

Einstein's Ph D Thesis

Tuesday, Jan 11, 2005 1:30 - 2:45 PM

Einstein's first advisor was Dr. Weber. He found that Dr. Weber's lectures were very traditional, lost interest, and stopped attending after two weeks.

As his Ph D project, Einstein proposed measuring "c" using an interferometer, similar to the Michelson-Morley experiment, of which he did not know at the time. Weber rejected the proposal. Next, Einstein proposed investigating the effect of heat on the electrical conductance of a material. Rejected again. Then, Einstein did some standard work on heat conduction, and wrote up the results as a dissertation. Weber rejected it because it had been written on the wrong kind of paper. Einstein chose not to rewrite it on the required paper, and it is lost to history.

Einstein's next advisor was Kleiner at Zurich Polytechnic in 1901. Einstein proposed the extension of intermolecular force theory from liquids to gases. He wrote a dissertation and submitted it to Kleiner. Kleiner delayed reading the thesis for several months, and then rejected it because it contained remarks critical of Boltzmann and others. Einstein withdrew the thesis.

In 1905 Einstein approached Kleiner with a thesis on the electrodynamics of moving bodies. It was rejected because a) the professors who reviewed it didn't really understand it, and b) it was purely theoretical in nature.

Later in 1905 Einstein submitted another dissertation which presented his results on measuring the molecular dimensions of sugar molecules. It was rejected for being too short. According to Einstein's sister, he then added one sentence, and resubmitted it. It was reviewed by Kleiner and Burkhardt, and accepted.

Einstein sent the thesis for publication in Annalen der Physik, but it was returned because better data was now available. Einstein added an addendum based on the new data. The thesis was published.

Experiments by others showed a discrepancy in Einstein's conclusions. Einstein could find no error. He asked a friend to check his calculations, and the friend found an error. Einstein published a correction.

One of the reasons for Einstein's difficulties stemmed from the fact that atomistic ideas were not fully accepted by the academic world until about 1910.

In 1905 and early 1906, he published five papers:

The Photoelectric Effect

Brownian Motion

Electrodynamics of Moving Bodies (Special Relativity)

$$E = mc^2$$

Molecular Dimensions

The last is the paper most cited in the literature.

Brownian motion resulting in Brownian coagulation is responsible for the true Blue Moon (not the numerological Blue Moon, which is simply a second full moon within a calendar month). The first real Blue Moon dates to the 1882 explosion of Krakatoa. Dust in the air produced optical scattering effects, resulting in both a Blue Sun and a Blue Moon. Small particles produce Rayleigh scattering, which explains the blueness of the sky, and the redness of sunset and sunrise. Larger particles produce a forward scattering effect called Mie scattering. Since the blue end of the spectrum is scattered the most, the sun and moon appear blue. Fine particles from Krakatoa moved in the atmosphere due to Brownian motion, and coagulated into larger particles, called Brownian coagulation. This narrowed the size distribution of the dust particles and resulted in Mie scattering, producing the observation of the Blue Sun and Blue Moon.