Chapter 8. The Big Bang Is Going On Right Under Your Nose.
Breath With Care.

In the last chapter we introduced the fundamental constants of modern physics and gave their values in scientific notation. We also mentioned that you can express relationships among the physical constants purely in terms of relationships of geometry. Let's take a look at a few examples and understand this profound principle. Then we will wend our way toward a radical new theory of elementary particles.

We selected six fundamental constants: $\hbar$, G, e, c, ε_o, and %. The first is called "h-bar" and is the reduced form of Planck's constant (and has a "radial" value rather than a rotational one). The % can be pronounced "o-per", and is a new one that is spatial, and comes to 3.16227766 m, or $(10\ m^2)^{1/2}$, or $2^{1/2}\times5^{1/2}$m. The permittivity constant $\varepsilon_o = 8.854\times10^{-12}\ kg/m^3$ is a density and here we interpret it as a bridge between matter and geometry. What I call the D-shift operator o-per (%) assists dimensional shifting or scaling of physical systems and is also a bridge between the physical world and geometry. We will introduce it in more detail now.

We will need a viewpoint shift, but we can think of a universal constant of physics as a very stable "particle" even though it usually seems to be constructed from a relationship among two or three of the basic physical units: L in meters, T in seconds, and M as a quantum particle in kilograms. I choose to use the kms system, because the numerical ratios work out to be very natural, -- that is, close to the way nature is (at least as we now perceive it). Universal constants are even more stable and universal than any ordinary physical structures. Included among these constants are the rest mass of the proton (m_p) and the rest mass of the electron (m_e). All ordinary matter is built from these two elementary fermions in various combinations. They are the basic building blocks of our physical universe. However, we will derive their rest masses from our basic set of constants, because physicists until now have no idea why these particles have the rest mass values that they apparently have. I say "apparently", because the notion of "rest mass" may be a misnomer representing the lowest possible "limit" to the kinetic mass measured by F/a. Perhaps the only measure of rest mass is obtained from particle-antiparticle pair annihilation via Einstein's mass-energy formula: $E = m\ c^2$, and that depends on the assumed correctness of the formula.

No one has satisfactorily explained why the proton and electron have the masses they have. I believe that we can not consider these particles in isolation, but must put them together with the other constants of nature. As we do this, we will introduce a set of simple relations based on the geometry of spheres and discs in ordinary Euclidean space.

Let's represent our chosen constant values of geometry as follows:

* R = a 1 meter "unit" radius. (The meter is a universal constant of space.)
* % = the o-per = 3.16227766 m. (% / R) = 3.16227766 = <u>%</u>).
* π = the ratio of a circle's circumference to its diameter (or twice its radius).
* Oo = A circular orbit, or circumference, with unit radius ($2\pi R$)

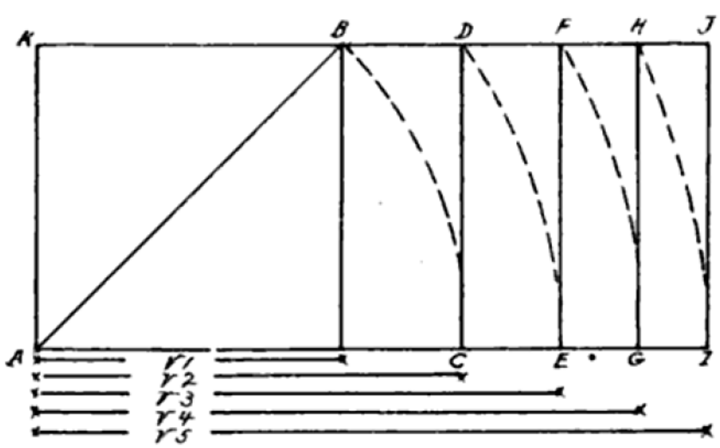
* Ao = the area of our unit radius circle. (πR^2)
* As = the area of our unit sphere. $(4\pi R^2)$
* Ss = the volume of our unit sphere. $(4/3)(\pi R^3)$

An important property of this list is that, although the last five are true at any scale or in any units of displacement, we will use the meter as our standard yardstick to define our standard unit radius *R*. Perhaps it will turn out not to be exactly the meter that we use now, but it will be very close. Whether intuitively or deliberately, scientists arrived at values for the the meter and second that work very well with the universal constants of physics. There may be historical reasons for this situation, but that is beyond the scope of this paper.

It turns out that we can express the natural numbers in terms of various ratios of these simple figures from geometry. Here are some examples.

* $R / R = 1$
* $\mathrm{Oo} / \pi R = 2$
* $(\sqrt{(\%^2 - R^2)})/R = 3$
* $\mathrm{As} / \mathrm{Ao} = 4,$
* $(\mathrm{Oo}^2 / \pi^2 R^2) + (R / R) = 5$
* $(\mathrm{Oo}^2 / \pi^2 R^2) + (\mathrm{Oo} / \pi R) = 6$
* $(\mathrm{Oo}^2 / \pi^2 R^2) + (\mathrm{Oo} / \pi R) + (R / R) = 7$
* $\pi \%^2 / \mathrm{Ao} = 10$

And so on. Of course, you can also just mark off unit radial length. You can also get square roots of natural numbers by generating the diagonals of dynamic rectangles, starting with the square's diagonal.



The drawing is from Jay Hambidge's 1920 illustration of the construction of root rectangles. The lengths of the horizontal sides of the original square and the four root rectangles derived from it, are respectively √1, √2, √3, √4, √5. (See, **Wikipedia**, "Dynamic Rectangles".)

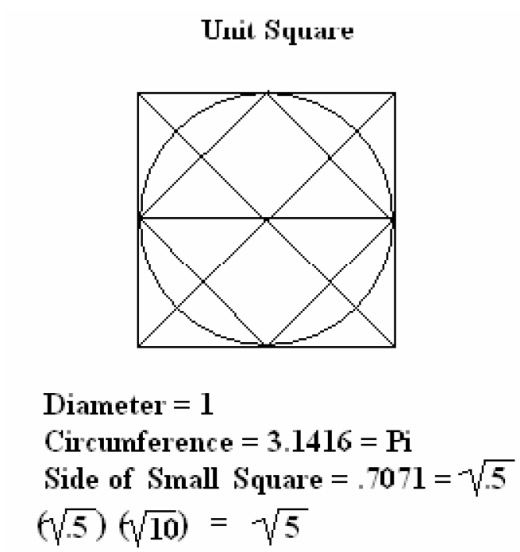
What is the point of expressing numbers as constants of geometry? Abstract geometry is how we encode information about our world in Mental Space. The properties of length, time, and mass are how we encode information about our physical World Space. We are going to introduce a system that links these two aspects of reality into a whole. With that we will be able to construct a unified Observer Physics. When we convert geometry directly into pure numbers, we have shifted into pure abstract Mental Space that can be represented as arising from the null set { }.

{ }, {{ }}, {{ }{{ }}}, and so on.

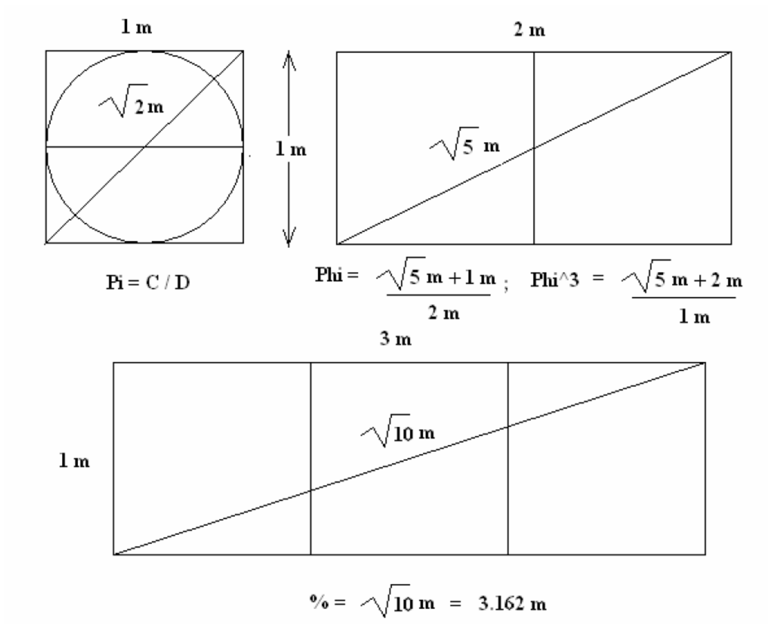
So now we will explore the origin of % in geometry, its relation to physics, and its mathematical usefulness in describing our world in terms we can easily understand.

O-per %

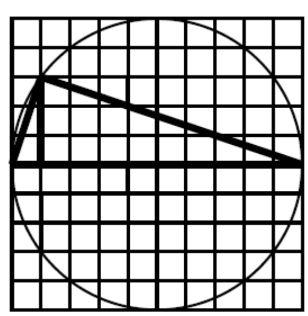
We begin by looking at a unit square. This could be of any size.



We arbitrarily assign the value of 1 unit to the larger square's side which is also the value of the diameter of the inscribed circle. The circumference of the circle is then π units. The diagonal of the unit square is (√2). The length of a side of the smaller square is (√.5) or the irrational decimal that begins .7071. . . . This number establishes the ratio between two other fundamental constants of geometry: (√5) and (√10). Also, (√.5) = [√5 /√(2×5)]. Another way of saying this is to simply note that (√2) (√5) = (√10). The diagram below shows how (√2) is the diagonal of a single unit square, (√5) is the diagonal of a doublet of unit squares, and (√10) is the diagonal of a triplet of unit squares. The triangle formed by the diagonal of the doubled unit square is the basis of the fundamental constant *phi* (*φ*), which is known as the Golden Ratio. The physical universe uses *phi* as the basic tool for generating diversity of forms beyond simple circles and squares as embodied in the unit square/circle.



There are many complex aspects to geometry, but all forms emerge from the basic figures: points, lines, angles, circles, triangles, and squares. The numbers derived above come directly from these fundamental relationships in geometry and thus are fundamental numbers. Scientists and mathematicians have studied *phi* in much detail. Less well studied is the fundamental constant that arises from the diagonal of the triplet of unit squares or the product of the diagonals of the unit square and the doubled unit square: (√10 = 3.16227766 . . . .) I use the percent symbol (%) to represent this number, since it represents a special ratio (√10) = [(√5) / (√.5)] that relates to the base ten on which our number system operates. It also has the curious property that it is a constant in physics as well as mathematics and geometry. It turns out that in physics this spatial constant (%) has the value of (√10) meters. The pure number value of % = 3.16227766 is the ratio of the diagonal of the tripled unit square to its unit side. The underscore is shorthand for % / *R*. The rectangle's length of 3 units is also important, and the square of that length is 9. By the Pythagorean relation, 1 squared (1) plus 3 squared (9) equals % squared (10). The ratio (10 / 9) = 1.11111. . . . This is the "unit" value in the curious domain of infinite recursion. Integer multiples of it give 0.0000, 1.1111, 2.2222, 3.3333, 4.4444, on up to 9, and then we get 11.1111, 12.2222, 13.3333, and so on.



(Each square on the grid = 1/3.)

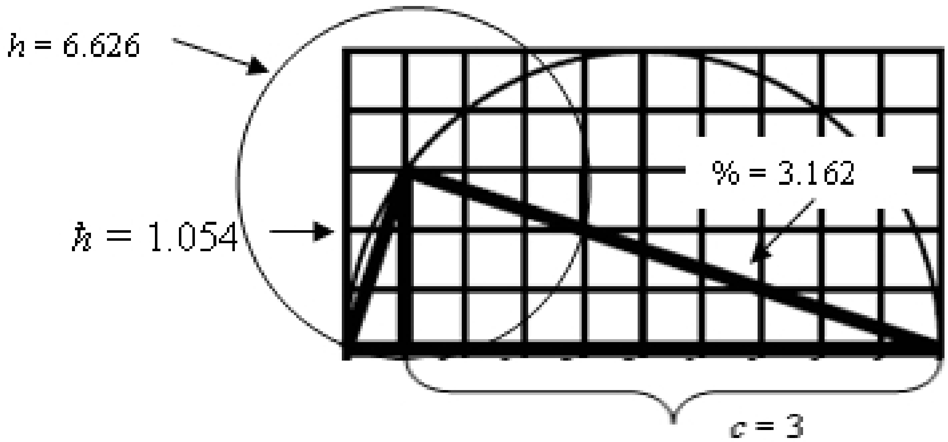
We return to a figure that we drew when we discussed the Einstein/de Broglie Velocity Equation. We made a 10-by-10 grid, drew a circle in it with a diameter dividing the square in half. Then we erected a perpendicular at various places and extended it to the edge of the circle. Then we connected the top of the perpendicular from the point where it cut the circle to each end of the diameter. Thus we constructed two similar triangles on the diameter that extended to the point where the perpendicular cut the circle. We used this diagram to model the Einstein-de Broglie Velocity Equation.

In this case we will erect the perpendicular just 1 square in from the left end of the diameter. This gives us a small triangle that has sides of 1 square length by 3 square lengths. The larger triangle has sides that are 9 square lengths and 3 square lengths. We will give each square length a value of 1/3, so that the large triangle has sides that are 1 and 3 units, and the small triangle has sides of 1 and 1/3 units. By the Pythagorean theorem the hypotenuse of the big triangle becomes $\sqrt{10}$. What is the size of the small hypotenuse with sides 1/3 and 1? By the same theorem we get $\sqrt{(10/9)} = 1.05409255338....$ This turns out to be very close to the ratio value of Planck's reduced constant:$1.054571726(47)\times10^{-34}$ J·s. Since the scale of Planck's constant is so small and is the smallest physical quantity that we imagine exists in those units in our universe, the tiny discrepancy with the "predicted" ratio in geometry may be due to problems in the calculations by physicists. In any case, for our calculations we will usually just use the ratio rounded off to 1.054.

Now we can look at the Velocity Equation in terms of our new diagram. We will set the side of a square to be 1×10^8 m. For simplicity we will use 3×10^8 m/s as our speed of light. If we send a light beam into open space for a time interval of 1 second, the distance traveled by the beam corresponds to the perpendicular on the diameter: 3×10^8 m. The large segment on the diameter becomes the phase velocity, 9×10^8 m, and the small segment becomes the group velocity, 10^8 m. The hypotenuse of the large triangle is then 9.48683298×10^8 m, and the hypotenuse of the small triangle becomes 3.16227766×10^8 m. The ratio of 9.48683298 to 9 is 1.054, as is the ratio of 3.16227766 to 3. Also, by the Pythagorean relation $(3.16227766)^2 + (1.054)^2 = (10 + 1.11111) = 11.11111 = 100/9$. The square root of this is 10/3, or 3.3333, the circle's diameter.

These relationships hold at all scales. If 3 is the ratio of light speed, then 1.054 is the ratio of Planck's reduced constant, and 2π times that is Planck's constant, the circle with radius 1.054. Then 3.16227766 is the ratio for universal scaling, and *R* is the universal radial unit of 1 meter.

In quantum mechanics we encounter the expression $\hbar c$ so often that physicists tend to represent it with "natural units", substituting 1 for each value. I maintain that this trick flattens the quantum scenery like viewing the world with only one eye. Let us return to our diagram and explore $\hbar c$.



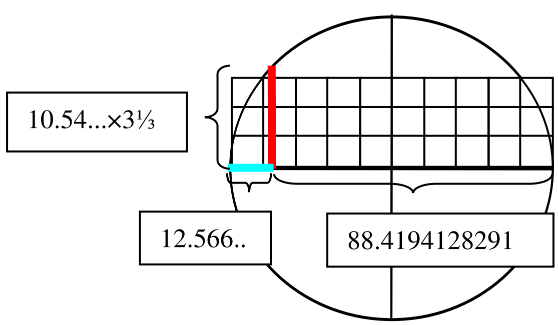
(Each square on the grid = 1/3.)

Planck's constant is the circle of circumference h with its center at the top of the perpendicular and with radius $\hbar$. We can use our similar triangle relationship to find the quantum expression $\hbar c$. The height of the perpendicular is 1, so we have the relationship $\hbar / 1 = \% / c$. We rearrange to find that $\% = \hbar c$.

Maxwell discovered a relation between the electric constant ε_o (permittivity), the magnetic constant μ_o (permeability), and light speed c. The relationship shows that all electromagnetic radiation moves at the velocity of light, and also suggests something about the properties of the vacuum of space that indicate an aether. The relationship is:

* $c^2 = 1 / \varepsilon_o \mu_o$
* $c^2 = (1 / \varepsilon_o)(1 / \mu_o)$

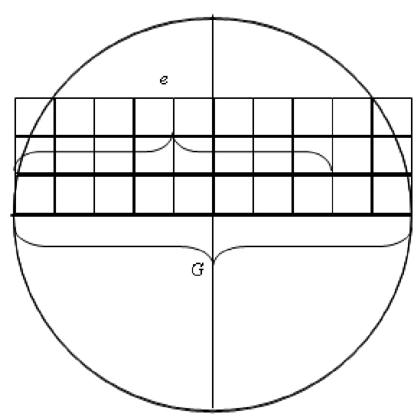
Recall that the numerical value of ε_o is 8.854×10^{-12}, and of μ_o is $4\pi\times10^{-7}$.
The equation fits nicely onto our grid with triangles except for the issue of scale.



$c = 299.79\times10^6$
$(1 / \mu_o) = .795775\times10^6$
$(1 / \varepsilon_o) = 112940\times10^6$
When we put the constants into the same scale we find that the electric constant component totally overshadows the magnetic constant component. That means the

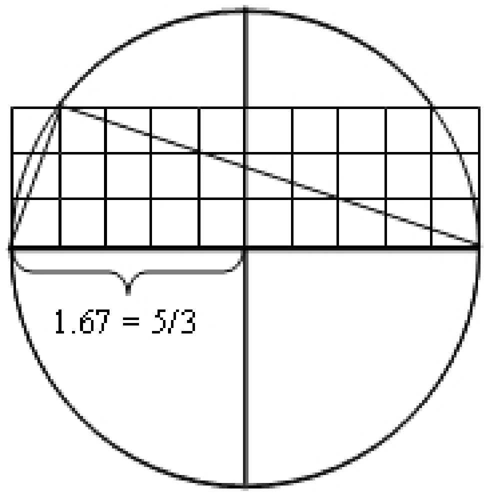
perpendicular is way over almost tangent to the edge of the circle, and the electric component takes up almost all the diameter line segment. So, although the formula fits the geometry, the triangles lie almost flat on the diameter. There is no point in drawing it, but we know they are there. However, there is another way of mapping them. We know that the magnetic constant is 4π. When we multiply that by 8.854 we get 111.265. If we invert that, we get .00898755224, the square root of which is the light speed ratio component. Now 4π is about 12.566. Why don't we set the product of the two EM constant ratios to 111.111111..., which is 1000/9. The square root of that is 10.54, which is just 10 times the reduced Planck constant ratio? If we tilt and slide our 1.054 side on the small triangle until it forms a perpendicular that cuts the big circle at 1.05409255338 (square root of 1.11111111...), then our two diameter segments will be approximately 2.9576611154 and .37567221793. The sum of these two numbers is 3 ⅓. However, if we set each square width to 10, then the value of the perpendicular is 10.54...×3⅓, which equals 35.136418288.... The square of this number is 1234.56789012.... This is a "9" number. (divide by 9 and you get very close to the inverse of the fine structure constant, *a*.) The two segments of the diameter become 88.54... (88.4194128291) and 4π, giving us the approximate ratios of ε_o and μ_o. (Note that when μ_o is defined in terms of 4π and the perpendicular is in terms of 10.54...×3⅓, the numbers for ε_o do not come out quite right along the diameter of our circle, because the value of the perpendicular mathematically **defines** the values of the two diameter segments. Maybe this is why the proposal is afoot to cut the electric and magnetic constants loose from the Procrustean bed of definition and let them float in concert with the other physical constants.)

What about the other physical constants: *e* and *G*? If we set the ratio of *e* at 1.6, then we simply mark off 8 squares along the diameter and set each square width as 1/5 or .2. For *G*, we take 6.666..... = 6 2/3 as the ratio. The length of the diameter is 3 ⅓ when we consider each square to have a width of ⅓. *G* is the diameter taken twice, so we set the square width to be 2/3. The length of the diameter is then 20/3. So we find that by adjusting the scale on our grid and circle, we can find all the basic constants.



The Proton Rest Mass

We can fit the proton rest mass ratio onto our little diagram. Notice also that the scale of the proton (10^{-27}) is suggested by the 27 squares in the portion of the grid occupied by the large triangle just like the scale of the electron (10^{-30}) is suggested by adding the 3 squares occupied by the smaller triangle.



According to **Mech a** the proton mass relates to the ratio of light speed and charge as *pi* relates to our unit radius, -- that is, half a unit circumference.

* $m_p\, c / e = \pi R$

One side of the equation is physics, and the other side is geometry!

* $(1.67\times10^{-27}$ kg$)$ $(3\times10^{8}$ m / s$)$ / $(1.602\times10^{-19}$ kg / s$)$ = 3.12734 m.
* $(9.86965)(1\ \text{m}^2) / (3.16227766\ \text{m}) = 3.121$ m.

This equation comes out very close considering that we rounded off slightly and matched items spread over a range of 27 orders of magnitude. (3.12734 m ≈ 3.14159 m)

If we use the **Mech d** units from chapter 7, then the quantum charge unit becomes kg m/s. Then our equation reduces further to

* $m_p\, c / e = \pi$.

The relationship of the proton mass, light speed, and quantum charge is basically just the universal ratio for all possible circles of circumference to diameter. True enough, if we use current CODATA values of

$1.672\ 621\ 777\times10^{-27}$ kg for the proton mass,
2.997 924 58 m/s for the speed of light, and
1.602 176 565 for quantum charge,

then we end up with a value of approximately 3.12973866167. The ratio of *pi* to this number is about 1.00378753412, which is very close to 1.00328671977, which is the square root of % / π. It seems there is some other factor in this relation, but, given the huge scale differences and the pure number ratio from universal geometry that results, the closeness of the numbers seems too amazing to be a coincidence. **The physical structure of the particle responsible for most of the stable matter in the universe happens to be almost exactly equal to the universal geometry ratio of the circumference to the diameter of any circle.**

How is it that the proton mass times the velocity of light, divided by the unit charge happens to be almost exactly *pi*? If we use **Mech a,** then we face the possibility that perhaps this universal constant should be the definition of a meter rather than the speed of light. If all other components of the expression are constants, then R must also be a universal constant of the physical world. The cluster (m_p c) represents the ideal momentum of a proton if it travels at the speed of light, and e is the proton's quantum unit of charge. The expression (π R) looks like half a circumference or half an orbit. One thing this equation tells us from **Mech a** is that the proton's charge is equal to the proton's momentum at light speed divided by half a circular orbit with a radius of one meter. From **Mech d** we simply get the proton mass as *pi* times the ratio of the quantum charge to the speed of light:

$$m_p = \pi e / c.$$

If we use the mass of the neutron $1.674927351 \times 10^{-27}$ kg, we get 3.13405275358 as our value for *pi*. However, we have error margins to play with. So we can take the margin (74) for the neutron ratio up to 1.674927425 and $1.602176565(35) \times 10^{-19}$ C for the charge down to 1.602176530, then we get up to 3.13405296051. This brings the ratio of *pi* to our quantum physical structure down to 1.0024057325, and this means our "square root of (% / π)" is within that marginal range -- but what would that mean? The question is, what is the real missing factor, or are our standard measurements of the proton and electric charge still off by a tiny bit? If we use **Mech a**, then perhaps a small adjustment to the meter (a little over 2 millimeters) is all that is required.

All of the matter that we see and play with in the world of physics is based on the proton (or neutron), because those particles form the nuclei of all atoms. It may be that the proton effectively generates our very concept of spatial intervals. It is therefore appropriate to define our basic spatial interval in terms of the constant relation of the proton (or neutron) to the speed of light, electric charge, and the constant geometry of a circle.

The value of the unit radius R = 1 meter is the Observer's Gauge with which to view the universe. Without this gauge and its companion %, we can not make sense of the rest masses of particles, the quantum unit of charge, or the speed of light. Nor is it possible to create a holistic quantum theory of gravity that will unify the various forces of nature.

These fundamentals are all determined by the inherent decision by the Observer to resist his creations. Human resistance takes the form of a unit distance that the observer places between himself and his creation. There may be an anthropic principle at work here that reflects into biological form. The human body grows to a height of between

1 and 2 meters.

* $2 \pi R = 2\, m_p\, c / e$.

Protons like to be in pairs to form molecular hydrogen. The ($2 \pi R$) also forms a circle with a radius of 1 meter. The normal personal space that an individual maintains around her is about that of a circle with radius 1 meter. The range from ($\%^2$) = 10 m^2 to $\pi\, \%^2$ is 31.416 m^2 forms an average area sufficient to provide air, heat dispersion, minimal furnishings, storage, and exercise room for an individual human's quiet living space. This perhaps can provide a little insight into what I mean when I say "resistance". If someone moves into your personal body space without your express permission, most people feel a subtle sense of pressure. This allows you to get a glimpse of the transparent belief structure we have by which we resist the world around us even while depending on it for our survival.

Experiment:

* Do Exercise #7, "The Behavior of Attention" in **ReSurfacing**. Read the sidebar comments very carefully.

* Try moving into someone's 1 meter radius personal space with or without their permission. Do not initiate physical contact without the person's express permission!! Feel what it feels like for you when you are near a person's space, at its edge, and within their space. Also notice how the other person reacts.

* Hold a conversation with someone and notice the distance between your hearts. Try it with different people and notice what the average comes to. This average may vary a little bit from culture to culture or from one age group to another.

* Sometimes in crowded places we draw in our edges a little based on a convention that "I'll give a little if you'll give a little and we all behave ourselves, because we are all here for some common purpose." Go to an event where there is a crowd or take a ride on a crowded bus or subway during rush hour. Pay attention to the distances between people and the feelings of resistance or attraction that are generated.

* Close friends and intimate couples are like molecules. Their energies are biased in such a way that they fit together comfortably. The resistance is turned into an attraction. Try this exercise with someone you have a strong mutual attraction to and feel what that feels like. Notice how it feels when the energy between you and a close or intimate friend gets "out of synch".

Applying %

Now let's get a little more adventurous and work out another example in which we can derive the D-shift o-per at work.

The Compton effect describes the angle and frequency shift that occurs when a photon passes near a free electron. This is found to be a universally constant relationship. We can think of a free electron as a tiny star. The passing photon is like a comet that swings by the star, shifting its angle and speed as it does so. Light has a fixed speed, so it shifts its wavelength instead of its speed. It conveys some of its energy to the electron, but, like the comet, it is so much lighter, that it shows the greater effect. The relationship looks like this:

* $\Delta\lambda = 2\,\lambda_c \sin^2 (\angle A / 2)$.

Here $\Delta\lambda$ is the wavelength shift, ($\angle A$) is the angle shift, and (λ_c) is the Compton wavelength, a constant unit of quantum space. For the electron the constant is:

* $\lambda_c = 2\,\pi\,\hbar / m_e\,c = h / m_e\,c = 2.4253\text{x}10^{-12}$ m.

The Compton Wavelength is the more fundamental Compton Radius for electrons (R_{ce}), or de Broglie wavelength, converted to circumference value: ($2\,\pi R_{ce}$), where $R_{ce} = \hbar / m_e\,c$.

Right off the bat we see two interesting things. Any charged particle (or massive gravitational field) can have a Compton effect, including a proton or a star. If the circumstances are right, the photon could even get trapped in an orbit around a particle that is a black hole.

So, let's substitute a proton into the relationship and look at its Compton radius (R_{cp}).

* $\lambda_{cp} = 2\,\pi\,\hbar / m_p\,c = 1.32\times10^{-15}$ m.
* $R_{cp} = \hbar / m_p\,c = 2.108\times10^{-16}$ m.

This makes sense, because the proton is more massive, so it has a tighter radius for the same photon when compared to an electron.

We'll divide this by ($m_p\,G$) and the Planck Velocity (Sp / Ps), then multiply by c^3 and a cluster of geometry relations: (Ao Ss^4 / Oo As^4). G is the gravity constant. Sp is defined as (Ss / Ao) = 4/3 m. Ps is the Planck Second, (Tp) = $(hG/c^5)^{1/2} = 1.35\times10^{-43}$ s, divided by a special ratio of (1 / .987654321....) = 1.0125....

The denominator of that ratio (.987654321...) is a D-shift number. Just as 1 / 9 = .111111..., integer multiples of .111 give .222, .333, etc. A second iteration, 1 / 81, produces .01234567..., the complementary D-shift number for base ten. That D-shift number comes from iterated powers of the decimal factor $\hbar_{df}$ of $\hbar$: $\hbar_{df}$ = (1.054....), $(\hbar_{df})^2 \approx 1.11111$. $(\hbar_{df}^2)^2 = 1.234567$.... The expression ($Sp$ / Ps) is thus what I call the Planck Velocity. It is a D-shift velocity. It's like countdowns to blast off!

We could use (Sp / Tp), but multiplying by the D-shift number gives us a nice value of unity:

* $(1.35\times10^{-43}\text{ s} / 1.0125) = 1.33333\times10^{-43}\text{ s} = (4/3)\times10^{-43}$ s.

So the 4/3 of *Sp* and the 4/3 of *Ps* cancel. The geometry of *Sp* and the relations of *Ps* are universal. (I round these numbers off to show the underlying geometry. The constants may need mutual adjusting or there may be small missing factors, such as the "neutrinos" that have been added to the mix to make the energy equations balance.)

Here's our full expression with terms organized a bit.

* $(\hbar c^2 / G m_p^2)$ (Ps / Sp) (Ao Ss^4 / Oo As^4) = 3.16×10^2 m^5.

This result happens to be $\%^5$.

* $\% = 10^{1/2}$ m. (It can go in positive or negative direction.)
* $\%^2 = 10$ m^2.

This D-shift interval is a critical factor in operations involving Planck's constant, interactions between charge and mass (as we saw above in the first equation), and in gravitational shifts. <u>%</u> / 3 = 1.054. 3 (1.054) = <u>%</u>.

This next equation expresses the relations among most of the fundamental physical constants in terms of corresponding relations between all of the basic geometric constants in our circular system. There's a corresponding equation that includes m_e, the rest mass of the electron. The factors on the left are physical, and the factors on the right are pure geometry, except that they are anchored in the unit radius $R = 1$ m.

Here is an equation that incorporates the fundamental physical constants and all the basic constants of geometry. I consider the electron a subsystem of the proton system, because (m_e) can be put in terms of (m_p), as we'll show later.

One way to explore the electron is through the Rydberg constant ($R_\infty = 10973731.6$ m^{-1}). Niels Bohr derived the Rydberg from the other physical constants. The importance of this approach is that physicists can get extremely accurate measurements of the Rydberg constant, but there is no way to directly measure the rest mass of the electron because it exists only as a theoretical limit, as we have mentioned previously in our discussions. So, as circular as this may seem, the Rydberg constant is a great way to get a simple definition of the rest mass of the electron in terms of other constants.

* $$R_\infty = \frac{m_e e^4}{8\epsilon_0^2 h^3 c_0} = \frac{m_e c_0 \alpha^2}{2h}$$
* $m_e = 8\, h^3\, c_o\, \varepsilon_o^2\, R_\infty / e^4$.
* $m_e = 2\, R_\infty\, h / c_o\, a^2$

Here m_e is the electron rest mass, e is the electric charge of the electron, h is the Planck constant, $\hbar$ is the reduced Planck constant, c is the speed of light in a vacuum, ε_o is the permittivity of free space, $a = e^2 / (4\, \pi\, \varepsilon_o\, \hbar\, c)$, is the fine-structure constant, $\lambda_e = (h / m_e\, c)$ is the Compton wavelength of the electron, $f_C = (m_e\, c^2 / h)$ is the

Compton frequency of the electron, $\omega_C = (2\ \pi f_C)$ is the Compton angular frequency of the electron, $a_0 = (4\ \pi\ \varepsilon_o\ \hbar^2\ /\ e^2\ m_e\ )$ is the Bohr radius, $r_e = (e^2\ /\ 4\ \pi\ \varepsilon_o\ m_e\ ^2)$ is the Classical electron radius. (See **Wikipedia**, "Rydberg Constant".)

We can express the 8 with our symbols as (Oo As / π Ao). The Rydberg constant is specifically tied to the orbital behavior of the electron and thus should tell us a lot about the inner nature of m_e if we can just read the number properly. Rydberg noticed that this particular value occurred in his refined version of Balmer's formula for the spectral lines of hydrogen. This value is confirmed experimentally as well as theoretically. I won't go into Rydberg's refinement of Balmer and Bohr's theoretical derivation. You can get that in physics texts.

There is a set of decimals, each of which, when added to a certain integer and then multiplied times the decimal itself, equals unity. (We keep getting back into these decimals as images of physical structures!!) The Rydberg scaled down by 8 orders of magnitude forms such a set with the integer 9. You have already seen above how 9 in our base-ten system serves as a D-shift operator when it interacts with wholeness (1) at various self-iterating powers. The experimental Rydberg value is pretty close to this number.

The general formula for the decimal relationship is:

* $x^0 = x^{(mn + nn)} = (x^{mn})(x^{nn})$.

In this formula x is any number, m is any natural number, and n is the decimal that pairs with m. The integer times the decimal plus the decimal squared also happens to equal one. Here is the "Rydberg" example.

* 1 = (9.1097722)(.1097722)

The experimental value of Rydberg for infinite mass is 10973731.6 m^{-1}; The experimental value for hydrogen is 10967757 m^{-1}. The value for hydrogen is remarkably close.

Other decimals in this set happen to include 1.618034, 2.41421, 3.30377, 4.236, 5.19258, 6.1622776, 7.14, 8.1231, 9.1097722, 10.099, ... The value m = 1 sure looks like *phi* = 1.618033988749894848204586834.... The value m = 6 is especially interesting here because its decimal (.1622776) happens to be the same as the decimal attached to %, that is 3.1622776 m. We discussed earlier the intimate relation between *phi* and %. Here is the formula for m = 6.

* (6.1622776 m)(.1622776 m) = R^2.
* 6.1622776 m - 3 m = %.

I can derive m_e from the other constants about a half dozen ways, getting slightly different values, which may be partly due to the limitations of my calculator, and partly due to rounding of numbers, and partly due to the possibility that these different relationships actually have different real world values if aligned with the universal constants of physics and geometry. But the average of these various values is quite close to the experimental value. Perhaps if we identify all the ways of deriving the electron mass and average them, we will get the exact value?!

Now let's step further in for some fairly outrageous propositions. The first is that we have right in front of our eyes a wonderful working model for the Big Bang. It is abundant and all around us and forms our very bodies. It is the **proton**.

Gravity and Electromagnetism

Along with this thesis comes the notion that the missing antimatter that is supposed to match to the matter but has not been found may also be right under our noses, trapped inside the protons. This was an outrageous idea that John Wheeler, mentor of Feynman communicated to Feynman (and Feynman shared with the world in his remarkable Nobel Prize acceptance speech). Along the way we will sketch out a model of the proton and the other elementary particles, plus a theory of the way atoms are built, using a model that will unify gravity and electromagnetism in a very simple and elegant manner.

If we accept the notion that gravity has its opposite pole in kinetic energy, then the major difference between the *e*-force and *G*-force is one of scale. We find that at our normal scale of observation the electromagnetic force overwhelmingly seems to dominate gravity in the way things work. On the cosmic scale of solar systems and galaxies gravity runs the show. The effect of the electromagnetic force tends to balance out between opposite charges most of the time, leaving the big cosmic scale masses to swing around each other doing their dance of inertia *vs* gravity.

But what happens at the small scale? If we follow the two forces "down the rabbit hole," they reach a scale where they begin to interact as equals.

Let us now begin to explore that area. If we understand it, we may be able to harness electromagnetic forces to control gravity more efficiently than we do now. We may also be able to tap into vast sources of energy. Remember that mass is resistance. By reducing resistance we may be able to get some macroscopic quantum effects for manipulating the *e* and *G* forces. Modern physics has already discovered lots of amazing quantum effects. Maybe we can find some more, or at least expand what we already know.

We'll start with the standard comparison that physics professors like to put in the textbooks to "prove" how far apart the scales of the *e*-force and *G*-force are. Having convinced you how ridiculous the whole situation is, they then dismiss the whole issue and move on to teaching the usual curriculum. The little exercise compares Coulomb's electrical law and Newton's gravitational law in terms of a single electron interacting with a single proton. What strikes everyone right away is how similar the physical laws look -- like they were struck off the same block. Then you see how far apart they are. Then you shake your head, forget about it, and move on to do your assignments.

You are familiar with the laws and no doubt have seen the demonstration, but I'll write the laws as they are joined together in the exercise, and we can enjoy the pure number universal constant that emerges.

* $F_g = G\, m_p\, m_e / r^2$.
* $F_e = k_e\, e^2 / r^2$, where $k_e = (4\, \pi\, \varepsilon_o)^{-1}$.

* $E_g = F_e / F_g = e^2 / (k_e)(G\, m_p\, m_e) = 2.3\times10^{39}$.

This elegant "Egant", as I call it, is a **dimensionless pure number** since it is the ratio of two forces, the electrostatic force and the gravitational force. When we look at the ratio, the separation r cancels out. So this ratio is **independent of the distance** between the particles. We have e^2 on top because the charges between m_p and m_e are equal; k_e is the constant for Coulomb's law, and G is Newton's constant. We know that the 4π comes from geometry:

* $\mathrm{As} = 4\, \pi R^2$.

We plug in here the masses of the proton and electron, and they interact gravitationally to attract. The e-force is attractive also because the charges are opposite. If they were the same, the e-force would be repulsive. So far this is the standard textbook example. The number 2.3×10^{39} is so huge that the student says, "Oh, yes. These two forces have nothing to do with each other."

Such an exercise does not seem like a very good way to indoctrinate students if you are serious about finding a theory that unifies gravity with the electromagnetic force. From the start you make it look very difficult and unlikely.

Now let's change our viewpoint and modify the exercise a little bit. We shall toss out (m_p) and (m_e), and plug in two other masses that we shall suppose are equal. We don't know what they are -- we shall call each one m_x. The radial distance cancels out -- just like the mass cancels with falling objects -- so our equations theoretically are good for any distance between the two m_x's. We're going to explore what happens when we set the ratio to unity!!

* $F_e / F_g = e^2 / 4\, \pi\, \varepsilon_o\, G\, m_x^2 = 1$.

We then solve this simple equation for (m_x).

* $m_x^2 = e^2\, \mathrm{Ao} / \mathrm{As}\, \pi\, \varepsilon_o\, G$.
* $m_x = 1.86\times10^{-9}$ kg.

Counterintuitively, this turns out to be a relatively massive particle when compared to m_p and m_e!! Yet it is still pretty small compared to the scale we are used to. We temporarily will call this hypothetical particle a Union ($m_x = U_n$) because it derives from a ratio of unity, and, as we will see, it may have some properties that resemble an onion, and also because it is an UNknown, and possibly fictitious, particle.

But, you say, this is preposterous. How could there be a fundamental particle that heavy floating around. It must be totally unstable and extinct. On the other hand, what are gravity and electricity doing unifying at a scale that is right under our noses at about the size of a very small grain of dust. Maybe this little dust mote is the door guard to a whole new world that we can imagine into existence.

* $U_n^2 = e^2 \text{ Ao / As } \pi \varepsilon_o G$,

* $U_n^2 = (e^2 / G \pi \varepsilon_o) (\text{Ao / As}) = 3.458 \times 10^{-18} \text{ kg}^2$.
* $U_n = 1.86 \times 10^{-9}$ kg.

These U_n's could manifest anywhere from the vacuum state spontaneously, just like anything else, as virtual particles. But a U_n particle by itself is unstable and will immediately decay back into our cooled down vacuum. Back in the pre-hadronic era that would not have been the case, but that's not where most of us are at the moment as observers.

Note that U_n's tend to come in pairs by the nature of the equation. This suggests that they are bosons, or at least pseudo-bosons, like mesons. If they annihilate when separated (and thus the distance between their singularities is not any value greater than one event horizon radius), what happens if they get close or even intersect?

Here, as you can see, we're going to make an assumption that we can treat these particles, and any other subatomic particle, as mini black holes (BHs). We know from BH research that big BHs generally are stable and cool, but the smaller they get, the hotter they are, and the less stable. Hawking radiation increases as they get smaller, eventually causing them to explode. This does not sound promising as a way of getting stable elementary particles from BHs. But hang on.

If these two tiny hot BHs come together, they start having sex. You've seen drawings of star-and-BH binary systems where the BH sucks an arcing trail of matter from the star and gives off X-rays as the matter falls in. Here we have a similar situation, but the two are actually stuck together like a couple of copulating beetles. They are perfectly balanced, so they form a loop that feeds back and forth, violently, but silently exchanging energy. (They must be shy. We don't hear them scream. The scream goes on inside, held tight by an event horizon. Or maybe it is at a frequency we can’t hear.)

Because they are stuck together, do their singularities become double? Yes and No. A gap forms where they overlap. It ranges from the tangent point of the two particles as one limit to the volume of U_n as the other limit, but may average as a vaguely lenticular shape, unless it is distorted by surging forces, which it probably is.

What happens inside this lens is of particular interest. This is where the action is with *e* and *G* tidal forces from both particles interacting. The two particles may just look like a single pulsating bubble having an orgy from the outside. Inside we find that U_n (A) sucks at U_n (B) and U_n (B) sucks at U_n (A). All this sucking flows into the lens, which is pulled both directions by equal forces of the two singularities. This sets up a powerful energy field inside the lenticular gap. The resultant is that it seems as if there is another particle in the gap! This is where the notion of "3 quarks for Muster Mark" comes from. (Quote from Joyce's **Finnegan's Wake**, the *locus classicus* of the word quark.)

The other particle could theoretically have a wide range of masses, but other factors come into play to limit the average choices.

We don't see quarks wandering around free in space. They are locked together inside the proton. How and why? What if the proton is defined by the ratio of the electric force *e* to the speed of light *c*, adjusted by a constant of geometry: π, or πR?

Now let's propose that the "quark" that lurks in the lens has just the right mass to give us a proton.

* $m_p = 1.67\times10^{-27}$ kg = $(1.86\times10^{-9}$ kg$)(1.86\times10^{-9}$ kg$)(4.83\times10^{-10}$ kg$^{-1})$.

The kg^{-1} in the third "particle" means that it is an antiparticle, so that it cancels out one of the other mass units. We would actually experience the third quark in free space as 2.07×10^{9} kg, a pretty hefty chunk of mass-energy if it were expanded out as a normal particle. But it is still small enough to be unstable by itself and in this scenario it is crunched and turned inside out, so it looks about the same size and mass as the other Union particles. You have three particles that interact forcefully and we get a resultant mass that ends up the same as the proton. The mass values are just averages, for they are constantly mixing and matching at very high speed. But why on earth would we end up with a proton mass and not some other arbitrary mass?

To see this we have to go back to Hawking's BH radiation equation. If (*Tbh*) is the temperature of a BH on the Kelvin scale,

* $Tbh = (1.2\times10^{26}$ K$)$ $(1 / (m_x / 10^{-3}$ kg$))$.

A BH of one solar mass about (10^{30} kg) has a temperature of 10^{-7} K. It's pretty cold. But at 10^{14} kg the *Tbh* is 10^{9} K and we are getting photons and neutrinos radiating from it. When we're down to 10^{11} kg, we're getting pion and kaon radiation, and *Tbh* is around 10^{12} K. When we get down to 10^{9} kg, which is the interacting black hole mass we get for the lenticular vesicle in the core of the Union ensemble, then Tbh goes up to around 10^{14} K. Now, if you look at the Fermilab chart of the universe evolving out of the Big Bang, you'll find that you have just passed the window of the Quark-Hadron Transition. You're now in the quark soup. But at this size and temperature window is just where a BH starts to spit out **protons**. You got it?

Bingo we have a watering hole of equilibrium!! On its own a 10^9 kg BH would almost instantly "evaporate", or rather it would explode. The ensemble of Union particles is imploding and exploding at the same time and produces the effect of a movie of a proton. Each frame shows a proton, and in between the proton disappears to become three "quarks", and then it appears, and so on, which makes it slightly jiggle about -- which is why protons inherently jiggle all the time. The Union ensemble spits out protons, and then sucks them back in again, spits them out, and sucks, spits and sucks, spits and sucks, and so on indefinitely, stuck in a perfectly balanced cycle. Maybe this is why π gets involved.

If we consider a Union as a BH, what is its *Tbh*? For a BH with a mass of around 10^{-9} kg we find it has a temperature at around 10^{32} K. On the Fermilab chart this is right after the Big Bang, but still in the era of super-gravity. This is not surprising since we set out to calculate in a simple way a particle that would unify the *e* force and the *G* force symmetrically. When we found our particle, it turned out to be right where modern physics puts super-gravity and super-symmetry.

If we are right, this tells us something about how symmetry broke at the end of the super-gravity era. As the energy level dropped when the system expanded, all single Unions boiled off back into the vacuum state and disappeared from the scene. From that point on, as the energy dropped, the *e* and *G* forces operated on different scales. (Why? See Chapters 13-14.) But a few Unions were caught with their pants down having sex. They still had lots of company for a while, but when the Quark-Hadron Transition window closed, all the quarks -- particles with an average mass of around 10^{-28} kg -- were imprisoned, trapped inside protons and neutrons, and the rest of the heavy particles decayed. In other words, the only heavier particles that survived were the Union pairs that could sustain themselves at equilibrium water holes. These mates have been at it ever since and continue to do the Big Bang even today. Now that is ultimate Tantra!!!

And that is also why I propose that the best laboratory for studying the Big Bang is right under our noses in the guise of the proton.

Why These Quarks?

The next question that comes up is this. Why is it that these "quarks" don't look much like what physicists imagine quarks look like?

The fact is that nobody has ever seen a naked quark, nor will they be likely to. If you think of the quarks in a classical sense as separate particles, then you get an average mass of slightly over 5×10^{-28} kg for each one, the down quark being slightly heavier. But quarks are innately bound. And from our above analysis we now see why. They would not survive separation. They would probably immediately join with a meson and make another particle that would then decay, the quark and anti-quark pair mutually annihilating into photons. Or they would just exchange with a quark in another proton or other elementary particle. They can't stand being alone. A quark left alone would immediately decay. Because of that, the distribution of mass among the quarks in a proton is ambiguous. It can be almost anything potentially, although some values are more probable than others, and the final result has to come out to the proton rest mass because of the nature of the universal constants.

Why do we multiply the proton components? The proton's components are inextricably mixed into a state of mutual interaction, so we must define them by using products rather than sums. Looking at them as summing their masses to form the proton mass is misleading, because that viewpoint assumes they can exist as separate particles, which, as we have seen experimentally, is just not the case.

We also notice that the boson Unions would seem to have identical charges. The model equation we started with had the proton and electron interacting. However, in our calculation we pitted the electrostatic force AGAINST the gravitational force. The Union particles should each have a positive charge so that the two interacting generate a repulsive force that just balances the attractive force of gravity. That implies that the quark inside the lens must have a negative charge. The combination of two positive charges and one negative charge results in a net single positive charge. At least that is what we might surmise at a first glance. But there's more to the story.

OK. Now we have a very nonstandard model of the proton. We go a few steps further and propose that the proton is the model of the unified field. It is the laboratory of the Big Bang. It is the "glory hole" sought by the super-string theorists.

Right now one of the "hottest" subjects in physics is super-string theory, the idea that you can mathematically construct a standing wave that can jiggle and wiggle out all possible states of matter and energy with its various harmonics like a magical electric guitar. The problem is that a very large number of possible theories are floating out there. Plus, they get very complicated and impossible to follow, and there is no way to test them in the laboratory, because the energy levels seem way out of reach.

If we can't teach high school students to spell, how are we possibly going to teach them super-string theory? Advanced physics, especially field theories and super-string theories, become the arcane mysteries of a secret priesthood.

So let's take a look at standing waves (SW). What is a standing wave? It is a wave that is localized in space-time. I include time because although standing waves "stand" for a while, they all eventually dissolve and dissipate. A simple example of a SW is a guitar string. If you pluck it, it vibrates between its terminal nodes. Outside those terminals it is severely damped and disappears as a part of the recognizable SW. SWs are black hole vortexes of energy trapped within boundaries. Or we can say that BHs are a type of SW if you want to say that BHs are SWs in which gravity is the dominant energy of the system. SWs also are quantum mechanical. They only count waves with whole numbers. Fractions cancel out by destructive interference. So SWs take very specific geometric shapes.

In mathematics you can have infinite waves. But from projective geometry we know that "infinite waves" terminate in a mental node called infinity at each end. Every creation, by definition, has boundaries. Thus the universe itself is a SW. Depending on the type of material and its shape, a SW will give rise to various harmonics and overtones. It is no accident that the ancients spoke of creation as being like music. Or we can say that music is a beautiful subset of the SWs of creation. Even EM (electromagnetic) waves that seem to go on forever are always terminated at each end, usually by an electron. The photon is an exchange of energy between two charged particles, so there has to be something at each end of the propagation. It can not just radiate on forever.

Now with our model of the proton we have a laboratory for the super-string theorist to play with. He has an actual, mathematically definable and experimentally verifiable super-string to work with. This string contains in its vibration modes the entire history of the universe right from the Big Bang. The Unions ensure that as does the proton's incredible longevity. Furthermore, the components of the proton are so relatively massive that they can easily generate all the subatomic particles and all the atomic nuclei as simple vibration harmonics.

Modern chemistry stands as it is, although there are still some arguments about atomic and molecular configurations and perhaps also many still-to-be-discovered molecular structures. It is OK because we can "see" what's going on. Almost all of the action is out there in the electron orbits. However nuclear chemistry is a different story. We can not "see" directly into the nucleus to observe what is happening. Thus even QCD, the "science" of gluons, is highly speculative. No one has ever seen a gluon or a quark. They are completely hypothetical.

What do we know about the nucleus? We know that it grows in units of charge (Atomic Number) and roughly double units of weight (Atomic Weight), but, as you go up to heavier nuclei, the weight goes up faster than the charge. We also know that electrons in orbits around the nucleus usually balance the charges on the nuclei. That is well studied. We also know that there is a funny jump from hydrogen at AN = 1 and AW = 1 to helium at AN = 2 and AW = 4+. We explain that with the idea of neutrons and protons tending to be in pairs. But why are the "isotopes" with AW = 2 and 3 so rare?

I suggest that all atomic nuclei above hydrogen are really just fat protons. Given the internal mass dynamics of our model, proton masses are easy to make. Furthermore, the SW harmonics would tend to produce increments of proton mass as the proton's energy is boosted. Rydberg's version of Balmer's series formula gives the energy of the *n*th state (principle quantum number) of an electron in orbit as:

* $E_n = - h\, c\, R_\infty / n^2$ [n = 1, 2, 3, ...] (Where R_∞ is Rydberg's constant.)

* $E_p = h\, c / \lambda$

(for photons; (λ) is wavelength, (h) is Planck's constant, (c) is light speed).

We can imagine that the "lens" formed by the intersection of Unions is vibrating. If the Unions intersect slightly, then the lens vibrates somewhat like a drum head. If they intersect almost completely, then it looks like spherical harmonics. I'm not sure where it averages, but we can take spherical harmonics as a limiting example. Such harmonics are distinguished by counting the total number of nodal circles (n) and the number of geodesics that pass through the poles (m). You get increments that of course are always whole numbers.

Planck's constant is involved in all BHs. This is the smallest SW configuration for energy, the ratio between energy and frequency (J · s). A feature of EM energy is that it is carried by frequency. This requires a constant factor to convert between frequency and energy. Planck named this factor "$\hbar$" (usually read "h-bar" and written as an "h" with a "bar" (-) through it.

* $E = \hbar\, \omega = h\, \nu.$

* $\omega = 2\, \pi\, \nu.$

Here ν is frequency and ω is frequency in radians. If the frequency is high enough, the energy density overwrites itself and forms a particle instead of a wave. A particle is a SW formed by gravity or high frequency self-containment.

* $h\, \nu = m\, c^2.$

Planck found the average energy of a set of SW oscillators vibrating in various quantum states (integral multiples of $\hbar\, \omega$.)

* $\bar{E} = \hbar\ \omega\ / (e^{\hbar\omega\ / k T}) \text{-1}).$

T is temperature, and k is Boltzmann's constant. The denominator in the form of an exponent gives the relation to temperature when there is a distribution of quantum states. The ratio ($\hbar\ /\ k$) is about 4.8×10^{-11} to 1, so when the frequency is around the infrared range (.3-300 THz) and into the visible range, we have values near unity for the exponent. As the frequency goes up higher, the value of the exponent increases and this drops the average energy. Higher frequencies are only sustained at extremely high temperatures.

The distribution of intensity for the frequencies of black body radiation is governed by the SW constant ($\hbar$). The quantization of energy explains why we do not have lots of X-rays coming out of hot boxes. The exponent damps them out. Planck's constant is related closely to the charge constant e, light speed c, and the permittivity constant (ε_o) in the following way, and here I am interposing some material from **Wikipedia**, "Planck Constant" explaining how Planck's constant is now integrated with other constants, defined with increasing precision, and measured in laboratories. The fine-structure constant is a pivotal dimensionless number that connects the constants and plays a key role in the way electrons interact with photons.

Sommerfeld originally defined the fine-structure constant α as:

$$\alpha = \frac{e^2}{\hbar c_0 \ 4\pi\epsilon_0} = \frac{e^2 c_0 \mu_0}{2h}$$

where e is the elementary charge, ε_0 is the electric constant (also called the permittivity of free space), and μ_0 is the magnetic constant (also called the permeability of free space). The latter two constants have fixed values in the International System of Units. However, α can also be determined experimentally, notably by measuring the electron spin g-factor g_e, then comparing the result with the value predicted by quantum electrodynamics.

At present, the most precise value for the elementary charge is obtained by rearranging the definition of α to obtain the following definition of e in terms of α and h :

$$e = \sqrt{\frac{2\alpha h}{\mu_0 c_0}} = \sqrt{2\alpha h \epsilon_0 c_0}.$$

*

Bohr magneton and nuclear magneton

Main articles: Bohr magneton and Nuclear magneton

The Bohr magneton and the nuclear magneton are units which are used to describe the magnetic properties of the electron and atomic nuclei respectively. The Bohr magneton is the magnetic moment which would be expected for an electron if it behaved as a spinning charge according to classical electrodynamics. It is defined in terms of the reduced Planck constant, the elementary charge and the electron mass, all of which depend on the Planck constant: the final dependence on $h^{1/2}$ ($r^2 > 0.995$) can be found by expanding the variables.

$$\mu_B = \frac{e\hbar}{2m_e} = \sqrt{\frac{c_0 \alpha^5 h}{32\pi^2 \mu_0 R_\infty^2}}$$

The nuclear magneton has a similar definition, but corrected for the fact that the proton is much more massive than the electron. The ratio of the electron relative atomic mass to the proton relative atomic mass can be determined experimentally to a high level of precision ($u_r = 4.3\times10^{-10}$). . . .

Determination

Method	**Value of *h* (10^{-34} J·s)**	**Relative uncertainty**	**Ref.**
Watt balance	6.62606889(23)	3.4×10^{-8}	[21][22][23]
X-ray crystal density	6.6260745(19)	2.9×10^{-7}	[24]

Josephson constant	6.6260678(27)	4.1×10^{-7}	[25][26]
Magnetic resonance	6.6260724(57)	8.6×10^{-7}	[27][28]
Faraday constant	6.6260657(88)	1.3×10^{-6}	[29]
CODATA 2010 recommended value	**6.62606957(29)**	**4.4×10^{-8}**	[1]
The nine recent determinations of the Planck constant cover five separate methods. Where there is more than one recent determination for a given method, the value of *h* given here is a weighted mean of the results, as calculated by CODATA.			

Josephson constant

The Josephson constant K_J relates the potential difference U generated by the Josephson effect at a "Josephson junction" with the frequency ν of the microwave radiation. The theoretical treatment of Josephson effect suggests very strongly that $K_J = 2e/h$.

$$K_J = \frac{\nu}{U} = \frac{2e}{h}$$

The Josephson constant may be measured by comparing the potential difference generated by an array of Josephson junctions with a potential difference which is known in SI volts. The measurement of the potential difference in SI units is done by allowing **an electrostatic force to cancel out a measurable gravitational force**. Assuming the validity of the theoretical treatment of the Josephson effect, K_J is related to the Planck constant by

$$h = \frac{8\alpha}{\mu_0 c_0 K_J^2}.$$

(boldface by me)

Watt balance

Main article: Watt balance

A watt balance is an instrument for comparing two powers, one of which is measured in SI watts and the other of which is measured in conventional electrical units. From the definition of the *conventional* watt W_{90}, this gives a measure of the product $K_J^2R_K$ in SI units, where R_K is the von Klitzing constant which appears in the quantum Hall effect. If the theoretical treatments of the Josephson effect and the quantum Hall effect are valid, and in particular assuming that $R_K = h / e^2$, the measurement of $K_J^2R_K$ is a direct determination of the Planck constant.

$$h = \frac{4}{K_J^2 R_K}$$

(Below is from **Wikipedia**, "Quantum Hall Effect")

"The quantization of the Hall conductance has the important property of being incredibly precise. Actual measurements of the Hall conductance have been found to be integer or fractional multiples of e^2/h to nearly one part in a billion. This phenomenon, referred to as "exact quantization", has been shown to be a subtle manifestation of the principle of gauge invariance. It has allowed for the definition of a new practical standard for electrical resistance, based on the resistance quantum given by the von Klitzing constant $R_K = h/e^2 = 25812.807557(18)\ \Omega$. This is named after Klaus von Klitzing, the discoverer of exact quantization. Since 1990, a fixed conventional value $R_{K\text{-}90}$ is used in resistance calibrations worldwide. The quantum Hall effect also provides an extremely precise independent determination of the fine structure constant, a quantity of fundamental importance in quantum electrodynamics."

Note that the above text says, **"The measurement of the potential difference in SI units is done by allowing an electrostatic force to cancel out a measurable gravitational force,"** which is what we did in our calculation of the Union particle. We will come back to this in more detail later.

Going back to *a*, we can express it in a simplified manner using $R_K = h / e^2$.

* $a = \mu_o c / 2 R_K$

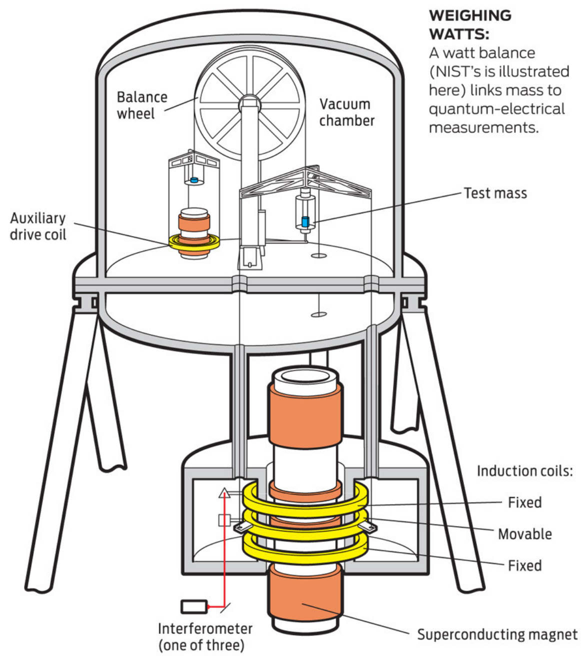
The Josephson constant is $K_J = 2 e / h$. Then $K_J^2 = 4 e^2 / h^2$. We multiply them together to get $K_J^2 R_K = 4 / h$. Thus we get an elegant and precise definition of *h*.

* $h = 4 / K_J^2 R_K$. Also,

* $$h = \frac{8\alpha}{\mu_0 c_0 K_J^2}.$$

The current value of $K_J^2 R_K$ hovers at around $6.0367625\times10^{33}\ \text{J}^{-1}\cdot\text{s}^{-1}$. Invert that and multiply by 4 to get *h* according to one recent measurement. The standards authorities average several tests by various methods (as shown above in the table) to arrive at the current suggested value. There may be a decision to fix *h* by definition as a fundamental constant and unit of measure. I suggest that they not be too hasty to set things in concrete. Things are evolving fast, and I suggest studying the geometry that underlies all of the physics as well as perfecting the Watt Balance before making a judgment. If we can adjust the physical constants so that they agree with the abstract relations of Euclidean geometry, then we have something solid and truly universal.

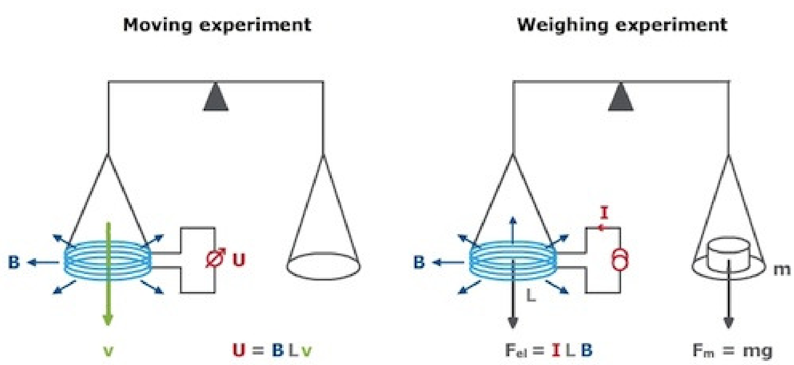
The Josephson-von Klitzing constant $K_J^2 R_K$ as implemented in the watt balance indicates that we are moving toward a resolution of the ambiguity about mechanical and EM units. "The product $K_J^2 R_K$ is determined by comparing electrical power known in terms of a Josephson voltage and quantized Hall resistance to the equivalent mechanical power known in the SI unit $W = m^2\ kg\ s^{-3}$. Comparison is carried out using an apparatus known as a moving-coil watt balance first proposed by Kibble (1975) at NPL. To date, two laboratories, NPL and NIST, have determined $K_J^2 R_K$ using this method." (CODATA 2006).



"A watt balance relates mechanical power to electrical power by comparing the gravitational force on a mass with the electromagnetic force on a current-carrying coil in a magnetic field.

A watt balance experiment has two parts:

* A static or weighing experiment in which the gravitational force on a given mass is balanced by an electromagnetic force developed on a coil.
* A moving or calibration experiment in which the same coil is moved through a magnetic field to produce a voltage."



http://www.sciencelearn.org.nz/Science-Stories/Measurement/Mass-standard-research-in-New-Zealand

A conducting wire of length *L* which carries an electric current *I* perpendicular to a magnetic field of strength *B* will experience a Laplace force equal to *BLI*. In the watt balance, the current is varied so that this force exactly counteracts the weight of a standard mass *m*, which is given by the mass multiplied by the local gravitational acceleration *g*. This is also the principle behind the ampere balance.

Kibble's watt balance avoids the problems of measuring *B* and *L* with a second calibration step. The same wire (in practice a coil of wire) is moved through the same magnetic field at a known speed *v*. By Faraday's law of induction, a potential difference *U* is generated across the ends of the wire, which is equal to *BLv*. Hence the unknown quantities *B* and *L* can be eliminated from the equations to give

* $UI = mgv$.

Both sides of the equation have the dimensions of power, measured in watts in the International System of Units, hence the name "watt balance".

Accurate measurements of electric current and potential difference are made in conventional electrical units (rather than SI units), which are based on fixed "conventional values" of the Josephson constant and the von Klitzing constant, K_{J-90} and R_{K-90} respectively. The current watt balance experiments are equivalent to measuring the value of the conventional watt in SI units. From the definition of the conventional watt, this is equivalent to measuring the value of the product $K_J^2 R_K$ in SI units instead of its fixed value in conventional electrical units.

$$K_J^2 R_K = K_{J-90}^2 R_{K-90} \frac{mgv}{U_{90} I_{90}}$$

The importance of such measurements is that they are also a direct measurement of the Planck constant *h*:

$$h = \frac{4}{K_J^2 R_K}$$

The principle of the "electronic kilogram" would be to define the value of the Planck constant in the same way that the meter is defined by the speed of light. In this case, the electric current and the potential difference would be measured in SI units, and the watt balance would become an instrument to measure mass.

$$m = \frac{UI}{gv}$$

(**Wikipedia**, "Watt Balance")

Voltage is defined so that negatively charged objects are pulled towards higher voltages, while positively charged objects are pulled towards lower voltages. Therefore, the conventional current in a wire or resistor always flows from higher voltage to lower voltage. Current can flow from lower voltage to higher voltage, but only when a source of energy is present to "push" it against the opposing electric field.

Oh well, we got close, but they still keep the electrical and mechanical units segregated in a kind of physics apartheid so that we never really know whether they belong to the same race of physical beings.

* $UI = mgv$.

* $K_J = \frac{\nu}{U} = \frac{2e}{h}$

For Josephson under **Mech a** we get $(s^{-1})(s\ m^{-2}) = (kg\ s^{-1})\ (s\ kg^{-1}\ m^{-2})$.
Under **Mech d** we get $(s^{-1})(s\ m^{-1}) = (kg\ m\ s^{-1})\ (s\ kg^{-1}\ m^{-2})$. Take your pick.

In the meantime, here is an interesting relationship between physics and geometry.

* $\hbar = (\pi\ e / c)\ (\pi\ e / \varepsilon_o)\ (\pi\ \%\ Ss / Ao\ As)^2$.
* $\hbar / (\pi\ e / c)\ (\pi\ e / \varepsilon_o) = (\pi\ \%\ Ss / Ao\ As)^2$
* $\hbar / m_p\ v = 1.111$ m

The units on the left in the second equation all cancel out leaving a pure number (according to **Mech a**). The geometry on the right comes out to 1.054^2, the ratio of the reduced Planck constant squared. The two factors in parentheses on the left give us the inverse of 1.054, which is slightly under 0.95. This elegant relationship says that we have two ratios: $(\pi\ e\ /\ c)$ and $(\pi\ e\ /\ \varepsilon_o)$ each multiplied by the same constant factor in geometry, and the first ratio is essentially a **proton per meter**. According to **Mech a** the two ratios on the left result in a proton times a velocity of around 5.68×10^{-8} m/s whereas the right side of the formula becomes a wavelength of 1.054^2 m = 1.111 m as the third equation shows. And that takes us in an interesting way back to the de Broglie wavelength (see **Wikipedia**, "Matter Wave"), and of course the Velocity Equation that falls out of it.

$$\lambda = \frac{h}{\gamma m_0 v} = \frac{h}{m_0 v}\sqrt{1 - \frac{v^2}{c^2}}$$

$$f = \frac{\gamma m_0 c^2}{h} = \frac{m_0 c^2}{h\sqrt{1 - \frac{v^2}{c^2}}}$$

(Here f = frequency.)

This equation is a profound contemplation of how energy unfolds itself in space/time. You can rearrange it in various ways and study it.

Recall our discussion of the odd mathematics behind the Rydberg number. The factor (10/9) is two factors of 1.054 away from unity. (1.11111...) / (1.054)(1.054) = 1. So by multiplying our dimensionless geometric configuration times the proton mass-voltage gives us Planck's constant. This derivation of Planck's constant shows the deep connection between charge quanta (e), energy quanta ($\hbar\ \omega$), and the geometry of circles and spheres, and patterns of numbers in abstract number theory. Do you also begin to see the deep importance of the % D-shift operator constant in the whole picture?

We can build a nucleon by simply amplifying the harmonics of our proto-proton's lens by increments of resultant proton mass. We see that since that resultant mass has the ratio of about ($\pi\ e$ Ao / c %), it also increments the charge e. But if we double the charge in a proton, it simultaneously brings another electron into the picture. This second electron will be pulled into an N = 0 negative energy orbit (below ordinary ground state) by the combination of opposite charge and mass. Thus you get two proton masses but only one extra charge. There's actually a little extra energy in there accounted for by an antineutrino.

Because of the huge energy difference between the nucleus and the outside world, it's hard to break nuclei. Because of the opposite forces of the charge, it's hard to make protons stick together by banging them into each other. If they get too close, they scatter off the EM field. Because of electron spin having two quantum states, up and down, electrons like to fit in up-down pairs when they form systems. Since a proton-neutron system has one of the electrons sucked in and held down in a negative orbital canceling the second proton's charge, there's really only one of two electrons out at play. So the nucleon doesn't feel comfortable until it has two proton-neutron pairs and hence two electrons to fill the ground state orbital. That makes helium the second stable atomic element, with two electrons, an up and a down, neatly filling in the (1s) orbital.

We know that it is possible to bombard a nucleon and split out protons or neutrons or other nucleonic "clusters", and that the heavier atomic nuclei will tend to spontaneously decay, splitting into lighter nuclei. How does this happen in our model? It's amazing and simple. The basic concept is the ground state. The single proton represents the apparent stable ground state of matter in our current reality. All other states seem to be excited states. (Actually, we know that helium has a lower ground state, which is why thermonuclear bombs are possible, but we will get to that later.) In any case, protons seem to be really, really stable. In fact, if one decayed, it would create a mini Big Bang. And if protons started rapidly decaying, there would not be much left of our physical world as we know it.

There's a lot of energy packed in there even though it doesn't seem so if you multiply a proton rest mass times c^2. That gives us just 1.5×10^{-10} J for a single proton. This usually only happens when a proton and an antiproton annihilate giving off twice that. (Whether it can happen like that is an issue under discussion in some quarters.) But in any case the proton left by itself does not decay, because the proton watering hole is very stable. It is so stable that if a "hopped up" proton splits open, the energy that spills out, which if the erstwhile proton is functioning as a nucleon, will be some multiple of a proton mass, will just replicate itself automatically. It is a fractal object. Let's say you create an isotope by knocking a neutron out of a nucleon. The nucleon will just drop down a quantum proton (neutron) energy level, and the space right next to it will shift up from the vacuum ground state by one neutron mass, which will then not have enough charge to hold its electron in a negative orbit, so the electron and some antineutrino energy will pop out, usually with enough kinetic energy for the electron to become a free electron.

That's about all there is to nuclear chemistry on the fission side. On the fusion side we have to boost up the energy level of the proton so that it moves up one or more harmonics. You see by now that this model does not require gluons or any strong force. We only use the EM and G forces at the proper scale and get the same effect. The whole issue of hot fusion or cold fusion will be resolved once we learn how to finesse protons to move up the scale as well as down. It takes pumping a lot of energy into a set of nucleons to get them to fuse in our low energy environment. Usually this happens in the cores of stars. But the practical side is that fusion of hydrogen into helium releases an extra bit of energy because the heavier nucleon is a bit more efficient at storing mass-energy than a lighter one due to the harmonic cooperation.

When a nucleon splits, it stimulates the vacuum state around it to produce another nucleon. It could be any kind of nucleon or anything at all (like a rampaging herd of elephants from *Jumanji*). But statistically it is simplest for it to manifest as a set of nucleons that adds up nicely to the nucleon(s) in the initial conditions when we account for neutrinos, photons, and other flotsam. We also know that we can stimulate the vacuum state directly (usually in close conjunction to other particles) to spit out matter-antimatter pairs. These pairs can then annihilate and return to the vacuum state. This is the same procedure done on a smaller energy scale. Our proton model has an antimatter mate made of a pair of anti-Unions with a quark in its lenticular vesicle. Given a chance it could build into anti-atoms of various types, but that's hard to do in our neighborhood where antiparticles tend to meet particles and then annihilate.

The Maharishi often used the principle of the bow and arrow to explain why meditation is a good preparation for action. (The flaw in his analogy is that it takes physical work to pull an arrow on a bow, but meditation is almost effortless.) In a 2-D space a bow is an energy system. When we pull the arrow back on the bow, we create negative energy. Negative energy is usually called potential energy. A ball raised high above the ground has gravitational potential energy. Although we may measure the distance as a positive distance, it is actually a negative distance from the earlier equilibrium orbit of the ball relative to the planet. When we let go, the arrow and the ball both convert their supply of potential energy into kinetic energy. (The neutron's 0-orbit electron is another example.) Potential and kinetic energy are thus mirrors of each other. We can say that potential energy is negative kinetic energy, or we can say that kinetic energy is negative potential energy.

You can work hard to pull the arrow back or find a way to finesse it. A crossbow might be fitted with a little crank to give you mechanical advantage for pulling the arrow back. The meditation method is a finessing technique, much easier than pulling on a long bow. Penelope's suitors could not even string the bow of Ulysses. Physicists trying to get fusion by banging particles together are using the brute force technique, like a meditator trying to transcend by screaming his mantra as loud as he can. It can be done, and some people call this "primal scream therapy", but it exhausts you along the way, is not very efficient, and may bring unwanted side effects such as a sore throat.

We know that the vacuum state is stable as a ground state (relative to our ordinary level of perception). We know that protons are also stable, and so is the periodic table until you reach the unstable heavy elements and of course disregarding unbalanced isotopes. We also know that all particles are ultimately unstable. You can annihilate a proton with an antiproton. Actually, as a Feynman diagram shows, you don't ever really annihilate things. They just scatter and change directions in space/time or change states. An antiproton is a proton going backwards in time. It bounces off an energy field in the vacuum state and changes directions in time. It does not really "annihilate" except from a certain observer perspective. Virtual pair production and annihilation is an example of a quantum bubble at the smallest scale of creation. A decay process can be viewed the same way. Instead of viewing it as a nucleon splitting (or a heavy elementary particle decaying) we can see it as something bouncing off the vacuum state in space/time. If we map time horizontally and space vertically on a piece of paper, we draw a decay as a Y shape tilted to the right by 90 degrees (--<). If we flip it around by 180 degrees (>--), it looks like fusion. Thus, fusion is just fission run backwards in time. If the laws of physics in our world are really isotropic, it should not make any difference which way we orient the Y in space/time.

Demonstration: Draw a Y on a piece of paper and place it on the table. You can turn the paper around, or you can walk around the table. It's your choice, but the bottom line is that you have shifted your viewpoint as observer when you look at the Y from a different angle. We now have a model that shows how fission works from a single proton vibrating like a super-string at various harmonics. Walk around and look at it from the fission side. Then walk around and look at it from the fusion side. Or use a mirror.

The current situation is that physicists see fission and fusion happen, but do not fully understand the mechanism. So they are banging their heads against a wall. They think they have to bang particles together to get them to stick together. This is trying to do it the hard way. In our model we see that fission takes place when a heavier nucleon is disturbed and it releases energy. Since that energy can only come in units of proton mass, it means that the nucleon splits like an amoeba. Each fragment is a smaller (energy-wise) but complete amoeba. Each nucleon is a proton at some quantum energy level of $[n\ (m_p)]$, not a little bundle of billiard balls. We were supposed to have left billiard ball models behind a long time ago.

Therefore, we do not have to hit the nucleons to break them, nor do we have to smash them together to get them to fuse. We understand that the energy in the proton is in a resonating harmonic state, it is a Standing Wave. We can tease it to go up or down with resonance, the same way we modulate electron orbits to get various laser effects at precise frequencies. We just need the right "mantra" and the right way to use it. For example, if we have a container holding dense hydrogen plasma, there are lots of protons zipping around incoherently. A properly applied magnetic field can get them oscillating the way photons do in a resonant cavity. We then build up a macroscopic quantum coherent wave that multiplies the protons into a large macroscopic proton. This is equivalent to enlivening the "proton" value of the vacuum state in the vicinity of where we want fusion to take place. Now we adjust it up to the frequency of the nucleon we want -- say helium. We get the container of protons all resonating in that way and bingo, they start glomming up into helium nuclei. This reaction can be controlled the same way a laser can be controlled. The photons originally are single photons. When they lase, they glom together like bosons into macroscopic photon waves. We only need 4

m_p wave packets to get helium atoms.

It may help if the shape of the container is such that it fits the shape of the harmonic wave of the proton's lens when it is in the helium state. To find this we need to calculate the shape it takes inside the Union pair's lenticular vesicle. The temperature of this nuclear reaction may be high, but it is nothing like the stellar core temperatures that happen in nature because we can finesse it with technology. Remember that the laser does **NOT** occur normally in nature. Stimulated emission is something Einstein dreamed up as a thought experiment. He examined the normal process of emission and absorption closely and came up with the idea of stimulated emission. The word laser is just an acronym for "**l**ight **a**mplification by **s**timulated **e**mission of **r**adiation". Many years after Einstein's idea was born scientists discovered how to apply this notion in practical ways and the physical laser with its many applications was born. If there is stimulated emission, there is also stimulated absorption for photons. The same is true of nucleons. The principle of deliberate stimulated emission and absorption is a general principle of physics. It took a few years to get from Einstein's idea to a real laser. It may take a few years (or less) to get from the idea of stimulated emission of particles (PASEP = particle amplification by stimulated emission of particles).

The vibration of the magnetic pulses within plasma contained in a magnetic plasma bottle is what I call a "Jitterbug Tokamak". You get some good rock music going, and the dance floor is soon filled with people rocking and rolling in synchrony with the music. This is fusion by entrainment, or perhaps we should say, enchantment.

In our next chapter we will go down deeper into the subatomic world and look at the leptons and the hadrons other than the proton, and the bosons. We know now that quark theory is just a classification system for identifying particles in a zoo of resonances, and gluons are not necessarily necessary. Nevertheless, the quark classification scheme may turn out to be quite useful after all. We also need to take a look at things such as gravitons and Higgs particles as well as all the hypothetical super-particles called for in super-symmetry theory.

A Further Note on the Significance of the Spatial Constant R

In this chapter we discovered the remarkable coincidence that according to the interpretation **Mech a**, the mass of a proton can be described as π times the unit charge e times one meter divided by the speed of light c. We called that unit meter R, the Unit Radius. The nature of electromagnetic phenomena suggests that R has to do with the magnetic field **B**, which is measured as Wb/m^2 (webers per square meter.) The reason **B** has only "virtual" units is that it is totally determined by the current. Current is in terms of newton-meters, which when considered with respect to a unit meter of distance leaves us with newtons, some value of force. So magnetic force varies directly as electric force (current per distance). In this light perhaps we should establish a magnetic constant:

* $(b)^2 = 1$ Wb.

This gives us:

* $m_p = \pi\, e\, b / c$.

Thus b represents the magnetic component of the proton, just as e represents the unit charge q. According to T.E. Bearden, q really should be written as $m_q\, f_q$, where m_q represents the mass component in kg units, and f_q represents the time domain component (Herzian) expressed in s^{-1}. This fits nicely with the Maxwellian relation:

* $(\varepsilon_o)(\mu_o)(c^2) = 1$.

Combining the two equations gives us:

* $m_p\, c^3 = \pi\, e\, b / (\varepsilon_o)(\mu_o)$.

* $m_p\, c^3 = \pi\, (e / \varepsilon_o)\, (b / \mu_o)$.

The right hand side here becomes π times the ratio of the quantum charge to the electric constant of the vacuum times the ratio of the quantum magnetic vector to the magnetic constant of the vacuum.

Interestingly the value b = 1 meter = R and the derivation of the weber unit (Wb) comes up in the definition of the ampere.

* $\mathrm{A} = 2\times10^{-7}$ N / m.
* $b = 2\times10^{-7}$ N / A.

When two parallel current-carrying very thin wires separated by a vacuum gap of b generate a magnetic force per b on each wire of 2×10^{-7} newtons, that is defined as an ampere. The total area involved in this determination is thus b^2, or 1 Wb.