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What is Physics?

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Abstract

Physics has evolved from an attempt by ancient researchers to understand the workings of their immediate surroundings to a body of mathematical descriptions and paradoxical physical interpretations. We have today no rational explanation for the simplest of systems and phenomena, for instance, how a magnet physically attracts another from a distance or by what physical means the Earth prevents the Moon from leaving the Solar System. Not one mathematical physicist can explain in a logical manner why a pen falls to the floor rather than to the ceiling. The equations suggest that 'mass attracts mass' or that 'north attracts south', but these are mere descriptions. They give us no insight as to the physical mechanisms underlying such phenomena. We trace these shortcomings to the nature of the scientific method inherited primarily from 17th Century researchers. We argue, in essence, that the current version of the scientific method is divorced from authentic Science. Here we propose an alternative – henceforth known as the Rational Scientific Method (capitalized to distinguish it from what is currently regarded as such) – and outline the steps necessary to present rational explanations for physical phenomena.

Keywords - Scientific Method, Science, Physics, rational, peer review, prediction, explanation, description, evidence, proof, truth, belief, knowledge, religion, Mathematical Physics

I. SCIENTIFIC KNOWLEDGE?

The notion of what science is or is supposed to be has evolved over the centuries. Science started out as mere philosophical speculations about the nature of our Universe and worked its way to laboratory pragmatism. The widespread belief that an experiment objectively proves a theory is deeply ingrained in layman and expert alike. Many still equate the scientific method with the development and invention of technology.

Today, *science* (from the Latin *scire*: to know) is defined in terms of knowledge:

> *"a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe"* [1]

> *"systematic knowledge of the physical or material world gained through observation and experimentation" (dictionary.com)* [2]

This modern conception of *science* flourished in the 17th Century when researchers began to question the wisdom of the Greek philosophers and associated knowledge with experimental evidence.

The fatal shortcoming of the contemporary definition of science is that the philosophers still have trouble zeroing in on the meaning of *knowledge*, a *sine qua non* word of the definition which perennially remains obscure after the conferences adjourn:

> *"The definition of knowledge is a matter of ongoing debate among philosophers in the field of epistemology.* [3]

> *"Knowledge, being a primitive fact of consciousness, cannot, strictly speaking, be defined… The distinction between knowledge and belief is more difficult to draw... both belief and knowledge imply certitude, and denote states of mental assurance of the truth…"* [4]

> *"The attempt to analyze knowledge has received a considerable amount of attention from epistemologists, particularly in the late 20th Century, but no analysis has been widely accepted. Some contemporary epistemologists reject the assumption that knowledge is susceptible to analysis."* [5]

Plato is credited with having defined *knowledge* as *'justified true belief'*, a peculiar rendition that is still widely used and analyzed. [6] [7] Replacing the word *knowledge* with the word *belief* in foregoing definitions of *science* results in...

> *"a systematic enterprise that builds and organizes* **belief** *in the form of testable explanations and predictions about the universe"*

> *"systematic* **belief** *of the physical or material world gained through observation and experimentation"*

If we proceed with Plato's version of *knowledge*, science reduces to nothing more than a system of beliefs. Certainly, many scientists would beg to disagree that they do nothing but 'believe truly'.

But then, if science is not about believing or knowing, what is it in the alternative?

One way to converge on an answer is by eliminating all those non-essentials that are often stacked under the umbrella of *science*. These include elements that are rarely challenged in school and later taken for granted by professionals. Here we review *de novo* whether descriptions, predictions, irrationality, technology, experiments, evidence, proofs, and equations have anything to do with science.

II. IS SCIENCE ABOUT DESCRIBING?

Science has been equated with Mathematics since at least as early as the 17th Century when tenacious, mathematically-inclined individuals began to tackle questions of nature aggressively. The researchers synthesized their findings in the form of equations which were widely interpreted as testaments of natural law. It is thanks to them that mathematics stealthily became the language of physics and of science. [8] [9] [10]

However, math can only describe and then only quantitatively. By their very nature equations were devised to describe, most often a single position of an object on a set of coordinates. Math has no power to explain causes or mechanisms. Explanations require interpretation and qualitative responses. It is thus that the contemporary scientists casually state that science is merely about *describing*, specifically in mathematical form. [11] [12] [13] [14a] The mathematician is saying that a scientist describes a chair quantitatively – 4 legs, 1 seat, and 1 backrest – and he accomplished his job.

It is as a result of equating science with mathematical descriptions that university professors can at best *describe* the strength of a magnet or the acceleration of a pen falling to the floor with equations, but not *explain* the mechanisms by which they do so. There is no quarrel that the two modern-day pillars of Mathematical Physics – Quantum Mechanics and General Relativity – mathematically *describe* the workings of the Universe at the micro and macro level quite adequately. The argument is that neither branch offers rational *explanations* for the invisible processes observed indirectly in the field and in the lab. [12] [15] [16] [17]

If the purpose of science was to explain the workings of the Universe, a description alone does not constitute science. What was the point of Physics in the alternative if we have measurements, equations, and proofs, but can't answer a simple question such as how or by what means a magnet attracts another from a distance? We still have no idea how the magician sawed the lady in half and later appears with her on stage when the curtains open again. How does Mother Nature do her invisible tricks? That's what Physics was supposed to be about. That was the purpose of science.

III. DESCRIPTION VS. EXPLANATION

One unresolved problem that interferes with our quest to define *science* is that many researchers regard descriptions and explanations to be synonyms:

> 1. The Wikipedia begins its definition of the word *explanation* as "*a set of statements constructed to describe*…" [18]
>
> It then defines a description as…
>
> *"a written or spoken account presenting characteristics and aspects of that which is being described"* [19]
>
> Is the *description* of a chair and of a broken window the same thing as an *explanation* of how the chair was used to break a window? Is a *description* of a chair flying through a window ("The chair flew through the window.") the same thing as an *explanation* of why (cause, mechanism) the window is broken?
>
> 2. At face value, the common dictionary seems to define *describe/description* slightly differently than *explain/explanation*:
>
> *Describe: to tell or depict in written or spoken words; give an account of:* [20]
>
> *Description: a statement, picture in words* [21]
>
> *Explain: to make plain or clear; render understandable or intelligible; to make clear the cause or reason of; account for* [22]
>
> *Explanation: a statement made to clarify something and make it understandable; exposition* [23]
>
> However, it is not altogether clear whether *'to tell and depict'* or *'give an account of'* are significantly different than *'to make clear and understandable'*.

It is as a result of vague, ambiguous definitions of ordinary speech that many professionals and laymen confuse the two terms and define one in terms of the other.

For the purposes of science we have to make the distinction between description and explanation absolutely clear because therein lies the key to their definitions:

> *Description: An objective listing of properties, attributes, qualities, etc., and/or behaviors, conduct, performance, etc., of a physical object, scene or concept*
>
> *(Synonyms of describe: characterize, depict, portray, delineate)*

Explanation: The causes (Physics) or reasons (Philosophy) underlying a phenomenon; the prosecutor's version of how (cause/mechanism) or why (reason/purpose) a consummated event happened.

(Synonyms of explain: theorize, elucidate, expound, interpret)

In short, an explanation is a movie of how an event occurred. It deals exclusively with dynamic and consummated incidents. We can at best explain a phenomenon that has already transpired.

A mathematician may dismiss these arguments as petty semantics that have no bearing on his illustrious discipline. What is the relevance to science of defining words precisely? What can it matter? What does it change? How can it affect the equations we have developed and the evidence we have accumulated through carefully executed and measured experiments?

A few examples highlight the important role language plays in science and illustrate why the 'semantic' argument raised by skeptics has no teeth. Hawking states that spacetime is a four-dimensional object. [14b] What has he said if we have no firm definition of the word *object*? Genzel affirms that black holes exist, but what has he said if we have no firm definition of the word *exist*? [24] What meaning can statements such as '*the mass moved*' or that '*energy was transferred*' possibly have if we have no definition of either term? What is it that moved? What is it that we transferred? What does a mathematician mean when he states that '*time is dilated*' or that '*a particle carries an interaction*'? The entire language of Mathematical Physics is riddled with metaphors, figures of speech, and the movement of concepts.

Therefore, we cannot avoid defining words precisely if an understanding of the theory hinges on them. Words are what we use to convey theories. Without them, what have we understood? The crisper a definition, the clearer the message that gets across!

IV. Is science about making predictions?

Another widespread misconception is that science is about making predictions or that predictions are an integral part of science. [25] Predictions have to do with the future, with what has yet to happen. Traditionally, it was prophets, astrologers, and seers who engaged in this type of activity. Today, those activities have been taken over by the mathematical establishment and promulgated as a synonym of science throughout the land.

The fundamental problem with the so-called 'scientific' predictions is that none of them deal with the future. Unwittingly, 'scientists' who do predictions to impress the crowds end up predicting the past. The most obvious case is a popular one we find in Mathematical Physics. The theorists talk about 'predicting' the conditions at the moment of Big Bang 13 billion years *ago* and how matter, galaxies, and gravity waves *came* into being. [26 27 28] This is incongruous and misleading language at best.

A mathematical theorist envisions his retroactive 'prediction' by entertaining a thought experiment. He dreams up a movie of the phenomenon he intends to *explain*. He has *already watched* the film of the model that he is going to stage in the auditorium of his mind. The proponent is familiar with the scenes he is going to put in each of the frames of the motion picture that he is directing because it is founded on experience. He asks, "What *will be* the results if these happen*ed* to be the initial conditions?" and refers to this process of running a model in his head as a 'prediction'. The entire thought experiment has the purpose of 'proving' his hunch to himself. This make-believe movie is also based on experience: the past. He already has a body of theories that the establishment subscribes to from which to choose and use as foundations. He simulates his thought experiment with these established theories and crosses out all the 'what ifs' to his satisfaction. He finally presents his findings to his peers using phrases such as "the model predicts that…" The entire scenario – results included – takes place in past tense.

The mathematical theorist is actually attempting to *explain* a phenomenon. He is trying to reassure his audience that he visualized the entire mechanism and that the outcome can be in no other way; ergo: *prediction*. Hindsight will 'prove' that his theory *was* correct. What those who use the word *prediction* are completely oblivious to is that we can at best *explain* a consummated event. Predict, we can at best predict the future. The 'prediction' segment is the result of a thought experiment that he uses to *persuade* his peers (i.e., opinion) whereas the explanation is the only part of his presentation that has anything to do with science.

Without more, a prediction is not an *explanation*, but rather a *description*: "I predict that there will be an eclipse tomorrow at 2:00 o'clock." What have I explained? There is no cause or mechanism offered so far for this event. If, instead, the prophet can *explain* why (cause, mechanism) there will be an eclipse, it is only because he draws on experience (the past). He has already seen or heard or studied eclipses that occurr*ed*. He is already familiar with such phenomena and extrapolates this familiarity to the problem at hand. He has already seen the movie of the Moon passing between the Sun and the Earth and is now simply regurgitating what he already *saw* or visualiz*ed*.

Therefore, the alleged 'prediction' of contemporary 'science' is an attempt to *explain* causes and mechanisms by way of a model simulated from experience. Since explain we can at best explain consummated phenomena, the use of the word 'predict' has no other purpose than to stun audiences with the alleged magical ability a mathematician possesses of foretelling future events. We are back to biblical prophecies and infallible astrologers.

V. IRRATIONAL SCIENCE?

Does science make allowances for patently irrational explanations or for theories that invoke magic? Should elements of traditional religions, normally regarded as supernatural – God, heaven, spirits – be allowed into the discussion? How about theories that propose 0D black holes, invisible, super-heavy dark matter, fantastic wormholes to parallel universes, unimaginable 4D spacetime, and surrealistic alternative realities? Are these any different? Are they rational? Do they have a place in science?

We can only answer such questions in a meaningful way once we get a handle on the crucial term *irrationality*. We can't dismiss them until we clarify unambiguously and objectively what we mean when we say that something is *irrational*.

The Wikipedia defines *irrational* as: *'opinion given through inadequate use of reason'*. [29] It then defines *reason* as: *'the capacity for consciously making sense of things, applying logic' and logic as 'deductive reasoning'*. [30] We have made a full circle and ended up chasing our tail because '*making sense*' is the notion that we are trying to define.

It is because of using synonyms to define strategic words that philosophers have despaired and finally thrown in the towel. The consensus is that ultimately words will remain undefined because we define them with other words that also need to be defined and so on *ad infinitum*. What is missing from this recursive reasoning is that in science we do not have to define every word in the presentation. We merely need to define those terms that make or break our theories. Key words that comprise the foundations of Physics do not rely on an endless string of terms. They can be understood by merely eliminating synonyms and restricting the range of meanings the word typically has in ordinary speech.

The ordinary dictionary defines *irrational* as *'without the faculty of reason'*. It then defines *reason* as *'basis or justification for belief'*. [31] [32] If belief is nothing more than a personal opinion, whether a proposal is rational becomes a subjective matter. In science, however, we must propose objective notions of *rational/irrational* if we are to exclude irrational as well as supernatural explanations from its body.

The Stanford Encyclopedia of Philosophy contains no definition of *rational* or *irrational* despite dedicating several articles to this subject. It raises an eyebrow that the authors of the different topics talk about a word they never bothered to define or understand.

The Catholic Encyclopedia, on the other hand, provides a definition and one which most philosophers would be comfortable with:

> *"Rationalism, in the broader, popular meaning of the term, is used to designate any mode of thought in which human reason holds the place of supreme criterion of truth; in this sense, it is especially applied to such modes of thought as contrasted with faith.* [33]

The fatal problem with this definition is that it relies on subjective terms such as *truth* and *faith* and synonyms such as *reason*. [34] [35] [36] *Reasonable* and *reasoning* are the words we are trying to define.

For the purposes of science, an irrational explanation is one that has no chance of being imagined. *Irrational* differs from *supernatural* in that the proponents cannot make a movie of their proposal. There are at least three reasons for this. [37] Briefly:

a. reification: converting a concept into an object, moving a concept

b. using undefined words or inconsistent definitions

c. proposing a theory that doesn't follow from the hypothesis

a. Reification. The prosecutor either attempts to move a concept (e.g., movement of 'the' center of mass, transfer of energy or of information, astronaut falls into 'a' 0D singularity) or introduces an irrational object. An irrational object – as opposed to an *impossible* object – is one you cannot visualize, imagine, or draw (e.g., 0D point, 1D line, 4D space-time, 0D black hole singularity, wave-packet of light, etc.) The theorist of Physics cannot start his presentation because he cannot even illustrate the objects with which he intends to explain the workings of the Universe. What image is he going to put in the first frame of his film for 4D spacetime?

b. Using undefined words. Another variant of an irrational explanation is one in which a theorist is unable to define the key terms that make or break his theory. The theorist defines terms using synonyms, introduces functional or operational definitions, or excuses himself saying that it is difficult or impossible to define words precisely.

> *Synonyms*. The fatal problem consists of using synonyms in the definition. An example that concerns Physics is the word *object*. The definition of ordinary speech includes words such *thing*, *something* or *anything*, or proposes criteria such as *touch* or *see* which tacitly invoke a second object. A synonym is a circular definition: no definition at all.
>
> *Operational 'definition'*. A functional or operational definition is one in which the meaning of a word is the outcome of an experiment. It is a proof disguised as a definition. The proponent does not define his terms up front so that you can follow his presentation. You have to wait until the end of the presentation to guess what he was talking about for the past hour.

Harrison's operational definition of light is a case in point. [38] After applying his operational definition throughout his presentation, Harrison cannot tell you whether light is a particle or a wave. His logic runs in reverse. Light *must* be a wave if we can explain such and such experiments with waves, and light must be a particle if we can explain other behaviors with corpuscles.

The only reason that a theorist insists on functional and operational definitions is that he cannot define the word at the center of his talk. After-the-fact operational definitions are nothing more than attempts to elude the scientific requirement of defining terms.

It is impossible to define. The myth has spread widely that ultimately words cannot be defined because they rely on other words which also need to be defined and so on *ad infinitum*. This traditional excuse relieves the presenter of having to use a single definition throughout the dissertation. For instance, the word *line* is rarely used consistently in Geometry. It cannot be otherwise because the geometer starts his presentation stating that *line* is a primitive (undefinable) term. Yet, *line* is one of the foundations of Geometry! [39] This fine print comes in handy to the prosecutors because it enables them to use the word *line* as a series of dots here, an itinerary there, and as a sequence of numbers farther away. [40] [41]

c. Inconsistency between theory and assumptions. Yet another type of irrational explanation is one where the theory (explanation) does not follow from the hypothesis (assumptions). The proponent illustrates a 2D dot, calls it a 0D *point*, and explains his theorem using positions, locations, numbers, ordered pairs, nodes, and events. [40] [42] Or the proponent has a discrete particle attracting another from a distance without any intervening medium. [43] The theorist is in effect introducing unaccounted for spirits in that space which he never introduced at the beginning of his presentation during the *assumptions* phase. He is filling in the blanks with magic.

To summarize, *irrationality* can be defined objectively. *Irrational* refers to theories that include:

- objects that cannot be illustrated because they are actually abstract concepts introduced in lieu of objects
- inconsistent definitions or undefined words
- explanations that don't follow from the assumptions

Irrational explanations are clearly outside the bounds of science. They belong exclusively in the realm of religion. The audience has no chance of following the speaker's presentation.

VI. IS SCIENCE ABOUT RUNNING EXPERIMENTS?

Several official sources reinforce the long-held view that science consists of running experiments. [44] [45] [46] [a] The justification for experiments is that other researchers should be able to reproduce the same results independently and objectively.

Let's 'test' this argument with an experiment. We let go of a pen and observe that it always falls to the floor rather than to the ceiling or to the side walls of the room. We can measure and describe how fast it falls and create an equation that anyone can verify in their own labs. We have experiment and Math, two vital elements of what practically all scientists today regard as essential to the Scientific Method.

What have we learned? Does simply running this experiment, measuring, calculating, verifying the equations, and reproducing the results that someone else published give us any insight as to the causes or mechanisms of gravity? In fact, an observer can watch birds flying around all day and not understand a single thing that is happening before his very eyes. A description alone is not science!

VII. IS SCIENCE ABOUT PROVING?

The initial purpose of running experiments in the old days was ideally to discard possibilities and hone in on causes and mechanisms as well as on the physical nature of invisible entities underlying phenomena such as light and gravity. Researchers ran experiments to test their hunches. Experiments enabled hands-on investigators such as Newton and Faraday to amend their theories. Running an experiment necessarily preceded their conclusions. However, running an experiment did not guarantee comprehension. A researcher could even verify the results of someone else's experiment, confirm all the measurements and equations, and still fail to understand the underlying causes.

Today, the purpose of running experiments has drifted far from its original intentions. Today, running experiments is so widely deemed an essential part of science that no one has to justify the need for an experiment. Indeed, it is expected. Without it, there is no evidence, and without evidence, there is no proof. However, a contemporary researcher runs an experiment to become a celebrity, to make a name for himself.

What we ended up with today, actually, is a conflict of interests. The scientific establishment pays very close attention to evidence, and the consensus is that without it, there is no science. Graduates are well aware of this state of affairs and adjust their careers and behaviors accordingly. The contemporary researcher caters to those in power in

hopes that the establishment will recognize him some day, make him famous, and bestow upon him a 'knowledge' medal of some kind. Individuals who are in a position to do so, especially, are those who have a monopoly over a project that no one else can reproduce because of its enormous costs. The audience must simply have faith that the project manager did everything right, made no error in judgment, and – God forbid – did not tamper with the data to ratify his preconceived conclusions. One would hope that, ideally, the decision makers delegated so much responsibility to him because he is a genius and an objective theorist.

Therefore, the purpose of running experiments has shifted to political and career ends and no longer has the purpose of attempting to determine the architectural nature of the invisible mediators of light and gravity. Researchers run experiments to collect evidence in order to convince the peer reviewers that the author has discovered something new that should make him famous. The purpose of evidence is to persuade the juror. The purpose of persuasion, in turn, is to convince in order to convert. And the purpose of convincing and converting is to recruit. A prosecutor presents evidence in order to sway the jurors, to induce them to change their minds in his favor. The prosecutor is merely interested in winning his case at any cost. The end game in Law is not to arrive at what actually happened, but to win the case. But Law is politics, not science. What if one juror believes that the prosecutor proved his theory, but another one doesn't? What if one juror believes that the theory that God created the Universe is correct and another one doesn't? Should we flip a coin, submit it to a vote, meet the other party halfway? Do we prove how the Universe works by consensus?

Evidence is what we gather in order to prove, but proof is an element of religion. *Proof* means that someone became convinced of something and now believes it. He has adopted a theory that he allowed himself to believe as his own.

It is religion which claims to have proven and to know. It is religion which attempts to convert, claiming that it 'knows' the truth and has proven through evidence. Science is much more modest. Science only claims to explain. In science, we do not run experiments. In science, we explain them.

VIII. IS TECHNOLOGY PROOF OF SCIENCE?

The most sweeping evidence that a prosecutor can present to convince the jurors is technology. If a device works it is because the theory is correct. Right?

Or is it?

The most widespread misconception among laymen and professionals alike is that technology is the corroborator of science. The common man has been conditioned to believe that science has to do with 'what works': the production of a viable gadget confirms that our theories are correct. The two most common examples that most people invoke are that computers wouldn't work if Quantum were wrong and that GPS wouldn't work if General Relativity were wrong.

These are misconceptions because an explanation (theory) has nothing in common with constructing a device that performs a function. The inventor doesn't even have to understand the causes behind the mechanism in order for his invention to be functional. A missionary can show the backward native how a magnet magically picks up pins (technology). He discovered this phenomenon through trial and error. It doesn't follow that he can explain the invisible mechanism that produces the physical effect or that the theory that he proposes is how Mother Nature actually runs her shop. Thomas Edison synthesized the difference between science and technology in a famous two-liner. He allegedly said: *"I have not failed. I just found 10,000 ways that don't work."*

Does GPS perchance 'prove' that time is a physical object that can be dilated like the pupil of an eye (i.e., the physical interpretation that General Relativity offers for the phenomenon)? Does the fact that computers work prove that there are zero-dimensional virtual particles that pop in and out of the vacuum as Quantum Mechanics suggests? In other words, the fact that a device works has nothing to do with the explanation of how or why it works. A working device tells us nothing about mechanisms or the invisible agents that serve as mediators.

The development of the atomic bomb is in great measure responsible for the 'technology-equals-science' misconception. The military brass was completely blown away by the power the mathematicians had to invent such a device by merely putting a little bit of chalk on their blackboards. The men in uniform put the pressure on the politicians to support 'science'. Tangible results did indeed emanate from all those equations. Or did they?

Actually, the case of the bomb shows the opposite. People time and again miss the point and draw incongruous conclusions. We developed the bomb by trying one thing after another until we got it right. We develop and invent by trial and error. 'Proof' of this is that Iranian engineers and mathematicians are acquainted with all the equations devised by the West, yet to this day Iran doesn't have a bomb. Clearly, it's not equations which produce a working physical gadget. It is in the lab where we make it.

The development of the bomb started when early 20th Century researchers looked for ways to peer into the microscopic world of atoms. Gradually, the engineers developed machines that could 'accelerate charges' and smash 'particles' together. The researchers then analyzed whatever debris came out of those collisions and came up with explanations that made sense to them. They quickly realized that you need quite a bit of 'energy' to accelerate these 'corpuscles' and that when certain chemical elements are smashed they create a big bang: a chain reaction. They also realized that unstable radioactive atoms spontaneously

emit 'particles'. They put 2 and 2 together and 'predicted' that a heavier, radioactive atom such as Uranium might actually produce the chain reaction that underlies the bomb.

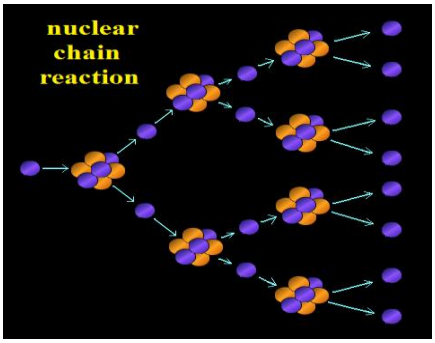
The following is a list of milestones referenced in the Wikipedia that led to the atomic bomb:

1. Curie discovers that radium releases radioactivity
2. Rutherford surmises that atoms are converting into different elements.
3. Szilard argues that a chain reaction can be induced by bombarding uranium with neutrons
4. Joliot-Curie discover that you can induce radioactivity in stable elements by bombarding them with alpha particles
5. Hahn/Strassmann discover that neutron bombardment of uranium produces barium
6. Meitner/Frisch interpret that the bombardment split the uranium atom
7. Columbia University conducts the first nuclear fission experiment in the US

These are all qualitative milestones and indicate that the making of the bomb required no Math. Researchers stumbled upon a phenomenon, then used their intuition, tried one thing and tested another until they got it right and perfected a working device. The same occurred with computers and GPS. It is Mathematical Physics which spreads the myth that, were it not for Math, we would not have the technology that we have today.

If doubts remain, we need only look at the irrational explanation Mathematical Physics offers today for the way a nuclear chain reaction takes place inside the bomb. The mathematicians argue that a heavy, radioactive atom disintegrates or splits upon bombardment by a particle, releasing particles that bang against other atoms which then break up as well (*Fig. 1*).

Fig. 1 Mathematical Physics continues to explain a nuclear chain reaction in terms of the debunked Rutherford and Bohr's Planetary model of the atom which Mathematical Physics denies today: Fig 2.



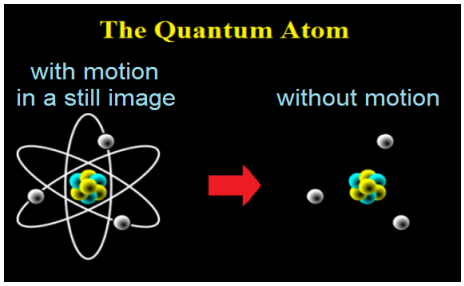
This explanation is irrational because it is based on the thoroughly debunked Rutherford – Bohr planetary model of the atom (*Fig. 2*). [47] [48] [49] [50] Yet, despite that the explanation is patently irrational it is the official explanation of Quantum Mechanics. The bomb obviously works (technology). We have no quarrel there. What is inconceivable is the explanation (science).

Fig. 2 Planetary Atom

Bohr's planetary model is still widely used, so much so that it is practically the only one in use. The model consists of electron beads orbiting the nucleus. The white curves on the left side represent their paths. The scientific way to illustrate an object is without motion as shown on the right. The question Quantum has never answered (and which renders this model irrational) is: What entity binds the electrons to the nucleus? What keeps the discrete electron beads from flying away?

The mathematical physicists argue that the electron is always in motion and that, therefore, there is no way to depict the atom in a single static image. This is like arguing that we can't illustrate a dog because he's always moving. In fact, every bit of matter in the Universe is constantly in motion.

A scientific explanation requires the speaker to illustrate an object before setting it in motion. We need an object before we can talk about motion. Hence, QM has no excuse to elude explaining what prevents the electron bead from being flung out of the atom. The mathematicians are, in effect, introducing spirits in that space.



IX. Is science about collecting data and observing?

The contemporary scientific method includes two essential requirements: observation and data collection. [51] [52] [53] It is widely believed that without these two ingredients, science cannot even get started. These claims are perplexing because they summarily rule out a great deal of Mathematical Physics, specifically the entire field of Theoretical Physics. A popular celebrity of physics such as Stephen Hawking certainly never observed a black hole or collected any data. He does not have these credits on his resume. Does this remove him from the list of scientists?

In the real world, the people who observe and run experiments and collect data are variously known as technicians, secretaries, and assistants. The job of an engineer is not to use his hands, but his head. The job of a paleontologist is not to get his hands dirty brushing bones in the field, but to make sense of what his assistants dug up. The job of a scientist is to think.

Nevertheless, anyone can observe a phenomenon all year long and never understand the mechanism. And if we make observing a requirement of science, all blind men would summarily be excluded from the discipline.

What the contemporary scientist has done is confuse the series of steps he takes to come up with an explanation with the only part of this process that belongs to science: the explanation. The scientific method is not the manner in which a researcher arrived at his conclusions or how long he researched the problem in his dark basement or whether the equation describes the phenomenon perfectly well. The scientific method consists of the logical steps he must follow to deliver his theory so that his audience understands the causes of the phenomenon. A scientist is not a detective who collects clues, researches a case, and boasts about how many hours he spent solving a problem. A scientist is a prosecutor who can explain in a logical manner how or why an event occurred.

X. WHAT IS SCIENCE?

In summary: science is not about observing, making predictions, running repeatable experiments, falsifying and verifying theories, persuading peers, recruiting followers, or winning prizes in order to become a world-renowned celebrity. Science is about presenting a theory in a logical manner so that the interlocutor understands the cause or reason…

Science: rational explanations

In Science, we explain in order to understand. Whether the listener will believe the theory is of no concern to Science.

Science (capitalized in order to distinguish it from the 'science' that has been done until now) is a body of intelligible theories. The purpose of Science is not to run an experiment in order to have evidence that will help you prove the truthfulness of your theory to a panel of hooded peers so that they knight you. The purpose of Science is to explain a phenomenon in a logical manner so that the audience understands a mechanism. A scientist is not a detective. A scientist is a prosecutor.

Science has two branches: Physics and Philosophy. Physics deals with objects and causes. Philosophy deals with concepts and reasons. Physics is interested in mechanisms, Philosophy in purposes. Typical subdivisions of Physics include: Paleontology, Biology, Geology, Chemistry, Architecture, Anatomy, Engineering, etc. Typical subdivisions of Philosophy include: History, Psychiatry, Psychology, Anthropology, Sociology, Linguistics, Politics, etc. Some disciplines – for instance, Archeology and Economics – have elements of both and fall somewhere in between, depending on which aspects we are attempting to explain. Mathematics is not on the lists because it is neither a branch nor a subdivision of Science. Mathematics is a language, a language that is circumscribed to quantitative descriptions. In Science, we don't describe. In Science, we explain.

Here, we are interested in Science as it pertains to Physics. We will not be analyzing how Science relates to Philosophy. Therefore, the first thing we must do is make it absolutely clear that Mathematics is not the language of Physics or of Science as the establishment has widely proclaimed and disseminated. The language of Physics is *illustration*. If you cannot make a movie of your theory, showing images on the screen, it has nothing to do with Physics.

XI. THE RATIONAL SCIENTIFIC METHOD

The contemporary 'scientific' method inherited from 17th Century mathematicians consists of a series of steps. The first half of the method lists the steps necessary to diagnose a problem and arrive at a solution:

1. observe a phenomenon
2. describe it
3. formulate a tentative theory (known in mathematical circles as a 'hypothesis')
4. collect data
5. make a prediction
6. run experiments
7. measure
8. calculate
9. devise an equation
10. write and publish a paper

The second half of the method has to do with persuading, convincing, converting, and recruiting. You absolutely must convince the peer reviewers that your theory is 'correct' for else you are not doing mainstream 'science'. The ultimate aim, today, is not to understand the workings of the Universe, but to win recognition. This second step includes presenting evidence in order to prove the speculation and thus get it voted into the mainstream by a majority of peers (consensus).

Many times the guild is more or less evenly divided in their opinions, or one of the theories cannot be ruled out. It is in these instances that the scientists reach a compromise and incorporate elements of the competing theories in order to appease lobbyists on both sides of the divide (e.g., wave and particle theorist blend both proposals and end up with Complementarity's irrational wave-packet; [54] asteroids and

volcanoes are incorporated into a single theory to appease both sides of the dinosaur extinction debate [55]). It is then that the tentative hypothesis magically morphs into a viable theory: a more widely accepted explanation (usually just a mathematical description referred to as 'theory'). When the proponent and his followers are able to convince a larger majority of their colleagues, the theory now becomes an undeniable fact: a proven theory. It can no longer be challenged for what would this otherwise say in retrospect of those who regarded it as a fact in the past? The next steps in this sequence are predictable. They include winning medals and prizes in recognition for the contribution, being knighted as an authority by the congregation, and acquiring the power to censor alternative theories through the peer review system. This description of the mainstream's version of the scientific method may come across as cynical and facetious, but it is actually how science is run today.

The Rational Scientific Method (also capitalized to distinguish it from what the mainstream does) pays little heed to experiment, evidence, proof, or authority. It matters not how much effort and time the researcher spent diagnosing the phenomenon if he does not yet have a rational explanation for it. Similarly, it matters not how many peers he has converted if all of them subscribe to flat-Earth theories. In Science, we care not one iota about opinions or beliefs or show of hands. In Science, we explain objectively in order to understand. That's where Science stops and religion (opinions, beliefs, proofs, truths) begins.

The Rational Scientific Method brushes aside the 'scientific' methods of both Aristotle and Newton and those who followed in their footsteps and proposes an alternative that concentrates on explaining and understanding objectively. It consists of three steps necessary to present a theory to an audience: Hypothesis, Theory, and Conclusions. The purpose of these steps is not to convert the peers or to inform them of how the presenter came to his conclusions. The purpose is to follow an orderly procedure in explaining so that the audience understands the causes and/or mechanisms underlying a phenomenon. Any and all voting for or against the theory will be done outside the conference room, preferably in churches. It is in religion where they vote for theories (i.e., opinions, beliefs, proofs, truths and facts). Science is not democratic!

XII. HYPOTHESIS

The mainstream formally defines a *hypothesis* as a 'tentative theory', as a provisional, rough-draft explanation for a yet unaccounted phenomenon.

> *"A hypothesis is a proposed explanation for a phenomenon. For a hypothesis to be a scientific hypothesis, the scientific method requires that one can test it.* [56]

> *A hypothesis is a suggested solution for an unexplained occurrence that does not fit into current accepted scientific theory.* [57]

However, usage of this word has expanded so much that it ended up losing all meaning. The contemporary hypothesis can be:

1. an objective or purpose [58]
2. a prediction [46b]
3. a testable statement [59]
4. an assumption [60 61 62]
5. an explanation [63]
6. an untested theory [14c 64]

If the words *prediction*, *assumption* and *explanation* are not synonyms, then we clearly have a problem with what is perceived in the contemporary 'scientific' world. And if both hypothesis and theory are explanations, we have redundancy and can get rid of one of these steps. Indeed, many definitions of the term 'scientific method' do not include the word *theory* or make any allusion to it. This has much to do with the fact that the mathematicians regard science to be a synonym of mathematical descriptions.

In the Rational Scientific Method, a hypothesis is something else.

Hypothesis: the assumption(s) that underlie a theory

A hypothesis consists of the assumptions that a theorist must make to establish the participants, the definitions, and the initial scene in order for the audience to understand the theory founded upon it.

In Physics, the hypothesis consists of: objects, definitions, and a statement of the facts. [37 65]

a. objects. We introduce the subject by enunciating the mandatory Golden Principle of Physics:

The Golden Principle of Physics

Physics requires an object; without objects, we can do no Physics.

The Golden Principle of Physics is non-negotiable and cannot be amended. Those who attempt to skirt it are attempting to shield their religion from attacks at all costs:

> *Religion: subjective and irrational explanations, including: opinions, irrationalities, surrealism, magic, supernatural entities and processes, predictions, witnesses, testimony, proofs, evidence, truths, etc.*

Objects are the bread and butter of Physics. What would there be to study if there was absolutely nothing in the Universe? What events would take place? What would we see or imagine if there was nothing? What experiments would we do in the lab if there were no objects – assuming that experiment were a component of the scientific method as held by the mathematical establishment? Without an object, there can be no Physics!

If, as the establishment holds, experimenting is an essential part of *science* and of the *scientific method*, then where is there a provision for objects in the official definitions of either of these two terms? What do the 'physicists' pretend to do their experiments at the lab with if they have not identified the objects that will play vital roles in their theories?

It is because of failing to include this *sine qua non* step in the official version of the scientific method that contemporary 'physics' is done exclusively with abstract concepts and thought experiments (e.g., moving 'a' mass, dilating time, transferring information, warping spacetime). Not a single textbook of Physics on Planet Earth begins by defining the bread and butter of Physics: the word *object*. Not a single book exalts the importance of defining this key term or ever has.

> *object: that which has shape (synonyms: thing, anything, something, entity, substance, body, structure, physical, stuff, architecture, etc.)* [37] [65]

Therefore, we cannot emphasize it strongly enough: the Golden Principle of Physics is non-negotiable. Eluding it only leads to irrational explanations: the movement of abstract and mathematical *concepts* (e.g., transfer energy, warping 'the' vacuum, stretching time, accelerating 0D 'point particles', alternative realities in parallel universes).

> *concept: a word that invokes or embodies two objects (synonyms: relation, idea, notion, perception)* [37]

The attempt to move a concept is irrational because a concept is a relation that a conscious observer establishes between two objects (one of which could be the observer or a concept treated as an object – e.g., space).

For the purposes of Physics, the subjects and nouns in any statement can only be objects, and only objects may be preceded by adjectives and followed by verbs. However, an object is presented as a standalone image, sculpture, or mockup, without adjectives or other qualifiers. There are no such things as 'red love', or 'dead cat', or figures of speech such as 'love moves mountains' in Physics. Poetry is outlawed. Physics is literal.

A physicist has the *obligation* to introduce all the objects that will play a relevant role in his theory *before* he presents his case, much like a prosecutor must describe the scene of a crime before he explains what he thinks happened.

If an object is *that which has shape*, the theorist has no excuse to avoid illustrating an object. The skeptic has the burden of providing a crisp, unambiguous definition of the word *object* for the purposes of Physics in the alternative. If, instead, the theorist introduces a word as a *concept*, he has no choice but to define the term. Only then can the audience understand what he is referring to. Objects, we illustrate; concepts, we define.

b. definitions

A presenter must crisply define the strategic words that make or break his theory up front. A definition is '*a limitation placed on the extent or usage of a word'.* [37] A theorist must define the concepts that render *his* theory intelligible before he uses them in a sentence. If he proposes different definitions for the same word or uses them inconsistently, his explanation will undoubtedly be irrational and the audience will be unable to follow his train of thought.

c. statement of the facts

Science doesn't deal with facts because what is a fact is subject to opinion. True facts belong exclusively to religion: opinion. Only Mother Nature 'knows' for sure what is truly a fact. Science demands a *statement of the facts*. In Science, the proponent is required to make an assumption about the initial scene much like a prosecutor needs to illustrate the crime scene for the jury before he explains what he thinks happened. The defense may have another version. A *statement of the facts* should therefore not be confused with a *fact*.

A statement of the facts is the first frame in the prosecutor's movie: a description of the initial scene. A physical theory is a motion picture. It is a plot – usually chronological – of how something happened. All motion pictures and film strips have a first frame. A theorist cannot start his explanation in the middle of his film and hope that the audience follows his train of thought. Although a statement of the facts is a description this alone does not constitute Science. The juicy part of Science is the explanation: the theory.

XIII. THEORY

A theory is an explanation; the words *theory* and *explanation* are synonyms. Theories – and nothing else – are what Science is all about. Without explanations, there is no such thing as Science. Science is not about knowing or believing or proving or predicting or describing, but about explaining.

The second step of the Rational Scientific Method is, therefore, the vital part: the reason the audience paid to pay attention. The listener came to understand a new theory. This doesn't mean that he will believe the version being exposed. Belief is something that each individual does on his own clock in the privacy of his home. Belief, opinion,

and truth are matters of personal biases and prejudices. Belief (i.e., knowledge, proof, truth) is a creature of religion. The same evidence proves to one that God made Man and to another that humans evolved from prehistoric hominids. Therefore, the Rational Scientific Method dispenses with subjective observation, testimony, witnesses, experiment, evidence, proof, truth, facts, verification, falsification, persuasion, conversion, recruitment, prizes, and authority. The Rational Scientific Method deals exclusively with objective explanations: rational theories.

XIV. Closing arguments

The last step in the Rational Scientific Method consists of the closing arguments and recapitulation. It may not be as critical as the first two steps, but it would be in the interest of the theorist to tell the jury what he inferred from the theory during this segment of the talk. The explanation may be rational, but the conclusions that a theorist comes up with may not necessarily be so. Or there could be different interpretations of the theory. For instance:

1. One proponent may conclude that we can settle whether God made the Universe with an experiment whereas another member of the congregation may conclude that it's ultimately a matter of belief.

2. One proponent can conclude that an experiment will settle whether space is warped whereas another member of his team may conclude that warped space is nothing more than a mathematical artifice.

3. One explanation for the light-on-light 'tangling' problem is that the EM ropes go through each other. [37] Another interpretation may be that the ropes are made of parts and they cross each other in the space between these segments. Although these two versions would constitute different theories because they are based on a different set of assumptions, the clarification during the *conclusions* phase is a new base from which to induce discussion.

XV. Summary

A magician is not someone who can *describe* how a trick was done. A magician is someone who can *explain* how a trick was done. If he cannot explain the mechanism behind the trick, he cannot perform the magic in front of a crowd. Explanation is a measure of his 'knowledge'. Likewise, a physicist is not someone who can *describe* a phenomenon, mathematically or otherwise. A physicist is someone who can *explain* the causes and mechanisms underlying a phenomenon. The 400-year old emphasis on observation, experiment, prediction, evidence and proof does not constitute science, let alone physics. Anyone can observe and repeat experiments without understanding. Without more, predictions are mere descriptions. And evidence and proof are the stuff of belief and opinion.

The mathematical establishment's definition of *science* makes no provision for the only thing that has to do with genuine Science: explanations. The proof is in the pudding. After 400 years of Mathematics, not one professor or theoretical physicist can explain what gravity is or how magnetism does its magic from a distance. The main reason for this inability is that the mathematical establishment's definition of Physics makes no provision for the only thing that is absolutely essential in Physics: things. The irrational conclusions we read about in mainstream 'physics' are the result of indulging in reification, inadequate definitions, and the motion of concepts. It is thus that we have here defined Science as '*rational explanations*' and outlined the steps of the Rational Scientific Method. Once we introduce objects in lieu of equations and numbers we can finally begin to understand the invisible workings of our Universe.

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*"First of all the **straight line**. Its distinguishing feature is that it is determined by two of its points… we shall obtain an array of points on the straight line under construction… the end-points of all vectors OP… form a straight line… the sum total of all the end-points P of vectors… occupy fully an h-dimensional point-configuration… The one-dimensional configuration of this type is called a straight line"*

"I shall here outline a preliminary argument in which not only the straight line, but also the plane is based on a property of rotation… all the points which we obtain finally fuse together into a linear continuum, in which they become embedded, giving up their individual existences (this description is founded on our intuition of continuity). We may say that the straight line is derived from a point by an infinite repetition of the same infinitesimal translation and its inverse."

"If we now introduce the equation AB = A'B' for the points of the straight line by interpreting it as meaning that AB is transformed into the straight line A'B' by a translation, then the same things hold for this conception as for time. These same circumstances enable us to introduce numbers, and to establish a reversible and single correspondence between the points of a straight line and real numbers by using a unit of length OE."

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