



Cyprus
University of
Technology

Faculty of Mechanical
Engineering and Materials
Science and Engineering

Master's Thesis

**The Joule Experiment: Unravelling the production of
degraded heat in the most prolific spontaneous process**

Konstantinos Panagiotou

Limassol, May 2022

CYPRUS UNIVERSITY OF TECHNOLOGY

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Approval Form

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Signed:



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ABSTRACT

Joule performed an experiment which involved filling a copper vessel with a gas at some pressure and connecting this vessel via a stopcock to a similar but evacuated vessel. The two-vessel system was immersed in a quantity of adiabatically contained water and the stopcock was opened, thus allowing free expansion of the gas into the evacuated vessel. After this expansion, Joule could not detect any change in the temperature of the system.

The purpose of this analysis is to present the outcome of an everlasting, intense and agonizing effort to physically understand a prototypical spontaneous process such as the one involved in the Joule experiment with the ultimate intent to establish the means needed to simulate and control the equilibrium state of any spontaneous reactions as it evolves in real time. The following analysis will investigate the production of degraded heat in the Joule experiment unravelling the sequential production of degraded heat through the most prolific spontaneous process.

This analysis will execute different simulations of the actual experiment such as using the volume as an independent variable, using the pressure as an independent variable and through an isothermal reversible process to quantify the production of degraded heat within the system.

Based on the analysis, a conclusion of great significance comes up. For now, though, it will simply suffice to say that, through the use of the infinitesimal changes of volume, we managed not so much to invent a tool that quantifies the loss of mechanical energy as the system moves from one instantaneous state to the next, but to finally pull out from the darkness and obscurity the origin of the mechanical energy that keeps being degraded while the magnitude of the temperature and internal energy remain unscathed.