

# The Law of Cause and Effect

## *Dominant Principle of Classical Physics*

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**Abstract.** For thousands of years, the *law of cause and effect* guided scientific inquiry. In fact, the history of the concept of causality can be traced through Hebrew, Babylonian, Greek and European cultures. Certain Greek philosophers, however, introduced the atomistic concept of *chance-events* to oppose the common-sense application of causality. The resulting conflict between *cause versus chance* has not only shaped the history of science but has imposed lasting effects on Western culture as a whole. This conflict intensified during the Twentieth Century as the Heisenberg Uncertainty Principle (HUP) became the leading tool of the proponents of chance. More recent findings have now demonstrated that the HUP fails in six actual cases. Common Sense Science counters chance-based philosophy by returning to causality and other principles of Classical Science such as the *conservation of energy* and the use of physical finite-sized models for fundamental particles (e.g., the electron). This paper shows how physical models based on the laws of electricity and magnetism fully implement the *law of cause and effect* in the manner of the four causes required by Aristotle. Chance-based physics is exposed as false science based on erroneous assumptions about supposed chance-events instead of causal relationships.

**Chance Events?** Nothing happens by chance! Classical Science, which dominated studies of the physical universe before the Twentieth Century, generally held an opinion that **there are no events that happen by chance**. For many centuries, it seemed obvious that all things were caused by something physical or mental. This idea was expressed by Hippocrates of Cos (c. 460-377 B.C.): “Every natural event has a natural cause.” [1, p. 12].

**History of the Concept of Cause and Effect.** The concept of order maintained by the *law of cause and effect* is a scientific principle with a history traceable through Hebrew, Babylonian, Greek, and modern civilizations.

Hebrew Concept of Causality. Certain Hebrews acknowledged the role of *causality* in the universe before the Babylonians and Greeks. These Hebrews denied *chance* and its offspring *chaos*:

That they may know from the rising of the sun to its setting  
That there is none besides Me;  
I am the LORD, and there is no other;  
I form the light and create darkness,  
I make peace and create calamity;  
I, the LORD, do all these things....

Shall the clay say to him who forms it, “What are you making?”  
Or shall your handiwork say, “He has no hands”?...

I have made the earth,  
And created man on it.  
I—My hands—stretched out the heavens....

For thus says the LORD,  
Who created the heavens,  
Who is God,  
Who formed the earth and made it,  
Who has established it,  
Who did not create it in vain [**chaos**, Revised Standard Version],  
Who formed it to be inhabited:  
“I am the LORD, and there is no other.” [2, Isaiah 45:6-7, 9, 11-12, 18].

From these and other writings, it is clear that the Hebrews believed in a Creator who not only created the universe but who also continues to maintain order in the universe through the *law of cause and effect*. In the Hebrew concept of causality, God first created (caused) the universe and now controls natural events by imposing physical laws that all creation follows. Thus, the Creator is both the *prime cause* of and the *sustaining cause* in the universe. The Hebrew concepts of *order* and *causality* by the power of the Creator were subsequently adopted in Christian doctrine:

For by him were all things created,  
That are in heaven,  
And that are in earth....  
All things were created by him and for him.  
And he is before all things,  
And by him all things consist [3, Colossians 1:16-17].

By the short clause “and he is before all things,” the writer is specific about a feature of the *law of cause and effect*: every effect has a *preceding* cause.

Babylonian View of Causality. In Mesopotamia, the Hebrew concept of causality was maintained in appearance but substantially changed in form. Stephen Mason explains that these Babylonians believed that various gods controlled events in the heavens and earth:

At first the Mesopotamians considered that the earth and the heavens were two flat discs supported by water, though later the heavens were thought of as a hemispherical vault resting on the waters surrounding the flat disc of the earth. Above the vault were more waters, and beyond the waters was the dwelling of the gods. The sun and the other heavenly bodies were such gods who emerged from their dwelling daily and trace finite orbits over the immobile vault. *The gods controlled terrestrial affairs, and thus the motions of the heavenly bodies were taken to be indications of the destiny that the gods were to mete out to man on earth* [4, p.20, emphasis added].

In Mesopotamia, the *law of causality* was not recognized. Natural events could happen any time—without natural explanations—for it was the whims of gods that caused events on earth. This perversion of the Hebrew concept of causality made the Babylonian ver-

sion unsuitable for the conduct of science and attempts to explain any natural phenomena, for the reason that natural laws did not apply to decisions of the gods.

Early Views on Causality Held by Greek Natural Philosophers. Initially, the early Greeks conceived of the *law of cause and effect* in the form expressed by Hippocrates: “Every natural event has a natural cause” [1, p. 12]. Plato (c. 427-347 B.C.), the consummate rationalist, “considered that intellectual designs and purposes were the formative and guiding principles of all natural processes” [4, p. 42]. But Aristotle (384-322 B.C.)

had a richer view of causality than Plato as he accepted also some of the doctrines expressed earlier upon the matter. There were, Aristotle indicated, four main types of cause. *Firstly*, there was the material cause of things, the primary matter out of which objects were made. *Secondly*, there were formal causes, the designs, patterns, and forms which were impressed upon the primary matter. There were, *thirdly*, efficient causes, providing the mechanisms whereby such designs were realized, and *fourthly*, final causes, which were the purposes for which the objects were designed [4, pp. 43-44].

Atomists Attack Causality. A strong challenge to the prevailing view of causality began to emerge in Greece with the teachings of Leucippus (c. 440 B.C.) and Democritus of Abdera (c. 420 B.C.):

They believed that everything in the universe was composed of atoms, which were physically indivisible. There were an infinite number of atoms, and they moved perpetually in an infinite void. They had *existed from eternity*, for they had not been created, and could not be destroyed [4, p. 32].

Atomists thus challenged the traditional view that the Creator was self-existent and “before all things.” They asserted a principle that **elementary particles called atoms were self-existent and before all things**. The eminent spokesman for atomism, Lucretius, asserted about 50 B.C. that

Nothing can ever be created by divine power out of nothing [5, p. 31].

But how, then, could atomism explain the combination of atoms into molecules, living cells, plants, and animals that readily are seen to exist and even grow? It’s all possible, Lucretius tells us, by *chance events*\* called *the swerve of the atom*:

Here too is a point I’m eager to have you learn.  
Though atoms fall straight downward through the void  
by their own weight, yet at uncertain times  
and at uncertain points, they swerve a bit—  
enough that one may say they changed direction [6, p. 34].

Although the *swerve* was never observed, the concept evolved into the second great principle of atomism, **chance**, for the atomists imagined that it was a law of nature that made the Creator irrelevant:

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\* Epicurus (342?-270 BC) is credited for the original concept of chance events in nature.

Thus, the inherent power of the atom to move by its own weight plus its equally inherent power to swerve from its normal path, plus its power to cling together with other atoms both like and unlike itself, plus the **law of chance**, can and do account for themselves without the intervention of any outside force or guiding intelligence, for every form of being that can be observed by one or another of our senses [6, p. xii, emphasis added].

Atomism Versus Creationism. The atomist worldview was extended by Epicurus about 300 B.C. in Greece such that by the middle of the First Century B.C. atomist philosophy had spread to Rome. As noted above, Lucretius promoted the new ideas in a poem that is much studied and still being published today in other languages [5, 6, *etc.*]. In summary, the leading ideas of ancient atomism are:

- ♦ Atoms were not created, for they always existed.
- ♦ Atoms have inherent power to move by their own weight.
- ♦ Atoms have inherent power to swerve from their normal paths.
- ♦ Atoms have inherent power to cling to other atoms to form new molecules.
- ♦ Atoms give rise to living things which soon die; then the cycle of life and death repeats.
- ♦ The *law of chance* accounts for these motions and combinations of atoms.
- ♦ The world is inherently chaotic and not deterministic.
- ♦ These powers of atoms suggest there are other universes that we cannot observe.
- ♦ No outside force or guiding intelligence is needed to explain what the atoms can do.

Each of these principles of atomism oppose a pre-existing principle of Judeo-Christian creationism. The underlying tenets of these philosophies differ in regard to two important questions:

1. Which entity is self-existent—atoms or a Creator?
2. Which entity has inherent power—atoms or a Creator?

From their earliest expressions, atomism and creationism have been in conflict. A few years after Lucretius died, Rome's greatest orator, Cicero, responded to the atomists' claims with his own book titled "Nature of the Gods" [7]. The conflict concerns philosophy, science, government, and religion. The controversy "on the nature of things" has great significance in public and private life, particularly in Western Culture.

Defense of Creation. As already noted, the Judeo-Christian concept "on the nature of things" includes the scientific premise of *order* and the *law of cause and effect*. About 51-52 A.D., an influential Christian defended the same premise in a public debate held in Athens, Greece, against Epicurean (atomist) philosophers [3, Acts 17:18]. Paul, the creationist, denied the atomists' premises by stating that atoms were not (1) eternally self-existent, nor (2) capable of moving on their own, nor (3) capable of giving life:

For in Him [the Creator] we live, and move and have our being [3, Acts 17:18].

Paul concluded his arguments with a reference to the resurrection of Christ [3, Acts 17:32] which Paul presented as evidence that life came from the Creator and not the atoms. To this evidence, the atomists could only respond by mocking Paul or saying they would hear him again on another occasion [3, Acts 17:32].

For many centuries following, the influence of atomism declined and Western civilization sought knowledge by studying the extensive writings of Aristotle whose premise of causality was inherent with creationism.

Causality Assumed in Classical Science. Around the Sixteenth Century, a scientific revolution began to emerge with explanations of natural phenomena explained by the *law of cause and effect*. Galileo, 1564-1642, professor of mathematics at the University of Padua, used mathematics to state scientific processes with rigor and relationships that clearly showed *cause and effect relationships*. The principle of causality became a fundamental principle of the Scientific Revolution that explained how

Events on Earth would help explain what could be seen in the sky, [and] the sky could show us how things happened on earth. Everywhere nature behaves in an orderly manner, which we can understand... [1, p. 29].

Until the end of the Nineteenth Century, scientists who believed the *law of cause and effect* applied the law in their research on the structure of the atom and ultimately produced the Periodic Table of the Elements—a great achievement in knowledge of the order found in nature. With convictions that order could be found in the universe, Classical Physics searched for the cause of that order. Models of matter had to be physical models for interactions in a physical universe. And discoveries in electricity and magnetism by Michael Faraday, 1791-1867, fully incorporated causality and quickly spawned the Industrial Revolution with enormous benefits to mankind.

Atomism in the Twentieth Century. As the Twentieth Century began, most scientists optimistically believed that the Scientific Method employed with the Classical Principles of *causality, reality, and unity* would continue to unravel the remaining mysteries of physical entities and processes.

But tragically, Niels Bohr, among others, led many physicists astray by abandoning the *law of cause and effect*. In 1913, Bohr proposed a model of the atom that polarized particle physicists into one camp of admirers and another camp of protesters. Among other problems, the Bohr Model depended upon many *chance-events* that came to be called the “quantum leap”: an orbiting electron was supposed to jump from one orbit to another orbit at the whim of nature. This was *not* an original idea: As noted above, another atomist had proposed about 300 B.C. that matter swerves “at uncertain times and at uncertain points.”

There are remarkable similarities of Bohr's "quantum leap" and Epicurus' "swerve" that link together ancient and modern atomism:

- ♦ Both assert the power of an elementary particle to swerve from its previous position by changing its motion.
- ♦ Both assert the existence of *chance events* by the power of nature and reject "the intervention of any outside force or guiding intelligence" [6, p. xii].
- ♦ Both deny determinism in the physical universe.

As Quantum Theory developed, the infamous "quantum leap" came to be associated with emission of photons—quantized particles of light that travelled from one electron to other electrons or protons. These photons have no mass, yet they are endowed with the power to carry momentum and a force from one charged particle to another. Robert Walgate explains the Quantum Theory of force:

Force Carriers. What causes a force between one particle and another at a distance? Modern physics answers: the exchange of yet other particles. Imagine two skaters throwing a ball at one another. The act of giving momentum to the ball in throwing it—and of receiving momentum in catching it—pushes the skaters apart. This accounts for repulsive forces. But in Quantum Mechanics, which affects small-scale phenomena, there is a strange extension and delocalization of events that allows a seemingly impossible event: one skater throws the ball away from the other, in the opposite direction, but the other skater is still able to catch the ball. A little thought shows that if such events were possible—as they are in the world of elementary particles—they would cause an attractive force between the skaters [8].

Atomists state that these (imaginary) random forces (from force-carrying particles called 'bosons'\*) put sub-atomic particles in constant motion. The concept of chance-events was quantified and elevated to a principle to quantify the amount of this action: The Heisenberg Uncertainty Principle (HUP) became the defacto *law of chance* that dominated the theory of particle physics in the Twentieth Century. HUP asserts that "if you measure position accurately you must sacrifice an accurate knowledge of momentum" in an elementary particle:

$$\Delta p \Delta x > h \quad (1)$$

where  $\Delta p$  is the uncertainty in momentum and  $\Delta x$  is the uncertainty in position and  $h$  is a small number known as Planck's Constant." Atomists claim this uncertainty is a law of nature and the result of bosons,\* not simply a measurement disturbance [9, pp. 68, 103] (*i.e.*, Bohr and Heisenberg claimed that elementary particles such as electrons actually do move randomly by their autonomous power to move).

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\* Bosons are said (by modern atomists) to be short-life elementary particles that carry forces by traveling between long-life material particles. One type of boson is the *photon*, a particle that carries a force of repulsion from one electron to a second electron.

Physical System	Uncertainty in Position $\Delta q$	Uncertainty in Momentum $\Delta p$	Observation $\ll$ HUP	Magnitude of Failure
Photon in a Living Cell	$\Delta q < 10^{-3}$ cm	$\frac{\Delta p}{\hbar} < 10^{-1}$ cm <sup>-1</sup>	$\frac{\Delta p \Delta q}{\hbar} < 10^{-4} \ll 1$	10,000
Photon Received by a Pocket Radio	$\Delta q < 10$ cm	$\frac{\Delta p}{\hbar} < 2 \times 10^{-7}$ cm <sup>-1</sup>	$\frac{\Delta p \Delta q}{\hbar} < 2 \times 10^{-6} \ll 1$	500,000
Electron in the Hydrogen Atom	$\Delta q < 10^{-8}$ cm	$\frac{\Delta p}{\hbar} < 10^2$ cm <sup>-1</sup>	$\frac{\Delta p \Delta q}{\hbar} < 10^{-6} \ll 1$	1,000,000
Photon in tip of Scanning Light Microscope	$\Delta q < \frac{\lambda}{10}$	$\frac{\Delta p}{\hbar} < 6 \times 10^{-6} / \lambda$	$\frac{\Delta p \Delta q}{\hbar} < 6 \times 10^{-7} \ll 1$	1,670,000
The Electron in Beta Decay	$\Delta q < 3.4 \times 10^{-13}$ cm	$\frac{\Delta p}{\hbar} < 8 \times 10^9$ cm <sup>-1</sup>	$\frac{\Delta p \Delta q}{\hbar} < 3 \times 10^{-3} \ll 1$	333
A Photon in Wiener Fringes	$\Delta q < 2 \times 10^{-6}$ cm	$\frac{\Delta p}{\hbar} < 5 \times 10^3$ cm <sup>-1</sup>	$\frac{\Delta p \Delta q}{\hbar} < 10^{-2} \ll 1$	100

**Table**  
*Magnitude of failure of the Heisenberg Uncertainty Principle in actual cases.*

Recently, however, Paul Wesley has shown that HUP “fails by many orders of magnitude for actual examples, where the uncertainties are known.... There does not appear to be any intrinsic limitation to our knowledge about the state of a system as implied by the Uncertainty Principle.... Ordinary scientific considerations indicate that our knowledge is limited only by ordinary experiment error” [10, pp. 152-166]. Wesley shows six actual examples where the HUP fails badly (*i.e.*, HUP is wrong by factors ranging from 100 to over 1,000,000). See the Table for a list of these six cases. If the so-called “law of chance” is wrong, an unbiased conclusion should be that the *law of cause and effect* is right.

Pseudo-causality of Albert Einstein. Albert Einstein (1879-1955) never accepted the Heisenberg Uncertainty Principle with its implications for chance events by the power of the atom. Nevertheless, his own ideas on “space” were eagerly adopted and incorporated into the Quantum Theory by atomists who imagined that “quantum fluctuations” were common not only in the sub-atomic realm but also in the cosmos.

Einstein rejected the so-called *law of chance* and proposed a mechanism for causality to govern forces on objects that include electrons and stars. Instead of the power of nature residing in the eternal atoms, he asserted the power of nature residing in eternal “space.” The traditional view of the great expanse—sometimes called heaven or the sky but always characterized by *void* and *the absence of material objects*—was given a name

“space” and assumed by Einstein to have physical properties. The imagined existence of “space” underlies Einstein’s Theory of Relativity. Writing in 1905, Einstein stated:

The principle of inertia, in particular, seems to compel us to ascribe physically objective properties to the space-time continuum [11, p. 55].

...the properties of the space-time continuum which determine inertia must be regarded as field properties of space, analogous to the electromagnetic field [11, p. 56].

To atomists, the concept of space with properties and power was as appealing as the concept that the atom has autonomous power. Today, while modern physicists imagine tiny quantum fluctuations occurring in atoms as bosons carry forces between material particles, modern cosmologists imagine that a huge quantum fluctuation called “The Big Bang” caused the entire universe. Today, natural philosophers called “physicists” are much like the first atomists, who “used the atomic philosophy mainly to combat religion, not to extend man’s understanding and control of nature” [4, p. 2]. The hostility of modern atomists unleashed against anyone who believes in a Creator or creation is well-known. Atomists still reserve all power for “Nature” which grants such power to “space” and atoms.

However, the imagined properties of space are based solely on theory and have *not* been observed. Physicist and philosopher David Harriman says that space is “absolutely nothing”:

I want to start by stating unequivocally, there is no such thing as “space,” whether viewed as the infinite void of the Greek atomists, or the receptacle of Plato, or the absolute cosmic reference plane of Newton, or the acrobatic and curving frame of Einstein, or the final frontier of James P. Kirk. *There is no such entity* [12].

If “space” is not a real physical entity, then “space” cannot cause anything to happen. When atomists look to “space” for explanations of events in the heavens, they place their hope in a powerless non-entity—an impotent, ignorant, and non-existent god.

Causality in Common Sense Science. Common Sense Science has implemented Aristotle’s ideas on causality in a comprehensive theory of forces and matter. Consider, for example, the fundamental cause of exerting a force between charges (*e.g.*, two electrons). For this situation, Aristotle’s four causes in CSS theory are:

1. Material Cause. Electrons are composed of electrical charge. Furthermore, this charge, causes an external electric field and an external magnetic field. The fundamental entities found in nature are electrical charge, electric fields and magnetic fields [13, Concept #3, Table 1].
2. Formal Cause. The Helicon is the form of elementary particles that stores charge in a stable configuration. The charge and its motion on the boundary of a helicon cause specific shapes and intensities in the fields surrounding the helicon, reach-



ing out to great distances at the speed of light [14, Properties #8, 12, 16, Table 2a].

3. Efficient Cause. The mechanism for one electron to repel another electron is the interaction of the fields of the first electron with the charge of the second electron. An electric field acts upon the charge of the second electron. A magnetic field acts on the current of the second electron. Both electrons deform (change shape and size) in order to emit and absorb electromagnetic field energy.
4. Final Cause. The purpose of an electron's design, in this example, is to repel another electron. The final, ultimate cause of the repelling force is the interaction of one electron's charge with the other electron's fields.

This explanation solves an age-old mystery of how forces are transmitted across great distances without any physical contact of two interacting bodies. By applying the *law of cause and effect* in physical models, Common Sense Science invariably predicts the results of actual measurements from the cosmic to microcosmic realms of the universe.

**Cause of the Universe.** What explains the *existence* of the physical universe? Three distinct cosmologies are widely held and summarize the leading explanations of origins.

- a. **Eternal Cosmology.** The universe had no beginning because it always existed, or
- b. **Creation Cosmology.** The Creator made the universe with all its laws, energy, and features, or
- c. **Natural Cosmology.** Nature made the universe and it evolved into its present form by evolving laws, materials and natural processes.

How does the *law of cause and effect* enter into each view? According to **Eternal Cosmology**, the universe is self-existent, and there is no cause for its beginning. The *law of conservation of energy* has always prevailed and will continue to prevail forever.

According to **Creation Cosmology**, the power to create resided eternally in the Creator who then established the universe in a mature, functional form [15, Genesis 1:11] by supplying the energy now contained in the universe. After the events of creation, the order in the universe has been maintained by the *law of cause and effect* as well as the *law of conservation of energy*.

According to **Natural Cosmology**, the story of origins is more complicated. Modern atomists believe that Space always existed everywhere. At the beginning, Space is supposed to have caused the first quantum fluctuation, a primeval event called "The Big Bang" that produced all the energy in the universe. From that moment, the prevailing laws of physics governed the evolution of matter through stages of increasing complexity that produced elementary particles, atoms, molecules, stars, galaxies, heavy elements, biologically important molecules, amino acids, proteins, DNA, life (the first living cell), all forms of plant and animal life and man (both male and female). To accomplish this, the laws of physics, chemistry and biology also evolved to their present state. Thus, Space itself is considered the primeval source of the energy and intelligent design now embod-

ied in the entire universe. However, atoms, elementary particles, and the Sun are also endowed with power to maintain the processes in operation today.

***Causality in the Law of Conservation of Energy.*** The fundamental force laws of physics specify the motions of material objects. Thus, these laws explain the cause and effect relationships that constrain motions of objects, as well as their sizes and shapes. Evidently, the *law of cause and effect* is embedded in the fundamental force laws of physics (*e.g.*, Faraday’s *law of magnetic induction*, Newton’s *law of gravitation*, *etc.*).

By the end of the Nineteenth Century, concepts of energy, potential energy, kinetic energy, and conservation of energy were so well-established and interrelated by theory that few, if any, questioned the intrinsic relationship between the *law of cause and effect* and the *law of conservation of energy*. And thus, scientific evidence for the *law of cause and effect* is enhanced by validation of the *law of conservation of energy*—presented in the remainder of this report.

The *law of conservation of energy* has been verified every time it was tested, making it certain as a law of science [17]. Although many have tried to make a “perpetual motion machine” that produced more energy than it consumed *no one has ever succeeded*.

All physicists know this law of nature, but many still insist that Quantum Mechanics need not follow the law, because Quantum Mechanics makes some successful predictions, or because, they say, the law does not apply over short time-intervals, or because “laws of physics evolved and changed, especially during the first moments of The Big Bang. Since the failure of HUP has been demonstrated, true science does not use it but proceeds with models and force laws that conserve energy. A dictionary gives a definition of the conservation law:

**conservation of energy, Physics.** The principle that in a system that does not undergo any force from outside the system, the amount of energy is constant, irrespective of its changes in form. Also called *law of conservation of energy* (1850-55) [16].

In physics, the application of a force acting over a distance adds or removes energy from a system. Since force causes some action, it is evident that causal force laws are conservative (*i.e.*, they strictly adhere to the *law of conservation of energy*).

In contrast, the Heisenberg Uncertainty Principle *never* adheres to the *law of conservation of energy*. When written in the form of energy  $E$  and time  $t$ , the HUP becomes:

$$\Delta E \Delta t > h \quad (2)$$

Even atomists—who claim this Principle allows Space to create a virtual particle of energy  $\Delta E$  that self-annihilates after a time-interval  $\Delta t$ —recognize a violation of the *law of conservation of energy*. Although the *law of conservation of energy* was established upon valid experimental data, atomists ignore this evidence and claim that this law, and other laws of physics, **change** depending upon domain, scale, and historical epoch.

**Conclusions.** Classical Physics, Common Sense Science, and Creation are all *scientific* systems of knowledge based on causality, logic, observed data, and an unbiased analysis of all the available information. Modern Physics based on Quantum Theory and Relativity Theory, Atomism, Naturalism, the Heisenberg Uncertainty Principle, Evolution, and the *law of chance* are all based on unvalidated (and/or falsified) assumptions driven by agendas often religious in character. Atomism has been exposed as false science based on erroneous assumptions about chance-events instead of causal relationships.

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