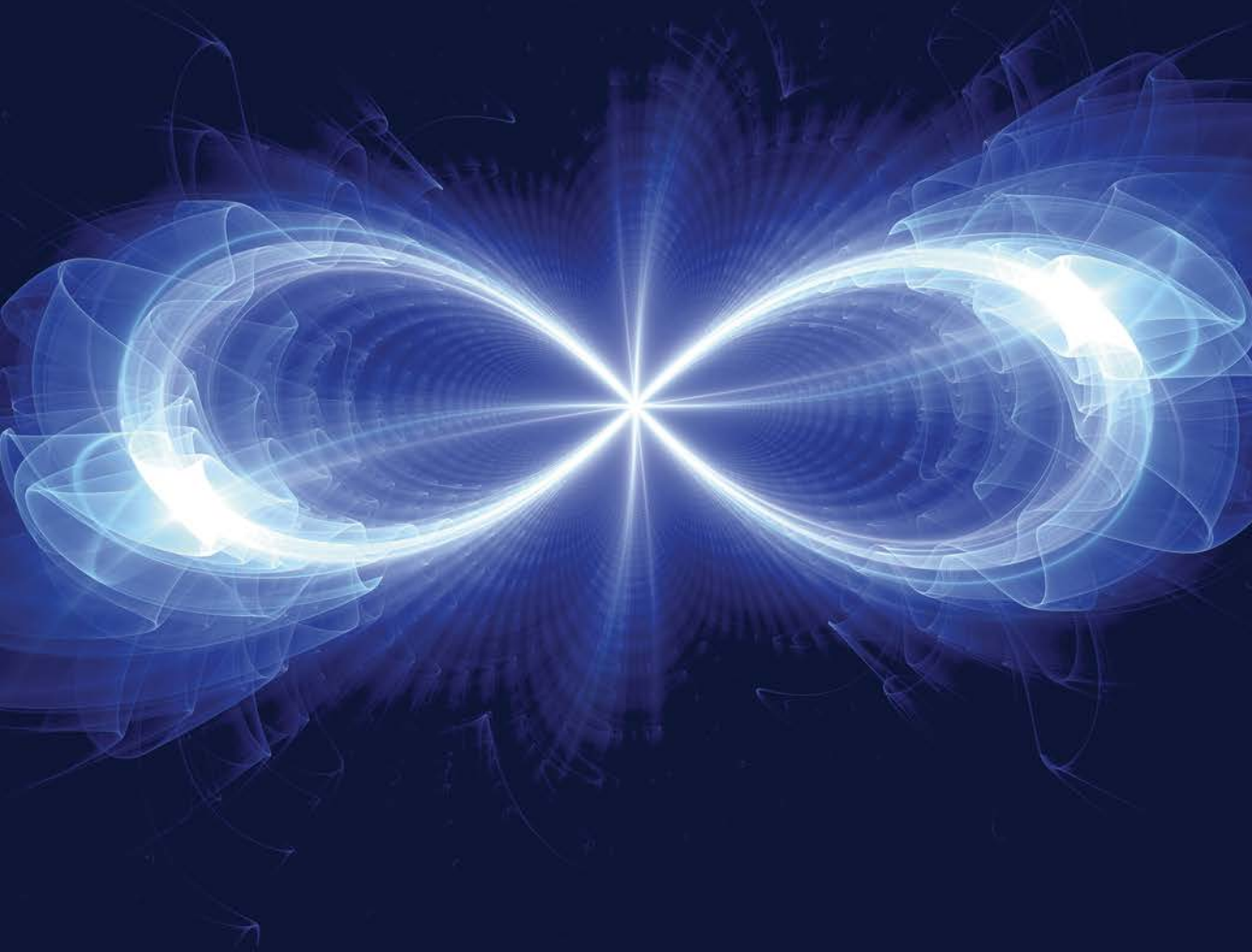
SYMPHONY OF MATTER AND MIND

PART TWO

THEORY OF ENERGY HARMONY

MECHANISM OF FUNDAMENTAL INTERACTIONS



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Symphony of Matter and Mind. Part Two.
Theory of Energy Harmony. Mechanism of Fundamental Interactions.

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TABLE OF CONTENTS

INTRODUCTION

Current mainstream theories of physics, the Standard Model of particle physics and the General Theory of Relativity, are incompatible due to the different mechanisms that they offer as explanations of fundamental energy interactions. This is considered the main problem for unifying them into a 'theory of everything.' Unfortunately, the problems are not limited to this issue.

Both theories contain arbitrary variables and constants that do not have any physical meaning and are fitted to the results of experimental tests every time the predictions fail. Moreover, the equations lead to infinities that are hidden by mathematical tricks to adjust the solutions to reality. Many physicists consider this internal inconsistency to be a sign of the mathematical ingenuity of the models. However, the sad truth is that the descriptive and explanatory basis of the models is a muddle and the predictive power is zero. Thus, they are practically useless. On top of this, both postulate the existence of virtual entities responsible for observable physical interactions. This means that the models have become metaphysical belief systems. Some physicists dare to correctly call the situation the fall of theoretical physics as a science. To see it rise, we need an alternative path.

In the second volume, the author continues to build the Theory of Energy Harmony based on the model of the universal mechanism proposed in the first part of the study. This mechanism underlies all fundamental interactions and can be called a unifying physical principle. The model does not use any virtual "ghosts" or arbitrary postulated parameters. It is self-consistent and adequate to reality. It contains only empirically verifiable assumptions and predictions. This is a paradigm shift that takes us back to physics.

CHAPTER 1

THE FUNDAMENTAL MYSTERY

To tell us that every species of things is endowed with an occult specific quality by which it acts and produces manifest effects, is to tell us nothing.

Isaac Newton

People noticed a long time ago that in nature there are two main and opposite directions of interaction: attraction and repulsion, merger and separation, creation and destruction. They attributed a religious character to this phenomenon and created mystical entities responsible for it. These were the gods of creation and destruction, or one god became two-faced and combined two opposite principles. Then came the era of the scientific approach, and physicists began to call the phenomena of interaction manifestations of "forces." They gave different names to these forces (electromagnetic, gravitational, strong nuclear, weak nuclear). However, in order for such an approach to differ from a religious one, an explanation of the physical mechanism of the work of such forces is needed. Otherwise, there is no difference between the concept of Force and God, since the paths of both are inscrutable. The concept becomes an auxiliary variable that patches a hole in the explanatory base and can act as it pleases.

There is a very subtle point here. If we use the verb "act," then its personal form carries the connotations of the work of some transcendent entity that acts on the phenomena of the world in one way or another. This again brings us back to the religious concept of the world order. It is no coincidence that physicists gradually switched to the term "interaction." This word denotes a process that occurs with the phenomena themselves and is carried out by them. However, to say that a fundamental interaction occurs is just as insufficient as to say that a fundamental force is at work. We need to understand the mechanism of interaction.

Mainstream theoretical physics applies the "good old" corpuscular model, which can be briefly described as follows: everything complex consists of simple parts; simple parts in their depths consist of the simplest indivisible parts. This is

reflected in the name of the main theory of physics: the Standard Model (SM) of elementary particle physics. It is the heiress of the Quantum Mechanics (QM) model that we have dealt with in detail in the first part of the "Symphony of Matter and Mind" series.

The question remains: how do those fundamental parts interact to form complex things? Here is a short description of the SM answer: all interactions are the exchange of virtual particles. Such a description involves virtual entities that somehow take part in the real physical process and are the force behind it. The ghosts materialize the world: they are responsible for the interaction of physical entities and for the formation of these entities. Astonishingly, this loss of physical meaning is taken as a standard in theoretical physics.

It is very important to remember here that we are talking about interaction at a distance because no matter how much space there is between particles, it still exists. For example, if we correlate the scales of the Solar system and the atom, the electron in the nearest orbit in the hydrogen atom will be 12 times farther than Pluto from the Sun or 490 times more distant than the Earth from the Sun (Hotson, 2002). How does SM explain such interaction at a distance? The answer looks like this: virtual particles (photons, gluons, bosons, gravitons) are carriers of the corresponding interaction (electromagnetic, strong, weak, gravitational) and constitute the fields corresponding to these interactions.

For example, here is how any textbook on particle physics describes the mechanism of the strong interaction: quarks exchange gluons. The question from a student: what are quarks? The answer from SM: quarks are structureless point particles that no one has ever observed but we know that they exist as they constitute hadrons (protons and neutrons). The question from a student: how did we determine that they are there if they are unobservable? The answer from SM: they should exist because they explain the laws of the relationships in the interactions of other particles.

Physicist Fritjof Capra wrote: "The persistent failure to detect them experimentally, plus the serious theoretical objections to their existence, have made the reality of quarks extremely doubtful. On the other hand, the quark model continues to be very successful in accounting for the regularities found in the particle world … The quark puzzle has all the traits of a new koan, which, in turn, could lead us to a major breakthrough in our understanding of subatomic particles" (Capra, 1975). We can only wonder, how a koan (a statement that has no logical structure, contains alogisms and paradoxes) can lead to a breakthrough.

It is interesting that within the particle zoo there is even such a beast called "Kaon" (K meson). It is a group of four mesons with a quantum number called "strangeness." They are also called bound states of a "strange quark" (or antiquark). They are used as an explanation of the matter-antimatter symmetry (Nobel Prize in 1980). They are at the foundation of the quark model within SM and the theory of "quark mixing" (Nobel Prize in 2008). This strange mix of virtual quark koans and kaon koans seems to be good foundation for real prizes.

Gluon is another koan of mainstream physics. It is postulated as an elementary particle without mass, which combines everything like glue (hence the name). It

is a carrier of the strong interaction between quarks. According to SM, strong nuclear interaction, which "glues" nuclei together, behaves strangely. "Up to a distance of around a fermi (10^{-15} m.), it is very strongly repulsive, keeping the nucleons apart. Then, for no apparent good reason, it changes abruptly to very strongly attractive, then drops off very rapidly, so that at a distance of around three fermis it becomes immeasurable. This peculiar shape has never been successfully modeled by any theory. Note how current theory, in which the fudge is an accepted scientific procedure, "solves" this problem. Since current theory can't model this *observed* force, it simply ignores it, and instead invents (fudges) an *unobserved* (fifth!) force carried by eight "gluons" (*designed to be unobservable*) between eighteen or thirty-six "quarks" (*also designed to be unobservable*) inside the nucleon. It then "suggests" that this fudged gluon force in some unspecified way "leaks out" of the nucleon to make up the peculiar shape of the measured strong force … After fifty or so years of effort, the huge physics establishment admittedly has failed utterly to provide a model that comes close to matching that peculiar shape of the nuclear force" (Hotson, 2002).

Here are more questions from a student who has not traded physical sense for good scores on the exam. How do these virtual particles without mass and structure convey interaction? Answer: they fly in the void on their angelic (massless) wings and do what they should. Question: let the angels bring the "glad tidings," but how do they transmit it? Answer: a real elementary particle swallows the virtual angel. How does it swallow? Isn't it elementary, structureless, fundamental, indivisible, and so on? And where did these angels without flesh come from? Answer: another real particle spat them out. How? Isn't it elementary, structureless, fundamental, indivisible, and so on? Sit down, student. You poorly studied the introductory dogma: everything happens through the interaction of particles. If there are no particles, we will invent them and their special properties to keep a lid on things. Particles copulate, give birth, or swallow each other, and let it remain their intimate secret. The main thing is to describe the process with beautiful formulas and diagrams. Shut up and calculate.

The student sits down and thinks: you need to either leave the mainstream and look for physical meaning or believe in ghosts, but get the best marks, and then a salary, titles, bonuses and prizes. Generations of students made the second choice. As a result, the Standard Model is the mainstream in theoretical physics. But in essence it is a belief system that is similar with the most ancient religious picture of the world — animism. According to this model, there are many virtual spirits in the world, which are responsible for the phenomena observed in it. This version of the mechanism has existed for thousands of years. But it is not about a physical mechanism and is not about science.

However, the field of knowledge we are talking about is called elementary particle physics and it claims to be scientific. Any textbook or encyclopedia will necessarily contain lines stating that the SM is the most successful and experimentally proven theory in the history of science. What is its success? The mathematical description of virtual objects. However, the question of the physical reality of the interactions remains.

Capra wrote: “Particles are processes rather than objects … The simple mechanistic picture of basic building blocks had to be abandoned, and yet many physicists are still reluctant to do so. The age-old tradition of explaining complex structures by breaking them down into simpler constituents is so deeply ingrained in Western thought that the search for these basic components is still going on … The incomplete character of a theory is usually reflected in its arbitrary parameters or ‘fundamental constants,’ that is, in quantities whose numerical values are not explained by the theory, but have to be inserted into it after they have been determined empirically. Quantum theory cannot explain the value used for the mass of the electron, nor field theory the magnitude of the electron’s charge, or relativity theory that of the speed of light. In the classical view, these quantities were regarded as fundamental constants of nature which did not require any further explanation. In the modern view, their role of ‘fundamental constants’ is seen as temporary and reflecting the limitations of the present theories. According to the bootstrap philosophy, they should be explained, one by one, in future theories as the accuracy and scope of these theories increase. Thus, the ideal situation should be approached, but may never be reached, where the theory does not contain any unexplained ‘fundamental’ constants, and where all its ‘laws’ follow from the requirement of overall self-consistency” (Capra, 1975).

Capra is right: nothing in physics, as, indeed, in any branch of science, is ideal. Any theory can have only the best explanatory power at this stage of cognition and cannot claim to be final. The new idea may just be a hypothesis, or it may be a whole set of hypotheses and a coherent, self-consistent theory. It can never be entirely new. Any theory is a bootstrapping from the previous ones, even if it refutes some of them. Nevertheless, it must possess the primary feature of a scientific model: to be testable and refutable in principle. It cannot contain arbitrary parameters or virtual entities that “explain” things while being unexplainable themselves.

Unfortunately, the situation in theoretical physics has not changed, and everyone is still talking about some future theory that should explain all of the conundrums self-consistently. For example, physicist and psychologist Arnold Mindell wrote: “If you don’t like the concept of virtual particles, you can always come up with a better idea. You never have to understand or agree with anything in physics. If you can think of something better, just rebel against what has been taught until now, and prove your ideas. Nothing in physics is final. If something in you refuses to understand something in physics, it may be that everybody else is wrong and something is missing” (Mindell, 2000).

Mindell is correct: if you do not agree to something in current theories, just offer your ideas and prove them. It makes no sense to just criticize and negate without suggesting anything instead. But as a psychologist, he must understand that rebellion is not as easy as he describes. In reality, it is suicide for a physicist’s formal career. It is impossible to make a career if you don’t wear the “Particle” team uniform. You should not think, but just play for your team. The “Particle” team sets the rules. There are only two of them. Rule number one: the “Particle” team is always right. Rule number two: if it is not right, see rule number one.

The history of science teaches us two lessons. First, old paradigms are not easily discarded. There are multiple factors that contribute to this phenomenon, such as politics, economics, personal beliefs, and national interests. However, the main reason is that the model of reality must be both stable and dynamic. If the model is too dynamic, it cannot meet the current tactical needs. Conversely, if the model is too rigid, it cannot provide the strategic needs of adaptation to a dynamic world, and eventually, it will simply collapse. Second, history teaches us that a paradigm shift is inevitable but only after a decisive accumulation of evidence in favor of a more accurate representation of the world. Until then, no matter how many contradictions the old model contains, it will remain the dominant theory.

Physicist Matt Strassler described the problems of the corpuscular model as follows: “The term “virtual particle” is an endlessly confusing and confused subject for the layperson, and even for the non-expert scientist. I have read many books … and all of them talk about virtual particles and not one of them has ever made any sense to me … The best way to approach this concept, I believe, is to forget you ever saw the word “particle” in the term. A virtual particle is not a particle at all. It refers precisely to a disturbance in a field that is not a particle. A particle is a nice, regular ripple in a field, one that can travel smoothly and effortlessly through space, like a clear tone of a bell moving through the air. A “virtual particle,” generally, is a disturbance in a field that will never be found on its own, but instead is something that is caused by the presence of other particles, often of other fields. Analogy time (and a very close one mathematically); think about a child’s swing. If you give it a shove and let it go, it will swing back and forth with a time period that is always the same, no matter how hard was the initial shove you gave it. This is the natural motion of the swing. Now compare that regular, smooth, constant back-and-forth motion to what would happen if you started giving the swing a shove many times during each of its back and forth swings. Well, the swing would start jiggling around all over the place, in a very unnatural motion, and it would not swing smoothly at all. The poor child on the swing would be furious at you, as you’d be making his or her ride very uncomfortable. This unpleasant jiggling motion — this disturbance of the swing — is different from the swing’s natural and preferred back-and-forth regular motion just as a “virtual particle” disturbance is different from a real particle. If something makes a real particle, that particle can go off on its own across space. If something makes a disturbance, that disturbance will die away, or break apart, once its cause is gone. So it’s not like a particle at all, and I wish we didn’t call it that” (Strassler, n.d.)

So, particles are not particles at all but ripples in the field. Some ripples are nice and regular so they are real, others are disturbed ripples and they are virtual. But here come the main questions of theoretical physics. How are those nice or disturbed structures produced? How do they interact? The authors explanation: something makes them and they go off across space; if this something as the cause of everything is gone, they die away. This explanation makes no sense to either the layman or the non-expert scientist, unless that person is fascinated by magical explanations of how something produces something with the shove of a hand

(God's?), that makes those nice regular motions of the swing or causes them to jiggle.

Does it make sense to the expert scientist such as Strassler? It seems so because he does not care to dwell on the mechanism of the creation any further and proceeds with the explanation of the interaction mechanism: "Two electrons approach each other; they generate a disturbance in the electromagnetic field (the photon field); this disturbance pushes them apart, and their paths are bent outward. One says they "exchange virtual photons," but this is just jargon … But if two electrons pass near each other, they will, because of their electric charge, disturb the electromagnetic field, sometimes called the photon field because its ripples are photons. That disturbance is not a photon. It isn't a ripple moving at the speed of light; in general isn't a ripple at all … This disturbance is important, because the force that the two electrons exert on each other — the repulsive electric force between the two particles of the same electric charge — is generated by this disturbance. The same is true if an electron and a positron pass near each other; the disturbance in this case is similar in type but different in its details, with the result that the oppositely charged electron and positron are attracted to each other" (Ibid).

Things interact by the magic of the disturbance of the field which is a ripple called photon which is not a ripple at all. This is an enlightening explanation. To top it off with a nice cherry, it all happens because of the charge type. How? Just because there is a charge sign that makes things attract or repel depending upon whether it is opposite or similar. Why do these charge types attract or repel? Because they are of a specific type. The author does not even notice that this is a circular logic (logical fallacy) and considers that this completes the explanation of the mechanism: "That said, it is not at all mysterious; it is something whose details, if we know the initial motions of the electrons, can be calculated easily. Exactly the same equations that tell us about photons also tell us about how these disturbances work … Perhaps unfortunately, this type of disturbance, whose details can vary widely, was given the name "virtual particle" for historical reasons, which makes it sound both more mysterious, and more particle-like, than is necessary (students of math and physics will recognize real photons as solutions of a wave equation)" (Ibid).

Students of mathematical physics, who must shut up, calculate and not care about physical sense, remember that the wave equation was stripped of its physical meaning as the description of waves in a medium and turned into the description of the probability of finding particles in this or that state (Copenhagen interpretation of quantum mechanics). Overall, the quantum equations do not tell us how these disturbances work. The attempts to describe the mechanism of interaction come to the same old mantra of exchange of virtual particles that the author calls just jargon. They substitute the phenomena of energy oscillations in a medium with magic interactions of particle-like entities in an empty space.

The author tries to explain: "Physicists often say, and laypersons' books repeat, that the two electrons exchange virtual photons. But those are just words, and they lead to many confusions if you start imagining this word "exchange" as meaning

that the electrons are tossing photons back and forth as two children might toss a ball. It's not hard to imagine that throwing balls back and forth might generate a repulsion, but how could it generate an attractive force? The problem here is that the intuition that arises from the word "exchange" simply has too many flaws. To really understand this you need a small amount of math, but zero math is unfortunately not enough. It is better, I think, for the layperson to understand that the electromagnetic field is disturbed in some way, ignore the term "virtual photons" which actually is more confusing than enlightening, and trust that a calculation has to be done to figure out how the disturbance produced by the two electrons leads to their being repelled from one another, while the disturbance between an electron and a positron is different enough to cause attraction" (Ibid)

The mechanism of "virtual particles exchange" is just words that cause confusion. But is there any alternative explanation? No, we do not need one because what we need is just math to figure out how things attract or repel. The standard way of the Standard Model is to confuse a physical explanation with a mathematical description, trust in it and get enlightened.

This is how the enlightenment sounds: "The language physicists use in describing this is the following: "The electron can turn into a virtual photon and a virtual electron, which then turn back into a real electron." And they draw a Feynman diagram (which is) a calculational tool, not a picture of the physical phenomenon … For those who learned (and recall a bit of) freshman physics, what is happening is that the oscillating electric field that makes up the photon is polarizing the electron field — inducing a dipole moment. Remember dielectrics and how electric fields can polarize them? Well, the vacuum of empty space itself, because it has an electron field in it, is a polarizable medium — a dielectric of sorts" (Ibid).

We need to stop here because the picture gets so confused that Strassler does not even notice the oxymorons that it produces. Just look at the last statement: the empty space is a polarizable medium. How can the void be a medium? If it is a medium, it is not an empty space. This is what any person who recalls a bit of freshman physics and has not parted with common sense would think. Are there any reasons the expert's explanation gets so confused? There are two major reasons.

The first one is political: the mantra about the empty space is still so imprinted in the minds of mainstream physicists (experts) that they do not even notice how they reach a dead-end using it and begin to contradict themselves. It started with Einstein abolishing the notion of an all-encompassing medium: "The first step we must take is to *give up the ether* … From this it follows that the only way to arrive at a satisfactory theory is to give up the notion of a medium filling all the space. This is the first step to be taken" (Einstein, 1910). What did he leave physicists with? "The region of space without matter and without an electric field appears completely empty, i.e., it cannot be characterized by any physical quantities" (Einstein, 1918).

Something that cannot be characterized by physical parameters is an intangible void. Did he or others arrive at a satisfactory theory using the concept of a void?

Not at all. That is why there is still no unified theory of fundamental interactions. By the end of his life, Einstein had to admit that "the concept empty space loses its meaning" (Einstein, 1954).

We will deal with these vicissitudes of his model in the later chapters where we will make a step back and give up the void to return physical meaning to our modeling of the world. Here we only note that the intuition about wave phenomena, which Strassler refers to, does not work for phenomena occurring in the void, because waves, by definition, are the movement of oscillations in a medium. That's why he has problems when he tries to unite the empty space and the field. If there is an empty space in-between, how can something induce momentum on something? We can only think of some virtual entities flying in it and carrying the interaction momentum on their "angelic wings." The indirect interaction of real things at a distance becomes possible only by exchanging some unreal things as only something intangible can move in an intangible void. But such a picture requires faith, not scientific knowledge.

So, the second reason for the confusion is related to the main question of theoretical physics: how matter forms and interacts. If we think of the mechanism as some magic transformation of virtual entities into real entities, we are back to the religious animism that speaks of spirits. The only difference is that SM offers a mathematical description of these spirits. The author speaks the truth: a diagram of particle interaction is just a math tool not a picture of a physical phenomenon.

But we are back to the question of attraction and repulsion: "It's not hard to imagine that throwing balls back and forth might generate a repulsion, but how could it generate an attractive force?" (Strassler, n.d.) The author tries to explain it by ripples: "The reason ties back to the very reason that there are anti-particles in the first place: every field, by its very nature, has particle ripples and anti-particle ripples" (Ibid) This is the explanation: the field by its nature has particles and anti-particles that attract or repel. Why? Because they are particles and anti-particles. The circle is closed. We are enlightened.

The author wishes that we would not call those ripples "particles" but keeps on using the term for historical reasons. Of course, the word inevitably leads to an image of a discrete entity, not a ripple (continuous phenomenon). This intuition is the basis of the millennia-old atomistic paradigm. It certainly has many flaws. The main one is that it gets into an impasse when it comes to the question of the mechanism of interaction. It inevitably leads to a mechanical picture of the process as flying balls that repel or attract. This picture can describe direct contact. But when it comes to interaction at a distance it is useless. Moreover, it cannot explain both sides of the interaction. And we should not forget the balanced state due to which stable structures exist. The only way to arrive at a satisfactory theory is to account for all three aspects (attraction, repulsion, balance) and return to the notion of a medium filling all the space.

Often people say that the problem is not in terminology. Yes, we can choose any words. But words carry meanings. We lose meaning if we are careless with the terms. Can we choose another word to describe the fundamental levels of matter? Can we use another analogy that will lead us to true enlightenment out of

the oxymorons of SM and get us back to the physical sense? Werner Heisenberg, one of the pioneers of QM and its heiress SM, explained: “The only thing we know from the start is the fact that our common concepts cannot be applied to the structure of the atoms” (Capra, 1975). The creator of virtual particle interaction diagrams, Richard Feynman wrote: “I think I can safely say that nobody understands quantum mechanics … Do not keep saying to yourself, if you can possibly avoid it, ‘But how can it be like that?’ because you will get ‘down the drain’, into a blind alley from which nobody has yet escaped. Nobody knows how can it be like that” (Feynman, 1965).

So, the prophets know from the start: do not even dream of any physical analogies; forget about common sense and physical meaning. Asking questions will not lead you to enlightenment but only into a blind alley. QM became a select branch of “super-knowledge” that no one understands, including the model’s creators. Believing is the only solution for the parishioners of this church. But to get enlightenment we need to do exactly the opposite: start asking questions and seeking answers that have physical sense.

Let’s go back to the musical analogy used by Strassler: the tone of a bell. Unfortunately, he does not pay enough attention to it. However, it has two main points that can lead us out of the difficulties of theoretical physics as a whole and the author in particular. First, it is a wave phenomenon, which can be described using common physical concepts. Second, it clearly indicates the need for a medium for the distribution of energy and the implementation of energy interactions. The author writes about the field all the time, but it turns out to be “empty space” for him. Thus, he nullifies his own analogy with the propagation of the sound of a bell in the air. Nothing can propagate in the void, neither “nice ripples” nor “disturbances.”

As soon as we include an all-filling energy environment in the model, there is no need to build castles in the void. Moreover, the concept of virtual intermediaries of energy exchange becomes superfluous, no matter how we call them, “particles” or “disturbances.” The all-filling environment is a universal intermediary. In fact, the word “intermediary” will not be correct because it is not just in between the material entities. It is what constitutes the entities and what is between them. We can call it with various words (ether, field, etc.) but we should stick to the meaning of a continuous energy environment with no void gaps. There are just various states of this energy in different regions. A vacuum is not an “empty space.” It is just a region where forms of matter are not created. The only thing we need to solve the basic problem of theoretical physics is to show the mechanism that creates them.

If we choose a musical analogy, we are physically grounded. Such a change of analogy seems trivial but leads to a way out of the blind alleys of mainstream models of theoretical physics. We can explain things (even the structure of an atom) by common physical concepts. We can deal with all those mysteries that SM has proclaimed unexplainable. We return physical meaning to the wave equation that becomes the description of actual physical waves and not “waves of probability.” We can explain the periodicity of the chemical elements table

without using virtual balls orbiting other balls in the void. We can explain also the real "balls" of celestial bodies' movements and structures. We can explain the uncertainty principle without any mystical awe of Nature that plays tricks with us to make us uncertain about the position and momentum of balls in the void. We can explain the double-slit experiment result that Feynman called "the mysterious behavior in its most strange form" (Feynman et al., 1964-1966). But most important is that we can explain how structures of matter form and how they interact. It may sound like an unsupported extravagant claim. How can a simple change of an analogy perform such a "miracle"?

First, if the statements sound extravagant there is only one reason for that: usually, people take something new as extravagant. Only when they get acquainted with the idea it becomes self-evident and trivial. So, the reader should be patient, look into the details supporting the model and not jump to conclusions before that.

Second, we have dealt with the foundations of the model called the Theory of Energy Harmony (TEH) in the previous part of the study and solved the mysteries listed above using the musical analogy (see "Part One. Music of Matter"). So, the claims are supported and for an informed reader, they are, probably, not extravagant by now.

Third, we need to stress that the use of musical terms in TEH is not a loose metaphor but a strict physical analogy. Any scientific model is analogical as we build our new knowledge using the acquired knowledge of phenomena that demonstrate similar characteristics.

Fourth, simply using the concept of a clear tone (or better still, a musical note) as a general analogy does not solve the problem. It is necessary to elucidate the mechanism underlying the analogous system (in this case, musical phenomena) and the target system (in this case, fundamental energy processes). Moreover, saying that it is all about ripples (nice or disturbed) does not get us anywhere specific. We need to show how those ripples (or better still, energy oscillations) interact and form structures that we call atoms, molecules, chemical compounds, and further forms of inanimate and animate matter.

It is not enough to engage in hand-waving by describing the hand pushing of the swing to produce an even or jiggling motion. Even this mechanical analogy is not as simple as it seems. Let's get back to the description by Strassler: "Now compare that regular, smooth, constant back-and-forth motion to what would happen if you started giving the swing a shove many times during each of its back and forth swings. Well, the swing would start jiggling around all over the place, in a very unnatural motion, and it would not swing smoothly at all. The poor child on the swing would be furious at you, as you'd be making his or her ride very uncomfortable" (Strassler, n.d.).

There is a major gap in the description that prevents the theoretical physicist from explaining the real phenomenon. Thus, the analogy only raises further questions instead of giving the answer. Why should one shove make the swing do a "natural motion" and many shoves should cause "unnatural jiggling"? Actually, this is not true. The expert-theorist missed the mechanism of interaction of

oscillations, and therefore its description does not correspond to reality. Any layman or even a non-expert scientist, who happened to help his child on a swing at least once in a life-time, knows that one shove is not enough for the child to be happy. The reason is again known to any layman: the swing loses energy due to friction. It will not go on swinging naturally and needs an input of energy. It could be an external shove or the child's own movement.

Here comes the main question: what shoves will make it continue its natural motion and which ones will cause it to jiggle? Any practical layman knows that for the ride to be comfortable one must synch with the swing motion parameters. It means that shoves should have a specific frequency related to the frequency of the swing and come at specific phases of the swing. If these two requirements are not met the shoves will cause a disturbance in the natural motion or even a complete stop. We are talking about frequency-phase coupling which is the essence of synchronization. We are talking about an optimal energy transfer mode and an interaction of oscillators. The swing and the hands make oscillations of different types and have different parameters. But for them to form a stable system they have to synch. They do not have to be in unison (1:1 frequency ratio). They do not have to be coupled constantly. They just need to intersect at some points in their phase space. They have to form a common phase portrait as a stable attractor. If they fall out of the synch region (specific ratios of their parameters), the system will collapse. This analogy works for any kind of interaction and energy exchange.

Back to the description of the expert: "This unpleasant jiggling motion — this disturbance of the swing — is different from the swing's natural and preferred back-and-forth regular motion just as a "virtual particle" disturbance is different from a real particle" (Ibid). Please, note that the author tries to explain the major tenant of SM that interactions are the result of virtual particles exchange. Ok, this is just jargon and we should call them disturbed ripples now. But, judging by the description of the author, disturbances are counterproductive for the movement of the swing. How can something counterproductive be the mediator of interaction? We are losing logic and common sense here. This is typical for the standard descriptions within Standard Model. Why? The reason is simple: they do not enlighten us on the actual mechanism of interaction.

Of course, going from the notion of a "virtual particle" to a "disturbed ripple of the field" makes the description sound more scientific as it gets rid of connotations of intangibility. But it does not help us in understanding the physical mechanism. This is why the author's formulation of a comparison of an analogous system (swing) with the target system (fundamental energy interactions) is incomplete, to put it mildly.

Let's get rid of the "virtual particle" or "disturbed ripple" concept in the above analogy. Let's imagine that the swing and a parent helping a child are interacting oscillations of energy. It is not a great stretch of the imagination as physically all forms of matter are structures of energy oscillations. For the interaction to be productive and create stable system these oscillations' parameters have to be within the synch region (frequency-phase coupling mode). If not, the swing will jiggle or even stop and the child will be furious.

Helping a child on a swing is a simple example of synch. It is far better to use the musical analogy because music is about the interaction of many oscillators with various parameters creating stable harmonious structures with specific patterns that can be described both by complex math of wave physics and simple math of frequency ratios that produce these structures. It really works as a physical analogy as it uncovers the universal mechanism of structure formation and energy interactions. As we have seen already in the previous volume of the series and will see later on, the description of this mechanism is quite intuitive and does not require any faith in virtual entities. To understand it we need a small amount of math to use it not only as a calculational tool but as a description of the physical phenomenon.

Here it makes sense to get back to the basic TEH hypothesis. It speaks of a mechanism that can be a realization of a dream to connect all Nature with the properties of whole numbers thus providing us with a model of the world that is coherent and simple. Simplex sigillum veri.

Hypothesis:

The Universe is a continuum of energy oscillations with various amplitude-frequency characteristics and phase portraits. These oscillations create forms of matter by frequency-phase coupling process (synchronization) which is optimal when parameters tend to harmonious ratios of integer numbers (synchronization region).

Using musical analogy, we can call fundamental stable structures of matter the musical notes. Composite forms are harmonious combinations of different notes that combine into the symphony of matter. In the previous part of the study, we developed detailed models of how notes of matter produce structures of the microworld (atoms, molecules, chemical compounds) and structures of the observable macroworld. Here we will move on to the mystery of energy interactions and the observed phenomena of attraction, repulsion and balanced state. For this, we need to take a step back and get to some freshman physics and look at it from a fresh point of view.

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