



## Joule in the Crown



Energy is measured in joules, in honour of the English physicist and brewer James Joule. He spent much of his life studying heat and famously made the link between mechanical work - the act of doing something and the production of heat as a by-product. Joule's father was a wealthy and famous brewer of beer. Due to his wealth he was able to pay for James to be tutored by a famous scientist called John Dalton. Dalton was famous due to his studies of the structure of atoms and his research into colour blindness. As an adult James managed his father's brewery, all the while carrying out experiments on electric motors and the amount of heat that they produced. His idea, that much of the energy produced in an electric motor was lost as heat, was not readily accepted. This was because he wasn't a scientist nor was he studying at University (he conducted his experiments at his home and in the brewery). Also, the theory of heat at the time (which Joule was disproving) had been proposed by a respected, established scientist. This meant that he had to work extra long and hard to prove to the scientific community that his ideas were correct. Even though atoms and molecules were not yet understood, Joule proposed that heat was due to the movement (kinetic energy) of particles, an idea that is now readily accepted.

Joule worked closely with Lord Kelvin (another famous mathematical physicist and engineer) and together they even attempted an experiment on Joule's honeymoon. They looked at whether the temperature at the bottom of a waterfall was greater than that at the top. The experiment was unsuccessful due to the water breaking up into fine spray. The two men worked together for many years with Joule conducting experiments and sending his results to Kelvin for analysis and interpretation. They developed the absolute scale of temperature which includes absolute zero a temperature determined to be  $-273.15^{\circ}\text{C}$ . Based on the International System of Units (SI Units) the symbol for joule is a capital J, as it comes from a person's name. However the word joule (in reference to the name of the unit) is spelt with a lower case j.

1 joule of energy is equal to...

- The electricity needed to light a 1 Watt LED bulb for 1 second.
- The heat needed to raise the temperature of 1 g of water by  $0.24^{\circ}\text{C}$ .
- The amount of energy released as heat by a resting person every 60<sup>th</sup> of a second.

There are two scientific ideas known as Joule's Laws that he established. The first relates to the equation  $Q = I^2.R.t$  which means that the amount of heat produced (Q) is related to the amount of electric current (I), the resistance in the object (R) and the time the current runs for (t). The more current, resistance and longer it is run, the more heat produced.

The second law of Joule's states that the internal energy of a gas does not change if volume and pressure change but it does change if temperature changes. This means that the amount of energy in a gas only changes if the gas is heated or cooled. If the gas is heated, the amount of energy within the gas increases and if it is cooled it decreases.

Joule won many awards and was bestowed many honours for his great work on heat and the development of his theories around the relationship between work and heat. His work also led to the development of the Law of Conservation of Energy and our modern understanding of how energy is transformed.

Joule died in his home on 11<sup>th</sup> October 1889 at the age of 70. He left behind a lasting scientific legacy and his family's brewery still exists today.