

From Gilbert's magnetism to the Electric Universe: understanding the genealogy of a pseudoscientific theory

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Abstract: Science historian Micheal D. Gordin (2012) asserts that “each use of pseudo-science is tied intimately to its historical context”. Nevertheless, history of physics as a field has so far paid little attention to the development of pseudo-scientific ideas. The article aims to analyse with a genealogical approach borrowed from the history of ideas the popularity of the so-called “Electric Universe” model, a pseudo-scientific theory alternative to the theory of relativity that postulates a universe dominated by electromagnetic force, used to explain the gravitational force as well.

Keywords: pseudoscience, history of ideas, electric universe.

1. The Electric Universe model

The Electric Universe (EU) model is a pseudoscientific theory, developed since the 1990s in the United States, and enjoying a large popularity today thanks to the multiplicative effect of social media (about 20,000 followers on Facebook, more than 100,000 subscribers on YouTube with over 500 videos uploaded, in some cases with over 1.5 million views). As the *Beginner's Guide to the Electric Universe* states on *The Thunderbolts Project* website (the online reference resource for the EU), the main aim of this theory is to challenge the “gravity-centric viewpoint” of contemporary physics and cosmology (Schirrot 2013).

Indeed, EU model is extremely simple in its fundamental concepts. The basic idea is that astrophysics and cosmology do not need of gravitation, because its force is too weak to act on a cosmic scale; electromagnetic force alone can instead answer for all astrophysical phenomena. The result is that for EU the mainstream explanations of the Big Bang, cosmic expansion, galaxy formation, star and planet formation, planetary motions, comet composition and other minor theories must be rejected. In the EU model, the universe is not basically “empty space”, but is filled with plasma. Since the easiest way to generate plasma is to subject a gaseous mixture to a powerful electromagnetic field, EU supporters conclude that electromagnetic force is of paramount importance in space, unlike in mainstream cosmological theories state. Galaxies, as well as most celestial bodies, including stars and planets, would be composed of plasma. The movement of charged particles between the different celestial bodies and between galaxies would give rise to electric currents, responsible for the extreme astrophysical phenomena we observe, from supernovae to neutron stars to quasars and black holes.

In their pantheon of founding fathers, EU supporters include scientists such as physicist Kristian Birkeland (1867-1917) and the Nobel Prize-winning chemist Irving Langmuir (1881-1957). Birkeland was the first to explain the northern lights (*aurora borealis*) suggesting the existence of electric currents that flow along geomagnetic field lines connecting the Earth's magnetosphere to the ionosphere. These currents are now called Birkeland currents and play a decisive role in the EU model. Langmuir was responsible for the first use of the current term "plasma" in physics, and the discovery of the double layer effect in plasma which is considered very important in the EU: this effect occurs when an electric current flows between a charged body and the surrounding plasma, to form an isolating double layer barrier that insulates the charged body from the plasma.

In the EU model, a central role is played by the so-called "Z-pinch effect", a type of plasma confinement system that uses an electrical current in the plasma to generate a magnetic field that compresses it. Plasma filaments would combine in pairs (Birkeland currents) to transmit electricity efficiently in space; when two large-scale (many megaparsec long) Birkeland currents meet, they can form an electromagnetic "instability point" that produces a strong compression force identical to the Z-pinch effect reproduced in laboratories. The meeting point of the two currents produces a powerful long-range attractive electromagnetic force drawing matter towards it (Findlay 2013). The result is the formation of a concentrated plasma structure called a "plasmoid", that has natural spin. This model, developed in the early 1980s by the American physicist and engineer Anthony L. Peratt, would explain the mechanism of galaxy formation without gravitation. It is therefore called "Peratt Galaxy Model".

A similar mechanism has been proposed to explain star formation without gravitational attraction. Smaller Birkeland currents interact attracting more and more matter through electromagnetic interaction, to form stars of different sizes, colours, brightnesses and apparent behaviours. In the EU model, these different characteristics of stars do not depend on the nuclear fusion processes that take place within them, on age or other astrophysical characteristics, but on the type of material they have attracted during their formation and from the electrical power available for initiating the star birth process (Findlay 2013). Similarly, mainstream explanations about the energy that lights the stars are rejected, since they would not be able to explain the paradox that the outer surface of the stars is warmer than the inner core. This would show that there are no nuclear fusion processes favoured by gravitational contraction within the stars, but that energy production takes place on the surface of the stars. Two possible explanations for this phenomenon have been proposed. The "Solar Resistor Model" provides that the residual plasma filaments after the intersection between the two main Birkeland currents continue to power the stars as a resistive load. The "Solar Capacitor Model" is a spherical capacitor model with the heliopause as the cathode and the solar photosphere as anode (Bridgman 2008).

According to the EU model, all celestial bodies are electrically charged bodies, surrounded by Langmuir's double layers that isolate them from the external plasma (plasma-sphere). Each star system is surrounded by a double layer granting the system to continue its journey through the galactic plasma and maintain its internal stability. However, unlike the standard cosmological model based on gravity, the EU model is characterized

by violent periodic and unpredictable upheavals produced by electric currents within the heliosphere (i.e. the plasmosphere of each star) and by the interaction between plasmospheres. The intense electrical stress of some stars entails that some of them, subjected to the necessity to reduce the current density they experience, may explosively fission into two more stars. This would explain the large quantity of multiple star systems that exist in the universe (Scott 2006). When instead the heliosphere of two star systems come into contact, the star system with greatest level of charge will electrically dominate and manipulate all the bodies within the less powerfully charged system: in particular, “the star in the less powerful system will quickly lose its glow and stop looking like a star since it is negatively charged in relation to the dominant system” (Findlay 2013). This mechanism, they say, would be the basis of the formation of planets like Saturn, considered an ancient star absorbed by the electromagnetic attraction of our Solar System. The Earth, in particular, would initially orbit around a brown dwarf, since the planets around these kinds of stars are supposed to be more suitable for life (Thornhill 2008).

Comets, EU supporters say, could prove the basic principles of their model. Since gravitational interaction in the EU cannot account for the perturbations that would occur at the borders of the Solar System and that leads comets to begin their race toward the Sun, they claim that comets are electrically charged rocks left over from catastrophic collisions and ancient electrical discharge events (Findlay 2013). Comets would come from low voltage regions, so during their approach to the near-Sun (higher-voltage) region current flows to the comet in response to this voltage difference, and the comet produces a tail and a coma plasma layer surrounding its nucleus (Scott 2006). EU supporters claim that the morphology of cometary nuclei as observed by probes and telescopes contradicts the traditional belief that they are made of “dirty ice”, as they reveal imprints of craters. In the EU framework, craters on celestial bodies are not the result of meteoric impacts or impacts with other objects attracted by the gravitation of larger masses, but the product of electrical discharges (this would also explain geological formations such as the Grand Canyon). The presence of craters on the surface of comets would corroborate their theory.

2. The genealogy of a pseudoscientific idea

The genealogy of the Electric Universe theory is much older than one can think. EU supporters cite as its first precursor William Gilbert (1544-1603). In his famous work *De Magnete* (1600), Gilbert suggested that the cause of gravitational attraction was magnetism. This force could not occur in vacuum (according to common beliefs), so Gilbert assumed that magnetism would propagate through fluids that filled the universe. Gilbert’s ideas profoundly influenced Kepler (1571-1630), who was also convinced of the impossibility of an acting-at-a-distance attractive force through vacuum. He imagined that the Sun would possess an *anima motrix* that would give the thrust to the planets by hitting them with its rays (Kuhn 1957): a concept very similar to the way electricity is imagined propagating between the celestial bodies in the EU model.

During the 18th century, the first experiments with electricity began to influence the vision of the cosmos of many thinkers. This is the case of Prokop Divisch (1698-1765), a

Moravian Catholic theologian defined by his contemporaries as *theologus electricus*. His peculiar “theology of electricity” was exposed in his book *Theorie von der meteorologischen Electricité* (1765) and in the work of his disciple Théophile-Frédéric Roesler (1740-1790), *De luce primigenia* (1764). The basic idea is that the “primal” light in the book of Genesis was an “electric fire”, “a principle of life full of heat, energy and power; a fire that first penetrates all matter and then, as the principle of life, merges with matter itself” (Benz 1989). According to Divisch, once God created the Sun, the electric fire stopped spreading in space and mixed with matter, giving life to the celestial bodies, which are composed of the same type of fluid. Divisch was particularly interested in affirming a concordist theory between the new discoveries of electricity and the biblical text: he proposed that several unexplained phenomena in the Bible could be explained through electricity, such as the passage in *Ezekiel* 1:10 where the Throne of God is described as surrounded by a luminescence (*chasmal*) that manifests itself first as a cloud and a vortex and then as a sparkling light, similarly to storms and lightning strikes. These ideas also influenced Lutheran pastor Friedrich Christoph Oetinger (1702-1782), who suggested several demonstrations of the use of electricity by the wise Jewish men of the time, such as the passage in *Zechariah* 14:12 where the Lord strikes “the peoples who fought against Jerusalem” by rotting their flesh, their eyes and their tongue. Following Gilbert’s cosmology, Oetinger interprets the Newtonian theory of gravitation as a consequence of magnetism, arguing that magnetic attraction represents “the principle of nature” (Benz 1989).

A direct heir of these theorists was Immanuel Velikovsky (1895-1979), who in his controversial best-seller *Worlds in Collision* (1950) claimed to have found in the ancient holy and legendary texts of the great civilizations around the world traces of cataclysmic events that occurred several centuries before the current era, transformed into tales of gods at war or great miracles. Starting from the fact that, according to his reconstruction, the planet Venus was unknown to ancient civilizations, Velikovsky imagined that Venus was not a real planet, but a huge comet expelled around 1500 BC from the planet Jupiter that collided with the Earth’s atmosphere; the comet’s tail, in contact with our atmosphere, burned for many decades, causing huge disasters but also justifying a miraculous event narrated by the Bible, namely the fall of the manna from the sky during the exodus of Jews from Egypt. Finally, the nucleus of Venus broke free from Earth’s atmosphere and began to move away from the Earth, but clashing several times with the planet Mars around the eighth century BC, an event that would be the basis of Homer’s *Iliad* (where the Trojan war is the result of a war between the gods, especially between Mars and Athena, who Velikovsky identified with Venus).

Despite having a scientific background (he was a trained physician), Velikovsky was not an expert in physics and astronomy. His book is full of references to texts and historical events, but he was aware of having to question the dominant scientific axioms in order to demonstrate that Venus did not exist until about 1500 BC and that the planets of the Solar System had not followed for millions or billions of years the same elliptical orbits around the Sun. He therefore began to question the theories on the formation of the Solar System and more generally Newtonian theories of gravitation. In the 1920s, Velikovsky founded a journal in Berlin, the *Scripta Universitaria*, with the aim of spreading the

thought of Jewish scholars from all over the world and promoting the development of a Jewish university in Jerusalem. On this journal (that boasted even Albert Einstein among his first editors) Velikovsky published in 1946 an article entitled *Cosmos without Gravitation*, where he presented his heterodox vision of physics and cosmology, providing for a pseudoscientific basis to the theory exposed in *Worlds in Collision*. The fundamental theory of his paper was that “gravitation is an electromagnetic phenomenon. There is no primary motion inherent in planets and satellites. Electric attraction, repulsion, and electromagnetic circumduction govern their movements”. He claimed to have come to that conviction in 1941 “as the result of my research in the history of cosmic upheavals as they affected the earth and other members of the solar system”, adding that a number of facts proved to him “that the sun, the earth and other planets, the satellites, and the comets, are charged bodies [and] that not gravitation, but electric attraction and repulsion and electromagnetic circumduction govern the solar system” (Velikovsky 1946).

Based on this “scientific” background, in *Worlds in Collision* Velikovsky imagined that several catastrophic events told in the Bible could be explained by electrical phenomena produced by celestial bodies. In a later paper that was initially to be included in his book but which the editors suggested to remove, Velikovsky analyzed the myths of Biblical Genesis claiming that the Deluge was caused about then thousand years ago when Saturn exploded, and the hydrogen of the planet combined with the oxygen of the terrestrial atmosphere in electrical discharges and turned into water. In addition, the tale of the Tower of Babel “recounted an electrical discharge from a Mercury fly-by”, while “the destruction of Sodom and Gomorrah was produced by an electric bolt shot out from Jupiter” (Gordin 2012).

Velikovsky’s theories came back into vogue during the 1970s after a period of dormancy. They were relaunched by the university magazine *Pensée*, founded in 1966 at Portland State University by David Talbott. In May 1972, the magazine began to host a series of contributions entitled “Immanuel Velikovsky Reconsidered”, which transformed the scholar into a star of counterculture. *Pensée* sold between 10,000-20,000 copies, and the first issue of the series “Velikovsky Reconsidered” reached, through numerous reprints, the incredible number (for a former student magazine) of 75,000 copies. The editorial board was colonized by Velikovsky’s disciples and the magazine helped build the community from which the Electric Universe emerged years later. In fact, fans from all over the United States began to flood the magazine with hypotheses, theories, counter-theories on all the different aspects of Velikovsky’s work, including, of course, its “scientific” premises (Gordin 2016). In 1980 Doubleday published the first book by a Velikovskian, David Talbott: *The Saturn Myth* assumed that in ancient times the Earth was a Saturn’s satellite (previously devoid of its rings, the result of a late planetary collision), until a subsequent cataclysm pushed both planets, along with Mars and Venus, to change their orbits. This caused serious cataclysms on Earth that put an end to the so-called Golden Age and the decline of ancient, glorious and advanced civilizations. In their book *Thunderbolts of the Gods* (2005), Talbott and Wallace Thornhill, a trained engineer, used the pseudoscientific background of the Electric Universe to support Velikovsky’s and Talbott’s thesis.

The case of the EU can be a perfect example to understand how scientific ideas are transformed and distorted in the historical process, through transposition and adaptation in different cultural contexts. Gilbert's first cosmological ideas, already misrepresented in the 18th century, were further distorted by Velikovsky, returning in the contemporary era through the EU model. Historians of ideas define *concept drift* the process that leads to a transformation of the original meaning of an idea in its passage within another cultural context (Wang, Schlobach, Klein 2011). Understanding the mechanism of this concept drift may prove an effective strategy of debunking. While traditional debunking tries to unveil the misconceptions at the basis of a pseudoscientific theory through science or logics, using history to trace back the genealogy of misconceptions can aid the deconstruction of pseudoscience, and even reveal a new strategy in the teaching of the history of science. As Gordin notes: "Each use of pseudoscience is tied intimately to its historical context. If you want to know what science is or has been, show me contemporary pseudoscience" (Gordin 2012). This final suggestion can explain why historians of science should devote more attention to the history of pseudoscience in their own work.

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