

On
The Nature of Reality
And
The Mind of Nature

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Preface

The increase of new information and knowledge has been on an exponential growth path for over the past century. My great grandparents (Dr. Mitchell) left the state of Georgia by covered wagon to settle in West Texas. Less than 100 years later, I landed on the moon; literally and figuratively an incredible leap for humankind! The pace of change has become so rapid that it is now said that for a student majoring in college in any of the sciences, mathematics, engineering or related disciplines, fifty percent of the knowledge learned in the first two years of college will be obsolete in eighteen months.

This monograph presents a tutorial on the concept of Quantum Holography based on recent developments over a very broad spectrum of emerging scientific disciplines. Most of these developments have occurred within the last two decades. Because of the diverse backgrounds of the intended audience, it is difficult to write this monograph without being redundant in some areas and esoteric in others. Those readers with considerable knowledge of science and its classical beginnings may want to skip some of the introductory chapters and go directly to those describing the Quantum Hologram and the Zero Point Field.

Readers with little or no knowledge of science will find it most useful to read this manuscript in its entirety because the Quantum Hologram is a powerful new information tool that provides insight and a mechanism for perceptual phenomenon totally missing from classical approaches in science. However, an understanding is not possible without some indoctrination to classical physics, then into recent scientific developments including quantum mechanics.

Chapter one of this manuscript describes the issues and the context of sustainability our global civilization now faces. It also provides the rationale as to why it is essential that our civilization must make a fundamental shift in our worldview if we are to survive and maintain an acceptable standard of living for the long term. Chapter two covers ontological and epistemological assumptions that underlie the physical sciences

(e.g. how we know what we know about reality). Chapter three discusses emerging paradigms in science and covers recent developments in several disciplines such as chaos and complexity theory, emergence and non linear dynamics. Chapter four is a review of the strange world of quantum mechanics. Comprehension of its basic tenets is essential for an understanding of the theory of the quantum hologram presented in this manuscript. Chapter five covers energy, information and the zero point field which is the fundamental scaffolding upon which all physical matter rests. Finally in chapter six we present the concept of the quantum hologram which is the primary focus of this document. Chapter seven provides an explanation of the implications and applications of the quantum holographic model. Finally chapter eight summarizes and places the quantum holographic model in the larger context.

We trust that all of our readers will find this document informative and enlightening.

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There are more things in heaven and earth, Horatio,
Than are dreamt of in your philosophy

Hamlet, 1.5
William Shakespeare

CHAPTER 1 - INTRODUCTION

Seeking Answers Through Science to the Most Challenging Questions of the 21st Century

Our solar system, including Earth and the sun, have been around for about 4.6 billion years or roughly one-third the age of the observable universe. Humankind as a species has roots that go back about three million years. Modern civilization is approximately 10,000 years old, which is a mere blinking of an eyelid in geological terms.

Some 2,500 years ago religious stories and traditions were spawned from the efforts of a few inspired individuals from various cultures who endeavored to make sense of reality. Our contemporary world view and cultural and societal beliefs, in large part, have remained nearly the same since the days of these early thinkers even though our knowledge of our shared collective reality has grown enormously. As recently as the middle of the 19th century, for most of humankind, all the knowledge we needed to lead successful and productive lives could be learned from our parents by the age of 6. Just a short 150 years later our knowledge and our technologies are expanding at incredible rates doubling (and becoming obsolete) every 18 months. Just keeping up in modern society requires a life-long commitment to learning.

It has only been in the last 400 years or so that humankind has made an organized attempt to understand the world and our relationship to it. This effort divided the quest to understand reality into two separate realms, one related to matters of the physical world (science) and the other related to matters of spirit (religion). Clearly we are still a very young species as compared to the age of the Earth, barely out of the trees, and even though our progress in understanding the physical world has been dramatic, it is still embryonic and perhaps even crude. Our current knowledge base regarding our subjective

(e.g. inner) experience is clearly incomplete, and may even, in many respects, be totally incorrect. We have come far as a species; however, we still have a long way to go to gain a comprehensive understanding and knowledge of the true nature of ourselves and the universe in which we live. In spite of our progress, our everyday understanding of reality, our cultural beliefs and our values have remained in many ways unchanged and are lagging far behind our current “scientific” understanding.

As our understanding evolves civilization is now confronting some of the greatest challenges it has collectively had to face. Among them, are: an accepted and widespread belief in the culture of materialism, the use of violence for conflict resolution, global population explosion, environmental degradation, wholesale species extinction which threatens the web of life on the planet, unparalleled rate of consumption of renewable and non-renewable resources, proliferation of weapons of mass destruction, corporate and political malfeasance, etc.

One issue that is especially troubling is the lack of conservative management of Earth’s huge but finite reserves of natural resources. Many notable authorities believe humankind’s unconstrained population growth, outmoded energy generation and usage, and its current pattern of reckless consumption are environmentally unsustainable and are leading towards unprecedented disaster, chaos and economic collapse. This outcome is likely to occur within our own lifetimes unless drastic actions are initiated soon on a global scale. This conclusion has not been arrived at hastily, lightly or alone, but only after a great deal of study, analysis and discourse with the most trusted and respected collaboration with colleagues and the research of respected authorities.

For the first time in the history of humanity, we can now change our perspective and view our planet from space. When we do that, we see Earth for what it really is, a beautiful oasis in a dark void with an incredible eco-system sustaining an amazing array of diverse life forms including our own. It is our home, a fragile planet having vast but limited resources. For most of its history Earth was self-contained and self regulating. Sustainability was not a concern for any of its inhabitants. Earth’s natural processes took care of all of the planet’s needs. Nothing that any of its inhabitants could do affected the

planet's innate harmony and balance. Only major natural events, such as variations in the sun's intensity, asteroid impacts, volcanic eruptions, tidal waves, earthquakes, or similar massive natural disasters had any kind of serious impact on our planet.

Now, for the first time in history, a single species – humankind, is dramatically impacting Earth's natural processes. The reasons are many but the most significant ones are outmoded cultural beliefs coupled with our modern technologies and our ever increasing population. Exponential population growth is forecast to continue to occur even if the number of births per female and the deaths per year were to be maintained at current levels. Our planet's human population increased from 1.5 billion people in 1900 to 6.8 billion today. It is expected to reach 9 billion by 2050. Conservative estimates are that the earth can sustain a population of not more than 2 billion persons at the current consumption rate of western industrial cultures.

Along with mushrooming population have come the unintended consequences of our powerful technologies: our insatiable appetite for consuming non-renewable resources and pollution on a scale never before seen. In short, what presently hangs above our head like the sword of Damocles is a fast approaching perfect storm for unparalleled cataclysmic disaster. By any measure, the adverse impact humans are now having on the planet is enormous and highly deleterious to the point where we may face extinction at our own hand from our own mindless excesses, bringing many other precious species into the abyss with us through no fault of their own.

Our violation of Earth's natural systems cannot be repaired by edict or legislation. Earth's systems are determined by nature and are not politically or economically negotiable. Our global civilization, led by existing and emerging industrialized nations, is blindly pursuing a path leading toward catastrophe. Yes, we have the knowledge to mitigate many of the threats we are facing, but do we collectively have the will? Some of our problems can be by regulation, but most cannot. Industrial world governments, in general, lack the motivation, resources and vision to embark on such a massive effort, and would never do so without the impetus of unprecedented popular demand.

While legislation and treaties can provide economic incentives to promote resource conservation, pollution reduction, alternative energy sources and even stabilizing human population growth, it cannot change thousands of years of cultural and societal conditioning of scarcity, greed and materialism. Nor can it easily change the lack of knowledge and understanding of Earth's intricate and delicate biosphere. These are the real underlying causes of our growing problems. Apathy, ignorance, and lack of commitment can no longer be tolerated if we are to recover from our dangerous and life-threatening behaviors.

It is possible to predict the consequences of our past and present behavior, but the timeframe in which these consequences will manifest cannot be easily determined. However, the most informed scientists generally agree they will occur within the lifetime of people currently alive on the planet. Some would say that we have already passed that invisible barrier known as the "tipping point." Either way, without immediate massive action, at best, some of us will survive the coming crises, but at a much lower standard of living and as a greatly diminished technological society. At worst, only microbes and insects may survive the incredible folly of our ways.

Curbing exponential growth is one of our greatest challenges, for it is perhaps the greatest threat to our survival, one that is most insidious and difficult to comprehend or recognize. In exponential growth, at first, the rate of expansion is extremely slow, almost unnoticeable. However, as time progresses, the rate of growth becomes extremely rapid. For example, you may have heard the metaphor of a pond with a water lily floating on the surface. Assume the expanse of lilies doubles in size every day and if the growth is left unchecked, lilies will smother the pond in 30 days, crowding out all other living things in the water. For most of the 30 days, the growth seems inconsequential and so the lilies are left to grow. But then, on the 29th day, the lilies have expanded until they cover half of the pond. That leaves just one day left to save the pond, but almost no time remains to clear the pond of the menacing threat. Such is humanity's present predicament. Without hyperbole, it is midnight on the 29th day in the lily pond we call Earth.

At the same time we are facing these challenges, wisdom is now manifesting that is seeking a different way of being and a more lofty perspective of our place in the Universe. In these circles our current predicament is seen, in large measure, to be a crisis in our individual and collective thinking or, as some would say, a crisis in consciousness. This wisdom supports the notion that no amount of Earthly business success, scientific or technological achievement, or power and control over humanity can compare to the age old wisdom at the very core of all our spiritual traditions. Namely that we live in an interconnected, abundant Universe and that the most noble pursuits are living lovingly and compassionately among ourselves and with all living entities with which we share this existence.

Civilization's survival and future well-being is entirely dependent upon the emergence of this completely different worldview, one that properly addresses, in verifiable scientific terms, our collective relationship to each other, to the environment, and to the Universe. Only by a fundamental change in perspective and in our beliefs and values can we begin to know who we really are and provide a higher purpose for our existence. It was Albert Einstein who said "You cannot solve a problem with the same level of thinking that created it." So the question we are focused upon is -- How do we fundamentally change the dominant world view and replace it with a higher level of thinking? This shift can come about if a significant portion of humankind develops this new awareness and understanding and incorporates them into individual and societal belief systems. Science can support this shift by providing reliable and credible empirical data in support of these premises.

Since the 17th century science has been based on the belief that all phenomena are the results of blind but predictable interactions with matter. This concept has led to a reductionist view of reality and a materialistic focus – one of consumption, competition, conflict and domination. However, by the end of the 20th century, new scientific evidence has emerged from several new fields of study such as quantum mechanics, non linear thermodynamics, systems and chaos theory and the study of so-called supernatural

phenomena that render the reductionist and materialist view of reality not only untenable, but incorrect as well. Instead, a new paradigm is surfacing which:

- 1) Places great emphasis on consciousness and its role in the creation of physical reality;
- 2) Reality is a holistic, interconnected matrix;
- 3) Information, once gained is never lost;
- 4) These concepts are true at a deep and fundamental level of existence.

Throughout the ages great spiritual teachers from all traditions have spoken of reality being a limitless, transcendent and holistic consciousness. Partly as a result of the legacy of the French philosopher Descartes and the separations of the domains of religious and scientific thought, the spiritual view of reality has been ignored by modern science. Yet, our spiritual teachers have taught us for millennia that we all have the ability to experience transcendent states of awareness and intentionality and that they are demonstrably resident in the human condition. These states are now beginning to be understood as fundamental properties of our consciousness.

These transcendent states have been visited and described for millennia by both our ancestors and contemporaries. Enlightened individuals have been called by many names including avatars, mystics, sages, saints, gurus and shamans. By whatever name they have been called, all held a similar world view and advocated oneness, unconditional love, living harmoniously with nature and one's fellow humans and recognizing the interconnectedness and interdependence of all creation.

Many current world crises, including energy consumption, inadequate health care, rampant malnutrition, environmental degradation, and violent conflict between countries, regions and religions, are not isolated events. Growing evidence suggests that myriad misunderstood phenomena in nature be they physical, mental, or spiritual, may be best explainable by a new framework that treats events in the world as interdependent components of an inseparable whole.

This hypothesis of interconnectedness, proposed by ancient sages from many pre-scientific cultures has never been rigorously explored or tested by modern mainstream science. To create the fundamental shift in consciousness necessary to preserve civilization, experimental and theoretical investigations are needed to fully understand and test these unifying approaches to nature. The goal of these investigations must be to fully integrate the reductionist, and purely materialistic view, characterized by classical Newtonian science, with the holistic view emerging from promising scientific disciplines in a manner that also addresses consciousness and transcendent states of awareness. This holistic view can then be applied to the macroscopic world including living systems and social phenomena.

This monograph addresses questions fundamental to achieving a sustainable civilization because it is concerned with the essence of understanding our existence as a unified whole without any artificial separations or preconceived ideas related to old cultural stories and traditions. Specifically, it is concerned with how consciousness works and its relation to the origin of life and its current condition, the codependency and interconnectedness of all life with itself and its environment, including the past, present and future evolution of our Universe and everything in it. Knowledge gained by the answers to these questions will provide insight, technologies and hope for the survival of our civilization.

Despite advances in science and technology over the last three centuries, these burning questions have been largely ignored and are still the most challenging issues of the modern era. One of the main reasons for this is that subjective experience, including the existence of consciousness, to a large extent, has been overlooked and neglected by mainstream science. Until recently these areas of inquiry have been considered to be outside the scope of scientific study. Indeed, many established scientists still think these issues are strictly philosophical, psychological or theological and are not subject to the accepted scientific methods of inquiry. However, new discoveries in several scientific

and related disciplines now offer clues that are suggesting that such issues can be tested and studied reliably using commonly accepted scientific methods.

In this monograph we take the position that quantum mechanics, an important branch of modern physics and the only existing *quantitative* theory that takes the subjectivity of the observer into account, must be fully extended to macroscopic levels. Certain basic concepts in quantum mechanics such as energy emission and absorption, entanglement, coherence, non-locality, zero-point-energy, and resonance appear to offer plausible explanations to intertwined relations in living systems, social phenomena, and something as intangible as consciousness and its relation with our environment.

Recent work in Quantum Holography, validated by experimental results with functional Magnetic Resonance Imaging (fMRI) techniques, demonstrates the applicability of quantum mechanics to macro scale systems, in general. *The application of these concepts to macroscopic phenomena has been largely excluded from scientific research for the past eighty years of quantum mechanical research even though the evidence has been steadily increasing suggesting that these phenomena can no longer be overlooked.*

Quantum mechanics must also be integrated or contrasted with thermodynamics, the only quantitative, non-reductionist approach in fundamental physics that has been proven to be applicable to systems as large as our cosmos, but yet it has not been applied to living systems. Finally, information theory, chaos theory, complexity theory, non-linear dynamics, self-learning and self-organizing systems also need to be understood on a much grander scale particularly as they apply to living systems.

This manuscript outlines a new perspective and a new view of reality grounded in current discoveries in several of these related scientific disciplines that promise to challenge thousands of years of cultural conditioning. In doing so, our objective is to provide new insights into the nature of reality and therefore into the tremendous challenges humanity is now facing. These new insights will provide clarity as to how our

behaviors must change in order to engender a sustainable future for our children and the children of future generations. Clearly our civilization has many of the technologies, and knowledge to solve the most serious challenges that humanity faces. Unfortunately, our cultural conditioning and those vested interests that gain from maintaining the status quo have for too long either inadvertently, covertly or overtly prevented us from resolving these issues. Additionally many of the rest of us seem to lack the understanding of the severity and full implications of the situation with which we are confronted. Only by a fundamental shift in understanding to a more complete view of the nature of reality will we have the motivation, understanding and wisdom to create a sustainable civilization for all.

Although our problems are extremely serious, once we have the proper perspective to know who and what we really are, the tremendous creative abilities that humankind has consistently demonstrated throughout history (when confronted with inconceivable challenges) can resolve the challenges we have created. It is our belief that we can utilize these creative capabilities to create a sustainable future for all of humanity. Failure to do so is not an option and, as we shall show in this manuscript we are all in this together!

CHAPTER 2 – WHAT WE KNOW

How We Know What We Know and What We Think We Know

From the beginning of time to the modern era, change has usually occurred over eons (geologic timeframes) except for rare natural catastrophes. In the former case nature and all living things on earth have been able to adapt to these changes, thrive and fill whatever ecological niches that became available to them. In the latter case, when change was extremely abrupt, such as a large meteor impact or super-volcanic eruption, most living things on earth were wiped out in mass extinction events. In these cases, the change was so rapid that living things had no chance to adapt. Now, for the first time in the history of planet earth, humans with their incomplete knowledge, cultural myths, powerful technologies and their large numbers are having an unprecedented effect on the earth and are moving inexorably towards a mass extinction event of their own creation. Change is occurring at a rate that is so rapid, that nature's evolutionary processes will not provide humans and most living organisms with the tools to adapt to the current changing environment. To survive humans must evolve consciously, intentionally, recognize nature's limits, and live in harmony with them. To do this we must first understand the nature of reality. This is a tall order but one that we have no choice but to pursue.

So, how do we know what we know of our external reality? What we know is what we think reality is and yet, reality is not what we think it is. As we shall show, it is all a matter of perspective, prior experience and knowledge, and the stories (assumptions) we tell ourselves.

One of the most obvious ways to know about reality is by direct observation using our five senses. The tree outside my window certainly looks real as do the bushes and the flower beds, etc. in my front lawn. If my neighbor looked out her window and I asked her, she would tell me that she also sees the tree, and if her view is not obstructed, perhaps the flower bed and bushes in my yard as well. She sees the tree whether I am

simultaneously looking at it or not¹. But does an independent observation by my neighbor mean the tree is real? Both of us infer that the tree exists by using the information we perceive and by comparing the current view of the tree we perceive with our prior experiences (stored information) about trees that are retained in our memory. We see the green leaves rustling the branches swaying and the trunk holding fast against the force of the wind. We know what the movement of a tree looks like from our prior life experiences with trees. But what would a tree look like to a boy raised in the desert where there were no trees? Would he have any idea of what he was observing?²

But, even if we grow up in a forest of trees, there is also a lot we wouldn't observe about the trees around us: we wouldn't see the leaves absorbing carbon dioxide from the air surrounding the tree, water from the ground being transported upwards first through the root system, then the trunk, the branches and finally to the leaves. Nor would we see simple sugars being produced in the chemical factories of the cells from the energy of the visible light striking the leaves via the process of photosynthesis. We don't see these cellular mechanisms because we don't have the direct perceptual mechanisms to see these microscopic processes taking place. We don't see the atoms and molecules making up the tree, nor could we realize that 99.9% of all the space that the trees occupy is devoid of any matter at all³. Clearly we need instrumentation that extends our senses for all these additional levels of observation. With such measuring tools to augment our senses, our perspective changes and our understanding of nature changes right along with it.

But perception goes much deeper. Instrumentation does not always help especially if *it appears* unrelated to the object we perceive. Any high school physics student can tell you that all motion is measured relative to a reference point (e.g. an observer). Near the equator, the earth is rotating on its axis at a speed of roughly 1600

¹ As we shall see one interpretation of quantum mechanics is that objects do not exist when they are not observed but only exist as probabilities.

² This suggests that two people engaged in communicating meaningful information requires prior common experiences by both of the communicators.

³ The nucleus of an atom contains 99.9 percent of the mass but only occupies 1/100,000 of the space of the atom; the vast majority of the rest of the atom is empty space.

kilometers per hour, completing one complete cycle of rotation in 24 hours. But the earth is also revolving in orbit around the sun at an average distance of 150 million kilometers so it is also moving in its orbit at a speed of approximately 108,000 kilometers per hour. Not only that, but our entire solar system is revolving around the center of the Milky Way galaxy every 200-250 million years. The galaxy is moving with the local cluster of galaxies, and so on. So, is the tree moving or not? It depends on the reference point you choose or, said another way, on your perspective. Even though the tree outside my window does not appear to move except, perhaps, for the rustling of the leaves and the movement of the small branches in the wind, it certainly is. Any reasonable person would have to say that movement, like most things in our objective reality, is all a matter of perspective and consequently our relationship to that object. Change your perspective or your relationships and you change your reality.

Throughout history there have been many paradigm breaking shifts in perspectives. It is difficult for us to imagine the impact on society when Nicholas Copernicus proposed that the sun and not the earth was the center of the Universe. Nor can we imagine the impact on western society when Columbus proved that the earth's surface was the surface of a sphere. In modern times, perhaps the most profound change in perspective that ever came about was when humankind looked back at the earth from space. What we saw was a fragile planet with huge but finite resources. We saw an environment that is not separate from ourselves and one where all living things are interconnected and interdependent. This is something that our ancestors knew innately but something that we somehow had seemed to have forgotten.

So, in some ways we have come full circle but in other ways we have learned much more than our forbearers could have possibly known. Our ancestors also observed trees very similar to the one outside my window and they probably had a very similar experience at some level of understanding of what it meant to experience a tree. And yet our experience and understanding of a tree is also very different than our ancestors because our reality of the object called a tree can be viewed from many different perspectives than the ones that our ancestors were aware of. Clearly our everyday

experience shapes our reality. The more we experience and know, the more our reality changes. We have come a long way since our cultural myths (religious traditions) were created over 2000 years ago and yet modern western society is still heavily influenced by these antiquated beliefs.

From the proceeding discussion it should be clear that perception of reality depends on our perspective and what we already know (or think we know). Figure 2-1 describes three aspects of our external (e.g. objective) reality at any point in time. The smallest oval represents all that we can currently observe with our senses and/or available instrumentation to augment those senses. The middle oval represents aspects of objective reality that we infer exists but cannot observe directly due to lack of appropriate instrumentation (ex. mostly empty space within the atom). As our technology improves, portions of reality that were not available to our observation come into focus so the scope of knowledge of observable reality increases (top oval in the figure) while in the scope of that objective reality that we cannot sense shrinks. But new knowledge implies new perspectives and new aspects of reality that we did not know existed before. This causes the domain of knowledge of what we cannot observe to increase again in an ever increasing spiral.

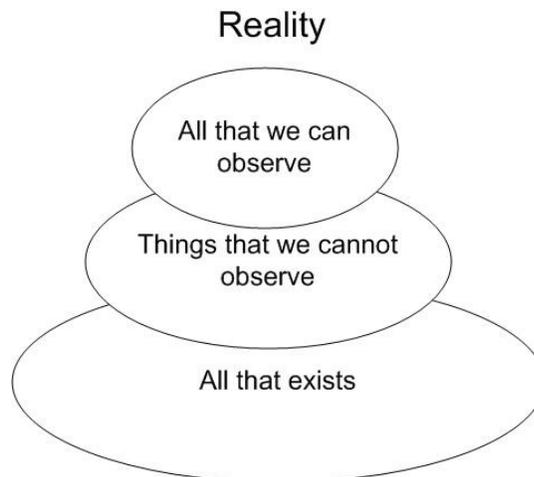


Figure 2-1

Throughout history there have been many pronouncements by respected individuals proclaiming the end of science. For example, at the end of the 19th century Lord Kelvin, the president of the prestigious British Royal Society made such a pronouncement to aspiring physics students telling them to pursue other interests because “all that was left to do was to refine nature’s constants to a few more decimal points”. According to Lord Kelvin and many of his colleagues, there were a few minor anomalies, but they were not a big deal and would soon be resolved:

1. The sun’s energy source - It had become clear that through the geologic record, the age of the earth (and by implication, the sun) had to be much older than previously thought. A sun made of coal would only burn for thousands of years, not the billions indicated by the geologic record.
2. The black body radiation problem - Predicting the intensity of radiation of heated objects at specific wavelengths was a problem. Predictions worked for longer wavelengths but did not at shorter wavelengths. This became known as the ultraviolet catastrophe.
3. The speed of light - The speed of light should be different depending upon where it was measured in Earth’s orbit as the planet moved through the aether of deep space.

Of course prevailing scientific explanations and speculations turned out to be completely incorrect. Eventually new investigations, discoveries and theories spawned whole new branches of scientific endeavors and technologies⁴ with major impacts on all facets of life. These new scientific disciplines were based on the discoveries of special and general relativity, and quantum mechanics that arose out of the investigations of those three anomalies. How were these discoveries made? By changing perspectives, questioning established paradigms and being open to anomalies that could not be explained by existing theories. Einstein changed his perspective by wondering what it would be like to travel across the universe on a beam of light – a question that no one had bothered to ask previously. The result was his now famous special theory of relativity.

⁴ nuclear power, semiconductor and associated electronic technologies

The modern formal process of gathering knowledge about the natural world is called science. As an organized method of inquiry into understanding the natural world, it is a very young but extremely successful discipline and is responsible for many aspects of our modern technological society. Over the years, science has developed a very powerful and successful protocol to investigate new phenomena. This protocol is called the scientific method of inquiry or scientific method for short. It is based on experimentation, repeatability, and peer review. Using this method of inquiry, only when multiple independent efforts have duplicated and validated the experimental results are the new theories accepted.

As productive as the scientific method has been, it is heavily influenced by prevailing paradigms. Like every other civilization throughout history, these paradigms are based on a set of largely unstated assumptions about who we are, what kind of universe we live in, and what is largely important to us. These assumptions, often unstated, spill over into science just as they do into all human endeavors. However, unstated assumptions or not, because of the tremendous successes of science in the last few hundred years, our existing world view is heavily influenced by the interpretations and pronouncements of the findings and discoveries of science.

Unstated assumptions in science grew in part out of the clash between western religious doctrine and the development of science as a formal method of inquiry during the renaissance. Today these interpretations are based on a set of metaphysical assumptions⁵ that underlie modern science. They are collectively referred to as scientific materialism and are based on several unstated principles. The first states that the only reality of importance is the one composed of independent objects and material items made of matter that exist outside of our minds. This is what we experience as objective reality and this concept is known as *objectivism*. It also implies that our inner subjective thoughts and feelings are of no consequence in studying these objective phenomena.

⁵ For an excellent reference on Scientific Materialism see B. Alan Wallace, *Embracing Mind: The Common Ground of Science and Spirituality* (Boston:, Shambhala Publishing, Inc, 2008)

Related to objectivism is the notion of *metaphysical realism* which purports that even though the external reality cannot be influenced by our subjective experience (e.g. mind), objective reality can be known and understood by it as a set of ideas written as mathematical formulas that are implicit in the very nature of reality. Unfortunately we often confuse the map (mathematical formulas) with the territory (material objects) and assume that the mathematical models are that reality rather than just predictions of how those material objects behave in certain situations.

Another assumption of scientific materialism is the *closure principle* which states that nothing can affect nature that cannot be explained by purely material causes. Strong emotions, prayer, remote healing and all psychic phenomena are all ruled out by this principle. A related principle is *physical reductionism* which is an approach to understanding the nature of complex things (e.g. systems) by reducing them to the interactions of their parts, or to simpler or more fundamental things (independent sub-systems). Furthermore these parts can each be isolated from the rest and have no relationship or connections to them. An example of this would be the mind arising out of the brain but where that mind can have no influence on the underlying brain structures comprising it.

The final principle is called *universalism* and supports the notion that natural laws are the same everywhere and for all time. For example, a hydrogen atom which comprises a water molecule in a cell of the human body operates according to the same principles a hydrogen atom undergoing a nuclear fusion reaction at the center of a star.

This philosophy of scientific materialism and its five cornerstones developed gradually over 300 years and have been unwittingly assimilated to be a part of science. So, scientific materialism is the current philosophy that guides and interprets most of modern science. Most scientists are unaware that they operate from within this interpretative framework and, as a result, it has provided its own set of biases to science. Scientific materialism is not science but is a set of beliefs that underlie science. It is only

one way to interpret scientific information and, as we shall see, there are other ways to perceive and interpret what we know as well.

Science has done a fantastic job at explaining objective (e.g. physical) reality but it has not been successful at explaining subjective (e.g. inner) reality. This includes things like feelings and emotions, creativity, meaning and purpose. It also includes what it means to be alive, to be in love, to appreciate and savor beauty or to experience despair or grief. It does not explain many other phenomena involving consciousness like psychic experiences or certain aspects of quantum physics (which also seems to be related to an observer's consciousness). There are many reasons for these failures but to understand them we need to review the context in which the roots of our scientific protocols for investigating nature developed.

Our scientific protocols started about the time of René Descartes. Descartes was a very influential French philosopher, mathematician, scientist, writer and scholar who was highly respected by church authorities. He lived in the first half of the 17th century, a product of a European religious society and one dominated by the church. Descartes developed a philosophy which is now referred to as the Cartesian duality. It arose because as science evolved based on the findings of several early scientists such as Copernicus, Galileo, Newton and their contemporaries, their hypotheses and experiments proved so successful in explaining aspects of the natural world that a conflict developed between theories validated by experimentation of these scientists and standard church doctrine.

Descartes' reflections on mind and mechanism began the separation of Western thought into two schools of thought: the "outer" material world (objectivity) and the "inner" world of consciousness (subjectivity). The compromise between the two, based on Descartes' philosophy, led to the separation of domains of inquiry between scientists and the church authorities. Science restricted its studies to the physical world and the church focused on matters of mind and spirit. This got scientists out from under the

authority of the church and allowed the church to be the sole “authority” on consciousness and spirituality.

This uneasy truce has lasted until the present day and has been primarily responsible for the reason why, until very recently, science has all but ignored the study of consciousness and several other related disciplines such as psychic phenomena, prayer and various non-local healing modalities. As we shall see later it has also led to ignoring the role of the observer in many scientific phenomena (such as quantum mechanics). The good news is that it also got the domain of science out from under the scrutiny of the church which is one major reason why science was able to advance so rapidly. The bad news was, however, that it also placed other ways of knowing (consciousness & subjective experiences) outside the bounds of science, a legacy that is only just now beginning to be addressed.

Unfortunately, for most of the modern period, studying objective reality in isolation from other ways of knowing leaves out much in our ability to understand the whole of reality. Science is not purely objective because scientists (like all people) are also subjective. Scientists interact with what is being studied. They are influenced by personal and societal beliefs and values. They experience the whole range of human emotions and feelings, and they are led to conclusions based on aesthetic considerations, intuition, creativity and flashes of insight all of which are part of the subjective experience.

From the perspective of mind (consciousness) there are really three ways of knowing reality, not just the aspect of knowing based on scientific materialism. Figure 2-2 describes a more complete view of how we know about reality. As we have already seen, knowledge can be obtained directly (e.g. objectively) by our senses or their extensions via instrumentation. These instruments augment the senses and include devices such as microscopes, telescopes, and various electronic devices that can detect all parts of the electromagnetic spectrum that the human senses are not naturally attuned to.

But we also learn about reality by direct inner experience (e.g. our conscious experience) which is our internal (e.g. subjective) view of reality.

In both cases, whether by subjective or objective experiences, every one of us provides meaning to our experiences by our own filters of mind. These filters are habits formed from our prior experiences (memory) and knowledge of similar situations or are based on where we focus our attention. Often these filters are handed to us by cultural and social conditioning and by authority figures so early in our lives they are later accepted by us to be fundamental truths. But they are not reality; they are based on our beliefs, values, expectations, assumptions and prior experiences.

Going back to the example of the tree at the beginning of this chapter, I expect that each time I look out my window, I expect (*expectation and belief*) the tree to be at the exact same location as the last time I looked (unless it was knocked down or moved by an external force) because trees do not sprout legs and move on their own (*prior experience with trees*). What would happen if the tree was still observable outside my window but had moved 1 meter away from the house? I would assume that someone had moved it because trees don't move on their own (*prior experience*). But as we shall see later, in many aspects of science our everyday experiences and interpretations are not correct when applied to many phenomena.

Three Ways of Knowing

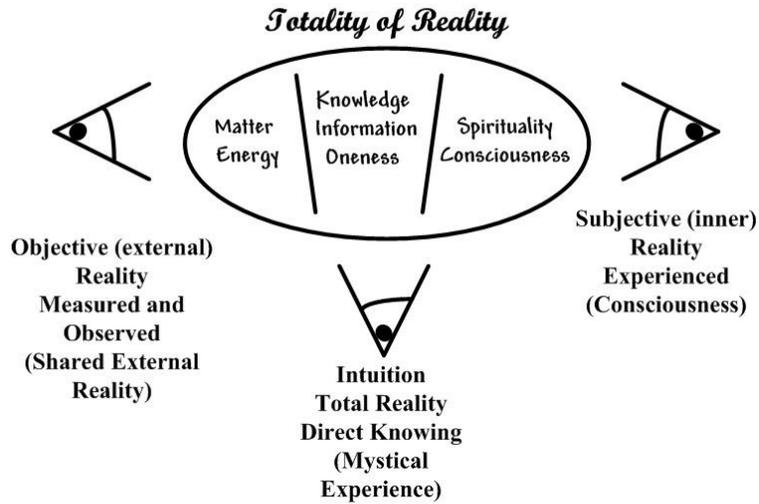


Figure 2-2

Throughout most of the modern era, faith can be particularly problematic in science where we are constantly probing nature to test the bounds of reality. Faith is usually based upon a firm belief for which there is no proof, passed on to us from an authority figure or it can be an inference based on prior knowledge. Either way, being open minded in science is very important to its advancement and therefore it is essential to understand where our faith or beliefs come from. Blind faith is the antithesis of scientific discovery but, if history is any indication, even in science faith directs scientific investigation more often than one might otherwise believe.

As an example, for almost 2000 years, it was assumed by everyone that heavier objects fall faster than lighter ones did because the highly respected ancient Greek philosopher Aristotle said so. It took Galileo in the early 1700's to finally prove by experiment that Aristotle was wrong. How many of our earliest scientists were burned at the stake by so called authorities of the time whenever a new idea violated established doctrine? And the problem still continues to this day. However instead of being burned at the stake, mavericks are ostracized or ridiculed by their peers and sometimes even forced to leave their chosen profession when they oppose accepted paradigms! History is full of

examples where new ideas are first ridiculed, then with new evidence, persistence and persuasion they become a revolutionary new theory and eventually become accepted and viewed as self-evident.

More subtle examples of blind faith or hard core beliefs can be seen today especially in areas related to consciousness studies or psychic phenomena. These beliefs can easily cause us to become blind to the obvious. These limiting beliefs can be summarized, according to Willis Harman⁶ as “the only limits to the human mind are those we believe in”. One of the common problems of investigating psychic phenomena and experimentation in the laboratory is the often negative correlation on the outcome of experiments as influenced by participants or experimenters that hold negative biases - the belief that psychic phenomena cannot possibly be real. Statistical evidence to the contrary is now overwhelming to anyone who cares to look⁷.

Knowledge is defined by the dictionary as what results from perception, learning and reasoning. We either perceive the object under investigation directly by observation or acquire facts of the object based on experimentation and inference. These resulting facts are the evidence that furnishes the proof one way or the other of our understanding of the phenomena being investigated. If the experimental or observational evidence supports our hypothesis, we have verified our hypothesis. If the evidence does not support the hypothesis we are testing, we have falsified the hypothesis and will have to consider alternatives. Such is the nature of the scientific method. But, implicit in this is that the experimenters’ beliefs do not affect the outcomes of the experiments. Unfortunately we know that this is not the case especially when those beliefs are emotionally charged. Experiments at the Institute of Noetic Science have now decisively demonstrated how experimenter bias can affect experimental outcomes.

We are all familiar with how beliefs and expectations can affect our state of mind and what we pay attention to. To demonstrate this assume, for example, you have just

⁶ President of IONS from 1977 to 1997

⁷ See Dean Radin, *Entangled Minds: Extrasensory Experiences in a Quantum Reality* (New York, Paraview Pocket Books, 2006)

met a person of the opposite sex that you have experienced an attraction and interest in. In that first encounter you did not have time to exchange phone numbers but you both agree to meet downtown in the park by the bench near the statue commemorating the town's founders tomorrow afternoon at 2:00PM. In anticipation of the meeting, you arrive early, take a seat on the bench and enjoy the scenery. Your mind is filled with romantic thoughts and you find yourself exploring the possibilities and excitement of a new relationship. You notice the birds, the people and the children on the playground. You are at peace and harmony with your environment and are experiencing a wonderful sense of wellbeing. At 5 minutes after two o'clock, your excitement has been tempered slightly but you still look forward to the encounter. At 2:10 you start getting concerned, upset and wonder if something has happened. By 2:15 a dark cloud begins to form in your mind and you notice feelings of irritation are stirring. No longer are you focused on the beauty of your surroundings and your mind is running through all kinds of scenarios including the possibility of being stood up. You fail to notice the fender bender on the street less than 100 yards away as your mind considers various options. By 2:20 you are now questioning what you should do and find that the concern has turned to anger and humiliation. You are contemplating leaving the park when you suddenly notice a familiar face walking toward you looking slightly hassled. After an apology for being stuck in traffic, your feelings of anger and humiliation quickly evaporate and you find yourself in a state once again of hopeful anticipation.

As this example shows, we provide our own meanings, our own interpretations to all events that we experience in our lives. And, they can change instantly based on the stories that we tell ourselves. These situations have a powerful effect on our emotions, feelings, beliefs and our perceptions of what we are experiencing. Our thoughts affect what we focus our attention on and on the assumptions we create about what we are experiencing. Scientists, of course, just like the rest of us, focus their consciousness based on their feelings and expectations. Perhaps this is why people make such unreliable witnesses in criminal investigations. It may also be the reason why it is difficult to get repeatable results in doing experiments involving consciousness when a skeptical participant is involved with the procedure.

So far we have discussed two ways of knowing: objective reality which is based on measurements and observations and subjective reality which is based on our conscious inner experiences. Figure 2-2 indicates that there is also a third way of knowing. This has been talked about and described in the literature and in cultural myths for millennia. Stories come from shamans, sages, aboriginal tribes, near death experiences, meditative states and states of higher consciousness. They all describe a holistic way of knowing. This is the same experience that sometimes happens during epiphanies. It is called by many names: Universal Mind, morphic fields, the collective unconscious, the noosphere, the akashic record or the inner wisdom voice. It is a way of knowing or / and a sense of oneness with all that is. In animals it is called instinct. In humans it is sometimes referred to as intuition. It happens to scientists, musicians, artists and anyone engaged in creative activities. Oftentimes flashes of breakthrough insight are the result of a period of intense conscious investigation and thinking lasting weeks or months which is finally put to rest and, as some would say, turned over to our subconscious mind. At some point later, a profound insight suddenly pops into consciousness and a new perspective or understanding is found often accompanied with a deep sense of truth and conviction.

Whether it is by objective, subjective or intuitive ways of knowing, it is clear that all ways of knowing have one thing in common and that is *our consciousness*. So, if we want to understand reality we better understand consciousness. The problem is that consciousness is not well defined or understood. In science, the mind has been treated pretty much as a black box because it cannot be directly detected with instrumentation. Provide some input into it (e.g. objects of awareness or stimulation) and observe the outcome (attention or intention). Twenty five hundred years ago Buddha made the observation that “We are what we think. All that we are arises with our thoughts. With our thoughts we make the world”. So it seems that we have known for over two millennia that we cannot remove ourselves from interacting with what we are studying.

During the modern era in our studies of brain / mind, the accepted paradigm is the notion that consciousness is an epiphenomenon (e.g. an after-effect) that emerges from

complex physical brain structure. However this is an assumption that has never been observed and certainly not proven by the scientific method. In many cases alternative explanations for consciousness have not been considered. By studying people that have experienced brain damage and how it affects those individuals, the claim is made supporting epiphenomenalism. But these studies with their so called clinical evidence do not prove that the brain produces consciousness. They only show that consciousness is associated with the brain. And so it is for all organisms with brains. But, what about living organisms that do not have a brain? Clearly amoeba are aware of their surroundings and therefore have some aspect of consciousness (awareness and intention) but without brains.

An analogy often cited to illustrate this point is that of a television set. If I tamper with the color circuitry of the set such that the picture is only displayed in black and white, have I found where the color in the picture originated from? Clearly not, it came from the TV station that broadcast the image. All the TV set did was to decode the received signal and display the resulting images in the form that we could recognize. Damage the color reception and decoding circuitry in the TV and the picture is affected but the incoming TV signal is still intact. Similarly, with regard to consciousness, there have been many well documented cases of people who were declared clinically dead (EEG totally flat) that when later recuscitated recalled detailed experiences during the time they were clinically dead⁸. How would such a phenomena be possible if consciousness was an epiphenomenon of the brain?

The architect, designer and author Buckminster Fuller wrote that “if you want to understand the human condition, you must first understand the universe”. If you ask any great mystic, they will say if you want to understand the universe, you must first understand the ‘Self. To do that, clearly our study of reality must begin with an understanding of consciousness. We must begin by questioning the meaning we have

⁸ For an excellent account of Near Death Experiences (NDEs) see Kenneth Ring, Ph.D., *Lessons from the Light: What we can learn from the near-death experience* (Needham, MA: Moment Point Press, 2000).

given to the world and question all the assumptions and beliefs that we all harbor about that world.

We have attempted to show in this chapter the following:

- Our science is clearly incomplete and has a long way to go
- Our cultural traditions are based on knowledge and understanding of reality that is woefully out of date
- Our experiences are real but our interpretations of them may not be

To gain a better understanding of reality we must include many natural phenomena which exist outside the scope of current science. That means including our inner experiences (e.g. consciousness). We must also reassess our ways of knowing about reality and how our existing paradigms, belief systems and prior experiences can affect our reality. From these expanded perspectives we will then be in a better position to develop a new and expansive view of reality.

We shall now turn our attention to new developments in science that will lead us to such a change in perspective.

CHAPTER 3 - SCIENCE IN THE 21ST CENTURY

Emerging Discoveries in Science

According to accepted theory our universe began in a spectacular fire ball called the big bang some 13.7 billion years ago. Before that initial moment there was nothing, no matter, no energy, no space and no time and certainly no life. Shortly after this incredibly explosive beginning from a point infinitesimally smaller than an atom, the energy of creation cooled and produced vast quantities of primordial gas: hydrogen, some helium and very small amounts of lithium. These gases filled all space and all were products of the big bang. Over eons gravity caused these gas clouds to condense forming the first prototype galaxies and later prototype stars within those galaxies. As the primordial gases compressed further into islands of dense condensed gas under the increasing pull of gravity, these coalescing islands of gas eventually got hot enough to ignite the nuclear fires within and nuclear fusion began heralding the birth of the first stars.

For eons, the outward pressure of nuclear fusion balanced the inward pull of gravity and these stars remained in a state of equilibrium radiating out electromagnetic energy primarily in the form of heat and light in all directions. Over the eons as the hydrogen fuel was used up, the stars compressed further since the nuclear fires had diminished to the point that enabled gravity to gain the upper hand. However, the increase in gravitational compression raised the temperature at the core of those stars and the process of nuclear fusion continued on - this time with the burning of helium, a heavier element that fused at a higher temperature. As this fuel was consumed, this process repeated several times and each time still heavier elements were created

depending on the mass of the star⁹. These elements included carbon, oxygen and so on all the way up through iron.

Finally as these stars used up all their remaining fuel, there was no longer anything to counter the gravitational pull of the matter comprising the stars, so they collapsed upon themselves, rebounded from the incredible pressure built up and then literally blew themselves apart in super nova explosions. In these tremendous explosions the remaining heavier elements were created and scattered throughout interstellar space to mix with primordial hydrogen and helium left over from the big bang. The shock waves from these explosions also created so much energy and force in these gas clouds that they began to coalesce again. Gravity did the rest and eventually second generation stars and planets were created.

But something else also happened as well. These stellar explosions produced so much energy that the heaviest elements beyond iron and complex chemical compounds (consisting of molecules made up of the atoms which combined chemically) formed in inter-stellar space. Spectral analysis of these interstellar clouds of dust and gas reveals that many compounds that formed included many of the organic molecules that are the building blocks of life¹⁰. So, it seems that we are direct descendants of the ashes of previous generations of stars and, in fact, can trace our roots back along an unbroken chain of events some 13.7 billion years ago when it all began in the gigantic fireball of the big bang.

Our solar system, the sun and the planets are at least the third generation in the process described above. The sun and its companions in the solar system coalesced about 4.5 billion years ago. As the earth and the other planets formed, for the first 500 million years or so they were constantly bombarded with the remnants of the debris (meteors and

⁹ The mass of the star also determines how long a star will shine. The bigger the mass the shorter the life span of the star because larger stars consume fuel much more rapidly to counteract the pull of gravity.

¹⁰ Since light travels at a finite speed of 300,000 km/sec, looking at huge distances in space is like looking back in time because of the time it takes light to reach us from distant celestial objects. In fact the standard measure of distance in space is the distance it takes light to travel in one year (light-year) or 9.5 trillion km. This is not quite 20% of the distance to the nearest star from our sun.

comets, etc.) left over from the formation of the solar system. These impacts generated tremendous heat as these objects slammed into the earth and the dissipation of this energy kept the earth's surface in a molten state making the environmental conditions suitable for life impossible. But as the debris cleared and the earth's surface cooled, life evolved in very short order. In fact, the geologic record shows fossil evidence of single cell organisms inhabiting the earth as early as 3.8 billion years ago, a mere few hundred million years after the earth's surface cooled. Once life began it took that single cell life almost 3 billion years before multi-cellular organisms evolved. But during that long process cells grew increasingly complex. Some differentiated and some used photosynthesis to produce and release vast quantities of free oxygen first in the oceans and then into the atmosphere, perhaps creating the prerequisite for all multi-cellular organisms on earth. And with these multi-cellular organisms came nervous systems, brains and eventually higher states of consciousness culminating in the arrival of self-reflective consciousness residing in homo-sapiens sapiens today. And it only took 13.7 billion years from the start of it all for nature to reach this level of incredible complexity.

Just how complex is an adult human body? Our bodies are made up of approximately 100 trillion cells (10^{14}). Each of these 100 trillion cells performs about 10,000 (10^4) biochemical reactions per second which involve about 100 billion (10^{11}) atoms in each cell in this process. Furthermore, while these cellular processes are going on, each night up to 1 trillion (10^{12}) cells die and are replaced. Cells, of course, are differentiated into organs; the brain, for example, is made up of 100 billion neurons with an average of 2,000-5,000 synapses per neuron. The activities within and between all of these cells, tissues, organs and organ systems are all running simultaneously. It is difficult to imagine that the growth, building, repairing, the coordination and managing of this huge number of cells can be explained just by electromagnetic and chemical signaling alone or from the information coded in our genes¹¹.

Examining the evolution of the universe and everything in it from the perspective described above, it becomes clear that since the very beginning, the universe has been

¹¹ DNA and RNA

continuously evolving to increasing states of complexity (e.g. highly ordered states) and further that the rate of this complexity has been increasing exponentially. This is depicted in figure 3-1. It appears that we live in a universe that not only exists because of its energy and matter but has evolved in such a way that it also knows itself through evolved intelligent beings who can utilize nature's own information to understand itself and perhaps someday all of creation. This incredible outcome prompted the Princeton physicist Freeman Dyson to speculate that "It seems that nature knew we were coming" since the universe appears to be such a friendly place for the formation of complex life forms. Perhaps a better explanation is that the universe fine tuned itself through trial and error learning with feedback and memory to bring about the prerequisites for life and then life itself along with self reflective consciousness.

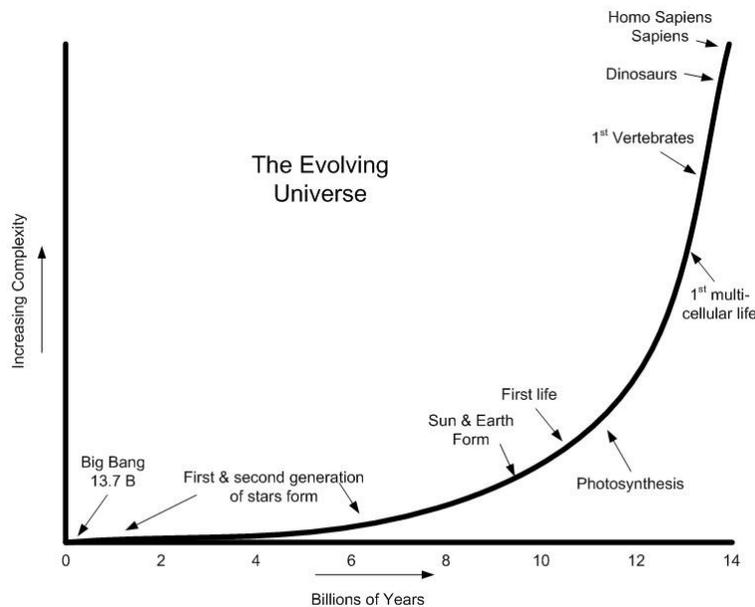


Figure 3-1

But how could such a magnificent trial and error learning process of evolution have come about and what are the mechanisms that make it so effective? Certainly it does not seem that random mutation and chance as described by Darwinian evolution brought us to the present moment. Several scientists¹² have made calculations based on mere random chance that indicate that the probabilities of life and complexity reaching the current levels would not have happened for 10^{100} years. This time span is way beyond the

¹² See Roger Penrose, *The Emperor's New Mind*, Penguin Books, 1991, NY

present age of the universe. This prompted the British astronomer Fred Hoyle to proclaim that “The odds against the spontaneous assembly of life are similar to a whirlwind sweeping through a junkyard and producing a fully functioning Boeing 747”. Also, emerging evidence suggests that Hoyle’s early concepts of continuous creation, rather than big bang are gaining some acceptance. Recently discovered dark energy and dark matter have been suggested as proto-matter beginning to organize.

So we have now defined our task for the remainder of this monograph. We started the last chapter with what we know about reality. Let us now examine this more closely and see where it leads and on the journey we will develop the evidence that supports the following suppositions:

The evidence that we shall present suggests that we live in a universe that that is

- Self organizing
- Intelligent
- Creative
- Trial & error
- Interactive
- Learning
- Participatory
- Informationally non locally interconnected
- Evolving
- Based on the same principles as quantum mechanical systems

Furthermore we are a part of this universe and cannot be separated from it and are interconnected with it all.

In 1400 BC, the Oracle of Delphi was the most important shrine in all Greece, and in theory all Greeks respected its independence. Built around a sacred spring, Delphi was considered to be the center of the world. People came from all over Greece and beyond to

have their questions about the future answered by the priestess of Apollo. And her answers could determine the course of everything from when a farmer planted his seedlings, to when an empire declared war. One of the key lasting messages that the oracle advised was “to know thyself”. In modern times perhaps we need to extend this wisdom by stating that we should know ourselves as part of an interconnected rapidly changing and evolving world.

There have been many scientific discoveries in the last few decades that are pointing to the new sciences of our evolving universe and the implications of oneness and interconnectedness that we have been describing. They include the following disciplines that we shall introduce in the remainder of this chapter:

- Systems & process theory
- Non linear systems & complexity theory
- Chaos theory
- Non-linear thermodynamics
- Information theory
- Theories of self-organizing and self-regulating systems

One obvious conclusion of anyone trying to understand the nature of nature soon reaches the point where he/she realizes the awesome complexity involved. Scientists try to simplify this complexity by breaking reality up into the smallest and simplest pieces. They then try to look for the understanding of what is usually an oversimplification of nature and one that is often divorced from the real world that is being studied. The process of breaking a system down into its component parts is called reductionism. It is an approach to understanding nature that is accomplished by reducing components to the interactions between them, or to simpler or more fundamental things so that the whole can be understood. Unfortunately, as we shall soon see, understanding nature requires a much more holistic approach.

The classical way of analyzing something in nature is to consider the phenomena being studied as an isolated system. The system and subsystems that comprise it are further treated as a group of independent but interrelated elements comprising the unified whole. In reality, the elements of a system usually all work together by way of some type of dynamic process. Usually there is a flow of matter or energy or transfer of information between the parts. These flows, for purposes of analysis, are classified as closed or open systems. In an open system both matter and energy can transfer across the boundary that defines the system. In a closed system only energy can transfer across the boundary but not matter.

Note that since information is nothing more than patterns of matter or energy¹³, in both types of systems, information can transfer across the system boundaries. Systems or, more correctly, their subsystems are defined to exist at all scale sizes from the sub components comprising an atom, to organ systems in animals and all the way to the largest structures in the universe. In nature however there is really only one system and that is the entire universe. All of nature's components interact with each other in a cosmic dance that has been going on for the last 13.7 billion years. In reality, everything affects everything else and to understand it all you have to understand the whole web of connections. For this reason, in the last few decades, more and more scientists have come to the conclusion that the mathematical formalisms (models of reality) are really abstractions that often ignore the real complexities that exist in nature. In other words, they are maps (e.g. models) and only partially describe the territory they represent.

For much of the past 300 years scientists have assumed that the most important systems were all linear. And in linear systems¹⁴ the whole is exactly equal to the sum of its parts. If a system is nothing more than the sum of its parts, each component can be thought of as independent from all others regardless of what is happening elsewhere. Linear systems tend to be easy to analyze. And there certainly is a portion of nature that appears to behave in a linear fashion. Historically, one of the reasons that science has

¹³ As we shall soon see, meaning is assigned to information by consciousness.

¹⁴ The name linear system refers to the fact that when the equations representing them are plotted on a graph, the resulting plot is a straight line.

placed so much emphasis on linear systems is that before the advent of high speed computers, it was very difficult to think about many of the more complex processes of nature because the tools to analyze them did not exist. So, nonlinear systems were not considered. Equations with more than just a couple of variables were often just too complex to handle. However, most of nature is nonlinear especially much of the really interesting phenomena of our world. With ubiquitous, high speed computers now available for the first time, some of these difficult and complicated nonlinear systems can be analyzed. The new science is known as nonlinear dynamics. These new tools force scientists to recognize the important fact that often the whole of reality is much greater than the sum of its parts¹⁵.

All life is a nonlinear system and operates as an open system as well. One of the properties of open systems is interaction with their environment by exchanging matter, energy and information through utilization of either positive or negative feedback loops (see figure 3-2). A negative feedback loop is one where these exchanges are used to maintain a system in a relatively stable condition by oscillating about some optimum state. For example, when a human gets too hot he/she perspires and the evaporating moisture cools him/her down; on the other hand if he/she gets too cold he/she will start shivering which will warm the body back up. In a positive feedback loop, the process does the opposite and increases the rate of change away from equilibrium which can create run-away processes. As an example of positive feedback loops, consider one of the consequences of global warming. As the polar ice caps on earth continue to melt, the decreasing ice surface covering the ocean (which is a great reflector of radiant energy from the sun) and enables the liquid ocean to absorb much more energy, further exacerbating the global warming problem¹⁶.

¹⁵ The mathematical formulas for these systems are represented by non-linear equations (curves when plotted on a graph).

¹⁶ A similar positive feedback loop also occurs as ocean temperatures rise; carbon dioxide dissolved in the warming oceans can escape into the atmosphere trapping more heat near the surface of the planet.

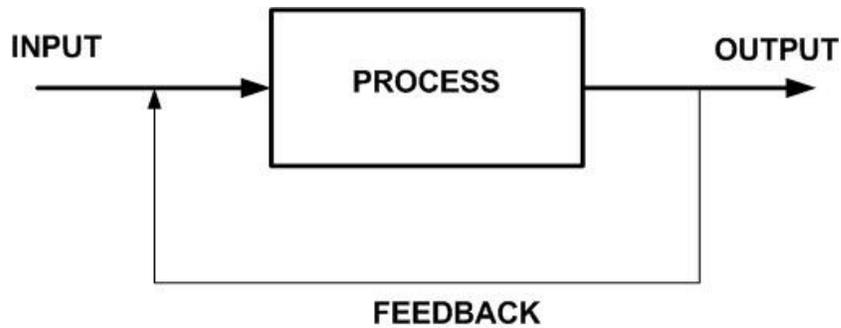


Figure 3-2 Example of a Feedback loop

Clearly all systems cope best when they are utilizing feedback to operate close to their equilibrium (or optimum states) because a large deviation from that equilibrium will force them to operate much less efficiently and may even prevent them from working at all.¹⁷ In an evolving universe, the flexibility that is achieved via feedback loops allows all subsystems to adapt to changes in the environment and is essential. These feedback loops also imply that there is some type of self-organizing and self regulating principle directing this feedback process that is at work. These directed processes, in turn, also imply a number of other attributes such as awareness, intention, and memory (more about these later) that are also at work¹⁸.

As mentioned earlier, one of the interesting properties of non-linear systems is the idea of emergence where the whole demonstrates properties that are greater than the sum of the parts. Systems that exhibit emergence are often driven by some form of self-organization where the system migrates from a state of less organization to one of even more organization. This runs counter to the second law of thermodynamics and the idea of entropy that states that systems move to more and more disorder (e.g. they run down and eventually reach a point know as “heat death” or thermal equilibrium with the surrounding environment; for example, a cup of coffee cooling until it reaches room temperature). Increasing entropy turns out to be just the opposite of what biological systems (e.g. life) do. For example, living organisms take in energy, matter and information from their environment to maintain a stable and highly organized internal

¹⁷ In living systems that is called death.

¹⁸ We shall see later that this is the fundamental definition of consciousness

condition usually far from the equilibrium (disordered) conditions of their surroundings. They also use these to increase their own structural integrity (growth, repair and reproduction). Living organisms also shed the increase in disorder (entropy) to the surrounding environment while using energy to minimize the harmful effects on their own structure.

In self-organizing systems there are often long periods of stability followed by what appears to be a significant “random” change which is followed quickly by evolving to a higher state of complexity. This process is called emergence. Emergence manifests at all levels of nature. As an example, consider hydrogen gas (H_2) which is a colorless and odorless gas at room temperature with a boiling point of $-252.87^\circ C$. Oxygen (O_2) is another colorless and odorless gas at room temperature with a boiling point of $-182.95^\circ C$ that is also highly reactive. So reactive, in fact that it reacts explosively with hydrogen. When they react together they produce a universal solvent, a liquid at room temperature known as water (with a boiling point of $100^\circ C$). One of the interesting properties of emergence is that it is often impossible to predict the emergent properties (water) knowing only the properties of the components that made it up (hydrogen and oxygen).

By the way, emergence is one of the reasons why the reductionist approach to understanding nature is so problematic. Imagine that you were to disassemble your automobile and spread out all the individual component parts on the floor and ask someone to figure out how all these parts worked together and what their emergent properties were. That would be a very difficult challenge indeed (even if we know what the fully assembled automobile is supposed to do). Certainly life also is an emergent phenomenon where the whole is greater than the sum of its parts. It is much more than the product of DNA, RNA, proteins and many other molecules all just obeying the laws of chemistry. As will be described later, life also utilizes many other aspects of nature at the quantum (e.g. subatomic) level that are only now beginning to be understood. Life is truly complexity built upon complexity and the result is that at each new level of complexity entirely new properties appear.

Related to nonlinear systems is a new branch of science called chaos theory. This new science defines a set of approaches used to study nonlinear phenomena. Specifically chaos is a particular type of nonlinear phenomena where seemingly random events are actually predictable using very simple equations. Something that appears to be locally unpredictable (the flapping of a butterfly's wings) may have global implications (a hurricane changing directions off the coast of Florida three weeks later) and that this effect is extremely sensitive to initial conditions (exactly when the butterfly flaps its wings). If the butterfly flaps its wings just a few seconds later the hurricane veers to the north instead of to the west. For obvious reasons this extreme sensitivity to initial conditions in nonlinear systems is known as "the butterfly effect".

Clearly when a butterfly flaps its wings is unpredictable, but so are the effects of that flapping. Flap them at one point and one thing occurs, flap them at another point and something different occurs. These points are referred to as bifurcation points and usually occur far from the point of equilibrium of the system. Any further energy input into the system at such a point will cause the system to branch into a totally new type of behavior (see figure 3-3). Usually when such a change happens it is very sudden rather than a slow and gradual change. The change is not predictable and it heralds the transition of a nonlinear system into a realm where new laws will dictate the behaviors of what will occur to the system.

Sometimes when a bifurcation point is reached the system will disintegrate into chaos and at other times it will transition to new or more differentiated higher level of order. But in either case it is often impossible to determine in advance which way the system will move in advance¹⁹.

¹⁹ This is one of the potential problems with the effects of global warming on the earth's climate.

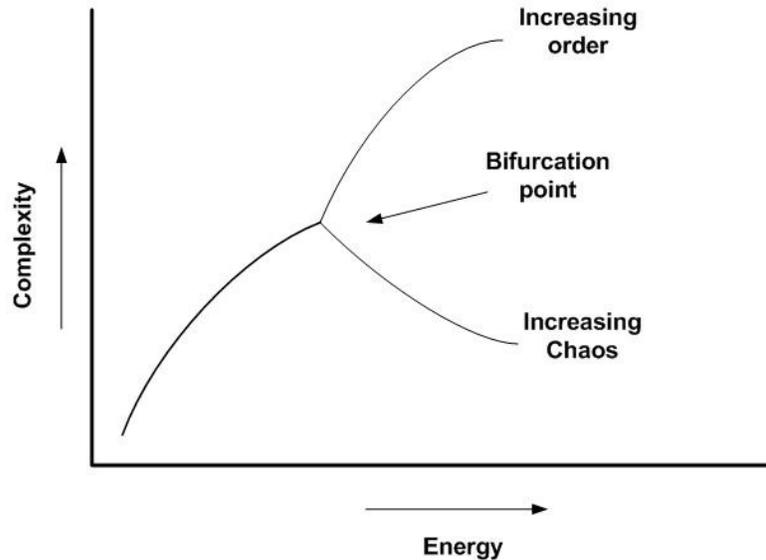


Figure 3-3 Bifurcation Points

A basic condition of all living systems is that they are dissipative (e.g. exist far from thermodynamic equilibrium and do so by efficiently generating and dissipating heat to sustain them). They require a flow of energy in and out of themselves and this energy is used to keep these organisms alive and also to maintain the boundary between themselves and the outside world. All life therefore interacts with its environment in complex, non-linear ways. These complex adaptive living systems from a single celled organism all the way to humans; all improve their fitness to their environment by learning (e.g. utilizing feedback and memory). As the environment changes they must adapt to survive by taking new forms or exhibiting new behaviors that work better in the new environment. Does this imply in some sense that living things can anticipate the future? Feedback and memory seem to provide the mechanism that complex adaptive systems use to make predictions and to modify behavior based on those predictions. Perhaps this is the root cause of creativity in living systems.

Earlier in this chapter we described how every day many of the cells in our body die off and are replaced. Over the course of one year just about every cell in the body has been replaced; some many times like the cells comprising our stomach lining. Other cells, like bone cells can last far longer. But, in spite of the frequency at which they are replaced, our bodies retain our identities. Perhaps what makes us who we are is not so

much the cells comprising our physical bodies (e.g. structure) at any point in time, but rather the processes, matter, energy and information that are utilized and are transmitted by those structures. Malcolm Hollick²⁰ also makes a very important distinction between structure and process - one that is all a matter of perspective: “Many systems change very slowly compared to the human time frame of years or decades. The sun, and moon, rocks and non radioactive atoms all appear eternal and it is often appropriate to treat such systems as constant structures. But, if we change our timeframe, our perceptions also change. In infinite time, everything changes and nothing is a fixed structure. But in an infinitesimal time span, nothing changes and everything is static.” Needless to say all living systems operate in the middle of these two extremes.

Complex adaptive systems have a wide range of applicability and can be used in studying things ranging from social systems, ecologies, ant colonies, neurons in the brain and even developing embryos. In all these cases coherent behavior operates by cooperation among the components themselves. It turns out that coherence is a fundamental property of nature and exists at the most basic levels – that of subatomic particles and everything that they comprise. This coherence serves as one of the building blocks for the components at higher levels of organization. It enables organization and the experience gained from the organization to have a positive effect on the system to provide a further strengthening or reinforcement while those with negative or no effects on the system tend to weaken that coherence and eventually cause it to die out. Could this be the mechanism for evolution?

In this and subsequent chapters we have begun alluding to and making the case that complex molecules, cells & living organisms seem to exhibit self organizing and quantum-type processes on a macro scale (e.g. human scale) that include the following principles:

- Demonstrate self organization and emergence
- Utilize coherence and feedback

²⁰ Malcolm Hollick, *The Science of Oneness*, John Hunt Publishing, Ltd., 2006, London, UK

- Are interconnected
- Are nonlinear
- Perform transfers of energy, matter and information
- Transfers happen within and between the genome and phenome²¹ for all organisms and their environment
- Mutations of genomes appear to be influenced by the changing states of the phenome and not just by purely random means

We have also alluded to a number of properties that apply at the most fundamental levels of reality. Finally we have also seen how all of reality is a complex interactive, interdependent, and interconnected system.

Let us now turn our attention to the mechanisms of these interactions at this most fundamental level – quantum physics.

²¹ The *genome* of an organism is the complete set of heredity information that is encoded in the organism's genes (DNA & RNA). The *phenome* is the set of all observable characteristics of an organism. It results from both the expression (e.g. what it looks like and how it behaves) of an organism's genes as well as the influence of environmental factors.

CHAPTER 4 – QUANTUM PHYSICS

THE STRANGE WORLD OF THE QUANTUM

Classical physics traces its roots back to the days of the ancient Greek philosopher Aristotle but it really became a major force in science from the contributions of Galileo and Sir Isaac Newton and their contemporaries in the 17th and 18th centuries. It is the branch of physics that is based on the science of describing and predicting the position and motion of objects and the forces that act on them. It generally deals with macro-scale objects (e.g. human sized or larger). It specifically excludes objects at relativistic speeds or quantum mechanics both of which were not developed until the 20th century.

Quantum mechanics deals with the behavior of matter and energy and the forces that act on them at the atomic and subatomic level. It is an attempt to describe reality at its most fundamental level since all macro-scale matter is composed of atoms. It has been combined with Einstein's theories of relativity which include how massive objects influence other objects in their vicinity or how objects move at speeds at or near the speed of light. So combining quantum mechanics with relativity theory, both products of the 20th century, describes a new physics that shows how matter and energy are connected across time and space.

Both quantum mechanics and relativity theory have proved to be the most successful models of nature that have ever been discovered and are responsible for much of the technologies and products in use by the public, commercial and governmental sectors of modern society. In spite of their successes, both theories describe a reality that is very different from what we experience in everyday life. At this level:

- Matter consists of mostly empty space. The nucleus of an atom takes up 1/100,000 of the volume of an atom but contains 99.9% of the mass. If an atom were expanded to the size of a football field, the nucleus would be

the size of a pea in the center of the field on the 50 yard line and the closest electron whirling around the nucleus would be the size of a grain of sand and located in the end zone.

- Matter and energy exist as quanta or packets (e.g. they only come in fixed sizes with nothing in between those fixed sizes)
- Objects do not move from point A to point B but disappear from point A and then mysteriously reappear at point B without traversing the distance between the two points.
- Objects exhibit characteristics of both particles and waves simultaneously. What you observe depends on the experiment you conduct or the questions you ask.
- It is impossible to determine both the position and speed of an object simultaneously. If you know one quantity the other one will be indeterminate.
- Particles are “entangled” in such a way that they communicate with each other instantaneously across vast distances (seemingly violating nature’s ultimate speed limit – the speed of light). This property is called non-locality. These entangled particles maintain coherence with each other irrespective of their path or distance between them in the cosmos.
- Matter curves space. Very large objects (e.g. stars and other stellar objects) bend space significantly. Black holes bend space so much that not even light can escape from them. (at least in one accepted interpretation of the phenomenon)
- To an outside observer, as objects move at speeds close to the speed of light their mass increases to infinity, time slows down and stops (at the speed of light), and objects shrink in the direction for travel (to zero length).
- Fundamental processes of nature seem to be governed by laws of probability and not laws of certainty.

Properties like the ones described above prompted the following comments from some of the founders of quantum mechanics. From Niels Bohr: "If your head doesn't swim when you think about the quantum, you haven't understood it". From Richard Feynman: "My physics students don't understand it either. That is because I don't understand it."

So, what is the essence of quantum mechanics? It is a theory and the current standard model of describing the behavior of matter and energy at the smallest scale sizes and includes particles like photons, atoms, nuclei, quarks, gluons, etc. Like all theories in science, it consists of a model (e.g. mathematical formalism) that predicts the behavior of these particles under various circumstances and it also includes an interpretation of that model (in fact, several). The model used in quantum mechanics has been accepted by the mainstream physics community and used for over 80 years and is one of the most successful ever discovered in science. It has been verified by experiment many, many times. No exceptions to the model have ever been found, however, the interpretations of the model remain a matter of controversy and debate and are counter-intuitive to everyday experience as we shall now describe.

The accepted 20th century interpretation of quantum mechanics that applies today is that the theory only pertains to atomic scale matter. This view is still accepted by the majority of the mainstream physics community. However evidence is now being amassed by experimental results in the laboratory that demonstrates that some of the aspects of quantum mechanics also apply to all physical matter including macro scale objects (e.g. human scale and above). These macro scale objects seem to display several quantum properties including:

- Entanglement
- Coherence / Quantum correlation
- Non-locality (near & far)
- Resonance

We shall describe these properties later in this chapter since they have enormous implications for the nature of reality and a key new discovery called the Quantum Hologram which we will describe in chapter 6.

It was mentioned before that although the model used to describe quantum events is extremely accurate, the interpretation of what the model means is still subject to debate and controversy. One of the most widely accepted interpretations is called the Copenhagen Interpretation proposed originally by Neils Bohr but vigorously rejected by Albert Einstein. This interpretation presents the quantum world as having the following characteristics:

- The properties of matter do not exist until the matter is measured
- Indeterminacy (only probabilities exist) is a fundamental property of matter. Einstein strenuously rejected this tenant with his famous quote “God does not play dice with the universe”.
- There is a fundamental paradox between the probabilistic nature of microscopic physics (e.g. unpredictable outcomes) and the determinist nature of macroscopic systems that we are familiar with in our everyday world (e.g. predictable outcomes).
- Matter seems to exist as waves while it is not being observed and is spread throughout space. Once observed the “wave function collapses” and matter becomes a particle defined at a specific position in space. The mechanism collapsing the wave function seems to be the act of observation or consciousness. This prompted Albert Einstein to speculate “Would the moon exist if no one was looking at it?”

The Copenhagen Interpretation implies that absolute reality does not exist, but that there are an infinite number of potential realities. When a conscious observer (sentient being) comes along, the universe collapses into what we observe. So if a tree falls in the forest and there is no one there to observe it, did it really make a sound? With

the Copenhagen Interpretation, the answer has to be no because the tree and the sound do not exist as discrete separate entities if no one is there to observe them.

There are also several other major interpretations of quantum physics and include the “Many Worlds” and “Transactional” interpretations to name a few. The Many Worlds interpretation proposed by Dr. Hugh Everett at Princeton University is an approach to quantum mechanics which assumes that in addition to the world that we are directly aware of, there are many other similar worlds that exist in other universes which exist in parallel with ours. With this interpretation, every time an observation is made at the quantum level (e.g. an experiment), all possible outcomes are obtained, each in a different universe. The implication is that everything that can ever happen did happen in an infinite number of universes and that everything that could possibly happen in our universe but doesn’t happen in another universe. Our world only sees one possible outcome. Since the role of the observer (e.g. consciousness) lies at the heart of most quantum paradoxes, this theory seeks to circumvent the need for consciousness to have any influence on an experiment.

Another interpretation, Transactional Theory, first proposed by John G. Cramer at the University of Washington in 1986, tries to get around the role of an experimenter (consciousness) by assuming that particles on the quantum scale “know” about things in the future. Somehow the particle sends out waves from the present to the future and then receives advance waves from the future. This process is repeated several times until the transaction is completed and the wave function collapses. The Transactional Theory removes causality from reality which states that there must be a prior cause if an event is to happen.

A recent experiment²² seems to suggest that the transactional interpretation may be the correct one since the other two interpretations mentioned above fail the experiment. As we shall see later this experiment, although still controversial in the

²² This experiment is called the Afshar experiment and was designed and tested by Shahriar Afshar in 2001. The experimental results were later reproduced at Harvard University in 2003.

physics community, lends significant support to transactional interpretation. The transactional interpretation is also consistent with the Quantum Hologram which we shall present in chapter 6. So, it would seem that Transactional Theory may, in fact, be a better description of the nature of reality than that offered by either the Copenhagen or Many Worlds interpretations.

Before we can discuss some of the quantum properties of sub-microscopic systems we must first review the phenomenon of waves because, as we shall soon see, waves play a major role in defining quantum reality. So, what is a wave? Simply put, a wave is a disturbance or vibration that transmits energy through a medium²³ (e.g. a substance such as air, water or solids). A typical description of a wave is shown in Figure 4-1.

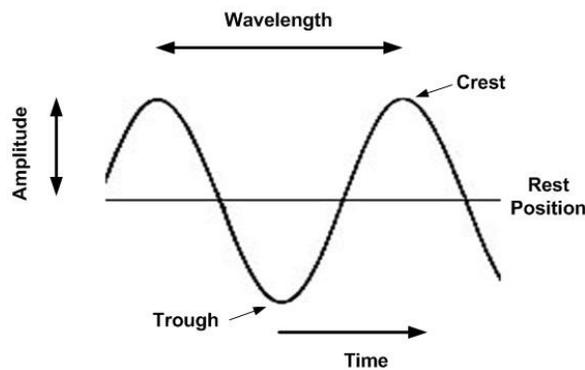


Figure 4-1

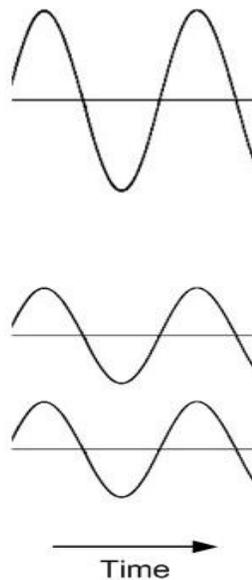
This figure shows the waveform of a sine wave. The height of the wave from the rest position of the medium to the top (wave crest) of the wave is called the amplitude and reflects the amount of energy in the wave²⁴. The amplitude can also be measured from the rest position of the medium to the bottom of the wave (wave trough). The wavelength is the distance from two consecutive identical points although by convention it is often measured from one crest to the next adjacent crest. It turns out that wavelength and frequency (e.g. the number of times the wave repeats in a given time and is usually

²³ Electromagnetic waves do not require a medium and can propagate directly through the vacuum of space.

²⁴ Both amplitude and frequency reflect the amount of energy carried by a wave. In either or both cases larger values implies the wave carries more energy.

measured in cycles per second) are inversely related by the formula $V = F \times \lambda$ where V is the velocity of the wave, F is the frequency of the wave in cycles per second and λ represents the wavelength. Since the velocity of a wave is constant²⁵ in any given medium, as you decrease the wavelength the frequency must increase by a corresponding amount as described by the formula.

Waves are basically energy disturbances and unlike matter, two or more waves can coexist at the same place and at the same time. When two waves of the same wavelength are aligned such that the crests overlap, constructive interference occurs and the resulting combined wave amplitude is the sum of the amplitudes of the two individual waves that are combining. As the waves pass each other each wave returns to its original shape. This superposition (top image) is shown in the following figure:



Constructive Interference of Two Waves

Figure 4-2

When two waves of the same wavelength are aligned such that the crest of one wave and the trough of another are aligned, the two waves cancel each other out (e.g. the

²⁵ For light or any kind of electromagnetic radiation, the speed of the wave is always 300,000 km/s in a vacuum regardless of frequency. Because it is constant in a vacuum, the speed of light is often represented by the letter C so the formula relating frequency and wavelength is often written as $C = F \times \lambda$.

wave amplitude of the combined wave becomes zero). This is known as destructive interference.

Coherence is a property of waves describing how well two or more waveforms line up with each other in time and space. Two sources emitting waves are coherent if their waves line up perfectly. For waves to be coherent they must have the same wavelength and hence the same frequency. Since waves are often emitted in bursts that are finite in length, the wave packets must also be in phase to be perfectly coherent. For a good example explaining how powerful coherent waves can be, consider waves of coherent light emitted from a laser beam and contrast that with light emitted from an ordinary light bulb. In the former case the laser is emitting coherent light of a single fixed wavelength while in the latter case the light is non-coherent and is emitted in a whole range of wavelengths. Consequently a 100 watt laser can cut through a solid steel plate or a pulse of laser light can be shot at the moon and will reflect back to earth while a 100 watt light bulb will barely light up an average size room let alone even come close to hitting the moon. We shall see later that coherence plays a major role in our understanding of the Quantum Hologram.

Related to coherence is another property of nature called resonance. Most of us are familiar with the old TV commercial with the great jazz vocalist Ella Fitzgerald when as she reaches a certain high note, a champagne glass on the opposite side of the room suddenly shatters. This is a demonstration of the property of resonance, which is the tendency of a system to oscillate (e.g. vibrate) with high amplitude when excited by energy at a certain frequency. This frequency is known as the system's natural frequency of vibration or resonant frequency. Resonance has many practical applications in every day experience. Piano tuners use tuning forks to tune the strings of a piano. When striking a tuning fork of a designated frequency, the piano tuner observes the appropriate piano string to see if it is also vibrating in resonance with the tuning fork. If it is not the tension in the piano string is adjusted until it is vibrating in harmony with the tuning fork. At that point the piano string is tuned to the proper frequency.

Resonance can be destructive as well as constructive. In 1940 the four month old Tacoma-Narrows Bridge in Tacoma Washington began to vibrate dangerously from side to side. People on the bridge at the time had to abandon their cars and literally crawl to safety. A few hours after it started vibrating, the bridge, which was designed to withstand winds of over 120 MPH, collapsed although the wind speed at the time of the collapse was only about 40 MPH. In analyzing the collapse, it seemed that the wind was blowing in such a way that resonated with the natural frequency of the bridge. Engineers learned a very hard lesson about the power of resonance from this experience.

It turns out that resonance appears all throughout nature and occurs in everything from bridges, to musical instruments to radio and television receivers. In fact, one could say that resonance is nature's way of transferring and receiving information and has an important role to play when we discuss the phenomena of the Quantum Hologram.

We can now begin our discussion of quantum reality by discussing wave / particle duality. Prior to quantum theory all electromagnetic (EM) radiation (including light and radio waves, etc.) was considered to be waves of energy of various frequencies. This radiation showed all the properties of waves: it could be reflected, refracted (e.g. bent) and diffracted (spreads out around a barrier). EM waves also demonstrate the properties of constructive and destructive interference. However, all this changed when scientists at the beginning of the 20th century began to study a phenomenon called the photoelectric effect. It was known that when light struck a conducting metal plate, the energy of the light was absorbed by the electrons within the plate and if that energy was sufficient, electrons would be ejected from the metal plate. Using the wave theory of light, the more intense the incident EM radiation, the greater energy with which the electron should be ejected from the metal plate. Unfortunately scientists found that this was not the case as the energy of the emitted electrons was independent of the incident EM radiation.

In 1905 Einstein resolved this issue by speculating that the incident light was composed of energy quanta (e.g. discrete packets) of fixed sizes called photons. These photons interacted with the electrons in the metal just as one would expect as discrete

particles rather than as waves. Furthermore he speculated that for any given frequency²⁶, each photon carried a specific amount of energy. In Einstein's model, increasing the intensity of the light meant an increase in the number of photons striking the metal surface in a given unit of time. This would cause more electrons to be emitted from the metal surface but each photon still carried the same amount of energy. Einstein also assumed that as you increased the frequency of the light source (e.g. color), the energy of the photons increased and therefore so would the energy of the ejected electrons. Einstein's speculations were confirmed by laboratory experiments and led to the conclusion that EM radiation behaves in the quantum world as if it were composed of individual particles²⁷.

Partly because of the photoelectric effect, one of the first concepts that scientists had to reconcile was that, in the emerging quantum model of the atom, light was treated as individual particles (e.g. photons) while an electron was often treated as a wave. This was the very opposite of what our everyday experience would suggest. An electron should be a particle and a photon, a unit of EM radiation, should be treated as a wave. As it turns out all objects at some times exhibit a wave-like nature and at other times exhibit a particle-like nature depending on the experiment being performed. This is where the role of the observer (e.g. consciousness) seems to come into play. Furthermore, this property does not even depend on the size of the object – even a human body, a mouse or an elephant can exhibit a wave-like nature, although the wavelengths will be extremely tiny. To demonstrate how this can happen consider the diffraction experiment shown in figure 4-3. The lines correspond to the wave fronts (crests) of the waves.

²⁶ For visible light frequency and color correspond: each frequency represents a unique color.

²⁷ The relationship between the energy of a photon and its frequency is given by $E = hf$ where E represents the photon's energy, h is Planck's constant, and f is the frequency. The photoelectric effect allowed scientists to calculate the value for h experimentally by measuring the other two values in the equation.

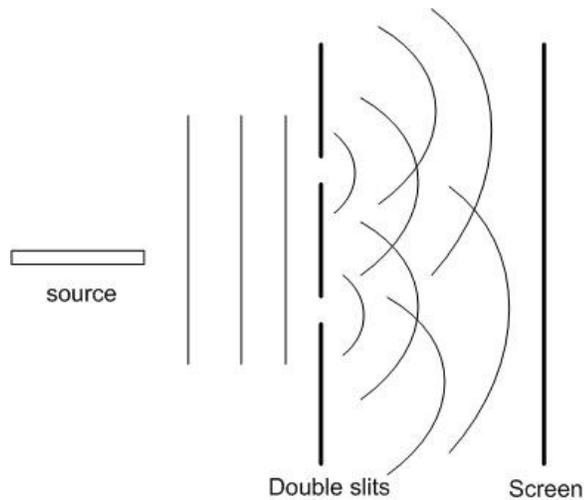


Figure 4-3

Let us say light (as a series of waves at a given frequency) is emitted from the source in the figure. As the light goes through the two slits in the screen, it is diffracted (e.g. spread out) as it travels through the slits if the size of the slits are close to the wavelength of the emitted light. Since there are two slits the wave will spread out as they pass through each of the slits and interfere with each other on the screen to the right side of our experimental setup. As this interference pattern falls on a screen composed of a photographic plate, where the wave crests are aligned from the light emitted from the two slits, we observe constructive interference and a bright spot will appear on the photographic plate. Where the wave crest of a wave from one slit meets the wave trough of a wave from the other slit, the two waves cancel out in destructive interference and a dark spot will occur at that spot on the photographic plate. So in viewing the entire exposed photographic plate, we will see a series of light and dark fuzzy bands called fringes which are an indication of the interference pattern just described.

We now close one of the slits and repeat the experiment. This time as expected, we see a bright spot only where the plate is lined up with the slit in the screen and dark everywhere else just as expected. This is what you would expect if light behaved as particles. Now let's make the experiment a little more interesting, We go back to the two slit version of the experiment and this time reduce the intensity of the light source so that

only one photon of light is released at a time. Clearly if light is a particle it will only go through one slit (although it is not possible to determine which one it will go through). We then repeat this experiment many times, each time emitting only one photon at a time. As each particle lands on the photographic plate it produces a bright spot. Where each particle lands is totally unpredictable, but as many of them accumulate on the photographic plate over time, the spots build up into a definite pattern where most of the particles land, with very few hitting the gaps in between on the plate. Later when we develop our photographic plate, we will see the same interference pattern. So how can this be? Each particle seems to travel through both slits simultaneously. Is each particle really interfering with itself? If not, how does a particle know where the next and previous particles will land?

But, wait, this is just the beginning. We can do this same experiment with electrons, protons, atoms and molecules, always with the same results. In fact we can scale up this experiment from micro scale to human sizes, but we don't see this phenomenon in humans because we lack the proper instrumentation²⁸. So one of the strange things about quantum mechanics is that the behaviors exhibited by objects can depend on what we are trying to find out. Thus they will either act as a particle or as a wave depending on how we set up the experiment.

Another interesting fact is that if we place a detector next to each of the slits so that we can observe which slit each photon goes through, the interference pattern disappears. From the Heisenberg uncertainty principle, it is impossible to know the position and motion of a particle at the same time; the more we know about one of these the less we know of the other. The bottom line is that simply by changing how we set up our experiment, we can show how interference occurs only when *indistinguishable* alternatives (from the observer's viewpoint) are utilized. By placing a detector at the slits we remove the indeterminism and the object behaves like a particle.

²⁸ The wavelength of humans is so small we would need for a human traveling at 1 m/s through a slit about 10^{-34} m wide. We could increase the size of the slit by reducing the speed that the human was traveling at since the wavelength of an object is inversely proportional to its speed.

Perhaps the strangest experiment of all occurs when we decide to take measurements *after* the particle has gone through the slits. This is called the delayed choice experiment (also known as the quantum eraser). When we look at the photographic plate, the results we see are consistent whether or not we decided which slit the object went through *after the fact*. What happens is that the results we get are what we would expect to see and so it seems that somehow making a choice (e.g. consciousness choosing) after the fact can affect things that happened at an earlier time. It does not matter how long after the experiment has been done, it could be as long ago as half of the age of the universe and we can still affect the outcome of the experiment²⁹. This is shown in figure 4-4 using light that was emitted from distant stellar objects eons ago.

What these experiments show is that consciousness seems to have a definite affect on the outcome of these experiments. The act of observing light makes its wave nature instantly collapse and its particle aspect become manifest. It appears that a photon (or any atomic or subatomic sized particle) “knows” when it is being watched and changes its behavior accordingly. This is one of the issues in quantum mechanics that scientists have been wrestling with for the last 80 years. Perhaps instead of ignoring the role of consciousness in these issues it is time to embrace it.

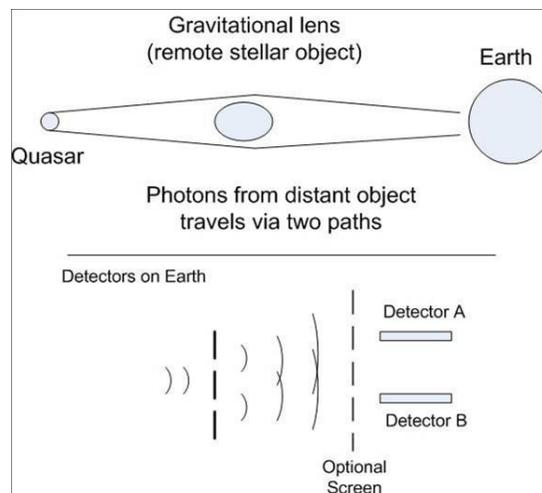


Figure 4-4

²⁹ This has actually been done using the concept of gravitational lensing of light emitted from very distant stellar objects long ago. Since massive objects bend light, the light will take two different paths to reach earth effectively recreating our double split experiment

If you have ever placed an object out in the sun or in the path of any other stream of energy, you know that the object heats up. The amount of heat that an object will absorb depends on what the object is made of and the color of the object. Transparent objects do not absorb much radiation (it passes right through the material) and shiny objects (e.g. metals) reflect much of the radiation. Objects with a light colored surface tend to reflect heat or light much stronger than objects that have a darker surface. In either case, as the object absorbs the radiation it gets warmer. Not only do objects absorb energy in the presence of radiation they also emit radiation back to the surrounding environment as well. In physics any object that absorbs all the radiation that falls upon it is called a black body and the phenomenon is related to what is known as the emission / absorption spectrum of the object.

When an object absorbs radiation, the molecules and atoms of the object vibrate as they absorb the energy. The atoms and molecules will start vibrating faster and their temperature will increase since temperature is just a measure of the average kinetic energy (e.g. motion) of the molecules or atoms. According to quantum mechanics, one of the ways atoms can gain energy is by transferring that energy to the atom's electrons³⁰. As more energy is absorbed, much of it is being transferred to the atom's electrons. Since electrons are charged particles and are moving (e.g. oscillating) around the nucleus of the atom, they will eventually radiate away the extra energy in the form of electromagnetic radiation. In fact, all bodies at any temperature radiate energy; the higher the temperature the more energy radiated away. The intensity and wavelengths at which they will radiate depends on several factors including the composition and structure of the object. In the simplest case, an object that is a perfect absorber is also a perfect radiator, and since black objects are the best absorbers, this phenomenon is referred to as black body radiation.

³⁰ Energy hitting an object is in the form of electromagnetic radiation (microwave, heat, light, ultraviolet, etc.). All radiation is in the form of waves which oscillate about a reference point. As a charged particle like an electron is vibrating back and forth, it is accelerating and picks up energy from the electric field associated with the radiation.

When an object emits radiation, a fixed amount of radiation is emitted at each wavelength (e.g. color if in the visible light part of the EM spectrum) for a particular temperature. A standard curve can be drawn for each temperature which is called the black body radiation curve. Figure 4-5 describes one such plot.

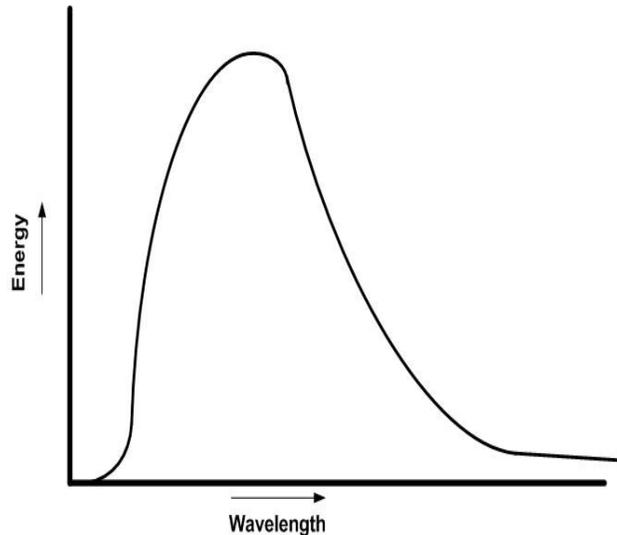


Figure 4-5 – Black Body Radiation

In this figure, which represents emitted radiation at a given temperature, notice that the black body does not radiate energy at every wavelength. There is a peak where most of the radiation is emitted. It turns out that as the temperature increases, the peak wavelength emitted by the object decreases but the total energy emitted by the object also increases (the shape of the curve stays the same but just moves to the left).

In the 19th century, the wave picture of light was the accepted theory. However scientists had a major problem predicting the intensity of radiation emitted by a black body at a specific wavelength especially at shorter wavelengths because the standard models predicted that the peak of the black body radiation curve would go to infinity. However it was known that there was a finite peak wavelength for each temperature of the object and that the emitted energy decreased on each side of this peak. This problem with the existing model became known as the “ultraviolet catastrophe” and was one of the abnormalities that eventually led to the discovery of quantum mechanics.

The great scientist, Max Planck, realized that the only way out of the ultraviolet catastrophe was if energy could only go up in fixed quantities. This meant that frequency (the inverse of wavelength) could also only go up in fixed amounts. The bottom line is that radiation from an object is not continuous but it consisted of packets of energy he called quanta. Einstein later extended this concept showing that all radiation is also quantized³¹ in discrete packets (e.g. particles) which are now called photons³². Furthermore, it is now known that, regardless of temperature, all objects emit and absorb energy in the manner described above and this characteristic of emission / absorption of energy by all objects will have an important consequence when we discuss the Quantum Hologram in subsequent chapter 6.

The mechanism for emission / absorption of photons is now well understood. A photon of light is absorbed by one of an atom's outer electrons which initially are in a low energy state. As the photon is absorbed, the electron is raised to a higher energy level and remains in this excited state for a period of time that is typically less than 10^{-6} seconds. The electron then spontaneously returns to the lower state with the emission of a photon of light. The energy of the absorbed photon must be equal to the change in energy between the lower and higher energy level of the electron and only photons of a particular frequency (or wavelength) that corresponds to that change in energy level of the electron will be absorbed. Finally, the photon emitted will have an energy (e.g. frequency) level also equal to the change in energy between the two energy levels of the electron. As we shall see later, all objects are constantly absorbing and emitting energy from their surroundings and this has a major implication for the mechanism of the Quantum Hologram.

It should be clear by now that in the microscopic world, all objects exhibit properties of both waves and particles simultaneously. These two properties are just two faces of the same coin. These properties also apply to objects at the macro scale but the

³¹ These packets of energy later became known as photons which we now know as particles and comprise all forms of electromagnetic radiation (radio, microwave, heat, light, UV rays, X-Rays, etc).

³² See the photoelectric effect earlier in this chapter.

effects on our level are much more difficult to notice. So every object has a wave associated with it that is spread out in a region of space associated with it. The waves are actually called wave packets and are made up of a variety of wavelengths. It turns out the momentum³³ (e.g. a quantity related to an object's velocity) of the particle depends on wavelength and since an object has many wavelengths it has an uncertainty in its momentum. It was discovered that if a wave packet is confined to a very small space it has a large uncertainty in its momentum. By the same token, an object whose wave packet is made up only of a small number of waves will have a small momentum and will be spread out over a large region. What this implies is that if the uncertainty in momentum of the object is small, the uncertainty in its position is large and vice versa. It seems like in the quantum world it is impossible to pin down both the location and speed of an object simultaneously. This curious property is called the Heisenberg uncertainty principle named after the scientist who discovered it.

The Heisenberg uncertainty principle is responsible for many strange phenomena at the quantum level. Perhaps one of the strangest is quantum tunneling or quantum teleportation as it is sometimes called. We are all familiar with rolling a round object up a hill. It takes a considerable amount of energy to push the object up to the top of the hill and then gravity does the rest as it rolls down the other side. In the quantum world, objects do not necessarily have to be pushed over a barrier by imparting energy to the object. They can sometimes penetrate the barrier directly (the hill in this case) and tunnel right through it and without damaging the barrier³⁴. The miniscule mass of our wave-particles (like any sub atomic particle) creates large uncertainties in position, which allows it to “disappear” on one side of a barrier and “reappear” on the other side. This is not just a theoretical prediction; it is an every-day occurrence, so common in fact, that it is the basis of operation of all solid state electronic devices.

³³ The momentum of an object is given by the formula $P = M \times V$ where P is the momentum, M is the mass of the object and V is the object's velocity.

³⁴ Recall the Heisenberg uncertainty principle in the previous paragraph. Some of the energy of the wave packet spreads out and penetrates through to the other side of the barrier.

In the macro world, all objects appear to be independent of each other. If something happens to one object, nothing will happen to a second object unless that second object is in direct contact (e.g. locally connected) with the first object. As usual, in the quantum world, things can behave significantly different. Particles can become “entangled” or “correlated” with one another when they interact initially (e.g. locally) with each having a certain momentum after they become entangled. Later, even after the two entangled particles have become separated by large distances, when something happens to change the momentum of one of the entangled particles, the momentum of the other one is immediately affected as provided by the law of conservation of momentum. The problem is that in the quantum world, this happens with no time having elapsed between the changes of both of the particles which is a violation of the theory of relativity. This means that either quantum mechanics or special relativity is wrong and yet these are the two most successful theories in all of physics.

Einstein referred to this strange interconnectedness as “spooky action at a distance” and this prediction of quantum physics led to many exchanges (attacks and counter-attacks) between Bohr and Einstein. Eventually Einstein along with two colleagues, Podolsky and Rosen, dreamed up a thought experiment that became known as the EPR paradox. The basis of their argument was that of the idea of “locality” which is consistent with how objects behave in the macro scale world as described above. If you want to affect an object that is not close by, you either have to get to the distant object or have to send information to it to affect a change in it. Since the speed of light is the ultimate speed limit, it takes a finite amount of time for that to happen thereby preventing a violation of the special theory of relativity. Unfortunately with non-locality this is not what happens. Figure 4-6 depicts this situation.

Non-Locality occurs where phenomena are instantaneously correlated regardless of distance

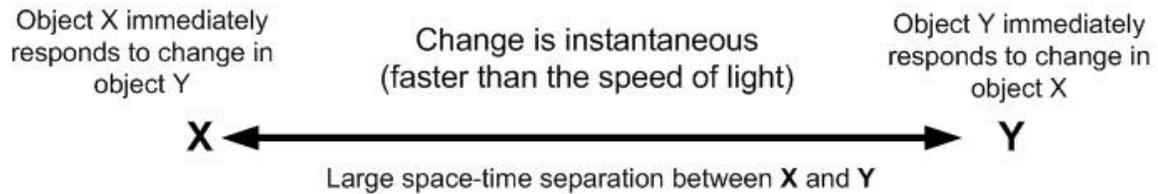


Figure 4-6 Non-locality

In the 1960's John Bell established a mathematical theory called Bell's Inequality which supported this non-local (instantaneous) communication between the two particles. This result has been tested since numerous times, first by Alain Aspect in 1982. The experiments proved that Bell's Inequality is violated, and the predictions of quantum mechanics are correct. Entanglement and non-locality are therefore indisputable aspects of reality. This means that entangled particles can somehow communicate with or influence each other instantaneously even though a message from one particle would have to travel to the other at speeds much faster than the speed of light. The big question is, if nothing can travel faster than the speed of light, how can this happen?

We showed earlier how in the quantum world properties of objects do not exist until they are measured so we have only a few options to explain what is happening here. By the way, another implication is that there is no real time ordering behind quantum correlations, one event like measuring the spin of X (or Y) above in Figure 4-6 cannot be considered to be the cause of the other. The options are: either there is no physical reality; or events have a common cause outside space-time reality; or that consciousness is somehow responsible for or related to the physical properties of matter. Clearly it is not the first for as Einstein said "The moon does not disappear when no one is looking at it". The second option implies that there is something else responsible for non-locality (to which we shall turn our attention shortly, called the Zero Point Field). In the last option,

perhaps non-locality is somehow related to the very basis for consciousness at the most fundamental level of reality. We shall discuss all three of these possibilities in the next chapter and show how the seeming paradox of non-locality and possible explanations for them play a major role in the Quantum Hologram.

Just as an aside, the quantum correlations we have been referring to do not decohere over distance or time and therefore have astonishing consequences. This was expressed by David Darling³⁵ as follows

“Some 14 billion years ago, all the matter now scattered across the vast reaches of space was huddled together inside a ball far smaller than the period at the end of this sentence. The mutual set of interactions between particles – the overlapping of their wave functions – at this early stage ensured that entanglement was, and is a cosmos-wide phenomenon. Even today, with matter flung across billions of light years, there remains in place this extraordinary web linking every particle in existence. It means that when you make the slightest change to the smallest thing in existence here and now, it will have some effect, however tiny, instantaneously, throughout all known physical reality.”

So, does entanglement mean that all things in our universe are in some sense interconnected? That is a topic we shall explore further in the next chapter.

³⁵ David Darling, *Teleportation – The Impossible Leap*, John Wiley & Sons, Inc, Hoboken NJ, 2005, Page101

CHAPTER 5 – ZERO POINT FIELD

Information and the Zero Point Field

By the early 1800's, it had been pretty much concluded by the scientific community that light demonstrated the properties of waves. A wave is generally defined as an energy disturbance that travels through a medium. Any wave that requires a medium to propagate is called a mechanical wave. Sound waves, for example, travel through many types of media including solids, liquids and gases. These waves are produced by vibrating objects. The vibrations of the object cause the molecules in the medium (assume air in this case) to vibrate at the same frequency as the object originating the sound. The sound waves expand outward from the source and are carried through the medium (e.g. air) where they eventually reach a receiver (a person's ear drum in this case) which begins to vibrate at the same frequency. The harder the medium is to compress, the faster the waves travel. That is why sound travels very fast in solids, slower in liquids and very slowly in gases like the atmosphere. The energy contained within the sound waves spreads out from the source while some of the remaining energy goes into vibrating the media and some is also absorbed or reflected by obstacles encountered along the way so sound waves eventually die out as they are transmitted through a medium.

Sound does not travel in outer space because there is no medium through which it can travel in the vacuum of space. Like sound waves, water waves, earthquake waves, etc. all exhibit similar properties. Similar to all mechanical waves, electromagnetic waves are also generated by vibrations. In this case the vibrations are caused by moving charged particles like electrons. The moving charges generate oscillating electric and magnetic fields that are vibrating perpendicular to each other and to the direction of wave travel. They are different from mechanical waves in one major way in that they can travel through the vacuum of space (e.g. without a medium). How is this possible? What medium is doing the waving?

Scientists in the 19th century postulated that light, like all EM waves, also required a medium to carry the energy. Since light could travel through the vacuum of space, there must be some strange material (e.g. medium) which they called the aether that permeated and surrounded everything (including outer space) that was responsible for the propagation of light in a vacuum. Otherwise how could astronomers see the light being emitted from distant objects like the stars and planets? Furthermore, the speed of propagation of EM waves was assumed to be relative to this elusive substance.

This aether had several mysterious properties: it must be of very low density and very hard to compress since light travels so fast³⁶ but it must also offer very little resistance to solid objects like planets, meteoroids, rockets, etc so they could easily pass through it. Otherwise these objects would slow down from the friction with this strange substance. Scientists pictured this aether as an ethereal wind that permeated everything, the vacuum of space and everything on the earth. To find out more about the properties of the aether, Albert Michelson in the mid to late 1800's devised several experiments using the speed of the earth's orbit around the sun to measure the properties of this aether. He teamed up with another scientist and the result of that effort has come to be known as the Michelson-Morley experiments. The results these scientists got did not match up with expectations. Every time a variation of this experiment was tried, the results were the same: no aether wind was detected.

Einstein attempted to answer this problem with his special theory of relativity. As any high school physics students can articulate, all motion is relative to a frame of reference and from Newton's first law, known as the Law of Inertia, that a body at rest will remain at rest. Or if the body is moving, it will move at a constant speed in a straight line if no net external forces act on the object. This constant speed (including a speed of zero) is relative to a frame of reference (e.g. where an observer is standing) called an inertial frame. Einstein realized that since the laws of physics must be the same in all

³⁶ The speed of light in a vacuum is 300,000 km/s.

inertial frames³⁷ (e.g. the same laws must hold for two objects moving relative to different inertial frames), the speed of light must be the same in all frames of reference. The bottom line is that there can be no aether, space must be empty, because there can be no absolute “at rest” frame of reference. If there were it would violate the speed of light being fixed in two different moving frames of reference. From Einstein’s special theory of relativity, light has to travel at a constant speed relative to an observer in all frames of reference. This ended the controversy with the aether and light and all other forms of electromagnetic radiation which somehow propagated itself through the vacuum of space without the use of any medium.

But the concept of aether has made a return to existence although initially for an entirely different reason than the propagation of waves through the vacuum of space. In the last chapter we described the Heisenberg Uncertainty Principle which states that it is impossible to predict the position and momentum (velocity really) of a subatomic particle. The more you know one value the less certainty there is in knowing the other value. Quantum mechanics uses this principle to predict the existence of what is called the Zero Point Energy³⁸ (ZPE) for all electromagnetic interactions. It is called zero point because it represents the energy of any quantum mechanical system at 0° K (or -273°C) which is also referred to as “absolute zero”, the coldest temperature known in nature. It is the point where the movement of atoms ceases due to thermal vibrations (e.g. no thermal vibrations.). Since temperature is really an indicator of average kinetic energy of the molecules or atoms of the substance being measured, absolute zero represents the lowest quantized energy state of any quantum mechanical system³⁹. Absolute zero represents the energy that remains when all other energy is removed from a system and is therefore sometimes called the ground energy state or simply “ground state”. So it seems that even

³⁷ Imagine being at a stop light next to another automobile on a slight incline. If the car next to you suddenly appears to be rolling backwards, is it because your car is moving forward or the other car has released the brake pedal and started rolling backwards? Motion is always relative to a reference point (e.g. inertial frame); your car, the other car or an object on the side of the road.

³⁸ There are several terms frequently used in the media to describe this phenomena and include zero point energy, zero point field, quantum vacuum and quantum foam to name a few.

³⁹ The formula for energy (E) of such a system is given as $E = \frac{1}{2}(h f)$ where h is Planck’s constant and f is the frequency of oscillation.

at absolute zero, all particles have some energy remaining. The question is “Where does this energy come from?”

One of the major contributors to quantum physics, Werner Heisenberg resolved this energy dilemma by using his uncertainty principle as described in the last chapter. At absolute zero if a particle stops moving, since the velocity of the particle is known, its position must remain unknown so the particle must still be moving around (e.g. oscillating around a reference point) otherwise it would violate the uncertainty principle⁴⁰. It turns out that this uncertainty principle also applies to energy and time. The implication here is that the residual energy of empty space is not constant and varies with time. From Einstein’s famous equation of describing the equivalence of energy and mass, $E = mc^2$, zero point energy must be able to create this energy as EM waves and their equivalent mass as “virtual” particles of empty space. In fact, these energy waves and particles⁴¹ pop into and then out of existence in a time interval dictated by Heisenberg’s uncertainty principle⁴². It turns out therefore from both quantum theory and verified by experiment, that all empty space (e.g. the entire universe) contains vast amounts of this so-called residual background energy. Furthermore electromagnetic fields of all frequencies are produced by this ZPE and are also continuously fluctuating about their zero baseline values.

Evidence for the energy of the zero point field was first suggested by Hendrick Casimir in the late 1940’s using forces resulting from zero-point energy. Casimir determined that two metal plates brought sufficiently close together will attract each other. The reason for the attraction is that the narrow distance between the parallel plates allows only small, high frequency (e.g. very small wavelengths) electromagnetic fluctuations of the zero point energy in between the plates. The outer surface of the plates does not block these lower frequency EM fluctuations (e.g. bigger wavelengths), so the

⁴⁰ It turns out that this uncertainty also exists for measurements involving both time and energy and are related to the value of Planck’s constant h .

⁴¹ These “virtual particles include photons along with positron-electron pairs. They are called virtual because of their very short period of existence.

⁴² The amount of energy required to create this particles is given by rearranging Einstein’s famous equation from $E = mc^2$ to $E/c^2 = m$

resulting overpressure forces the plates together. In 1997, this prediction was experimentally demonstrated in the laboratory⁴³ with the results very close to the values that Casimir had predicted.

The Casimir experiment has provided confirmation of quantum mechanics that predicts the all-pervading vacuum continuously spawns particles and waves with all possible wavelengths that spontaneously pop in and out of existence. This quantum foam extends everywhere throughout the universe, the vacuum of space and even fills the empty space within atoms. Furthermore moving electrically charged particles such as an electron will be disturbed (e.g. wobble) as they experience the vacuum electromagnetic fields. All atomic and subatomic particles are clearly influenced by the zero point field. This makes the vacuum act like a medium, so it seems that the previously discarded concept of an aether for EM waves to propagate though in empty space is now back in vogue (although in a slightly different form).

For macro-scale objects such as a person, standing in still air one would not feel the random motion of the air molecules constantly bombarding their body because this “air pressure” is uniform in all directions (e.g. it is isotropic). This is not unlike what a fish would feel swimming in water. For the same reason we can’t detect the zero point field because it uniformly surrounds and permeates us. Thus it is virtually impossible to detect its presence whether we are at rest or moving through it at a constant speed. However when we begin to accelerate through it we begin to feel its effects. We have all experienced pressure while in a car which accelerates rapidly. Your body gets pressed into the seat of the automobile. Earlier we talked about Newton’s first law of motion also known as the Law of Inertia and the resistance an object feels to changes in motion. This resistance is known as inertia. Physicists Hal Putoff and Bernard Haisch have written a series of papers describing inertia as a kind of electromagnetic drag caused by the acceleration of objects through the zero point field. Alfonso Rueda and Haisch have even gone one step further and have derived the most famous law of classical physics,

⁴³ Steve Lamoreaux at the University of Washington

Newton's Second Law of Motion⁴⁴, from the properties of the zero point field. Since inertia and mass are related to gravity there are also intriguing implications that gravity may also be an effect resulting from the zero point field. This was first proposed in 1967, by the Russian physicist Andre Sakharov. Specifically he proposed that gravity is not a fundamental force in the universe but is, instead an induced effect brought about by changes in the quantum fluctuation energy of the ZPF when matter is present.

In the late 1990's astronomers observed that the expansion of the universe (e.g. space) is accelerating. This acceleration is believed to be caused by dark energy⁴⁵ which is also attributed to the zero point field. This has had a major impact on cosmology, which had always assumed that the positive attraction of gravity by all matter in the universe was slowing down the rate of expansion. When Einstein originally developed his general theory of relativity, he added a term to his equations called the cosmological constant (a term for negative gravity or a repulsive force) to counteract the attractive (positive) force of gravity so the universe would remain in a steady state (neither expanding nor contracting). In the 1920's when Hubble produced evidence that the universe was expanding, Einstein removed the cosmological constant from his equations, calling it "the biggest blunder of my career". Now it seems that, thanks to the ZPF he may have been correct all along.

There are a few additional properties of the zero point field that are relevant for our purposes here. The ZPE is likely the mechanism for instantaneous transport of information between correlated particles (e.g. non-locality) through their wave properties. Furthermore the ZPF exists everywhere and waves transported through it, do not attenuate (e.g. they last indefinitely) and cannot be shielded in any way. Normal EM waves can be shielded. These shields, called Faraday Cages, are very effective at blocking out all outside information that could otherwise be transmitted via EM waves of any frequency. These cages are often used in all experiments where potential outside

⁴⁴ Newton's second law: $F = m a$; F is the force acting on an object, m is the object's mass, and a is its acceleration.

⁴⁵ It is called dark energy because scientists are not exactly sure what it is composed of. It seems to compose over 70% of the mass energy of the universe, and yet, no one knows for sure what it is.

influences or interference caused by the transmittal of EM waves can affect the experimental results. It is interesting to note that just as nonlocal affects cannot be shielded by these cages neither can gravitational effects. This further suggests that gravity also seems to be property of the ZPF and is probably related to the same mechanism as nonlocality. Since nonlocality requires some sort instantaneous communications and all particles exhibit the duality of both waves and particles, *it would seem that everything in the physical universe is interconnected in a very fundamental way and this interconnection occurs beyond space and time.*

In summary, the ZPF has been verified experimentally to be a real phenomenon and a vast source of energy. It appears to be the plenum that sustains all matter and energy in the universe and is the fundamental medium of the cosmos. It is possible in the future that it may provide a new and virtually unlimited useable source of clean energy. It has a wide variety of potential applications including everything from new technologies to energy generation and even to spacecraft propulsion. Our current understanding of zero point energy is still primitive but it is reasonable to expect that as our knowledge of this ubiquitous quantum foam is further developed, it will have a major impact in science and technology in the coming years.

As described above, energy disturbances are transmitted as waves. But these waves also serve another very important purpose: the variations in energy of these waves can produce patterns and these patterns can convey information. Clearly if it were not for this ability to transmit patterns of energy (e.g. information) via waves we would have no access to objective reality as information transmission is the basis for all sensory mechanisms and hence perception. As we saw in Chapter 2, the interpretation or meaning applied to the information carried in these patterns of energy (e.g. waves) requires a process to interpret the meaning of the information (e.g. consciousness).

There are many ways information can be carried by waves. One of the most obvious ways is to vary the energy in the waves either by producing waves of varying amplitude or by varying the frequency of the waves. In the former case this is referred to

as amplitude modulation and is the basis for AM radio station transmissions; in the latter case it is referred to as frequency modulation and is the basis for FM radio broadcasts. In either case the variations from an established reference point are used to convey information. Consider for example a radio station transmitting with a reference frequency of 100 megahertz⁴⁶. If the signal is modified so that the frequency of transmission is modified so that sometimes it occurs at 99.9 megahertz, at other times at 100.1 megahertz, and other times at the reference position of 100 megahertz, these two frequencies on either side of the reference frequency can correspond to a binary code that can be interpreted by a receiver where the lower frequency corresponds to a “0” and the higher frequency corresponds to a “1”. The result at the receiver will be a string of ones and zeros that can be used to convey information just as sequences of zeros and ones convey information in a computer system.

A similar process can be used with amplitude variations to accomplish the same purpose with AM radio transmissions. The problem with both of these approaches is that, even though the average energy of the signal may be constant, the instantaneous energy required to produce both of these signals changes over time. To overcome this, a third method can be used which varies the phase of the signal. In figure 5-1 the wave crosses the rest position at 0°. Since, for a given frequency (or wavelength), the time between adjacent wave crests is always the same (e.g. one period), we can use this 0° point as our reference position. We can then advance or retard the wave around this reference position (thereby changing a wave’s phase) to convey information just as was done above. Since information is conveyed in the phase relationships of the wave it is called phase modulation or PM for short. Note that, in this case, the instantaneous energy (either amplitude or frequency) of the wave does not change and, as we shall soon see, this seems to be the preferred method of nature to convey information.

⁴⁶ A hertz is an abbreviation for a unit of frequency based on the International System of Units (SI). It is measured in cycles per second and named after the scientist Heinrich Hertz.

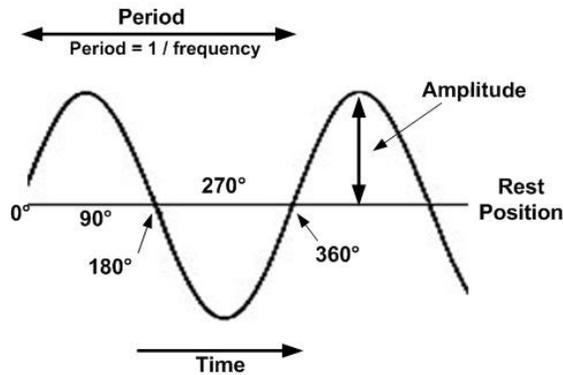


Figure 5-1

Earlier we discussed how all objects emit and absorb energy (as photons) and how emissions can be coherent. Furthermore, the information about the event history of the object that produced these coherent emissions is carried in the emitted photons and this information is transmitted in the phase relationships of the associated waves as described above in our discussion of phase modulation. Information transmitted by phase modulation as opposed to either the amplitude (height of the wave above its rest position) or the frequency variations of the waves that transmit information is extremely important for reasons we shall now describe. It has to do with a mathematical inconsistency in quantum field theory. This inconsistency is so well established that scientists are either forced to accept it without question or use it as an excuse in avoiding the study of certain aspects of quantum mechanics called Perturbation Theory. This theory is very important to the Quantum Hologram as we shall see shortly.

Perturbation Theory involves use of some higher order terms in the quantum mathematical model of particle interactions which are infinite and cannot be made to go away. At the present time this problem is still unresolved even though it was first recognized by Paul Dirac and Wolfgang Pauli back in 1928. The solution to the problem has been to “renormalize” these equations to remove infinity from the equations⁴⁷. Renormalization allows physicists to ignore the mathematical inconsistencies of the

⁴⁷ Literally by subtracting infinity from infinity.

model and still get fairly accurate results regarding energy predictions associated with this model. Unfortunately it throws out something very important which these higher terms describe, namely that of the information contained in the emitted and absorbed waves of all objects. The higher terms being eliminated contain the phase variations of the waves and *this is where information is conveyed*. As we shall soon see this has major implications for the Quantum Hologram that will be discussed in detail in the next chapter.

In chapter 3 we mentioned the concept of entropy and the second law of thermodynamics. This law states that there is a natural tendency of all systems to run down from an ordered state (low entropy) to a less ordered state (high entropy) and reach thermal equilibrium with their surroundings. Thermal equilibrium basically means that all the molecules or atoms of the object have the same average energy of motion with the atoms and molecules of the surrounding environment and are therefore in a highly disordered state. Think of a cup of hot tea cooling down to match the temperature of the surrounding environment; the tea and the cup cool down and the surrounding air warms up until all are at the same temperature. In the late 1940's Claude Shannon, working at Bell Laboratories, observed a direct link between entropy and information. He was not interested in the meaning conveyed by the information but only in the flow of information from one place to another⁴⁸ in a communication channel.

In a communications channel there is a wide range of possible messages that can be sent and in the process of whatever message is sent, a further uncertainty of the message that will be received can occur if the communications channel is noisy. The bottom line is that a key aspect of the transmission of a message is the amount of uncertainty in the transmission. Shannon realized that information transmitted represented a form of order while entropy represents a form of disorder. He linked the two by calling information negative entropy or neg-entropy for short. Although the relationship between entropy and information that Shannon uncovered was significant, it has since turned out that this implies a very significant connection between physics and

⁴⁸ Such as a communications channel connecting a transmitter to a receiver.

information. In fact, as we shall soon see, that at the deepest level of nature it is not just matter and energy that are fundamental but one also has to include information as a fundamental aspect of reality along with the other two.

In Chapter three we presented an exponential curve (Figure 3-1) that shows how complexity has been increasing (evolving) in the universe ever since the big bang some 14.7 billion years ago. This evolving complexity is not without a significant cost however. More complexity implies more ordered states (and therefore higher information content) and also lower entropy. The energy required to create this order means that entropy (disorder) has to increase elsewhere so the second law of thermodynamics is not violated. Complexity can increase in open systems by drawing in energy and matter from the surrounding environment. It does this in such a way that the total entropy of the entire combined systems always goes up. The bottom line is further linkage of the concept of information with the physical universe has been established by numerous scientists working in a number of diverse fields ranging from biology to quantum physics. The question that we must now consider is whether nature is actually some sort of giant computer⁴⁹ because using information cannot occur without some kind of a processing mechanism that applies meaning to the information. Could this mechanism be consciousness? Clearly this must be the case for all forms of biological life and we shall show it might apply to non living systems as well. We will address this more fully in the next chapter.

Earlier we talked about interference patterns caused by waves from at least two sources that interfere with each other. This interference from these two sources can be either destructive or constructive depending on how the two sets of waves line up with respect to each other. It turns out that interference patterns contain considerable information within them both in the amplitude of the resulting wave as well as in the phase relationships between them. If you have ever tossed a rock in a pond, you have noticed that a series of waves will spread out from the place where the rock hit the water.

⁴⁹ This prompted astronomer Fred Hoyle to proclaim that “the universe seems more like a giant thought than a giant machine”

Clearly you can trace the waves backwards and determine where the waves originated. If you repeated this experiment with two rocks and threw each of them in different places, each rock will also send out waves that expand outward from where it first struck the water. As the waves from the two disturbances expand outward they will eventually overlap and will create an interference pattern. It turns out that by careful analysis of the interference pattern (actually the information contained with it), it is possible to determine not only the source of the disturbance, but also the size and weight of the rocks that caused the disturbance and even the speed they were moving when they struck the water.

The last example is not unlike how a holographic image works. These images are made by splitting a laser beam from a single source into two separate paths. One half of the beam, called the object beam, falls on the object from which you wish to create the holographic image (an apple in this case). It then reflects and scatters off the object and interferes with the other half of the beam, called the reference beam, just before the resulting interference pattern hits a photographic plate. This is shown in figure 5-2.

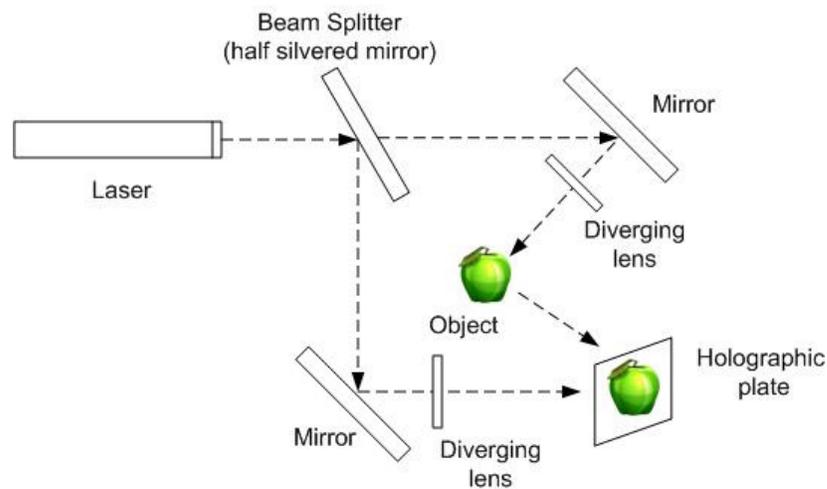


Figure 5-2 Holography Example

Laser light, unlike white light (which is made up of many different frequencies and with no fixed relationship between the wave crests and wave direction) is monochromatic light. That means it is composed of light of a single wavelength and therefore one frequency⁵⁰. The light that emerges from a laser is also coherent. All of the peaks and troughs of the waves are lined up, and are therefore in phase. The waves are also lined up in space and in time in the direction the beam is traveling. The result is that as you later view the image of the apple stored on the holographic plate by projecting another laser beam on the exposed plate, you can move around the holographic image and can see the image (e.g. apple in our example) from changing perspectives. Even though you can see the object from different perspectives, you cannot see those parts of the apple that were not in the line of sight of the original object laser beam as it interfered with the reference beam for obvious reasons.

You need the right kind of light source to see a hologram because the holographic plate records the object's image in the phase and amplitude of the resulting interference pattern. Rather than recording a simple pattern of reflected light from an object as in a photograph, the holographic plate *records the interference pattern* resulting from the waves from the reference beam interfering with the waves of the object beam. This interference pattern shows up on the holographic plate as a pattern of interference fringes. Decoding these recorded interference fringes to display the three-dimensional image of the object requires another laser beam⁵¹ of the same frequency as the original beam.

The interference fringes on a holographic image don't appear to contain useful information when observed directly because all that can be seen are the overlapping fringes of the interference pattern. But, if you pass another monochromatic light source through the plate you would see a 3-D image appearing at the same location where the object was when the hologram was originally made.

⁵⁰ The frequency of the light waves corresponds to the color of the light and frequency and wavelength are related by the formula $c = f \lambda$ (where c = the speed of light, f is the frequency and λ is the wavelength. Red light has a lower frequency and therefore longer wavelength than blue light.

⁵¹ The information that is stored in the interference pattern can be understood by analysis of these complex patterns into component sine waves using a mathematical technique called Fast Fourier Analysis.

As the object beam reflects off the apple, remember that the apple's surface (like all objects) is actually quite rough on a microscopic level, no matter how smooth it looks or feels to you. This rough surface causes a diffuse reflection as the object beam hits the object and causes the laser light to be scattered in all directions. This diffuse reflection of laser light reflected from every part of the object therefore reaches every part of the holographic plate. This is why a hologram contains redundant information. Each portion of the plate holds information about the entire object, so in the above example, if you ripped the hologram in half, you could still see the whole apple in either half of the remaining holographic plate. Note that as we remove half of the hologram, we have also removed half of the information required to recreate the original image of the apple. With fifty percent of the information removed, the resolution of the remaining image would not be as good but you would still recognize the image as an apple. This process of cutting the plate in half can be repeated several times and each time part of the remaining information is removed so the image quality gets continually reduced.

In the 1970's Karl Pribram a professor of neuropsychology and David Bohm a quantum physicist developed a theory called the Holonomic Model. It is a theory of how the brain uses interference patterns similar to the ones described in the holographic images above to store memory (e.g. information). The traditional view is that memory is associated with the cells and the interconnecting neural networks. Pribram's theory is based in part on the fact that when part of the brain is damaged via some sort of brain lesion, most of the memories will still be present but not as fully intact and also upon direct stimulation of the brain with electrical impulses. Pribram also believes that brain functions, information and consciousness go much deeper and actually are based on quantum properties. This is what we shall turn our attention to in the next chapter.

CHAPTER 6 – QUANTUM HOLOGRAM

Consciousness, Nature’s Mind, Quantum Hologram & Zero Point Energy

One common dictionary definition of consciousness is “the ability to perceive the relationship between oneself and one's environment”. The most basic definition, however, is simply “awareness”. Another definition suitable for more complex organizations of matter such as animals with a brain includes a description which contains some of the following ideas: “thoughts, sensations, perceptions, moods, emotions, dreams, and an awareness of self”. Just like life itself, consciousness is one of those things that is easy to recognize but very difficult to define. It has been debated by philosophers in the West since the time of ancient Greek civilization over twenty five hundred years ago. Eastern traditions have been wrestling with the concept of consciousness for millennia and seem to have a much better handle on it although still not nearly complete. In the West, explanations of consciousness have been mostly ignored or left to our religious traditions⁵². It has only been in very recent times that a serious effort to understand mind or consciousness has been undertaken by the scientific community. Much of the effort now underway is based on the assumption of epiphenomenalism, that consciousness, or mind if you prefer, is a byproduct of the functioning of underlying physical structures of the brain and that mind is confined entirely within the brain’s processes. However, there is a considerable amount of experimental evidence piling up suggesting that this interpretation is not correct.

At a basic level consciousness seems to be associated with a sense of separation and awareness of the surrounding environment from the conscious entity. It also seems to be associated with the ability to process information gathered from that external environment. But is consciousness restricted to a functioning brain? Are microscopic

⁵² This is certainly true since the time of Descartes and the philosophy of Cartesian duality.

organisms such as viruses, amoeba, and algae conscious? Clearly they do not have brains let alone a nervous system or even neurons. And yet they demonstrate purposeful behavior and are aware of their environment. Amoeba, for example, search for food by moving on pseudopods toward prey that they eventually surround, engulf and digest. Several types of algae are so versatile that they change the process how they obtain food based on available sunlight. When light is plentiful, they gravitate towards it, which they sense through a photoreceptor at one end of the cell. If the light is too bright, they will swim away toward more suitable lighting conditions.

Viruses at a more primitive level are considered by many scientists as non-living because they do not meet all the criteria commonly used in the definition of life. They do, however exhibit some aspects of consciousness. Unlike most organisms, viruses are not made of complete cells. They reproduce by invading and taking over the machinery of their target host cell. When a virus comes into contact with a potential host, it inserts itself into the genetic material of the host's cell. The infected cell is then instructed to produce more viral protein and genetic material instead of performing its normal functions. Is that purposeful behavior by the invading virus?

It would seem that based on our first definition, even simple living entities are conscious to some degree, since they display a level of awareness and intentionality in their environment. And, it's not just restricted to living entities. We find certain properties all the way down to the subatomic level, particles in some sense aware of their environment. How is this possible? At the molecular and subatomic levels it is through the quantum phenomenon of entanglement and nonlocality that particles act and react to other particles with which they have become entangled. Could it be that at the most fundamental level consciousness begins with these ubiquitous quantum events? We believe that is, in fact, the case. Furthermore evidence suggests that certain quantum phenomena operate at the macro level as well as the micro level and are responsible for many phenomena that living entities experience that cannot be otherwise explained. In fact, as we shall soon see, several of these so called quantum group effects have been demonstrated in the laboratory.

Just like everything else in nature, moving up the evolutionary chain of increasing complexity in organisms is built upon the foundation of what has come before. For consciousness, this evolutionary scaffolding is illustrated in figure 6-1. At the lowest level resides the most basic aspects of undifferentiated awareness built upon the quantum principles of entanglement, nonlocality and emission / absorption of photons. As we have described earlier in this manuscript these phenomenon are ubiquitous throughout the world of matter. At this level all matter seems to be interconnected with all other matter and this interconnection even transcends space and time. We postulate that this is the basis for the most fundamental aspect of consciousness which is undifferentiated awareness and this mechanism of basic perception extends up the entire evolutionary chain of increasing complexity.

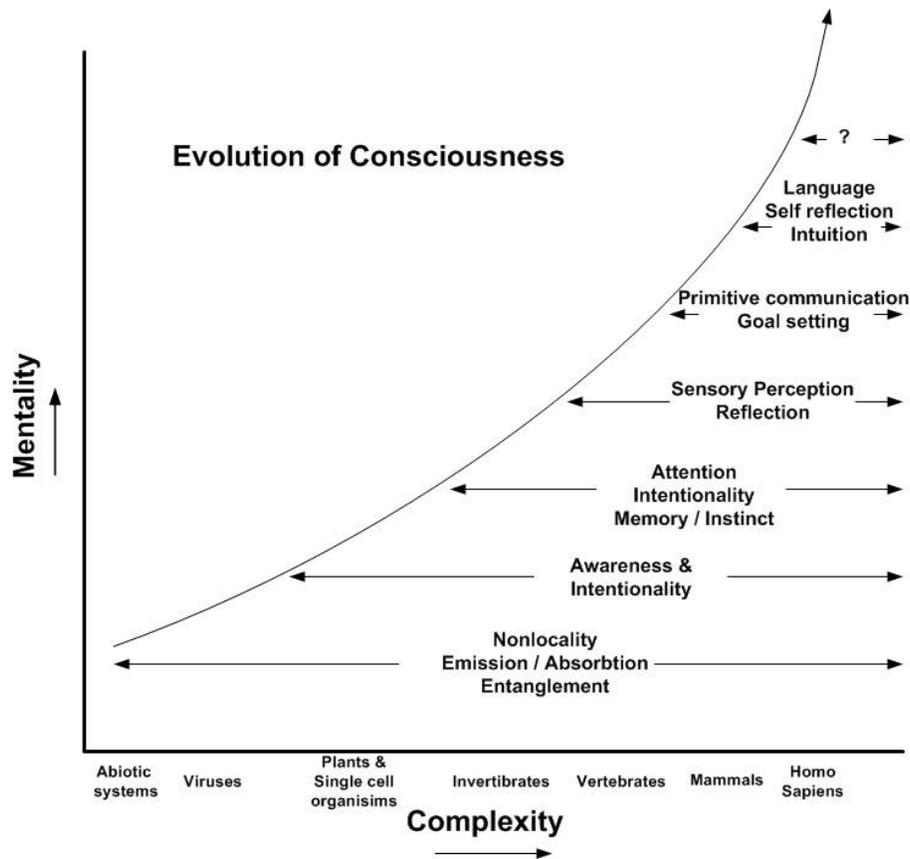


Figure 6-1 Evolution of Consciousness

Moving up the mentality ladder, the next level pertains to simple life composed primarily of single celled organisms. Here we have the beginnings of a crude capability of awareness through the use of molecular structures that are sensitive to their environment utilizing electro-magnetic⁵³ and chemical means. This is the mechanism of perception that has been the focus of classical science. For simple organisms, like plants, amoeba, viruses, etc. clearly there are no brain structures to facilitate perception. Peter Marcer⁵⁴ has applied the theory of the Quantum Hologram (see below) to propose that life at the most basic level including such things as prokaryote cells and neurons in higher organisms exchange information with their environment by utilizing the quantum property of nonlocality. The implication here is that all organisms from the simplest to the most complex are interconnected at a very fundamental level using information obtained by nonlocal quantum coherence and are even interconnected with the external environment by their coherent quantum emissions via the mechanism of the Quantum Hologram as we shall soon demonstrate.

Nature always seems to evolve into structures that enhance an organism's survivability in its environment. Additional levels of awareness are necessary to locate objects in space-time in addition to including the non-local quantum simple awareness effects as we have just described. So, as we move further up the evolutionary ladder, we continue to enhance mentality as shown in the figure. At each level, the organism has access to the perceptual mechanisms of the levels below. Clearly, at each level the organism is utilizing information (e.g. patterns of energy and matter) obtained from its environment and this implies that there is a process (e.g. consciousness) that utilizes and assigns meaning to this information. ("Meaning" is also information that places the perceived information into context for use by the organism.)

⁵³ Especially those frequencies of the EM spectrum corresponding to visible light, infrared and ultra-violet waves.

⁵⁴ Marcer P., Schempp W., The model of the prokaryote cell as an anticipatory system working by quantum holography, In: Dubois D. Proceedings of the First International Conference on Computing Anticipatory Systems, Liege, Belgium, August 11-15,1997:307-313.

Roger Penrose and Stuart Hameroff⁵⁵ have proposed that microtubules in brain cells might be responsible for perception and these microtubules provide the foundation for the emergence of higher orders of consciousness in species with a brain. Microtubules are hollow cylindrical polymers of the protein tubulin which organize cellular activities. These protein lattices exist in the cell's cytoskeleton found within the brain's neurons. Penrose and Hamerehoff claim that tubulin states are governed by quantum mechanical effects within each tubulin interior and these effects function as a quantum computer using "quantum bits" that interact nonlocally with other tubulins and with the Quantum Hologram. When enough tubulins are entangled long enough to reach a certain threshold a "conscious event" occurs. Each event results in a state which regulates classical neural activities such as triggering neural firings that ultimately affect perception, learning and / or memory. At first glance, quantum states in biological systems seem difficult to maintain in brains because these quantum states generally require extreme cold (e.g. close to 0°K) to eliminate thermal noise produced by the environment. Some researchers think this is necessary to prevent decoherence of these quantum states. However Penrose and Hameroff claim that decoherence may be prevented by the hollow microtubules themselves which act as shields to the surrounding "noisy" environment.

It has been suggested that the brain processes and stores information holographically as a massively parallel processing and associative computer system. Karl H. Pribram⁵⁶ and others have studied this extensively and demonstrated it in both the laboratory with animals and in operating theaters on humans. In the latter case the brain has been exposed and stimulated with low voltage electrical signals while the patient was conscious to describe the resulting experience. These subjects have recalled extremely detailed and vivid memories as if they were actually reliving the experiences being recalled. Animals that have had portions of their brains damaged or removed have been able to recall memories (ex. optimum ways to run a maze) even when the damage has been extensive. These experiments and several others provide evidence that suggest that

⁵⁵ Hameroff S. Quantum Computation in brain microtubules? The Penrose-Hameroff "Orch Or" model of consciousness. *Philosophical Transactions: mathematical, Physical and Engineering Sciences*, Royal Society of London, Aug 25, 1998; 356(1743): 1869-1896.

⁵⁶ Karl H. Pribram, *Brain and the Composition of Conscious Experience*, *Journal of Consciousness Studies*, No. 5, 1999, pp. 19-42.

brains store information holographically (meaning as images). P.J Marcer⁵⁷ has further extended this to postulate that not only information is stored in this manner but that information is processed holographically in the brain as well. He has also attributed this processing to, in effect, creating a detailed three dimensional movie generating the stream of consciousness that the mind experiences.

Holographic processing⁵⁸ is accomplished with the brain acting as a phase conjugating device (phase gate) producing a “virtual” signal which is a mirror image of the quantum emissions (e.g. photons of light) from the object being perceived. The brain acts as an information receptor utilizing adaptive resonance with a specific range of EM frequencies (e.g. wavelengths) in its input path which is a representation of the external object (e.g. input signal) resonating with similar virtual signals generated (output) by the brain. This sets up a resonance condition which may be interpreted as a standing wave between the object and the brain. The input signal is the quantum emission spectrum of the object being perceived. Like all holographic processing, this creates an associative pattern and facilitates retrieval of information in a resonant loop utilizing the overlapping reference signals of quantum emissions from the external object. It enables the brain structures to perform pattern classification and recognition of the resonating signals. This resonance process is called phase conjugate adaptive resonance (PCAR) and we believe that it is the basis for the most fundamental level of perception in living organisms. (Think of bats, dolphins, whales and their radar that sends signals and gets reflections back to locate targets. PCAR is the brain analog of that process.)

We mentioned earlier that a laser hologram exhibits the distributive property. This means that a small part of a holographic record contains the entire record of the recorded image but with less resolution (e.g. definition) when reconstructed. Figure 6-2 is an actual quantum hologram or wave interference pattern that would appear when exposed on a photographic plate⁵⁹. The left column labeled “A” represents the resulting interference

⁵⁷ P.J. Marcer, A Quantum Mechanical Model of the Evolution of Consciousness

⁵⁸ See figure 5-2 in chapter 5

⁵⁹ P. J Marcer, Quantum Holography - Illustration of the Concepts, retrieved from: <http://www.bcs.org.uk/siggroup/cyber/quantumholography.htm>

pattern and the right column labeled “B” shows the corresponding 3 dimensional brain image. These images were produced by a typical Magnetic Resonance Imaging (MRI) machine similar to the ones used in medical diagnosis. In the left column (labeled “A”) in the middle, and bottom row of pictures, the outside and inside respectively of the entire interference pattern shown in A (top row) have been removed to show the reduced resolution of B, compared to B (top) to illustrate A’s holographic nature.

Quantum holography operates similarly in that emissions from complex matter, for example, bio-matter, carry information about the entire organism. Stem cell research supports this concept. The fact that living cells in any organism evolve and grow from more simple cells, implies quantum entanglement throughout the organism and its composite parts, with an associated instantaneous exchange of information through PCAR. Thus some information about the entire organism is carried in the quantum emissions from its parts.

For those readers who are familiar with recent developments in ground based astronomical telescopes, a problem that has plagued astronomers since the invention of the telescope has been dealing with the aberrations in the telescopic images caused by the shimmering from the earth’s fluid atmosphere. Recent developments in laser technology and high speed computing have allowed astronomers to eliminate these aberrations. A coherent laser beam is targeted to follow the same path that the telescope is focused on. As the laser beam is reflected off the shimmering atmosphere back to a receiver the phase delay in the returning signal is processed and compared in real time against the reference beam transmitted. This comparison enables the computer to correct for aberrations with the telescope’s optical imaging system caused by the atmospheric distortions. This concept of self correcting optical imaging telescopes is not unlike the PCAR process described above.

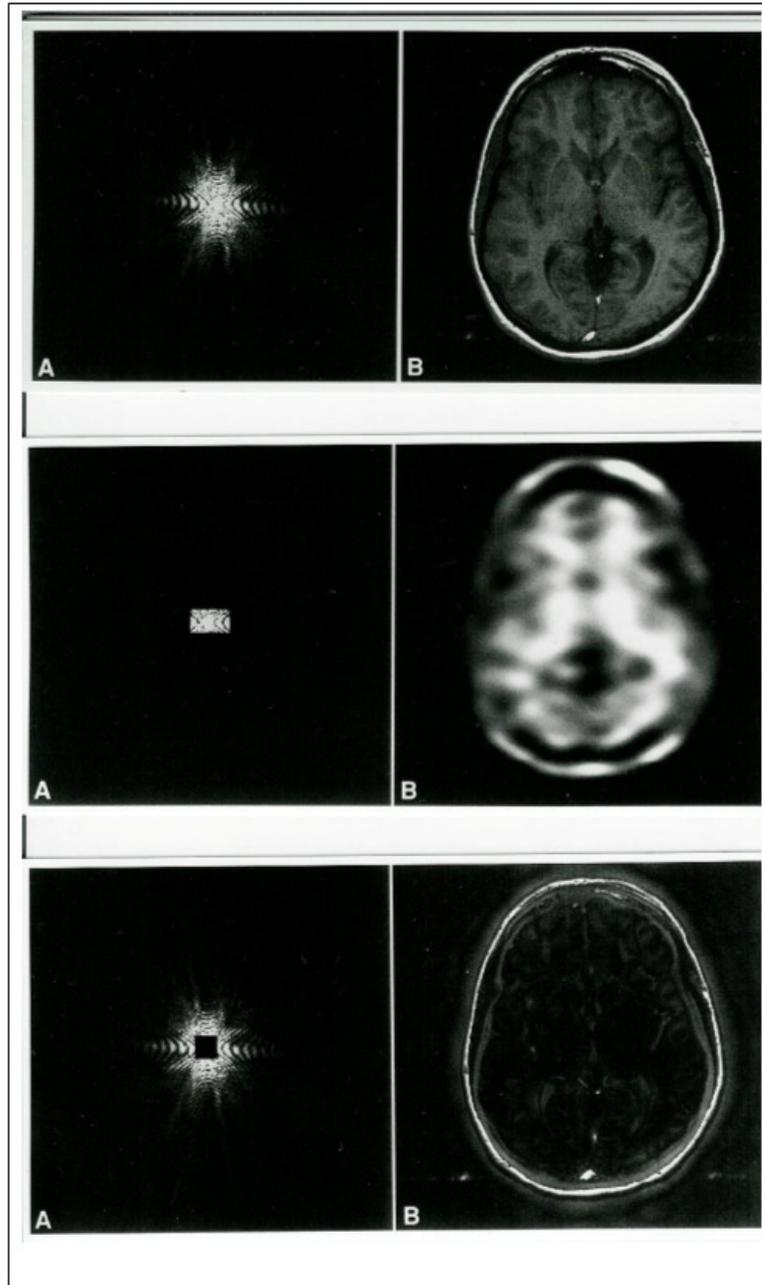


Figure 6-2 Quantum Hologram

PCAR is necessary for the brain to perceive objects as they really exist in three dimensional space. If the brain had to rely solely on the visible light spectrum that was reflected off the external object and onto the retina of the eyes, the object would appear two dimensional just as it would be if a picture of the object was recorded photographically with a camera. Contrary to the popular opinion that we see objects in

three dimensions entirely because of binocular vision, just close one eye and observe an external object with the remaining open eye. The object appears “out there” and not as an image “in the brain” because of PCAR. This clearly presents a survival advantage to an organism allowing it to accurately see and locate objects (especially predators and food) in three dimensional space.

Holographic processing is not restricted to processing sensory information in the visible light portion of the electromagnetic spectrum but it applies to enhancing all of the five normal senses. Consider snapping your fingers. The sound seems to originate from the location of the fingers in 3-D space and not at a point within the brain. As before, this experience results from the fact that the signal carrying the sound to the brain is resonating with the conjugate virtual signal created in the brain.

Figure 6-2 is an illustration describing the PCAR process. Emissions from the object of attention (e.g. the apple) are received (e.g. input) by the brain. The brain in turn creates phase conjugate (mirror image) “virtual” waves to identify the object. The standing wave that results allows the brain to locate and associate the object in space. The standing waves are created by interference of the two waves traveling in opposite directions.⁶⁰ This creates the resonant condition that allows the brain to process the information so as to locate the object in 3 dimensional space.

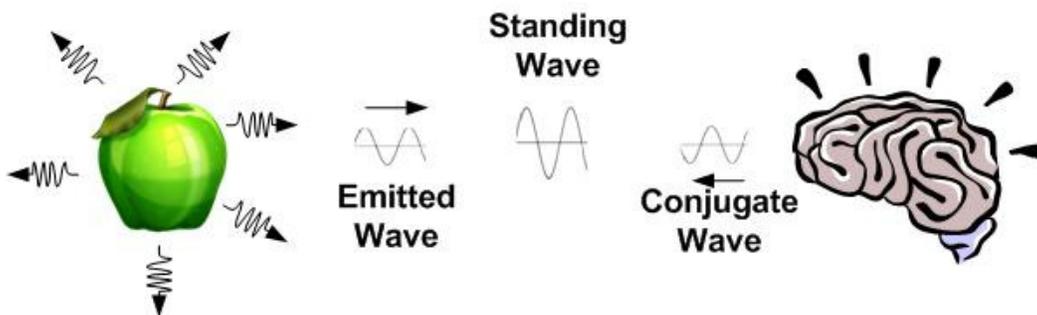


Figure 6-3

⁶⁰ Standing waves are waves that do not appear to propagate but are fixed in position and just move in the vertical direction about the zero point on the reference line.

In chapter 5 we described how all matter absorbs and reemits photons (quanta of energy) from and into the quantum foam called the zero point field that pervades all matter and even the vacuum of space. Normally these emissions are random exchanges of energy between particles and the zero point field. However, the emissions from complex matter have been shown to exhibit quantum coherence and also carry information nonlocally⁶¹. This is what we referred to earlier as a “group” phenomenon for macro scale objects. As a simple example, consider visiting a sacred place of worship such as the Notre Dame Cathedral in Paris. As one enters the cathedral, it is hard not to feel a sense of hush, awe and reverence. Over the centuries, countless people have entered this majestic cathedral with these very feelings. And these feelings were literally absorbed by the structure over the years through the process of quantum emission from the people and resonance with the very atoms and molecules of the cathedral structures. The longer the exposure to this resonance, the more coherence has been achieved with the molecules and atoms in the structure. This coherence re-manifests as emissions back into the environment which then resonate with the visiting people (via the cellular mechanism proposed above) entering the structure. The result is the subjective feelings of hush, awe and reverence which is exactly what a visitor experiences when entering the cathedral. This is another example of PCAR.

In figure 6-3, we show the emissions from the apple resonating with and being absorbed by the brain. However, the opposite is also true. The associated biomass of the entire body is also emitting coherent quantum fluctuations that are being absorbed by the apple and is therefore having some effect on the apple as well. Now add in everything else in the environment surrounding the apple and the human, which would lead one to conclude that every object, in some sense, has an effect on every other object. Like it or not, we appear to live in a participatory universe.

Quantum Holography (QH), which we have alluded to several times above, is a recently discovered attribute of all physical matter and has been validated by

⁶¹ Recall that nonlocality implies instantaneous transmission across space and time

experimental work with functional magnetic resonating imaging (fMRI). It provides a model to understand quantum level information processing of biological systems, specifically how the processing of information leads to the functions of memory, awareness, attention and intention. As mentioned earlier, we postulate that all the cells of the body and all other organ systems, including the brain, have evolved as a massively parallel, learning, computing system. And the key ingredient of understanding this computing system and its processes is the quantum hologram which we will now describe.

Quantum emissions also carry information nonlocally about the event history (e.g. an evolving record of everything that has happened) of the quantum states of the emitting matter⁶². Recall that these quantum emissions are in the form of waves of many different wavelengths (or frequencies if you prefer) and that the information is contained in both the amplitude and the phase relationships of the emitted waves as interference patterns. This is similar to the way that information is stored in the interference pattern on a holographic plate as described in the last chapter. These interference patterns can carry an incredible amount of information including the entire space time history of living organisms.

Mounting evidence seems to indicate that every physical object has its own unique resonant holographic memory and this holographic image is stored in the zero point field. As you will recall from the last chapter, the information in this field is stored nonlocally and cannot be attenuated. Furthermore this information can be picked up via the mechanism of resonance as we described above. This information, its storage and its access is the Quantum Hologram (QH). We can think of an organism's QH as its nonlocal information store in the zero point field that is created from all the quantum emissions of every atom, molecule and cell in the organism. Every objective or physical experience, along with every subjective experience is stored in our own personal

⁶² Walter Schempp used a mathematical formalism to expand quantum information theory. He validated his approach by significantly improving the definition and specificity of MRI tomography and, in the process, discovered the inherent information content of the emitter-absorber model of quantum mechanics. See Schempp W., Sub-Reimannian Geometry and Clinical Magnetic Resonance Tomography, *Math Meth Appl Sci* 1999; 22:867-922

hologram and we are in constant resonance with it. Each of us has our own unique resonant frequencies or our unique QH which acts as a “fingerprint” to identify our non local information stored in the zero point field. Since the event history of all matter is continually broadcast nonlocally and stored in the QH, the QH can be viewed as a three dimensional vista / movie evolving in time which fully describes everything about the states of the object that created it. Not only do we each have our own unique QH, but it is also possible for others to tap into parts of it through resonance. We shall develop this idea more fully in the next chapter.

To illustrate how resonance with an object’s QH might work, consider the following example. Take two identical guitars, tune the corresponding strings on each guitar to the same frequencies and place them on the opposite sides of a room. Now pluck a string on one of the guitars and notice what happens to the corresponding string on the other one. It will begin to vibrate in resonance with the first guitar. This is not unlike our example with Ella Fitzgerald and the shattered champagne glass we described earlier. It turns out that the vibrating strings on each guitar will produce a standing wave. The vibrations cause the wave to travel down the string (incident wave) to the point where the string is attached to the guitar. The wave will reflect off that point (producing a reflected wave) and travel back in the opposite direction as a mirror image of the incident wave. As the waves meet they will interfere with each other and produce our standing wave which is then propagated through the air.

Now add a third identical guitar with the corresponding strings also tuned to the identical frequencies as the other two. If the corresponding strings on each of any two of the guitars are plucked simultaneously at the same point on the string, the corresponding string on the third guitar will again begin to vibrate as before but with one slight difference. Since both plucked strings were struck at the same point and at the same time, the sound waves produced from each will constructively interfere and reinforce each other in the air resulting in sound waves of greater amplitude. So as before, the string on the third guitar will begin to resonate again but this time with greater amplitude. Now, repeat this process adding a 4th guitar and so on. In each case the amplitude of the

resonating standing wave will continue to increase (unless the responding guitar string should happen to break from the large amplitude of the wave it is receiving). As we shall see shortly this analogy of the strengthening of the resonating wave shall be of particular importance when accessing information stored in the zero point field.⁶³

The analogy of the guitars is similar to how information is stored in the Quantum Hologram with the zero point field. As we mentioned before the brain operates as a massively parallel quantum computer. The brain does this by setting up a resonant condition with microtubules scattered throughout the brain tuned to the same frequency as the standing waves of the same frequency located in the zero point field. Every macro-scale physical object in nature has its own unique QH. It exists in 4D space time reality and is a non-local information structure that never attenuates. And, most importantly, it carries the entire event history of the physical object it was created from or, in the case of living organisms, the entire subjective and objective reality experienced by that organism. All this information about the entity is carried in the amplitude, frequencies (e.g. wavelengths) and in the phase relationships of those waves from the emitted entity. Perhaps, most important of all, is the fact that the information stored in the QH is recoverable through the process of resonance not only with the individual organism that created it but with other organisms as well if they are “tuned” to it.⁶⁴

Note that we are not suggesting that we are all virtual beings living in a “literal” holographic reality as interference patterns on nature’s holographic plate. We are real beings living in a very real material world consisting of matter, energy and information just as we experience it. Also the quantum hologram is not about the discovery of some new kind of subtle energies such as “élan vital”, qi or prana suggested by many throughout history. Neither is it about multidimensional theories nor living in other planes of existence other than our normal 4 dimensional space time reality.

⁶³ The simple reason is the larger the amplitude of the standing wave, the easier it is for another object to resonate with it.

⁶⁴ This seems to happen most commonly when strong emotional connections exist between the two.

The quantum hologram is a model of how reality works. Like all models it enables us to make predictions and create interpretations about how nature operates. We can test those predictions to validate and refine the model and perhaps someday even design, build and utilize technologies that implement various aspects of the model's predictions. But remember, the map is not the territory and, like all models, it must be refined as more information becomes available and our understanding improves. And, most importantly, models are subject to interpretation based on our prior knowledge and experiences.

Our QH model seems to explain many effects including aspects of mind, memory, stream of consciousness, various factors affecting health, psychic events, Jung's collective unconscious, the Akashic record and other phenomena that arise out of the resonance with the QH residing in the zero point field. Before the discovery of quantum holography we had no mechanism to model or account for these phenomena let alone information transfers between objects that these effects imply. We believe that QH is supported by strong evidence suggesting it is also a model that describes the basis for consciousness. It explains how living organisms know and use whatever information they know and utilize. It elevates the role of information in nature to the same fundamental status as that of matter and energy. In fact the QH seems to be nature's built-in vast information storage and retrieval mechanism and one that has been used since the beginning of time. This would promote QH as a theory which is basis for explaining how the whole of creation learns, self-corrects and evolves as a self-organizing, interconnected holistic system.

We will now look at many previously unexplained phenomena and describe how they can all be explained with the quantum holographic model. Then we will attempt to describe some of the profound implications and ramifications to which this theory leads.

CHAPTER 7 – APPLICATIONS OF QH

Implications and Applications of the Quantum Hologram

In this chapter we will discuss anecdotal evidence, actual experiments, their implications and potential further applications of the Quantum Holographic (QH) model. Before we begin, let us briefly summarize what was discussed in the last chapter. QH describes a real phenomenon that has been validated in the laboratory. It is a description of reality that is based on a mathematical formalism (e.g. a theoretical model) of how nature implements and utilizes memory, perception, attention and intention. QH explains many phenomena in nature where no adequate mechanisms were previously known to describe them particularly in accounting for the transfer of information between material objects or between objects and their environment. QH offers a hypothesis and convincing evidence that explains how living organisms know and utilize information. In doing so, it elevates information to the same fundamental status as matter and energy. Furthermore when energy, matter and information are utilized in processes, QH leads us to the very basis of consciousness itself. So, perhaps the most profound implication of all is that the QH model provides a basis for explaining how the whole of creation learns, self corrects, evolves by being, in some sense, conscious of itself. In other words, QH describes the universe as a self-organizing inter-connected conscious holistic system.

The storage mechanism for the Quantum Hologram resides in the zero point field (ZPF). This field is ubiquitous, nonlocal, cannot be attenuated, lasts indefinitely (e.g. never loses coherence), can store unlimited quantities of information and any portion of it encodes the whole just as a hologram does. It can be thought of not only as nature's information storage mechanism but also as nature's information transfer mechanism. QH information is contained in the amplitude, frequencies and the phase relationships of the underlying interference patterns from the emitted quanta. It is emitted and absorbed by all objects and exists in four dimensional space / time reality. QH applies to all scale sizes from the smallest subatomic particle to the largest structures in the cosmos and takes place at all temperatures (even down to absolute zero). It exists simultaneously beneath

the classical descriptions of how information is exchanged between non living objects and below the normal five senses for living organisms. For living organisms QH applies to intra and inter communications between cells, organs and organ systems, and finally between organisms as well as with the larger environment. Whether abiotic or biotic, the entire event history of all matter from the micro scale to the macro scale is being continuously broadcast nonlocally by coherent quantum emissions. This history is also reabsorbed by (e.g. received) and interacts with all other matter and the ZPF through the exchange of quantum information.

The mechanism of QH applies to all of the cells of the human body (approximately 100 trillion) and answers the question that is often posed dealing with how all these cells cooperate and work together to make the whole human. While they are actively cooperating, thousands of cells are dying continuously every second; so many in fact that over the course of one week the body will have billions of new cells and yet you remain you with the same memories and the same functionality and the same distinct features. How does that happen? Every one of our cells contains the same genetic blueprint of DNA and clearly that DNA exerts a major influence over the development and functioning of our cells. But cells are not only subordinate to DNA; they also function and maintain homeostasis by communicating and cooperating simultaneously with many other cells of the body. Much of this inter-cellular signaling is electrochemical in nature but biologists still struggle with some aspects of the mechanisms utilized in this information transfer. With 100 trillion cells it is hard to imagine how that many cells can remain in harmony by the slow process of electrochemical signaling especially under times of great distress when survival of the entire organism is at stake and / or requires extremely rapid and coordinated responses.

The primacy of DNA as the master blueprint for an organism has been the central dogma for biology for a long time. There is now very convincing evidence that organisms from plants to mammals acquire characteristics through the interaction with their environment and can then pass these characteristics on to their offspring. This process is called “epigenetic inheritance” and has spawned a new field in biology called epigenetics

which is the study of the mechanisms by which the environment influences cells and their offspring without changing genetic codes. This is forcing scientists to rethink evolutionary theory and harks back to the days of Lamarckian evolution⁶⁵. Biologist Bruce Lipton states in his recent book⁶⁶ that “results from the Human Genome Project are forcing biologists to the recognition that they no longer can just use genetics to explain why humans are at the top of the evolutionary ladder. From this effort, it turned out that there is not much difference in the total number of genes found in humans and those found in primitive organisms”. So where does the information come from that defines who we are? Lipton further goes on to state that “cellular constituents are woven into a complex web of crosstalk, feedback and feedforward communication loops and that thousands of scientific studies over the years have consistently revealed that EM signaling affects every aspect of biological functioning”. How does this mechanism work? Could QH offer an explanation?

In addition to DNA, inter-cellular communication is especially critical in embryonic development. From a single fertilized egg, the embryo divides thousands of times and each time producing identical offspring cells called stem cells. Then at some critical point when the embryo has reached a certain size, something truly miraculous happens. Cells begin to differentiate and form groups of like cells that will eventually become all the highly specialized tissues and organs that make up the human body. Out of the entire mass of undifferentiated cells making up the embryo, how does a particular stem cell suddenly know that it is to transform into a heart cell, liver cell, neuron, etc? Clearly, some of the differentiation results from electrochemical signaling with the immediate surrounding cells. This exchange is certainly necessary and provides information about how a cell must change to express itself correctly to become the right type of cell at the right place and at the right time. But is it possible that this signaling, by itself is not sufficient to explain the full development of the embryo into a complete organism?

⁶⁵ Lamarck's theory, developed 50 years before Darwin, hypothesized that evolution was based on cooperative interaction between organisms and their environment. This interaction enabled these organisms to pass on adaptations necessary for survival as the environment changed.

⁶⁶ Lipton, Bruce, *The Biology of Belief*, Elite Books, Santa Rosa, CA, 2005, p 64

Rupert Sheldrake, a biologist in the UK, has studied this problem and has proposed a theory called the Hypothesis of Formative Causation. It describes an alternative explanation for how the structure and form (morphology) of an organism develops. In his model, developing organisms are shaped by fields which exist within and around them and these fields contain the form and shape of the organism. He further proposes that each species has its own information field, and within each organism there are fields nested within fields. All of these fields contain information derived from previous expressions of the same kind of organisms. He further states⁶⁷

That a field's structure has a cumulative memory, based on what has happened to the species in the past. This idea applies not only to living organisms but also to protein molecules, crystals, even to atoms. In the realm of crystals, for example, the theory would say that the form a crystal takes depends on its characteristic morphic field. Further, the morphic field is a broader term which includes the fields of both form and behavior;

Sheldrake's view is that nature forms habits and over time these habits strengthen and influence following generations. Similarly, other habits atrophy over time from lack of continued use. In fact Sheldrake is not alone in proposing such a mechanism. The great psychologist Carl Jung has proposed "the collective unconscious" which represents a vast information store containing the entire religious, spiritual and mythological experiences of the human species. According to Jung, these archetypes have existed since ancient times and are inherited where they exist deep with the human psyche and heavily influence the thinking mind. In a similar manner, Teilhard de Chardin proposed the concept of the "noosphere" which represents the collective consciousness of the human species that emerges from the interaction of human minds. De Chardin asserted that as individuals and the global society evolve into more complex networks, the noosphere evolves along with it. Finally there is the Akashic record which was developed in the Sanskrit and ancient Indian culture. It is described as an all pervasive foundation that contains not only all knowledge of the human experience but also the entire history of the universe. Our normal five senses cannot access this information but it can be accessed

⁶⁷ Sheldrake, Rupert, *Mind, Memory, and Archetype: Morphic Resonance and the Collective Unconscious*, Psychological Perspectives, 1997

through spiritual practices such as meditation. In the last few years, Ervin Laszlo⁶⁸ has also been promoting a theory he has named the A-field which contains many aspects that are also very similar to the concepts described in this monograph. All these concepts imply a mechanism very similar to our description of QH.

Whatever name this mechanism is called, we postulate that the primary means for accessing transcendent information is via the process of resonance. In higher organisms with brains, the massively parallel processing capabilities of the brain structures are capable of simultaneously resonating with QH information at an incredible range of frequencies. This is shown in figure 7-1 where the effects resulting from varying degrees of resonance with the QH is depicted. The simplest form of resonance (e.g. entanglement) is shown on the left side of the graph. Moving to the right we show phenomena that manifests with increasing degrees of resonance and frequencies. We have included several phenomena on this graph such as Out-of-Body-Experiences (OBEs) and reincarnation but, as we shall soon see, our explanations of them are based on QH theory and require a different interpretation than those commonly found in popular literature. Finally, we shall describe how the degrees of resonance can occur along with techniques to facilitate them.

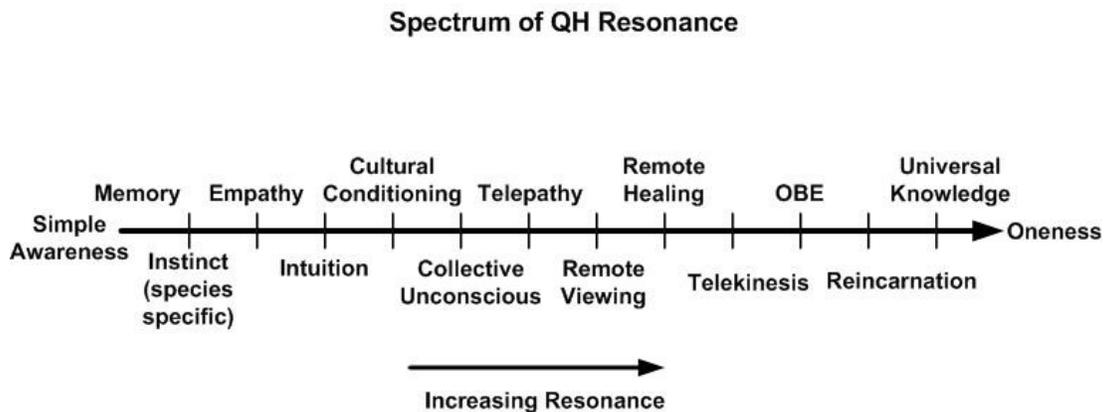


Figure 7-1 RESONANCE SPECTRUM

⁶⁸ Laszlo, Ervin, *Science and the Akashic Field*, Inner Traditions, Rochester, VT, 2004

We have indicated earlier that information is nothing more than patterns of matter or energy. The meaning that is derived from these patterns is developed in the mind of the percipient based on prior experience (e.g. knowledge and memory). In other words, all events are subject to interpretation and that in turn is based on the prior experiences and beliefs of the percipient. The more knowledge and experience we gain the more likely we will interpret an event closer to actual reality. Changing beliefs, however, is another matter entirely. For example, in colonial America, most people attributed thunder and lightning to evil spirits. At that time the obvious solution to the problem was to ward off the evil spirits by ringing church bells. Needless to say that was not very effective. More than a few well intentioned souls were electrocuted while in the bell tower ringing those bells. We now know that the premise of evil spirits is totally incorrect and that thunder and lightning are merely the results of electrostatic discharges between the atmosphere and the ground. How did we get to this understanding? We evolved our understanding and beliefs by learning about how nature really works through trials, by observation and by experimentation (remember the Ben Franklin experiments with kites we learned about in grade school).

We shall now describe some of the experiments testing the concept of nonlocality and their findings. There is considerable experimental and anecdotal evidence, although some of it controversial, to suggest that simple organisms perceive and respond to nonlocal information. In the area of human experimentation, results have likewise been mixed for much of the last 75 years. However meta-analysis⁶⁹ by Dean Radin⁷⁰ and independently by Jessica Utts⁷¹ across a large and appropriate spectrum of experiments demonstrates compelling statistics that the perception of non-local information exists and is real. Perhaps if there were a larger body of experimental evidence for simple life forms, similar results of meta-analysis would emerge. Failure to replicate results in well constructed experiments does not, in the case of subtle consciousness phenomena, prove that the phenomenon is missing but rather that a hidden mechanism below the threshold

⁶⁹ Meta-analysis is a new tool which has become essential in many of the soft sciences including ecology, psychology, sociology and medicine. The essence of meta-analysis is that outcomes of collections of previous experiments are analyzed.

⁷⁰ Radin, Dean, *The Conscious Universe*, Harper, San Francisco, CA, 1997

⁷¹ Utts, J.M., *Replication and Meta-Analysis in Parapsychology*, *Statistical Science*, 1991, 6: 363-382

of classical measurement may be operating. For example, the most telling experimental evidence to explain the sometimes inconsistent results relates to direct nonlocal and / or experimenter effects⁷².

Gertrude Schmiedler⁷³ isolated the “sheep / goat” (“sheep” is a label for believers and “goat” is a label for non-believers in psychic experiments) effect in human experiments decades ago. Experimenters and /or participants in human telepathy (or similar nonlocal) experiments exhibited results statistically above or below chance results depending on their subjective bias towards the experiment. In other words 100% wrong answers would be as statistically significant as 100% correct answers in such tests, and in addition would betray the mind set or intention of the subject whereas only chance results would be inconclusive. More recently, a series of experiments by Marilyn Schlitz⁷⁴ investigating intentionality clearly demonstrated that experimenter bias (intentionality) affected the outcome even in double blind experiments. Thus, in the subtle realms of mind and consciousness studies, bias, belief and intention clearly have an effect. The lack of an existing theoretical structure in classical science to support any type of perception of non-local information, much less to support bias, belief or intention as having a nonlocal effect, is quite sufficient to account for anomalous results in many scientific experiments. The prevailing dogma of classical science against any type of nonlocal action at the level of macro scale reality has not prevented experiments from successfully being conducted. It has sometimes caused positive results to be dismissed as anomalous, of faulty design or outright fraud when in most of these cases the results were defensible had proper nonlocal theory been available.

Dean Radin⁷⁵ describes a series of experiments conducted in the latter half of the 20th century on a whole range of psychic phenomena that suggests that experimenters are obtaining far more correlations than can be expected by chance. This was done by performing meta-analyses for random number generators (RNG) studies subjected to

⁷² Experimenter effects are unintentional biasing effects on the results of an experiment caused by the expectations, beliefs or preconceptions on the part of the experimenter.

⁷³ Schmiedler, G.R., Craig, J.G., *Moods and ESP Scores in Group testing*, Journal of ASPR, Vol. 66, no. 3, pp 280-287, 1972

⁷⁴ Schlitz, M., Wiserman, R., *Experimenter Effects and the Remote Detection of Staring*, Journal of Parapsychology, Vol. 61, Sept, 1997

⁷⁵ Radin, Dean, *Entangled Minds*, Paraview, NY, 2006

psycho-kinesis (PK) intention which resulted with the odds against chance of 35 trillion to one over the entire database. This analysis followed a decade long series of experiments⁷⁶ by Brenda Dunne and Robert Jahn at Princeton University who provided overwhelming evidence that human subjects could produce statistically skewed results in mechanical processes normally considered to be driven by random processes. A similar study with Ganzfeld meta-analysis by Radin demonstrated results with odds against chance of 29×10^{18} to one (e.g. one chance in 29,000,000,000,000,000,000). Radin goes on to describe several other studies showing similar results.

Radin has also discovered that audiences watching stage performances would skew the output of random number generators during periods of high emotional content in the performance. In a wide-ranging audience participation experiment, he recorded the output of computer random number generators during the television broadcasts of the O.J. Simpson murder trial. Most television news programs covered this event live for weeks on end with millions of viewers. Again, the results of random number generators set up to monitor this event were skewed corresponding to emotional peaks during the trial drama and corresponding to the number of people watching. A similar effect was noted on 9/11/2001 at the time of the World Trade Center disaster in New York City.

The thesis in the Princeton experiments was that participant intentionality created non random effects to bias the skewed distribution. In the Radin experiments, the results were not the result of intentionality because the participants were unaware of the experiment, but his hypothesis was that rapt attention drove the system away from randomness and toward greater order. These results suggest that attention and intention provide closely correlated outcomes and further, that randomness may not be a property of nature but what may be perceived as random noise in a system may just be awareness that is not in resonance at that moment with the particular perceptual system.

⁷⁶ Dunne, B.J., Nelson, R.D., and Jahn, R.G., *Operator-related anomalies in a random mechanical cascade*, JSE 2:155-80 (1988)

Many types of mind-to-mind or mind-to-object experiments have been rigorously and routinely conducted for decades with statistical significance but they are often dismissed or ignored by mainstream science because the implications of nonlocal action are so foreign to the mainstream view of objectivism and the possibility of mind matter interactions. However, if we consider the condition of resonance is necessary (specifically PCAR as described in the last chapter), then we must also consider the perceived object (e.g. the target) and the percipient's perceptual system as entrained in a phase locked resonant feedback loop. The incoming wave from the target carrying the emitted information may be labeled as "perception" from the view point of the percipient, and the return path may be labeled as attention (or intention) depending on what the percipient is trying to achieve. Note however that this is a two way street, the act of perceiving also affects the target object being perceived!

In the case of nonlocal effects at a distance, outside the body, simple correlation of entangled particles is the most basic form of perception. And these correlations between entangled particles are reciprocal. Action on one particle creates an effect on other entangled particles instantaneously and even across large distances. This phenomenon is no less important for macro scale objects. Sheldrake⁷⁷ has conducted experiments with dogs whereby the animals correctly anticipated their owner's departure from a remote location to return home. He has also conducted other successful experiments on previously unexplained behaviors of animals. In one example rats that were learning to traverse a new maze benefited nonlocally from the experience of others that had previously learned the maze in the total absence of classical space time information. Other examples include distant (e.g. nonlocal) awareness of deaths and accidents, animals that heal humans and those sensitive to forebodings of natural disasters.

It is not surprising then, that humans exhibit an even wider range of reactions to nonlocal information. The evidence suggests that humans can perceive, recognize and

⁷⁷ Sheldrake, Rupert, *Dogs That know When Their Owners Are Coming Home*, Random House, NY, NY, 1999

give meaning to nonlocal information across a broad range of complexity, from inanimate objects, simple organisms, animals and other humans (refer to figure 7-1). The existence of QH provides an adequate informational structure to permit a theory for the observed results. This is a classical example, where results are repeatedly observed over time that fall outside the prevailing paradigm, and must await new developments in science before the phenomenon can be adequately explained. Perhaps this explains psychic abilities.

In humans, it is a well established meditation principle that prolonged focused attention on an object of meditation causes the percipient and the target object to appear to merge so that a much deeper level of understanding about the object is obtained. This includes information such as its history or internal functioning that would not be available through classical space time information. The quantum holographic theory describes how this phenomenon might take place. Further, it is accepted that the mind and associated brain with its 100 billion neurons function together as a massively parallel pattern matching (e.g. information) processor, capable of performing many tasks simultaneously. Most of this processing is done subconsciously or in the right hemisphere which is attributed to the intuitive part of the mind.

Conscious focused attention is a unique and singular task that takes place sequentially mostly in the left hemisphere in the cognitive part of the brain. The condition of attention deficit disorder (ADD) is precisely the problem of a percipient being unable to maintain a singular focus for a sufficient time to complete a desired task or observation. Thus the action of focusing attention by a percipient may be construed as a necessary condition for resonance (PCAR) to be established with the perceived object. Even for people with such a handicap, reducing stress, eliminating distractions, and quieting the mind via meditation may also improve one's ability to focus thereby improving the resonance condition.

Healers typically report such a focusing to create a resonance with the object of their healing activities. Once in resonance, they often report sensing in their mind some

sort of picture which appears as a type of 3-D holographic image. They maintain that diseased or damaged tissues in the target often appear as fuzzy or appear somehow different from the normal tissue surrounding it. Sometimes they describe it as sensing energy blockages. They claim to be able to focus energy or somehow manipulate (e.g. intentionality) the diseased tissue which over time causes the image to change and take on the same characteristics of the healthy tissue surrounding it. Could this be the result of the act of intention of the healer resonating with the quantum emissions and subsequent absorptions by the diseased tissues?

Healers and other psychically sensitive individuals often enter into resonance with the object of their focused attention (or intention) by using an icon. Similarly people praying for others (not in a religious sense of supplication to a higher being) are suggestive of initiating a nonlocal resonance process with a target object. Healing prayer has existed in all cultures for millennia. If prayer did not produce some positive results, it is likely that religion would have abandoned it centuries ago. For most of its history healing prayer was attributed to supernatural agency rather than resonance with the target's QH. This is simply another example of phenomenology waiting while science catches up as in our colonial lightning example above. In recent times Larry Dossey⁷⁸ and many others have attempted to document the efficacy of prayer, particularly healing prayer. Some claim the results establish the case for healing prayer. However the difficulties of controlling all the variables, the experimenter effect, etc. in such clinical studies leave many avenues for valid criticism. The fact that Radin's many studies demonstrated that attention alone produced nonlocal results in REGs and other machines in reducing randomness (e.g. increasing order) confirms that information has a nonlocal effect and may be correctly formulated as negative entropy. These results apply to healing prayer as well.

In these cases, icons are often used to facilitate this resonant process. Icons can be an image, picture, representation or an article associated with the target object of the

⁷⁸ Dossey, Larry, *Healing Words- The Power of Prayer and the Practice of Medicine*, Harper, San Francisco, CA, 1993

intention. What each of these modalities has in common is that they appear to provide a mechanism for the intender to “tune in” or resonate with the target. Touching an icon seems to satisfy the resonant (PCAR) requirement and probably allows the intender access to the information about the target not available from normal space / time information. Police agencies often use this modality with psychics who then focus their attention to gain information about a crime scene often with considerable success. Healers and people praying may also utilize this modality but in this case with focused intentionality to resonate with the person to be targeted by similar means. The use of icons to retrieve nonlocal information also suggests an explanation of water memory and homeopathy. Molecules of toxic substances from an original solution are removed by serial dilution. Could some of the water molecules resonate with the emitted photons from the original toxic substances and later resonate with the human immune system when absorbed by it?

If, as required in the theory of the quantum hologram, the icon has been in the presence of the individual or contains the signature of the person about whom information or healing is desired, the event history of the icon and that of the individual intersect. The phase relationships of the quantum emissions of the icon contains a record of the target object’s journey in three dimensional space and time, as well as the quantum states through which it has passed on this journey. The sensitive individual, with a honed talent, often seems to be able to decode the information coded in these phase relationships of the photons emitted from the icon about the individual or object sought. It may also be the case with the bloodhound that additional non-local information has been gained about the subject, even though the classical explanation is that the animal is operating only with heightened olfactory sensing.

Although perception in the three dimensional world requires and utilizes resonance (PCAR), most humans do not routinely bring to conscious awareness nonlocal information when operating in ordinary three dimensional reality. We perceive objects as presented by space / time information, that is, shape, color, function (tree, chair, table, etc) but are not usually aware of the additional non-local information (location in space,

threats, etc) unless there is strong emotional connection. Consider the case of an infant separated from its parents during time of war or unprecedented disaster. Years later, by a chance reunion, the now unfamiliar child and / or birth mother sense a strong connection while others sense nothing. Could this be because of the resonance between mother and child during pregnancy and through the birth process?

It usually takes training as provided by many esoteric traditions and / or certain naturally sensitive individuals to routinely perceive the non-local holographic information associated with a particular target object. There is considerable evidence to suggest that the brain / mind has these latter capabilities at birth. The development of language, suppression of these capabilities by cultural conditioning and subsequent lack of practice all contribute to the atrophy of natural ability of conscious, intuitive perceptions. Perhaps cultural conditioning is one of the reasons why so called reincarnation experiences are so common in children in eastern cultures while virtually unheard of in the west. The late Dr. Ian Stevenson of the department of Psychiatric Medicine at the University of Virginia traveled around the world and investigated children usually from the ages between 2 and 5 who claim to have lived previous lives⁷⁹.

“At the same time they have often displayed behaviors or phobia that were either unusual in their family or not explained by any current life events. In many cases of this type the child’s statements have been shown to correspond accurately to facts in the life and death of a deceased person; in many of these cases the families concerned have had no contact before the case developed.”

Our view is that although the reincarnation event is a real nonlocal event experienced by the child, the interpretation of the event is not correct. We believe that the person is in a high state of resonance with the quantum hologram of the deceased and is able to retrieve QH information about the deceased from that resonance condition. As the child ages, rational left brain processing begins to dominate and the child is no longer able to resonate with the QH of the deceased unless the child has been trained to maintain that state of altered consciousness. We would attribute a similar effect with someone who experiences an out-of-body experience (OBE). Again, this most likely represents a high

⁷⁹ Stevenson, Ian, *Children Who Remember Previous Lives: A Question of Reincarnation*, revised ed., 2001, Jefferson, NC, McFarland & Company

state of resonance with the remote location and the experiencer is retrieving and processing the QH of the objects at the remote location being visited nonlocally.

In cases like the ones just described, meditators, mystic adepts and natural psychics routinely demonstrate that that nonlocal information is perceptible from physical objects and icons by focusing attention, quieting the left brain and allowing intuitive perceptions to enter conscious awareness. Those most practiced in meditation experience an altered sense of space time, the dissolution of self, have access to universal knowledge and sometimes feel a unified sense of oneness with all of existence. Along with this sense of oneness comes a feeling of immense bliss and a great clarity of mind. We postulate that they have entered into a state of high resonance with the QH and have access to all the information that is implied by such unification.

Particularly in western tradition, academic interest has been on left brain or rational processing rather than right brain intuitive functions. It is the left brain cognitive ability in humans that provides acceptable labeling of the intuitive, creative and artistic processes taking place in the right brain. Given the fact that with training and practice, all individuals can reestablish and deepen their cognitive access to intuitive, non local information demonstrates that learning recall is taking place within the whole brain itself and involves enhanced coherence and coordination between the hemispheres and with the QH. This process is different and distinct from the left brain function of extending and extrapolating factual data and forming conclusions based on logical deduction to leap to an “intuitive” conclusion, while omitting the immediate steps leading to that conclusion.

When an object or person of interest is not in the immediate vicinity of the percipient so that space time information obtained by normal senses is unavailable for receiving and interpreting nonlocal information, the method is somewhat different in obtaining resonance with the target. The case in point is the subject of Remote Viewing (RV) which is another latent ability we all have to some degree. RV allows us to describe and experience activities and events that are normally precluded from us with ordinary perception from our normal five senses. The phenomenon has been researched

extensively by Puthoff⁸⁰ and Targ⁸¹ at Stanford Research Institute since the mid 1970's. Their work attracted the attention and funding from the U.S. Central Intelligence Agency and was conducted in secret for almost 20 years. Some of the work involved exploring the limits of what remote viewing could do and also in improving the quality and consistency of the result. Much of the remainder of the effort was in training operatives to collect intelligence information against foreign adversaries. The government funding of the effort ended after the collapse of the Soviet Union in the 1990's.

For the purposes of our discussion with RV, the questions we are interested in pertain to the "reference signal" used to decode the quantum holographic information in the absence of any classical space time signals and also how the condition of resonance (PCAR) is established by the percipient. Experimental protocols from RV normally provide clues to the location of the target object such as a description, a picture or location by latitude and longitude or an icon representing the target. These clues seem to be sufficient for the percipient to establish resonance with the target. Space / time information (as perceived by the normal five senses) about the target is not perceived by the percipient, nor does the object usually appear at its physical location in space time like a photograph or map in the mind. Rather the information is perceived and presented as internal information and the percipient must associate the perceptions with his / her internal data base of experience in order to recognize and describe the target's perceived attributes.

In the case of complex objects being remotely viewed, the perceived information is seldom so unambiguous as to be instantly recognizable as correct. Sketches, metaphors and analogies are usually employed to recognize and communicate the nonlocal information. A considerable amount of training, teamwork and experience are necessary to reliably and correctly extract complex nonlocal information from a distant location. The information appears to the percipient as sketchy, often dream-like and wispy, subtle impressions of the remote reality. Very skilled individuals may report the internal

⁸⁰ Puthoff, H.E., CIA Initiated Remote Viewing Program at Stanford Research Institute, JSE 10:63-76, 1996

⁸¹ See Puthoff, H.E. and Targ, R., A Perceptual Channel for Information Transfer over Kilometer Distances: Historical Perspective and Recent Research, proceedings of the IEEE 64:329-354, 1976

information as frequently vivid, clear and unambiguous. The remote viewing information received in this case is strictly nonlocal and, based on the hypothesis of QH, the received information is missing the normal space time component information from any of the five normal senses about the object necessary to completely identify and specify it via resonance.

It has been demonstrated that this intuitive mode of perception can be enhanced by training in most individuals. Perhaps additional training and greater acceptance of this capability will allow percipients to develop greater detail, accuracy and reliability in their skill. In principle, training will not only enhance the remote viewing skill and its accuracy, but should also cause the associated neural circuitry to become more robust as well.

In the absence of normal perceptual sensory signals such as light or sound to establish the resonance condition to provide a basis for decoding the target object's quantum hologram, an icon representing the object seems to be sufficient to allow the mind to focus on the target and to establish the resonant (PCAR) condition as we have described earlier. However a reference signal is also required to provide decoding of the encoded holographic phase dependant information. It has been established⁸² that any waves reverberating through the universe remain coherent with the waves at the source, and are thus sufficient to serve as the reference signal to decode the holographic information from any object's quantum hologram emanating from a remote location.

We conclude our discussion of potential QH applications with the experiments conducted by George De La Warr in the 1940's and 1950's. De La Warr was a British engineer who became interested in understanding the mechanisms associated with remote diagnosis and healing⁸³. He began experiments with his wife, an accomplished psychic healer, to detect the radiation emitted in such processes. At first he thought this mechanism was related to some form of EM radiation but later realized that it was

⁸² Marcier, P. J., *The Jigsaw, the Elephant and the Lighthouse*, Proceedings of ANPA 20, 1998

⁸³ Day, Langston, De La Warr, George, *Matter in the Making*. Vincent Stuart LTD, London, UK, 1966

associated with resonance. He eventually built a diagnostic device which acted as a resonant cavity. Perhaps the strangest aspect of the discovery was that when the device was operated by his wife, she could focus her attention on a living target object and was able to produce a resonant condition between the target and the measuring device. She was also able to “project” this resonance condition and expose a blank photographic plate. She was eventually able to pick up resonances from plants, trees, humans and even diseased tissues. Over time they built up a library of several hundred such plates. Many years later M Sue Benford⁸⁴ came across this library and had some of the photographs analyzed by modern 3-D CAD/CAM software (Bryce® 4). The analysis showed that the images were spatially encoded with a 3-D effect similar to those produced by fMRI machines⁸⁵ but with much higher resolution. Recall that fMRI machines were not in existence until many years after these photographic plates were exposed by Mrs. De La Warr. These experiments along with fMRI machines seem to provide compelling evidence that macro-scale quantum holography is a real phenomenon and is produced by conscious attention and intention by a percipient on objects of interest.

We end this section with our model of QH summarizing how nature (and all living entities) perceives, learns, adapts and evolves in its environment. This model is shown in figure 7-2 below. In this model, we show how establishing resonance (PCAR) between a percipient and a target object, the phase conjugate (mirror image) signaling paths connecting the two, can be labeled “perception” on the input side and either “attention” or “intention” on the output side. In the case where the object is a simple physical object (like an apple), our interest is on the non-local information perceived by the percipient about the apple. However from the point of view of the apple, information about the percipient is also available to the apple. The resonant condition between the two is a reciprocal relationship.

⁸⁴ Benford, M.S, Empirical Evidence Supporting Macro-Scale Quantum Holograph in Non-Local Effects, Journal of Theoretics, retrieved from archives at www.journaloftheoretics.com/Articles/2-5/Benford.htm on 2/1/2008.

⁸⁵ As you will recall from the last chapter, Shempp made the discovery that fMRI machines encode quantum information holographically.

The Quantum Holographic model predicts that the history of events of the target object (apple in this case) is carried in the apple's QH which implies that the "attention" or "intention" focused on the apple by the percipient causes that event to be recorded in the apple's QH. Clearly we cannot query the apple to inquire about its experience but none-the-less, the interaction will create a phase shift in the apple's QH (interference pattern) which should be detectable. Although we are using anthropic labeling as we are discussing human perception with the apple, this phenomenon is rooted in natural (and primitive) nonlocal physical processes which are fundamental to the interaction between all objects whether living or not. The evolved complexities of perception, cognition, etc., associated with the brain, as yet have no obvious analogous label other than "nonlocality and entanglement" to describe the interactive experience with the environment for simple objects like apples.

Nature's Learning Mechanism

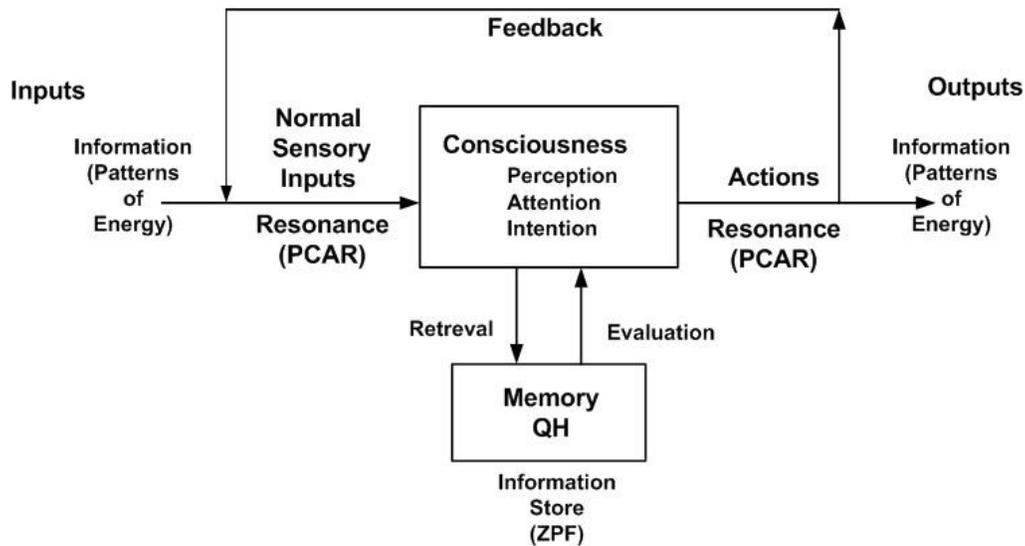


Figure 7-2 How Nature Learns

Once the resonance condition is established, the percipient can evaluate the results (via the feedback mechanism shown in figure 7-2) and can then change its mind state with regard to the object being perceived. The perceived information can then be

processed by brain functions so that cognition occurs with respect to the perceived information and thus allowing meaning to be assigned to it. Cognition and meaning require finding a relationship between the perceived information and the information residing in the percipient's memory and this information will be interpreted based on the percipient's beliefs and prior experience stored in its memory. The percipient can then form intent with respect to the object. In such cases the output labeled "action" changes from "attention" (passive state) to "intention" (pro-active state).

In self aware animals (e.g. those with a brain) cognition, meaning and intent with respect to an external object can often be described in simple terms, for example: enemy; fight or flight; food, eat; greet, etc. The nonlocal component of information, although present and creating effect, is operating below the level of conscious perception in humans and results in "instinctual" subconscious behaviors in animals. Classical modeling of this autonomous activity describes it in terms of classical information and energy flow in the central nervous system and the brain. However, as QH suggests, nonlocality is operating at all levels of activity, certainly there are resonances involving this nonlocal information operating throughout all the cells of an organism in parallel with classical space / time functions as described earlier in this chapter.

The results for intentional effects of nonlocality should be no more difficult to accept than the results for perception -- normal perception using the five senses. The resonant condition (PCAR) implies a symmetry whereby information flows in both directions between the object and the percipient such that each is both target object and percipient to the other. Only the complexity of the more ordered normal sensory mechanisms suggests a non-symmetrical relationship. In general, humans seem to have great difficulty accepting that thoughts, specifically intentionality, can cause action at a distance (remember Einstein's "spooky action at a distance"). Yet, it has been observed for centuries and only in recent decades has it been subjected to scientific scrutiny.

The case of resonance conditions via PCAR to create remote effects by transfer of nonlocal information between equally complex percipients like humans is not difficult to

understand. Indeed, hundreds of successful experiments have established the case. In all these cases no energy transfer is required, only nonlocal information, as each percipient / target object has access to its own energy source. The case for intentionality creating remote effects in inanimate objects is more puzzling. Teleportation of quantum states has been successfully accomplished for particles⁸⁶ and now has practical applications in quantum computing. Numerous studies⁸⁷ show that macro-scale objects can also be changed or moved, but the energy transfer mechanism by which the classical states of a remote object are affected remains elusive but perhaps is related to utilizing energy directly from the zero point field.

⁸⁶ Darling, D., *Teleportation - The Impossible Leap*, John Wiley & Sons. Hoboken, NJ, 2005

⁸⁷ Radin, D., *The Conscious Universe*, Harper, San Francisco, CA, 1997

See also Dunne, B., Jahn, R.G., *Operator Related Anomalies in a Random Mechanical Cascade*, JSE 2:pp 155-180, 1988

CHAPTER 8 – WHAT IT ALL MEANS

The Implications

Someone recently requested the authors describe quantum holography and its implications in two pages, a very difficult task indeed. It has taken us considerably more than that to get here. Nature is extremely complex and does not give up her secrets willingly. Humankind's efforts at understanding her rests on the shoulders of countless dedicated men and women who have come before and are yet to come. Clearly we have a long way to go before we understand it all. Perhaps what is truly most amazing about nature is that it appears to be knowable at all. In this manuscript we have argued that the best way to survive and sustain humankind as a civilization and to thrive as well is dependant upon the emergence of a new world view, one that understands our proper place in the larger scheme of nature. This includes a worldview that properly addresses, in verifiable scientific terms, our collective relationship to each other, to the biosphere, to the environment and to the entire cosmos. Towards that end, the evidence that we have presented suggests that we live in a universe that operates according to the following principles. It is:

- **Self-organizing** – All non living and living matter seems to be the result of the emergent complexity adapting and evolving in response to changes in the environment.
- **Intelligent** – The universe utilizes information, processes it and assigns meaning to it. It seems to evaluate new experiences against stored information and “chooses” actions based on that evaluation based on feedback mechanisms.
- **Creative** – All matter in the universe appears to be interconnected and communicates with itself to continually form more complex systems. These systems seem to regulate and organize themselves in ways that are flexible, adaptable and exhibit some form of purposeful behavior.

- **Trial and error** – The habits of nature, its laws, and its operating principles, seem to adapt and evolve by trial and error. The more successful an adaptation is the more it is reinforced. The less successful it is, it would seem to atrophy and eventually die out or fade away into disuse.
- **Interactive** – All matter continually interacts with all other matter. There is no such thing as independent action. Everything is defined in relationship to everything else.
- **Learning** – Experience is retained in nature’s memory, the Quantum Hologram. Once information is created it is always available and never forgotten.
- **Participatory** –The role of intention in conscious matter has demonstrable effect.
- **Evolving** – Since its beginnings, nature has been developing into ever increasing levels of complexity in response to environmental changes or pressures resulting from natural processes.
- **Non-locally connected** – All things in nature are interconnected in a very fundamental way beyond time and space. The exchange of information between any two objects occurs instantaneously no matter their space time separation and these interconnections cannot be shielded or attenuated.
- **Based on Quantum Principles** – From the micro scale of subatomic particles to the largest objects in the cosmos and everything in between, all matter displays the quantum characteristics of entanglement, coherence, correlation and resonance.

This universe seems, in some sense, to be a living, evolving, adapting universe that utilizes information to organize itself and to create ever increasing levels of complexity. We are a part of it and cannot be separated from it and are interconnected with it all. Furthermore it appears to be a self referencing system (see Figure 8-1). As nature learns, habits form and those that lead to useful outcomes solidify and effectively become “hard coded” in nature. Even then these “habits of nature” (including us) adapt and evolve by trial and error as change occurs. It appears that nature has bootstrapped itself not only into existence but has evolved itself into the current state of complexity that we now observe all around us. Most astounding of all is that humankind has evolved

to the point that we can ask questions and have begun to gain understanding fundamental to nature's very existence. Perhaps, then, we and all sentient beings really are one of nature's way of knowing about and experiencing itself. Not only that, in some sense, we seem to be able to influence its very evolution.

Our hypothesis of interconnectedness and oneness suggested by quantum attributes and processes have been espoused by ancient sages, avatars, mystics, spiritual leaders and shamans throughout all times and by all cultures. Just as modern man has evolved from our ape-like ancestors, so too must we evolve to the next level of sophistication and refinement, and by inference our civilization as well. Change, adaptation to that change and evolution seem to be nature's intrinsic mandate built in to the very fabric of reality. All creation must either perish or constantly evolve. Nature has demonstrated this principle throughout its entire history and has seen to it that there are no alternatives. The arrow of time flows in one direction only.

Nature - A Self Referencing System

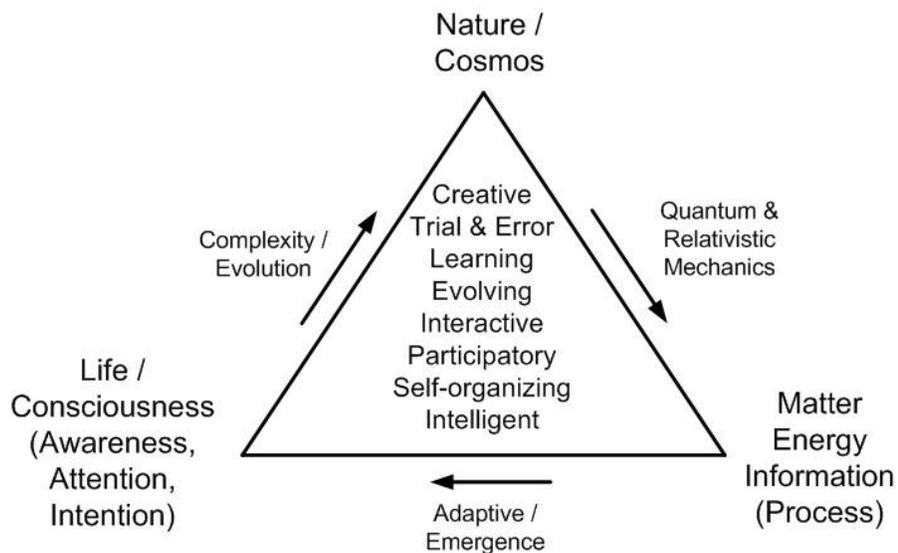


Figure 8-1 Nature's Bootstrap Process

We have presented our hypothesis as a map of reality that appears to match observations and experimental evidence fairly well. It seems to account for many phenomena in nature that here-to-for had no explanations to account for them. However, as we have said throughout this manuscript, the map is not the territory. Instead it is nothing more than a model of that territory that makes predictions about how the territory will behave under certain circumstances. We believe that the cornerstones of our theory are built upon known and verified properties and processes of nature and perhaps some yet to be discovered. However, like all theories in science, all that we have proposed is testable. Those parts of it that are not validated will have to be modified, revised or discarded and replaced. Such is the nature of scientific inquiry. At the very least we hope that we will encourage discussion and research to further enhance humankind's understanding of nature.

It has been said that democracy requires an informed electorate to thrive and prosper. It would seem that that is excellent advice in most areas of human endeavor. Sound bites, personal biases, self serving interests have no place if we are to adapt and evolve in our understanding. We must remain open, be willing and desirous to be informed and, most of all, willingly engage in learning and discovering new knowledge about this world in which we live and our true place within it. The issues we face are too important to ignore either by willful neglect or lack of understanding. Our very survival and the survival of all life on earth depend upon it.

We leave you this ancient Sanscrit proverb:

God sleeps in the minerals,
Awakens in plants,
Walks in animals and,
Thinks in man.

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