Nature of Physics, Modern and Ancient

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Introduction: Physics Generally

All that we know begins with the physical things that we know directly through the senses. For this reason, physics, the study of physical things, is the base of all our knowing. Hence, the health of physics is of primary importance for all of our cultural thinking and endeavors.

Aristotle (384-322 BC) moved human culture, for the first time, from an inchoate understanding of the physical world to a (broad sense) scientific understanding, that is a rigorous conscious understanding. This first part of physics that he established, which is grounded directly in sense knowledge, can be called the foundational part of physics. Aristotle did not successfully formulate more specific parts of physics beyond the foundational part; in particular, he did not successfully explain the specific causes of motion of bodies on earth or of the planets. His disciples, through the Mouseion at Alexandria founded by his student Demetrius of Phalerum (c.350-c.280 BC), did advance many areas of science and mathematics. This scholarly association included luminaries from Archimedes, Aristarchus and Hero to Euclid.

After the foundational physics was *reestablished* in the Catholic west and further advanced by St. Thomas Aquinas (1225-1274), medieval natural philosophers (scientists) advanced beyond the foundational part in many areas, including mechanics, optics, mathematics and astronomy. Science thrived in this milieu because of essential elements of Catholic culture, such as the affirmation that the material world has its own real existence, and it is good and intelligible, having been created by God. In “mechanics,” the understanding that massive bodies move by impetus (which may be considered the last part of the foundational part of physics and which was not understood by Aristotle) was put forward by medieval scholars and handed off to Galileo.

Modern physics, which gets its first full formulation in Isaac Newton's (1642-1727) mechanics, moves beyond the things that we know directly through the senses through the well refined modern scientific approach. With the discovery of the laws of thermodynamics and Maxwell's equations for electromagnetism in the 1800's, which codified the discoveries up to that point, along with the great advances in math, modern science moved along at a great pace. In the 20th century, physics' advances accelerated with the discovery of the atom and its parts, the advent of quantum mechanics, special and general relativity, and quantum electrodynamics. These were accompanied by deep successes in all areas of physics, including astronomy and cosmology with the success of the big bang model. In elementary particle physics, a principled understanding was codified in the electro-weak theory in the late 20th century, which empiriometrically (see below) unifies electricity, magnetism and the weak force. At that time, string theory began to offer hope of a unified theory that might account for both gravity and quantum mechanics, which seem intrinsically in opposition to one another. No one yet knows what string theory is (Gross, 2003) or whether it describes the real world in any way.

The successes of modern science are obvious and profound, but equally obvious are its attendant severe problems. Basic common sense is called into question, from whether motion needs a cause and whether the basic stuff of the world is there when you are not looking to whether or not we have a free will.

In short, modern physics has given much new information that in principle further specializes the generic understanding given in the foundational part. However, this knowledge is encapsulated in an empiriometric form that obscures essential parts of its physical content.

To understand the current state of physics, we will first recap the foundational physics and then explain the modern scientific method and its inchoate and confused grounding in that foundation.

Foundational Physics

Physics in the broad sense is the study of physical things. The first generic thing we notice about physical things, after their very existence, is that they change. They are changeable things. They are something but can become something else. We also learn that there are things that exist of themselves which we call substances, and things that exist in substances which we call accidents, and for which we find nine different types: quantity, quality, relation, action, reception, place, orientation, environment and time. By noting that change requires the coming to be of a new thing, we see the principle of causality that nothing changes itself. We also see the principle of non-contradiction, that a thing cannot be and not be at the same time and in the same way. The cause of locomotion, in a real way, belongs to this set of principles, but by an accident of history is not incorporated till much later.

These are the most generic principles of physics. The next level of general principles belongs to the subject of modern physics. Modern physics studies general principles *analogically*, usually, for example, leaving aside the distinctions between one and many substances and a part of a substance. The study of the interaction of macroscopic substances in more specifics is now called chemistry, though, building on empiriological physics, it also does not address substance per se in a clear way. Similarly, the study of living things is now called biology, though it is also primarily empiriological.

Modern Physics

To understand modern physics and the issues it raises, we have to understand the *empiriological* method, in particular the type called *empiriometric*. Both terms were first introduced by Jacques Maritain (1882-1973) and their use has since been clarified (Rizzi, 2004, 2011). The term "**empirio-logical**" refers to the defining aspect of the modern scientific method: (1) it looks at the physical world (empirical) (2) as captured in a logical system of schema or measurements. The core method, which is seen in modern physics, is the "**empirio-metric**" method which captures via measurement (metric) quantitative relations in an axiomatized symbolized system centered around an equation or group of equations. The empiriological method first appeared around 1600, most famously in the mathematical work of René Descartes (1596-1650) but also in François Vieta (1540-1603) and others. They discovered what we now call algebra, and Descartes showed how geometry could be treated with algebra. "Algebra" now means something the ancients never meant, namely a system of symbols that enables one, through a system of rules and beings of reason, to capture and apply the principles of quantity (though usually leaving aside various real distinctions). Before this time, the focus was on real quantity; now, it became possible to focus on the system of beings of reason to get quicker answers with fewer mistakes. More generally, one can call this method of capturing quantity in a symbolized-axiomatized system “quantiological” (Rizzi, 2011). This method was soon, by analogy, imported into physics, creating an increasing pressure for more and exacter measurements. The revolution in math and physics was profound. Because of it, at a profound level, advances in math and physics have dwarfed all that came before it.

Furthermore, the empiriological method made it possible for us to conceive of computers, i.e. machines that symbolically “do” rote parts of our thinking. The empiriological method is profound in its adeptness in making use of the connaturality of the human mind for mathematics and systemization through symbols to carry conceptual structure that if handled directly would be extremely hard for the mind to handle without logical error.

However, the method was not digested properly and, as a result, physics became increasingly empiriological not paying sufficient attention to the distinctions between the beings of reason that it created and the reality which those beings of reason encapsulated. The result of this habit of thinking in the base science of physics was codified in the thinking of the culture by Immanuel Kant (1724-1804). In trying to defend Newtonian physics, he started within his mind with regulative forms (which played a role very like a theoretical hypothesis of the scientific method) thereby introducing a totally new hardened strain of philosophical idealism in which it really was not possible to know the thing itself. In sum, Kant, without realizing it, showed where we end up when we take the empiriological approach as the starting point of our knowing.

Of course, modern physics implicitly depends on the foundational part of physics. Without those things we know directly through the senses, there would be nothing from which to even formulate a theory or a hypothesis. Furthermore, without further sensory input one could not experimentally test the theory even empiriologically, let alone decide what the experiment means by using analogies from the physical things that we already know. Why then has it been rightly said that all modern philosophy is a footnote on Kant? Because modern physics and after it all other modern sciences really work and have given us a flood of new information. And, since modern physics was not advanced by clearly building on the foundational physics, empiriological theories have been left in equational form, (i.e. reflected into mathematics and encapsulated in beings of reason) so that our *scientia*, our knowledge, from its base physics upward, gives the appearance of starting from beings of reason. In short, it gives the appearance that it is the *structure of our knowledge*, *not what we know,* that is important. Indeed, a real confusion of the two increasingly occurs. Gradually and more profoundly each year, cultural habits of idealism solidify, so that for some time now philosophical idealism has been largely the default functioning philosophy of our day, even though few may consciously recognize it as such.

The solution is to properly untangle what the empiriometric theories say and do not say and what they have yet to discover, making distinctions where the method flattens them. In this way, the beings of reason of a theory can do their job of providing a tool for working with and advancing our knowledge of analogically generic aspects of physical reality without being confused with the very reality which, after all, it is their final purpose to convey. Moreover, physicists must begin to think and work in this new integrative way.

Current State of Physics

Currently, this work has been done for Newtonian physics (Rizzi, 2008) and electricity and magnetism (E&M) (Rizzi, 2011) as well as special relativity (Rizzi, 2008, chapter 10; Rizzi, 2011, chapter 7). A good example of the problem and how it is fixed is seen already very clearly in the first modern science, Newtonian mechanics. For example currently, the definitions of mass and momentum reduce to equations. Mass is defined as momentum divided by speed. Momentum is mass times velocity. Notice how equations, that is a system of rules for manipulating analogically general quantities, substitute for reality. In the apple in front of me, where exactly is the division that gives me its mass? Physics for the general public, such as elementary grade books, will often mistranslate the equation to something like "mass is the amount of stuff." No translation is given for momentum. In fact, momentum is the measure of the strength of the impetus. Impetus is a power that moves a body at a constant speed in a certain linear direction. Mass is the resistance to the action of the impetus so that the more mass a body has the less quickly a given strength impetus can move it. In fact, because of the deep empiriological mindset that holds modern thought, typical physics books do not define basic concepts like "measurement" or "units" except functionally. Now, it is natural that as empiriological theories incorporate more of reality, they become more deeply *analogically* mathematical and more deeply embedded in beings of reason to hold that great depth of principle to enable them to make quantitative predictive statements.

Implications

The implications for physics are clear. If we do not build firmly from the foundational part of physics all the way up through the latest discoveries of physics, i.e.

physics at its most mature stage, we will not have a true understanding of the physical world but an inchoate confused one that cannot answer even our simplest questions about the world. Without an understanding of physics, all else fails. Metaphysics has no distinguishing subject because the proofs of God's existence and any understanding of human nature (even the substantial unity of man) are blocked. With the nature of the world and of man and his last end not understood, what is good for man cannot be a topic of objective discussion, so a subjectivization of morality becomes inevitable. More precisely, the working substitute for the individual man's last end, ultimate Truth, becomes *collective* empiriological truth gauged by its predicative success and its attendant technological advances. Increasingly, each man becomes a cog in the collective machine whose moral rights and duties are decided with respect to the empiriological efficiency of that machine. And, having lost the *preambula fidei*, religion retreats to fideism.

By contrast, with the work that has already been done in grounding mechanics, relativity and E&M, one can begin to see clearly how much further modern science specializes our knowledge beyond anything the ancients could even dream of. And, with this further physical understanding available, metaphysics can draw deeper insights about the human soul and God and man's right action in the world. Thus, a proper digestion of modern physics not only allows us to recover the generic understanding of the universe, man and God, but will allow us access to a far deeper understanding than any one that came before us.

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Published by IAP Press, Baton Rouge, LA
IAP Press: IAPpress@iapweb.org

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