

Lecture VI

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Faraday's story

- Faraday tried to find unity between the forces of electromagnetism and of light.
- He conjectured that magnetizing glass can affect the transmission of light in it.
- He was able to demonstrate it experimentally, but unable to find a theoretical explanation.
- That was done by others (the Faraday effect).

Levels of theory

- 1 Motivated by theological ('philosophical') ideas, Faraday speculates that there must be unity among different natural forces.
- 2 Faraday uses Brewster's analogy (that strain can affect light's properties) in his initial experiments.
- 3 An *ad hoc* mathematical representation is provided.
- 4 A mechanical model is provided.
- 5 Maxwell gives a formal analysis within the electromagnetic theory.
- 6 Lorentz integrates it within the electron theory (electrons are responsible for rotating light beams).

Theory and application

- Theoretical results ('paradigms') are not testable.
- They must be further articulated to become a tool in puzzle-solving (Kuhn).
- So there is a three-stage process of speculation, calculation, experiment.
- The point of calculation is to build a bridge between theory and observation.
- (Examples from ethics.)

Models

- Models are intermediaries between theory and phenomena.
- Models are approximations of the theory **and** of the universe.
- Cartwright: models are the only available representations of phenomenological laws. Science develops by preserving models (sometimes at the cost of dumping speculative theories).