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A Kuhnian Perspective of the Suppression of Scientific Inquiry and its Relationship to Medicinal Properties of Cannabinoids

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Abstract: Throughout human history societal constraints have been imposed on the areas of inquiry researchers are permitted to pursue, as well as their ability to share newly attained knowledge. American bureaucracy dictates that decisions regarding the suppression of scientific inquiry fall under the dominion of politicians. The political decision to prohibit research of the medicinal potential of phytocannabinoids has resulted in a paradigm Thomas Kuhn would have considered to be in a state of crisis, and the worldview to which cannabinoid scientists have been mandated to adhere with respect to medicinal properties of synthetic and biologic cannabinoids is currently experiencing revolutionary challenges.

Introduction

The pursuit of scientific knowledge has led humanity to places previously unimagined, but throughout human history societal constraints have been imposed on the areas of inquiry

researchers are permitted to pursue as well as their ability to share newly attained knowledge. For example, Socrates was executed for advocating paradigms contrary to those of which he was mandated to adhere by the society in which he resided. Since Socratic times scientists have been conditioned to respect and understand the dangers of pursuing research which has the potential to challenge the established paradigm.

Suppression of Inquiry in the Age of Scientific Revolution

The most often cited case of suppression of inquiry involves the Catholic Church's rejection of heliocentric (sun-centered) astronomy. At the beginning of the sixteenth century, the Catholic Church enlisted the aid of Polish astronomer Nicolaus Copernicus (1473–1543) to reform the calendar so the Church could more accurately predict when religious holidays, such as Easter, should occur. Copernicus discovered he was unable to produce a calendar which accurately predicted the movements of the moon and planets unless he placed the sun in the center of the solar system. In 1543, he challenged the paradigm of an earth-centered universe, authoring his book *On the Revolutions of the Heavenly Spheres*. His writings postulated the controversial notion of the earth revolving around the sun. The book at first did not generate much controversy because Church leaders interpreted Copernicus's heliocentric ideas as mathematical fictions useful for making calculations, and not as true representations of the world (Kuhn 2003).

The Church, as the governing bureaucracy, disapproved of this theory because it held that biblical cosmology should be taken literally. It considered the publication heretical because his theory was contrary to their interpretation of holy scriptures. Copernicus avoided persecution for this challenge to doctrine because he died shortly after publishing his treatise. As Copernicus's ideas became more influential, the Catholic Church took steps to suppress them. In 1616, the Church declared heliocentric theory heretical and banned the publication of *On the Revolutions of the Heavenly Spheres* until it could be corrected (Bergman, 2015).

The Italian astronomer Galileo Galilei understood the perils of challenging the Ptolemaic paradigm which asserts that Earth is the center of the universe, and he refrained from any public comment on astronomy for many years, instead focusing his attention on the more economically advantageous endeavor of solving navigational problems. In 1618 however, three comets were observed, and a Jesuit astronomer maintained their appearance disproved the Copernican view of a heliocentric universe. Galileo broke his silence with the 1623 publication *The Assayer*. The brief disquisition not only refuted the attack against Copernicus but also presented an elegant argument on behalf of free scientific inquiry. *The Assayer* greatly influenced scientific methodology and served humanity as a pioneering work establishing the scientific method, presenting the idea that the natural sciences should rely on mathematical tools rather than through dogma, which was the dominant paradigm at the time. In 1632 he challenged the paradigm directly, authoring his most important and controversial work, *Dialogue Concerning the Two Chief World Systems*. Although the book had received the Catholic Church's initial acceptance, it was placed on the Index of Forbidden Books shortly after its publication. A few months

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later, the Office of the Inquisition summoned Galileo to Rome to stand trial for heresy. At issue was whether he had defied a papal prohibition to "hold, defend, and teach the Copernican doctrine." More importantly, the Church's authority and ability to enforce compliance with its doctrine was at stake (Bald, 2011). After a five-month trial, Galileo was convicted because he "held and believed false doctrine, contrary to the Holy and Divine Scriptures." The punishment was an edict prohibiting the *Dialogue Concerning the Two Chief World Systems* and a prison sentence. Galileo was given the opportunity to recant, which he accepted, thereby silencing any past and future claims of scientific observations (Leveillee, 2011).

A Kuhnian Perspective of the Suppression of Scientific Inquiry in the Modern Era

Although religion still has a great influence on which aspects of scientific inquiry get repressed, American bureaucracy dictates that decisions regarding the suppression of new scientific knowledge fall under the dominion of politicians. Cannabinoid pharmacology has fallen under the elected official's scope of influence, both historically and politically. Cannabis is one of the oldest and most widely used medicinal plants in the world; however, it wasn't until the endocannabinoid system was discovered that we understood the mechanism through which it works medicinally. The presence of cannabinoids was first detected in the late 1800s with the discovery of the phytocannabinoid Cannabinol (CBN). By the 1930s the structure was understood, and the first synthetic cannabinoid was created in 1940. Also, in 1940, Cannabidiol was extracted, followed by Tetrahydrocannabinol (THC) two years later. Research picked up pace in the '60s and '70s with the increased recreational use of Cannabis (Pertwee, 2006). The Controlled Substances Act was signed into law by President Richard Nixon on October 27, 1970, establishing the categorization of drugs by a litmus test of criteria centered around drug abuse prevention. 1973 saw sweeping changes to cannabinoid research in the United States with the establishment of the Commission on Marijuana and drug abuse, aimed at studying cannabis abuse. At that time, endocannabinoids had not yet been discovered, and their discovery would not occur until two decades later. Amid the Watergate Crisis Nixon officially declared "war on drugs," targeting the cannabis plant as a whole, as well as the phytocannabinoids it produced, classifying these as schedule I drugs, thereby fettering research on them.

Synthetic cannabinoids were designed with a slightly varied molecular structure from the phytocannabinoids to ensure their legality. Their slightly different structure coupled with their synthetic origination assured their schedule II classification until these cannabinoids repeatedly demonstrated themselves to be deadly (Centers for Disease Control, 2018; Drug Enforcement Administration, 2017).

The first endocannabinoid receptor was discovered in 1988 by Howlett and Devane. Using Synthetic THC, these researchers set out to explore receptors in the brain. In 1990 Matsuda and colleagues isolated the THC sensitive receptor. A second cannabinoid receptor was identified three years later and dubbed the CB2 receptor. The function these receptors started to become clear in 1992 when Raphael Mechoulam, working out of Israel discovered the first endocannabinoid. The identification of a second endocannabinoid soon followed, leading to the discovery of a network of receptors and endocannabinoids within the body of all vertebrates, responsible for maintaining homeostasis.

Prohibition on research of the phytocannabinoid molecules lasted 47 years and ended on December 21, 2018, when Donald Trump ratified the Farm Bill which legally reclassified phytocannabinoids extracted from *Cannabis sativa* composed of less than 0.3% THC (hemp) as an agricultural product rather than a controlled substance. This legally (not scientifically) differentiated the molecules from those produced by *Cannabis sativa* varieties with higher THC content. When this bill was signed into law, interstate transportation of 113 known phytocannabinoid molecules became permitted, provided they originated from *Cannabis sativa* classified as hemp. This concession by the US opened the door to the research of phytocannabinoids, which scientists in the United States had been restricted from investigating for more than half a century.

While the prohibition of research on certain phytocannabinoid molecules has been significantly lifted, the paradigm of management of research on the medicinal properties of synthetic and phytocannabinoids, established by the FDA, the DEA, and NIDA remains. This paradigm, established nearly half a century ago, is currently in what Thomas Kuhn (1996) would have termed a "state of crisis." It has demanded acceptance of the proposition that synthetic cannabinoids possess medicinal properties while phytocannabinoids are dangerous, possessing none (Drug Enforcement Administration, 2017). Until the passage of the Farm Act, studies which might challenge this paradigm were technically illegal. This five-decade period defined the science of cannabinoids and dictated the methods of solving puzzles which arose. This period was a phase Kuhn would have referred to as "normal" science. The established paradigm dictated the way observational data was perceived, experiments designed, and the results interpreted (Kuhn, 1996).

With the methods in place and the assumptions defined, this paradigm flourished. However, deaths and other adverse events resulting from synthetic

cannabinoids as well as an accumulation of anomalies and discoveries have resulted in challenges to the dominant paradigm. Thomas Kuhn advanced the notion that the role of the scientist is to design studies with the possibility of producing results which challenge the dominant paradigm and established the word "revolution" to describe dramatic changes in scientific worldviews. Revolutionary science is torturous and painful because it shakes all confidence that science has in its present theories and underlying paradigms. Paradigm shifts occur gradually during a stage when the dominant paradigm is termed to be in "crisis." A new paradigm is now emerging, which professes the phytocannabinoids have medicinal properties without the adverse effects so often prevalent through intromission of synthetics. With changes in state regulations and implementation of the Farm Act, it is now possible to explore the limitations of the dominant paradigm. This is the nature of science, and when observations conflicting with the dominant paradigm appear to the scientific community to be insurmountable, a period of "crisis" results and political and economic events fuel the search for new understandings (Figure 1). From a Kuhnian perspective, it is the crisis stage we are in with respect to cannabinoid-based medicines. Studies are only now beginning to be proposed which might subvert the accepted assumptions (Dawson, 2018). History has demonstrated that whether the opposition to attaining and disseminating scientific knowledge is politically or religiously motivated, humanity has the potential to ensure this knowledge is eventually attained.

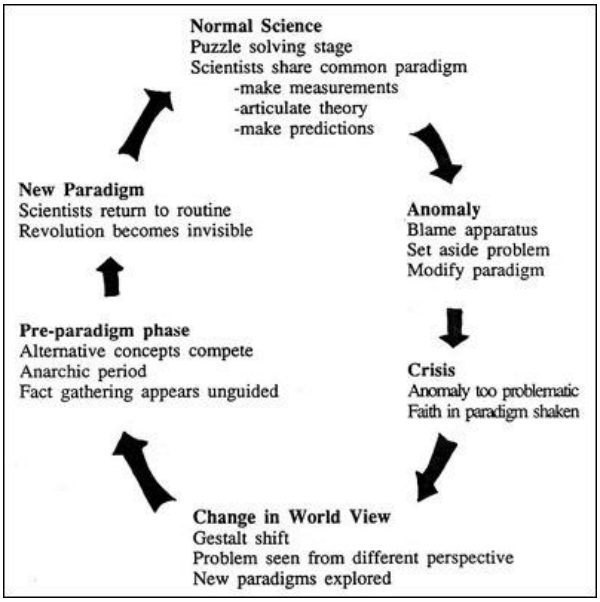

Figure 1 - *Image from The Structure of Scientific Revolutions (Thomas S. Kuhn, 1962)*

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