Chapter 2. Home on the Range Where Desires and Beliefs Like to Play.

In Observer Physics we will explore a range that encompasses two great spaces, the World Space and the Mind Space. One is what we call the physical world. Traditionally physics has been the discipline that proposes to explain how the World Space works. According to modern physics the World Space has a vast range from the Planck scale at 10^{-35} m out to at least 10^{26} meters for the visible universe, and perhaps quite a bit beyond that. According to the standard model four forces govern the physical world: gravitational, electromagnetic, weak, and strong. The physical structure of matter is built from fundamental subatomic particles to atoms, to molecules, to macroscopic structures, to cosmic structures that include vast galaxies, galactic clusters, and finally the universe as a whole. We will probe some of the unsolved mysteries of physics and see what we come up with. How do particles acquire mass? What is the relation among the forces? Where do the forces come from and what are they? What is time? How did the universe get started, and what may be its final outcome? How did WE get involved? Since the best minds in the business have not yet found all the answers to these questions, it does not hurt for us to hazard some out-of-the-box ideas and see where we go with them.

We will also explore the range of the Mind Space. This is considered subjective. Many also find it mysterious. It is less well studied and understood. We will develop a theory that World Space and Mind Space come from the same source and are connected. Therefore they can and must be studied together as a complete system. Our hypothesis is that both of these spaces are constructed out of beliefs. We will explore how beliefs are made and how they can be used to build structures in Mind Space and World Space.

Let's first see what we mean by a belief. Perhaps the best way is to consider examples, types of beliefs. Any idea or thought is a belief. Any word is an expression of a belief. So take your dictionary and thumb around in it. Every word represents a belief. The sentences I am writing are beliefs. This book is a belief system. Your whole world is defined by the beliefs that you hold.

We have beliefs about the world, beliefs about ourselves and our lives, beliefs about other people and their lives, about our bodies and our minds, our spiritual lives, our feelings and attitudes. We have abstract mental beliefs, such as mathematical ideas and philosophical ideas. We have beliefs about communication. We also have meta-beliefs, beliefs about beliefs. This paragraph consists of meta-beliefs. We have operational beliefs that we use to govern our lives, beliefs about how we ought to behave or ought not to behave, about duties, and obligations, agreements and responsibilities. Some of these are limiting beliefs. We also have beliefs about problems, uncertainties, unknowns, and worries. We have judgmental beliefs that set values on other beliefs. We have beliefs about truth, perception, life, and meaningfulness. And we have beliefs about our desires, preferences, and goals. We can also have beliefs about how to manage beliefs.

Harry Palmer's **Avatar Materials** consist of a set of beliefs deliberately designed as a technology for managing beliefs. These "Avatar Material" beliefs belong to a particular

class of operational meta-beliefs. One of these operational meta-beliefs is that a person should deliberately form his or her own beliefs. It is OK to borrow beliefs from others, but care should be taken to inspect them thoroughly before accepting them as operational in your own life. Another operational meta-belief is that it makes sense to take responsibility for one's own beliefs and behaviors based on the beliefs that one has adopted. Yet another is that the Avatar "operational meta-beliefs" are suggested as useful, but each person is advised to test and evaluate them as with any other beliefs or belief systems before adopting them as operational in his or her life.

The above list is just intended to give you an idea of the range of beliefs. You may add your own beliefs and any others that I may have left out. In **Living Deliberately**, Chapter 15, Palmer offers a nice sample list of beliefs. Later on in this chapter we will discuss a typology of four major classes of belief systems that Palmer has identified. Some beliefs seem trivial and only involve a small part of a person's reality, but others are global and may affect everything that a person feels, thinks, or does.

Exercise: To explore beliefs, you can begin with some of the exercises in **ReSurfacing**. Do #1 ("Personality Profile"), #10 ("Emotion and Importance"), #16 ("Self-Deception Signals"), #20 ("Conviction"), #21 ("Operational Beliefs), #22 ("Belief and Indoctrination"), #24 ("Exploring Definition"), and #25 ("Motivation"). To do that properly may take a while, so take your time. You can read on and come back to continue these exercises. As you go along in life, you may find that some of your beliefs change. In any case these topics will give you a tour of some of the beliefs you hold regarding who you are, things that are important to you, ways you may limit yourself, how strongly you hold beliefs, beliefs with which you manage your life, indoctrinated beliefs, your identity -- how you define yourself --, and why you define yourself that way (your belief role models.)

To get a peek at belief systems held by other people do the "Compassion Exercise" (#17) in **ReSurfacing**. This will often give you understanding of what others – and you – believe that is more accurate than listening to what they – and you – say.

If you want to go a bit "deeper" into things and peer under the hood to look at the beliefs you may hold that you are not consciously aware of, then find a partner and have him take you through exercise #23 "Transparent Beliefs." Sections II and III of the **Avatar Materials** are for the more intrepid individuals who are ready for adventure and really want to explore. These materials take you into "no-limit" territory. They also really put you completely in the driver's seat.

The range of creation goes from pure undefined awareness, to beliefs and thoughts, to physical expressions, and then via experience back to pure undefined awareness. Where your experience happens to be in that range depends on the current status of your attention. It is possible to have a thought or belief and not the physical experience, but once you have the physical experience, the belief is always there behind it. Another way of saying this is that a belief is a subtle form of experience, and an experience is a more expressed form of a belief. Yet another way of saying this is that physical

experience is a projection of beliefs. Projection occurs through an operation of the will called **resistance**. We will explore what that statement means.

Physics cherishes measurement and precision. However, there is a limit to precision -- by definition.

* "Precise: clearly expressed or delineated; definite." (**AHD**)

Precision is a creation. A creation is something defined. A creation is something that has limits. So every creation (by definition) has a limit somewhere. It is a bounded expression of unbounded awareness or pure creative intelligence. If you prefer, we can call it a defined and thus limited form of pure undefined existence.

Precision is not only a defined creation, it is defined as a state of clearly expressed definition. "Cision" means a cutting of something, and "pre" means that it is "pre-cut" before you encounter it. In practice this means someone has prepared a standard metric of some kind against which she measures something. Perhaps you can have unlimited imprecision, but that just means no precision at all. Thus zero is its limit. Zero precision is a completely undefined state. Nothing has been "pre-cut" in awareness.

You could have a perfectly "precise" number, but that is not really precision, because it is abstract and lacks a referent. Precision refers to measurement, which is a form of mapping. For precision to manifest, the precise number must refer to a precise object.

The notion of mapping derives from the model of the self experiencing the object of experience. You are you. You have mapped your notion of self onto a set of parameters (beliefs) that you consider you. That is your identity. Precise mapping exists only in the world of pure math. (Recall our discussion of the lens between mathematics and physics.) No object can be measured perfectly precisely. You reach a point where things get fuzzy. The ultimate reason for that has to do with the nature of attention and pure awareness. In between are issues of quantum mechanics that have to do with the nature of energy.

(**Optional Experiment**.) If you practice TM (Transcendental Meditation) or some similar type of meditation, you can do this experiment. Meditate for twenty minutes. The experience of attention focusing during the meditation is that it gets finer and finer as it follows the meditation process, and then -- suddenly the attention transcends the boundaries of thought and the mind expands. Attention suddenly defocuses and awareness becomes unbounded. Ironically, when you get to the finest focus, you get unfocused. There are many techniques of meditation available, but they do not necessarily result in the transcending process referred to here. If you do not know the TM technique, either learn it, a similar technique, or go back and repeat the attention exercises suggested in Chapter 1. They will give you a little flavor of this experiment. The behavior of attention during very subtle states of perception becomes subject to uncertainty, something we will study in more detail later in these discussions.

Maharishi refers to the "range" of creative intelligence as extending from "here to here through there." The meditation process recapitulates this range in miniature. Between each thought is a gap. It is neither thought (A) nor thought (B). When a meditator "transcends" thought during meditation practice, she finds herself in a state of restful alertness and experiences directly the gap between two thoughts. The last thought (A) drops away from the attention, and then, after some gap, another thought (B) appears. In between the mind is unbounded, and the attention is not focused on anything in particular. There is just pure awareness or inner wakefulness. This process goes on unconsciously all the time for everyone, but most of the time the attention tends to be held on the content level of individual thoughts and experiences. The gap passes unnoticed. Nevertheless, anyone can tell that thoughts do change. They come and go in the mind. Nobody thinks the same thought all day long. Between any two distinguishable items there must be a gap of some kind, otherwise how could we distinguish them? The gaps may be in time, space, or other media.

During meditation the thought process is clearly experienced in an innocent and natural way because we are not intending to focus on any particular content -- that would be contemplation, a different process. Innocent and natural just means that there is no straining, effort, or manipulative intervention involved other than the processes of thoughts and awareness that occur spontaneously all the time. The technique is quite simple and cleverly designed to allow the mind to follow its own natural tendencies. The eventual realization is that there is a kind of "gap" of non-thought that is a steady state condition and that underlies all thought activity. It is always "here" in the "here and now". Thought activity is a temporary excursion to "there." This is Maharishi's basis for claiming that the range of creation is from “here to here through there”. This is an experiential reality for any meditator who has practiced meditation for a while. How long a "while" takes depends on the individual.

This experiment is qualitative rather than quantitative. But research has been done that indicates there are physiological changes associated with the meditation experience of restful alertness. There is a distinct condition in which the body is deeply at rest, but the mind is awake and fully alert. It differs markedly from sleeping, dreaming, or active waking states.

Experiment: Find a partner to be your coach and have them take you through the little guided attention procedure called "The Expansion Exercise" (**ReSurfacing**, Exercise #26.) Relax and enjoy the experience of expanding attention step by step just on the thinking level alone. This will also give you a little foretaste of what it is like when the attention "transcends" particular thoughts. With practice you can do this exercise on your own.

When a physicist does calculations or experiments, he wants to attain the highest degree of accuracy possible. Amazing degrees of accuracy have been attained compared to our usual standards of measurement, but no one has ever achieved perfect accuracy except by defining the measurement arbitrarily. That way you can't go wrong. For example, the gravitational constant is known by experiment roughly to about five decimals. "In SI units the 2014 CODATA recommended value of the gravitational constant (with standard

uncertainty in parentheses) is $G = 6.67804(31) \times 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$." (**Wikipedia**, "Gravitational constant") Notice the "standard uncertainty" fuzziness in the "value". Gravity is a weak force and thus is hard to measure. The electron spin g-factor is known with fantastic accuracy, theory agreeing with experiment to about ten decimal places. Currently the most accurate (NIST) value for the electron spin g-factor is

−2.00231930436182, with an uncertainty of 0.00000000000052.
(**Wikipedia**, "g-factor (physics)")

The ratio of a circle's circumference to its diameter (π) has been calculated to an accuracy of over 2×10^{11} digits. The permeability constant used in the study of electromagnetism is known with absolute precision because it is defined arbitrarily by physicists.

According to modern quantum mechanics, the act of measurement brings an object into concrete reality. How can you tell the difference between creating and measuring a state if the act of measurement brings the state into concrete reality? A further interesting feature of measurement is that the more we know about the state of the concrete reality we have measured, the less we know about the state of its conjugate variable.

This feature of modern physics occurs because the physical world at the quantum level tends to be set up in conjugate pairs that relate via a quantum constant. These pairs are often reciprocal. In the case of measurement, we must choose which of the conjugate variables we want to measure. A major example of this phenomenon is Heisenberg's Uncertainty Principle, and we will play with it quite a bit in these discussions for it is one of the keys to understanding quantum mechanics.

We might choose to look at a system in terms of momentum and displacement. We must choose which parameter we are going to put attention on and measure. If the measurement is made at the quantum level, precise knowledge of the momentum will be sacrificed by our decision to measure displacement, and vice versa. Or we might choose to measure either a change in energy or a time interval. However we look at the system, once our choice is made, we can narrow the range of precision on the variable we choose as much as we like, given our measuring instruments, patience, and sharpness of vision. But the range of that one variable is reciprocally tied to the range of its conjugate variable. Thus, the more precisely we know that one variable, the less precisely we know the other variable. This is a real trade off.

Physicist Mark Merner believes this feature of quantum mechanics prevents causality violations in nature. He puts it this way. The more you know about how an event will turn out, the less you can do about it. One hundred percent foreknowledge means zero ability to change things. Zero foreknowledge means one hundred percent ability to change things. Fifty percent foreknowledge means fifty percent ability to change things. Quantum uncertainty inherently prevents us from having perfect foreknowledge of events.

He may be right about causality, but I suspect that this is his personal belief. From his

viewpoint, that is how things work. From a different viewpoint, things might work very differently. Maybe from a quantum mechanical viewpoint causality is not even relevant. Keep in mind that that may be true of anything I say in this book. That is not to deny the existence of truth. We will get to an understanding of truth in the course of our discussion. In the meantime as an exercise take a moment to consider what you believe about truth.

My explanation is simply that you are acting as the creator responsible for deciding on a particular certainty (or uncertainty), and to doubt your own decision regarding certainty (or uncertainty) would be a complete self-contradiction and abrogation of personal responsibility. If you could change a future that you "knew with certainty", then you didn't really know it with certainty. You either hadn't really made up your mind, or you changed your mind, or you lied to yourself or someone. If you change your future, then you transform a possible uncertainty in the past into a certainty in the past when you make the certainty you choose for the future certain in the future. Thus causality violation is automatically avoided by the proper assignment of responsibility for all outcomes to the observer. This is the critical importance of Observer Physics. It cultivates a sense of responsibility in the physicist. He realizes that the certainty or uncertainty of a situation is his personal responsibility and does not belong to anyone else. The possibility of "causality violation" implies a rejection of responsibility. If you are the Prime Mover, by definition you can not violate your own causality. All you can do is confuse yourself and then pretend that it wasn't your fault. You can put on a good show and entertain yourself.

The idea that we have some choices and some requirements is passing the buck. Ultimately it is the observer who fixes or frees conjugate variables. You have just as much freedom as you give yourself. You are only required to do what you require yourself to do. Each person is his or her own harshest judge.

Quantum mechanics claims that outcomes are statistical and governed by the laws of probability given certain initial conditions. With sufficient knowledge of the probabilities, the principles governing them, and a few management skills it should be possible to obtain one's desired results very consistently.

Exercise: Do Exercise #12 in **ReSurfacing**, "Releasing Fixed Attention." It is good to have a friend coach you in this exercise until you understand the process deeply.

One of the fundamental design features of science is that there is no preferred way for things to be. We decide what we want to look at, and then we describe what we see. If someone can look at the same thing and describe it differently or better, then that's wonderful.

Science has pitfalls. (There's a loaded belief.) A field of study that professes to be a science, but assumes that it has the final word, has abrogated its responsibility as a science, at least in my book. I believe that science is a flexible, open-ended discipline. At the beginning of the twentieth century a noted scientist predicted that heavier-than-air

flight was impossible (despite the contrary evidence provided by birds). Another authority once explained that he had reviewed all the patents and inventions and that all the major inventions had already been made.

Here is another pitfall. The more conservative followers of a paradigm often become defensive about new developments, as if new developments might threaten the *status quo*. New ideas may indeed be suspect, but are not necessarily wrong. As we shall see, right and wrong are secondary judgments that avoid getting to the real point of an issue. It is always possible to preserve the classical integrity of a solid science while still evolving it into new areas and refinements. A wheel is always a wheel, and the technology of wheels can be applied in many ways, times, and places. But the technology stays the same. That is the self-defining classical "purity" of science. We see how well Newton's laws have withstood the onslaught of relativity and quantum mechanics. They remain at the core of modern physics.

A beautiful corollary of this principle is that any paradigm worth its salt is also robust. You can break a particular wheel, but you can not break the principle of the wheel. Though a principle may get lost at times in the vagaries of history, any reasonably observant person can always recover it. Thus it is silly to worry about defending a paradigm as if it were something very fragile that required draconian measures to protect. We do not have wheel police watching out to protect the purity of wheels. Wheels are simple, but subtle. The need to get overly protective, a phenomenon often observed in political systems, suggests ulterior motives (lack of integrity) in an organization. To claim you have something really basic and cool and then not to be cool about it suggests something else is going on other than what you are talking about.

The native Mayans understood the principle of the wheel, because it shows up in their art. However, they deliberately chose never to use it as a utilitarian tool in their society. They had roads as good as the Romans, but no wagons. Hmmm.

Mathematics is a precise mental reflection of the objective world, or we might better say, mathematics is a clear and precisely focused mental formulation of an idea. This clarity and intensity of attention can help an idea to more easily become a physical reality. From this we derive the power of applied math and applied science. But, as we discussed in Chapter 1, a MENTAL image of a PHYSICAL object flips in terms of certainty. This fundamental principle of observational physics is worth emphasizing and exploring deeply. It is embedded deep in quantum mechanics, but it is also apparent at the level of everyday life as the uncertainty that entropy brings to every object in our environment. Wise people govern their lives by the statistical patterns of the dynamic "wave functions" that describe the flow of energy in an environment over time, not by how many particular objects they "possess".

There are no immutable laws of nature, other than perhaps the law that there are no immutable laws of nature. There are only mutually shared beliefs. One such belief might be that more general laws are less likely to be flexible, because they are essential to maintaining an orderly universe. The "behavior" of beliefs in the field of experience is

determined by the viewpoint one takes regarding the beliefs. This holds for Observer Physics and any other theory. Political platforms are really covers for the agendas (i.e. beliefs) of party leaders and at least some of their followers. Behind these may be unexpressed hidden agendas. Religious groups proclaim their beliefs to be Natural Law or the Will of God. This is usually a way of asserting that the group's particular beliefs are superior to those of others.

Palmer (**Living Deliberately**, Chapter 9) describes four main types of belief system that he has identified. Let's examine his typology of belief systems.

(1). Type One systems are *a priori*. In type one belief systems one assumes that God, Nature, Fate, or some other absolute entity or principle has priorly ordained the way things are and that "this is the way it is." There is nothing you can do about it. These belief systems are based on absolutes. You better not disagree with them. The consequences may be unpleasant. *A priori* systems are usually associated with religions and cults. They are disempowering to the individual. One's only hope of survival in an *a priori* system is surrender to an absolute authority that has been "externalized" as a relentless force. This "reality" is often disguised in the form of certain rewards a person receives if she acquiesces to the conditions of the absolute system.

(2). Type Two systems are *a posteriori*. They are established to "handle" an existing situation. Such expedient beliefs are based on social conventions. They are defined by mutual agreement of a group and reflect the customs of cultures, and ideas about proper behavior in daily life in order to "get along". Over time they tend to get pretty rigid, but are usually recognized to be expedient, and therefore not written in stone. They can be changed by consensus. Eccentric behavior is not necessarily forbidden.

(3) Type Three systems are empirical and/or deductive. Science is empirical and mathematics is deductive. Empirical systems tend to operate under the transparent belief that physical evidence demonstrates **correctness** of beliefs. The results of certain experiments prove that "this is how it is". Eventually, often under the influence of subtle experience in mathematics, type three believers come to the realization that evidence only demonstrates the **existence** of beliefs and says nothing about **correctness**. This gradually liberates people from the belief in the correctness of beliefs. The history of the liberation of mathematics is a fine example of the gradual discovery that deductive systems are totally arbitrary and subject only to the whim of the system designer. Deductive systems need not have any relation to real-life conditions. Once a scientist has realized that evidence supports the **existence** of beliefs, rather than their **correctness**, he is able to use the scientific method to uncover and handle transparent beliefs (beliefs that are overlooked, perhaps because they are too obvious or perhaps because they have been buried under habits that keep attention from noticing them.) Once his belief system is free of contradictions and also matches his evidence from experience, (no transparent beliefs), then he tends to spontaneously move into Type Four belief systems.

(4). Type Four systems are deliberate. Rather than designing a deliberate set of beliefs and actions to test a "hypothesis" or establish a discipline of knowledge, one deliberately

designs a set of beliefs and actions in order to experience a reality that he would like to experience. With the proper tools for belief management, this program is easily accomplished, so a Type Four believer will tend to change belief systems from time to time and not get stuck in a particular paradigm. Life becomes a paradigm-less paradigm. Once a particular belief set has been experienced fully, the believer lets it go and moves on to explore another belief system. The dominant modality of a Type Four believer is exploration.

Type One beliefs are the most rigid, and type four beliefs are the most flexible. Each type of belief system has its own value. For example, if you want an environment that is very stable, you choose a type one *a priori* absolute system and sacrifice personal power. The trade-off is that you delegate responsibility for your experiences elsewhere unless you are a control freak and impose **your beliefs** on everyone else. If experiences start to go in an unexpectedly undesirable direction, you may tend to conveniently forget who made the original delegation of responsibility or who decided to be the final authority.

If you want to adapt in various ways without fundamentally changing an existing system, then use an *a posteriori* expedient system and enjoy social compromise. You may place attention on group consensus. However, if the elected authority does not pursue your preferred policies, that's too bad, and you put up with the situation.

If you want to develop systems of knowledge and applications that grow and evolve in great detail, use type three empirical and deductive systems. Be aware of the arbitrary subjective nature of logical reasoning and do not forget that physical evidence only serves to support a belief, but never proves its absolute validity. Even paradigms are no more than temporarily popular belief systems.

If you want to explore unknown regions, make new discoveries, and unfold personal power to its fullest while living in the moment, use a deliberate type-four Avatar approach. Perhaps the only belief not subject to change is the belief that if any type of experience is involved, it must match the belief or set of beliefs that supports it. In other words, type four believers believe that belief is prior to (and perhaps concurrent with) experience.

Each modality has experts who are happy to promote the skills in developing that particular modality of belief. For example, you'll find type three intellectual aficionados in universities and research institutes, and type one total faith-in-X aficionados in religions. Social and political leaders will be type two specialists. Most people in certain areas of their lives are conservative and follow the type one and type two systems as default systems. Pioneers and highly creative self-realized people generally follow type four systems. To some extent each person has at least a little bit of each of the four types in his life, but will tend to emphasis the one that best fits her personality.

There may be other belief modalities, but this is a pretty good survey of the range of belief systems. Palmer's **Avatar Materials** focus on empowering a person to operate in the design and experience of type four beliefs. Interestingly, though, these same tools

can work very well for any of the other modalities as well. Just deliberately choose to develop the modality that you prefer and apply the tools.

More and more researchers are coming to recognize the importance of attention. In his recent work, **A New Kind of Science**, Stephen Wolfram has noticed that attention is involved in determining the complexity of a situation. He is working toward a definition of complexity. With his principle of computational equivalence he seems to believe that the complexity of an organism is defined by the most complex "object" (or set of objects) that the organism can put its attention on. This doesn't really define complexity (or simplicity). But it does comment on **us**, telling us that what we can perceive (and possibly understand) is limited by our attention skills. Harry Palmer provides practical exercises to develop the power of attention. He also comes pretty close to a good definition of complexity while discussing how simple his "Avatar" approach is. He says that, "something is complex only to the degree that it does not fit with what you already believe." (**ReSurfacing**, p. 5.)

This is a good start at a definition of complexity. The word derives from 'com' (with) and 'plex' (plait, entwine, weave). The idea is that several things are plaited together or parts of a single thing tangled or entwined together. Simplicity, to follow Palmer's reasoning, would be a situation where the objects of experience perfectly fit what you already believe. Thus, experience and belief match. This happens to be Palmer's operational definition of "truth". Hence truth by virtue of this definition is simple. The simplest state of awareness is thus pure truth. This is a good argument for the practical value of techniques like meditation or Avatar or any other procedure that gets you into the simplest state of awareness (living directly in the moment) as a base of operations. It's a good foundation for building true systems, at least according to that definition of truth.

Thus, we might consider that the range of **truth** is from the simplest state of awareness where what you see is precisely what you believe and what you believe is precisely what you see, to total complexity in which what you see completely contradicts what you believe, and what you believe totally contradicts what you see. It is no accident that very complex systems or explanations tend to be considered "opaque." This range of truthfulness also gives us a nice operational definition of "precision".

Precision cuts through the confusion. When it's simple, there it is. Here it is. It's clear and obvious. Observer Physics aims for truth, clarity, precision, and simplicity. The rest is just playing with the details, which at times may get rather complex.

If any of the principles and "discoveries" in this book are shown to be faulty or incomplete, then they will be replaced by corrected and more complete visions. Observer Physics is an evolving discipline and you are welcome to take it wherever you believe it "ought" to go, refining it and extending its range into any dimension you like. It is a "no-limit" creation.

Below are some examples from physics of superb gems of simplicity, profundity, generality, and clarity. Newton and Einstein were masters at seeing things in simple

ways.

* $a^2 + b^2 = c^2$.

The Pythagorean theorem for the sides of a right triangle only holds for Euclidean geometry and only holds under continuity. (It fails in digital space, as for example, on your computer and in crystals).

* $F_n = F_w - F_b$

Archimedes' Principle is that the buoyant force (F_b) on an object equals the weight of fluid displaced by the object. (F_w is the weight of the object, F_n is the net force.) This formula and the study of densities may hold the secrets of future transportation systems.

* $F = m\ a$.

"The force equals the mass times the acceleration" is Newton's second law. It properly should be written as $m = F/a$, and is Newton's **definition** of **inertial mass**. Acceleration varies directly as the force. Newton's definition of inertia (usually called his first "law") is that a body at rest tends to stay at rest or continue in straight line motion when in motion unless acted on by a force. The "force" principle and the "mass" that goes with it needs deeper examination in the light of modern physics and the scientific study of consciousness.

* $m_1\ a = m_2\ b$

This is the law of balance for first class levers, where a is the distance from m_1 to the fulcrum and b is the distance from m_2 to the fulcrum. The "heavier" mass will be closer to the fulcrum. Forces are hidden in the relation due to equilibrium.

* $-F_a = F_r$

The force of reaction (F_r) equals the force of the action (F_a) and is simultaneous with it. This is Newton's third law.

* $m_1\ m_2 = F_g\ r^2\ /\ G$

This is Newton's ingenious extrapolated definition of **gravitational mass** and a **universal gravitational constant** derived from Kepler's laws of celestial motion that Kepler in turn derived from Brahe's careful observational data. The subscripts with m indicate that the formula describes two interacting masses. The r is the radial distance between the centers of the two masses. Squaring indicates that the radial distance is the same relative to each mass. Multiplication indicates mutual interaction. G is a universal constant that Newton assumed was required and was later measured (roughly) by experiment. Fg is the hypothetical "gravitational force". Einstein later reinterpreted the "force" as a distortion of space-time. Gravity is still not well understood in standard

physics, but I will hazard a theory when we get to the discussion of that problem.

* $m = E / c^2$.

This is Einstein's famous derivation of the **rest mass** of an atomic or subatomic particle based on his theory of relativity. *E* stands for energy, and *c* is the velocity of light. Einstein and others assumed inertial, gravitational, and rest mass to be identical, but there is no clear understanding even today of what mass is or why the three forms of "mass" should be variations of the same fundamental property.

The nature of "mass" and how or why the three kinds of mass can be considered identical in nature is a profound question that we will explore together in these essays. We will also propose for consideration a theory of gravity.

As we go along through these essays we will also discover other examples of elegant laws of nature, such as Zel'dovich's law of phase conjugation. We will also look deeply into the relations these "laws" describe.

BELIEVE -- (1) To accept as true or real. (2) To credit with veracity.
The word "believe" derives from the Indo-European root *LEUBH (See the etymological list of roots in the **AHD.**) The basic meaning is to care, desire, love. The prefix "be-" is an archaic form generally indicating emphasis and a causative verbal sense. Here are some other examples with be-: becloud, become, bedazzle, bedeck, bedevil, bedew, befall, befriend, befuddle, beget, begin, beguile, behead, behold, belay, belie, belittle, beset, besiege, besmear, besmirch, besprinkle, bestow, bestrew, bethink, betoken, betray, betroth, bewail, beware, bewilder, bewitch.