

## The rotational specific heat of molecular hydrogen in the old quantum theory

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“Astonishing successes” and “bitter disappointment”: Thus did the German physicist Fritz Reiche portray the state of quantum theory in his 1921 text. His words apply in miniature to early descriptions of the fall in the specific heat of hydrogen gas at low temperatures—among the first systems studied in the old quantum theory. The earliest measurements were made in 1912 by Arnold Eucken in Walther Nernst's laboratory in Berlin. The possibility of applying a theory of quantized rotators to diatomic gases had emerged even earlier, at the first Solvay conference in 1911. Eucken's experiment was the first of many. Paul Ehrenfest, Erwin Schrödinger, Edwin C. Kemble, and John Van Vleck, among others, attempted theoretical descriptions of the rotational specific heat, as did Reiche himself in a widely cited 1919 paper. Despite these efforts, the problem proved intractable—its explanation involves identical particles in ways unsuspected before modern quantum mechanics. Nevertheless, the older theory worked reasonably well to describe the infrared spectra of other diatomic molecules. I will sketch the history of this intriguing problem in early quantum theory.