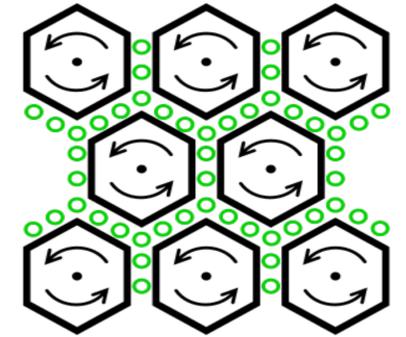
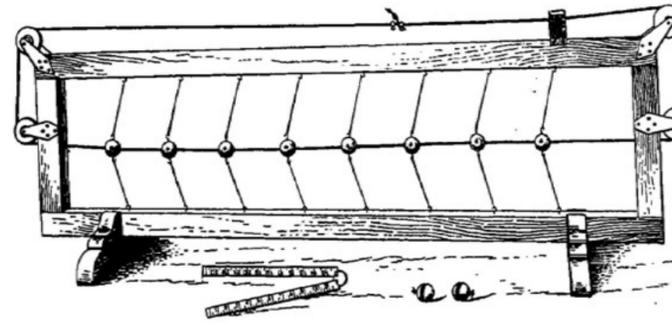
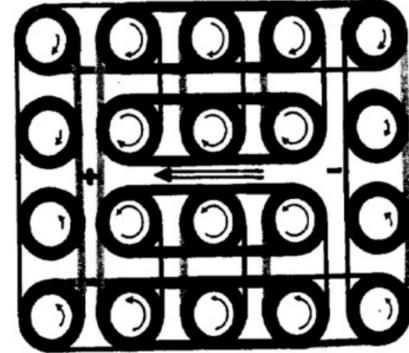
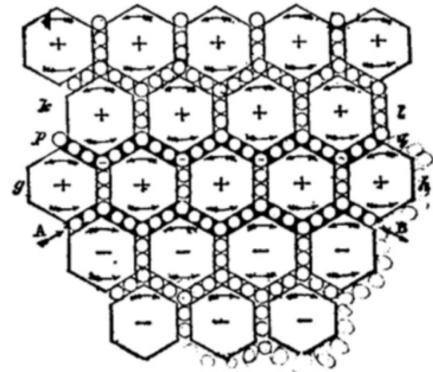


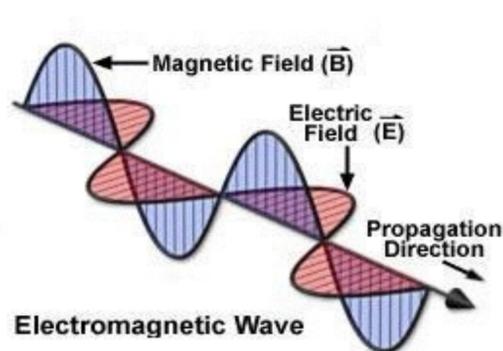
## Mechanical Models of the Aether



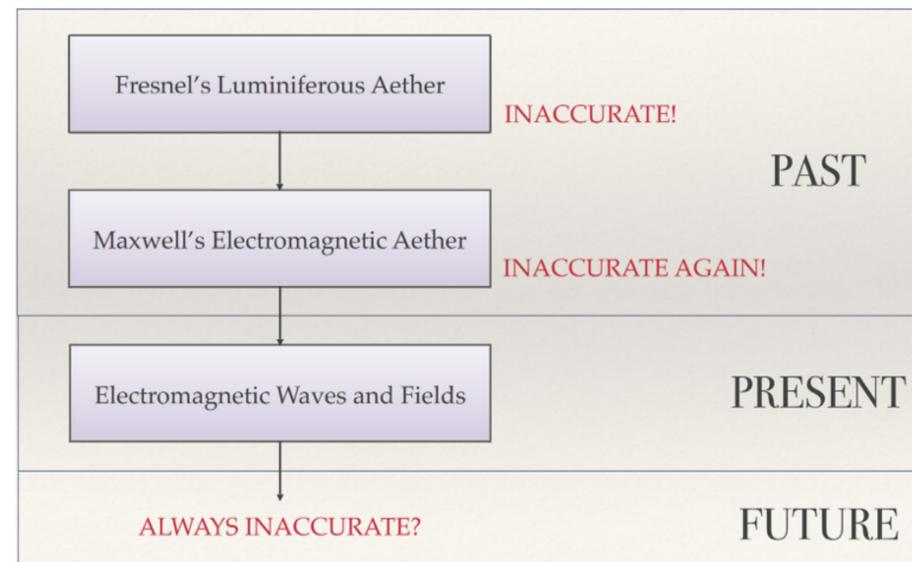
## Abstract

Before the advent of special relativity, wave theories of light required the existence of an optical medium, called the "aether," through which light waves could propagate. In 1861, the famed physicist James Clerk Maxwell proposed a unified theory of electricity, magnetism, and optics by appealing to the mechanical conception of an electromagnetic aether. That is, he attempted to describe this aether as a physical system purely governed by Newtonian mechanics. Followers of Maxwell subsequently proposed their own mechanical models as aids in the understanding of electromagnetic phenomena, for both research and instructional purposes.

Our research in the history and philosophy of science considers how these mechanical models of the electromagnetic aether provide formal scientific explanations of electromagnetic phenomena, with respect to standard accounts of explanation in the philosophy of science. Based on our findings, we suggest that the type of explanations offered by Maxwell and his followers cannot be readily understood by any of these standard accounts; rather, we suggest a new type of "intertheoretic" scientific explanation that utilizes links between Maxwell's theory of electromagnetism and Newton's theory of mechanics. By suggesting this novel form of explanation, we hope to contribute to new growth between related scientific theories, for instance in quantum gravity with respect to general relativity and quantum mechanics.



## A Grand Pessimism...



## ...Becomes Opportunity

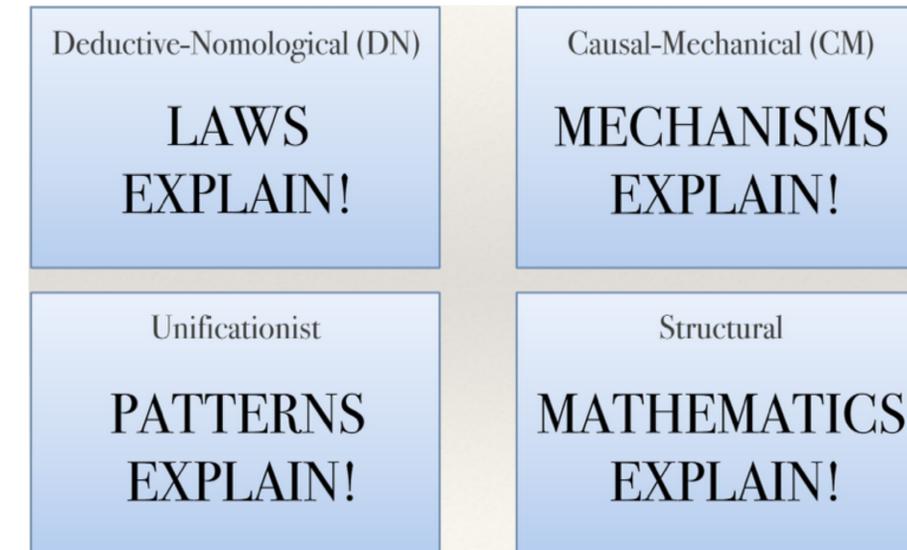
**Two** different approaches to this "problem" of pessimism:  
 1. Take this grand pessimism merely as opportunity to refine current techniques and **innovate** new ones  
 2. Maybe past isn't wholly inaccurate and we can still use pieces of it to **progress** to the future

This summer we applied these approaches by analyzing **(1)** how each of the mechanical models worked, and **(2)** how they offered legitimate scientific explanations.

## Works Cited

[1] Hunt, B. (2005) *The Maxwellians*, Cornell University Press.  
 [2] Siegel, D. (1991) *Innovation in Maxwell's Electromagnetic Theory*, Cambridge University Press.  
 [3] James Clerk Maxwell Foundation. (2014) University of Cambridge.  
 [4] Woodward, James. (2011) "Scientific Explanation," *The Stanford Encyclopedia of Philosophy*.  
 [5] Bokulich, A. (2011) "How scientific models can explain," Synthese.

## Four Types of Scientific Explanation



## Where To Go From Here

Looking back into the history of these mechanical aether models has given us a new "**intertheoretic**" form of explanation that can in general bring innovations to modern science and engineering.

For instance, we currently have two powerful, but distinct theories that hope to explain natural phenomenon (Quantum Mechanics and General Relativity) that are **completely inconsistent**.

By using this new account for scientific explanation, we can potentially **bridge the gaps** between these two theories.

Furthermore, by making such progress in theoretical physics, we can **push the bounds** of what is possible, when we, as both scientists and engineers, continue to **imagine innovation and invention** into the future...