



THE NOTHING THAT REALLY IS!

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Dialectical Contradictions in Mathematics and physics,
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Abstract

The denial of the existence of contradiction is at the root of all idealism in epistemology and the cause for alienations. This alienation has become a hindrance for the understanding of the nature and the historical evolution mathematics itself and its role as an instrument in the enquiry of the physical universe (1).

A dialectical materialist approach incorporating the role of the contradiction of the unity of the opposites, chance and necessity etc., can provide a proper understanding of the historical evolution of mathematics and may ameliorate the negative effect of the alienation in modern theoretical physics and cosmology. The dialectical view also offers a more plausible materialist interpretation of the bewildering wave-particle duality in quantum dynamics (2).

Introduction “Nothing” as a concept is an enigma

that has haunted natural philosophy, theology and mathematics since the beginning of human civilization and is still a deep mystery for natural science. For “good old commonsense” and formal logic; “Being” is the essence of all existence and other things arise from existing “Being”. As a logical necessity, everything has its opposite; so “Nothing” is the opposite of “Being”. But the conundrum arose, how “Nothing” is possible? “Nothing” is not an essence of existence; so it cannot exist; it is a contradiction of logic. This idea became the common wisdom in ordinary thinking and in formal logic, that formed the principle, “Nihil fit ex nihilo” This principle rules most of epistemology till today.

But “Nothing” obstinately crept into epistemology in various ways; first as 0 (Zero or *suññya* in Sanskrit) in the number system and in computing; then as the “Almost Nothing” of the Infinitesimals and in its opposite form, the Infinite; this was followed by the “Complex Number” i as an extension of the set of real numbers; when each real number can be considered to be a special case of a complex number $z = x+iy$, where the variable y has value 0; and finally the “Virtual Particles” of the quantum vacuum (or “Nothing”) in the course of the historical development of physics. And of course, “Nothing” had to be brought in through the back door in the theological and the modern Big Bang creation of the universe., both of which require creation from “Nothing”.

The real and a final glory of “Nothing” came, when G.W.F. Hegel ceremoniously elevated it to the same status of “Being” as a contradictory partner in his philosophy. This came through Hegel’s formulation of the universal contradiction of the “unity of the opposites” in epistemology and in its ultimate dialectical abstraction of “Being-Nothing” and “the negation of the negation” as the dynamics of the evolution the universe, Nature, life, history and thought. Contradiction according to Hegel is “the root of all movement and vitality, it is only in so far as something has a contradiction within it that it moves, has an urge and activity”. Any existence of a thought or a material entity or a process without its opposite, for Hegel is impossible and meaningless. Even almighty God of theology is forced to tolerate His opposite, the evil Satan; for Himself to be meaningful to humanity! The evolution of mathematics beyond Greek geometry and the description of motion (denied by Parmenides and Zeno), was possible only after the recognition of the “Nothing” (zero or *sūnya* in Sanskrit) and the “Almost Nothing” (the infinitesimals of calculus). These two elements of mathematics in a historical and dialectical sense, opened the gateway and the highway respectively for the evolution of mathematics and its use as a tool in the development of classical physics. In the same way “Being-Nothing” as the virtual particles of the quantum vacuum of space, is the basis for the manifestation of the material universe (3).

It is precisely because of the dialectical contradiction that zero and the infinite are both themselves and something else at the same time – a contradiction, that made the development of mathematics and physics possible in the first place! The generally accepted doctrine of “nothing comes from nothing” (*nihil fit ex nihilo*) and the monism of formal logic would make the quantum phenomena, or any evolution, development, change etc. impossible except for an appeal to “Divine Providence”.

This article strives to show that man created mathematics for his tangible needs of material life, and that mathematics has a long history of evolution - no less tortuous than the evolutionary history of man himself. And it is only precisely because of this that mathematics is relevant to man! But in the course of its development, mathematics became alienated from man as if it has an independent existence of its own, like God - and this divine like portrayal of mathematics was historically (since the early Greeks) used to serve the class interest of society, culminating in modern mathematical idealism under world monopoly capitalism.

The contradiction and the dynamics of “being-nothing becoming” and the “negation of the negation” of Hegel’s dialectics provides not only a better reflection of the actual nature of mathematics and the dynamics of its development through zero [4], but also an understanding of the objective reality of the world as reflected by classical physics and by quantum dynamics [3, 5]. The fierce resistance to the recognition of the role of contradiction in mathematics, Nature, history and in thought is at the root of the confusion and the crisis in modern official physics and cosmology (1).



The Historical and Philosophical Background:

Hegel divided all modes of human thought from the early Greeks onward in history, into two broad categories. The one comprising idealism, rationalism and classical materialism (including formal logic, mysticism and theology) was collectively termed as “the view of understanding” or crudely represented by causality that historically became the dominant mode of thought in a class society. The other one “the view of reason” or dialectics formed the second category; but always in a relation of the unity of the opposites opposition to the dominant category.

The “view of understanding” ranging from the early Greeks through medieval scholasticism, rationalism to classical materialism - to modern natural science - particularly post-Einsteinian physics, held the view that mathematics is the only vehicle to indubitable, infallible and the absolute truth of the world - and even the notion that mathematics constitute the primary elements from which the universe was created (6).

This view, formalized by Plato, asserts that the mathematical objects are “real” and exist as independent entities in a realm, unavailable to sense-perception - but can only be perceived by thought. For Pythagoras (580 (?) – 520 B.C.) - the father of idealism: “number is the essence of all things, and the organization of the universe as a whole in its determination is a harmonious system of numbers and their relations” (Quoted by Aristotle, *Metaphysics*, I, 5 *passim*) [7]. The rationalists Spinoza and Rene Descartes tried to correct the defects of old philosophy by adopting the rigorous methods of geometry and mathematics. Geometry begins with axioms, which are self-evident and necessary truths - and proceed by rigorous deductions to draw only those conclusions which follow by logical necessity - as demonstrated by Euclid.

The idealist view of mathematics lost some of its glory with the development of materialism and the bourgeois democratic revolution in Europe, when ironically, mathematics attained its rapid and most developed form. But the idealist view of mathematics received a new revival in modern times after Albert Einstein proposed his new theory of gravity based on geometrical idealism and the concept of an integrated spacetime geometrical manifold with tangible physical attributes; as the basis of objective reality. This theory has become the most influential theory of modern physics and cosmology and represents a point of departure from their basis on classical materialism. “How can it be” Einstein wondered, “that mathematics being a product of human thought which is independent of experience, is so admirably appropriate to the objects of reality?” [8].

Einstein even went one step further, when he said, “Our experience hitherto justifies us in believing that nature is the realization of the simplest conceivable mathematical ideas. I am convinced that we can discover by means of purely mathematical constructions the concepts and the laws connecting them with each other, which furnish the key to the understanding of natural phenomena. ... In a certain sense, therefore, I hold it true that pure thought can grasp reality, as the ancients dreamed” [9].

Einstein claimed that his theory of relativity (GR) is a vindication of mathematical idealism: “The natural philosophers of those days were on the contrary most of them possessed with the idea that fundamental concepts and postulates of physics were not in the logical sense free inventions of the human mind but could be deduced from experience by abstraction – that is to say by logical means. A clear recognition of the erroneousness of this notion really came with the general theory of relativity,” [10].

For his frenzied followers in modern theoretical physics, mathematics is not any more a mere tool of scientific inquiry, but rather it is an “a priori” determinant of the universe. Theoretical Physics, particularly modern cosmology and particle physics has become a field of the dazzling fireworks of mathematics. It no longer feels constrained by experimentation and/or the vagaries of empirical facts. A sense of beauty, symmetry, the consistency of mathematics and the “free creation of the mind” is all that is needed to find the ultimate truth of this world and a “Theory of Everything” - “Beauty before truth” [11] is its slogan. We see popular books by decorated modern physicists with titles like, “Our Mathematical Universe”. “Dream of a Final Theory” etc, where claims are made that the consistency of idealized mathematics alone will lead to a “Theory of Everything” and the ultimate truth of the world. The confidence for reaching the summit of knowledge is such that the Large Hadron Collider (LHC) one of the most ambitious experiment in the history of modern physics, aims to unlock the ultimate mystery of the world guided by the mathematics-based theories of modern physics.

The formal logic of non-contradiction rules official philosophy, physics and cosmology. For it everything was created perfect in itself and the opposites are separated from each other forever with an exclusive middle in between and hence there can never be any contradiction in the world; it is forbidden to have any unity between the opposites. The geometrical and the mathematical objects are believed to be the pinnacle of perfection, contradiction free, the most ideal, eternal and primordial determinants and the primary elements of the universe, through which indubitable final truth of the world could be unveiled. Spinoza and Descartes even tried to build philosophies on the model of geometrical truth. Albert Einstein revived the supreme role of geometry and mathematics in modern physics, negating Newtonian empiricism with geometrical axioms as the methodology of science. This mode of thought values precision, does not allow imperfection, change, development etc. except from an “impulse” from without. Thus the opposites such as “being” and “nothing” remain distinctly separate from each other and unique in themselves for ever. Mainly due to the efforts and the prestige of Einstein, idealized mathematics represent the subjective idealism in natural science; the same way as Kant’s logical categories are for his subjective idealism in philosophy.

The two primary elements of mathematics – zero (or śūnya in sanskrit) and its opposite end - the infinite, together with much of the objective reality are now becoming ever more mystical with the increasing infusion of mathematical idealism in theoretical physics and cosmology; as official science preoccupies itself with the aim of finding an illusory “Theory of



Everything” of the universe; following the lead of resurgent Platonic mathematical idealism.

This type of generally accepted mystical and esoteric view of zero in mathematics is common even in popular books on the topic. The following is a typical example: “Zero: The Biography of a Dangerous Idea” by Charles Seife [12]: “Zero is powerful because it is infinity’s twin. They are equal and opposite, yin and yang. They are equally paradoxical and troubling. The biggest question in science and religion are about nothingness and eternity, the void and the infinite, zero and infinity. The clashes over zero were the battles that shook the foundations of philosophy, of science, of mathematics and of religion. Underneath every revolution lay a zero and an infinity. ... Zero became the language of nature and the most important tool in mathematics. And the most profound problem in physics – the dark core of a black hole and the brilliant flash of the big bang – are struggles to defeat zero”. This passage and the book in general is mere verbiage, says less than nothing on the nature of Zero or the Infinite, but offers only wonder and mystification! Natural science is supposed to provide positive knowledge of the world by unveiling its mysteries; but mathematics in particular and modern theoretical physics and cosmology in general are only adding more mysteries, instead!

The Dialectical Materialist Approach:

But strong opposition to Greek mathematical idealism was initiated by none other than the Greatest of all Greek philosophers - the materialist Aristotle: “But (i) are these magnitudes Ideas, or what are they? They contribute nothing to sensible things, any more than do the mathematical objects already referred to. (ii) No mathematical proposition is true of them, unless we alter the concepts of mathematics and propound new doctrines of our own; indeed it is not hard to adopt any random hypothesis and spin out a long thread of conclusions. No, these thinkers are quite wrong in seeking to link mathematical objects with Ideas”, is how Aristotle [13] objected to this approach to knowledge.

Few centuries later Hegel echoed the view of Aristotle and rejected the geometrical methods of Descartes and Spinoza in philosophy: “That these methods, however indispensable and brilliantly successful in their own province (i.e. mathematics, A.M.), are unserviceable for philosophical cognition is self-evident. They have presuppositions; their style of cognition is that of understanding, proceeding under the canon of formal identity.” [14]. Hegel ranked the Science of Logic above mathematics in terms of priority for philosophical inquiry.

The idealist view of mathematics of the early Greeks, and particularly of Plato’s philosophy about the certainty, indubitability and the necessary objectivity of human thought etc., never materialized in the real world. Christianity, combining Plato’s ideals and the myths of some Jewish tribes, had to incorporate the contradiction of the evil Satan in God’s perfect world. Euclid’s three-dimensional geometry based on “self-evident truth” that formed the basis of Greek philosophy and even the rock-solid foundation of rationalism, became undone with the discovery of multi-dimensional space by Riemannian geometry.

Immanuel Kant showed that formal logic always leads to antinomies and contradictions in the fundamental issues of philosophy and declared contrary to the Greek idealists that the objective reality of the world is unknowable. The only way to deal with reality he posited, was to impose human subjective intuition, ideas and his infallible logical categories on the world; - the categories that Kant created out of thought. Modern theoretical physics faces a crisis similar to that of pre-Hegelian philosophy; about the certainty of the knowledge of the material world and of the cosmos at large, when dealing with the uncertainty of the newly emerged quantum world, as it’s in contradiction with traditional materialism.

Heraclitus (544 – 483 B.C.) was the first who opposed the notion of the non-contradiction of early Greek philosophy. and posited that everything in the world is in perpetual motion of coming into being and passing out of existence as a result of inner strife (the dialectical contradiction of unity of the opposites within it’s element A.M.) and is mediated by chance and necessity. This line of inquiry was followed through among the notables by Epicurus, Lucretius, Spinoza culminating in it’s modern formulation by G.W.F. Hegel.

Hegel developed dialectics in the all-round idealist form and distinguished dialectics from the old and non-dynamic mode of thought of Aristotle’s formal logic. Karl Marx and Frederick Engels developed Hegel’s dialectics to its more potent materialist version. We are not concerned here with the elucidation of the philosophy of Hegel, but with its implications for the nature and the dynamics of mathematical developments - and on the ontology of the objective reality as reflected by quantum dynamics and physics.

This work has its basis in the materialistic dialectical approach to the philosophy of mathematics and physics initiated by Frederick Engels [5, 15] and to the more recent self-proclaimed anti-Platonist approach to the philosophy of mathematics by some modern mathematicians notably Reuben Hersh [16]. The present work was particularly inspired by the excellent historical account of the development of the concept of Zero and thereby the evolution of mathematics, by Robert Kaplan in his book - “The Nothing That Is” [4], hence the title of this article.

Only a historical account of the development of mathematics - and in particular of zero (“nothing”), can reflect which of the two antagonistic perspectives of mathematics and physics, is a better reflection of the actual state of affairs. Idealism by its nature is anti-historical, because according to its doctrine, ideas (including the mathematical one) exist in a realm independent of man; it can be perceived only by a capable and receptive mind, so a historical context is only incidental and secondary.

Frederick Engels was the first person to formally elaborate the materialist dialectical position on the essence and the development of mathematics (in a polemic with the German idealist thinker Eugene Dühring) in his seminal book “Anti-Dühring” [15] in the following way:

“But it is not at all true that in pure mathematics the mind deals only with its own creations and imaginations. The concept



of number and form have not been derived from any source other than the world of reality. The ten fingers on which men learnt to count, that is - to carry out the first arithmetical operation, may be anything else, but they are certainly not a free creation of the mind.

Counting requires not only objects that can be counted, but also the ability to exclude all properties of the objects considered other than their number – and this ability is the product of a long historical evolution based on experience. Like the idea of numbers, so the idea of form is derived exclusively from the external world, and does not arise in the mind as a product of pure thought. ... But in order to make it possible to investigate these forms and relations in their pure state, it is necessary to abstract them entirely from their content, to put the content aside as irrelevant; hence we get point without dimension, lines without breadth and thickness, a and b and x and y , constants and variables; and only at the very end of all these do we reach for the first time the free creations and imaginations of the mind, that is to say, imaginary magnitudes.

Even the apparent derivation of mathematical magnitudes from each other does not prove their a priori origin, but only their rational interconnection.... Like all other sciences, mathematics arose out of the need of man, from measurement of land and the contents of vessels, from computation of time and mechanics. But as in every department of thought, at a certain stage of development the laws extracted from the real world become divorced from the real world and are set over against it as something independent, as laws coming from outside to which the world has to conform. This took place in society and in the state; and in this way, and not otherwise, **pure** mathematics is subsequently **applied** to the world, although it is borrowed from this same world and only represents one section of its forms of interconnection – and it is only just precisely because of this that it can be applied at all.”

Reuben Hersh a formal mathematician of repute, probably for the first time in the recent history of mathematics - and long after Aristotle, declared his views on mathematics which are in agreement with the view of Engels, stated above. Hersh writes: “This book (“What Is Mathematics Really”) offers a radically different, unconventional answer to that question. ... Repudiating Platonism, while recognizing the reasons that make them (alternately) seem plausible, I show that from the viewpoint of philosophy, mathematics must be understood as a human activity, a social phenomena, part of human culture, historically evolved, and intelligible only in a social context”[16].

Indeed, there is a contradiction between mathematics and physics - and between pure mathematics and applied mathematics. Modern official physics - following the lead from Albert Einstein, eliminated any difference between pure mathematics of idealism whose program is the exact deduction of consequences from logically independent postulates or axioms, and the applied mathematics of approximation needed for science. Physics traditionally used approximate empirical data, which could be fitted on in various ways to analytic functions of pure mathematics, but the results are only valid in a narrow range of the data values for the argument.

The analytic functions, i.e., those whose Taylor's series converge in the neighbourhood of a given point, have precise mathematical properties, continuity and smoothness. It is very easy for an idealist with aesthetic sense, to assume that only perfect symmetry, aesthetics and analytic functions present themselves in Nature and in the world.. Another property of the analytic functions, which impresses the worshippers of beauty and aesthetics, is that, such functions are known for all values of their argument when their values in any small range are known - thereby making it possible for its unlimited extension. Thus, the proposition that the laws of Nature only involve analytic functions leads to a complete mechanistic determination of the world based on their experimentally-determined value in a narrow range only

The alienation of pure mathematics in physics has gone to the extent that the physicist Arthur Eddington reportedly claimed that experimental results are valid only when supported by a good mathematics based theory [17]; in relation to his dodgy experiment on the bending of starlight by the sun to prove Einstein's theory of general relativity. This practice still continues and is rampant in modern physics.

The major justification for using idealized mathematics for an understanding of the world comes from a pre-supposition that the present reality of chaos, complexities, ugliness etc., is a result of a spontaneously broken symmetry from a previous perfectly symmetric and ideal state. According to this view, the task of mathematics and physics is to reduce or deduce the world to its original, perfect, simple and ideal form by putting together the pieces of the broken symmetry and restoring the primordial mathematical form. This supposedly primordial form will in turn be a basis for the understanding of the present state of the world. This view is nothing more than the “Absolute Idea” of such an idealist as Hegel. His “Absolute Idea” willy-nilly, alienates and disguises itself in crude and perishable material Nature, undergoes evolution and development following the laws of dialectics and evolve through the twists and turns of Nature, and comes back to its pristine self again through the thought of man and unsurprisingly through the philosophy of Hegel himself!

In its attempt to find the absolute truth of the world, modern official physics therefore shares the illusion of all past idealism – that of Hegel included. What is more, the existence of discrete matter particle – the fundamental basis of materialism, and the mysterious Infinite [18] are contradictions that stands in the way of the application of the concepts of symmetry, beauty, analytic functions etc., of idealist mathematics. So matter particles and the infinite as categories had to be banished from the lexicon of physics and replaced with the continuous and well- behaved “fields” that are conveniently amenable to geometry, symmetry, analytic functions etc.

According to Einstein: “Since the theory of general relativity (GR) implies the representation of physical reality by a continuous field, the concept of particles and material-points cannot play a fundamental part - and neither can the concept of motion. The particle can only appear as a limited region in space in which the field strength or energy density is particularly high” [19].

Similar concepts of reality in terms of fields - rather than matter-particles, were later extended to quantum-mechanics in



quantum-field theory (QFT, Higgs' field of the electro-weak force and quantum chromodynamics (QCD) for the strong force that became collectively known as the Standard Model.

The replacement of matter with continuous field, allows for a mathematically-convenient field-based concept of objective reality and the hope for the unification of all the four forces of Nature – a major preoccupation of modern particle physics and astrophysics. But the difficulty of such an enterprise is brought home by the Quantum Uncertainty Principle, because a great many of the difficulties in applying classical mechanics to quantum phenomena, lie in this kind of naive and oversimplified application and extension of idealized mathematics to the real world.

But it is precisely, this kind of unlimited extension of the finite mathematical laws to the infinite extremities of the microcosm and macrocosm which has brought modern official theoretical physics to its crises [1]. According to dialectics, any truth when extended beyond its natural limits either turns into its opposite or becomes an absurdity. Mathematics itself is rife with contradictions - and the prime example is zero or “Nothing”.

The evolution of mathematics beyond Greek geometry and the description of motion became possible only after the discovery of zero (“Nothing”) and the infinitesimal (“Almost Nothing”) and only because of the contradiction that zero is itself and something else at the same time. The value, or number, zero is not the same as the digit zero, in extending the numerical system using positional notation; and this contradiction is the very reason why the development of the numerical system was possible. In the same way, the number zero may be considered to be and not be a natural number at the same time. And because it is a whole number, it is both a rational number and a real number, as well as a complex and an algebraic number all at the same time.

Indeed, zero (“Nothing”) is not only the gateway to the mathematical world of numbers and sets, but so too, it forms the borderline between the negative and positive worlds of numbers; the “indeterminate” $0/0$; the mathematical infinite $x/0$. The exponential x^0 is another identity of the number 1 except where $x=0$. It also opens the highway to “motion” by introducing dialectical contradiction in mathematics in the form of “Almost Nothing” of the infinitesimal calculus.

Zero (nothing) also forms the invisible border between the real and the virtual worlds and is a gateway to the adventure of the quantum world- the virtual particles of quantum vacuum of “being-nothing”[2, 3]. This is because of the fact that zero is the only number in mathematics that is both a real and a complex ($0=0x + i0$) number! In his attempt to develop a theoretical framework to describe elementary particles with fractional (1/2) spin properties, Paul Dirac [20] made the revolutionary discovery of the antiparticles and the conjugate field of the complex/imaginary world of virtual particles of the quantum vacuum. Every real number x has its virtual or imaginary partner, $x = x + iy$, where the value of y is Zero (or Nothing), and hence can be considered to be in a dialectical (Being-Nothing) dynamic relation. Zero is also used in a formal sense as the lowest level of some arbitrary scale, such as the “zero-point” energy of the quantum vacuum; the thermodynamic absolute zero of the temperature scale etc.

Robert Kaplan in his delightful book [1] describes the protracted history of the development of the concept of zero and the evolution of the whole world of mathematics pivoted on zero or “Nothing”, as he says: “If you look as zero you see nothing; but look through it and you will see the world. For zero brings into focus the great, organic sprawl of mathematics, and mathematics in turn the complex nature of things ... But neither now will (it) ever be finished. Always beckoning, approached but never achieved: perhaps this comes closest to the nature of zero”.

If the contradiction within zero (or “Nothing”) gives rise to the “great organic sprawl of mathematics, and mathematics in turn the complex nature of things” of the quantitative universe; its counterpart the infinitesimal (“Almost Nothing”) gave the universe its qualitative character of motion and dynamics. The proper description of motion (of any kind like change, development, evolution etc) was possible only after the development of infinitesimal calculus by Leibniz and Newton. Like zero, the infinitesimal calculus can be considered as two of the highest achievements of the human intellect.

But it is not only in mathematics and physics that contradiction plays a fundamental role in their development. As Hegel showed through his dialectics; any existence in the final analysis is a contradiction of “being-nothing” or “The absolute Identity of identity and non-identity” – a universal contradiction. Its continuous resolution through the negation of the negation is the primary basis for the manifestation of the universe, Nature, of history, life, society and thought.

In the realm of the cognition of the universe, humanity itself faces a contradiction between epistemology and ontology. But from a dialectical point of view, the noble historical aim of official philosophy, natural science and mathematics to resolve this contradiction and to find the final and the absolute truth of the world - is illusory. Because positive knowledge of the world can only be gained as an iterative process of historical development without any end. “Being-nothing-becoming” and “the negation of the negation” is the process of discrete quantum, dialectical and historical leaps mediated by chance and a dialectical necessity (that is inherent in chance); form the basis of an eternal and infinite universe. Hence an exhaustive understanding of the universe in the form of an Absolute Truth – the aim of philosophy and physics; will always remain impossible

As modern official physics continues to pursue the idealist goal of a “Theory of Everything” (21), it must heed to the alarm raised by Prof. Ellis and Prof. Silk, in their recent comment in Nature [1]: “Scientific method: Defend the integrity of Physics”. With all its self-congratulations, boasting and celebrations; New Physics is not striving for positive knowledge of the world, but only esoteric myths based on mathematics-aided theories and the subjective “proof” of those theories. The mathematics based esoteric theories of modern physics can provide no positive knowledge. As Karl Marx said in his Theses on Feuerbach (22), “The question whether objective truth can be attributed to human thinking is not a question of theory but a practical question. In practice man must prove the truth, i.e., the reality and power, the “this-sidedness” of his thinking... The dispute over the reality or non-reality of thinking which is isolated from practice is a purely scholastic question”.



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