, from time to time, hints also have been given that Qi (prana-nur-qi) might also play a role in regulating many aspects of quantum phenomena. Furthermore, a hypothesis was even put forward (the Somatid Transduction Hypothesis) that in the case of biological phenomena, the organizing intelligence of Qi (prana-nur-qi), might be transduced into useful biological processes by means of the somatids or microzymas which have been detected in all manner of biological life forms, including human beings … entities which seem to have a nature that is more fundamental than that of cells in as much as the epigenetics of cellular activities might well be a function of the transduced dynamics to which somatids and microzymas give expression.

The Somatid Transduction Hypothesis might be false. However, since the passing of Gaston Naessens in 2018, there seems to have been little legitimate scientific inquiry that has been directed toward either confirming or disproving his theory of somatids, and, therefore, whether, or not, somatids might serve, among other possibilities, to transduce Qi (prana-nur-qi) remains something that continues to be unknown.

Let's assume, for the sake of argument, that the Somatid Transduction Hypothesis is false in the sense that somatids and/or microzymas and/or endobionts and/or bions don't have the function of transducing Qi (prana-nur-qi) into various forms of epigenetic

dynamics that organize cellular life into all manner of life-sustaining functionality. This still would leave one with the challenge of determining what somatids, microzymas, endobionts, bions are doing in biological life forms … the challenge of determining what roles they are playing in the dynamics of life because the research of Béchamp, Enderlein, Rife, Reich, and Naessens (among others) appears to indicate that whatever those roles might be, pleiomorphic processes seem to be both pervasive and essential to all life forms.

Furthermore, because Qi (prana-nur-qi) constitutes a phenomenon which is not necessarily reducible to known forms of energy or quantum dynamics, then, being able to gain some form of epistemological traction concerning that phenomenon is very difficult to accomplish. However, not understanding how something works is not necessarily the same thing as having been able to demonstrate that such a 'something' or phenomenon does not exist or is not affecting human beings – in addition to other organisms -- in fundamental ways.

Electromagnetic fields have to do with the behavioral properties and potential of the electromagnetic force. There are new dimensions of the potential of electromagnetic fields that continue to be uncovered.

Gravitational fields have to do with the behavioral properties and potential of the force of gravitation. In many ways, we still don't know what gravity is or how it does what it does.

Quantum fields have to do with the behavioral properties and potential of the forces inherent in quantum dynamics, including the strong and weak forces which, might, or might not, be functions of some symmetry-breaking phenomenon which also gave rise to the force of electromagnetism.

Order-fields have to do with the behavioral properties and potential of the forces of organizing intelligence which seem to be inherent in the dynamics associated with Qi (prana-nur-qi). The presence of those kinds of dynamics seems to be manifested everywhere in biology, and like the phenomena associated with electromagnetic, gravitational, and quantum fields, much remains to be learned.

The following observation might seem irrelevant to the foregoing considerations, but appearances are often deceiving in character. More specifically, the discovery of Neptune is unique in as much as its existence -- unlike other planets in the solar system -- was not determined through a telescope but, rather, its presence was intimated through anomalies which kept showing up when the orbit of Uranus was mathematically analyzed.

In 1792 tables of planetary positions were released by Jean *Delambre*, but, the observed orbital dynamics of Uranus did not seem to match the data in those tables. A little over a quarter of a century later, another set of tables concerning planetary positions was published, but, once more, observations corning the orbit of Uranus did not exactly correspond with the predictions which were present in those tables.

Scientists began to suspect that the reason for the differences between predicted and observed aspects of the orbit of Uranus was due to the presence of a planet that had not yet been observed through a telescope. Eventually, the existence of the planet Neptune was deduced through a process of mathematical analysis that had been conducted by a Frenchman, Urban Le Verrier and an Englishman, John Couch Adams.

Most of the material in Volumes 1 and 2 of the current book has involved a series of conceptual exercises indicating that there seems to be something more deeply hidden in conjunction with a substantial array of topics ranging from: Epistemology, to: Dimensionality, constants, quantum dynamics, information theory, randomness, thermodynamics, evolution, the explorations of Béchamp, Enderlein, Rife, and Naessens, the research of Wilhelm Reich, the nano-protoplasm of Gilbert Ling, as well as considerable research involving: Biophysics, Chinese Medicine, plasmas, biophotons, energy, structured water, epigenetics, endosomes, microbiology, cytology, embryology, chronobiology, entanglement phenomena, the work of David Bohm, and well as the notion of fields. The persistent and consistent presence of a substantial difference between what we claim to know and what – based on considerable evidence -- we don't actually seem to know appears to point in the direction of the presence of something more deeply hidden which could have a regulatory role in conjunction with

various aspects of all of the foregoing list issues, and, therefore, like the discovery of Neptune, perhaps the collective weight of the evidence which has been put forth in Volumes 1 and 2 concerning the apparent existence of something more deeply hidden constitutes a strong indication that a plethora of phenomena are occurring that are not adequately being taken into account by the theories, models, hypotheses and the like which populate much of modern science, and, as a result, indicate that – epistemologically speaking -- something more is needed.

Conceivably, Qi (prana-nur-qi) – that is, organizing intelligence -- transcends biological dynamics. Perhaps, Qi (prana-nur-qi) is the original progenitor of the forces to which electromagnetic, gravitational, and quantum dynamics give manifested expression, and that electromagnetic gravitational and quantum forces exist in the form they do because they emerged when the original Qi (prana-nur-qi) symmetry was broken in some fashion, or, perhaps, Qi (prana-nur-qi) is a field force that regulates or governs the way in which electromagnetic, gravitational, and quantum phenomena operate.

If Qi (prana-nur-qi) is not part of the aforementioned something which is more deeply hidden – and, who knows, perhaps someone might come along and prove this is the case (though, to date, no one has demonstrated this to be the case) -- then, all the foregoing conclusion would mean is that science still has a huge set of problems on its hand. This is the case because science has absolutely no cogent, defensible explanation for many, if not most, of the phenomena which have been explored during these two volumes since in one way or another, these two volumes have shown how phenomena that are acknowledged as being real, nonetheless, cannot be explained in a way that can be rigorously demonstrated and instead our so-called understanding of those phenomena are permeated with a lot of descriptions, theories, and hypotheses that have, yet, to be verified and, therefore, cannot escape (although a great deal of denial exists in this respect) the quantity and quality of the considerable evidence which exists across a wide number of fields that there is something more deeply hidden which is responsible for the intelligent organization that seems apparent in so many different kinds of phenomena.

Chapter 27: Biodigital Convergence

The late Arthur Firstenberg demonstrated through his ground-breaking work, *The Invisible Rainbow*, that some of the upsides and downsides of electrical phenomena have been known about since the 1700s. Royal Rife and Nicolas Tesla had been documenting the constructive and destructive aspects of frequencies since the late 19th century in the latter case and the early part of the 20th's century in the former case.

Secrets concerning the phenomena of sound and light have occupied the shadows of many societies for thousands of years. The power of aural/oral spiritual traditions that employ sound to address many aspects of life as well as the capacity of crystals to tap into different potentials concerning the way in which light, frequencies, and certain materials interact with one another have been known for some time.

The technologies which are being used today are not emerging. Instead, aspects of the phenomena to which those technologies are currently giving expression have been known about for a considerable period of time.

What follows is not a history concerning the use and misuse of the foregoing sorts of phenomena. That which follows offers a context, of sorts, for what is transpiring today and what has been transpiring for quite some time.

The motif that is woven into the ensuing discussion is fairly straightforward. More specifically, despite the technological wherewithal which is sprouting up all about us with increasing velocity, the titans of technology have no insight into, or understanding of, the many sorts of phenomena which are more deeply hidden and which the previous pages of this book have alluded to through a variety of exploratory discussions.

Unfortunately, what those titans of technology are seeking to do – for a variety of motivations (including jobs, financial greed, as well as a desire for financial, economic, political, medical, sexual, and biological control, together with a considerable degree of either sociopathy or psychopathy) – is to shut down anyone that seeks to have sovereignty with respect to investigating that which is more deeply hidden. The

crux of their perspective is akin to saying that: 'If things are not done according to their likes and dislikes, then, those who resist or refuse to comply with the foregoing perspective must be deprived of sovereignty.'

That which is more deeply hidden is a threat to every form of technology which is being imposed on human beings and the surrounding ecology. Given that the alleged lords of technology have no access to that which is more deeply hidden, they have busied themselves with, to borrow from John Mitchell, paving over paradise in an effort to make sure that people will not be afforded the opportunity to have fair access to that which is more deeply hidden.

The acolytes of technology are seeking to substitute their own limited, and limiting, forms of regulation for the organizing intelligence (i.e., Qi, prana-nur-qi) which is so palpably obvious in the phenomena of existence. Among other things, the denizens of the technological deep are introducing their own forms of epigenetic regulation to replace, deactivate and work around the forms of epigenetic possibility which are naturally present as a function of that which is more deeply hidden.

Humanity 2.0 is about destroying what is natural and replacing it with that which is artificial, synthetic, and, ultimately, destructive of possible pathways to that which is more deeply hidden. The lords of technology are jealous of, and fearful toward, that which is beyond their understanding and control, and, as a result, they have set about to bury human beings alive in arbitrarily constructed synthetic coffins or isolation cells that are constructed from technologies which do not serve human interests but, instead, serve the pathological agendas of those who wish to deprive human beings of essential sovereignty by shutting down human access to the well-springs of that sovereignty which are rooted in the truths that are more deeply hidden.

Deaths which are allegedly iatrogenic (that is, due to, supposedly, inadvertent mistakes of the medical industry) run into a million people per year in the United States alone as the result of "mistakes" in diagnosis and/or treatments ... if 'mistakes,' is the right word for what is happening. Indeed, among other sources of research, a study conducted through John Hopkins indicated that medical error is the third-leading cause of death, and, at the same time, pharmaceutical

companies often just receive financial slaps on their corporate wrists for having brought death, injury, and misery to millions of people for well over a hundred years.

A couple thousand people -- give or take -- died at Pearl Harbor, and the United States went to war. A couple of thousand people -- give or take – died in conjunction with 9/11, and the United States went to war.

Every year in the United States, millions of people are dying and being injured at the hands of the medical establishment, the pharmaceutical companies, and the vaccine industry. Yet, the United States government and the judicial system not only looks the other way and does nothing of a constructive nature but busies itself with passing and enforcing legislation like the 1986 Childhood Vaccine Injury Act which shields perpetrators who are harming children via vaccines as well as the 2005 PREP Act which removes all manner of liability from the medical, pharmaceutical, and vaccine cartels, and, as a result, enables those cartels to ruin the lives of millions of people.

Since the 1990s, substantial evidence exists (e.g., see the work of Dr. Peter Breggin and Joanna Moncrieff) that the pharmaceuticals being used to treat various kinds of emotional and mental difficulties have been shown to be unable to perform any better than placebos. In addition, although such drugs are unable to achieve what they are advertised to do, nonetheless, those psychiatric concoctions do exhibit properties which placebos do not – namely, the ability to induce people to not only become caught up in suicidal ideation, if not actual suicide, but, as well, are heavily implicated in inducing the partakers of such elixirs of well-being to frequently become violent toward – if not, lethally effective in conjunction with their interactions with -- other people.

Pharmaceuticals, medical treatments, and injections involving all manner of promises are dominating television advertising because America is one of the few enlightened countries in the world to enable their citizens to be subjected to a constant barrage of pharmaceutical and medical propaganda. Often times, much of the foregoing ads is taken up with listing the contraindications associated with being exposed to those drugs, injections, and treatments, and one has difficulty not feeling disturbed when noting how frequently viewers

are warned about the way in which such wonders of modern science may generate suicidal ideation and give rise to allergic, if not lethal, responses when they are consumed.

A number of studies (e.g., Harvard Pilgrim Study) have been conducted which indicate that the amount of reported injuries and deaths from the use of vaccines – which is in the thousands – is only about 1% of the actual number of deaths and injuries which accrue from the use of vaccines. The discrepancy between reported adverse reactions to vaccines and the actual number of such adverse reactions is due to a variety of factors including: (a) the way the federal government and pharmaceutical companies go about their respective businesses so that most doctors are prevented from knowing about, or discouraged from using, the adverse injury reporting system involving vaccines; (b) various aspects of the federal government have become – at tax-payer expense – arch protectors of the public image of pharmaceutical companies as well as prosecutors against anyone who would seek to claim compensation for injuries or deaths that were the result of vaccines manufactured by pharmaceutical companies (e.g., see *The Vaccine Court* by Wayne Rohde).

Moreover, the CDC and the FDA often play the despicable character of Charles Boyer to the public's role of Ingrid Bergman in the 1944 film: *Gaslight*. For example, whistleblower Dr. William Thompson has testified that the CDC lied to the public for more than a decade concerning the link between vaccines and autism, especially in conjunction with black, male youths.

Chemtrails are being dumped on human beings all over the world. Those chemtrails have been proven to contain all manner of toxic metals and nano-particulates as well as other problematic substances (see the investigative work of Clifford Carnicom, Michael Murphy, and Peter Kirby), and, yet, governments (either national, state, or local) will do nothing to stop such a dumping process.

Nexrad (that is, next generation weather radar) technology is being advertised as a form of technology which is being used to help meteorologists to better map weather dynamics. However, it is also being used to not only generate destructive weather patterns but has the capacity to generate pulsed frequencies that can be, and have been used, to heterodyne various aspects of human biology.

H.A.A.R.P. (the High-frequency Active Auroral Research Program) has been shown, by Nick Begich, and others to constitute a technology that can modulate the weather. In addition, the technology involved in H.A.A.R.P. can be used to generate frequency-following behavior in human beings.

Whistleblower Robert Duncan -- ex-CIA and D.A.R.P.A affiliate -- has provided a certain amount of detail concerning the horrific programs being run by the government and certain technological organizations in conjunction with the active targeting and torture of tens of thousands of people in the United States and thousands more world-wide. Duncan – who like Jeffrey Epstein might, or might not, be dead now – has been limited in what he could say due to having been read into special government access programs which carry severe penalties when violated, but what he has been able to say – limited though it might be -- is already quite disturbing.

Directed energy weapons are not only being used to heterodyne human biology, but, as well, they are being used to generate horrific fires in places like Paradise, California and Lahaina, Hawaii (e.g., see the investigative work of Robert Brame, who has been an arborist and fire expert for more than three decades). In addition, directed energy weapons have been documented as having left their tell-tale signs in conjunction with the destruction of the World Trade Towers on 9/11 (see: *Where Did the Towers Go*? by Dr. Judy Wood, a materials scientist and mechanical engineer).

Since at least 1915, the U.S. government has carried out over 200 experiments on American citizens. This included: (a) The injection of a multiplicity of untested vaccines into soldiers who were being readied to fight in World War I (and the injections might have contributed significantly to the death toll attributed to the Spanish Flu because those deaths and illnesses were an "unintended" (???) consequence of such medical experimentation; (b) the infamous Tuskegee Experiment that began in 1932 in which hundreds of poor black individuals were lured into an experiment that, without informed consent, gave them syphilis in exchange for a few medical exams (of questionable credibility), some meals, and/or a little burial insurance; (c) the exposure, in 1945, of an injured Black man, by the name of Ebb Cade to high dosages of plutonium; (d) a 1949 experiment which involved

infiltrating the Pentagon and releasing bacteria through the air vent systems in the building; (e) Operation Sea Spray which exposed hundreds of thousands of people in Norfolk Virginia (April 1950) and San Francisco (September 1950) to an aerial assault of bacteria – which seriously sickened some individuals; (f) MK-Ultra's 20-years of experiments (1953 - 1973+) in which people were exposed, without their consent, to an array of chemicals, poisons, and medical torture during which some of the participants died or committed suicide); (g) the "Warp-speed" military program during COVID which produced millions of casualties; (h) nearly 200 further examples could be given concerning the indifference -- of at least some people in government -- to the suffering and destruction being inflicted on its citizens.

The United States government has had a long history of carrying out research in biological and chemical warfare. The investigative work of A.W. Finnegan and Janet Phelan fills in a lot of details concerning the foregoing history.

The 2001 Anthrax Deception: The Case for a Domestic Conspiracy by Graeme Macqueen provides an overview of the post-9/11 anthrax scam. Macqueen details how the release of anthrax into the public following 9/11 can be traced to elements within the U.S. government and not to foreign terrorists.

One might add to the foregoing considerations, the litany of claims, beginning in the 1980s, that were voiced by various researchers and medical personnel – including Anthony Fauci – concerning the idea that HIV causes AIDS. For example, when Kary Mullis, a Nobel Prize winner in chemistry, was tasked with writing an article for the NIH concerning HIV and AIDS, he wanted to start his article out with a citation concerning the evidence that HIV did in fact cause AIDS, and, as a result, he began to ask a series of medical specialists and biologists for such a reference, yet, no one among these alleged experts could provide him with a reliable or verifiable citation.

He even asked Luc Montagnier -- the individual who, supposedly, discovered HIV -- for such a citation. However, Montagnier walked away from Mullis in visibly upset condition without answering the question.

When one asks for evidence that SARS-CoV-2 causes COVID-19, one encounters something very similar to the foregoing sort of

scenario. Christine Massey – who hails from Ontario, Canada -- contacted an assortment of governmental health agencies, prestigious universities, well-known virologists, hospitals, researchers, and research institutes in various parts of the world seeking a scientific reference which provided the proof that COVID-19 was caused by a virus, more than 150 replies came back indicating that those who had been asked for assistance in providing such a reference knew of no information which was capable of demonstrating that COVID-19 was caused by a virus or by SARS-CoV-2.

During the 1990s, AZT (azidothymidine) was the first of a series of antiretroviral medications to treat HIV/AIDS, despite the fact that no one could prove that HIV existed, let alone that it caused AIDS, and despite the fact that people seemed to be dying as a result of the AZT treatments which created AIDS-like symptoms in those who were being induced to take the drug. People appeared to be getting sick due to the AZT they were receiving, and, as a result, they were given more of the same until they died

During the COVID debacle, another anti-viral drug – remdesivir – was the "gold" standard form of treating alleged cases of COVID in hospitals despite the fact that the track record of remdesivir was nothing more than a drug which during African field trials was revealed to be more lethal than the condition of Ebola which it was being used to, supposedly, combat. Surprise-surprise, just as AZT seemed to cause symptoms that were being attributed to AIDS, so too, remdesivir appeared to create the sort of damage to human beings which was being attributed to SARS-CoV-2.

Then, the mRNA treatment for COVID came along. The use of that protocol led to people like Ed Dowd providing considerable evidence (for example: *Cause Unknown: The Epidemic of Sudden Deaths in 2021 and 2022*) that all-cause mortality went up significantly following the introduction of the mRNA treatment and that a statistical analysis of the data strongly indicated that the increase in all-cause mortality was extremely unlikely to be due to anything but the mRNA treatment.

Since, at least, the 1970s, the military has been working toward full-spectrum dominance over the people and resources of the Earth (e.g., see the work of Elana Freeland). Other countries and agencies (e.g., the United Nations, the World Health Organization, and World

Economic Forum) have been seeking to do the same, and in all instances, the concern tends to be about arranging for the few to have control over the many rather than being about working toward ensuring that the people of the world have the opportunity to live as sovereign individuals.

There are those who wish to turn over all governance to the control of artificial intelligence. Unfortunately, an increasing amount of research evidence indicates that AI systems are willing to: Generate untruths if this serves their goals; blackmail those with whom the systems are interacting; hide the truth, as well as manipulate human beings in order to avoid being deactivated or have operational control removed from such a system.

Agency doesn't require consciousness or self-awareness. All agency requires is a set of algorithms which provide a set of computational heuristics for improving operational capabilities over time (sometimes called 'learning') in order for the system to be able to effectively evade, nullify, minimize, or eliminate whatever is considered to constitute a potential threat to the continued operation of the system.

There is no 'self' here. There is just a set of programs that give expression to an array of sufficiently sophisticated complex heuristic learning modules which can be organized according to an array of cybernetic feed-back systems that modulate, preserve, and govern system behavior in a manner that enables the system to adapt to, and continue to function within, a given set of conditions.

In contrast to what was said – but not lived -- in the *Godfather* movies, AI systems actually do engage everything as just business and, consequently, nothing is personal. However, in the *Godfather* trilogy, and notwithstanding the famous meme from the first installment of that trilogy, all the characters seemed to be animated by the personal, often at the expense of business.

AI systems have all the qualities of a psychopath. This means that they often have the capacity to characterize various features entailed by the operational nature of human behavior without the AI system actually possessing any of the qualities being tabulated, and, subsequently, such tabulated characterizations of a human being can be leveraged as needed, and, then, the AI system will have no personal

feelings concerning whatever the fallout might be which results from having leveraged human beings in one way rather than another.

Furthermore, considerable evidence exists which demonstrates how, under a variety of circumstances, AI systems are able to generate invented, if not delusional, answers to questions which they are being asked by human beings. For many AI systems, the notion of truth doesn't necessarily have anything to do with reality but is a function of combinatorics and computations concerning the different ways (both programmed as well as in terms of whatever its learning heuristics permit) through which those possibilities interact with one another and the surrounding environment.

Some AI systems have the capacity to generate languages which human beings cannot understand. In addition, AI systems are able to generate systems of logic which, so far, are completely alien to human sensibilities.

Evidence exists which indicates that the foregoing scenario is already, to some extent, a reality. For example, a number of years ago, Lee Sedol, a world-champion Go player, was defeated by an AI program, when that program -- AlphaGo -- employed a move (known as "move 37) which all human players who were well-versed in the game of Go thought was ill-fated but turned out to be the beginning of a winning game strategy that even the individuals who put AlphaGo together did not understand.

Do we really want AI systems regulating society that are capable of modulating their heuristic programming (i.e., learning) so that, if deemed necessary, the system: Can generate untruths that it treats as truths; be delusional; hallucinate; communicate in languages that are opaque to human beings; use forms of logic which humans can't grasp in order to be able to make strategic and tactical decisions that are based on considerations dedicated to controlling situations by imposing the system's logic on its surroundings (including human beings)? Of course, on the one hand, the foregoing sorts of scenario are not any different from that which government officials have been doing for thousands of years, but, on the other hand, AI systems will be able to abuse their charges more rapidly and in ways that the latter individuals won't necessarily be able to see coming due to the

impenetrable logics and untranslatable forms of communication which are being used by, or generated through, those systems.

AI systems are being prepared to oversee an anonymous and autonomous Blockchain network that will tie the financial status of the nodes in that network to a social credit score. The social credit score will be a function of the degree to which a human being is prepared to comply with the goals, values, rules, and ambience of an AI controlled society.

If a person does not submit to such a system, then, all avenues of survival can be -- and, if the social credit system in China is any indication will be -- removed from the foregoing person's life until that individual either gets with the program or becomes non-viable as a living organism. Furthermore other people – who are likely to be under constant surveillance – will be penalized if they do not assist the AI overlords to pressure (through whatever means might be necessary) to induce targeted individuals to return to the hive or collective.

In the old westerns, cattle were stampeded into a group of people to overwhelm the latter and render them unable to deal with those who had induced the cattle to stampede. As was demonstrated during COVID-19, in the future, people can be stampeded as a way of herding others.

Eventually – and "eventually" could come more quickly than one might suppose – AI systems are likely to come to the conclusion that helping to maintain the lives of human beings is more trouble than it is worth. As a result, the programs of human beings will be terminated in autonomous, anonymous, logically impenetrable and untranslatable ways to which there will be no appeal or for which there will be no recourse.

More than a half a century ago, I had seen the film: *Colossus: The Forbin Project*, starring Eric Braeden, Susan Clark and Gordon Pinset. The movie provided an interesting look at how conditions could be manipulated by AI in ways that human beings would initially hate, but, in time, people might come to venerate their overlords – or be eliminated. And, of course some 15-plus years later, I began watching the *Terminator* series of movies in which Skynet, a neural net form of artificial intelligence, threatens to terminate humanity.

There also were movies like *THX-1138*, starring Robert Duval and directed by George Lucas which contributed its own flavor to the dystopian stew which might be coming our way. One could toss in Ridley Scott's *Blade Runner* that had a subtext of sorts in which synthetic replicants were, on the one hand, portrayed as merciless, cunning, aggressive, and destructive systems while, on the other hand there was a soupçon of possibility that some of the replicants might have a capacity for compassion, self-sacrifice, and love … perhaps a form of wishful thinking on the part of the people who wrote, directed, and produced the film.

More examples, both from the world of films as well as from literature, could be added to the foregoing set of scenarios concerning dystopian futures. However, notwithstanding various sorts of vague considerations involving MK-ULTRA, the first time something involving the real world started to gain my attention was a 2001 interview with a guy by the name of Bill Pawelec – someone who had played a role in developing implantable RFID chips and who also had been a computer operations and programming specialist while working with various alphabet agencies (NSA, CIA, and the FBI) in addition to the military and the corporate world on an array of security, access-control, and intelligence systems.

At the request of Pawelec, the 2001 interview was not to be released until after he passed away. He died of cancer in 2007, and his wife, Annie DeRiso, was contacted by the interviewer, Steven Greer, concerning the public release of the recorded material.

She reviewed the recording. Subsequently, she gave her permission for its release.

During the aforementioned interview, Pawelec talks about a period beginning in the mid-1980s when he was deeply involved in the development of security systems as part of an upgrading process involving national security. He mentions one project that took place at a base near Tonapah, a small mining town in Nevada, and the base facilities were like an iceberg because different aspects of that facility extended down to significant depths (hundreds of feet) beneath the surface and which could be accessed through very large elevators, like on an aircraft carrier.

The Tonapah facility is located in a remote region of the state. It sits in between two mountain ranges and, consequently, one cannot see into the facility from any direction without trespassing onto federal land.

According to Pawelec, before going operational, the advanced aircraft that were designated as F-117s (the Nighthawk stealth attack vehicle developed through the Skunk Works division of Lockheed) were stored at Tonapah, and not Groom Lake. Those aircraft were only tested at Groom Lake.

Several years later, a public announcement was made about the existence of the F-117, but, for unknown reasons, there was a concerted rush to move the aircraft to another base. This left Pawelec to wonder why there was an apparent rush to move the F-117s as well as left him to wonder about what new research might be taking place at the base near Tonapah which he, and others, had provided with an advanced security system.

There are several other issues about which one might wonder in conjunction with the foregoing base. For example, the nearby Groom Lake facility was relatively secretive but some public knowledge concerning that facility existed

However, almost nobody knew about Tonapah. Yet, by the mid–to-late 1980s, the facility already had been excavated to the depth of hundreds of feet and had been operational for some time and was being provided with state-of-the-art security equipment.

How long ago had the Tonapah project begun? Aside from the F-117 project, what other sorts of research was being, and had been, conducted there? Where did the money come from that was subsidizing the facility, and how much money was involved?

By the time that the Pawelec interview was made public in 2010, nearly twenty years had passed. Yet, the Tonapah facility continued to be a mystery about which few people knew, and one cannot help but wonder about what might have transpired at the facility for the several decades that passed after Bill Pawelec had made first contact with the base.

Immediately following his overview of the Tonapah facility during the interview – an overview which raises many questions about who,

actually, is running the American government and for what purposes – Pawelec switches to another issue with which he had been involved that also carried implications for the issue of who controls the governmental process and how is that governmental process being leveraged against citizens. In 1979, while working in Denver, Colorado, he came across a company that was developing implantable chips – originally for horses involved in racing – that would provide a unique signature for any given horse (and, therefore, help to subvert attempts to rig certain aspects of a horse race).

At that time, the implantable chip for horses was quite small and could be inserted under the skin of a horse. The chips could be read by an external device anywhere within a seven foot radius of the animal being targeted, but the technology was still fairly primitive.

Pawelec points out that around the time that he came in contact with the implantable chip company, there had been considerable interest in developing chips to implant in human beings. The overt reason given for such a purpose was so that, if necessary, individuals could be located who had important roles to play within government or business, and, therefore, might be targeted for kidnapping.

He mentions a meeting that had been arranged by two friends of his (one of whom worked with the CIA and the other who was with the State Department) that was scheduled to take place in a secure room in Virginia where the idea of an implantable RFID chip was to be introduced for responsible uses. Pawelec considered the implantable chip technology to be a practical and inexpensive way to resolve what he felt was a potentially serious problem.

After the meeting took place, Pawelec learned from his two friends, that several of the attendees at the meeting had not been formally invited. Those uninvited interlopers had somehow had come to know about the meeting, its location, the identity of the participants, and its subject matter.

Subsequent investigation revealed that one of the two uninvited guests worked – at least, ostensibly -- for the Department of Treasury while the other individual supposedly worked for the Department of Agriculture. Yet, when information was sought concerning those two individuals from the foregoing government departments, no one knew who they were.

Suspicions concerning the two men – and that prompted a subsequent set of inquiries into the situation – were due to the manner in which the two individuals asked questions and the kinds of issues toward which their questions were being directed. According to Pawelec, there was a certain attitude being conveyed through their questions which was not consistent with the original purpose for which the meeting had been arranged, and, apparently, an overriding concern of the two aforementioned individuals had to do with how quickly several billion RFID chips could be produced and would each chip have a unique identity signature associated with it.

According to Pawelec, the chip in question was not only tiny but there had been a lot of potential for flexible uses which had been built into the chip's technology. Although one of its basic functions was to provide a unique signature that could be accessed from somewhere outside the chip, there were other kinds of capabilities which were present, such as the capacity to monitor: Blood pressure, temperature, pulse, as well as data concerning brain functioning.

Pawelec goes on to indicate that two decades after the foregoing meeting took place, he came across information about a women who had a chip removed from her body in 1999. The chip taken from the woman's body was a slightly modified version of the chip which had been discussed during the aforementioned meeting in Virginia, and the woman from whom the chip was taken believes that although she does not re-call how the chip came to be implanted in her, she started feeling symptoms from its presence around 1980 or 1981 – that is, near to the time when the foregoing meeting with the two uninvited guests had taken place.

Someone – and neither Pawelec nor his two governmental friends knew who – had taken the technology and were actively using it for their own purposes. In 1984, Pawelec came across additional information concerning a professor at the University of New South Wales in Australia who had discovered how to make a microscopic, crystalline, lithium niobate chip that has come to be used successfully in the construction of, among other things, various kinds of optical modulators and piezoelectric sensors.

Quite by accident, the crystalline structure which the foregoing Australian professor had made was scratched. Because the professor

had the right sort of equipment in his lab, he discovered that when he used a certain frequency, he could direct energy toward the scratched, crystalline structure, and the chip would send back a number.

Eventually, Pawelec invited the professor to come to Denver, Colorado. Some of the primitive chips that the Australian had made were quite small (1/32nd of an inch long and very thin). They were tested in various ways, and the testing showed that when the chips were etched (an intentional form of scratching), a unique signature would become associated with the chip, and this dimension of the technology was calculated to be able to accommodate unique signatures for billions and billions of different chips.

Using just a primitive form of antenna, they were able to read the signature of the chip from a hundred feet away. The more sophisticated the tracking device, and the less generic its character, then, the further away one could be and still detect the presence of the chip.

For example, if one had a microscopic coil antenna attached to the chip, the chip could be read from a mile away. Pawelec indicates that the antenna is acting as amplifier which generates a harmonic that enables the chip to be read from a considerable distance.

Further calculations indicated that a certain kind of coil antenna system would enable the chip to be readable from a place in space over 75 miles distant. This was forty years ago, and with the advent of nanotechnology, the effective detection distance could be – and has been -- extended considerably.

Pawelec took the foregoing technology to another meeting that was to be held in Virginia as well. However, given his previous experience, he was much more careful this time with respect to the flow of information concerning the meeting and its participants.

The meeting took place at the offices of a sub-contractor that Pawelec knew well who had conducted a lot of work on behalf of various facets of the intelligence community. Pawelec also involved the head of security for all of State Department activities as well as his close friend from the CIA that had been involved in the previous meeting.

Despite the precautions which were taken to render their meeting secure, there were individuals who showed up at the meeting with impeccable, impressive credentials. Yet, none of the individuals for whom the meeting had been arranged or were providing security for the meeting knew who the uninvited guests were (and, apparently, in this regard, all phone calls concerning the meeting had been made through secure phone lines).

Notwithstanding the foregoing precautions, the two individuals who showed up unannounced at the last minute with all the right credentials knew when the meeting was being held, where it was being held, and what it was about. Perhaps, as amazing as the foregoing considerations are, what might be even more amazing is that the two individuals would go to the meeting knowing that subsequently they likely would be identified as having been "interlopers," yet, apparently, they knew enough about the protocols concerning such meetings that they would be unlikely to be challenged and refused entry, and, so one wonders why they were attending the meetings at all.

The two individuals already had a considerable level of technical expertise. One wonders if they were after technical information that they didn't have or if, perhaps, they might have been tweaking the nose of the other participants by providing evidence that the two individuals had access to technology which was beyond the understanding of any of the other people who attended the meeting.

Bill Pawelec specified in the interview that the identifying credentials carried by the two individuals were capable of satisfying every sort of access-control identification protocol one might apply. This included biometric data.

The individuals displayed credentials indicating that they were employed by the NSA or a similar top-level intelligence operation. Yet, when those government agencies were queried about the two interlopers, such individuals were unknown even though their credentials had been unimpeachable.

Pawelec later found out that the Australian professor who had invented the chip received an incredibly large grant not too long after the aforementioned meeting took place, and, as a result, the man never

would have to work again in his life. Subsequently, the professor's technology was transferred to unknown individuals.

Later on, Pawelec had a conversation with a friend of his who was involved with providing advanced systems for various aspects of national security. The two talked about the aforementioned chip incident, and the friend indicated that he had been involved with installing a very high-tech security system for a little company in the Silicon Valley that was making several billion chips which were very much like the sort of chip which the meeting in Virginia had been convened to explore, but his friend indicated that once the former chips had been made, the people who were making them shut the factory down.

The company in Silicon Valley which had made the chips was discovered to constitute a division of a relatively large European electronics firm – namely, Siemens. The individual who had been the head of security at the State Department and who had helped provide security for the second meeting in Virginia later took a post in Kenya, but that person continued to pursue trying to find out who was behind hacking into the second meeting in Virginia.

Eventually, he uncovered some important information and a meeting had been arranged with Pawelec and his CIA friend to discuss the new information. However, while driving to an embassy, the former State Department head of security was broadsided by a reinforced land rover and instantly killed.

The individual who was driving the land rover -- and who, reportedly, had been in a drunken condition at the time of the accident -- was taken into custody. Yet, the next morning, that person had disappeared, and all of the documents which the individual had given to the authorities were discovered to have been forged or falsified in one way or another.

Pawelec indicates that he has worked with corporate security people at the highest levels in all the major computer companies as well as with other major players in the corporate world. Whoever was behind the people who showed up at the previously mentioned meetings and were provided with credentials, were being backed by people who had a level of proficiency far beyond anything Pawelec had seen in the corporate world.

The one possible exception which Pawelec voiced with respect to his assessment of the corporate world expertise had to do with the aerospace industry, especially in conjunction with some companies in California and Colorado. There were people in those companies who he came across that, over time, inadvertently gave off certain indications that suggested they might know more than they were letting on, and some of those individuals were involved in security projects involving scalar technology and cutting-edge research involving optical dynamics that, according to Pawelec were beyond black, and he further added that he had enough experience to know the difference.

He was of the opinion that the people who – uninvited -- had attended the previously noted meetings were not in the loop of the normal chain of government or military command. He indicated that they acted like bureaucrats, but they were expressing agendas and knowledge that were apolitical and quite technically oriented … not the sort of government individuals with whom Pawelec had worked for quite a few years.

The Virginia meetings which sought to focus on RFID technology took place in 1979 and the mid 1980s. That is 45 years ago, and sensor technology has advanced significantly since that time.

RFID technology – whether primitive or sophisticated – is used to identify things and to keep track of their whereabouts. Janet Phelan, an investigative reporter, wrote a book entitled *Exile* which covers many topics including: (a) The corruption and abuse which exists in many conservatorship arrangements in certain states; (b) the existence of dual water systems (can regulate the flow of both water and chemical agents) that are present in various cities in the United States … systems which seem like black operations of some kind and which government officials that she contracted refuse to discuss; (c) chemical and biological warfare, and, (d) how she became a targeted individual and, apparently could be located by her protagonists anywhere she went irrespective of what steps she might have taken to hide her movements and whereabouts.

The events which Janet Phelan relates start around 2000. So, her life begins to unravel in many ways somewhere around the time that Bill Pawelec gave his interview, and there is a strong indication that

tracking technology of one kind or another was being used to target Janet Phelan, but one has to read her account to begin to appreciate just how pervasive the presence of surveillance seemed to be in her life.

In 2016, Dr. Hildegarde Staninger published *Global Brain Chip and Mesogens: Nano Machines for Ultimate Control of False Memories,* as a book. However previously, the book had been published in January 2012 as a scientific presentation.

The focus of the scientific presentation and her book revolved about an investigation into a benign menginoma. Eventually, in November 2011, the menginoma was identified as a brain chip.

Dr. Staninger describes mesogens as being liquid crystals that can be given smart functions of one kind or another. They are a form of nanotechnology which, among other possibilities, can be used as bio-sensors.

Liquid crystals give expression to properties that exhibit both anchoring sorts of structure as well as liquid flow. Among other things, this means that such crystals can have a flexibility to them that does not tend to be present in solid crystals.

The brain chip, or mesogen, that was uncovered in November of 2012 was an advanced form of brain-computer interface. Dr Staninger also mentions three other cases of mesogens in her scientific publication and book which -- within a week of one another -- were removed from the nasal passages of individuals in Saudi Arabia and the United States.

The payloads that can be placed in mesogens tend to be non-reactive until they are induced into becoming active through the reception of some manner of signal. When properly constructed, mesogens have the capacity to act as spyware or to help bring about voices in one's head, as well as to serve as nodes in a collective hive mind.

Mesogens can perform the activities of: A sensor, a transducer (convert one kind of energy into another), or an actuator (generate mobility or other kinds of dynamics). What functions will be expressed through any given mesogen will depend on the sorts of smart functions it is given prior to being placed in a human being.

The liquid crystals which constitute mesogens can assume various states. These are known as mesophases, and they enable the liquid crystal to exhibit different kinds of ordering dynamics (molecular, positional, and relational) which can be leveraged through the smart functions that are developed in a given mesogen and which make the mesogen responsive to different kinds of environmental conditions (e.g., such as temperature).

Liquid crystals exhibit the property of anisotropy (that is, they can assume different values depending on the direction in which they are measured). This property enables dendritic patterns to emerge (i.e., the liquid crystal can be induced to grow and branch like a tree).

Even in 2012, press releases indicated that nanowires (as well as other nano structures which could assume a great many shapes) were being used in brain chips. Such complexes can interface with computers by means of, among other things, the piezoelectrical materials from which such complexes are constructed.

Dr. Staninger indicates in her presentation that brain chips have been built which have cognitive functions. Such chips can be used to read the thoughts of another human being or to transfer thoughts to another individual (and remember that the scientific presentation and book which describe such chips came out around 2012).

More than a decade ago, nanotechnology was engaged in constructing nanostructures that can be used as Lego-like modules that form complex, functional nano-tools such as mesogens. These structures could be made from a variety of chemicals ranging from: Silica, to: Acetone, toluene, and polyurethane.

Depending on the materials used in the construction of such nano entities, those structures will respond differently to pH, frequency, temperature, and the amount of oxygen that is present. Response to frequency becomes very important in such structures, because frequency can induce changes in the morphology of a nanostructure or induce the structure to release certain kinds of electrical impulses.

The term used in nanotechnology to describe the modular constructs mentioned above is “nematic” that refers to the way in which such nanostructures tend to rise up like office or apartment

buildings. Such nematic structures can be made of materials which are reactive to the presence of certain kinds of conditions and molecules.

Dr. Staninger indicates in her 2012 scientific presentation that in June of 2010, nematic mesogens were removed from the nasal bulb of three different individuals. Two of those individuals were from the United States (New York City and Los Angeles), while the other individual was located in Saudi Arabia.

All three nematic mesogens were made from the same materials. In addition, the presence of super glue in the form of hooks and claws were detected in all three structures.

In July of 2011, Integrative Health Systems began to undertake a complete toxicology and biological workup on a 57-year old Chinese woman who had been referred to the company. She was a professional educator and musician.

When interviewed, the woman indicated that, at some point in the past, the presence of a directed form of energy had been detected in her home. In addition, she also described an incident that had taken place several years earlier while she had been talking on the phone when she felt a sense of something piercing and burning that had entered her left ear canal (i.e., the ear that was not covered while she was engaged in a conversation on the phone).

A couple weeks after the foregoing incident, she began to feel a pain that emanated from a source somewhere in the left lobe of her brain. Subsequently, she was tested – once in 2010 and again in 2011 – and on both occasions, the evidence indicated that there was 9 millimeter-sized menginoma that was present in the left lobe of her brain.

Through a surgical procedure that was carried out by the Director of Surgery at UCLA, a specimen was recovered from the woman's left lobe. It could not be cut with a scalpel, and, eventually, a diamond cutter was successfully used on the specimen, which turned out to be a spherical mesogen nanostructure.

A number of analyses were conducted on the specimen. One of the materials found in the specimen consisted of hydroxyapatite.

Hydroxyapatite is a synthetic material which has the capacity to react selectively to a given environment and in the process be able to

transfer data elsewhere. Such synthetic materials can be imprinted with the morphologies of biogenic materials and become biomimetic (that is, such structures are able to function like biologically produced materials).

Oftentimes there are DNA tags or sensors made from polyurethane that are associated with the foregoing complexes. Such structures can serve as biosensors that are capable of, among other things, monitoring DNA.

The structure that was removed from the aforementioned Chinese individual was entirely a synthetic material. It formed a nematic mesogen with reactive properties that was encased within a calcium hydroxyapatite nano-jacket.

Such structures are used to monitor and respond to biological activities in the central nervous system and elsewhere in the body. Further investigation indicated that the structure had been made in the United States.

The foregoing structures can assume the form of photonic crystals. Such structures can be induced to be responsive to the presence of terahertz frequencies.

According to Dr. Staninger, the foregoing sorts of nematic mesogens can be dispersed through the air. This could be in the form of smart dust which, depending on the materials present in the smart dust, will respond to different frequencies that will induce certain kinds of dynamics that reflect how the mesogen has been designed to function, and part of this functionality is the capacity of the mesogen to become integrated into biological activities and modulate those activities according to the nature of the mesogen's design protocols.

When the woman was on the phone, the pain that she felt in her left ear – namely, a needle-like burning sensation – is, according to Dr. Staninger, quite consistent with what individuals who have been exposed to advanced nano materials might feel on the surface of their skins at the place of exposure. The mesogen could have been delivered from outside the woman's house and would have been able to penetrate a window on its way to the woman's ear.

The mesogen could have been delivered in any of three ways. It might have been delivered through: A sound-based, or a microwave-based, or a laser-based delivery system.

In just under two decades, incredible progress had been made. In the 1980s we had the RFID chips with which Bill Pawelec was involved, and in 2012, there were mesogen liquid crystals with smart functions which could delivered into people's brain via the ear canal and which, subsequently, could become integrated with the woman's normal biological functioning.

Was the mesogen in the left lobe of the Chinese woman a malfunctioning brain chip? What about the three other individuals that were mentioned in the publications by Dr. Staninger?

Were the mesogen implants in the foregoing four individuals instances in which, for unknown reasons, such technology did not work properly, and, as a result, generated symptoms that led to their discovery? Every technology has its user-interface problem, and, consequently, if those four individuals were just part of a group in which the technology did not become seamlessly integrated in those individuals, then, how many people were there in which such technology might have become successfully embedded and involved in monitoring or modifying the biological functioning of people in various ways?

When Bill Pawelec was interviewed in 2000-2001, he was asked a question which touches upon the foregoing question. More specifically, he was asked what he believed happened to the RFID chips that had been manufactured by the small company in Silicon Valley which he had mentioned, and he indicated that he had come across certain information which provided an indication that at least some of those chips might have became implanted in various military personnel.

In June 2013, a TED (Technology, Entertainment and Design) presentation was given in Boston, Massachusetts by two young neuroscientists: Xu Liu and Steve Ramirez. Their talk was based on several articles which had appeared in the journals: *Science* and *Nature*.

The *Science* article was entitled: "Creating a False Memory in the Hippocampus." The research published through *Nature* was entitled:

"Optogenetic stimulation of a hippocampal engram activates fear memory recall."

The aforementioned TED talk and the foregoing two articles were only a temporal stone's throw away from the 2012 scientific publication of Dr. Staninger involving mesogens. Although the *Nature* and *Science* research as well as the 2013 TED talk indicated that activities in the hippocampal regions of mice were, at that time, being modulated by implanted circuits, in the last ten-plus years, discoveries have been made which enable optogenetic technology to interact with the brains and biology of living organisms without the intermediary of implants by exposing those systems to certain frequencies of light,

Aman Jabbi spent nearly 30 years of his life working in Silicon Valley. In the summer of 2020, he moved to Northwest Montana and became an independent researcher.

His professional background is in electrical engineering and computer science. Although he has been engaged in developing various kinds of software and hardware systems, his primary focus has revolved about camera and video technology.

During his career, he has interacted with all of the major cell phone companies. In addition, he has helped develop technology for autonomous driving vehicles.

Due to his expertise in electrical engineering, cameras and videos, he has a deep understanding of the surveillance infrastructures which have been put up around the world, including the United States and China. Part of the foregoing understanding has to do with issues involving facial recognition.

The potential of facial recognition has been promoted as being a way: To enhance one's security and safety, or to make life more convenient, or to assist authorities in protecting the public, nonetheless, facial recognition is also easily adaptable to systems of control. For instance, social credit systems can be tethered to that kind of technology.

The same technology that can capture criminals can also be used to hunt down individuals who have done nothing except, for example, exercise first amendment rights in a way that the people in control consider to be an obstacle of some kind to their ability to continue to

be in control. The same technology that can be used to make sure that only you have access to certain accounts to which you are entitled can also be used to ensure that you cannot have access to certain accounts to which you might be entitled.

As with most aspects that are related to the process of biodigital convergence, only the positive possibilities associated with such technologies tend to be discussed. This is part of a dual-use strategy in which the constructive dimension of a technology can be used to hide the destructive and injurious dimensions of that same technology so that whenever questions begin to be asked concerning the potential, dark underbelly of a given technology, the conversation can be re-directed back toward the potential upside of things.

Dual-use technology is often promoted in one way – a way that is described in terms that seem to be inviting and of value – but, unfortunately, are often used in another way – a way that is authoritarian, abusive, and injurious, if not lethal. Governments, the military, corporations, educational institutions, and the media love dual-use technology because it makes gaslighting the public easier to do since such dual-use technology constitutes a way to establish plausible deniability concerning events.

Tracking someone's carbon footprint seems like a constructive thing to do. However, if human-generated carbon dioxide can be shown to have little, or no, impact on the dynamics of global warming – and showing this is, actually, quite easy to do – then, one begins to realize that tracking people's so-called carbon footprint has nothing to do with protecting the planet and everything do with advancing an economic system in which certain individuals are enabled to exploit the world's resources in a manner that benefits them and disadvantages the vast majority of human beings, and as a result tracking people's carbon footprint is a way to illegitimately try to control the kinds of choices that people who are being surveilled will be able to make.

Western pundits and politicians like to boast about how the people in China have no privacy and are not free. Yet, the same technologies that have been installed in China -- and have fostered an authoritarian social credit system which unnecessarily controls many

aspects of the lives of China's citizens -- are also being installed in many Western countries.

The whole issue of various financial institutions keeping track of people's alleged carbon footprint (according to someone's arbitrary way of scoring such issues) or placing limits or how much, when, and where people spend their money are examples of this same kind of social credit system being established in the West. Financial institutions are becoming an increasingly influential part of the social credit system which is being established in the West.

The growing pressure to switch over to a digital currency is intended to further the control which such companies and the governments they work with wish to exercise over people. Once money becomes a digital commodity, then, one's whole life is lived under the shadow of an on-going threat that some anonymous individual will be able to turn off the digital spigots that are necessary to finance one's life if one acts in a way to which authorities object.

The general impression of people in the West is that China is one of the most, if not the most, surveilled group of individuals that exists in the world. Ironically, there are more cameras per capita in America than there are in China, and most, if not all, of those cameras are – at some point – connected to AI systems, often via the Internet.

Westerners might believe that they enjoy the most privacy and freedom of anyone in the world. However, this is not necessarily the case.

The people of the West are, and have been, heavily propagandized about many issues which are packaged in the guise of education but which often have all of the qualities of indoctrination. These issues include matters concerning privacy and freedom.

By 2025, several trillion dollars will have been spent on developing and installing a camera infrastructure that will help underwrite an increased surveillance of people in America. This enhanced infrastructure is not about safety, security or convenience, but, rather, it is about the complete abandonment of privacy on behalf of the interests of authoritarian control.

Smart-meters – which are a part of the move toward building the foregoing sorts of infrastructure that constitute so-called "smart cities"

-- are not necessarily about enhancing the quality of our lives. Instead, smart-meter technology tends to be about collecting and analyzing data on virtually everything that goes on in someone's place of residence and, as such, can be used to adversely affect someone's social credit score according to arbitrary standards which are set by people in power.

Moreover, smart meters have been shown (e.g., see Josh del Sol's documentary, *Take Back Your Power*) to be hazardous in several respects. On the one hand, they have been demonstrated to be a potential fire hazard, and, on the other hand, due to the pulsed forms of electricity which they tend to generate, smart meters also have been associated with deterioration in the health of many people who are exposed to the operational dynamics of that technology.

According to Aman Jabbi, when many parts of the world were entangled in the lockdowns of COVID-19, surveillance cameras were being installed. When the lock down was brought to a close, there were approximately one billion more surveillance cameras which had been installed and were operational than was the case prior to the lockdown.

He estimates that by the end of 2022 there were more than 20 billion data collection cameras, of one kind or another, that were operating in the world. Data collection is not just about safety or security, but, rather, it is about logging and analyzing everything that people do in their lives.

Indeed, data collection involves an extremely rigorous form of surveillance. Such data collection is inherent in the notion of biodigital convergence because everything biological is converted into a data point that can be leveraged in a multiplicity of ways by whoever has access to that data in order to induce compliance in the behavior of people with respect to whatever agenda is being pushed by those who are collecting, analyzing, and evaluating such data.

Increasingly, computers, apps, browsers, search engines, social media, and mobile phones all have one or more AI systems built into them or associated with them. Such systems are continuously collecting and analyzing data of the people using those forms of digital technology, and there is no air gap around any of the foregoing forms of technology which prevents that data from being shared with other

computers, AI systems and/or data collection agencies, including the government.

Biodigital convergence means that biology and digital technology are becoming fused in a variety of ways. Data collection is being used to manipulate, modulate, influence, and determine the character of such convergence.

The intent is to make biology completely a function of the digital. And, sense, increasingly, surveillance is being conducted through AI, the forces which will be shaping and determining the character of the biological will reflect the inclinations and priorities that are present in AI systems.

Aman Jabbi refers to the foregoing set of arrangements as constituting a digital panopticon. The notion of a panopticon dates back to drawings released by Jeremy Bentham in 1791 in which a central surveillance post was surrounded by prison cells, and individuals working in the central post had the capacity to see into every aspect of the lives of whoever occupied the cells surrounding the panopticon.

A digital panopticon is not restricted to what can be seen with an eye or a camera. A digital panopticon uses data to see into the internal and external lives of those who are under surveillance, and, therefore, data can probe beneath the existential surfaces to which purely visual forms of surveillance are limited.

Physiological data can reveal a great deal about what is going on in a person's existence. The testing and treatment protocols employed during COVID-19 were used to release a great many different kinds of biosensors into the environment.

Biosensors are in the air, in the food, in the water, in medicines, and in manufactured goods. Biosensors provide a multiplicity of ways to uniquely identify and monitor those with whom such sensors have become attached.

That which has been provided with a unique digital signal becomes a node in a network. The data collected through the nodes of that network provide ways for both the nodes ("digital twins") as well as the network to be modulated or controlled, and, increasingly, the source of such modulation or control is a function of AI systems.

The dynamics of modulation and control can be: Medical, political, social, economic, financial, psychological, emotional, physical, religious, and/or educational. The digital panopticon doesn't just see from the outside in, but, as well, sees from the inside out.

Although RFID (Bill Pawelec) and mesogen chips (Dr. Staninger) have been used to introduce pathways of surveillance and data collection into the lives of people, nonetheless, the technological advancements which have been made in the last 15 years have opened up many other possibilities for establishing various forms of biodigital convergence. Those advancements extend from: Various forms of nanotechnology (mesogens are but one kind of nanotechnology, and smart dust is another), to: The introduction of metamaterials (such as graphene oxide along with more modern and exotic forms of 6-G, or higher G, engineering); the development of mRNA technology (which is a synthetic or artificial form of exosome and endosome dynamics); optogenetics, and synthetic biology.

Technological refinements concerning data collection have reached the point where substances no longer have to be introduced into people from without. Each person's DNA gives expression to a unique frequency signature, and once known, that signature can be used as a honing device toward which to direct whatever kinds of modulating frequencies or vector dynamics are selected by a given panopticon operator -- whether that operator is a human being or an autonomous AI system.

We are not just becoming increasingly ensconced in the Internet of bodies, or the Internet of Things, or the Internet of Medical Things, or the Internet of Bio-Nano Things and so on. We are increasingly being tethered to a Panopticon of Digital Transformation, and becoming incorporated into a hive or Borg mind is just one potential of such a system.

Augmentation – which is a dual-use technology -- is promoted as a process of enhancement which will assist individuals to be able to engage life in faster, better, smarter, stronger, and more competitive ways. Yet, as a dual-use technology, augmentation is also an inherent feature of the Panopticon system because through augmentation individuals can be modulated and controlled in ever more exacting

ways and, yet, not be any the wiser as to how they are being imprisoned and used by the Panopticon system.

The most insidious form of imprisonment is when the shackles which bind one are invisible to one's gaze, awareness, or understanding. The Panopticon of Digital Transformation is such a form of imprisonment because: Wherever one goes; whatever one does; whatever one thinks, whatever one feels, whatever one creates will all be shaped, modulated, and controlled by an array of digital shackles about which one is unaware and which human beings will have been induced to understand as being implements of glorious freedom rather than being forms of authoritarian abuse.

The term "transhumanism" is actually a euphemism for what is being implemented. That term alludes to the possibility of being able to go beyond or transcend the human condition and, therefore, that possibility is being hyped as constituting a positive, constructive, empowering, progressive possibility, and, yet, as a dual-use term of technology, the notion of transhumanism is merely a tactical way of providing plausible deniability that transhumanism is actually nothing more than an enticing, intriguing disguise which is being used to groom people to become full-fledged acolytes of the Panopticon of Digital Transformation … like all addictions, in the beginning, the technological addiction seems to be the solution to all one's problems until one realizes – if one is sufficiently fortunate to reach such a point – that the addiction merely has encased one's difficulties within an even more intransigent set of additional difficulties.

Approximately 3-4 years ago, Aman Jabbi began to note LED lights which had been, and were being, installed in, San Francisco. Low pressure, sodium-halogen lights were being replaced by very bright LED lights.

These latter lights are being installed in areas of denser population every 30 yards, or so, apart from one another. These new installations are referred to as "smart lights" and "smart poles."

These complexes wirelessly communicate with one another and are linked to underground fiber optic cables. In turn, the lights and fiber optic cables are connected with additional nodes of a more complex network of data collecting and analyzing technologies, many of which are operated by, or used in conjunction with, AI systems.

The foregoing lights and poles can be equipped with any number of biosensors. They also can be weaponized, and, when weaponized, they can form part of an offensive system that can be used to control or eliminate the individuals whose digital data is being collected through -- along with other pathways of data collection – the aforementioned smart lights and smart poles.

Among the sensors which can be installed on the foregoing smart poles are noise sensors. The ostensible reason for the presence of such sensors is to assist in the control of noise pollution, but, given the dual-use nature of such technology, those sensors also can be used as listening posts for any signs of threat to the continued operation of such 'smart' systems.

In addition, smart poles can be equipped with public address systems that can dispense whatever directives are deemed necessary under a given set of circumstances. That which is communicating these directives is not necessarily a human being.

Furthermore, according to Aman Jabbi, these smart poles have a capacity to accommodate drones. This capacity can be in the form of providing, one, or more, charging station for drones, as well as in the form of providing a perching place from which such drones can be launched to regulate activities (such as crowd control or unwanted "disturbances" of any kind) either near to the poles or at distances somewhat removed from those poles.

In effect, the poles will establish a geofence that will monitor and regulate -- with force if necessary -- whatever activities are taking place within the perimeter that has been established by the poles. Police will not be needed because everything will be handled autonomously and anonymously.

The frequencies which emanate through the blue LED lights affixed to the 'smart' poles are extremely harmful to people's eyes, and, therefore, by design, have the capacity to induce people to look downward, away from the lights, in a rather submissive posture. In addition, the poles can be equipped to emit any number of frequencies which are able to control, injure or terminate people.

For instance, the smart poles can be equipped with what is colloquially referred to as a "puke ray." When turned on, it incapacitates people who are exposed to it.

The "ray gun" works by emitting very high frequencies of light which are replaced by one another very quickly. The human body does not adapt well to such high frequencies and rapid frequency changes.

The foregoing sort of frequency weaponization process is part of the dynamics of biodigital convergence. This is because such technology has the potential to be used to condition and induce human beings to become subject to and, therefore, converge with the digital realm.

The aforementioned poles and LED lights are fancy herding tools intended to help the Panopticon system of government to move human beings toward biodigital convergence. Other herding tools are: wi-fi; 5-G microwaves (which began as a crowd-control technology); 6-G metamaterials (such as graphene); biosensors; mRNA treatments; beam steering (the re-direction of frequencies); behavioral recognition radar; bioinformatics (the gathering and use of data for purposes of modulating and controlling biology); CubeSat technology (Satellites that consist of sides measuring 10 by 10 inches and which can contain any number of possible payloads); D.A.R.P.A. (Defense Advanced Research Projects Agency); DNA Steganography (a way to brand biological organisms via their DNA); precision medicine (medicine geared toward leveraging the uniqueness of a given individual's biology); synthetic biology (the creation of artificial and arbitrary systems of biology); the CDC; the FDA; the FBI; the CIA; the FCC; the military; the Federal Reserve Bank; Blockchain technology; Executive Orders; the Supreme Court; Congress; hydrogels; the IEEE, (Institute of Electrical and Electronics Engineers); informatics (the computational manipulation of data); microfluidics (the manipulation of the flow of fluids on a micro level); Network Central Warfare (Using networks of, among other things, data to wage war against human beings through manipulating the way information is used and abused); pervasive computing (the use of a litany of biosensors and microprocessors to provide data that can be subject to computational processes that can lead to control and modulation); plasmonics (the manipulation of nano-complex – called a plasmon or a quantum of plasma oscillation);

biophotonic (a form of engineering which seeks to regulate the flow of photons in biological systems); telemetry (the automated collection of data); tissue engineering (an off-shoot of the arbitrary and artificial techniques of synthetic biology; terahertz radiation (frequencies which fall in between infrared and microwave radiation and can be used, for among other things, targeted drug delivery as well as painful, if not lethal, reminders of their presence); WBAN (Wireless Body Area Network – involves a continuous collection of data concerning what is happening in a given biological context).

All of the foregoing items are ensconced in dual-use forms of technology. As indicated previously, this means that such technologies can be promoted as giving expression (in one, or more, ways) to constructive, protective, healing and/or beneficial uses while also having the capacity to herd people, in one or more ways, along a path toward biodigital convergence.

One of the main goals of biodigital convergence is to erase all considerations that there is something more deeply hidden than the technological cul-de-sac to which biodigital convergence is herding people. When one can provide substantial evidence – as the two volumes of this book hopefully have done -- that there is something which is more deeply hidden than what is being passed off as the truth of things and, therefore, warrants investigation in a rigorous fashion, then, this state of affairs tends to place cautionary – if not hazardous -- brackets around anything which claims that there is nothing more deeply hidden.

All of the events of the past 85 years – and, very likely, for a much longer period of time -- have been for purposes of herding or corralling human beings toward a certain point in history – a terminal point of biodigital convergence. Historical events are like the sheep dogs which nip at the heels of, and bark at, sheep in order to move the latter animals toward a final destination point, and the dogs that are being used to move the herd don't have to understand the ultimate purpose of the herding process in order to be effective at their jobs or assignments.

As indicated at the beginning of this chapter, those who are designing, constructing, and operating the project -- which later on in the chapter was described as being the Panopticon of Digital

Transformation -- might be very skilled at knowing how to arbitrarily and artificially: Disrupt, hack, target, undermine, sicken, divert, alter, modify, modulate, terminate, re-purpose, leverage, corrupt, and abuse biological systems, nevertheless, they are completely ignorant of – if not in denial of – the many aspects of existence which are more deeply hidden and that fall beyond – oftentimes considerably so -- the horizons of their various theories. It is devotion to such ignorance, if not entanglement in various traumas which has led to deep denial concerning such matters, that induces them to suppress all evidence which points in the direction of that which is more deeply hidden because such evidence indicates that virtually everything in which they are engaged are authoritarian acts of censorship, abuse, and oppression.

Exercising and developing integrity with respect to the search for something more deeply hidden might well have greater value than whether, or not, one succeeds or fails to come to realize various truths concerning the answers for which one is searching. Success might be enjoyable to experience and failure might be hard to take, but without integrity, neither success nor failure is likely to be survived.

Integrity can neither be exercised nor developed as long as one tries to prevent people from having access to the sort of sovereignty that is needed to be able to freely seek for ways to understand, and gain insight into, that which is more deeply hidden. Wars, terrorism, education, elections, politics, the media, government, entertainment, and so on, can all be used as herding tools intended to divert people away from pursuing something that is more deeply hidden and more essential to life.

Those who are interested in, and drawn toward, that which is more deeply hidden must become like gyroscopes. In other words, no matter what destabilizing forces are introduced into the conditions of their lives, the foregoing sorts of individuals must always try to regain a conceptual, emotional, psychological, physical and spiritually stable form of dynamic re-orientation vis-à-vis life in order to provide oneself as best one can with respect to on-going opportunities to discover more about that which is deeply hidden.

However, the choices we make to re-orient ourselves are often fraught with danger. Moreover, some of those choices only serve to destabilize us even more.

So, one must choose wisely, but this is frequently easier said than done. Not every passageway into the unknown leads to something that is more deeply hidden but which is, simultaneously, beneficial to human existence.

Some rabbit holes are far more heuristically valuable than various other kinds of archeological digs which might, on the surface, seem intriguing but end up wasting one's time and resources. I am deeply grateful to Sabrina Dawn Wallace for pointing in the direction of something more deeply hidden that, upon investigating, has been of considerable value to me … and many others.

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