Exercises in Natural Philosophy

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Scientific method requires the use of empirically tested observations to arrive at verifiable results. Evidence obtained from introspection or personal experience is not normally admitted to a scientific theory except historically in the case of natural philosophers such as Socrates, Aristotle, Descartes, and Kant. However, in these exercises I will revive practices from the past by reinstating the philosophical principle of dualism. Dualism is the idea that there is an external world of appearances that is the subject of science and an internal world independent of experience that is outside the possibility of experiment. Because dualism is a universal principle it can be used to comment on problems from quantum mechanics to cosmology. Specific topics of discussion will include evolution, human consciousness, and galactic structure.

1. Hypothesis

It would be absurd to try to compare well publicized problems in the theories of quantum mechanics, evolution, and cosmology to each other. However, when we examine the methods used to formulate these theories we will see that the controversies originate not in the theories themselves, but in a characteristic of human nature that was recognized by philosophers over 2,000 years ago.

2. Introduction

Newton expressed his feeling for continuity with past generations by writing famously, "If I have seen further it is by standing on the shoulders of giants." [1] We can interpret Newton's meaning in two ways: start where others have left off and try to extend their theories further; or use their teachings as a foundation to formulate new ideas. The tendency of today's scientists is to skip literature more than a few years old and follow the former practice. The ideas of previous generations are thought to be either outdated or already included implicitly in current works. The intent of these exercises, on the other hand, is to show that the foundations of science are faulty so we must go back to the beginning and reassess everything that has been done. The work of those who have contributed to natural science in the past is important and should not be bypassed. Each possesses a piece of the truth and to ignore the wisdom and patient striving of our ancestors represents a folly of the greatest magnitude.

The earliest studies of natural phenomena were carried out without the testing of ideas in a practical way and were referred to as natural philosophy. A common practice of natural philosophers was to use introspection to examine human consciousness and compare it to the external world to look for similarities. They believed themselves to be intimate participants of the natural world rather than mere observers. **Robert Boyle** (1627-1691), was the first to question the validity of natural philosophy and fully embrace the current practice of scientific method, or empiricism. He shared with **Francis Bacon** (1561-1626) and **Galileo** (1564-1642) a conviction that experimental observation was key to a more satisfactory understanding of nature than otherwise possible. As experimentation increased, however, the accumulation of facts became so overwhelming that no single person could be knowledgeable in all scientific disciplines. Scientists were forced to specialize in very narrow fields of expertise as opposed to natural philosophers who speculate about the entire spectrum of knowledge. Because the empirical approach to science analyzes natural phenomena in ever greater detail it is more skillful at predicting the outcome of physical processes; however, knowledge is more fragmented and from a lay person's perspective less coherent. Also because the study of nature has been ceded to the specialist there is little agreement as to how the various scientific disciplines should overlap. On the other hand, prior to the development of empiricism natural philosophers throughout history shared the same goal, to develop a unified approach to the study of nature. Both of these attempts to understand nature, analysis by empirical methods and synthesis by philosophical methods, have their own unique advantages and both will be used in these exercises to achieve a coherent view of nature.

2.1. Dualism

In contrast to modern science natural philosophy has shown remarkable progress towards consensus. This may be verified by comparing the writings of some of the better known philosophers. The first recorded natural philosopher, **Socrates** (c.427 BC- c.347 BC), and his pupil **Plato** introduced the idea that there are two worlds, the apparent world which is constantly changing, and the permanent and heavenly world of ideas which is a more unchanging cause of what is apparent. They believed that just as shadows are temporary, physical objects are themselves fleeting phenomena caused by more substantial causes. **Aristotle** (384-322 BC), another of Socrates' students, referred to these two aspects of nature as matter and form. We see in Greek philosophy early attempts to analyze the real world in terms of two complementary aspects, an idea that has persisted throughout history and is referred to in philosophical circles as "dualism".

The Chinese philosopher **Zou Yan** (305 BC - 240 BC) interpreted dualism from the perspective of time by means of the Yin and the Yang. Yin and Yang refer to opposite and equal qualities, or complementary opposites within a greater whole. Whenever one quality reaches its peak it will naturally begin to transform into the opposite quality: grain that reaches its full height in summer (fully Yang) will produce seeds and die back in winter (fully Yin) in an endless cycle. Every advance is complemented by a retreat, and every rise transforms into a fall. Yin or Yang elements, such as male and female or hot and cold, are in everything but may be manifested more strongly in different objects or at different times. Because the Yin and the Yang appear alternately they often contain the element of time within them.

The Persian philosopher **Avicenna** (980-1037) returned to the idea of dualism inspired by consciousness with the first known use of a thought experiment. He described the relationship between human consciousness and physical form by imagining a "floating man". He supposed the existence of a person suspended in space and devoid of all sensory perception even with his own body. Because that person would still have the ability to think he concluded that consciousness is a primary concept, independent of any physical thing, and need not be verified independently to justify its existence. He was the first to ascribe real attributes specifically to consciousness, a theme that continues in natural philosophy to the present.

The modern concept of dualism begins with **Descartes** (1596-1650). He suggested that because the body has the material properties of extension and motion it works like a machine and follows the laws of physics. This view has been corroborated in recent times by advances in modern medicine such as organ transplants and by the discovery that cells may be engineered to perform tasks or implant desirable properties in a life form. He also believed that, in contrast to the body, the mind is a non-material entity lacking extension and motion which does not follow the laws of physics. His belief that consciousness exists outside the possibility of scientific analysis is an idea that appears often in natural philosophical theories.

Spinoza (1632-1677) used "thought" and "extension" to explain the dual nature of the world. He believed that all natural phenomena proceed by necessity from the internal nature of objects in a deterministic universe. Thus anything that happens in the universe comes from the essential nature of objects, and may be equated with God who is the personification of Nature. God does not act according to purpose, but everything follows necessarily from His nature according to natural law. Due to the intimate connection of God with all natural phenomena Spinoza believed that reality is perfection. If circumstances are seen as unfortunate it is only because of our inadequate ability to conceive of reality. Although single elements of the chain of cause and effect are not beyond the grasp of human reason, our understanding of the infinitely complex whole is limited because of our inability to take account of the whole sequence. We see in Spinoza's writings a realization of the limitations of science. When Einstein was asked whether he believed in God he responded, "I believe in Spinoza's God who reveals himself in the orderly harmony of what exists, not in a God who concerns himself with the fates and actions of human beings".

Following in the footsteps of previous philosophers **Immanuel Kant** (1724–1804) continued working to clarify the concept of dualism. In Kant's view, we can make sense out of "Things" in various ways, but we can never directly know the "Things in Themselves", the actual objects and dynamics of the natural world. "Everything that can come before us externally as an object" is in both space and time, while our internal intuitions of ourselves, or consciousness, are only in time. The Thing in Itself is absolutely real in the sense that it would exist and have whatever properties it has even if no human beings were around to perceive them. Appearances, on the other hand, are not absolutely real in that sense, because their existence and properties depend on human perception. Science applies to appearances, which are described in space and time by mathematics, but ultimate reality is with the Thing in Itself which is unknowable and cannot be described by mathematics. Quantum physics overestimates the importance of appearances by assigning reality to mathematically defined observables and creating from them hypothetical structures such as parallel worlds. Dualism resolves these questions in very ordinary fashion by treating quantum systems the same as any object, as having appearances that are observable and internal properties that are either not observable at all or only partially observable. Natural philosophy cuts through the complex mathematics of quantum "logic" to expose the fundamental simplicity of the measurement process.

Schopenhauer (1788-1860) accepted Kant's version of dualism; the world of experience and the world independent of experience, but he believed them to be two different sides of the same coin. The thing-in-itself does not cause appearances, but rather they are simply the way by which our minds perceive it. Schopenhauer also argued that Kant's demarcation contains a significant omission. There is, in fact, one physical object we know more intimately than any object of sense perception: our own body. As soon as we are aware of an external world we know that our bodies have boundaries and occupy space. Though we do not yet think of our body as a physical object, we are aware that other objects also have boundaries and that it shares some of an object's properties. We know this even if we do not understand the physics involved. Our conscious mind inhabits a physical body that is similar to other physical objects, but that we are not in full control of. We usually are not aware of the breathing of our lungs or the beating of our heart unless somehow our attention is called to them. Our kidneys command our attention on their schedule rather than one we choose. These organs have an agenda which the conscious mind did not choose and over which it has limited power. The Thing in Itself is identified with these internal processes and also with the desires, needs, and impulses in us, which we call "will". The rational mind is, for Schopenhauer, a leaf borne along in a stream of pre-reflective and largely unconscious emotion. That stream is will, and through will, not logic, we can participate in the underlying reality beyond mere appearances. We cannot prove that our mental picture of an outside world corresponds with reality by reasoning; but through will we know without thinking that we are one with the world.

Herbert Spencer (1820-1903) described a different aspect of dualism, pointing out that we can frame no conception of a creator or the substratum underlying our experience of phenomena. He concluded, that religion and science should agree in the supreme truth that the human understanding is only capable of relative knowledge. Due to the inherent limitations of the human mind, it is only possible to obtain knowledge of phenomena, not of the reality underlying phenomena comprising the absolute. He called this 'the Unknowable' and he presented worship of the Unknowable as capable of being a positive faith which could substitute for conventional religion. Discussions by natural philosophers of spiritual matters such as Spencer's are not uncommon. We see, for example, Spinoza's belief that God is the personification of Nature included as a part of natural science in a matter of fact way. Similarly Schopenhauer's concept of "will" is comparable to biblical descriptions of the soul. In fact all religions are inherently dualistic because they acknowledge the existence of both spiritual and corporal matters. This is in contrast to current scientific disciplines that have become ever more distant from spiritual aspects, rejecting suggestions that anything exists beyond the scrutiny of experiment.

Interest in natural philosophy waned in response to the experimental successes of the 19th and 20th centuries, and as a result natural philosophers were gradually forced out of university positions. One theoretical physicist who labored in obscurity and frustration because of this purge was **Pierre Duhem** (1861-1916). He had views of science similar to Kant's: that an external reality exists, but only its appearances can be studied effectively. The goal of science, he said, is to discover rational order in the universe and to express these regularities as "laws". However, the laws should not be regarded as identifying the way things actually are, rather they are simply convenient short-hand notations. He noted that because of the successes of empiricism we judge a theory according to how well it accounts for observations and its ability to make accurate predictions rather than on its ability to explain reality. This observation is even more accurate today. Duhem was especially critical of mechanical models of reality such as Maxwell's use of displacement currents in electromagnetic waves because they give the false impression that we understand what is "really" occurring. Displacement currents were hypothesized in order to introduce symmetry to the wave equation, but they have no basis in experiment. His distaste for mechanical models could be applied today to the methods of cell biology which routinely use molecular models to "explain" life processes.

The founders of quantum theory ignored the principles of natural philosophy even though many can be considered adherents of its principles. Shroedinger, for example, conceived of his cat paradox in order to demonstrate that quantum mechanics misinterprets wave function collapse and forms an incomplete description of nature as a result. Einstein also rejected quantum mechanics. "I cannot", he stated, "base this conviction on logical reasons, but can only produce my little finger as witness." The giddiness that existed at the time due to frequent experimental advances caused mainstream physicists to dismiss his views as being hopelessly out of touch. Consequently when he published his views formally in the EPR thought experiment his objections were believed to be trivial. However, Einstein did not subscribe unequivocally to a mathematical solution, rather he believed, as many others also believed, that there is an underlying, unobserved reality to which science does not have direct access. In more recent times the position of quantum mechanics has become even more polarized, claiming that in order for a competing theory to supersede quantum theory it must be more accurate. In other words, we are advised to stop trying to understand nature and instead design more accurate experiments.

The prominent place that dualism maintained in human thought for over 2,000 years has been replaced by an overwhelming emphasis upon experimentation. Thus when quantum mechanics introduced the concepts of "duality" and "uncertainty" to explain subatomic behavior, rather than relate them to the dual aspects of nature already in place they were declared "mysteries" that human minds are incapable of comprehending. In spite of their many differences elementary particles have unobserved properties that are comparable to the unobserved properties of personal experience. We are both in the world and of the world. We share experiences consciously with others, but our own sense of consciousness is singular, unique, and indescribable to or by anyone else. Observables such as diameter and mass are applied to all scales of measurement so unobservable properties must apply to all levels as well, from the tiniest elementary particles to human consciousness.

Quantum physicists believe that what cannot be detected need not be included in a scientific theory. Dualism is rejected therefore because it violates the requirement that all scientific knowledge be accessible to experiment. Even the life sciences presume that all properties must be measurable in order to be valid. Consciousness, for example, is treated the same as other natural phenomena and analyzed by using electronic monitors and other sophisticated instruments. It is thereby suggested that creativity, emotions, and other thought processes must be reduced to a series of instrument readings before they can be incorporated into a scientific theory. Nevertheless we are all acutely aware of the importance of even the most subtle of thought processes. Although these thoughts cannot be detected or quantified, they are unique to us as individuals and essential to our survival. Fear and love are not learned from experience nor can they be detected by scientific instruments. They are innate at birth and we require them to survive. They are an essential part of our existence, they are real, and perhaps they can help us to understand how dualism is expressed in other objects and organisms; especially with regard to the unobservable aspects of nature.

How can internal, unobserved processes be analyzed? Our thought processes are immersed in a space-time that is unavailable to outside inspection, and by assuming that the same relationship exists throughout nature we acknowledge the presence of "unknowable" properties in all things. On the other hand, objectively determined properties occupy ordinary space-time and are referred to as the "knowable" properties of life, or its "appearances". For example, eyes and vision are two completely independent aspects of the same process; the eyes are objects whose properties are anatomically well understood and shared by all individuals, while vision is an experience that is unique to each individual. It is impossible therefore to describe an individual or organism with a single set of space-time coordinates. We occupy the environment physically in one set of space-time coordinates and simultaneously we perceive the environment in another. The two space-times coexist, are independent of each other, and are linked by consciousness. An objective analysis of consciousness is necessarily incomplete and must be complemented subjectively by examining actual experiences through introspection. Consciousness changes day to day during sleep and wakefulness, and minute by minute according to the intensity of experience. The memory provides a record that varies according to the intensity of experience and is a more complete register than possible by empirical methods because it is continuously active. We all share the same types of experiences, and they can be analyzed and compared in what may be referred to as "consciousness experiments".

3. First Consciousness Experiment

If I had purposely designed an experiment to investigate the properties of my mind then the results could easily be prejudiced. Instead I have reviewed past memories and selected experiences that most clearly illustrate the nature of consciousness and its external manifestation, the will. The experiences I selected include unobservable sensations, but hopefully you will recognize them within the context of your own experiences so that they serve as a means of verifying the essential correctness of the experimental procedure. The first step to analyzing consciousness is to establish a sensory stream and then follow it as it extends outwardly in space and forwards and backwards in time.

Fig. 1. Southern Chile

It is the second of February 1973 and I am in southern Chile at a saw mill in the town of Contao. I am on summer vacation from my position as assistant professor of physics at a technical school in Santiago, the capital, and patiently waiting to talk to the administrators of the sawmill. I am quite content to wait though. First, because I have left the interminable noise and dirt of Santiago and secondly I find myself in Patagonia, an area of the world that has a mythical air about it. It consists of inland seas encompassing scattered islands, mountains, and a mild climate that has been compared to the Mediterranean Sea. As I gaze around me the ocean waters of the Pacific are to the north and west. Blocked from ocean swells by islands and other geographic prominences the waters are nearly landlocked, and they have the appearance of a large lake. To the south are scrub lands from the recently logged-off alerce forests and to the east are the coastal mountains. The distant snow capped peaks of the Andes can be seen beyond the coastal range seemingly suspended in midair. They are relatively young mountains still being pushed upwards by the tectonic plates and one day, I am told, they will be taller than the Himalayas. They appear deceptively close standing like sentries all in a row and I find their presence both comforting and to a certain extent stimulating. If I had more than one life to live I would travel there to examine their majestic beauty more closely. Instead duty calls, reminding me that it is more important to achieve something permanent no matter how mundane that may seem in comparison. I am here to search for inhabitable land to homestead on. There must be land available, I reasoned, because maps show no roads in the area and very few towns. Upon arriving it soon became apparent why it is sparsely inhabited. In most areas the mountain slopes extend down close to the ocean's edge leaving very little arable land. No matter, when there is a will there is a way. I am determined to succeed.

Accessible to vehicles only by sea, Contao is similar to frontier outposts of the past. It was hastily constructed to take advantage of the close proximity of an alerce forest to population centers. The alerce tree is one of nature's noblest achievements. It is the second oldest living thing in existence and one of the biggest with many examples attaining life spans of 3000 years or more, heights in excess of 60 meters, and several feet in diameter at the base. The wood of the alerce tree is highly prized for its light weight and resistance to rot. At one time there must have been a lot of activity at the saw mill, but the hilltops surrounding Contao are bare now and work has slowed considerably. The few remaining residents are company workers housed in regularly spaced, single story buildings constructed of wood and tin. Displaced from the comfort zone of home, friends, and family they seem oblivious to their surroundings as they hurry about their business. To relieve them from the relative isolation of the camp the logging company allows passengers to accompany cargo on an amphibious landing craft that departs to Pto. Montt each day at high tide. I had also come by way of Pto. Montt, but because I was unaware of an easier way I had gone by foot along the coast crossing the Estuary Reloncavi by row boat. In any case I find it preferable to journey slowly in order to absorb as much of the surroundings as possible; the mountains, the rocky coastline of the ocean, the sound of seagulls, the feel of the wind and rain, new foods and customs; in other words, the observables. Although I learned a lot and it is always fascinating to experience new places, the natural beauty of the area is not what compelled me to come here. The actual causes are unobservable and will require patience to explain.

As we age we mature and maturity is more than a biological process, to some extent it is also learned. We spend time adapting mentally to social norms of behavior. We learn what is acceptable and what is not by developing a sense of judgment until it becomes second nature. Naturally it is preferable to be faced with obvious choices so that decisions come easily, but sometimes they are not obvious and must be carefully weighed. If there is an unfavorable outcome, decisions must be questioned, a natural part of the learning process. Actions, whether successful or unsuccessful, are recorded in the memory which then acts like a feedback mechanism to improve judgment by positive reinforcement. It would be a wonderful thing for society if this was all there was to it and that the judgment process once learned becomes hard wired into our consciousness. The study of human behavior would then be a more precise science than it is. However, that is not the case and in fact what I discovered was that sense of judgment is highly variable; and that it changes depending upon a barely noticeable, almost unobservable factor. The sensation I speak of is an internal property of our bodies that is part physiological and part psychological, but which cannot be detected by instruments. It is what Schopenhauer described as our desires, needs, and impulses; and what he referred to as the will. It is an important property of the individual because it makes up a large percentage of our personality. We all have a clear impression of the difference between a strong and a weak will, but no one can say precisely what the will is. In order to analyze it more closely I will try to describe its unobservable properties; unobservable, that is, except by introspection.

When I am inactive I can sense deep inside of me, in the pit of my stomach, what is best described as a nervous feeling, or slight uneasiness that is slow to develop and seems to urge me into motion. This causes me to seek out locations or situations where activity is more likely and I also become more amenable to suggestions of activity. The longer I ignore these feelings the stronger they become and the more the cautionary influence of inhibition is tempered. My sense of judgment is gradually reduced to an extent that I may act in haste or even behave irrationally just to rid myself of the uncomfortable feeling inside of me, with the result that the memory of my actions sometimes torments me. On the other hand, when I listen to these inner voices and engage in constructive activity, or at a minimum conduct some form of exercise; the inner restlessness usually fades away, I feel confident; and I am more likely to exercise good judgment. In other words, I am more content and feel healthier if I choose a "holistic" lifestyle that includes activities to satisfy body *and* mind. Extensive experiments by the medical profession have confirmed that this is true in general and that individuals who follow a holistic lifestyle have fewer medical problems. Life is the objectification of movement so to deny motion to a life form whether consciously or unconsciously is unnatural. Medical practitioners now routinely question patients about mental and physical activity during regular check-ups in order to anticipate future health issues. By examining my inner sensory stream and paying close attention to its properties I was able to deduce intuitively in a relatively short time something that medical science required decades of research to confirm by experiment. Although experimental studies are helpful, self-analysis can sometimes provide valid results more quickly and efficiently than empirical methods.

3.1. Rain Forests

By seeking land for homesteading I was taking my desire for a holistic life style to its logical extreme. My actions are not carefully reasoned, rather they are determined by the will. Better to attempt too much and fail than attempt too little and later question whether it was sufficient. Socrates advised, "Know thyself" and how better to comply than by testing one's limits to the extreme. The only way you will know what is possible is to set your goals too high. Then no matter what you achieve it will be more than if you had acted cautiously. And so I set out into the unknown on an overly ambitious project to see what would come of it. It was an experiment, an experiment in life.

The area is populated, but commercial activity is nearly nonexistent so I carried a tent, blanket, and food with me so as not to restrict my travels. The climate is incredibly damp receiving close to 200 inches of rain a year, but if it rained during my stay I have no recollection of it. I am focused on more immediate goals. I eventually received permission from logging company administrators to go through the logged off area in search of land. They arranged quite unexpectedly for a truck to drop me off at a trail that leads to the next town, Hornopiren. So early the next morning I boarded a log truck and passed through what twenty years earlier had been a virgin forest, untouched and unexplored even by aboriginal peoples. Now, except for a few inaccessible groves on the mountainsides the forest is clear cut. On the way we occasionally pass what appears to be ten foot high mounds of sod. Squatters from nearby areas are manufacturing charcoal from the left over scraps of timber they scavenge. The wood is stacked sloping inward and upward, and then covered with sod leaving a small vent at the top. It is then ignited from the base and allowed to burn for several days with insufficient oxygen. Due to its light weight charcoal can be easily transported to Pto. Montt and sold where the majority of households still cook and heat with wood.

About halfway through the logged-off area we pass along side of the extinct Apagado volcano, the black cinders of its conically shaped slopes completely devoid of vegetation. We eventually arrive at a mountain range where nature has stopped the loggers' progress. The driver beckons towards the edge of the forest where a blazed trail begins. I thank him, hoist my knapsack, and climb down from the cab eager to begin my long planned search for land. I soon found the path and began to follow it up the gradual slope of the mountain. In some places foot long strips of bark have been ripped off, but on others the markings are barely visible. Each time I lose track of the slightly used trail I must retrace my steps and change direction until I find it again. The path leads to the top of a mountain range which stretches in an unbroken north-south line along the Rio Negro, a small glacially fed river. It is already late afternoon by the time I reach the peak. Upon cresting I begin to descend the darker eastward facing slope in a northerly direction, parallel to the distant sun bathed river valley below. Now I am on a more visible path that leads to my final destination, Hornopiren, and I can increase my pace substantially.

It is a beautiful summer day. Part way down the slope the foliage suddenly opens up and I can see the entire valley spread out before me. Hornopiren is situated at the mouth of the Rio Negro where a wide river delta has formed. I quickly take a picture and continue. Close examination of the picture reveals a single row of houses bordering the western bank of the Rio Negro, a boat on the beach, and a large piece of cleared land on the opposite side of the valley. The river is bordered on all three sides by mountain slopes. It emerges from a mountainous region to the north and empties into the ocean to the south. Protected as it is from outside intrusion I am hopeful that I have found what I am looking for.

Fig. 2. Hornopiren village 1973

As I continue the terrain gradually flattens out, I pass through scrub land and fields with a few grazing sheep. It is evening by the time I finally enter Hornopiren which takes its name from a volcano that looms above it to the north. The shallow waters of the delta make access by small boat rather difficult. It is low tide and a motor launch rests on its side on the sand, rather distant from both town and ocean. When I inform residents that my journey took 9 ½ hours they are quick to reassure me that it will be much easier to travel when the road to Contao is finished. Although there is uncleared land available for homesteading it is already dependent on outside industry and a road will only increase that dependence. I decide not to pursue my search for land further in this area.

That night I slept on the floor of the local schoolhouse. The next morning a gentle south wind is blowing and the weather continues fair. I am in no particular hurry to return to Contao and anyway this is an interesting area of the world. It is part of a larger ecologically distinct region formed by the Andes Mountains to the east, the Atacama desert to the north, and the Pacific ocean to the south and west. As a result of these naturally occurring obstacles plants and animals evolved in isolation from outside influence, and it could be argued that this was true to some extent of the local inhabitants as well. I talked to an old man as he patiently grasped bunches of grass in one hand and cut them with a small sickle to save for winter. The winters are mild here and animals can graze nearly year round. Everything is new and different, and I need to soak up as much information as possible about farming practices, fishing, types of wood and their uses, and many other things in hopes of eventually settling in the Patagonian region. They were curious as well. A group of young men were organizing a soccer team and they asked my opinion on what they should name it. I suggested a traditional name, but they settled on a political slogan. Instead of feeling disappointed that Hornopiren is unsuitable I feel encouraged to continue looking for a more favorable location.

I left early the next morning thinking to allow myself plenty of time for the return trip. I advanced quickly through fields to the foot of the mountains and up the well-marked eastern slope. I anticipated an early arrival at the logging camp as the downward slope aided my progress substantially. After losing the trail several times I tired of backtracking to find the missing blaze mark and decided to continue on in the same general direction. The logged off area is extremely large and I can't miss it if I maintain the same general heading. However, as I descend into lower elevations the growth becomes thicker. Animal trails that show the possibility of easier passage are common in Midwestern forests, but are nowhere to be seen here. I have entered a section of rain forest that the loggers passed over due to the difficulty of the terrain. It is difficult at times to force my way through the dense foliage and though I am aided by the steepness of the slope my progress slows to a crawl. The purpose of the rain forest is to transform the disordered heat energy of the sun into the order and harmony of growth and it has achieved that to perfection. Large ferns obstruct my view so that I can only see a few feet in any direction. The forest floor is an indistinct mass of organic matter with fallen logs strewn about in varying stages of decay so that organic matter appears to transition gradually into inorganic. I walk long distances without touching the ground, struggling to step up onto a fallen log and then tentatively bracing myself as I locate my next step several feet below in an indistinct layer of vegetation. More than simply tiring the forest hinders my every movement, sapping energy, and seeming to want to keep me in its grips. This is an alien world where plants are dominant and traces of animals are nowhere to be seen. Plants are assembled in a collective, a society that has evolved literally over thousands of years such that their individual relationships are now synchronized. They act in unison to resist incursion and impose their will, slowing all that enters to the same pace. According to Kant organisms have an internal sense of time that is analogous to consciousness and it is manifested by the rain forest as a resistance to change. The passage of time is irrelevant to organisms whose lifetime is measured in millenia. No amount of increased effort seems to hasten my pace, and the afternoon sun is by now low in the sky. I am an intruder and the forest opposes my every movement insisting that I conform to its will, and until relatively recently its will has gone unopposed; but weakened by loggers the size of the rain forest is a fraction of what it once was, the shadows of the forest canopy eventually begin to lighten, and I push through the last few thickets into a clearing.

I didn't emerge in the same place I started, but it hardly matters. All logging roads eventually lead to the saw mill. The administrators arranged a ride so that I could find the trail, but it is up to me to find my way back. I soon came upon well-traveled vehicle tracks through the wasteland that was once a forest and followed them to a deserted lumber camp where I slept that night. I hiked throughout the next day reaching the main logging road late in the afternoon and caught one of the last trucks back to Contao. It is clear to me now why company officials had advised caution so I returned to the office and informed them of my safe arrival. On the fifth day of my visit, February 6th, I boarded the amphibious supply boat to Pto. Montt seemingly empty-handed. However, when venturing off the beaten path it often happens that we encounter something completely different than what we are seeking. As it turns out what I learned by chance is far more important than if I had been successful.

The rain forest made an indelible impression on me that is much stronger than would be possible by any amount of written or spoken testimony. I live in the Midwest at about the same latitude north as this is south, where forests are not nearly as dense or lush. In areas of ample rainfall, abundant sunlight, and fertile soil the plant world reacts with incredible strength and vigor. There is a force at work in the rain forest that determines how plant life evolves, a force that is not directly observable, but whose influence is unmistakable. I was not sure what it was but I knew that it acted on a fundamental level because the plants here behave more aggressively than in the forests I was acquainted with. I also knew that if I was to understand life I would need to find out what it was. Knowledge usually stays with us only if it is used, but knowledge that is etched in experience is never forgotten. It has associated with it many sensory streams that act together to reinforce the memory with an accumulation of mental images. Now after nearly 40 years I am reviving that knowledge in order to reestablish the logical process that led me to these conclusions. In the next section I will argue that the will that led me here and the force that drives rapid growth in rain forests are a result of the same physical parameter, energy.

4. Energy

4.1. Physical Energy

Energy is a much used but poorly understood concept. We all recognize energy when we see it, but it's not easy to describe. It takes on many different forms and can be transformed from one form to another so it is difficult to say exactly what it is. We use the same term "energy" to describe natural phenomena as diverse as a hurricane, life forms, and nuclear reactions, but we cannot compare the different uses of energy with each other because the material systems that support them differ widely. The energy of a hurricane, for example, refers to an area of the atmosphere hundreds of miles across. Empirical science tells us that its energy is due to the sum of the kinetic energies of the air molecules, but a hurricane has a distinct form and behavior, and due to equipartition its molecules share energy to create these appearances. The same is true of life forms. When science analyzes the life form empirically it refers to energy in terms of metabolic reactions and the transport of energy rich molecules at the molecular level. As a result there is a disconnect between the empirically derived biological treatment of energy and our understanding of what it means when we refer to the energy of an individual. Just as there is no way to make a mental leap from an understanding of air molecule behavior to hurricane behavior the same situation exists with regard to life forms.

The inability to define energy precisely also extends to the most accurate analytical methods in existence. Energy may seem to be well understood when used within the context of well-known nuclear, chemical, or electromagnetic interactions; but if we attempt to pin it down by defining it independently we cannot say what it is. For example, when the energy of an electron is calculated in quantum mechanics using Feynman's path integral method it yields an extremely accurate value for the magnetic moment that is equivalent to the breadth of a human hair in the distance from LA to New York. However, the methods employed to perform these calculations use ordinary physical parameters such as charge, mass, and time in a way that is completely foreign to everyday experience; moreover the calculations themselves lead to infinities that have yet to be satisfactorily resolved. Common sense has been sacrificed for the sake of improving the precision of empirical methods. The calculations give a precise determination of the appearances of energy, but they do not translate into a better understanding of the concept of energy.

4.2. Life Energy

In the life sciences energy is treated as just one more of the many components necessary for life. Thus biology defines energy at the microscopic level in terms of energy rich molecules, adenosine triphosphate, that store and transport energy within the cell yet it ignores the fact that all of the many other characteristics used to define life; reproduction, mobility, communication, and consciousness to name a few; are meaningless without energy to fuel them. As a result the important conclusion, that energy acts on a primary level and is more fundamental than any other property, is missing. A mechanistic view of life has prevailed because it is easier to discuss what can be observed than what cannot be. By insisting on a description of life based on observables the study of life has assumed extreme complexity.

Life energy is described biologically in terms of its observable molecular and free radical carriers, but energy itself has not been analyzed at all. A simple example will serve to explain how this has happened. Imagine that you were raised in the complete absence of technology. Then one day you find a perfectly preserved gasoline engine. In order to understand what it is you examine its pieces. Reducing something to simpler processes in order to understand it is referred to as reductionism and forms the basis for most of what we know in science. You look at the motor's parts and you see how they move by turning the drive shaft manually. As the motor turns the pistons move up and down, the valves open and close. Shifting the transmission to a higher gear, while turning the drive shaft, makes the parts move faster. You are able to figure out how this happens by examining the inside of the gear box. You also notice that a vacuum is created by the downward moving pistons. The motor sucks air into the chamber and forces it out the exhaust as the pistons move upwards. By this time you have invested a lot of time examining every aspect of the motor. You can describe all the internal motions of its parts and their relationships in detail. In other words, you have a nearly complete knowledge of its observable characteristics. Based upon the theory that the whole is the sum of its parts you believe that you know almost everything there is to know about the motor. However, you didn't see the engine run. The energy of combustion, an unobservable process, causes the motor's internal parts to function and is the key to understanding its purpose. Because you can't see it, you think that the motor's only purpose is to suck air in through the carburetor and expel it from the exhaust pipe.

We can compare the study of life to our example of the motor. The life sciences analyze the complexity of the life form by separating it into simpler parts, and the methods of reductionism appear at first glance to have been quite successful. The closer one examines life forms the more machine-like they appear. When the cell is examined with microscopes we find that it functions as an immensely complex production line. Energy and raw materials are imported and used to produce complex substances which may then be exported to other areas of the body. The biological machinery needed to accomplish these processes may be compared to a motor. The mitochondria act like pistons converting energy from one form to another. The nuclear DNA are the transmission gears determining how energy and materials are directed. The genome seems to embody all that is essential because it determines all of a life form's observable characteristics. However, reductionism fails to determine the essence of life because it is impossible to analyze energy into its parts whether we are referring to an electron, a hurricane, or a life form.

Consider the life form at the moment of death. Blood flow stops, the brain ceases to function, and physical response is absent; but cells continue to metabolize for a time and the body remains warm for several hours. We see signs of life at the microscopic level, but what is missing is the “life force”; the global energy that we observe as behavior in other life forms and we experience in ourselves as consciousness. Detailed physiological studies show that energy generated at cell level expands to organismic level through homeostasis, and is then focused for use in directed behavior [2]. At the moment of death, the connection between cellular energy and organismic energy is interrupted. For a time energy continues to be metabolized at cell level, but it is no longer being transformed into organismic energy. Empiricists have created a false sense of optimism by disregarding the connection between a life form's microscopic and global energy. When the first cloned animal, Dolly the sheep, was produced it was identical to its forbears with respect to its observable features; however, as is well known it had a shortened life span. Its total energy, as determined by summing over the life span, was much less than that of a naturally born animal. Cell biologists know a lot about the metabolic processes used to run a cell's machinery, but they don't know anything at all about how microscopic energy is transformed through equipartition into behavior. Empirical logic protests, "Why bother about something that you can't see?" Science ignores unobservables because they can neither be rationalized nor controlled. No one wonders why they have energy, but they expect it to be there when they need it. Our present day understanding of the life form is comparable to the knowledge of a motor in the absence of combustion. *The single most defining property of life is also its least understood.*

4.3. Rain Forests and Civilizations

The existence of the rain forest cannot be logically explained. Mutations occur randomly, but the unusual life forms and oversized plants that populate rain forests are not randomly located. They appear at exactly those locations where they can most fully realize their potential. A rich, fertile environment and abundant sunlight seem to have triggered an energetic plant response. The competition within rain forests is not among plants in a struggle to survive, rather it is the struggle to collect sunlight. Plant species have developed their own unique method of competing for sunlight, and plants distinguish themselves individually in their ability to collect and utilize energy. The access of giant alerce trees to energy is aided by their great height, while ferns though short have extremely large leaves for the same purpose. When we observe a three thousand year old alerce tree as it soars from its immense base to a practically invisible peak it is impossible not to appreciate the energy required to build and sustain its immense size. Natural selection in the rain forest is not a result of plants killing each other in a struggle to survive, rather it occurs when plants are unable to access sufficient sunlight. By supporting numerous methods for accumulating energy the plant collective extracts maximum possible energy from the sun. The energy of individual plants is maximized due to extreme rates of growth and the total solar energy collected by the forest is maximized due to plant density and efficiency.

Rain forests represent the highest expression of evolution in the plant world while civilizations occupy the same position with respect to the animal kingdom. We can compare them with each other since they both evolved according to the same evolutionary law. Both originated in conditions of ideal weather and fertility where energy is readily available. Rain forests are tied to a particular area, but the location of civilizations is only limited by the ability to transport food. Greek and Roman civilizations owed their success to the mild climate and easily accessible food sources that exist around the Mediterranean basin. Similarly the success of today's societies is due to easily obtained energy. We are constantly exploiting new sources of energy to fulfill every conceivable need. The success of a civilization is determined by its success at collecting and utilizing energy, and the success of individuals is measured by their ability to apply energy in new and useful ways. The abundant availability of energy has caused the influence of natural selection through survival to be practically eliminated in modern societies. As long as there is an ample supply of energy we don't need to compete to survive. Like the plants in a rain forest we survive by collecting energy.

If the methods of natural philosophy are correct then life forms have an unobservable aspect that is as important as their observable features. The life sciences have avoided this possibility as much as possible. Thus Charles Darwin closely followed empirical methods by gathering evidence of evolution based on the observable properties of organisms, living and fossilized. Modern empirical methods have added considerable amounts of molecular and genetic evidence to support Darwin's original premise so that the present day interpretation of evolution is divided into two complementary aspects, natural selection and genetic variation; both of them observable. Even disputes between evolutionists and creationists have centered upon evolution's observable features. While controversy about observables is intense, questions about the underlying fundamentals are ignored. Natural selection is driven by competition among life forms, but there was no competition when life first appeared. So what is it that allowed water and minerals to combine in self-replicating form? When Newton saw an apple fall he did not immediately declare that he had discovered a law of gravity. Darwin has accomplished the important first step in formulating a theory of evolution by documenting evolution's observable features, but its elevation to the level of natural law is unwarranted. Fossils, natural selection, and genetic codes are the observables, but the evolutionary force that determines how evolution occurred is unobservable and has yet to be precisely defined.

5. Second Consciousness Experiment

Until now these exercises have concerned general, non-quantitative applications of energy; such as rain forests, hurricanes, and organisms. In each case energy derives its existence from the myriad infinitesimal, *unobservable* contributions of particles and is conceived of globally. This is in contrast to empirical models which are described by a sum of parts, with *observable* contributions from each of the parts. In fact some scientists believe that it will one day be possible to reconstruct thought processes by interpreting the activity of individual neurons. However, neuroscience does not allow evidence obtained from introspection. They believe that subjective analysis need not be considered in a theory because it cannot be objectively verified. In other words, consciousness lacks substance so it must depend on something else for its existence, something observable.

Natural philosophy, on the other hand, teaches that consciousness is a product of the will and it has properties that may only be analyzed through introspection. The will is both the origin of consciousness and of our attempts to understand so it is more fundamental even than empiricism. Without the will there are no experiments, no understanding, and no life. In this section an experiment is described showing what happens when the will is stressed by occurrences that far exceed what is possible in the laboratory. From this experiment we will learn more about the will and its manifestation as consciousness then would ever be possible by empirical practices and discover, in the process, that consciousness is subject to changes that are beyond our control.

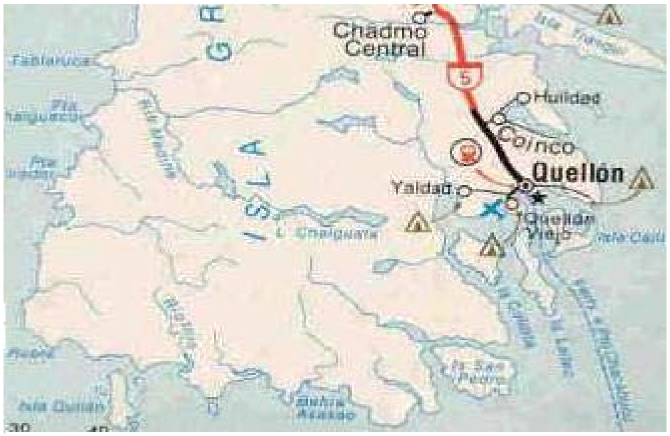

Fig. 3. Southern end of Chiloe Island, Chile

It has been 15 years since my last experiment and the same deep-seated uneasiness that inadvertently introduced me to a rain forest has returned with even greater force, empowering the will and demanding action. It is even stronger now and has assumed a life of its own, independently, like a force of nature. Once the will is focused on a certain path of action, it ignores objections and sweeps away obstacles. Only the goal is of importance and reason is cast aside in order to restore sanity. It is 1988 and its force has caught up my wife and three small children in its grips as well and we find ourselves in southern Chile. We have purchased land on the tiny island of Laitec about three miles south of the town of Quellon, which is situated on the much bigger island of Chiloe. In order to homestead I insisted on land that is relatively inaccessible to regular supply routes while my wife wisely stipulated that it be not too distant from neighbors. Laitec fulfills both requirements.

Life on Laitec is severe compared to our previous farm life and we soon settled into a daily routine that consisted of efforts designed to achieve maximum activity with minimal sustenance. In this way we discovered that an intimate relationship exists between food energy and consciousness that becomes evident when food is scarce. Blood flow is necessary to provide oxygen to neurons. During periods of abundant food when internal energy is relatively high 20% of the blood flowing from the heart is pumped to the brain and the mind is clear. On the other hand, during periods of reduced food supply there is a corresponding decrease of internal energy and we noticed that brain activity is one of the first areas to be affected. When food intake decreases homeostasis causes the body to conserve by reducing mental activity. Neurological function retracts inwardly from the cerebrum towards the brain stem in order to maintain the essential functions of autonomic activity. We become less thoughtful, reacting instinctively to satisfy immediate needs and lacking will power to accomplish more extensive goals. Consciousness shrinks in space and in time causing us to plan less into the future and to be more concerned with occurrences in our immediate vicinity. We would discover later that these conditions persist for several months after returning to a normal diet. Through experiment and introspection we established that consciousness is variable on a short term basis due to emotional experiences and long term due to food intake.

Fig. 4. A neighbor, myself, and our house in the background

We need energy to survive, we seek excess amounts to prosper, and it is included in our psyche in the form of the will. We embody energy physically, physiologically, and psychologically; both consciously and unconsciously. Nearly everything living or contributing to life has something to do with energy. Although the energy we feel within us is unobservable it can be described in terms of the changes it undergoes as it moves from one physical support system to another. Thus food energy that begins at cell level is soon transformed into myriad forms of blood flow, nerve activity, growth, and muscular motion; which are finally combined and expressed as activity. Because all of these processes have the same underlying source we can refer to them simply as energy flow. The flow initiates in the cell, and then expands its influence due to equipartition by merging with other microscopic flows to perform directed behavior and generate consciousness. In the next exercise we will explore the relationship of energy and consciousness more thoroughly.

6. A Wave Mechanical Model of Consciousness

Consciousness is the basis for the age-old philosophical idea of dualism which has occupied human thought since the time of ancient Greece. Descartes was the first European philosopher to openly discuss the mind-body problem asserting that the body obeys the laws of physics, while the mind is non-material and does not follow the laws of physics. Despite the successes of empiricism during the 17th and 18th centuries natural philosophers steadfastly maintained that there are certain aspects of nature that are inaccessible to experiment. However, scientists have overwhelmed popular opinion in their favor by using highly sophisticated instrumentation to reveal intricate and often fascinating details about natural phenomena so that empirical theories are virtually unopposed in the literature of today.

The biological sciences have had great success following empirical practices. They have thoroughly investigated the structure of life forms, mapping genomes and raising the possibility of medical treatment on the molecular level to name two more notable advances. However, in the case of life there are many unexplained phenomena that empirical methods have had only limited success with, and consciousness is perhaps the most prominent of them. In spite of efforts in the field of neuroscience to analyze consciousness as a summation of parts by seeking out the "neuronal correlates of consciousness" there are many aspects of brain function such as memory that have eluded explanation. Although researchers in all the life sciences believe that biological laws are fundamentally distinct from physical laws we shall assume in these pages, as natural philosophers have done in the past, that they are the same laws acting at a deeper level. To understand life processes, we will seek out similarities with inanimate matter rather than differences.

6.1. Physical Evidence

The greatest part of consciousness is occupied by vision as may be seen by its physiological complexity. Images are captured on the retina by an estimated 125 million photoreceptor cells. The information is then compressed by about 1.2 million ganglion cells into the same number of nerve fibers and transmitted to the brain. The high resolution of the retinal signal is restored when it reaches its final destination in the visual cortex. The unexplained increase in accuracy from the optical nerve to the cortex is called 'hyperacuity'. If it is assumed that Nature's design is efficient so that information is not lost during transmission then a nerve impulse model cannot account for data transfer. Neither the 100 fold compression of information by ganglion cells nor its recovery in the visual cortex can be explained by known physiological or biological processes. Instead we shall interpret this as an ordinary physical process governed by natural laws so that it becomes a routine case of information transmission from one format to another. The highly complex input from photoreceptor cells is comparable to a digital signal and the best way to compress, transmit, and then restore it to its original state is by using frequency or amplitude modulation in an analog system. Analog transmission is also advantageous to the life form because it is more energy efficient than digital transmission.

Electrons traveling in free space have both particle and wave properties, where the wavelength of an electron is obtained by dividing its momentum into Planck's constant, or $\lambda = h/mv$. To determine whether a wave model may be used to describe optical signals the velocity of the signal must be calculated. Although vision is a continuous process we can calculate the nerve conduction velocity by determining the elapsed time of an optical signal and dividing it by the distance. The elapsed time is simply the visual threshold, the minimum time necessary to distinguish one image from another, or 70 milliseconds [3]. The distance from the retina to the primary visual cortex, located in the extreme back of the head is about 14 cm, so an approximate value for the speed of an optical signal is 2 m/sec. The wavelength of an electrical signal traveling at 2 m/sec may be calculated as follows:

$$\lambda = \frac{h}{mv} = \frac{6.6 \times 10^{-27} \text{ erg-sec}}{\left(9.1 \times 10^{-28} \text{ gm}\right)\left(200 \text{ cm / sec}\right)} = 0.36 \text{ mm} \qquad (1)$$

The value arrived at for the wavelength is similar in size to many physiological parameters related to vision. In the center of the retina and on the visual axis is a small pit called the fovea which makes up 1% of the area of the retina but provides 50% of the information transmitted to the visual cortex. In the center of the fovea is the foveola, an area 0.35 mm in diameter, the same value we obtained for an electron wavelength; and it is tightly packed with cone cells, each of which is connected to a separate nerve fiber (Fig. 5). Because cone cells are precisely mapped on both the retina and the visual cortex they are sources of the sharpness of visual images. Thus light waves induce frequency specific cone cells to emit nerve impulses whose fields superpose to produce a spatially coherent electron wave. The transformation of nerve impulses into waves allows the transmission of the visual signal without the loss of information and with great energy efficiency. The diameter of the optic nerve gradually increases from 1.6 mm at the eye to 4.5 mm so it can be pictured as a wave guide for gradually dispersing waves.

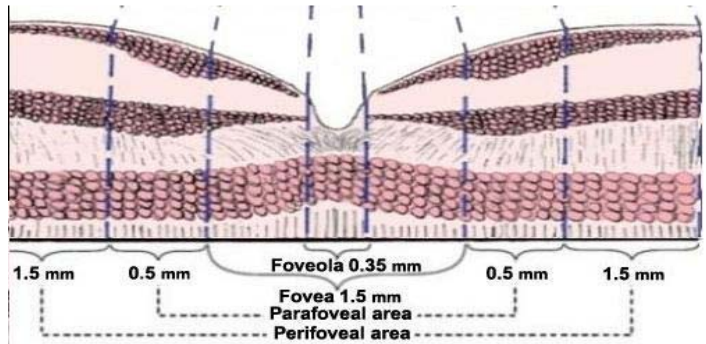

Fig. 5. Retina detail

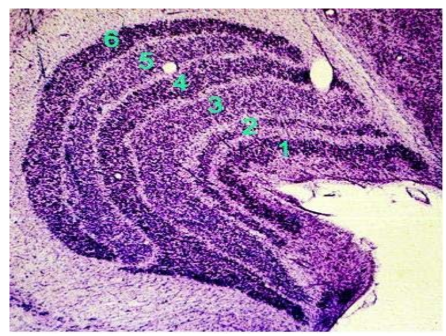

Fig. 6 Lateral Geniculate Nucleus

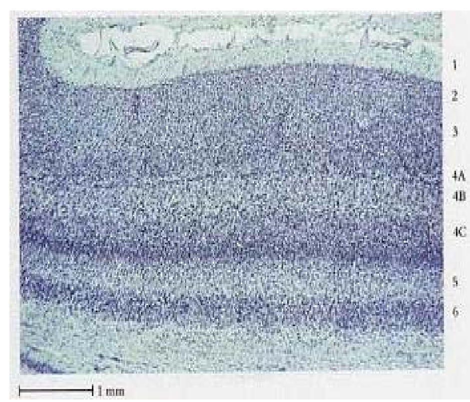

Fig. 7. Visual cortex detail

Optical signals from the left and right eyes meet and combine in alternate layers within the lateral geniculate nucleus (LGN) suggesting that the signals merge by means of a field effect (Fig. 6). This is confirmed by examining the signal after leaving the LGN. The optical signals are relayed unchanged so that the retinal map from each eye is preserved and the signals from the two eyes are combined seamlessly. The signals arrive in layer IV of the primary visual cortex, which has a thickness approximately the same as the wavelength, before being distributed to other areas of the cortex (Fig. 7). The layered structure of the cortex suggests that it acts as a three-dimensional wave guide containing a standing electron wave [4]. This interpretation explains why the brain never shuts down and why it is so energy intensive. Wave perturbations move laterally while interacting with neural networks allowing the wave to stimulate dendritic nerve endings or to be influenced by the wave properties of afferent nerve impulses.

Biologists have not considered the possibility of a wave model because they only recognize the observable properties of life forms. Physicists are familiar with wave behavior of all types but they are accustomed to studying free electrons with much shorter wavelengths. Electron waves are normally observed by means of interference and diffraction effects impinging upon a two dimensional screen, a much simpler case than the three-dimensional wave fields conceived of here.

Rather than use the wave properties of free electrons as a model for vision and consciousness it is more accurate to use frozen light [5]. In frozen light experiments light may be slowed, stored, and even brought to a complete halt by a super cooled atomic vapor. If the wave fields of the resultant "quantum state" are modulated with lasers and imprinted with information then the information may be stored indefinitely and read later in time with nearly 100% efficiency by applying a pulse. It suggests the possibility of extremely fast optical computers and also provides a model for certain aspects of human consciousness.

The brain may be thought of as a cellular medium which supports a standing electron wave. Energy is expended to create the electron waves by means of nerve conduction, but the waves themselves exist in a virtually loss free state. The wave is continuously updated by information from sensory inputs, and at the same time information is accessed by focusing attention on a particular aspect of the wave by means of nerve impulses. The frozen light model demonstrates the computational properties of the mind, but does not indicate how free will is possible.

To see how free will arises we approximate consciousness as a conservative system, a term physicists use to describe loss free (frictionless) states. In quantum mechanics a conservative system is assumed as a point of departure for Schroedinger's wave mechanical model of the hydrogen atom. If the atom were not a conservative system the electron would spiral down into the nucleus. The wave mechanical model describes many of the properties of atomic electrons in terms of three-dimensional standing waves, or "clouds". Atomic electrons remain in the same energy state, but are not constrained to follow strict paths. Their positions are determined by probability functions, so they may "choose" from an infinite number of possible paths. The electron waves in the brain are not constrained to follow well-defined paths either and may circulate throughout the cortex, simultaneously influencing and being influenced by nerve fibers just as our thoughts also wander.

Frozen light illustrates computer-like properties of the mind such as memory function while wave mechanics shows how free will can exist in terms of physical principles. They may be thought of as the external and internal aspects of a standing electron wave. In the next section we will look at the anatomical properties of the brain that have evolved to provide support for electron waves.

6.2. Anatomical Properties

The neocortex is involved in the higher function of sensory perception; motor commands, spatial reasoning, conscious thought, and language; and therefore forms the anatomical basis of the mind. The surface of the cortex is folded such that in the human brain more than two-thirds of it is buried in the grooves. In general the greater the area of the neocortex the more advanced the cognitive skills of the organism. Its large area serves no particular purpose in a neurological model of the brain; but in a wave model it dramatically increases the space available for establishing what we recognize as the persona; an amalgamation of sensory perceptions, emotions, instincts, thought processes, and memory that synthesize harmoniously to form the individual. The compact, convoluted surface allows electron waves access to all of the neurological pathways that lead into and out of the brain yet it simultaneously allows for consciousness to be conceived of globally in accordance with properties of directed behavior. There are a considerable number of anatomical properties of the brain which support this view.

Forward projections of sensory information such as vision terminate in the middle layers of the cortex. This allows them to continuously update information contained in the electron waves. Feedback terminates in the upper and lower layers allowing the capability of sensing its properties.

Dendrites from cortical neurons and collaterals from pyramidal axons are lamina specific suggesting horizontal communication within layers.

While moving longitudinally along layers we encounter columns of neurons with regularly varying orientation (Fig. 8). Horizontal penetrations of the layers find neurons with the same angle. These findings are consistent with the idea of a standing wave's phase.

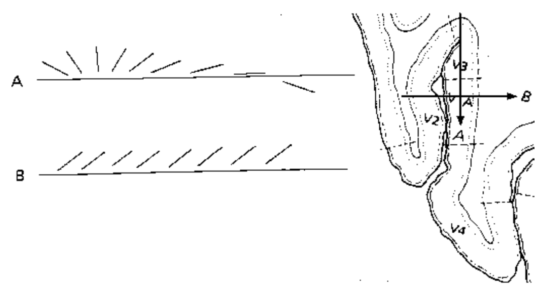

Fig. 8. Measurements of "phase"

Integrative areas of the brain; such as the neocortex, corpus callosum, and claustrum; are conducive to wave behavior. Nerve conduction velocities in these areas are low suggesting that they are centers for wave processing. Large diameter axons normally conduct at higher velocities, but the conduction velocity of "rather stout" claustral axons is only 2.4 m/sec [6].

The brain is moderately myelinated at birth. Postnatal myelination starts at one point in a lobe and gradually fills the entire lobe. This is consistent with the idea of an electron cloud that gradually increases in energy as the brain matures.

Neurons in layer IV of the visual cortex are arranged in vertical columns with diameters approximately the same dimension as the wavelength (Fig. 9). The formation of synaptic sites into columns stems from a competitive interaction which may be interpreted as arising due to interference between the visual inputs of the two eyes. Field reinforcement due to slight differences in transmission distance causes neurons to fire together thereby enhancing permanent synaptic connections. As expected the columns are sharp in layer IV where optical signals arrive and are blurred in neighboring layers where connectivity is neuron dominated.

Fig. 9. Ocular dominance columns

Horizontal communication among layer IV neurons is short, only 1 or 2 millimeters, while efferent signaling to outer layers is much longer. Thus if lateral communication does occur it must be due to unobservable means.

The width of layer IV changes the least suggesting that it conforms to a specific physical parameter, the wavelength.

7. Functional Properties

When we look at brain function we see many indications that information processing in the cortex is widely distributed. Cell level evidence obtained by using multiple microelectrodes in the brain demonstrates that mental processes are composed of locally random events that are synchronized globally to form the wave patterns of EEG measurements [7]. In a study of primates decision making processes are expressed as a spatial distribution of the activity in the superior colliculus [8] rather than from individual neurons. The oscillatory responses of spatially separate neuron clusters are synchronous. These clusters are temporary and composed of cells whose allegiances may shift from one state to the next even over short periods. Information is not contained in the spike discharges, but rather in the spatial distribution of activity. Neuronal discharges that occur concurrently but at different locations are what we expect from parallel processing of the continuous fields in a standing wave.

If the skin of a finger is pricked by a needle there occurs first a short burst of impulses carried by nerve fibers towards the central nervous system conducting at around 100 meters/sec. There follow impulses at other velocities, many at about 20 m/sec; and finally a trail of numerous impulses at about one m/sec. By the time an awareness of the event is created in the brain the hand has already been withdrawn. Several very selective control mechanisms have combined to initiate an involuntary reaction and the characteristic of the mechanism that is the most impressive is the exquisite timing of the events [9]. The hand withdraws due to very fast nerve signals that do not register in the conscious mind. The slower impulses provide an awareness of the needle prick by using the properties of a propagating wave to modify a standing wave.

Memory and vision receive inputs from many different areas of the brain simultaneously. Facial recognition depends on analyzing the global configuration of a stimulus rather than its parts. Global processing requires neuronal networks in the visual cortex to be organized for orientation, color, motion, and eye dominance, and to operate in parallel and concurrently to create an image; which must mesh perfectly with auditory perception to provide directional capability. It is improbable that the fine timing essential for visual, auditory, and somatosensory inputs to merge flawlessly can be supplied by nerve cell discharges that originate distant from each other and must synchronize with perfect accuracy like so many tiny gears. The flexibility and sophistication of movements by practiced musicians, for example, are arguments for a standing wave that synchronizes continuously with subcortical structures acting as resonance chambers to modify field values.

7.1. Discussion

Highly sophisticated empirical methods have successfully determined the number of photoreceptors on the retina, the number of ganglion cells they feed into, and the number of nerve fibers that conduct signals to the visual cortex; just a few of the many observables that describe visual processes. But because the importance of measurable quantities is overemphasized researchers still do not recognize the presence of the unobserved continuity that ties them together, energy flow. There can be no understanding of life forms without an understanding of the energy that flows through them, binding the innumerable mechanisms of life processes into a coherent whole. Energy and the physical features that conduct it are the two fundamental components of consciousness, and indeed of the entire life form. In the next section an analysis of energy flow will lead us to a discrepancy in elementary particle theory.

8. Galactic Structure

When a detailed plot of the orbital speed of our galaxy is calculated as a function of radius one finds that the rotation curve of the galaxy stays flat out to large distances, instead of falling off as expected. This means that the mass of the galaxy should increase with increasing distance from the center. The rotation curve of the Galaxy indicates a great deal of mass, but there is no light to be seen out there. In other words, the halo of our Galaxy seems to be filled with a "dark matter" of unknown composition and type.

It is common knowledge that the bigger the black hole at the center of a galaxy the faster the rotational velocity of the stars in its arms. The tightness of the spiral also correlates with black hole size. A 2008 study of 37 spiral galaxies shows that the smallest black holes have their arms outstretched at angles of as much as 43°, while those with the biggest black holes are wound more tightly, with as little as 7° separating the galaxies' arms from their cores.[10] These properties suggest the presence of a central force field that is located within the black hole that is of an altogether different type than gravitational field.

It is hypothesized that the source of a galaxy's rotational velocity is due to one of the universes most prolific forms of matter, the neutrino. Elementary particle theory supposes that of all particles only the neutrino does not have a field. It is subject to gravitational field, but has not been assigned field attributes of its own. This would mean that neutrinos have asymmetric structure interacting only by means of very short range, particle interactions. In order to restore physical symmetry an infinite field and a field geometry must be assigned to the neutrino. The fact that neutrinos have spin suggests that they have a spiral field geometry and induce transverse angular perturbations upon matter. Their fields would alter space-time geometry in a completely new way.

When large amounts of matter are localized by a black hole and the fields are summed linearly they result in action-at-a-distance forces due to baryonic matter that accelerate matter radially and due to neutrinos that accelerate matter tangentially. The baryonic field is governed by an inverse square law and drops off rapidly, while the neutrino field is weaker but does not diminish in intensity. When the fields superpose baryonic fields form the galactic bulge while neutrino fields form spiral arms. The missing rotational energy of galaxies is explained therefore by insisting on neutrino symmetry and accounting for rotational acceleration by means of its field geometry. If the tangential acceleration of matter by neutrino fields is imposed over billions of years it can also account for extremely high-energy cosmic rays.

9. Conclusion

Dualism is the idea that nature has both an observable and an unobservable aspect. We have followed dualism from its crude beginnings in ancient Greece through to the sophisticated sciences of today and find that its importance is more important than ever. Although the principle of dualism represents a limitation of the powers of reason, by using it we can eliminate unrealistic speculation among scientific disciplines. Newton understood well the need for caution when describing natural phenomena. "I have not as yet been able to deduce from phenomena the reason for these properties of gravity, and I do not feign hypotheses. For whatever is not deduced from the phenomena must be called a hypothesis; and hypotheses… have no place in experimental philosophy."[11] By recognizing the inherent limitations of empiricism, Newton accepted the belief of natural philosophers at the time in the existence of unobservable factors that remain outside the possibility of analysis.

In these exercises several prominent theories are singled out that are in violation of the principle of dualism and are therefore overly speculative. Quantum theory's claim that matter is observable but inherently probabilistic is the most egregious. The presence of cosmological "dark" matter also contradicts dualism. If a field source causes the rotational velocity of the stars to increase it must be observable. There cannot exist field sources that are unobservable.

We believe we are unique in the universe, and that our thoughts are sacrosanct and cannot be reproduced. We also believe that human life is a normal occurrence and we evolved naturally from ordinarily occurring substances. Nevertheless the sciences contend that the inviolability of consciousness does not extend to the remaining natural world, especially in the case of evolutionary theory. Darwinian evolution proposes that an observable process, natural selection, acts upon an observable property of life forms, genetic variation, to produce a life form with unobservable characteristics; a result that is, in view of the properties of energy, physically untenable.

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