EINSTEIN'S GEOMETRY

In 1905 Einstein noticed that space and time are a pair of opposites, and the total can go to zero.

The cosmological model popular at the present time is known as the Big Bang. Since I am not very enthusiastic about that model I was asked to engage in a debate with someone in England. Among my remarks I told him that as I see it, the Big Bang model takes *non-existence* for granted, and thus gets the Universe out of *nothing*. Whereas what I see as my model takes existence for granted but *not space and time*.

Now if we take existence for granted, but not space and time, we see at once that *that existence* must be changeless (not in time), infinite, and undivided (not in space). So that seeing that existence in space and time must be a mistake.

One can't mistake one's friend for a ghost without [first and always] seeing one's friend – because that friend must show through in the [mistaken] ghost. [Similarly] the Changeless, the Infinite, and the Undivided must [first and always] show through in the physics which we see. As I see it, it shows through as a "wind-up" against the mistake.

What is the Universe made of? It is not made of forces. For every force there is an equal and opposite force – so the total force goes to zero. Also the total momentum goes to zero. And the total electrical charge goes to zero. (It is interesting that they all go to zero). We learned from Einstein in 1905 that space and time are opposites and that they can also go to zero. So, what is the Universe made of? It is made of energy. And what we see as mass and energy, I see as the "wind-up" against the mistake.

There were some physicists in India long ago who built their physics into their language and left it there for all to see. They said the whole Universe is made of energy, and that even if we divide it up into mass and energy, as we all usually do, it is still [really] only energy (Shakti).

Swami Vivekananda translated that Sanskrit to Nikola Tesla at Sarah Bernhardt's party in New York on the thirteenth of February, 1896. He then asked Tesla if he could show that what we see as matter can be reduced to potential energy. Tesla gave that information to his close friend Mileva Mari, Einstein's first wife and she put it into the most famous equation ($E=mc^2$) that ever hit the fan. It says that what we see as mass is only energy. That is the information that I conveyed to Gargi (Marie Louise Burke) first by word of mouth, and then in writing shortly before she died.

But the Einstein's equation has been misinterpreted over this entire planet to mean that mass can be *converted* into energy. No! That would be E+m=K or the sum of mass and energy equals a constant. But the Einstein's never made that mistake. What we see as mass (or matter) is simply energy.

Now if the Universe is made of energy we need to know what energy *is*. Richard Feynman once said that "it is important to realize that in physics today we have no knowledge of what energy *is*." But as I see it, energy is simply the "wind-up" against the mistake of seeing the Changeless, the Infinite, and the Undivided as in space and time.

As I see it, the wind-up of the Infinite against the appearance of smallness is the rest mass of the electron. It is wound up *only* against smallness. The wind-up of the Undivided against the appearance of dispersion is the rest mass of the proton. It is wound up against smallness but *also* against the dispersion of the particles through space. And, of course, the electron and the proton both show inertia because they are both wound up against time as well as against space. Because they are wound up differently they can't sit together and disappear. That is the reason we see a Universe of hydrogen. The hydrogen appears to be the wind-up against the mistake. And all the rest of the chemical elements are made out of that hydrogen.

I once asked Feynman if we could consider the rest mass of the proton as just the energy represented by its separation in the gravitational field from all the rest of the matter in the observable Universe. He replied, "if the mass of the Universe is the critical mass, it looks as though you are right." Then he added, unasked, "the electron is purely electrical; the proton is not." The electron is wound up *only* against smallness.

As I see it, this is why we see a Universe of hydrogen and not something else. And, because the Undivided shows through the hydrogen falls together by gravity into galaxies and stars.

This information was not available in Swami Vivekananda's day; and I failed to get it to Gargi before she died.

As the hydrogen falls together by gravity to galaxies and stars its radiation drives the cosmological expansion. This expansion imposes a boundary to the observable Universe – where the speed of recession reaches what is known in the trade as the speed of light. All radiation going through that region near the border, where the rest mass of the particles is seen to be very low, will be so often picked up and re-radiated that it will be thermalized to the microwave background radiation discovered by Pensias and Wilson in 1965.

The other interesting thing about the border is that through Heisenberg's Uncertainty Principle it recycles the hydrogen and the negative entropy back in.

As the mass of the particles approaching the border is seen to go down by redshifting, approaching zero, their momentum is also seen to go down, approaching zero. With that our uncertainty in that momentum is going down to zero [too]. However, by Heisenberg's Uncertainty Principle, our uncertainty in their positions must go [up] and approach totality. [Therefore] they must recycle from the border. They must "tunnel" back in.

The observational evidence for the recycling from that border is that the Hubble telescope reports that there is more than enough hydrogen in those inter-galactic voids to make all the known galaxies. Where else could this hydrogen come from?

I think that the negative entropy for everything happens in this Universe is recycled with the hydrogen from that border, and that we only *think* that we are the doers.

John L. Dobson, Hollywood, California
February 28, 2008

FOOTNOTE FOR INDIA

Through the veiling power of Tamas we fail to see the Changeless, the Infinite, the Undivided.

Through the projecting power of Rajas we see the changing, the finite, the divided [Universe] by mistake.

Through the revealing power of Sattva we see the Changeless in the changing (inertia); the Infinite in the finite (electricity); and the Undivided in the divided (gravity).

FOOTNOTE FOR THE U.S.

We get our negative entropy from sunlight through the courtesy of the chloroplasts and the mitochondrias. The Sun gets its negative entropy [from hydrogen] recycled from the border. The chloroplasts take the oxygen out of the carbon dioxide and water and feed us the glucose and the oxygen. But we don't even know how to put the oxygen back in. The mitochondrias do it for us, and we think we're so smart. We don't do anything. All the negative entropy comes from the border.

As Sri Ramakrishna once said, "He is truly free, living even in this body, who knows that God is the doer, and that he is the non-doer."

J. D. 2008

In a lecture titled, "*The Absolute and Manifestation*", delivered in London in 1896, Swami Vivekananda said:

"This Absolute (a) has become the Universe (b) by coming through time, space, and causation (c). This is the central idea of Advaita. Time, space, and causation are like the glass through which the Absolute is seen, and when it is seen on the lower side, It appears as the Universe."

(a) - The Absolute

(c) -

Time

Space

Causation

(b) the Universe

EINSTEIN'S PHYSICS OF ILLUSION

(From a lecture delivered in the auditorium of the Vedanta Society of Berkeley on October 12th, 1980, by John Dobson of the San Francisco Sidewalk Astronomers.)

Some of you may think from the title, "Einstein's Physics of Illusion", that I'm going to be talking about the physics which underlies what we think of as magic. That is not what I expect to talk about. Some of you may think that I suspect that Einstein had some special physics of illusions. If he did, I don't know anything of it. Instead, what I want to do, with Einstein's help, is to trace our physics all the way back to "square one", and to find out whether, underlying it, there may possibly be something akin to magic.

George Valens has written a charming book called "The Attractive Universe". It is subtitled "Gravity and the Shape of Space", and on the very first page he says that when a ball is thrown straight up, after a while it comes to a stop, changes its direction and comes back. He says it looks like magic, and probably it is. Now what he is taking for granted is that it should have gone off on a straight path without any change in speed or direction. But you see that *also* would have been the result of magic. We do *not* understand in physics *why* the ball comes back. But we *also do not* understand in our physics why the ball should have continued without any change in its direction or its speed.

Now in the title, and in the remarks that I have made so far, what I mean by magic or illusion is something like what happens when, in the twilight, you mistake a rope for a snake. This sort of thing was analyzed very carefully by some people in North India long, long ago. They said that when you make such a mistake there are 3 aspects to your mistake. First, you must fail to see the rope rightly. Second, instead of seeing it as a rope you must see it as something else. And finally, you had to see the rope in the first place or you never would have mistaken it for a snake. The reason you mistook a rope for a snake was because the rope was 3 feet long, [it also had the same diameter of a snake] and you are accustomed to 3 foot long snakes.

But before I speak further about illusion, I want to say a few words about what we *do* understand in physics, and I also want to point out a few gaps in that understanding. When we talk about the Universe, or when we look out and see it, what we see is that the Universe is made out of what we call matter. It is what we call a material Universe. What we want to do, first of all, is to trace that material back, not quite to "square one", but to "square two" at least. We want to find out whether we can think of all these things which we see as being made out of matter, as *really* being made out of only a few ingredients. And the answer is yes we can. Long ago the chemists pointed out that all these things that we see are made out of not more than 92 ingredients. Those are the 92 chemical elements of the Periodic Table.

In 1815 it was suggested that all those different chemical elements were probably made out of hydrogen. That was "Proust's Hypothesis", because in those days no one knew how to do it. But now in modern times we *do* know how to do it, and we *do* know that that is what actually happens. All the other chemical elements are actually made out of hydrogen, and the process happens in the stars.

The Universe, even as it is today, consists mostly of hydrogen. And what it is doing is falling together in the gravitational field. It falls together into galaxies and stars, and the stars are hot. Falling together by gravity is what makes them hot. And they get hot enough inside so that the hydrogen is converted into helium [by fusion].

Now helium has a very strong atomic nucleus, and so the main line in building up the atoms of the Atomic Table goes this way: First, 4 hydrogen atoms fuse to make one helium atom. Then 3 helium atoms fuse to make one carbon atom. Two helium atoms won't stick. That would be beryllium 8, but there is no beryllium 8 because it won't last. But 3 helium atoms *will* stick, and that is carbon. Four helium atoms make oxygen. Five is neon. That is the way it goes in the stars; all the other nuclei are built out of helium nuclei. Six makes magnesium. Then silicon, sulfur, argon, calcium, titanium, chromium, and iron.

In big stars it goes like this. But in small stars like our Sun it goes only up to carbon or possibly carbon and oxygen. That is where our Sun will end – at about the size of the Earth, but with a density of about 4 concrete-mixing trucks stuffed inside a one-pint jar.

Larger stars get too hot by their own gravitational squeeze, and the carbon cannot cool off like that. They go right on to oxygen, and so on, until they get, in the center, to iron.

Now iron is the dumbest stuff in the Universe. There is no nuclear energy available to iron – nothing by which it can fight back against gravitational collapse. So gravity collapses it, but this time into the density of a 100,000 aircraft carriers squeezed into a 1-pint yogurt box. Yes, 100,000 aircraft carriers in a 1-pint box. And when it collapses like that the gravitational energy that is released to other forms blows the outer portions of the star all over the galaxy. That is the stuff out of which our bodies are made. Our bodies *are all made out of star dust* from such exploding stars.

We do know that the main ingredient of the Universe is *hydrogen* and the main useable energy in the Universe is *gravitational*. We know that the name of the game is falling together by gravity (hydrogen, falling together by gravity). But what we *do not know* is *why* things fall together by gravity. We *do know* that the stuff out of which this Universe is made is hydrogen, but we *do not know* from

where we get the hydrogen. We *also know* that the hydrogen is made of electrical particles, protons and electrons, and we know that the total electrical charge of the Universe is zero. But we *do not know*, you see, *why* it is made of electricity. We do not know why it falls together, and we *do not know why*, when things are moving, they should coast. There are these gaps in our understanding. We know *how* things coast. We know *how* things fall. We know *how* the electrical particles behave, but we don't know any of the why questions. We don't have any answers to the why questions.

What I want to talk about next is a discovery made by Albert Einstein when he was 26 years old and working in the Patent Office in Bern. Then I want to talk about the consequences of that discovery and, through that, I want to trace our physics back, if possible, to answer those why questions.

Einstein noticed that we cannot have an "objective" Universe in only 3 dimensions. We all talk about "3D". Hardly anybody talks about "4D". But the Universe is really 4D. It is not possible to have a Universe of space without a Universe of time. It is not possible to have space without time, or time without space, because *space and time are opposites*. I don't know that Einstein ever used the language that space and time are opposites, but if you look at his equations, it is very, very, clear that *that's exactly what they are*. If, between two events, the space separation between them is the same as the time separation between them, *then the total separation between them is zero*. That is what we mean by opposites in this case. In electricity if we have the same amount of plus charges as we have of minus charges, say in the same atom or the same molecule, then that atom or that molecule is neutral. There is no charge seen from the outside. Likewise here. If the space separation between two events is just the same as the time separation between those two events, then the total separation between those two events is zero.

I'll give you an example. Suppose we see an exploding star, say, in the Andromeda galaxy. There's one going on there right now. It's been visible for about a month or so. Now the Andromeda galaxy is 2.25 million light years away, and when we see the explosion now, we see it as it was 2.25 million years ago. You see, the space separation and the time separation are the same, which means that the total separation between you and what you see is zero. The *total* separation, the *real* separation, the *objective* separation, that is, the separation as seen by *anybody*, between the event which you see and the event of your seeing it – the separation between those two events is *always* zero. What we mean when we say that the space and time separations between two events are equal is that light could get from one of those events to the other in a vacuum.

We see things out there, and we think they're really out there. But, you see, we cannot see them when they happen. We can't see anything exactly when it happens. *We see everything in the past.* We see everything a little while ago, and always in such a way that the "while ago" just balances the "distance

away", and the separation between the Perceiver and the Perceived remains always at zero.

As soon as Einstein noticed that we cannot have a Universe of space without a Universe of time and vice versa, and that they are both connected in this way, and that the only way to have an objective Universe is in *four* dimensions, and not in two or three or one – as soon as he noticed that, he had to re-do our physics.

Now Relativity Theory is a geometry theory. It is not something else. It is a geometry theory. It is about the geometry of the real world. I'm sure that most if not all of you have been exposed, somewhere along your educational careers, to the geometry of Euclid. His geometry is in two dimensions and in three, but he didn't have any idea about introducing a fourth dimension. His geometry is a *theoretical* geometry about a *theoretical* space which does not, in fact, exist. Newton based his understanding of physics on that understanding of geometry, and Newton's physics is a *theoretical* physics about a *theoretical* Universe which *does not*, in fact, exist. We know now, you see, that Euclid was *wrong* in his understanding of geometry, and that Newton was likewise wrong in his understanding of physics.

We had to correct our physics in terms of Einstein's re-understanding of geometry. It was when Einstein went through our physics with his new understanding of geometry that he saw that what we had been calling matter or mass or inertia is *really just energy*. It is just potential energy. It had been suggested a few years earlier by Swami Vivekananda that what we call matter could be reduced to potential energy. In about 1895 he wrote in a letter that "he is to go next week to see Mr. Nicola Tesla who thinks he can demonstrate it mathematically." But without Einstein's later understanding of geometry, Tesla apparently failed to do it.

It was from the geometry that Einstein saw that what we call rest mass, that which is responsible for the heaviness of things and for their resistance to being shaken, is really just energy. Einstein's famous equation is $E=mc^2$. Probably most of you have seen that equation. It says that for a particle at rest, its mass is equal to its energy. Now those of you who read Einstein know that there is no c^2 in that equation. The c^2 is in there just in case your units of space and time measurement don't match. If you have chosen to measure space in an arbitrary unit and time in another arbitrary unit, and if you have not taken the trouble to connect the two different units, then, for your system, you have to put in the c^2. If you are going to measure space in centimeters, then time must *not* be measured in seconds. It must be measured in "jiffies". A "jiffy" is the length of time it takes light to travel one centimeter. Astronomers are rather broad minded people, and they have noticed that the Universe is quite a bit too big to be measured conveniently in centimeters, and quite a bit too old to be measured conveniently in seconds. So they measure the time in years and the distance in

light-years, and these units correspond. That c in the equation is the speed of light in your system of units, and if you've chosen years and light-years then the speed of light in your system is 1. And if you square 1, it is still 1 and the equation does not change. It becomes E=m. The equation simply says that energy and mass *are the same thing*.

Our problem now is that if we're going to trace this matter back and find out what it is, we have first of all to find out what kind of energy makes it massive. Now we only have a few kinds of energy to choose from. Fortunately, there are only a few: gravitational energy, kinetic energy, radiation, electricity, magnetism, and nuclear energy. But I must allay your suspicion that nuclear energy might be very important. It is not. The nuclear energy available in this Universe is very small. If all the matter in the Universe began as hydrogen gas and ended as iron, then the nuclear energy released in that change (and that is the maximum nuclear energy available) is only 1% of what you can get by letting that hydrogen fall together by gravity. So nuclear energy is *not* a big thing, and we have only 5 other kinds of energy to choose from in order to find out what kind of energy makes the primordial hydrogen so hard to shake. That, you remember, was our original problem.

What we want is potential energy because the hydrogen is hard to shake even when it is not doing a thing. So what we are really after is potential energy and that restricts it quite a bit more. Radiation, for example, has nothing to do with that. Radiation never stands still. And kinetic energy never stands still. Even magnetic energy never stands still. So we are left only with electricity and gravity. There are only two. We don't have any choice at all. There is just the gravitational energy and the electrical energy of this Universe available to make this Universe as heavy or as massive as we find it.

Now I must remind you here that the amount of energy we are taking about is very, very large. It is [the equivalent of] 500 atom bombs per pound. One quart of yogurt, on the open market, is actually worth 1,000 atom bombs. It just so happens, though, that we are not in an open market place. We live where we have no way to get the energy of that yogurt to change form into kinetic energy or radiation so that we can do anything with it. Its energy is tied up in there in such a way that we can't get it out. But right now we are going to talk about the *possibility* of actually getting it out. We want to talk about how this tremendous energy is tied up in there. We want to talk about how this matter is "wound up".

Let's first talk about watches. We all know how they are wound up. They are wound up against a spring. Now when we wind up a watch what I want to know is whether it gets heavier or lighter [or perhaps stays the same]. If we have a watch and we wind it up, does it get harder to shake it or any easier? The answer is that it gets harder to shake because when we wind it up we put more potential energy into it, and energy is the *only* thing in the Universe that is hard to

shake. OK. So now we want to know in what way the whole Universe is "wound up" to make it so heavy and hard to shake. We already know that it must be wound up against electricity and gravity. The question is: how is it wound up?

Well, we need to know some details on how to wind things up. How, for instance, do you wind up against gravity? You wind up against gravity by *pulling things apart* in the gravitational field. If you do so, they all want to go back together again. So if the entire Universe were to fall together into a single blob, the gravitational energies that would be released to other forms of energy would be 500 atom bombs per pound. The Universe is "wound up" on gravitational energy *just by being spaced away from itself* against the gravitational pull inward. And this turns out to be just the right amount. It really does account for the fact that it is 500 atom bombs per pound.

How do we wind up against electricity? We do it by pushing like charges toward each other. If you push two electrons [both have a negative charge] towards each other you have to do work, and it gets heavier or more massive. Similarly, if you take a single electric charge and make it very small, since you are pushing a like charge towards itself, it too becomes more massive. It just so turns out that the work that is represented by the smallness of all the teeny-weeny particles that make up the hydrogen atoms and all the rest of this stuff is – once again – exactly 500 atom bombs per pound. Some of you might assume that it should come out to a total of 1000 atom bombs per pound – 500 gravitational and 500 electrical. No, it is only 500 atom bombs per pound because winding the Universe up one way is *exactly the same thing* as winding it up the other way. Coins have two sides, heads and tails. You cannot make coins with only one side. For every heads there is a tails. Plus and minus charges are like heads and tails. Space and time are like heads and tails. And electricity and gravity are like heads and tails. You cannot space things away from each other in the gravitational field without making them small in the electrical field.

I think that we are ready now to attack the consequences of this new understanding of physics. We want to find out whether, through this understanding, we can trace our physics all the way back to square one, to see whether, underlying it, there may be something akin to magic. We want to know *why* things fall. We want the answers to our why questions.

I am going to draw you a quick map. This is a picture of the physics before Einstein. Then I will correct it. The M is for mass, the E is for energy, the S is for space, and the T is for time:

M	**S**
E	**T**

In the last century we thought that mass was one thing and energy was another. We thought that space was one thing and time was another. In our present understanding of physics that won't work anymore. Space and time are just two sides of the same coin. Mass and energy are also just two sides of the same coin. And so there is no line through there:

M E	S T

There is no line between mass and energy or between space and time. We just talked about the way in which the Universe is wound up in order to make the particles massive. They are wound up against *space*. They are spaced in against the electrical field and they are spaced out against the gravitational field, which means that what we call matter and energy are also nothing but geometry, and the line down the middle goes too. But when these lines go, the picture goes too.

When the lines of demarcation between mass and energy and space and time are obliterated we do *not* have a model of a physical Universe. Every definition in our physics, every concept in our physics, requires measurements of length, or of time, or of mass – one or more of these measurements. And without discrimination between length, time, and mass we have no way to measure anything in physics, no way to define anything in physics. Our model of the Universe does not hold up when we examine it from the standpoint of Einstein's equations. What we are left with I shall indicate here by a question mark:

?

What is it that exists behind our physics? Relativity Theory does not say exactly what it is, but our task is to find it out if we can.

First let us understand a little bit about what we call "causation" in physics. What do we mean when we say that one thing causes another in physics? We mean that there is a transformation of energy from one form into another. For instance, if the hydrogen falls together to form galaxies and stars, the gravitational energy is first converted into kinetic energy in the falling; and then the kinetic energy is converted into radiation [as the friction between the moving particles is converted into heat] when the hydrogen falls together into stars. When radiation from stars like our Sun is picked up by all these green leafy things which we call plants and trees it is converted into electrical and magnetic forms.

So all these things happen by changes in energy, by changes in the *form* of the energy. The *amount* of energy does *not* change. There is no such animal as the generation of energy [from "nothing"]. The amount of energy, whatever it is, seems to be completely unchangeable. That is one of our *most basic* observations in physics. And what we mean by "causation" is changes in the form of this energy. Matter itself is energy, and what we mean is that when something happens, whether it is hydrogen being converted into helium or whatever it is, there is some change in the form of the energy.

The Universe cannot arise by this kind of "causation" simply because in any such change the amount of energy at the end is never any greater than the amount at the start. You cannot manufacture gold by re-molding gold. You can never finish with more than you started with.

With this understanding of "causation" in mind I want to go back to our question mark. We want to see whether we can get some idea of the nature of what the equations of Relativity Theory say must exist behind the Universe of our observations. We want to see how, from that nature, we come to the world of our perception.

When we look at this question mark what we see is that it *has* to be beyond space and time. Our physics is on "*our*" side of space and time, if you like, but Einstein's equations say that *behind* our physics there is this question, "What is it?" *And we know that it has to be beyond space and time.* For that reason we can make a negative statement about what "it" is. If it is beyond time, it must be Changeless, because only in time could we have change. And if it is beyond space, it must be both Undivided and Infinite, because only within space could we have things finite and divided. Without space you could not break a cookie in two. Without space you could not have cookie crumbs. And without time you could not do anything, because you couldn't have any kind of change. So whatever exists behind this Universe must be Changeless, Infinite, and Undivided.

Changeless

? = Infinite

Undivided

The curious thing is this, that what we all see is apparently not changeless, not undivided, and not infinite. It is obviously finite. The teeny weeny particles that make up the hydrogen atoms and all the rest of these atoms and molecules are really miniscule. The number of hydrogen atoms required to make a single drop of water is equal to the number of drops of water in 1 million cubic miles of ocean. They are certainly finite. And this matter is divided up into

atoms. Why should it be so divided? It is also continually changing. You can look anywhere.

So what we see is changing, finite, and divided. But now comes the question: *By what kind of causation could we get from the Changeless to the changing? By what kind of causation could we get from the Infinite to the finite? And by what kind of causation could we get from the Undivided to the divided?*

We haven't proved that we can get there by magic, but we have proved that we can't get there any other way. We cannot get there by the causation of our physics because that would require that we change the Changeless into the changing, that we divide the Undivided, and that we make the Infinite, finite. As I say, we can prove that we cannot get there any other way, but we have not yet proved that we can get there by magic. So now I want to ask: What happens if we look at this problem from the standpoint of what I will call "apparitional causation"? My favorite word for this is not quite magic. It is not quite illusion. It is "apparitional causation". It is the kind of thing you do when you mistake a rope for a snake.

Could we have "mistaken" the Changeless for the changing? Could we have "mistaken" the Infinite for the finite? Could we have "mistaken" the Undivided for the divided? That is now the question.

So let's go back to a very old analysis of "apparitional causation" to see if such a mistake could actually give rise to our physics. We want to know whether "apparitional causation" can answer our why questions.

When we mistake one thing for another there are three aspects to our mistake – three consequences if you like. First, *we must fail to see it rightly.* In this case we must fail to see the Changeless, the Infinite, and the Undivided. That is fine as we have certainly failed to do so. Second, *we must see something else in its stead*, and that "else" must be different. Well, so it is. What we see is changing, finite, and divided. Finally, you must remember, we had to see the "actual" thing to start with. For example, if we had not seen a 3-foot rope we would not have mistaken it for a 3-foot snake. If you happen to mistake your friend for a ghost, and if your friend is tall and thin, then the "apparitional" ghost will be tall and thin. But if your friend is roly-poly then you will see a roly-poly ghost. Had you not *seen* your roly-poly friend you certainly would not have see a roly-poly ghost [or anything] at all.

If, then, our physics has arisen by "apparition", then the Changeless, the Infinite, and the Undivided *must show through* in the physics. Yet isn't that exactly what we see? The Changeless shows through as *inertia*. The Infinite shows through as *electricity*, and the Undivided shows through as *gravity*. Had we not seen the Changeless ["to begin with"] it would not have shown up in our physics. It is the Changeless which we see and as a consequence that

Changeless shows up in what we see. That is the reason why things coast. That is what we see as inertia. That is what we call mass.

Likewise, in order to see the Undivided as the divided we still had to see the Undivided, and that is what we see as gravity. It is a direct consequence of having seen the Undivided. You cannot see a Universe of particles, all spaced out, without having them all fall together again. You cannot make the mistake of seeing it as divided without having the ["real"] undividedness show. And finally, you cannot make the mistake of seeing the Infinite broken up into teeny weeny particles without the consequence of seeing those particles as electrical. Probably some of you don't know quite enough physics to understand what I mean by that. Every electrical particle has energy *just because of its smallness.* If you let it get bigger its electrical energy would go down. And if it could get infinitely big its electrical energy would go to zero. So you can think that electrical energy is just the tendency [of a tiny particle] to go back to the Infinite, just as gravitational energy is just the tendency to go back to the Undivided.

Now these two "things" [gravity and electricity] are really the same thing. The wind up against gravity by being *spaced out* is *exactly the same thing* as the wind up against electricity by being *spaced in.* And these two things make up the rest mass. They make up the thing called inertia. It is the electro-gravitational energy of the particles which we see as their rest mass. It is that energy which is hard to shake.

It is *impossible* to see an apparition of this sort without having it wound up. It is *not possible* to see this Universe except as wound up. The Infinite and the Undivided must necessarily show up as the electrical and gravitational energy. ***There is no such thing as matter.*** There is only this energy, and the energy is [equivalent to] 500 hundred atoms bombs per pound. This energy is the consequence of the apparition. It is the yearning for [infinite] freedom in the "apparently" finite. It is the yearning for the undivided in the "apparently" divided. And it is the yearning for the changeless in the "apparently" changing.

With the help of this notion of "apparitional causation" suggested by Einstein's equations we are able, you see, to trace our physics all the way back to "square one" to answer those why questions. With Einstein's help we are able at last to understand why matter falls, why it coasts, and why it is made of discrete electrical particles.

We have to *look at this very, very carefully.* We have to completely change our understanding of geometry. Our native understanding of geometry, or rather, our native misunderstanding of geometry is a *genetic* mistake. We all make this mistake because it was *never necessary not to.* It was never necessary in the long past history of our race for us to see space and time correctly. It never was. It was *definitely necessary* that we have at least a dog's understanding of a three-dimensional space, otherwise we wouldn't have had

offspring and the entire species would have all died out. Regardless, it was never necessary to understand that space and time are opposites. It was never necessary to understand the origin of gravity, or the origin of inertia, or even the fact that the atoms are made of electricity, or the fact that there are 92 chemical elements. It is not necessary to understand any of these things in order to have offspring and have the perpetuation of the species go on. It works all right through many, many mistakes.

You must not think that just because it is a native perception on your part that it is "true". That has *nothing* to do with it. Just look back and see how you got to be the way you are. You have got to think that it is all a mistake, and you have to notice that our genetic misunderstanding of space and time is at the *root* of it. That is where the root is. It is within our mistaken notions of space and time that we see this Universe just the way we do. So what we have to do is to straighten out our understanding.

Space is *not really* that which separates the many. It is that which *seems* to separate the One. There is only One. And in that space that Oneness shines, *therefore* falls whatever falls.

Space is *not really* that in which we see the finite. There is no finite. Space is that in which the Infinite appears as small, and in that space that vastness shines, *therefore* bursts whatever bursts. Every electrical particle wants to become infinite, *therefore* shines whatever shines.

Time is *not really* that in which we see change. Time is that in which the Changeless *seems* to change, and in that time the Changeless shines. *Therefore* rests whatever rests, therefore coasts whatever coasts.

Our problem is to discriminate between what is behind this notion of space and time and what is within it. Our problem is to discriminate between the "real" and the make believe.

BERKELEY PUBLIC LECTURE

EINSTEIN'S PHYSICS OF ILLUSION

~

JOHN DOBSON

OF THE

San Francisco Sidewalk Astronomers

WILL SHOW THAT IN THE LIGHT OF EINSTEIN'S DISCOVERY IN 1905
THERE EXISTS THE CLEAR POSSIBILITY OF EXPLAINING
THE ORIGIN OF ELECTRICITY, GRAVITY, AND INERTIA.

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EINSTEIN'S PHYSICS OF ILLUSION

(From a lecture delivered in the auditorium of the Vedanta Society of Berkeley on October 12th, 1980, by John Dobson of the San Francisco Sidewalk Astronomers.)

Some of you may think from the title, "Einstein's Physics of Illusion", that I'm going to be talking about the physics which underlies what we think of as magic. That is not what I expect to talk about. Some of you may think that I suspect that Einstein had some special physics of illusions. If he did, I don't know anything of it. Instead, what I want to do, with Einstein's help, is to trace our physics all the way back to square one, and to find out whether, underlying it, there may possibly be something akin to magic.

George Valens has written a charming book called The Attractive Universe. It is subtitled Gravity and the Shape of Space, and on the very first page he says that when a ball is thrown straight up, after a while it comes to a stop, changes its direction and comes back. He says it looks like magic, and probably it is. Now what he is taking for granted is that it should have gone off on a straight path without any change in speed or direction. But you see, that *also* would have been the result of magic. We do *not* understand in physics *why* the ball comes back. But we *also* do not understand in our physics why the ball should have continued without any change in its direction or its speed.

Now in the title, and in the remarks that I have made so far, what I mean by magic or illusion is something like what happens when, in the twilight, you mistake a rope for a snake. And this sort of thing was analysed very carefully by some people in North India long, long ago, and they said that when you make such a mistake there are three aspects to your mistake. First you must fail to see the rope rightly. Then, instead of seeing it as a rope, you must see it as something else. And finally you had to see the rope in the first place or you never would have mistaken it for a snake. The reason you mistook it for a snake is because the rope was three feet long, and you're accustomed to three foot long snakes.

But before I speak further about illusion, I want to say a few words about what we *do* understand in physics, and I also want to point out a few gaps in that understanding. When we talk about the universe, or when we look out and see it, what we see is that the universe is made out of what we call matter. It's what we call a material universe. And what we want to do, first of all, is to trace that material back, not quite to square one, but to square two at least. We want to find out whether we can think of all these things which we see as being made out of matter, as *really* being made out of only a few ingredients. And the answer is that we can. Long ago the chemists pointed out that all these things that we see are made out of not more than 92 ingredients. Those are the 92 chemical elements of the periodic table. It was suggested in 1815 that all those different chemical elements are probably made out of hydrogen. That was Prout's hypothesis, because in those days no one knew how to do it. But now, in modern times, we *do* know how to do it, and we *do* know that that's what happens. All the other chemical elements are made out of hydrogen, and it happens in the stars.

The universe, even as it is today, consists mostly of hydrogen. And what it is doing is falling together in the gravitational field. It falls together to galaxies and stars, and the stars are hot. Falling together by gravity is what makes them hot. And they get hot enough inside so that the hydrogen is converted to helium. Now helium is a very strong atomic nucleus, and so the main line in building up the atoms of the atomic table goes this way: First, four hydrogens make one helium. Then three heliums make one carbon. Two heliums won't stick. That would be berillium 8. There is no berillium 8. It won't last. But three heliums *will* stick, and that's carbon. Four is oxygen. Five is neon. That's the way it goes in the stars; the other nuclei are built of helium nuclei. Six makes magnesium. Then silicon, sulfur, argon, calcium, titanium, chromium and iron.

In big stars it goes like this. But in small stars like our sun it goes only up to carbon or possibly carbon and oxygen. That's where our sun will end, at about the size of the earth, but with a density of about four concrete mixing trucks in a one pint jar. Larger stars get too hot by their own gravitational squeeze, and the carbon cannot cool off like that. They go right on to oxygen, and so on, until they get, in the center, to iron. Now iron is the dumbest stuff in the universe. There is no nuclear energy available to iron - nothing by which it can fight back against gravitational collapse; so gravity collapses it, this time to the density of a hundred thousand airplane carriers squeezed into a one pint yogurt box. One hundred thousand airplane carriers in a one pint box. And, when it collapses like that, the gravitational energy that is released to other forms blows the outer portions of the star all over the galaxy. That's the stuff out of which our bodies are made. Our bodies are all made out of star dust from such exploding stars.

We *do know* that the main ingredient of the universe is *hydrogen* and that the main useable energy in the universe is *gravitational*. We *know* that the name of the game is falling together by gravity (hydrogen, falling together by gravity), but what we *don't know* is *why* things fall together by gravity. We *do know* that the stuff out of which this universe is made is hydrogen, but we do *not* know from where we get the hydrogen. We *know* that the hydrogen is made of electrical particles, protons and electrons, and we know that the total electrical charge of the universe is zero, but we do *not* know, you see, *why* it is made of electricity. We do *not* know why it falls together. And we do *not* know why, when things are moving, they should coast. There are these gaps in our understanding. We know *how* things coast. We know *how* things fall. We know *how* the electrical particles behave, but we don't know any of the why questions. We don't have any answeres to the why questions.

What I want to talk about next is a discovery made by Albert Einstein when he was 26 years old and working in the patent office in Bern. Then I want to talk about the consequences of that discovery and, through that, I want to trace our physics back, if possible, to answer those why questions.

Einstein noticed that we cannot have an objective universe in three dimensions. We all talk about 3D. Hardly anybody talks about 4D.

But the universe is 4D. It is not possible to have a universe of space without a universe of time. It is not possible to have space without time, or time without space, because *space and time are opposites.* I don't know that Einstein ever used the language that space and time are opposites, but if you look at his equations, it is *very, very clear that that's exactly what they are.* If, between two events, the space separation between them is the same as the time separation between them, *then the total separation between them is zero.* That's what we mean by opposites in this case. In electricity if we have the same amount of plus charges as we have of minus charges, say in the same atom or the same molecule, then that atom or that molecule is neutral. There is no charge seen from outside. Likewise here. If the space separation between two events is just the same as the time separation between those two events, then the total separation between those two events is zero.

I'll give you an example. Suppose we see an exploding star, say in the Andromeda galaxy. There's one going on there right now. It's been visible for about a month or so. Now the Andromeda galaxy is two and a quarter million light years away, and when we see the explosion now, we see it as it was two and a quarter million years ago. You see, the space separation and the time separation are the same, which means that the total separation between you and what you see is zero. The *total* separation, the *real* separation, the *objective* separation, that is, the separation as seen by *anybody,* between the event which you see and the event of your seeing it - the separation between those two events is always zero. What we mean when we say that the space and time separations between two events are equal is that light could get from one of those events to the other in a vacuum.

We see things out there, and we think they're really out there. But, you see, we cannot see them when they happen. We can't see anything when it happens. We see everything in the past. We see everything a little while ago, and always in such a way that the while ago just balances the distance away, and the separation between the perceiver and the perceived remains always at zero.

As soon as Einstein noticed that we cannot have a universe of space without a universe of time and vice versa, and that they are connected in this way, and that the only way to have an objective universe is in *four* dimensions, and not in two or three or one - as soon as he noticed that, he had to re-do our physics.

Now relativity theory is a geometry theory. It's not something else. It's a geometry theory. It's about the geometry of the real world. I'm sure that most if not all of you have been exposed, somewhere along your educational careers, to the geometry of Euclid. His geometry is in two dimensions and in three, but he didn't have any idea about introducing the fourth dimension. His geometry is a *theoretical* geometry about a *theoretical* space which does not, in fact, exist. Newton based his understanding of physics also on that understanding of geometry, and Newton's physics is a *theoretical* physics about a *theoretical* universe which does not, in fact, exist. We know now, you see, that Euclid was *wrong* in his understanding of geometry, and that

Newton was likewise wrong in his understanding of physics. And we had to correct our physics in terms of Einstein's re-understanding of geometry. It was when Einstein went through our physics with his new understanding of geometry that he saw that what we had been calling matter or mass or inertia is really just energy. It is just potential energy. It had been suggested a few years earlier by Swami Vivekananda that what we call matter could be reduced to potential energy. In about 1895 he writes in a letter that he is to go next week to see Mr. Nicola Tesla who thinks he can demonstrate it mathematically. Without Einstein's understanding of geometry, however, Tesla apparently failed.

It was from the geometry that Einstein saw that what we call rest mass, that which is responsible for the heaviness of things and for their resistence to being shaken, is really just energy. Einstein's famous equation is $E=mc^2$. Probably most of you have seen that equation. It says that for a particle at rest, its mass is equal to its energy. Those of you who read Einstein know that there is no c^2 in that equation. The c^2 is just in case your units of space and time don't match. If you've chosen to measure space in an arbitrary unit and time in another arbitrary unit, and if you have not taken the trouble to connect the two units, then, for your system, you have to put in the c^2. If you're going to measure space in centimeters, then time must *not* be measured in seconds. It must be measured in jiffies. A jiffy is the length of time it takes light to go one centimeter. Astronomers are rather broad minded people, and they have noticed that the universe is quite a bit too big to be measured conveniently in centimenters, and quite a bit too old to be measured conveniently in seconds; so they measure the time in years and the distance in light-years, and the units correspond. That c in the equation is the speed of light in your system of units, and if you've chosen years and light-years then the speed of light in your system is one. And if you square it, it's still one, and the equation doesn't change. The equation simply says that energy and mass are the same thing.

Our problem now is that if we're going to trace this matter back, and find out what it is, we have first of all to find out what kind of energy makes it massive. Now we have only a few kinds of energy to choose from. Fortunately there are only a few, gravitational energy, kinetic energy, radiation, electricity, magnetism and nuclear energy. But I must allay your suspicion that nuclear energy might be very important. It is not. The nuclear energy available in this universe is very small. If all the matter in the universe began as hydrogen gas and ended as iron, then the nuclear energy released in that change (and that is the maximum nuclear energy available) is only one percent of what you can get by letting that hydrogen fall together by gravity. So nuclear energy is not a big thing, and we have only five kinds of energy to choose from in order to find out what kind of energy makes the primordial hydrogen hard to shake. That, you remember, was our problem.

What we want is potential energy, because the hydrogen is hard to shake even when it's not doing a thing. So what we're after is potential energy, and that restricts it quite a bit more. Radiation has nothing to do with that. Radiation never stands still. And kinetic

energy never stands still. And even magnetic energy never stands still. So we're left with electricity and gravity. There are only two. We don't have any choice at all. There is just the gravitational energy and the electrical energy of this universe available to make this universe as heavy or as massive as we find it.

Now I should remind you that the amount of energy we're talking about is very large. It's five hundred atom bombs per pound. One quart of yogurt, on the open market, is worth one thousand atom bombs. It just happens that we're not in the open market place. We live where we have no way to get the energy of that yogurt to change form to kinetic energy or radiation so that we can do anything with it. It's tied up in there in such a way that we can't get it out. But right now we're going to talk about the *possibility* of getting it out. We want to talk about how this tremendous energy is tied up in there. We want to talk about how this matter is "wound up".

First let's talk about watches. We know how they're wound up. They're wound up against a spring. Now when we wind up a watch, what I want to know is whether it gets heavier or lighter. If we have a watch, and if we wind it up, does it get harder to shake or easier? It gets harder to shake because when we wind it up we put more potential energy into it, and energy is the only thing in the universe that's hard to shake. So now we want to know in what way the whole universe is wound up to make it heavy and hard to shake. We know that it must be wound up against electricity and gravity. The question is: How?

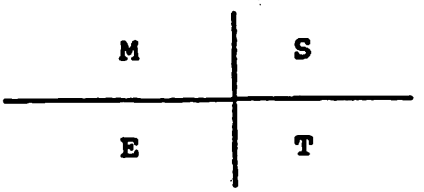
We need to know some details on how to wind things up. How, for instance, do you wind up against gravity? You wind against gravity by pulling things apart in the gravitational field. They all want to go back together again. And if the entire universe were to fall together to a single blob, the gravitational energies that would be released to other forms would be five hundred atom bombs per pound. The universe is wound up on gravitational energy just by being spaced away from itself against the gravitational pull inward. And it turns out to be just the right amount. It really does account for the fact that it's five hundred atom bombs per pound.

How do we wind up against electricity? We push like charges toward each other. If you push two electrons toward each other you have to do work, and it gets heavier or more massive. If you push two protons toward each other it gets more massive. And if you take a single electrical charge and make it very small, since you're pushing like charge toward itself, it too becomes more massive. Now it turns out that the work that's represented by the smallness of all the teeny weeny particles that make up the hydrogen atoms and all the rest of this stuff is, once again, five hundred atom bombs per pound. Some of you might think that it should come out to a total of ten hundred atom bombs per pound - five hundred gravitational and five hundred electrical. No, it's only five hundred atom bombs per pound because winding it up one way is *exactly* the same thing as winding it up the other way. Coins have two sides, heads and tails. You cannot make coins with only one side. For every heads there is a tails. Plus and minus charges are like heads and tails. Space and time are like heads and tails. And

electricity and gravity are like heads and tails. You cannot space things away from each other in the gravitational field without making them small in the electrical field.

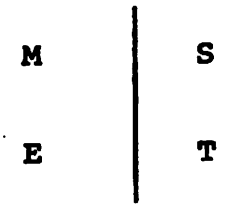
I think that we're ready now to attack the consequences of this new understanding of physics. We want to find out whether, through this understanding, we can trace our physics all the way back to square one, to see whether, underlying it, there may be something akin to magic. We want to know *why* things fall. We want the answers to our why questions.

I'm going to draw you a quick map. This is a picture of the physics before Einstein. Then I'll correct it. The M is for mass,



the E is for energy, the S is for space and the T is for time.

In the last century we thought that mass was one thing; energy was another. Space was one thing; time was another. In our present understanding of physics that won't work. Space and time are just two sides of the same coin. Mass and energy are just two sides of the same coin. And there is no line through there.



There is no line between mass and energy or between space and time. And we just talked about the way in which the universe is wound up in order to make the particles massive. They're wound up against *space*. They're spaced *in* against the electrical field, and they're spaced *out* against the gravitational field, which means that what we call matter and energy are also nothing but geometry, and the line down the middle goes too. But when the lines go, the picture goes. When the lines of demarcation between mass and energy and space and time are obliterated, we do *not* have a model of a physical universe. Every definition in our physics, every concept in our physics, requires measurements of length, or of time, or of mass - one or more of these measurements. And without the discrimination between length, time and mass we have no way to measure anything in physics, no way to define anything in physics. Our model of the universe does not hold up when we examine it from the standpoint of Einstein's equations. And what we

are left with I shall indicate here by a question mark.

?

What is it that exists behind our physics? Relativity theory does not say exactly what it is, and our task is to find it out, if we can.

First let us understand a little bit about what we call causation in physics. What do we mean when we say that one thing causes another in our physics? We mean that there is a transformation of energy from one form to another. For instance, if the hydrogen falls together to galaxies and stars, the gravitational energy is first converted to kinetic energy in the falling; and then the kinetic energy is converted to radiation when the hydrogen falls together into stars. When radiation from stars like our sun is picked up by all these green leafy things which we call plants and trees, it's converted to electrical and magnetic forms. So all these things happen by changes in energy, by changes in the *form* of the energy. The *amount* of energy does *not* change. There is no such animal as the generation of energy. The amount of energy, whatever it is, seems to be completely unchangeable. It's one of our most basic observations in physics. And what we mean by causation is changes in the form of this energy. Matter itself is energy, and what we mean is that when something happens, whether it's hydrogen being converted to helium, or whatever it is, there's some change in the form of the energy. *Now the universe cannot arise by this kind of causation simply because in any such change the amount of energy at the end is never any greater than the amount at the start. You cannot manufacture gold by remolding gold. You never finish with more than you started with.*

With this understanding of causation in mind, I want to go back to our question mark. We want to see whether we can get some idea of the nature of what the equations of relativity theory say must exist behind the universe of our observations. And we want to see how, from that nature, we come to the world of our perception.

When we look at this question mark, what we see is that it has to be beyond space and time. Our physics is on *our* side of space and time, if you like, but Einstein's equations say that *behind* our physics there is this question, "What is it?". *We know that it has to be beyond space and time.* And for that reason we can get a negative statement about what it is. If it's beyond time, it must be changeless, because only in time could we have change. If it's beyond space, it must be both undivided and infinite, because only within space could we have things finite and divided. Without space you couldn't break a cookie in two. Without space you couldn't have cookie crumbs. And without time you couldn't do anything, because you couldn't have any kind of change. So whatever exists behind this universe must be changeless, infinite and undivided.

? = Changeless
Infinite
Undivided

The curious thing is this, that what we see is apparently *not* changeless, *not* undivided and *not* infinite. It is obviously finite. The teeny weeny particles that make up the hydrogen atoms and all the rest of these atoms and molecules are really minescule. The number of hydrogen atoms required to make a single drop of water is equal to the number of drops of water in a million cubic miles of ocean. They are certainly finite. And this matter is divided up into atoms. Why should it be so divided? And it's continually changing. You can look anywhere.

So what we see is changing, finite and divided, and now comes the question: *By what kind of causation could we get from the changeless to the changing? from the infinite to the finite? and from the undivided to the divided?*

We haven't proved that we can get there by magic, but we have proved that we can't get there any other way. We cannot get there by the causation of our physics, because that would require that we change the changeless to the changing, that we divide the undivided, and that we make the infinite finite. As I say, we can prove that we cannot get there any other way, but we have not yet proved that we can get there by magic. So now I want to ask: What happens if we look at this problem from the standpoint of what I'll call apparitional causation? My favorite word for this is not quite magic. It's not quite illusion. It's apparitional causation. It's the kind of thing you do when you mistake a rope for a snake.

Can we have mistaken the changeless for the changing? Can we have mistaken the infinite for the finite? Can we have mistaken the undivided for the divided? That's the question.

So let's go back to that old analysis of apparitional causation to see if such a mistake could give rise to our physics. We want to know whether apparitional causation can answer our why questions. When we mistake one thing for another, you remember, there are three aspects to our mistake - three consequences, if you like. First, we must fail to see it rightly. In this case we must fail to see the changeless, the infinite and the undivided. That's fine; we've failed. Then we must see something else in its stead, and that else must be different. And so it is. What we see is changing, finite and divided. Finally, you remember, we had to see the thing to start with. If we had not seen a three foot rope we would not have mistaken it for a three foot snake. When you mistake your friend for a ghost, if your friend is tall and thin then the ghost will be tall and thin. But if your friend is roly-poly you'll see a roly-poly ghost. Had you not seen your roly-poly friend you would not have seen a roly-poly ghost.

If, then, our physics has arisen by apparition, the changeless, the infinite and the undivided must show in that physics. But isn't that exactly what we see? The changeless shows as inertia, the infinite as electricity, and the undivided as gravity. Had we not seen the changeless, it would not have shown up in our physics. It is the changeless which we see, and, as a consequence, that changeless shows in what we see. That is why things coast. That is what we see as inertia.

That is what we call mass. Likewise, in order to see the undivided as the divided we had to see the undivided, and that is what we see as gravity. It is a consequence of having seen the undivided. You cannot see a universe of particles, all spaced out, without having them fall together again. You cannot make the mistake of seeing it as divided without having the undividedness show. And, finally, you cannot make the mistake of seeing the infinite broken up into teeny weeny particles without the consequence of seeing those particles as electrical. Probably some of you don't know quite enough physics to understand what I mean by that, but every electrical particle has energy just because of its smallness, and if you let it get bigger, its electrical energy would go down. If it could get infinitely big, its electrical energy would go to zero. So you can think that electrical energy is just the tendency to go back to the infinite, just as the gravitational energy is just the tendency to go back to the undivided.

Now these two things are really the same thing. The wind up against gravity by being spaced *out* is *exactly* the same thing as the wind up against electricity by being spaced *in*. And these two things make up the rest mass. They make up the thing called inertia. It's the electro-gravitational energy of the particles which we see as their rest mass. It is that energy which is hard to shake.

It's *impossible* to see an apparition of this sort without having it wound up. It is *not* possible to see this universe except wound up. The infinite and the undivided must necessarily show as the electrical and gravitational energy. *There is no such thing as matter.* There is only this energy, and the energy is five hundred atom bombs per pound. The energy is the consequence of the apparition. It is the yearning for liberation in the apparently finite. It is the yearning for the undivided in the apparently divided. And it is the yearning for the changeless in the apparently changing.

With the help of this notion of apparitional causation suggested by Einstein's equations, we are able, you see, to trace our physics all the way back to square one to answer those why questions. With Einstein's help we are able at last to understand why matter falls, why it coasts, and why it is made of discrete electrical particles.

We have to *look at it very carefully.* We have completely to change our understanding of geometry. Our native understanding of geometry, or rather our native misunderstanding of geometry, is a genetic mistake. We make the mistake because it was *never necessary not to.* It was never necessary, in the long past history of our race, for us to see space and time correctly. It never was. It was *definitely* necessary that we have at least a dog's understanding of a three dimensional space, otherwise we wouldn't have had offspring, and the species would all have died out. But it was never necessary to understand that space and time are opposites. It was never necessary to understand the origin of gravity, or the origin of inertia, or even the fact that the atoms are made of electricity, or the fact that there are 92 chemical elements. It's not necessary to understand any of these things in order to have offspring and have the perpetuation of the species go on. It works all right through many, many mistakes.

You must not think that just because it's a native perception on your part that it's true. That has nothing to do with it. Just look back and see how you got the way you are. You have to think that it's all a mistake, and you have to notice that our genetic misunderstanding of space and time is at the *root* of it. That's where the root is. It is within our mistaken notions of space and time that we see this universe the way we do. So what we have to do is to straighten out our understanding.

Space is not really that which separates the many. It's that which *seems* to separate the *one*. There's only one. And in that space that oneness shines. *Therefore* falls whatever falls. Space is *not* that in which we see the finite. There is no finite. Space is that in which the infinite appears as small, and in that space that vastness shines. Therefore bursts whatever bursts. Therefore every electrical particle wants to become infinite. And therefore shines whatever shines. And time is not that in which we see change, but that in which the changeless *seems* to change, and in that time that changeless shines. Therefore rests whatever rests; therefore coasts whatever coasts.

Our problem is to discriminate between what's behind this notion of space and time and what's within it. Our problem is to discriminate between the real and the make believe.

ENERGY

What energy does has long been known by the European scientists. But what it *is* is considered to be unknown. That is our question. What is it that we call energy, and why is it conserved? Why, when the form of the energy changes, does the amount never change?

Energy takes many forms. There is the energy of a wound watch, the energy of a pitched ball, and the energy of a moving train. There is the energy of a hurricane or a tsunami, the energy of sunlight, and the energy of an exploding star. And we have several *kinds* of energy in the world. We have gravitational energy, kinetic energy (which is the energy of motion), radiation, electrical and magnetic energies, and what is called nuclear energy. The energy can change from form to form. In the collapse of a hydrogen cloud to form a star, the gravitational energy is converted first to kinetic energy and thence to radiation, but with no change in the amount. In a swinging pendulum, gravitational energy is transformed to kinetic energy on the down-swing, and back to gravitational energy on the up-swing, but the total amount of energy remains constant. It is easy to change the form of the energy, but it is impossible to change the amount of energy.

So what is this thing we call energy, and why is it conserved? And why is matter heavy?

Matter is heavy because it is energy, and energy is what's heavy and hard to shake. Einstein pointed out in 1905 that what we see as matter is just potential energy (E=m). That famous equation is usually written with a c^2 (the speed of light squared) after the m which Einstein just added to clean up the units in the physics department. When we found out that mass and energy are the same thing there was a problem. We already had a unit for energy called the erg. And we already had a unit for mass called the gram. So now we had to know how many ergs make one gram. What the c^2 says in that equation is simply that nine hundred billion billion ergs make one gram. That is all it really says.

Because of the c^2 (in the equation $E=mc^2$) that equation is usually mistaken to mean that mass can be converted to energy, and that energy can be converted to mass. Or, to put it another way, it is mistakenly thought that the sum of mass and energy is always a constant. But if that were true the equation would have to be written E+m=K. But if that was what Einstein had actually meant that is what he would have written.

So now that we know that all energy is massive, the question still remains: what kind of potential energy makes all this stuff heavy? Since we are here concerned primarily with potential energy (which does not involve motion), kinetic

energy, radiation, and magnetic energy (which all involve motion), may be left out. We are left, then, with gravitational, electrical, and nuclear energies.

Let us start with spring-wound watches.

Suppose we have two identical watches, one that is wound up tight and the other that is completely unwound. Which one would be heavier? Which one would be harder to shake? The wound up one, of course, because we put some extra energy into it by winding it up, and energy itself is what is heavy. Energy is the only thing that is hard to shake. Now what will be the final difference if we dissolve the two watches in equal beakers of acid? The one with the wound up watch dissolved into it will be warmer. The extra energy, the extra weight will translate into more heat (Temperature measures the energy of motion). A pitched baseball weighs more than an unpitched baseball.

Now how do we wind up a cuckoo clock? We pull up the weights. We raise the center of gravity of the weights in the gravitational field of the Earth. So if we put the clock on a higher shelf it becomes wound up even more. That is the plain fact. If the clock falls from a higher shelf, the destruction of the clock will be severe. If you drop it to the basement, the destruction will be even more severe. And if you were to drop it onto the surface of a Black Dwarf star, you'd need to stand away because the splash would be explosive. If you were to drop your cuckoo clock onto the surface of a Neutron star, with the density of a hundred thousand battleships fit into a one-pint jar, the energy released in the splash would be enough to vaporize all the buildings in the Los Angeles area. In such a splash about $1/10^{th}$ of the energy *which was itself the clock* would be converted into kinetic energy in the fall.

Things are wound up against gravity by being spaced away from each other in the gravitational field. Gravity wants everything to be in one place. So the energy required to get a 10 gram marshmallow away from a Neutron star is the energy of an atomic bomb (Hiroshima size). The energy required to get it away from the Event Horizon of a small Black Hole is about 3X that much. And the energy required to get it away from the sum total of all the rest of the matter in the observable Universe is the energy of 10 atomic bombs. *That is what the marshmallow really is.* 10 grams *of anything* in this Universe is the energy of 10 atomic bombs. I know, they will sell you a whole bag of marshmallows at the grocery store for $1.69 or something. They have no idea what they are doing...So all this stuff is heavy by being wound up against gravity.

But things are wound up against electricity as well, and it's the same wind-up. How do we wind things up against electricity? Not by pulling like charges apart, but by pushing them together against their mutually repulsive electrical charges. Suppose you try to push two electrons toward each other. Do they like it? No. Do they weigh more when pushed together? Yes. You put some extra energy in, and energy is what is heavy and hard to shake. Now just suppose you

had an infinitely large electron, but holding only the charge of one electron, and then you squeezed it down to the size of one electron. The work you would have done, that is, the energy you would have put in, would simply be the mass of that electron. There's no one else at home. *There is no material particle with an electrical charge in there.* There is *just the electrical charge* and *the smallness of that electrical charge*, and there is no one else at home. The mass of the electron is simply the energy that you would have to put in to make it that small.

So then you might ask: why is the proton so much heavier than the electron? That is because of its gravitational wind-up. A proton is wound up to 500 atom bombs per pound by being gravitationally separated from all the rest of the matter in the observable Universe. It is both smaller and heavier than the electron because its electrical wind-up must match its gravitational wind-up. They are both the same thing. They are two sides of the same coin. But as Richard Feynman once said, "The electron is purely electrical, the proton is not." The proton is the canoe; the electron is the outrigger. And the canoe is 1836 times as heavy.

But, you might ask, where does nuclear energy fit in all this? Is it also a part of the same thing? Are gravitational, electrical, and nuclear potential energies all the same thing? They are, and the question becomes this: what do you mean when you say that you know where something is in space and time?

When we say that we know where something is, we mean three things. We mean that we know where it is with respect to other things; we mean that it is small enough so that we could accurately designate its position; and we mean that it is in space and time. Now if we know where a proton is with respect to all the other protons in the observable Universe, it will be wound up against gravity to 500 hundred atom bombs per pound. And if we know that it is small enough so that we could accurately designate its position, it will be wound up against electricity to the same 500 hundred atom bombs per pound. And finally if we know where it is in space and time, it will be wound up against Heisenberg's Uncertainty Principle, and it is again to the same 500 hundred atom bombs per pound.

In 1926 Werner Heisenberg pointed out that if we can know where a particle is in space, we cannot quite know its momentum. And that if we can know when a particle has some energy, we cannot quite know how much energy it has. That is Heisenberg's Uncertainty Principle. It says that the product of our uncertainty in where something is and our uncertainty about its momentum can never be less than Planck's constant of two pi. His principle also states that the product of our uncertainty in when something has some energy and our uncertainty in how much energy it has can never be less than that same small amount. That is the reason why the electron won't sit down on the proton in the hydrogen atom in spite of the enormous electrical attraction between them. If we could know that the electron is sitting on the proton, our necessary uncertainty

would be enough to jump it off again. But we can't quite tell *when* it will jump because if we know that it has enough energy to jump, we can't quite tell when it has it.

Now suppose the electron were to sit on more than one proton, say two, or four, or twelve of them. Then it would not be required to jump away because we wouldn't quite know where it was. That is why the nuclear energy goes down from hydrogen, through Helium, to Carbon and Oxygen. The energy released when hydrogen fuses to Helium is $7/10^{th}$ of one percent of the rest mass of the hydrogen. And if the electrical charge of the protons did not interfere with the formation of larger nuclei (so that the nuclei could become indefinitely large), the nuclear energy might also fall to zero as the position of the particles became indeterminate.

But why does matter show gravity, electricity, and inertia which the physicists at the universities have had to take for granted? Why do the dispersed particles fall together by gravity? Why are the miniscule particles electrically charged? Why does matter fight every change in its state of motion? Why, when matter is standing still, does it want to stay standing still, and why, when it's moving, does it want to stay moving in the same direction? Why should gravity, electricity, and inertia characterize what we see as matter? Could it be simply that through some sort of misperception we see what we see as if in space and time? Could there be something which underlies what we see, something that's not in space and time, and which shows up in our physics as these potential energies? If so, what could it be?

Instead of asking what might exist in the absence of space and time, let us ask instead what could *not* exist in the absence of space and time. That's easier. What could not exist is the changing, the finite, the divided, since change is in time, and smallness and dividedness are in space. So what might exist behind what we see, in the absence of space and time, would necessarily have to be Changeless, Infinite, and Undivided. But since what we see as the Universe is changing all the time, is finite, and is made of minuscule particles, and divided into atoms, it could only be due to a misperception, since you cannot change the Changeless, nor cut up the Undivided. If our physics is due to such a misperception, like mistaking a rope for a snake, then the nature of the misperceived *must* show up in our physics, just as the length and diameter of the rope must show up in the snake for which it is mistaken. Perhaps, then, potential energy is like the nature of the rope showing up in the snake. Gravitational potential energy would be the Undivided showing through our misperception of the Universe. Electrical potential energy would be the Infinite showing through our misperception of the Universe. And inertia would be the Changeless showing through our misperception of the Universe. Simply because we see the Universe in space and time it would be wound up against Heisenberg's Uncertainty Principle imposed on us by the fact that it is a misperception. You can never identify the snake for which a rope has been mistaken.

Gravity causes things to move, and if you see them moving with respect to you, you will see that they have what we call kinetic energy, related to the direction of the motion. Electricity also makes things move, and if you see them moving with respect to you then you will see that they have magnetic energy in the plane perpendicular to the direction of motion. And apparently you will also see what we call radiation.

Why apparently? Because in 1905 when Einstein put time into our geometry where it belongs, (and changed our geometry from 3-D to 4-D), he put time and space in as a pair of opposites. And although Einstein didn't see it that way, that geometry actually leaves no room for the photons of radiation. It puts the total separation, the space-time separation, between the emission and absorption events of the photons at zero. So, if we see a star eight and a half light years away, we also see it eight and a half years ago. And the "ago" comes into Pythagoras' equation squared with a minus sign which cancels the "away" which comes in squared with a plus sign. The result is that the "real separation" between us and what we see *stands always at zero*. As Richard Feynman long ago pointed out, there is no way that our physics makes sense if we allow that there could be energy in the radiation state. But when Einstein threw out the "luminiferous ether", in which the protons "swam", he should have also thrown out the photons that swam in it.

The fact that Einstein's four-dimensional geometry denies the separation between the Perceiver and the Perceived is itself sufficient to cast doubt on the "actuality" of our observed Universe. It suggests that it might instead be due to a misperception.

Now the entire Universe is made out of energy. It is not made out of anything else, like force or momentum or electric charge. And since energy appears to be the underlying existence showing as Changeless through the changes in time, we have both the Conservation of Energy law and inertia. Also, since momentum is the space component of the energy, we have the Conservation of Momentum law, both linear and angular as well. However, the Universe is not made out of momentum, so momentum comes in as pairs of opposites like plus and minus electrical charges so that the total goes to zero. The energy of the Universe does not go to zero. The Universe is made out of energy. But momentum to the right plus momentum to the left does go to zero, and spin-up plus spin-down does go to zero. That is why our inertial guidance systems get us to where we are going. Momentum is always half of something, and the other half is packaged into the Universe at large. And that is the reason why our gyroscopes can keep track of it.

So why do we have both linear and angular momentum? Why, when gravity makes things move, do we have kinetic energy which appears to be linearly related to the direction of motion, whereas, when electricity makes things move we have magnetism angularly related to the plane perpendicular to the

direction of motion? And why do we have three dimensions of space and only on dimension of time?

It was suggested long, long ago that what we see in this world is pairs of opposites: east against west, north against south, up against down and future against past. We see momentum to the right against momentum to the left, angular momentum in one direction against angular momentum in the opposite direction, and spin-up against spin-down. We see plus against minus, and the gravitational direction (spaced out) against the electrical direction (spaced in). The question still remains: since Einstein's geometry puts space and time in as a pair of opposites, why does space have three dimensions and time have only one?

It might be that if space had only one dimension, space and time, as a pair of opposites, might cancel each other out so that we would see no Universe at all. We actually see the Universe "away from us" in space by seeing it "back in time" – in just such a way that the space and time separations between us and what we see add up to zero. We see it as a picture spread out in two dimensions in the plane perpendicular to our line sight. But in the absence of those other two dimensions we might see no Universe at all.

The Universe could have been real in three dimensions. It could not be real in two dimensions, for it would lack depth and substance. When we watch a movie or a television screen, we seem to see a three dimensional world "behind" the screen. But there is always the awareness that the screen is two-dimensional and that the three-dimensional world which we seem to see behind it is actually illusory. We watch with the conviction that the movie theatre or the room in which we watch the television is three-dimensional and "real". But alas, the physics won't allow it. The Universe which we see is actually four-dimensional and the separation between us and what we see always stands at zero.

Einstein was very much concerned about the origin of our concepts of time and space and he wrote, "It appears to me, therefore, that the formation of the concept of the material object must precede our concepts of time and space." It would seem, then, that the concept of a material object arises in our genetic programming through the identification of the Perceiver with a physical organism.

Perhaps it is the genetic programming itself the "veils" the Changeless, the Infinite, the Undivided, and projects in its place the changing, the finite, and the divided. Thus we see the Changeless as inertia, (energy), the Infinite as electricity, and the Undivided as gravity. And we see the attraction between opposites like plus and minus charges and spin-up and spin-down.

If our genetic programming is indeed responsible for this apparent misperception, then we can understand why we run after peace, freedom, and

love. Peace and security is the Changeless. Freedom is the Infinite. Love is the Undivided showing through in our genetic programming. But our genes have us persuaded to chase these reflections in ways that get the prime directive of our genetic programming fulfilled. After all, the only thing that survives in the gene pool is babies. So any programming that gives rise to babies survives. Meanwhile our "vital energy", by eating and breathing, is borrowed from the Sun.

1997

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ENERGY

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Energy takes many forms. There is the energy of a wound watch, the energy of a pitched ball and the energy of a moving train. There is the energy of a hurricane or a tsunami, the energy of sunlight, and the energy of an exploding star. And we also have several *kinds* of energy in the world. We have gravitational energy, kinetic energy (which is the energy of motion), radiation, electrical and magnetic energies, and what is called nuclear energy. And the energy can change from form to form. In the collapse of a hydrogen cloud to form a star, the gravitational energy is converted first to kinetic energy and thence to radiation, but with no change in the amount. In a swinging pendulum, gravitational energy is transformed to kinetic energy on the down-swing, and back to gravitational energy on the up-swing, but the total amount of energy remains constant. It is easy to change the form of the energy, but impossible to change the amount.

But what is this thing we call energy, and why is it conserved? And why is matter heavy? Matter is heavy because it's energy, and energy is what's heavy and hard to shake. Einstein pointed out in 1905 that what we see as matter is just potential energy, (E = m). That equation is usually seen with a c squared after the m which Einstein added to clean up the units in the physics department. When we found that mass and energy are the same thing we had a problem. We already had a unit for energy, the erg. And we already had a unit for mass, the gram. And we had to know how many ergs make a gram. What that c squared says in that equation is simply that nine hundred billion billion ergs make a gram. That's all it says. But because of that c squared, that equation is usually taken to mean that mass can be converted to energy, and energy can be converted to mass, that is, that the *sum* of mass and energy is a constant. But if that were true, the equation would be written E + m = K, and if that was what Einstein had meant , that's what he would have written.

So now that we know that all energy is massive, the question still remains: what kind of potential energy makes all this stuff heavy? Since we are here concerned primarily with potential energy (which does not involve motion), kinetic energy, radiation and magnetic energy, which all involve motion, may be left out. We are left, then, with gravitational, electrical and nuclear energies. But let us start with spring-wound watches.

Suppose we have two identical watches, one wound up tight, and the other completely unwound. Which one would be heavier? Which one would be harder to shake? The wound one, of course, because

we put some extra energy in it by winding it up, and energy itself is what is heavy. Energy is the only thing that is hard to shake. Now what will be the final difference if we dissolve the two watches in equal beakers of acid? The one with the wound watch dissolved in it will be warmer. And this time the extra energy, the extra weight, will be the energy of motion. A pitched baseball weighs more than an unpitched baseball.

Now how do we wind up a cuckoo clock? We pull up the weights. We raise its center of gravity in the gravitational field of the Earth. So putting the clock on a higher shelf winds it up even more. That is the plain fact. If it falls from the higher shelf, the destruction of the clock will be severe. If you drop it to the basement, the destruction will be even more severe. And if you were to drop it to the surface of a black dwarf star, you'd need to stand away because the splash would be explosive. And if you were to drop your cuckoo clock to the surface of a neutron star, with the density of a hundred thousand battleships in a one-pint jar, the energy released in the splash would be enough to vaporize all the buildings in the Los Angeles Area. About a tenth of the energy *which was itself the clock* would be converted to kinetic energy in the fall.

Things are wound up against gravity by being spaced away from each other in the gravitational field. Gravity wants everything to be in one place. So the energy required to get a ten gram marshmallow away from a neutron star is the energy of an atomic bomb. The energy required to get it away from the event horizon of a small black hole is about three times that much. And the energy required to get it away from all the rest of the matter in the observable Universe is the energy of ten atomic bombs. That is what the marshmallow really is. Ten grams of anything is the energy of ten atomic bombs. I know, they sell you a whole bag of marshmallows at the grocery store for a dollar sixty-nine or something. They have no idea what they are doing. So all this stuff is heavy by being wound up against gravity.

But things are wound up against electricity as well, and it's the same wind-up. So how do we wind things up against electricity? Not by pulling like charges apart, but by pushing them together against their mutually repulsive electrical charges. Suppose you push two electrons toward each other. Do they like it? No. Do they weigh more pushed together? Yes. You put some extra energy in, and energy is what's heavy and hard to shake. Now suppose you had an infinitely large electron, but with only the charge of one electron, and you squeezed it down to the size of one electron. The work you would have done, that is, the energy you would have put in, would be the mass of that electron. There's no one else at home. There is no material particle with an electrical charge in there. There is just the electrical charge and the smallness of the electrical charge, and there's no one else at home. The mass of the electron is simply the energy that you would have to put in to make it that small.

So then you might ask: why is the proton so much heavier than the electron? That is because of its gravitational wind-up. It is wound up to five hundred atom bombs per pound by being gravitationally separated from all the rest of the matter in the observable Universe. It is both smaller and heavier than the electron because its electrical wind-up must match its gravitational wind-up. They are both the same thing. They are two sides of the same coin. But as Richard Feynman once said, "The electron is purely electrical; the proton is not." The proton is the canoe; the electron is the outrigger. And the canoe is 1836 times as heavy.

But, you might ask, where does nuclear energy fit in all this? Is it also part of the same thing? Are

gravitational, electrical and nuclear potential energies all the same thing? They are, and the question is this: what do you mean when you say that you know where something is in space and time?

When we say that we know where something is, we mean three things. We mean that we know where it is with respect to other things; we mean that it's small enough so that we could accurately designate its position; and we mean that it's in space and time. Now if we know where a proton is with respect to all the other protons in the observable Universe, it will be wound up against gravity to five hundred atom bombs per pound. And if we know that it is small enough so that we could accurately designate its position, it will be wound up against electricity to the same five hundred. And finally, if we know where it is in space and time, it will be wound up against Heisenberg's uncertainty principle, and again, to the same five hundred atom bombs per pound.

In 1926 Werner Heisenberg pointed out that if we can know where a particle is in space, we cannot quite know its momentum. And that if we can know when a particle has some energy, we cannot quite know how much energy it has. That is Heisenberg's uncertainty principle. It says that the product of our uncertainty in where something is and our uncertainty in its momentum can never be less than Planck's constant over two pi. Also that the product of our uncertainty in when something has some energy and our uncertainty in how much energy it has can never be less than that same small amount. That is why the electron won't sit down on the proton in the hydrogen atom in spite of the enormous electrical attraction between them. If we could know that the electron is sitting on the proton, our necessary uncertainty in its momentum would be so large that the momentum associated with that uncertainty would be enough to jump it off. But we can't quite tell *when* it will jump because if we know that it has enough energy to jump, we can't quite tell when it has it.

Now suppose the electron were to sit on more than one proton, say two, or four, or twelve. Then it wouldn't be required to jump away because we wouldn't quite know where it was. That is why the nuclear energy goes down from hydrogen, through helium, to carbon and oxygen. The energy released when hydrogen fuses to helium is seven tenths of one percent of the rest mass of the hydrogen. And if the electrical charge of the protons did not interfere with the formation of larger nuclei (so that the nuclei could become indefinitely large), the nuclear energy might also fall to zero as the position of the particles became indeterminate.

But why does matter show gravity, electricity and inertia which the physicists at the universities have had to take for granted? Why do the dispersed particles fall together by gravity? Why are the minuscule particles electrically charged? And why does matter fight every change in its state of motion? Why, when matter is standing still, does it want to stay standing still, and why, when it's moving, does it want to stay moving in the same direction? Why should gravity, electricity and inertia characterize what we see as matter? Could it be simply that through some sort of misperception we see what we see as if in space and time? Could there be something which underlies what we see, something that's not in space and time, and which shows up in our physics as these potential energies? If so, what could it be?

Instead of asking what *might* exist in the absence of space and time, let us ask instead what could *not* exist in the absence of space and time. That's easier. What could not exist is the changing, the finite, the divided, since change is in time, and smallness and dividedness are in space. So what might exist behind what we see, in the absence of space and time, would necessarily have to be changeless, infinite

and undivided. But since what we see as the Universe is changing all the time, finite, made of minuscule particles, and divided into atoms, it could only be due to a misperception, since you cannot change the changeless nor cut up the undivided. But if our physics is due to such a misperception, like mistaking a rope for a snake, then the nature of the misperceived must show up in our physics just as the length and diameter of the rope must show up in the snake for which it is mistaken. Perhaps, then, potential energy is like the nature of the rope showing up in the snake. Gravitational potential energy would be the undivided. Electrical potential energy would be the infinite. And inertia would be the changeless. And simply because we see it in space and time, it would be wound up against Heisenberg's uncertainty principle imposed on us by the fact that it is a misperception. You cannot identify the snake for which a rope has been mistaken.

But gravity causes things to move, and if you see them moving with respect to you, you'll see that they have what we call kinetic energy, related to the direction of motion. But electricity also makes things move, and if you see them moving with respect to you then you'll see that they have magnetic energy in the plane perpendicular to the direction of motion. And apparently you'll see also what we call radiation.

Why apparently? Because in 1905 when Einstein put time into our geometry where it belongs, and changed our geometry from 3-D to 4-D, he put time and space in as a pair of opposites. And although Einstein didn't see it that way, that geometry leaves no room for the photons of radiation. It puts the total separation, the space-time separation, between the emission and absorption events of the photons at zero. If we see a star eight and a half light years away, we see it also eight and a half years ago. And the "ago" comes into Pythagoras' equation squared with a minus sign and cancels the "away" which comes in squared with a plus sign, so that the real separation between us and what we see stands always at zero. And as Richard Feynman long ago pointed out, there is no way that our physics makes sense if we allow that there could be energy in the radiation state. When Einstein threw out the luminiferous ether, in which the photons swam, he should have thrown out the photons that swam in it.

The fact that Einstein's four dimensional geometry denies the separation between the perceiver and the perceived is itself sufficient to cast doubt on the actuality of our observed Universe, and to suggest that it might indeed be due to a misperception.

Now the Universe is made out of energy. It is not made out of anything else, like force or momentum or electric charge. And since energy appears to be the underlying existence showing as changeless through the changes in time, we have both the conservation of energy and its inertia. And also, since momentum is the space component of the energy, we have the conservation of momentum, both linear and angular, as well. But the Universe is not made out of momentum, so momentum comes in as pairs of opposites like plus and minus electrical charges so that the total goes to zero. The energy of the Universe does not go to zero. The Universe is made out of energy. But momentum to the right plus momentum to the left goes to zero, and spin-up plus spin-down goes to zero. That is why our inertial guidance systems get us where we're going. Momentum is always half of something, and the other half is packaged in the Universe at large. And that is why our gyros can keep track of it.

But why do we have both linear and angular momentum? And why, when gravity makes things

move, do we have kinetic energy which appears to be linearly related to the direction of motion, whereas, when electricity makes things move we have magnetism angularly related to the plane perpendicular to the direction of motion? And why do we have three dimensions of space and only one dimension of time?

It has been suggested long ago that what we see in this world is pairs of opposites, east against west, north against south, up against down and future against past. We see momentum to the right against momentum to the left, angular momentum in one direction against angular momentum in the opposite direction, and spin-up against spin-down. We see plus against minus, and the gravitational direction (spaced out) against the electrical direction (spaced in). And the question is this: since Einstein's geometry puts space and time in as a pair of opposites, why does space have three dimensions and time have only one?

It might be that if space had only one dimension, space and time, as a pair of opposites, might cancel each other out so that we would see no Universe at all. We see the Universe away from us in space by seeing it back in time, and in just such a way that the space and time separations between us and what we see add to zero. But we see it as a picture spread out in two dimensions in the plane perpendicular to our line of sight. But in the absence of those other two dimensions we might see no Universe at all.

The Universe could have been real in three dimensions. It could not be real in two, for it would lack depth and substance. When we watch a movie or a television screen, we seem to see a three dimensional world behind the screen. But there is always the awareness that the screen is two dimensional and that the three dimensional world which we seem to see behind it is illusory. And we watch with the conviction that the movie theater or the room in which we watch the television is three dimensional and real. But alas, the physics won't allow it. The Universe which we see is 4-D and the separation between us and what we see stands at zero.

Einstein was much concerned about the origin of our concepts of time and space and he wrote, "It appears to me, therefore, that the formation of the concept of the material object must precede our concepts of time and space." It would seem, then, that the concept of a material object arises in the genetic programming through the identification of the perceiver with a physical organism.

Perhaps, then, it is the genetic programming itself that veils the changeless, the infinite, the undivided, and projects in its place the changing, the finite, the divided in which we see the changeless as inertia, (energy), the infinite as electricity and the undivided as gravity and the attraction between opposites like plus and minus charges and spin-up and spin-down.

And if the genetic programming is indeed responsible for this apparent misperception, then we can understand why we run after peace, freedom and love. Peace and security is the changeless. Freedom is the infinite. And love is the undivided showing through in the genetic programming. But the genes have us persuaded to chase these reflections in ways that get the prime directives of the genetic programming fulfilled. The only thing that survives in the gene pool is babies. And any programming that gives rise to babies survives. And our"vital energy," by eating and breathing, is borrowed from the Sun.

ENTROPY

It is easier to scramble an egg than to unscramble it.

Entropy is a measure of the "scrambledness" of energy, and because there are more ways to be scrambled than to be unscrambled, the scrambledness of energy tends to increase. The entropy tends to go up.

Energy is simply the nature of the underlying existence showing through in space and time, and its amount always remains constant. It is only the "quality" of the energy - its "usableness", that gets degraded. Entropy is a measure of this degradation.

> *"Die Energie der Welt bleibt constant; die Entropie strebt einem Maximum zu."* (The energy of the world remains constant; the entropy strives to a maximum.) – *Rudolf Clausius (1822-1888)*

This is a statement of the first and second laws of thermodynamics. The term "laws" doesn't mean edicts, but only statements about how matter behaves. Physics is about how matter behaves, and these are statements about that. This is simply a statement that although the energy in the Universe remains constant, the entropy tends to go up.

Negative entropy is a measure of the usableness of the energy. Gravitational energy and the kinetic energy of large moving objects is completely usable. Heat energy is not, because the directions of the motions of the particles have been scrambled. That is what we call heat. Temperature is a measure of the mean kinetic energy of the molecules.

When you panic stop on the freeway, the kinetic energy of your large moving vehicle gets scrambled to heat by friction in the brake drums and the brake shoes, the tires and the road. If you could unscramble it, it would once again be the kinetic energy of your large moving vehicle. Now if, instead of being scrambled by friction in the brakes, the energy had instead been run into a flywheel (which is also a large moving object), you could have then used it to re-start your car. That is how they re-start the mail trucks and the milk trucks in Europe.

Since all living organisms must find and use a source of energy less scrambled at the start, life is impossible except in a world that is going from bad to worse. All living organisms live in this cascade of increasing entropy by directing streams of the increase in entropy through their forms. For all living organisms, negative entropy is food. When you eat it, it's cake; when you're through with it, you push the plunger.

In the last century(19th), and in the early days of this century (20th), it was usually taken for granted that the mix of the chemical elements in the Universe was given at the time of creation, if there was a creation, or had been around forever, if there was a forever. (It was not known then that the other chemical elements are fashioned from hydrogen in the bellies of stars.) And it was thought then that if you just shuffled the mix long enough, it might come out in the present configuration again. But then there was the problem of entropy. It was already known that entropy tends to a maximum and would surely go up. (Back in those days the expansion of the Universe had not been noted yet, nor the extent of it.)

Back then, considering the consequences of continuously increasing entropy, it was thought that the Universe would eventually reach a "heat death." It was thought that eventually every chemical reaction that could have taken place would have taken place, and that everything that could have fallen would have fallen. And it was thought that when all these other energies had gone to heat, the Universe would be just a little warmer and life would be snuffed out.

Now it turns out that, like life, the formation of galaxies and stars would also be impossible except in this cascade of increasing entropy. A galaxy could not be formed by stars falling together because the stars would be too lonely to collide. The entropy would not go up because the stars would not collide and therefore the energy of falling would not be scrambled to heat. Galaxies are formed when clouds of hydrogen fall together because the clouds are big enough to collide. The clouds, unlike the stars, are large with respect to the spaces in between them. So the particles of each cloud collide with the particles of the other cloud and thus scramble their motions to heat. (Stars like the Sun have a density of more than a pound per pint, whereas the density of the interstellar clouds is closer to a pound per billion cubic miles.) It is because of their large sizes that the clouds collide, and the energy of falling is transformed to heat. We say that the entropy has gone up.

Similarly, stars are formed when clouds of gas and dust collide because the entropy goes up as the energy of falling is transformed into heat. (Stars are not hot because of nuclear fusion at the core. They are hot because the energy of falling has been transformed into heat. The heat released by fusion simply keeps them from collapsing further and thus getting too hot. But this is only temporary until the fuel for fusion runs out).

Locally, within the Universe, the entropy always goes up. However, for the Universe as a whole, the entropy may not go up. The observable Universe has a border, some fifteen billion light years distant in all directions, imposed on us by what is called "the expansion" of the Universe. It is imposed on the observer by the fact that all the distant objects appear to be moving away from us at a faster and faster rate. At some fifteen billion light years from us (at the apparent rate of expansion), they are estimated to be receding from us at or very near the speed of light. It is this apparent "expansion" that imposes a border to

the observable Universe because things receding from us faster than the speed of light are not observable. Note that if the rate of expansion were higher, the border would, of course, become closer.

Now, when we consider matter near the border its radiation, as seen by us, would be redshifted (lowered in frequency) much as the pitch of a fire engine's siren lowered when the fire engine has passed us and is going away from us. But if the energy of the radiation of the distant particles is lowered, so too is the energy of the particles themselves as seen by us, and therefore also their mass (because E=m from Einstein). (We know from Einstein's 1905 equations that what we see as matter is just potential energy. Swami Vivekananda had suggested this to Nikola Tesla some ten years earlier. But Tesla had failed to show it.)

There are two very interesting consequences of this apparent lowering of the mass of these particles. First, radiation running through a field of low-mass particles would be so often picked up and re-radiated that it would be thermalized to 3^{o} Kelvin. It would appear as the background radiation discovered by Penzias and Wilson in 1965. Second, if the mass of the particles approaches zero, their momentum must also approach zero (because momentum = mass times velocity, and the velocity approaches a constant.) However, if the momentum approaches zero, so does our uncertainty in that momentum. As such, by Heisenberg's Uncertainty Principle, our uncertainty in where they are must approach totality. (According to Heisenberg's Uncertainty Principle if we can know where a particle is, we cannot know its momentum. Conversely, if we can know the momentum of a particle we cannot know precisely where it is. So then, if we can know the momentum of a particle at the border we cannot know that it is at the border. We cannot know both its momentum and its position.) If the particles thus recycle by "tunneling" back into the observable Universe as hydrogen (with its gravitational energy thus restored), then the entropy of the whole Universe might not increase but always remain the same.