IT’S ELEMENTARY

A review essay by Dean M. Sandin (© 2009)

The Theory of Elementary Waves: A New Explanation of Fundamental Physics
Lewis E. Little
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THE BROADEST SCIENCES OF the natural and human worlds are full systems of thought. They unify a multitude of layers of complex, interrelated phenomena; they are world-views. In the humanities this means a system of understanding ourselves and our own existence: our minds, our values and purposes, our art, our societies and politics. We have economics, literature, history, anthropology, political science, and much more. Ultimately this entails a system of philosophy.

Correspondingly, in the natural sciences this means a system of physics – as Newton profoundly put it, the system of the world.

These sciences – chemistry, biology, geology, meteorology, etc. – are pursued with the objective of reaching our basic understanding in some area of what physically exists. They identify the natural objects we perceive, and they explain these things and their actions. The common ground of all these areas is the science of physics itself. The purpose of physics is to find our full grasp of whatever basic objects and forces exist, and to discover how they ultimately underlie all physical processes and events.

Physics is hierarchical in its scope and in its subject matter, and therefore in its theory. It spans the entire range of distance and time scales. It subsumes all manner of specific areas, each rich in itself: mechanics, gravitation, thermodynamics, optics, electromagnetism, solid-state phenomena, fluid phenomena, nuclear phenomena, and so on. It seeks to unify these areas into one system of understanding. At the base of this hierarchy lies the quantum realm of waves and particles. Our questions in that realm are the most fundamental of all. What are these seemingly ultimate constituents of the universe? How do they act? How do they underpin the objects, forces, and motions we observe on the molecular and every higher level?

The process of the unification of knowledge into a system true of the world can go very right. We’ve seen how it can take us into new eras, not to mention reach out to new planets. But being a human activity involving an intellectual division of labor and trust in arriving at the answers, the process can also go very wrong even as we progress into the new eras. In a 1996 journal article,[1] Lewis E. Little identified and innovatively rectified something that went very, very wrong nearly a century ago. Now, he presents his work in the 153 pages of *The Theory of Elementary Waves: A New Explanation of Fundamental Physics.*

Who is Lewis Little? What has he accomplished? Why has he written this book for the general public?

There is, in the realm of ideas and their presentation to the interested public, the venerable role of the public intellectual. These thinkers may vary in their professional or academic roles. They may vary in where they stand in the chain of transmission of ideas from the primary originator of them on down to the simple generalist who understands and conveys them. But they all speak to the interested among us from some earned authority.[2]

Lewis Little is a primary originator and he is speaking to the interested among us. His area is fundamental physics. His accomplishment calls to mind something from almost 500 years past, as the publisher of *The Theory of Elementary Waves* notes in his Foreword (xiii):

> My favorite books are ones that dispel decades, centuries, or millennia of misconception in one brilliant stroke. Intricate, long-standing theories built upon such misconceptions are called "error pyramids." Perhaps the greatest error pyramid ever constructed in the hard sciences was the one built around the false premise of a geocentric universe…. Astronomers produced complicated calculations and theories to account for the motion of the planets in a perceived geocentric solar system, even to the point of perfect prediction. Yet Copernicus' 1543 book on celestial mechanics, *On the Revolution of the Heavenly Spheres*, wiped away the entire vision and replaced it with one that made sense not only in the calculations but also, for the first time, in the physics.
>
> This is precisely Lewis Little's achievement with respect to the behavior of sub-atomic particles: making the physics fit the calculations.

Just what is Lewis Little's "one brilliant stroke"? How did the efforts of the primary intellectuals of physics go wrong with quantum mechanics? What gave rise to the "error pyramid" that they erected, and how has this wrongness been sustained for nearly a century?

TO HELP US APPRECIATE what went very, very wrong, here is the author's opening statement in Chapter 1 ("Introduction") of the consequences (1):

> The science of physics, as conceived by today's leading academic theoreticians, has become insane to the point of farce. Physicists proudly claim to have demonstrated that subatomic particles can be in two different places at the same time; that time can go backwards; that widely separated events can affect one another instantaneously and by no means; that the effect of an action can precede its cause; that objects can exist whose physical parameters have no quantitative value in particular and/or many different values simultaneously; that many behaviors of subatomic particles occur by chance and are uncaused; that the law of cause and effect has been refuted…. An internationally known physicist and professor at Cornell has stated, "We now know that the moon is demonstrably not there when nobody looks."[3]

As an aside, I can't resist paraphrasing the time-honored sophomoric question: does this also mean that a tree falling in the forest "demonstrably" (!) isn't there when nobody listens? Anyhow, here is the author's summary of how it all went wrong (2):

> Some 80 or 90 years ago, physicists made a fundamental error in their development of the theory known as quantum mechanics…. Because the theory is erroneous, physicists inevitably began to uncover laboratory evidence that contradicted it. In the face of that evidence, physicists should have retraced their steps until they discovered the error; but instead, reluctant to give up the partial success they had achieved with the theory, they chose to "twist" reality in an attempt to make it agree with the theory. The absurdities listed above are the product of that twisting….Today, matters have reached the ultimate extreme: Serious academics…claim to have "refuted reality," by which they mean that physical behaviors are not the product of anything real.

What is the logical, inevitable consequence of all this? What must follow if a radical "refutation of reality" is accepted? Dr. Little relates that in his grad-student days at Princeton a famous mathematical physicist (an eventual Nobel Laureate) told him in conversation that "Physics consists only of relationships between states of consciousness" (48). This is the position that quantum physics finds itself in today, even if many of its practitioners would not want to believe in its fullest meaning.

But what of the enormous success, mathematically speaking, of quantum mechanics (QM)? What of its comprehensive ability to calculate observed outcomes, as typified by the amazing accuracy of quantum electrodynamics? To avoid misunderstanding what it is that the Theory of Elementary Waves (TEW) *does* criticize and reject in conventional theory, and what it does *not* criticize or reject, consider the difference between mathematics and physics. It holds that the *mathematics* of QM is *valid,* because it applies to reality. It works: the very job of the mathematical methods is to calculate what will be observed. But the *physics* of QM is *invalid,* because it maintains nonsense about the physical objects.

This leaves us to conclude that whatever the correct physical picture is, it must be describable with mathematical formalisms and methods already established in QM. The author of TEW shows that it passes this test. The key is QM's well established reciprocity principle: a quantum wave traversing a system from a source at A and reaching a detector at B will have the same intensity at B as the identical but "reciprocal" wave traversing the system from B to A would have at A.

The physical objects of the quantum realm are indisputably the quantum particles and the quantum waves. The totally successful mathematical account of that realm leaves no opening for disruption by a new kind of physical feature. TEW's bold move is instead to literally reverse QM's fundamental physical premise: "*Quantum mechanics has the waves moving in the wrong direction*" (26, emphasis added).

A generalization of quantum experiments would feature the emission of particles from a source, their scattering through some system, and their arrival at a detector, along with the transmission and scattering of quantum waves through the same system. QM insists that the waves are emitted with the particles and travel to the particle detector. Indeed, this physical premise is the defining characteristic of QM as a species within the genus of potential theories of the subatomic world. Conversely, it is the defining characteristic of TEW that the waves go in reverse, from detector to source.

It is perhaps surprising that this issue of direction is not even raised in QM. What Dr. Little terms its "forward-wave hypothesis" has not been questioned until TEW. How so? Looking ahead to Chapter 3, he states there: "…[A]t the time the forward-wave hypothesis was first accepted, no one had as yet recognized the impossibility of explaining the behaviors of the individual particles under this assumption. By the time it was recognized, so much had already (apparently) been accounted for by the forward-wave theory that no one thought to question it. The forward wave had come to be accepted as established fact" (33).

Really basic assumptions can disappear from view.

The result of institutionalizing a massive error is predictable: a massive, institutionalized insulation from corrective ideas. Also unsurprising, then, would be a touch of mystery religion: "Quantum mechanics, along with much of modern physics, riddled as it is with contradictions, undefined terms, disembodied behavior and other ‘weird’ notions that defy reason, has given many observers the impression that physics is by nature an incomprehensible science. Indeed, many modern physicists appear intent upon making the subject as opaque as possible, having built their public reputations largely around their alleged ability to comprehend the incomprehensible" (2-3).

WHAT MIGHT BE SOME of the laboratory evidence that in fact stands in contradiction to the forward-wave stance? The author obliges us in Chapter 2 ("Quantum Mechanics") by discussing several revealing examples. Echoing Richard Feynman in observing that all the issues of weirdness and unreality in QM are captured by the famed double-slit experiment, he begins with that.

In the double-slit experiment a stream of particles (say photons) is emitted from a source (say a light bulb), toward a barrier with two slits through which they may pass into the region beyond the barrier. A screen is placed in that region. The observed pattern built from the detection of these photons by the screen is one of interfering waves: alternating regions of high and low particle incidence. QM has the indicated waves also being emitted from the source. But it turns out that with this physical picture, there is truly no way to regard a given photon particle as going through just one of the slits. We have a paradox.

Explanations of phenomena are founded on the discovered identity of the objects that underlie those phenomena. Faced with unresolved mystery, we necessarily resort to interpretation in place of explanation. QM is universally regarded as requiring interpretation in this sense. The usual interpretation of the double-slit paradox is that the photon doesn’t exist as a particle until it strikes the detector screen. Until then it exists as a wave spreading and diffracting through the environment. Only when some point in this extended wave-object interacts suitably with some local object (here, some particle in the screen), does this photon wave somehow "collapse" (go out of existence instantaneously and everywhere) to become a localized entity (the photon particle). The intensity of the wave at a given point on the screen is due to the degree of constructive or destructive wave interference there. This intensity determines how likely it is that a given photon will appear there rather than somewhere else.

There are insurmountable problems with this physical picture. But QM doesn't mind the implicitly magical nature of it. The author argues that, instead, QM resorts to rejecting and rewriting reality – "twisting" it – in order to maintain the forward-wave picture. The universal element across the range of specific proposals for how to do the twist, so to speak, is what is known as "nonlocality". Nonlocality in fundamental physics is a simple idea. It means "direct, instantaneous causal contact between arbitrarily separated objects" – *immediate* causation across *any* distance – up to and including cosmological distances![4]

This represents the contradiction of physical causation through no physical means. Even in a minority-report forward-wave interpretation that seeks to picture an objective particle with an objective trajectory, nonlocal causal influences throughout the arbitrarily extended field of the wave are necessary for the determination of the trajectory.[5] Isaac Newton denounced such abandonment of physical explanation as "…so great an absurdity that I believe no man who has in philosophical matters any competent faculty of thinking can ever fall into it."[6] Albert Einstein famously contented himself with a more restrained rejection of nonlocality for being as unreal as ghosts: "spooky" action at a distance.

Lewis Little is equipped to go beyond simply decrying the nonsense. We might call that first stage the negative one of demolishment. He goes on to offer his positive step: an explanation of the double-slit results that dispels by its very example any *appearance* of a need for nonlocality. His picture of the waves explains the interference pattern at the screen without anything acting on the particles to bring them to the screen besides waves *from* the screen – with these waves acting only at the moment-to-moment locations of the particles along the single lines of their trajectories. In short, he rescues in full the essential principle that all physics is local.

Another piece of evidence for reciprocal waves being "twisted" is the 1992 Kaiser experiment. It involves a neutron interferometer: an apparatus that splits a beam of neutrons into two paths, then brings them together "downstream" where ultimately detectors await. Along one of the beam paths is placed a variable-length bismuth sample that alters the spectrum of the applicable waves passing through it. The workings of the experiment are numbingly technical, but one upshot is starkly plain. There are circumstances in which a certain element of the apparatus located downstream clearly influences the behavior of the neutrons while they are still upstream.

Now, one has to speak forcefully against pure travesty that is also received wisdom, and the author does so. In any normally physical view of something like this, the downstream element must be acting on the upstream particles *via something moving upstream to them.* That would be the one preliminary conclusion that physicists would even think of drawing while groping towards a full account. (The batter hits a home run because he swings right where the ball is pitched.) It would be almost too obvious for them to mention. But with the QM's implicitly forward waves rooted in place, theorists "did the twist". They concluded that the downstream element acts on the upstream particles *backwards in time!* (The batter's future swing causes the pitch to head right to the bat!) I'm *not* joking. This is the *really* bizarre sort of result to be expected when a calcified error pyramid has been decades in the hardening.

The TEW sweeps aside this outre claim by noting one elegant idea: the prospect of reciprocal waves. The entire Kaiser experiment, along with all its analogues that use other particles and apparatuses, is fully explained simply by having the waves moving in the other direction. Just as planetary mechanics is fully explained by having the planets move in heliocentric ellipses in accordance with Newtonian gravitation.[7] Just as Hank Aaron swung his bat according to where the ball was headed.

Recall that the TEW argues from the same experimental results and the same mathematical approach that QM relies on. If the initial development of quantum mechanics had conceived of the reciprocal-wave possibility on an equal footing with the forward-wave possibility – and if physics had been dominated by Einstein's philosophical expectation of an objective reality – then step by step the experimental findings and mathematical development would have led to the universal acceptance of reciprocal waves. The forward option would have been aborted as entailing nonlocality, backwards-in-time causation, and other such absurdities that the elementary wave picture had no motive to introduce.

RETURNING TO THE DOUBLE-SLIT case in Chapter 3 ("The Theory of Elementary Waves"), the author goes into his conception of the elementary waves. First, he does so insofar as they explain the double-slit case.

In effect (a qualification explained below), each particle in the screen "emits" elementary waves along lines in every direction. The particle uniquely organizes (puts its own "marker" on) these waves. Take a wave from screen particle *B*, and take a line of this wave that penetrates one slit and another line that penetrates the other slit. Each diffracts and some piece of each converges at the photon source *A*, interfering constructively or destructively to some degree and thus enhancing or diminishing the probability that some piece of the elementary wave from *B* will stimulate a particle from *A*.

Any particle born into an arriving piece of this wave remains a creature of that wave and follows it in reverse (through whichever slit) to its origin at *B*. The result is the diffraction pattern at the screen due to different locations of the screen emitting waves that self-interfere differently at the source. Meanwhile, wave pieces from the other points of the screen converge at *A* as well, but they do not share a common organization with the waves from *B* (are said not to be coherent with them) and thus do not interact with them.

In a strong sense this is the reverse of the QM picture. The reciprocity principle of wave direction mentioned earlier guarantees that the results predicted by TEW match the results predicted by QM. But the two pictures are not entirely symmetric. Regarding a particular emitted particle, QM has the same wave emitted from source *A* to every screen point *B*. But TEW does not send the same wave from every screen point *B* to source *A*. Rather, TEW must send a unique wave from every screen point *B*. This distinction is vital. It is TEW's cure for nonlocality. A particle reaching the screen can be affected by, and wind up at, only the point that is emitting its wave. No magical wave "collapse" across the entire screen is called for. We have pure locality: the moment-to-moment action of the wave on the particle, always *at* the particle.

There are a couple of logical loose ends here that are tied off at the end of the chapter.[8] The first point regards the "emitting" of the waves. They are not continually created ex nihilo; they are an ambient condition everywhere: (36)

> "Elementary waves are present at all times throughout all space in the universe. A detector or other object from which elementary waves emanate does not actually

> create or emit those waves. Instead, the subatomic particles that make up a detector act to rearrange, or 'organize', the waves that impinge upon them. No net 'quantity of wave' is either created or destroyed in the process."

The second point regards the connection of the wave emanation at *B* with the subsequent particle detection at *B*. This is not just a happy coincidence of two different things matching up. The particle is following the wave not by accident, but because of what the wave is. When it reaches the fount of the wave organization, it cannot continue as that particle. The detection is an inevitable part of whatever change must then occur.

UPON ENTERING CHAPTER 4 ("Schrödinger's Cat") we immediately find ourselves doing battle with the *bête noire* of QM. I don't mean just the cat itself, even assuming it's black. I mean the impenetrable mystery that the cat represents: "measurement theory". A QM particle exists everywhere and nowhere until its wave collapses. But if we don't look (measure where it is), this extended wave continues to evolve. But what is a measurement? The system that the particle is part of, including the measuring apparatus, is itself a complex wave that evolves until *its* collapse. (Perhaps that system encompasses a certain cat in a box, which feline is either dead or alive, depending on whether or not a photon emission has occurred to cause a hammer to trip and break a cyanide capsule.) What causes *that* collapse? A measuring apparatus within yet a wider system? But what causes *THAT* collapse?...

QM contains no principle for stopping. It can offer no determinate, objective final reality.[9] But since we do indeed see the particle somewhere (or a definitely dead or definitely live cat) when we do look, there must be some form of stopping point. One candidate remains. The renowned Princeton theorist who insisted that "physics consists only of relationships between states of consciousness" named it. Dr. Little is scathing about this: "The view that consciousness determines reality is not a new, progressive innovation but in fact represents a regression in human thought back to the dark ages" (40).

The measurement theory quandary is a creature of the forward-wave picture. TEW has objects – waves and particles – with determinate attributes and trajectories. It disposes of the very subject of measurement theory with one stroke of its reciprocal-wave sword. When it enters the battle and punctures the *bête noire* of QM, the *bête* ceases to exist, like a collapsed wave.

PERHAPS EVERYONE IN OUR solar system has heard mention of the subject of Chapter 5 ("Heisenberg's Uncertainty Principle"). The author recaps QM's exposition of this as involving "wave packets" that are taken as representing the particle. These are mathematical abstractions that combine simultaneous waves possessing a certain range of wavelengths (which corresponds to a range of momenta, since the particle momentum is inversely proportional to the wavelength).

Luckily these mathematical conglomerations vanish, via destructive interference, outside a certain central region: the "packet". A narrower packet means a smaller range in the positions that the represented particle may be found to have when measured, but also a greater range in the momenta that the particle may have. These ranges form the position and momentum "uncertainties" typically termed Δx and Δp. Conversely, a wider packet means a larger uncertainty for the position (Δx) but a smaller uncertainty for the momentum (Δp). Some mix of these uncertainties must always exist (if one were zero, the other would be infinite), and this is taken as proof of a metaphysical indeterminacy at the fundamental level of reality. Here is another manifestation of QM's insistence that nothing in particular exists until it gets measured.

But this picture stems from taking the waves as moving forward. TEW eliminates the suggestion of metaphysical uncertainty – of no objective underlying attributes – by reversing the waves. In that view, a particle is emitted into a particular wave within the ensemble of waves present in the environment. The QM packet that fuses this range of waves into a coherent entity becomes a fiction. TEW can credibly treat the particle's particular wave as causally independent of the waves of other slightly different wavelengths, while QM cannot. The abstract ensemble is not a causal combination. Only an individual wave is causal.

However, we do know that the mathematical Heisenberg relation, famously expressed as

$$\Delta x * \Delta p \geq h,$$

does apply in some way to observed results. (The *h*, Planck's constant, is a tiny value that reflects the tiny scale of the quantum world.) So the author goes on to derive it from the aspects of his elementary-wave scenario. He moves the uncertainty into the only realm in which that concept can have actual meaning: our knowledge, not the objects that our knowledge is of. Since the expression pertains to an ensemble of waves, the uncertainty refers to our inability to determine in advance exactly which of these waves will stimulate the emission of the particle. But once created (and because it does exist) the particle is specifically and exactly what it is.

WE MIGHT SAY OF Bell's Theorem in QM that it is the final bastion of refuge for supporters of nonlocality. Thus the need for Chapter 6 ("Bell's Theorem"). Historically, this mathematical argument concerning "EPR" experiments (named for Einstein, Podolsky, and Rosen) has been taken as a nail in the coffin of locality-based quantum physics. Since the theorem is irrefutable as a mathematical result, an opponent of TEW might seize upon it as grounds for peremptorily rejecting TEW.

In the 1930s, Einstein, Podolsky, and Rosen challenged the nonlocality in QM with certain thought experiments. These involved a pair of particles *A* and *B* (perhaps photons) emitted in different directions (say left and right) as part of a single process that correlates *A* and *B* in regard to some quantum property; we might arbitrarily call this property "orientation", which could be either *H* ("horizontal") or *V* ("vertical"). If one detector, perhaps *L* on the left, has measured a particular value for *A* (say *H*), then a corresponding detector *R* on the right must have found the other value for *B* (namely *V*).

But QM must say that neither *A* nor *B* is in any particular state until it is measured, with *L*'s measurement *causing A* to be *H* in this case, and likewise *R*'s *causing B* to be *V*. The problem here is that there is in general some frame of reference in which the detection events at *L* and *R* are simultaneous: each *must* occur before any *imaginable* signal from the other can arrive (although see the "further note" below). How could *L* and *R* coordinate what they are separately determining when no signals of *any* speed (including superluminal ones) can be exchanged in time to affect things? QM's answer is – must be – nonlocality: *A* and *B* must be "entangled" such that something happening to *A is* something happening to *B*, be they millimeters or light-years apart. (Of course, this used to be called "sympathetic magic" before QM came along to make it sound scientific.[10])

J.S. Bell sealed this argument in the 1960s with his ingenious mathematical derivation. Einstein himself failed to turn back QM long before Bell, but with Bell it became even harder to do so. Credit Lewis Little with the creative move of turning this matter on its head. By rejecting the silent premise of forward waves, he could reject the otherwise necessary corollary that the actions that determine what parameter values are *seen* at *L* and *R* must also *take place* at *L* and *R*. In the reciprocal-wave picture, the particle correlation is due to the elementary waves from *L* and *R* arriving at the particle source and jointly acting right then and there to correlate the emissions; the correlation is *observed* at *L* and *R* but is jointly *determined* by waves at the same place: the source. (Just as the double-slit interference is observed at the screen but determined at the source.)

Thus, TEW presents a *local* process that accounts for what is always observed. Precisely this feat was long thought to have been proved impossible by Bell beyond any question. Dr. Little observes that the validity of Bell's Theorem serves not as a proof of nonlocality, but as a reductio-ad-absurdum *disproof* of QM's silent but defining premise: forward waves.

As promised, a further note: A particular EPR setup, the "Innsbruck experiment", which features "double-delayed choice", has been put forth as the ultimate refutation of locality and of TEW along with it. It has apparatuses *L* and *R* independently altered to new conditions after *A* and *B* have begun their flights to *L* and *R* (perhaps even right before they arrive). This delay is meant to close a technical loophole: the hypothetical possibility of some special form of communication, pre-existing between *L* and *R*, that would coordinate in advance, at some finite speed (even faster than light), what they will measure for *A* and *B*. But this supposed final nail in the coffin becomes irrelevant if the waves are reversed, for then the coffin is empty. The exact moments at which *L* and *R* get placed into their final measuring configurations have nothing to do with what the elementary waves have already coordinated at the common source of *A* and *B*.[11]

PROBABLY THE MOST FAR-REACHING and stunning consequence of TEW is argued for in Chapter 7 ("Relativity") (84-85):

> "The elementary wave theory of subatomic physics and Einstein's theory of relativity are thus not separate theories but in fact are part and parcel of the same single theory. TEW explains the wave-like behaviors of particles, and simultaneously, when applied to photons, explains relativity…. Had Einstein not yet discovered relativity theory, TEW would have predicted it. The fact that TEW, discovered solely on the basis of the wave-like behavior of particles, predicts and explains relativity theory strongly corroborates TEW as being the correct theory of subatomic phenomena."

How does Dr. Little arrive at this? First, he knows in principle that the universal constancy of *c*, the speed of light, must have a physical explanation. Einstein himself thought it had to lie in the physical nature of light itself, but he could provide only a quantitative description (including the famous Lorentz transformation of spatial and temporal coordinates). Second, the author has the advantage of having TEW's physical picture of light: a photon particle following, in reverse, the photon elementary wave that establishes the dynamics of the photon particle, including its velocity *c* with respect to the origin of the wave organization: the detector or observer (perhaps your eye). This is the causal factor (heretofore missing because reciprocal waves had not been imagined) that *explains* the constancy of a photon's velocity *c* with respect to the observer of it. And once this mechanism is recognized, it follows, as the only consistent result, that light travels at *c* with respect to all other objects as well.

By considering the elementary waves in the context of relativity, Dr. Little is able to complete his description of them as physical objects[12] (85):

> Elementary waves do not propagate in a medium. They are "stand-alone" objects in their own right. The elementary wave along a line that a particle might follow moves as a single, independent unit. It might best be described as a "flux" that carries the wave oscillations along with it. The elementary wave previously described as emanating from a detector, or from a point on the screen in the double-slit experiment, and moving out from there in all directions actually consists of an independent flux line along each of the many directions from that detector. The detector gives the independent fluxes a common phase and marker, so they add up to what looks exactly like a wave propagating in all directions…. The fluxes move with the velocity of light, *c*.

He also describes the transformation of the fundamental characteristics of a given wave from one frame of reference to another. In a particle's own frame, the flux line in effect has an infinite wavelength; i.e., it has the same phase all along it such that it is simultaneously everywhere the same as it oscillates.[13] This is the periodicity of some internal parameter that governs the interference of like flux lines at their points of intersection. But in reference frames in which the particle is moving, this means that the rest-frame's uniform wave-phase transforms to a regularly varying phase along the flux line: a traveling wave. The greater the relative velocity, the shorter the wavelength (thus the greater momentum that the greater velocity brings). QM may offer the same mathematical description, but TEW provides something QM never could: a *physical* picture of the underlying entities.

WE GET A VERY specific application of the elementary waves idea in Chapter 8 ("Particle 'Diffraction'"). Dr. Little is brief and to the point in illustrating the role of the reciprocal waves in the phenomenon of Bragg scattering of electrons from crystals with a certain uniform, planar molecular structure. Predictably, he turns the QM account on its head. Just as with the double-slit, QM cannot explain this scattering without nonlocality and particles that are waves before they are particles. He shows how the reciprocal direction of the waves allows for a continuous single trajectory of a scattered electron. It is only the waves, not the particles, that diffract.

WE’RE ALL ALLOWED OUR own pet favorites. Call me old-fashioned and raised on Newton, but mine in this book is Chapter 9 ("Classical Mechanics"). The author explains that a key misstep in QM’s development was a mathematical process called "canonical quantization". Classical mechanics was taken as given, such that quantum mechanics had to be justified from it. But in physics, phenomena are properly explained in the reverse manner – by appealing to the entities at a more basic level to account for the things that comprise them at a higher level. This is a hierarchical process. For instance, the bulk properties of materials are explained in terms of their constituent molecules; the molecular properties are explained in terms of their constituent atoms; the atoms are explained in terms of their constituent particles and waves (which, for now, we take to be the "ultimate" constituents).

In classical mechanics, a method of treating some problems, called "Hamilton-Jacoby theory," was developed. It established that, mathematically speaking, particle trajectories could be treated as paths perpendicular to wavefronts moving forward with the particles. It was realized that the foundational Schrödinger wave equation of QM is the equivalent of the Hamilton-Jacoby equation of classical physics when the wavelength is small enough. But this strongly suggestive piece of evidence was not taken as reason for physicists to fundamentally recast the classical picture as stemming from the correct quantum-level picture and embodying some analogue of actual waves at the macroscopic level. Instead, the dominant non-objective, "reality-refuting" interpretation of QM-level phenomena was already being cast in stone by leading physicists. They remained oblivious to the actual role of Hamilton-Jacoby.

The author goes on to use the basic properties of the elementary waves (wavelength and frequency) to explain the actual status of the physical concepts in Newton’s laws of motion (mass, energy, momentum). Although Isaac Newton made a titanic advance in understanding the system of the world, Lewis Little (standing on the titan's shoulders) sees how those mechanics ultimately have to be understood as artificial: "[N]ow that [Newton’s] laws have been explained, those concepts should be defined…in terms of the nature of the underlying causative objects – the elementary waves" (104).

THE THEORY OF ELEMENTARY waves already has illuminated physical reality in the quantum realm by placing it on an objective footing. It already has found itself naturally integrated with special relativity in a way that unexpectedly illuminates the physical reality behind that realm as well. Now it has done the same for classical mechanics. A theory that truly accomplishes so much is rightly considered epochal.

Yet there is another startling exposition in Chapter 10 ("Magnetism") – although from that title don’t expect a relatively narrow focus. I find it a major understatement. The full topic is the nature of classical electrodynamics. Bringing that broad subject into the orbit of TEW would be all the more momentous. Dr. Little makes an impressive start.[14]

A particular philosophical practice tied up with the conceptual errors of QM, but which is wider than just QM in scope and helped allow QM’s picture to gain traction, is the fallacy of regarding physics as only a mathematical description of behavior per se, instead of as the identification of the physical objects of the universe. This dropping of objects from the picture is a step toward QM’s ultimate "refutation of reality", and so it is one of the practices that the author excoriates.

He applies his critique to the concept of fields, especially to magnetic fields. Fields are a concept of behavior: they describe what happens, for example, to a test charge that is placed in relation to other stationary or moving charges. To claim a concrete reality for fields is to reify an abstraction, turning into an entity something that quantitatively describes an effect. This closes the door to asking what the actual entities are.

With regard to magnetic fields, Dr. Little points out what is implicitly known already: their field lines cannot be physical things. The magnetic effects of changes to the field sources are known to be delayed at the test charges by exactly the time a speed-of-light object would need to travel there in a direct line. The curved, *longer* paths of the magnetic field lines can only be fictitious – concepts useful for methods of calculation. Yet the implications have not been heeded and the laws of electrodynamics have remained behavioral axioms only.

The principles of local physics, therefore of TEW, insist that *something travels, at light-speed, in that direct line*. Lewis Little terms these somethings "vectons", because they behave as if a vector quantity were attached to them that pushes or pulls on the charged particles that they reach – hence the basic case of the electrostatic field with its repulsions and attractions directed along a line from the field source. He analyzes other cases in electromagnetism on this basis (the forces between current-carrying wires, and the Faraday effect in magnetism) to show how the vectons explain them as well, based on the fact that in a moving reference frame the direction of "push" is rotated from the direction of travel. In fact, the vectons are seen to be our familiar friends, the photons.

Which takes us to electromagnetic waves. Conventionally, photons are attributed the form of a traveling, self-renewing piece of electromagnetic field that is waving in two planes at right angles. TEW has a simpler picture that does not resort to a complex account of fields that cannot be true since the fields cannot be real.[15] TEW's picture is simply of the photon elementary waves and the photon particles that they elicit from charged particles.

DR. LITTLE TAKES THE opportunity in Chapter 11 ("Modern Physics") to distill his broadsides against the proclivity of modern physics for treating its content "as a giant edifice of interlocking mathematical formulas describing behavior – not behavior of anything, just behavior." (129). Mathematical formalism, he says, has discarded actual physics "as if physicists had discovered the ideal world of Plato's 'forms'….Theories began to appear that were either totally vacuous or had so little connection to any real objects as to be effectively vacuous." (130). His purpose here is not to resolve some enigma by presenting the correct physical solution to what QM mishandles. It is to shine his spotlight on this policy, which I might dub "behaviorism", that needs to be rejected across the board. He goes into two instances: parity violation and dark matter.

Take the former in this limited space. Parity violation is a technical point in particle physics, involving the mirror-image modes of decay of a particular meson and its anti-particle. These modes fail to obey a certain formulaic rule called "parity" in regard to the respective probabilities of their mirror-image outcomes, so parity violation was born. No account of this in terms of the actual particles' attributes is sought. QM closes off the natural avenue of seeking an explanation and merely adds or modifies a formulaic rule, as if an explanation lurked somewhere in that;

more accurately, as if no explanation is called for at all since a particle is simply its behavior. But with TEW the avenue is open. This "violation" is a clue to physical factor(s) that QM wave theory is incapable of conceiving.

BACK IN THE CHAPTER ON special relativity, the author, in describing the physical picture of the elementary waves as independent flux lines moving at *c,* was mainly concerned with the transformation in how a wave looks when we pass from one frame of reference to another. But he did mention this in passing (85):

> When an elementary wave flux along a particular line interacts with an elementary particle, the flux does not actually deflect, or scatter, into a new direction. Instead, the interaction connects the initial flux with a second flux already traveling along a different line. Both fluxes continue along their initial line with the same intensity. In the 'connection,' the phase and 'marker' carried by one flux might be passed to the second flux, depending on the nature of the specific interaction; but there is no net increase of decrease in the 'quantity' of flux in any direction.

The subject of electron orbitals in the atom provides a rich opportunity for TEW to shine by applying this. Chapter 12 ("Physics of the Atom") enlarges upon the interactions of the elementary waves in that arena. In doing so it illustrates TEW's path-breaking power to penetrate into the details of an important and complex subject, so an extended look is worthwhile. The form of exposition is common to much of the book: describing what is found by experiment, reviewing what QM says to mis-explain or non-explain it, then drawing the TEW's conclusions from the same facts in the light of its reciprocal-wave standpoint. Here that method reveals the detailed dynamics of the miniature world of electron waves, photon waves, electron and photon particles, and the atomic nucleus, all interacting.

It is would be criminal not to emphasize that *nothing like this has been achieved before*. QM is vague, hand-waving, and nonsensical on this topic, in contrast to TEW's specifics of the objects and processes within the atom. QM even denies that such a picture is possible. Indeed, whereas the section titled "How an Electron Follows Its Wave" (141-143) is a model of concision, clarity, and realism in physics, QM would have treated things under that heading rather in the way Kipling treated "How the Elephant Got Its Trunk": just so. Again – what is in question is not the wonderful ability of the mathematical methods of QM to describe what is observed in subatomic phenomena; it is QM's ability to deliver a rational *physical* picture of what is observed.

For an orbiting electron wave-state to be able to guide an electron around its path (in reverse, of course), photon waves emitted and organized by the charges in the nucleus must be continually interacting with the passing flux lines of electron waves over the entire atomic region. These photon waves "connect" (as defined above) a given electron wave's segments into an irregularly polygonal orbit by causing that wave's state (the flux organization that a following electron would respond to) to change direction into new flux lines at various points around the nucleus, which TEW terms "vertexes". Such electron wave orbitals exist throughout the region of the atom. But only at certain radii do a wave's frequency and wavelength mean a reinforcement, instead of cancellation, of its power to stimulate electrons into itself as it endlessly overlaps itself. Since the wave's frequency is equivalent to the energy of a particle following that wave, the celebrated "energy levels" of the atom are born.

These levels are actually somewhat broad not exact, since a certain small band of frequencies around that energy level will also see constructive interference to some significant degree. When an electron is stimulated into one of the waves in this narrow spectrum, it orbits the nucleus in that level so long as it remains undisturbed from that spectrum. At each path-vertex where the wave-state changes direction into its next segment, a photon particle is emitted toward the nucleus in response to the photon wave from it that is connecting the segments.

Here we have gone beyond the stage of simply regarding the elementary waves as stimulating the particles into existence and channeling their trajectories. Now we can glimpse underlying laws of wave connections by realizing that they must occur in a certain manner. Momentum is a stand-in for wavelength, and energy for frequency. The photon wave that is able to divert the electron into the new flux segment by stimulating the emission of a photon particle from a vertex back to the nucleus, must be the one with the particular wavelength and frequency that results in the conservation of overall momentum and energy in this process. No other waves need apply. Here is an example of why TEW concludes that the conservation laws for particles are but consequences of the nature of the elementary waves. The waves interact only in a manner that could cause particle processes. Nothing else could be observed! The conservation laws of momentum and energy, long regarded as lying at the root of physics – as representing basic, inexplicable axioms – turn out to be expressions of the truly fundamental laws of the waves.

With these established principles of the wave interactions in mind, Dr. Little goes on to similarly explain atomic decay: the process of an electron in a higher-energy orbital "jumping" to a lower one. We saw above how the TEW electron follows a wave orbital; here we get the supplementary account of how it gets into one in the first place. As with the depiction of the orbital process itself, this is revelatory as a clear and real view of things, where QM shrouds it in the usual anti-causal terms. However, this topic would take too much more space here. Pick up the book! No essay can cover it all.

Finally, the author addresses a corollary matter: the Pauli exclusion principle by which only a single electron may exist in an orbital wave-state, as if some force were keeping any more electrons from entering it. Here QM talks abstractly about an "anti-symmetry" of the wave functions of all fermions (which include electrons) – whereas TEW causally explains things by noting that electron waves continually converge on the electron from all directions. The waves thereby "emitted" from it have the electron's own organization stamped onto them. But this is necessarily the same organization possessed by the electron wave-state that the electron is following. The Pauli principle would be the charmingly simple, natural consequence if the waves thereby "emitted" – pointedly including those along both directions of the wave being followed – are shifted in phase by 180 degrees and thus cause totally destructive interference along that wave. Totally destructive interference means total inability to stimulate another electron into the wave.[16]

So small a matter, the Pauli principle…yet solving its mystery is emblematic of TEW's power to pierce the fog of so many others.

WE KNOW THAT TIME waits for no one. Even the greatest of innovations can be works in progress and face future demands on their potential. We see a few of these demands in Chapter 13 ("The Future"). To give a flavor of what fruitfulness the TEW may have in future areas, it is helpful to briefly cover a couple of Dr. Little's examples.

One is the subject of subatomic particle transformations. The oft-termed "zoo" of the multitude of such particles is understood abstractly and mathematically at best. Just as with explaining atomic orbitals and decays by the characteristics of real particle and wave objects, possibly TEW with its fresh approach could help in the area of particle transformations – such as the common example of the decay of a neutron into a proton, electron, and anti-neutrino. In TEW, each particle type at least provisionally has its particular form of elementary wave. But perhaps the waves can be understood more economically with a smaller number of types, as forming compounds that can be broken down in some way that simultaneously explains the transformations and reveals just a relative handful of irreducible wave entities or properties. QM approaches this with merely mathematical quantum fields that the author calls "shooting in the dark…with unreal bullets" (151). Why not give a promising entity-based approach a try?

Then there is the elephant in the room: gravity. Beyond Einstein's major role in helping launch quantum theory and his authorship of special relativity, there is his achievement of general relativity (GR), which brings gravity under relativity. Although I would note that Einstein himself arguably agreed with Dr. Little's point that "Space and time are concepts formed through observation of real objects; they are not real objects themselves" (152), it is clear that GR as presented today commits this error. It portrays gravitation not simply as a real thing called a field, but as curvature of a real thing called space-time. It even has this reified space-time physically expanding (universally from every point of it!), starting at some initial zero over lo these many gigayears. But if what physically exists is not "space-time" as a universe-filling stuff, but actual objects called elementary waves as universe-constituting flux-line material, then gravitation would be open to description in the TEW framework.

In this regard the author states, "I have yet to understand a mechanism by which a massive body might produce curvature in the elementary waves. A major 'piece' in the explanation of gravity remains to be discovered." (pg. 153). TEW, like every broad theory on record, has its current limits and its potential to grow.

THERE IS ANOTHER ASPECT to considering where TEW might go in the future. TEW is uniquely the creation of Lewis Little and at this early juncture can't possibly be characterized by any identification or hypothesis that he has not offered or accepted. But any mystery remaining that it someday will or might explain is open to our own sense of wonder. The TEW is so stimulating that a serious study of it cannot help but provoke further wondering. With that in mind, I can offer several thoughts outside any current boundary of TEW.

The first is an observation on the vecton picture of classical electromagnetism and the quantum-level picture of electrodynamics. Perhaps it is not even open to much controversy. It is instructive that the quantum electrodynamics of QM involves the exchange of photons between charged particles as the means by which the electromagnetic interaction is produced between those particles, and further that the 1996 paper gave TEW's account of this exchange mechanism. Surely TEW will eventually achieve a full integration of a mature account of the vecton mechanism over the vast range of distances in classical electromagnetism, with the photon-exchange mechanism at the subatomic scale.

The second is the speculative matter of a surprising but seemingly essential similarity between the fine-scale geometry in GR and TEW. Einstein held that at the smallest scale of the curvature of his mathematical space-time, particle motions are Euclidean and uniform: straight lines with no accelerations (no gravitational forces). Dr. Little stated in his 1996 paper that at the smallest scale, TEW particle trajectories between the successive wave vertexes that change their motion are also Euclidean and uniform. What I gather from this is that accelerations of any kind (gravitational and mechanical alike) are reducible to a certain pattern of action: a particle repetitively being altered from one state of uniform motion directly into another at successive vertexes.

It is true that there are differences in what the two theorists mean by this miniscule scale being Euclidean in nature. Einstein thought predominantly in terms of a continuous field, implicitly taking the components of a particle path down to the infinitesimal level whereas Lewis Little abjures infinities and intends a Euclidean realm in the real sense of finite intervals. My point is that this similarity is an encouraging sign that the unification of general relativity with TEW is achievable. Indeed, Dr. Little himself noted in his 1996 paper that this unification should be found in the deflection by graviton elementary waves of elementary waves in general, at vertexes (section 14, "General Relativity").

If GR can back off just a tiny bit from the infinitesimal nature of its gravitational field picture and accept that the field it takes as the physical reality is instead once removed from it – an abstraction from the effects of exceedingly tiny, yet finite, physical objects (the waves) – then its well tested, crowning-glory mathematics would lose true applicability only at the very tiniest scales. Would this not someday allow TEW’s equivalent of the long-sought unification of QM with GR, and with no "strings" attached?

I would think that from success in completing this picture there might emerge the means to finally begin to understand certain subjects found at the extremes of GR, including "black holes", for which we are now limited mainly to non-physical descriptions relying on metaphors and infinities ("event horizons", "singularities", "white holes" into other universes).

Finally, I have to bring up the subject of big-bang, expanding-universe cosmology. It wants to deal simultaneously with the largest scale of all – the universe as a whole – and the smallest scale of all – entities down to what is called the Planck scale. I find it blindingly obvious that we will never properly generalize from the observations that lead to arguments for cosmological ideas until we understand and properly characterize the nature of the quantum realm. To say "space is expanding" without knowing exactly what exists concretely – in place of the space or space-time that is fallaciously regarded as a thing – is meaningless. This is a matter of scientific epistemology. To understand the very large, first understand the very small.

Does the notion of a "Planck scale" for the noumenal-mystery realm of QM suggest anything deep and revealing for the object-oriented physical realm of TEW? Could QM’s putative quantums of space (10^{-33} cm) and time (10^{-43} sec) translate into the language of TEW with any basic meaning, especially in regard to the form and behavior of the lines of elementary wave flux? What lies in the ultimate reaches of the small? What does it mean for the large?

To ask is not even to begin to answer such veritably ultimate questions. But without asking and without seeing clearly what it is we must ask – without the right theoretical framework – we'll never, over any amount of time, get the objective answers.

This review essay appears – and first appeared, in June 2009 – at http://www.troynovant.com .
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NOTES

[1] Lewis E. Little, "The Theory of Elementary Waves", *Physics Essays*, 9, no 1 (March 1996): 100-132. Another early presentation of the theory was a talk by Dr. Little at Caltech in February 2000. As of this writing, it is available for viewing (in 18 parts) at http://www.youtube.com/user/tewlipdotcom .

[2] "Authority" here does not presuppose institutional credentials or peer approval. That would be putting it backwards. As a root concept that subsumes the forms of authority in all its wide-ranging guises, "authority" is a corollary of the marriage of human reason with human action: the virtue invested in someone who has discovered how to understand reality in some realm and respect, and how to act accordingly for the better. Dr. Little is indeed formally trained in the ideas and applications of physics, with his MA from Princeton and his PhD from NYU, but this fact is not essential to his claim to our attention.

[3] Let there be no illusion that Lewis Little offers his theory simply to supplant the orthodoxy of the day in some collegial, evaluation-suppressing fashion. He is attacking the orthodoxy of the day as an offense to reason. He would hardly say that conventional quantum theory and elementary wave theory are two rational alternatives with the evidence possibly supporting either but his own theory being far, far better. To uproot an entire system growing from the soil of basic conceptual error so that the correct system can grow, one must remove and replace the offending soil. Opportunities for this are seized throughout the book.

[4] "Nonlocality" is sometimes also used in a restricted sense pertaining to any conjectured interaction involving faster-than-light influence. No evidence for such a thing is known. But regardless of whether this idea can be reconciled with the physics of relativity, in accounting for the nonlocal aspects of QM no less than an infinite "velocity" will do.

[5] A primary example of doomed attempts to preserve objective trajectories is David Bohm's well known, self-styled "ontological" approach via his explicitly nonlocal "quantum potential".

[6] Letter to Richard Bentley. See http://www.newtonproject.sussex.ac.uk/view/texts/diplomatic/THEM00258 .

[7] Yes, it does turn out that the orbit of Mercury subtly flouts Newtonian law and ultimately defers to general relativity.

[8] There is at least one more loose end: how to account for the entire history of the wave-following by a particle that was emitted at some "remote" distance (think even of intergalactic light). The wave organization imposed by the detector could not have been involved in that emission. The process is well discussed in the 1996 paper, but is not fully touched on when mentioned later in Chapter 7 of *The Theory of Elementary Waves*. Suffice it to say that to explain a particle of remote origin eventually being detected, it is necessary to regard it as "jumping into coherence" with each of the successive new flux organizations it encounters along the way, with these "jumps" ensuring that the particle's behavior under the influence of the detector at close range will be exactly as if the detector's wave state had been present over the whole path. A chief consequence of this for photons in particular is that of preserving the constancy of their velocity over the whole trip.

[9] Thus a flight into incredible rationalism: the "many worlds" interpretation. QM is unable to resist its eligibility for consideration, because it is a logical consequence of having forward waves. It treats all of existence itself as an ever-evolving, never-collapsing über-wave, developing into an ever-growing infinitude of specific universes for every quantum possibility at every location.

[10] I mean "magic" literally, not hyperbolically. This usage occurs in discussion of this topic even by great physicists. Einstein's view aside, when DeBroglie and Schrödinger were playing their noteworthy parts in the development of QM in the 1920s, they too solidly rejected as supernatural the purported instantaneous connections between objects that was being claimed early on. See *New Perspectives in Physics* by Louis DeBroglie, Basic Books, 1962, pg. 172: "According to Schrödinger, only magic could explain this phenomenon, and 'magic' is, in fact, the only word to describe it."

[11] It may prevent confusion to note here that Dr. Little was forced to scrap the TEW explanation of double-delayed choice that appeared in his 1996 paper. Likewise with a first attempt to fix it. His final account is available at http://physics.prodos.org/ddcexplained.pdf . A shorter, less technical presentation of this account is used in the book (section 6.3). It should be obvious that such error-correction is a normal part of the development of broad theory.

[12] A detailed look at how the elementary waves can interact among themselves, and at how they can determine complex particle behavior, awaits us in Chapter 12's account of the physics of the atom.

[13] For the curious, these oscillations have a period inversely proportional to the particle mass: h / mc^2 .

[14] Terming the vecton picture of electromagnetism a "start" is not in the least dismissive. Dr. Little has stated on the TEWLIP forum, "A vecton is a (somewhat speculative) theoretical model of the particle photons responsible for electric and magnetic forces." (http://tewlip.com/viewtopic.php?f=6&t=12#p25) Also, "The main import of the vecton theory as developed so far is the fact that all the diverse effects of electric and magnetic fields can be reduced to this simple push vector picture." (http://tewlip.com/viewtopic.php?f=6&t=8&start=0#p15).

[15] Even the simple electric field is necessarily fictional. Its being electrostatic is a fluke of the frame of reference selected for observing it. In general, there will be both electric and magnetic field components (strictly related by an invariant-interval formula in special relativity), and we have seen that under *any* physical theory the magnetic component is necessarily an abstraction.

[16] This cancellation applies to fermions. All other particles are "bosons" (which include photons). The opposite effect occurs with these. Their emitted elementary wave organization is precisely *in* phase with the wave being followed, producing totally *constructive* interference, which enhances the wave's power to stimulate *more* of the bosons into its state (as with lasers). The TEW explanation of fermion vs. boson behavior accounts for the subject of quantum statistics.