

Walther Nernst, Albert Einstein, Otto Stern, and the Specific Heat of Hydrogen

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In 1911, the German physical chemist Walther Nernst observed that the new quantum theory might both clarify unresolved problems in the specific heats of gases and shed new light on quantum theory itself. He noted that measurements of the specific heat of hydrogen gas at low temperatures might be particularly informative. Arnold Eucken, working in Nernst's laboratory in Berlin, published the first measurements in 1912. They showed a sharp drop, corresponding to the rotational degrees of freedom "freezing out." Nernst also developed a theory in his 1911 paper, in which, remarkably, rotational energies were *not* quantized. Instead, the specific heat fell off because the gas was in equilibrium with quantized Planck oscillators. Nernst's theory was flawed. But Einstein adopted an improved version at the 1911 Solvay Conference, and in 1913, he and Otto Stern published a more detailed treatment, in which they suggested tentatively that Planck's recently introduced zero-point energy might reduce or even eliminate the need to quantize physical systems. This episode points out just how mysterious quantum phenomena seemed early in the 20th century.