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THE INFINITE PATTERN

Explaining Nature

by Chongo in collaboration with José

ABRIDGED COMPACT VERSION

(FIELD GUIDE HAS IDENTICAL ABRIDGED CONTENT AND COMPACT FORMAT)

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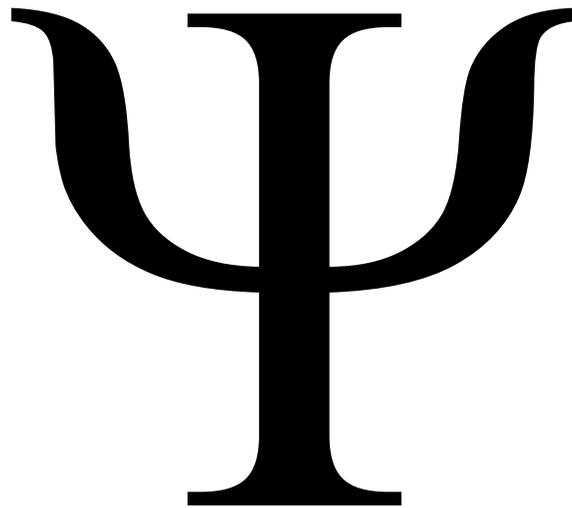
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THE
INFINITE
PATTERN

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Explaining Nature

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Compact Version (Abridged)

by
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José

EXPLAINING
NATURE

“In the life of a man, his time is but a moment, his bearing an incessant flux, his senses a dim flash of light, his body a prey for worms, his soul an unquiet eddy, his fortune dark, and his fame doubtful. In short, all that is of the body is like flowing water, all that is of the soul as dreams and vapors; life a warfare, a brief sojourning in an alien land, and after[ward] ... oblivion.

Where then can man find the power to guide and guard his steps?

In one thing and one alone: the love of knowledge.”

–Marcus Aurelius, Emperor of Rome, *Meditations*



PLEASE, STOP AND READ FIRST!

Please note that if the reader embraces mysteries* or beliefs that he or she is convinced that they genuinely love, and he or she wishes to continue loving them, on, into the future, especially if they depend upon these ideas as a source of excitement, essential to their happiness, then the reader should not turn another page of this book. Mystery and belief CAN be exciting, especially when we are children (and as long as they are ultimately not mistakenly confused with real, physical truth, or, in particular, here in this text, confused with genuine scientific fact). Learning science, by virtue of science being the very pursuit of the discovery of physical truth, cannot avoid dispelling mystery and belief in the course of replacing them with explanation and understanding, because that is exactly what science does. In the process, the mysteries and beliefs that we may be convinced add so much to our lives, lose their capacity for doing so with the acquisition of accurate scientific knowledge. Thereafter, they may come to entertain and excite us little more, and in this way be 'gone' from our lives irrecoverably, forever, because explanation and understanding, once acquired, are never easily, if at all, really ever wholly forgotten. So if, for whatever reason, you wish to continue retaining your mysteries and beliefs, then close the book immediately after finishing reading this page, and do not open it ever again, until these ideas that might mean so much to you now, someday begin to falter in their power to bring joy, upon being faced with the certainty of the rigors that the immediate and unassailable realities of the actual, physical facts of life, as you age, are sure to eventually present in progressively greater and greater, abundance and frequency, with the continued passage of time. Should this moment arrive, then the reader may wish to revisit this page and choose to finally read on, in order to begin discovering that the *true* story of how nature really works is *magnitudes and magnitudes* richer, deeper, grander, and far, far more beautiful, than any conjured mystery or mere belief *could ever hope to even begin to approach* (which again, to be perfectly clear, is an absolutely irrefutably true, physical fact, that reading the next page and all those that follow, can begin to reveal, to *absolutely anyone*, who is willing to think).

* - Scientific mystery excluded.

Mystery* and belief are synonyms for ignorance* and fear.

* - Scientific mystery included. In science, besides being a synonym for ignorance, mystery is a synonym for *opportunity* (to discover).

FOREWORD

by Victor Pereyra, Professor of Mathematics, Stanford University

In the few years that began the twentieth century, Albert Einstein's Theory of Relativity revolutionized the world of physics by showing that Newton's account of natural laws did not model nature's motions accurately. At about this same time, a new model, named the Theory of Quantum Mechanics, expressed the individual wave character of all energy. Like no others before, these two descriptions of the world changed our understanding of the smallest to the largest, and everything in between, forever, enduring now over a *century* of repeated testing, with exquisite and unparalleled accuracy and precision, having never failed even once. Together, these two descriptions of the world encompass everything existent in nature, including our very awareness of life. No other body of ideas ever imagined even comes close in performance and revelation.

The consequences of these two giant leaps in science have had immense repercussions in everyday life. From atomic bombs to nuclear energy, from computers to cell phones, lasers and microwave ovens, the Theory of Relativity and the Theory of Quantum Mechanics have changed the world in which we live, in every way. Now, after more than a century of unprecedented success, common and widespread understanding of these brilliant intellectual tools is still limited to the very few, even though the fundamentals can be understood by anyone capable of reading and of grasping the most simple of abstract ideas.

This work attempts to expose people to the simple ideas underlying these two magnificent accomplishments, and in so doing, advance overall human understanding of nature, by explaining these ideas in great conceptual depth, but without resorting to any mathematics whatsoever. Nature's founding principles are explained, using only words, a few illustrations, and a simplification of our own reality, by means of an imaginary world inhabited by much less complex, two-dimensional versions of us. Though far simpler than ourselves, just like us, these two-dimensional creatures discover the relativity of space and time measures with respect to the motion and gravity characterizing their much simpler world. Next, these creatures discover their own version of the Theory of Quantum Mechanics, identical to ours. In doing so, their story shows us how we, much more complex three-dimensional creatures, in our much more complex three-dimensional world, can do the very same. And, we can do so far more easily, given our additional dimension of depth and its matching insight, by following their rich story of scientific discovery, which parallels our own even richer story. Together, the Theory of Relativity and the Theory of Quantum Mechanics comprise the most fundamental and accurate working description of space, time, and everything in them that has ever been conceived. They ultimately even lead to explaining life itself, and moreover, can flatly *demonstrate* life's distinction in actual physical experiments.

The foggy veil of mystery that seems to surround physics is a mere illusion. It exists only in a lack of a comprehensible exposure to the subject matter. This veil serves, no less than it has throughout human history, only as barrier to beholding what can be the richest, most interesting, and most lasting aspects of nature. Seeing through the illusion that that mystery is reveals a stunning beauty that lies hidden beneath this veil.

No mysteries need stand between us, and our understanding anything. If we simply choose to learn for ourselves the truths that science has worked so tenaciously, often at the price of enormous living sacrifice, to identify, we will discover that anyone can comprehend anything they wish to comprehend about natural phenomena, utilizing the sound conclusions of science as a foundation. No formal education is needed for this text. Simply choosing to learn is the only real step that one must take. All subsequent steps are far, far easier.

Understanding science begins with understanding its most fundamental description of the world, the Theory of Relativity and the Theory of Quantum Mechanics, which are, unquestionably, among the most outstanding of all human achievements, short of humankind's refinement of courage, insight, compassion, and liberty. Science gives these refinements, and many others like them, wings, so that all humankind can soar.

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Explaining** Nature by Chongo in collaboration with José

Compact Version (Abridged) – July 2016
www.chongonation.org

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The foremost purpose of this book is to make available to those having the least access to the most advanced achievements and discoveries in science, an open window into its most fundamental foundations so that they too can have that access.

This book is dedicated to the memory of a committed thinker, physicist, mathematician, a very conscientious human being, a scientist, a world-class rock climber, a skilled outdoorsman, as well as my tutor, collaborator, and best friend, José. His understanding of nature led to my ultimate understanding of it, which will hopefully, eventually lead to many other people’s ultimate understanding of it too, as José would have wished.

* -The term “pattern” used in the title could easily be replaced by the term “formulation” or “computation,” either of which are perfect synonyms for what the content explains.

** - It should be noted that the definition of the words, explanation and explaining, can be reduced to this: the specification of more complex patterns, in terms of simpler ones.

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Some paragraphs are combined (concatenated), all margins reduced to their minimum, and words extensively and ‘creatively’ hyphenated, in order to fit all the text into the physical limitations presented by the binding method, while maintaining a font size large enough to be easily read unaided by most.

The term “infinity” replaces the term “effective infinitude” throughout. This was done for the sake of the understanding of the lay reader, who may be unfamiliar with the latter term, but most of all, for the sake of fitting the text within the number of pages allowed, while maintaining an adequately large font for easy reading. (If the number of possible histories for reality are finite, then this term may refer to what is actually a finite number that is so staggeringly big that it is effectively infinite, application of the term outside of this context makes reference to a genuine infinitude, which may be either countable or uncountable infinitudes, whichever applies.)

ACKNOWLEDGEMENTS: Development and initial publication of text, including text, any illustrations, editing, and reproductions were accomplished with no resources other than the author’s, collaborator’s, and that of all those who helped them in their endeavors. No assistance whatsoever was obtained from any government, institution or organization of any kind. This was a purely private endeavor, sponsored solely by two free-thinking individuals, and those who provided support for them in their many years of determined effort, all of whom so loved the liberty that comes with understanding nature accurately, that they believed that for the benefit of all it should be made readily available to anyone and everyone who sincerely seeks this deep understanding of our world. In particular, Cybele Blood for her months of dedicated editing, Werner Braun for all of his technical computer assistance, Lee Parks for his artistic skills in refining and digitizing the important illustrations, and Debbie Collins at Ms. Dragon Print & Copy for her years of uninterrupted support in our endeavor.

"Ignorance and liberty are mutually exclusive."

Introduction: MOTION AND INTUITION*

Look around, what do you see? You see 'things', things occupying space, and with its passage, occupying time. Reality seems to be made of things occupying space, and in the process, occupying time. An additional feature of our immediate vicinity is that, regardless of wherever we may find ourselves, these things that constitute reality, including ourselves and notwithstanding a couple of rare exceptions, seem always to be being "pulled" downward, relentlessly. Wherever we find ourselves, gravity seems as relentless and inescapable as time. As is readily obvious, gravity 'is' the force that is constantly pulling things downward, given something "else," namely *time*, providing the liberty for things to change their position as a result of this force, or of any other. With time, comes the capacity for things to change their position in space, for them to move. This is what we call, motion: things changing position as a result of their being pulled or pushed. We intuitively *understand* motion; we *know* that we do, it is a certainty.** How could we not?

There is yet another almost universal feature of motion that we might overlook by living in such a modern world where if, for no other reason, common, widespread understanding of the motion of the planets around the sun would perhaps unknowingly mislead us to ignore this obvious feature, even though this feature is almost universal to all of our notions of movement. That obvious, universal feature of motion is that wherever we observe movement, it is universally, of something moving, with respect to something else, like all of the local surroundings, that is *not*. That is, motion seems always to occur against a backdrop of everything else that is not moving, but is instead, stationary. If we did not know that the earth itself is constantly moving, as humans once did not, throughout most of their history, then all motion it would seem, is with certainty, innately modeled with respect to a stationary perspective. In other words, things always, unambiguously, either change position, or do not change position, that is, either they are in a state of motion, or they are stationary. According to this innate, intuitive perspective, the distinction between what is moving and what is not moving is absolute and universal. According to this perspective, nothing whatsoever can be both in a state of motion and stationary, together, in the same moment. Moving while stationary is unimaginable; it contradicts the deepest, most fundamental foundations of our very reason.

This is the intuitive way that we see motion: things moving amidst a stationary world that itself, does not seem to be doing so. It is clearly how we humans evolved to envision motion, something changing position amid all that does not. This is for the very simple reason that throughout human history, this simple picture has served human needs so effectively that it has brought us to the point of being able to question our intuition's very validity. It is in this exact way that the great thinker, Albert Einstein, discovered relativity. He assumed something much more certain than common, human intuition, because he knew something about nature that humans had never known before that time, or had been capable of knowing or of even understanding, an incredibly important detail about the world that is wholly unimportant to common intuition; that detail being that the speed of light never changes. Because it never does, our intuition's conclusion that moving and stationary are mutually exclusive states is a completely incorrect one. Not only can anything be both moving and stationary, together, **everything that is anything cannot avoid doing both together, ever.**

We, and everything else existent, are always in motion while being stationary, unless we, or what-

* - *Clocks on a Train, Relativity - The Pamphlet* is available for free on-line viewing, PDF download, or hard copy purchase for a nominal fee, at chongonation.org Library page.

** - To be clear about what is being said, we intuitively understand motion because we intuitively *believe* that we intuitively understand, owing that our intuition so determines.

ever else, are being pushed or pulled (and even then, the effects of ANY pushing or pulling can be ignored). The rotation and orbit of the earth with which we are always in motion, while being absolutely stationary, prove this. To be perfectly clear, unless we are being pushed or pulled (acceleration or gravity), we are always doing both together, moving, and standing still, as it is impossible not to, when not being pushed or pulled! But again, this is not how our intuition ordinarily works. It MUST assume that one is not the other, meaning that it must assume that moving things are not, nor can they ever be, stationary, according to it. If our intuition did not work as it does by means of the distinctions (meanings) that it makes, like stationary being distinct from moving, then our ability to interact with our local world would most likely not be as effective as it is, either, and we would not be here in the first place. But, our world has grown colossally. Our intuitive picture of the world includes the whole of the universe now.

Humanity's picture of reality has expanded vastly, to encompass magnitudes more than the flat extent of local terrain that ordinarily surrounds us in every lateral direction and upon which we map our world. It is now common knowledge that earth is a planet itself, moving, by rotating and by orbiting, around a star called the sun, along with a variety of other planets that are doing the identically same thing. The 'world' includes more, far, far more, than what we evolved to contemplate. Yet we can hardly escape being forced to do so, anyway. So our mind constructs a mental picture of all this celestial motion. We represent it by the image of a set of smaller spherical bodies orbiting a larger one, these smaller systems orbiting around the largest, central stellar body. This collection is formalized by the scientific term, solar system. The solar system, in turn, spins with the motion of the rotating wheel of the entire Milky Way Galaxy. We imagine the motion of this set of 'floating' bodies in our mind, in the same way that we imagine any other kind of weightless motion here on the surface of Earth. Naturally, this mental image makes perfect sense; because it is our very 'reason' itself that creates it, along with the firm belief in the certainty of reason's validity, owing that it is our very reason itself that determines its own validity, and with great bias. But, this intuitive mental image has a failing flaw: it persists with the notion of this collective motion happening upon a stationary stage, YET NO SUCH STAGE EXISTS; hence, the model FAILS. It is but one, among a multitude of many other intuitive simplicities, that we wholeheartedly believe (that is to say, that our reason wholly presumes with unquestioning certainty are absolutely true.), yet are utterly and completely wrong too!

Now we must know far more in order to understand our world and to operate even better in it, because the future of humankind and of human liberty flatly depend upon accurate understanding of nature being widespread, instead of how it is now. Widespread accurate understanding of nature is achievable only when recognition of inaccurate understanding of nature and the fallacy of our intuition become simple, open, common knowledge. The effort to make such understanding as widespread as is necessary begins with the individual initiating that journey that leads to such a world to actually start embarking upon it, literally. The content of this text stands wholly dedicated to bringing the reader who is willing enough to take the time to make the intellectual effort necessary for taking the first step toward gaining this stunning understanding that grasping relativity and quantum theory are, to a breathtaking vista that allows viewing what is their outcome, after it is achieved. Equally, it is to demonstrate just how easily that understanding can be acquired *by anyone*, especially anyone who has taken the initiative to read to the end of this opening; as the current reader must have done to now be reading these lines. Again, anyone who can read can learn both what space and time being relative, and all energy being quantum, actually mean, and why.

"The most incomprehensible thing about the universe is that it *is* comprehensible."

–Albert Einstein

PREFACE

We live in a quantum universe, and there is a reason why we do: we must. Were our universe any other kind of universe, then 'we' would not exist in it, nor would anything. Fortunately for us, our universe *is* a quantum universe, and because it is, 'something', each one of us, is here in it, very *alive*, along with everything else required that allows us to be. This book is a description of the principles upon which our quantum universe operates and an explanation of why these principles are what they are. Perhaps most of all, it is an exploration into the reasons why these principles *must* be what they are, and why they can be no others.

In understanding this description, we can uncover the stunning beauty that lies beneath everything we observe, removing the myths and misunderstandings that have, now even up into these modern times, always stood between us and what is really true about anything. Understanding the principles upon which a quantum reality is based can introduce anyone who simply wishes to know what is truest in nature, to a completely new way to see the universe, and possibly even a new way to consider physical existence.

Understanding the founding principles upon which our world is based can reveal why the smallest fundamental particles of nature (which includes *every/last* bigger thing that is made of these particles) are actually finite partial 'representations' (projections) of something that is not finite at all, but infinite. In this way, we can see that a particle and a wave are two aspects of the very same thing, and thereby discover why physical existence is simply a shape and how all motion is just the shape of the universe changing, as we and everything living roll down a one-way road called time, observing the contours of this shape with each moment of our journey. By describing physical existence in this new way, we can ultimately discover the very nature of our awareness, and thus discover the true nature of all awareness anywhere; as well as its enormous significance in very real, very physical, and indeed very tangible and understandable terms. Using the conclusions made by physical science, namely, the Theory of Relativity and then the Theory of Quantum Mechanics, the book you are holding in your hand will explain exactly 'what' life is, precisely 'why' life is, and most importantly, **why life absolutely *must* be**, for there to be anything existent or purposeful at all!

This is the story of the Theory of Quantum Mechanics, described in a very simple manner, without any mathematical notation. Quantum theory can lead us to see why the universe is the way it is, by the necessity which is 'implied' by the other working physical theory, the Theory of Relativity, but which is ***absolutely REQUIRED*** by quantum theory. That necessity is the necessity for an observer in a universe, an observer who is 'alive' and who is 'aware' of something, *anything*. The presence of an observer and the fact that no observer is preferred (by the laws of nature) over any other lead not only to the inevitability of relativity for describing space and time, but to the inevitability of quantum mechanics too, for describing those things which lie within relativity's space and time. Quantum mechanics is an outcome of a universe characterized by constant and ongoing observation. The chapters that follow will explain how observation and the life that observation implies are a most natural and inescapable consequence of any physically 'real' universe. Most amazingly, living observers emerge because they absolutely *must* emerge, for the sake of a very naturally occurring and absolutely unavoidable 'inevitability', the all-encompassing one that we call "existence."

PROLOGUE

IMPORTANT: If the reader already accepts the validity of theoretical physics and need no explanation of the basis for its validity, then proceed directly to the first chapter. By addressing the subject of theoretical physics, one is compelled to ask, how in the world can an understanding of nature's deepest truths enrich one's life experience? What exactly are the benefits that a conceptual grasp of quantum theory, based upon first understanding relativity, yields, that can be applied in everyday practice? How can the contemplation of the motion of subatomic particles, particles that are far too small to ever be seen and whose existence can only be inferred, improve our participation in the big motions occurring around us and in us always? Why learn such a seemingly abstract subject?

First, to explain why, it is appropriate to state that, from the point of view of those individuals who have acquired such an understanding (not the least of which are the collaborator and the author), gaining it is as worthwhile an endeavor as one could *ever* pursue. According to this view, achieving an understanding of the founding principles, upon which nature – indeed, upon which existence – is based, matches the thrill of living the most exciting adventure, the satisfaction that comes from solving the most elusive puzzle, or the fulfillment of gratifying the deepest passion (all of which the collaborator and author have both genuinely known first hand). Indeed, such an understanding of the physical world can be bliss itself. Nonetheless, the realization of these esoteric rewards is always subject to the preferences of the individual, not to mention the faith that an individual might have in realizing them. So, one need not, necessarily, seek only these apparently intangible benefits, anticipating no others; there are others also.

The most practical and tangible reward that an accurate conceptual understanding of theoretical physics renders is that it makes understanding everything that 'is' reality much easier too, than does a lack of such an understanding. Having it, we can consider nature's phenomena using altogether new ways of thinking and using ideas that we probably (unless we already possess them) never imagined before. Remarkably, by having this new understanding, we can even shape our very wants, by understanding 'why' we even 'want' at all. That is to say, *an understanding of quantum mechanics provides genuinely new ways of dealing with the world, ways that can provide the mind with completely new concepts and wholly new insights upon which to base its (i.e. our) decisions, concepts and insights that would simply never exist in our old ways of thinking* (unless these old ways incorporated a valid theoretical model). In understanding *genuine* science as the pursuit of natural truth, we gain intellectual tools that we may have imagined only *others* ever being capable of possessing, not us. But 'we', meaning anyone, can possess them too!

Armed with these tools, we (anyone) can begin to see nature's founding design. Nature's ways need not be mysteries if we choose that they not be. Beyond mystery's illusion lies an elegant, abstract beauty that nature's design encompasses. In recognizing the depth and extent of this beauty, one cannot help but come to appreciate the rigors utilized, that provided the means for arriving at these new ways of thinking, rigors that we (again, anyone) can apply in understanding *anything*. Nature does not use mysterious powers for performing its apparent 'miracles'. It does not 'use' such things because it flatly *never* needs to.

Most wonderfully, and perhaps more so than all the other benefits, an understanding of physical theory (but in particular, an understanding, be it only in the most simplified, general, and conceptual terms only, of quantum theory) can identify those conventional notions that fail in the face of accurate understanding, exposing them for what they really are (and always were anyway): *simply untrue*. This, in turn, provides the

opportunity for embracing those notions that demonstrate themselves to be consistent with nature and hence to be true in it, which are the very notions revealed by the theoretical model. Ignoring false notions and replacing them with true ones reveals the elusive yet magnificent beauty that quietly hides in nature's seeming mysteries, introducing reason as an alternative to reaction. This hidden beauty waits, patiently indifferent, to be revealed by our understanding of it; starting with the simple idea of natural truth. Real science is the pursuit of natural truth, objective truth, truth that may be much, much different from what one might imagine truth being according to 'conventional', nonscientific views. Ideally, truth is *not* subjective for science.

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The science of physics, like any discipline, can be a time-consuming labor to learn and understand. This is due to the simple reality, as the chapters will serially explain, that thinking, and therefore learning and understanding, are motion, no different from the motion of our overt actions, like when we walk or talk (or read). And, just as it is required for ALL overt motion such as walking or talking (or reading), the motion of our thoughts requires time too. Time is required to think, and, unless our understanding is innate, time is required to understand, anything, meaning that time must be spent to learn and understand relativity and quantum mechanics. But, given enough time invested, which is not that much (a few months), and given a meaningful description of these theories and the conclusions that they yield (this book), ANYONE (like the reader) CAN eventually learn and understand, if only in purely conceptual terms alone (and, in the case of the condensed explanation of relativity, only in the most brief, general, and summary terms) these proven theories that model and describe physical reality so impeccably well—ANYONE. That is the intention of this book (among many), to educate *anyone* in the principles of modern theoretical physics. *In particular, the text was designed for those individuals with least access to the means, material, and resources necessary for gaining such an understanding* (e.g. poor, disadvantaged people). Anyone, even the most uninformed or least formally educated, if they read the text enough times (provided that they read the *whole* book FIRST [this, **reading the entire text first, INCLUDING the one-page glossary** (inside front cover page), **is critically important!**] then **rereading** it [easier the second time]: rereading the long paragraphs if necessary, repeatedly), should ultimately grasp the ideas and concepts underlying the two physical theories (relativity and quantum mechanics), upon which all theoretical physics is built. To put it bluntly, *anyone can, at least in summary fashion, learn and understand just what this book is trying to teach!*—again, **ANYONE**. And ‘anyone’, includes the reader. Should modern culture ever recover from its arrogance and its achievements survive, then someday school children will begin their studies of geometry using relativity (by simply understanding how light’s speed never changing explains gravity), and initiate their explorations of science with at least a conceptual introduction to the ideas that underlie quantum theory (like nature’s necessity for life to observe it and why, as well as the alternative).

In short, if you can read, you can understand the content. Convinced that it is really possible to gain an actual understanding of theoretical physics, **it only remains to be adequately motivated to make the appropriate effort by investing the time it takes to learn.** Doing so one begins to understand *why* these theories are, indeed, why they *must* be, true. In other words, if the reader does indeed accept, and in so doing, ‘believes’ in their heart that it is truly possible to really understand the two theories, accepting what they reveal about the nature of reality, then the reader need only ‘want’ badly enough, to spend the time necessary (which may vary from individual to individual) reading, slowly and carefully, and, most importantly, **taking the time necessary to think, contemplating thoroughly the concepts that the words reveal** (**haste fails**). By taking the time required, and by understanding that it is indeed possible for anyone who can read to do so, one can begin to understand the very foundations upon which **all** real science is ultimately based, and thus realize that any science that is not consistent with physical theory either someday will be, or instead, be recognized as having never been a ‘real’ science (as truth’s pursuit), in the first place.

So, in order to begin to develop a *true* understanding of physical existence, **we must make one, tremendously important step.** That step is to ***ignore everything (which means precisely that, ‘everything’) that we might intuitively believe or presume being true about physical existence.*** We must ignore our intuitive beliefs and assumptions (unless they agree with working theory), because that is precisely what one

absolutely *must* do in order to genuinely grasp the principles that underlie nature. Indeed, the history of physics is a history that, at each step, and with each of its new achievements, demonstrates that our conventional, intuitive notions are far less than truthful; that is, except for a single such notion that all of us can hardly avoid having, namely the notion of how two straight lines can be *perpendicular* to one another.

In ignoring ALL the other intuitive notions that we might have, we can start with this single notion of perpendicular, and build upon it. By understanding this simple, commonplace concept, one has the necessary foundation to imagine geometry (as an organized labeling system for a set of distances and directions). And, utilizing, by imagining, geometry alone, one can understand in general though nonetheless unambiguous and most importantly accurate terms, just how these theories (relativity and quantum mechanics) work, and precisely what they say about the character of nature and those things constituting its phenomena.

Now, in ignoring every last notion we might have about physical reality – except, of course, the single notion of perpendicular – we must replace such notions with altogether ‘new’ ones. This, however, is not as simple as it might, at first, seem to be. For, upon incorporating new notions into our thinking, we must start thinking in what may be wholly unfamiliar ways. Unavoidably, this is what we *must* do (that is, think in what may be wholly unfamiliar ways), in order to think in the altogether new ways that we must in order to begin building a ‘true’ understanding of nature, *because that is exactly what learning theoretical physics is*.

Thinking, in completely new ways altogether (*ways which may flatly contradict ‘old’ and very fundamental ways*) is the price that we pay for understanding. **We MUST be willing to pay this price, or we will understand little at all;** our intuitive notions, just like our preferences for how the world ‘should’ or ‘must’ work, will stand between us, and what is genuinely true about nature, no less than they did throughout the history of our physics – until about a century ago, with the discovery of two very, very important sets of ideas: the Theory of Relativity, and the Theory of Quantum Mechanics, both of which are the subject of this book.

Finally, there is one last thing that the reader should also consider, especially if one is not so convinced that understanding theoretical physics is as easy as to gain as stated or should one lose their motivation to finish reading the *whole* book, first. (**Skip parenthesis if necessary, and remember, grasping relativity is the *biggest* conceptual step that one must make.**) But, if all else fails and interest wanes, then (provided that you have made it through the first chapter, which is only four pages long) go to the last chapter (page 104), read it first, and then start reading the chapters in *reverse* order. This non-sequential, reverse order happens to be an equally valid order – **provided one reads the *entire* book. There is no need to grasp details upon the first reading;** it is only to realize that there is a whole and complete picture, a grander picture that spans *more* than just the three dimensions that we see at any given moment. Physical existence extends far beyond any conventional notions that we might have about natural extent, and is so much richer than any imagination could ever conjure that no imagination can, except through a single means: natural science, the human pursuit of truth. Although time, thought, and effort must be made to understand nature as science does, the view is absolutely stunning to all who behold it, and again, all (anyone) can.

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