

On Causality, Impossibility, and “The Scientific Method”

by

Roger Ellman

Abstract

The ancient philosophers attempted to address science issues by reasoning conducted largely without experimentation.

Scientists from Galileo onward developed “The Scientific Method”, the procedure of: observations – hypothesis – experiments iterated with adjustments each iteration until a satisfactory result obtained. They also criticized the ancient philosophers for the defect of their neglect of experimentation, and rightly so.

But “The Scientific Method” of modern science has its own defect, one just as severe and damaging as that of the ancients: modern science too often neglects mechanism or causation. It accepts explanations and hypotheses on the basis of experiments and predictions without treating the problem of how and why the experimental or predicted behavior occurs.

Non-attending to mechanism and causation sometimes leads to seriously proposing a hypothesis that is actually physically impossible.

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The Development of Scientific Method

The ancient philosophers attempted to address the field that we now refer to as science. Their method was one primarily of rationalizing and logic based only modestly on observation and in general lacking experimentation.

The post-renaissance scientists, dating approximately from Galileo onward, greatly improved on the ancient method by pursuing experimentation. More precisely, they developed “The Scientific Method” the procedure of: observation – explanatory hypothesis – testing experiments iterated with adjustments each iteration until a sufficiently satisfactory result was obtained [or until the process had to be abandoned for lack of the technological ability to pursue it].

However they believe and act on the assumption that explaining and defining what and how much happens in physical processes is sufficient. They neglect understanding of how those physical processes take place and why – their mechanism and causation. Those post-renaissance scientists fail to recognize that defect of their own even though they rightly criticized the ancient philosophers for their defect, their lack of experimentation.

Those post-Renaissance scientists also introduced and now heavily depend on a new principle – that, if a hypothesis makes predictions and those predictions are subsequently validated by observations, then that is deemed validation of the original hypothesis. But, that principle is simply unreliable as in the following example.

The ancient cosmologist Ptolemy, residing in the metropolis of Alexandria in Egypt about the 2nd Century BCE, developed his hypothesis on the motions of the heavenly bodies, principally the planets and the moon. Ptolemy’s system was believed, used and relied upon for over 1,500 years. It was based on the Earth as the center of the universe, which is now known to be completely incorrect.

Nevertheless, the Ptolemaic system correctly and accurately made predictions such as eclipses and conjunctions until it was overcome, finally, after one and a half millennia of successes, by more accurate measurements facilitated by technological advance.

Validation of predictions cannot be relied upon as proof of the validity of the hypothesis used to generate the predictions.

The Defect in “Scientific Method”

The defect in contemporary science’s “Scientific Method”, one just as severe and just as obvious if one “stands back and looks at it” as the defect in the ancient philosophers’ methods is the problem of mechanism or causation. One has not explained something, one cannot be said to understand something, unless one has a thorough, valid explanation of its mechanism, its

causation: the “how” and “why” of its taking place. Contemporary science tends to treat only the “what” and “how much” of events.

Some examples of this are as follows.

- Einstein’s general relativity description / explanation of gravitation contends that the effect involves gravitating masses “bending” “space”. But, for that to be a valid contention it is necessary to explain the mechanism, the causation, how the “bending” of space takes place, how the gravitating masses “bend” space. It would also be necessary to explain what “space” is at least sufficiently so as to be able to understand how it can be “bent”. It will not do to merely claim that it happens. And, it will not do to merely present equations and the results of their manipulation to justify the claim.

- The same problem applies to the concept that the expansion of the universe is expansion of space itself. Again, what is space ? How can it expand ? For it to be expanding the expansion must be relative to some static non-expanding reference; why is it not that which is “space” ?

- Milgrom’s proposed solution to the problem of the missing gravitational action indicated by galactic rotation curves is termed MOND, Modification of Newtonian Dynamics. The contention is that gravitation is non-linear, behaving differently at small accelerations. But, for that to be a valid contention it is necessary to explain the mechanism, the causation, how gravitation operates normally and how at small accelerations it is different. It will not do to merely claim that it happens. And, it will not do to present equations and the results of their manipulation to justify the claim.

- Quantum Mechanics began with and depends on the contention that the angular momentum of atomic orbital electrons’ stable orbits is quantized. How ? By what mechanism ? [Although unrecognized by contemporary physics, it turns out that the determining factor for atomic orbital electrons’ stable orbits is that the orbital path is exactly an integer number of the orbital electron’s there / then matter wavelength for which there is a clear specific cause and mechanism for that behavior.]

- In Einstein’s special relativity, while the relativistic contractions are valid they are unexplained. How do things shorten in the direction of motion ? How does mass increase with velocity ? And so on. The causation and mechanism are completely ignored.

- The original Heisenberg uncertainty had a valid cause and mechanism: the communication with the object measured inevitably changes that object so that the reported value is no longer valid the moment it is generated. But the extension of that uncertainty to general uncertainty of everything, independent of measurement, has no cause and no mechanism. Yet it has been comprehensively accepted by the scientific community.

How did such a strange state of affairs come to be ? The problem stems from the difficulty of comprehending all of the background that goes into our thinking, our view of reality. We tend to function unaware of many of the underlying attitudes built into our thinking. In particular, the Christian concept of God and his role in creating and running the universe inherently affects scientists’ thinking, even that of atheist scientists.

That concept of God completely dominated the society, culture, and thinking of Europeans for about fifteen centuries, until the “enlightenment”. Even after the enlightenment the concept continued more subtly but still effectively present. It is subtly innate for us.

That most obviously shows in the terminology “physical law”. That terminology implies that the particular behavior, for example Coulomb’s Law or Newton’s Law of Gravitation, is

because God ordained it – because it is God’s Law. That attitude substitutes for accounting for the mechanism, the causation involved.

Religion requires belief in things which cannot be proven, which cannot be substantiated, cannot be explained. That amounts to belief in or acceptance of magic and miracles, they being unexplainable events or actions independent of the natural physical behavior of the universe. The thinking of the physical behavior of the universe as in terms of “laws”, [subtly] God-ordained and God-maintained “laws”, is akin to inherently believing in a universe functioning on magic and miracles.

Then, what is the key to accurate, valid, reliable science, valid and reliable knowledge ? A hypothesis must appear to validly describe a phenomenon and to be so experimentally verified, but that is not enough. The additional pertinent factors bearing on the validity of any truth, any component of knowledge, are: resolving and understanding of the causality and mechanism involved, non-dependence on unsubstantiated assumptions, and valid relating to and integration with all other truths, the body of validated knowledge.

Those are all essential for any contended truth to be acceptable as valid truth, as being in agreement with reality. They operate as follows.

Causality or mechanism

Causality or mechanism is apparent from observation and experience which show that every thing and every event has a cause, and that those causes are themselves the results of precedent causes, and *ad infinitum*. Defining and comprehending the causality or mechanism operating to produce any contended or proposed truth is essential to authenticating or validating that truth.

The candidate truth cannot be deemed valid until its causes and mechanism are analyzed back to an already substantiated operating cause upon which it effectively depends. If that is lacking then it is always possible that a candidate truth will be found not to have a valid precedent operating cause, a valid mechanism in its precedence and, therefore, itself not be valid.

Assumptions

Assumptions are proposed or contended truths, proposed or contended components of knowledge, that lack sufficient proof or justification to credit them as real truths, as really in agreement with reality. Clearly that infection cannot be part of knowledge without contaminating the whole.

It is not easy to avoid assumptions. Personal prejudices and beliefs may not be apparent to their holder, or they may be apparent but are nevertheless deemed exceptions to the requirement prohibiting assumptions. That may be because he considers them so important or fundamental as to be beyond question.

Or it may be because he is psycho-emotionally wedded to them, dependent on them. For example, in the history of philosophy the God assumption appears abundantly, major instances being, for example, Augustine, Aquinas and Descartes.

In the sciences, hypotheses that have not [or not yet] succeeded in advancing to the state of completely determined and validated laws nevertheless acquire over time the status of being treated as if completely validated and not subject to questioning. Major modern instances of this include the “Hubble Constant” and its related red shift cosmology, Quantum Mechanics, and Einstein’s General Relativity treatment of gravitation, the latter two in spite of their unresolvable inconsistency.

In addition there can also be assumptions that are so embedded in the psyche of the pursuer of knowledge that he is not even aware of their presence and influence on his thinking and research such as the subtle implication inherent in the terminology of physical “laws”.

Validly Relating to the Body of Validated Knowledge

Validly relating to the body of validated knowledge is fundamental to what knowledge is: accumulated truth, assembled agreement with reality, that is agreement with that which is. Overall consistency is a fundamental requirement. A component of knowledge not being so compatible would constitute a contradiction, the holding that a thing and its refutation are simultaneously valid.

Just as there is only one reality and can be only one reality, so is there and can there be only one knowledge, one overall collection of truths, one system of everything. Any proposed piece of science, of knowledge, must completely, accurately, compatibly fit in with the rest.

Impossibility

In quantum mechanics, if two particles "are in a state such that there is a matching correlation between two ‘canonically conjugate’ dynamical quantities", quantities like position and momentum, whose values suffice to specify all the properties of a classical system [Schrödinger's definition], they are termed as being "entangled". Experiments have been conducted the results of which have been interpreted as instantaneous communication of a such ‘canonically conjugate’ dynamical quantity from one particle to the other, the communication exhibited as a responsive change in one particle due to an introduced change in the other particle.

That interpretation is contended in spite of the material impossibility of instantaneous communication no matter what the circumstances. Of course, the quantum mechanics oriented investigators do not treat the problem of mechanism and causation for the event.

Conclusion

It was stated earlier above that “Causality or mechanism is apparent from observation and experience which show that every thing and every event has a cause, and that those causes are themselves the results of precedent causes, and *ad infinitum*”. That means that substantiating the causes and mechanisms of physical processes and events requires ultimately developing a correct understanding of the beginning of the universe upon which everything that followed depends.

To arrive at the truth one must begin at the Beginning.