



Institute for Advanced Physics

What is Science?

by Anthony Rizzi

Our science, modern science, determines what we think and, therefore, what we do and what we value! Indeed, science is the core of any culture. So, it is imperative that we know what it is and what it tells us. Science (from the Latin *scientia*) means knowledge. It is what we think we know. But, when asked: *what is science?*, most of us would immediately give, roughly, the definition we were taught: science is the process of making hypotheses and testing them. People more attuned to the modern science culture would add that they must be falsifiable. Asked about the relation between science and religion most Americans would say: *religion and science talk about two different things. Science is about how things work; religion is about morality and choices. Religion is a personal choice.* This view then ultimately amounts to the statement that religion is subjective and science is objective. This is the on-the-ground view of most Americans (and it is the more explicit view of those in first world countries outside the US). By this, I simply mean that most people actually talk and live as if this were the case, i.e., they live and talk as if this were true when not answering questions about religion directly. Another way people express their view about science and religion is by saying: *Science is about how and religion is about why.*

None of these statements about science and religion are true. As we will see, science, as defined by the way we actually think and talk about it, neither finds the how, nor the what, *nor anything about the essence of things.*

Not that it cannot and not that it does not already, though in a confused way. Real science must answer all questions about a thing including: *What* is it? *Why* does it do what it does? *How* does it do what it does? To see these things more clearly, let's look at our modern view and un-entangle it.

Looks Like We Know Nothing!

You will often see in science texts something like:

Not all hypotheses meet the criteria of science: You wouldn't be able to test the hypothesis that invisible ghosts are fooling with your desk lamp! Because science only deals with natural, testable explanations for natural phenomena, it can neither support nor contradict the invisible ghost hypothesis, nor whether spirits or elves cause storms, rainbows, or illnesses. Such supernatural explanations are simply outside the bounds of science, as are religious matters, which are issues of personal faith. Science and religion are not mutually exclusive or contradictory; they are simply concerned with different issues. (Campbell¹)

In fact, science is broader than this. Science, in the full meaning of the term, is the study of reality, in which we have various branches that focus given areas of reality. For example, the science of psychology studies human nature. Not all science studies the physical world but all must be ultimately based, in some sense, in the physical world, since everything we know comes through what we know through the senses. Today science is

¹ Campbell, Urry, Cain, et al., *Campbell Biology 11th edition* (Pearson, NY, 2017), pg 18.

spontaneously and confusedly thought of as being purely *empiriological*, i.e. purely the task of creating a logical system of symbols to capture (through quantity²) some aspect of reality, especially, in its most robust form, through equations.³ This system then becomes a working substitute for the essence of a thing or things. Finally, through a habit of thinking and acting *as if* the organizational principles we use to encapsulate the properties of a thing were the essence of the thing, we effectively take those principles as the essence of the thing under study. This means we take a mental construct (i.e., something we made up, something that can exist only in the mind) as reality. We have thus made an implicit identification of the external reality with our own mental activity. In this way, effectively, in a lived way, reality becomes a construct!

² The empiriological method only works well when the reality under study can in some (analogical) way be cast into quantity, but any logical system of symbols constructed to describe reality is empiriological. Quantity is the first category of property of physical things (see A. Rizzi, *Kid's Introduction to Physics (and Beyond)* (KIP) (IAP Press, Rochester NY, 2012), which includes both geometry and number. In empiriological biology, tree diagrams and pictures with parts identified by shapes have more prominence. This is because of the higher nature of the science of biology; as such, it does not as easily allow the use of equations, with their focus on numbers. Organisms have a higher level of reality, which is evident in their more complex (quantitative) structures and simpler natures (see: A. Rizzi, *Answering Dawkins on Simplicity*, Physics and Culture (iapweb.org), 2011)

³ For more on the empiriological nature of modern science and what modern science means, see A. Rizzi, *Science Before Science: A Guide to Thinking in the 21st Century* (SBS) (IAP Press, Baton Rouge, 2004), *A Kids Introduction to Physics (and Beyond): I and II* (2012, 2018), A Rizzi, *Physics for Realists: Mechanics* (PFR-M) (IAP Press, Rochester NY, 2008). (See iapweb.org/store).

If we then remove the confusion in our thinking and clearly assert our assumptions, we can see that the empiriological-only thinking leads to nonsense. That is, we note our central assumption: the only real science is empiriological science, i.e. the process of creating logical systems to capture reality. Then, once one points out that this view asserts that there is no point in returning to understand what is encapsulated in our system, we then must admit we know nothing, for then all we know is the system and that's just in our minds.⁴ Unlike the above textbook quote which assumes this view, people who hold this view must say science is not *finally* about understanding at all, but about regulating our activity⁵ with no ability of understanding the what, why, or how of anything. There is no point in excluding spirits, religion, and the like from the definition of science because everything, all reality, is excluded from objective knowing. On this approach, we finally understand nothing!

Start from What You See!

Now, the above quote was taken from a biology book, and biology is the study of living physical things, including man in so far as he is a physical thing (remember he has a non-material core revealed by his ability to think

⁴ The structure should be something you see through, not end at.

⁵ The goal of this regulation of activity (though implicit not explicit), finally, must include implementing many structures that support and flourish the empiriological-alone thinking. Obviously, this must be part of the system, at some level, if it is to finally succeed, at least, as an activity. It demands that all activities be regulated in such a way that the method will work. If one wants to have an empiriological science, one needs to regulate even human behaviors in such a way that the method can work in every sphere. Empiriological systems are sensitive to being effective in this sense as well as to being as logically consistent as possible.

intellectually and his ability of free choice)⁶. Spirits and other things related to religion per se are of their nature non-physical, so clearly, in so far as one is studying biology, one is not studying religion. So, we should exclude those from our study. Notice this is a radically different thing than what is claimed in the above quote from Campbell. Furthermore, this does not mean the two are not related. Non-physical things are related to physical things, for example in the case of man. One cannot, a priori, say they are unrelated, but one should not presume a relationship; one should see or prove any relationship. In true science, one starts with what one knows and then only concludes to what one did not initially know only after evidence, something one sees, forces one that direction.

Also, the author of the quote is arbitrarily leaving aside the non-physical as a possible area of study (e.g., spirits are not natural according to him).⁷ He does this because

he is implicitly⁸ assuming science=empiriological and then implicitly noting that the empiriological method only robustly works in the physical realm. This, then, brings him to the conclusion (though he does not argue it but asserts it) that science cannot study anything else but physical reality. Notice his hidden assumptions (hidden from us and himself!) lead him to think and speak of nature as if he already knew that it was limited to physicality.⁹ Again, this does not mean one should assert the existence of non-physical things. One must have evidence that forces one to such a conclusion.¹⁰

So, even when one leaves the sphere of biology proper, a hypothesis, therefore, should start with direct evidence and should be driven only by what appears necessary to causally¹¹ explain what needs to be explained. There is no formula for this (science is, in fact, not purely empiriological); one's good sense of paying attention to and attuned to the facts helps one formulate the hypothesis. In physics, which is

⁶ For proof, see *The Science Before Science* referenced in footnote 3.

⁷ Modern physics is equational and, as such, tends to push our thinking toward the idea that all that is real is quantity. This tends to make us, at some level, identify *nature as simply a system of atoms (ball-like parts) randomly "moving" around*; anything outside of this can feel to us like something non-physical, even supernatural. This feeling that *only* things to do with quantity can be known and proven is inculcated deeply in us. This is true despite the fact that modern physics *does* include more than this in its structure. We feel that all is number, geometry, and shape because of modern physics' (apparently) nearly exclusive use of quantity. Again, this makes it look like physicists are simply discussing quantity, though this is not true (See *Kids Introduction to Physics I and II, Physics for Realists: Mechanics*, see footnote 3. Also, see A. Rizzi, *Physics for Realists: Electricity and Magnetism, Physics for Realists: Quantum Mechanics* (IAP Press, Rochester NY, 2011, 2018); abbreviated PFR-E&M and PFR-QM.

⁸ He doesn't explicitly know the nature of his method.

⁹ This is one of the many deep profoundly anti-reason results of empiriological-alone thinking. We get thoughts that we take with certainty that we never even truly notice we have! In empiriological-alone thinking, everything appears to close nicely in a mental circle, a circle that excludes reality! In this mindset, when we note that the circle doesn't close, the task is simply and only to figure out how to close the circle. This tends to keep one at a task that excludes the very reality one is trying to reach.

¹⁰ The existence of God is proved in *Kid's Introduction to Physics (and Beyond)*; there it is proved that He is wholly non-material.

¹¹ By this we mean all four causes: *material cause*, that out of which a change proceeds, *formal cause* that into which something is changed, *efficient cause*, that which causes the change, and *final cause* the intrinsic direction or goal of the change. For example, change of place has the goal to proceed through various places to the final place. (See PFR-M and E&M referenced in footnote 7.)

the science for which the empiriological method works the best, one gets a real feel for the equational structures that will best encapsulate the causal structures at play.

The empiriological method is never used alone. It is not the beginning, it is not the end, but it is essential. One needs to build the structure and, ideally (though not always possible), one needs to understand it at each step of the way. In any case, the goal of science is to understand the world, so if one doesn't quite know what the meaning of the empiriological structure is during its creation (as has happened historically), one must go back and figure out what that meaning is. If we don't, we will do it in a confused way and make the kind of statements that we cannot quite mean, like: "all we are is a bag of chemicals anyway" (a quote from a respected biology professor teaching from Campbell).

Is Spirit Excluded from the Full Meaning of Science?

So, given this background, how do we specifically understand:

... it can neither support nor contradict the invisible ghost hypothesis, nor whether spirits or elves cause storms, rainbows, or illnesses. Such supernatural explanations are simply outside the bounds of science, as are religious matters, which are issues of personal faith.

The empiriological method of itself cannot, by definition, contradict or affirm *any* view of reality as long as it is confined to its empiriological structure. After all, it is not per se about reality; it is only secondarily about reality; it is first about finding organizational principles, logical rules to order the things that we have mentally collected. So, the first statement is trivially true. But there is more. To understand biology (remember this is the subject the book is discussing), one should not jump to spirits or

elves (that can disappear and all that) which are non-material. This would be silly, even crazy! How can a physical subject be actually non-physical? Such a jump reveals that one has not clearly seen what the object of study is! This is one of the many hazards of empiriological-only thinking.

As for the second sentence, as we have said, such entities would, in principle, lie outside the bounds of biology, but they are not outside the bounds of science fully defined. But, first one would have to have reason to even suppose their existence.

Finally, to say religious matters are simply a matter of personal faith is to judge them to be simply subjective. That is, it is to say that religion has no external reality to which it corresponds. This is an example of a statement (at least as presented) that is not grounded, as it should be, in things we know through the senses. The claim is that religion is not testable, but that criterion is itself not grounded anywhere. And, "testable" is not defined in any clear way. It is implicitly defined as a key criterion necessary for a subject to be amenable to empiriological investigation, which, in turn, to make sense in context, supposes the empiriological method is the first method of knowing. And, again, if the latter were true we would know nothing. So, it would not just be religion that would be singled out as personal faith; whatever understanding of reality we happen to have would be simply our choice and all science would be subjective!

The Proper Understanding of Science

In summary, science is the study of reality, having multiple branches; each branch is somewhat different in its methodology. For most sciences, including all the sciences of the physical world (physics, chemistry, and

biology¹²) at some point one needs to use the empiriological method. In physics, chemistry, and biology, when one reaches a certain level of understanding, the empiriological method is necessary to make further progress in one's understanding. However, one must guard, as we have seen, against taking the organizational principles that take front stage in the empiriological approach from usurping the role of the actual principles of nature that are encased within them. To be a full science, it must include understanding the meaning of the properties of physical things that one has so adeptly organized. The empiriological method works less well as one moves from physics to study higher and higher levels of reality. By the time one gets to human psychology (with its need to study the higher powers of will and intellect), for example, its role is extremely muted and requires even more care to properly understand.¹³ And, as one can expect, in religion proper it has even less of a role. Not knowing this, psychologists and those who study religion try to center on empiriological thinking, and this is why the study of these high subjects is in such disarray.¹⁴ But, still more must be said to be accurate and avoid misunderstanding. Namely, when it comes to *specifics*, even religion and psychology depend

¹² Note, the study of man is a cross disciplinary subject (involving the physical and the non-physical) so does not properly belong to biology alone.

¹³ Modern empiriological-centered thinking does not even clearly speak about human nature, or clearly define the human mind or the role of the brain. E.g., take the confused and erroneous statement from *Psychology* by Lilienfeld: "... 'the mind' is just the brain in action." In fact, the mind includes the intellect which is non-material. (see SBS, footnote 3)

¹⁴ More completely, the loss of the basic physics that arises from empiriological-alone thinking has two outcomes; 1) one loses the fundamental starting principles needed to understand these subjects, and 2) one loses the ability to generate appropriate methods to address these subjects.

on having properly understood the meaning of the empiriological results of the lower sciences, including those of the first science of physics.¹⁵ And, at this point in our culture, because of our largely empiriological-only physics, even the generics of physics are misunderstood, so all higher fields are absent their proper ground; as a result, the higher the field, the more confused it is. In short, our science is not a full knowing, not a full science, because it has been and is increasingly empiriological-alone; we need to reground our science.

All this brings up the deep need for us, each one of us, to properly understand modern thinking, from physics and math all the way up to the study of the non-physical parts of reality, by understanding the deep things that modern science has uncovered in a fully real way. The Institute for Advanced Physics (IAP) is the first and only institution which has done (and is continuing to do) this work. Important parts of IAP's material have been referenced throughout this article; more can be found at iapweb.org. You are encouraged to start grounding your thinking, including your everyday decisions, in reality by accessing this material.

Anthony Rizzi, Ph.D., Director of the Institute for Advanced Physics, gained worldwide recognition in theoretical physics by solving an 80-year-old problem in Einstein's theory; has physics degrees from MIT and Princeton University; has been senior scientist for Cal-Tech's Laser Interferometer Gravitational-wave Observatory (LIGO), which won the Nobel Prize in 2017. He taught graduate courses at LSU; worked on the Manned Mars Craft and the Mars Observer spacecraft; received the NASA Award, as well as a Martin Marietta New Technology Award.

He is author of The Science Before Science: A Guide to Thinking in the 21st Century and A Kid's Introduction to Physics (and Beyond): Vol. I and Vol. II; he has been interviewed in many media outlets. In addition to his

¹⁵ Recall physics is the first science because everything we know comes through what we know through the senses.

professional articles, Dr. Rizzi recently authored the ground breaking texts Physics for Realists-Mechanics and Physics for Realists-Electricity and Magnetism (both recommended by the journal of the American Association of Physics Teachers), and the recently released text: Physics for Realists: Quantum Mechanics.

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