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Julius Robert von Mayer
(25 November, 1814 – 20 March, 1878)

Julius Robert von Mayer made one of the most fundamental discoveries in physics. Besides his law of the conservation of energy, in 1842 he described the vital chemical process now referred to as oxidation as the primary source of energy for any living creature. His achievements were overlooked and priority for the discovery of the mechanical equivalent of heat was long attributed to James Joule in the following year.

He was born in Heilbronn, then in the Kingdom of Württemberg. It is now in Baden-Württemberg, one of the states (Bundesland) in the German Federation. His father was a pharmacist. Even as young child, Mayer showed an intense interest with various mechanical mechanisms, and as a young man he performed various physical and chemical experiments. One of his favourite hobbies was creating various types of electrical devices and air pumps.

After completing his Abitur, Mayer from May 1832 studied medicine at the Eberhard-Karls-Universität Tübingen, where he was a member of the student corps Corps Guestphalia. In 1837, he and some of his friends were arrested for wearing the colours of a forbidden organization. The consequences for this arrest included a one year expulsion from the college and a brief period of incarceration.

In 1938 he passed the Staatsexamen and obtained his medical doctorate from the University of Munich. Mayer then travelled to Switzerland, France, and the Dutch East Indies. After his stay in Paris 1839/1840 he became a ships physician on a Dutch three-mast sailing ship for a voyage to Jakarta. His observation that storm-whipped waves are warmer than the calm sea sparked deep thinking about the laws of nature, in particular about the physical phenomenon of warmth and the question: whether the directly developed heat alone or whether the sum of the amounts of heat developed in direct and indirect ways contributes to the temperature.

On this voyage he also observed the light red venous blood from the numerous bloodlettings on the crew. Venous blood carries less oxygen than arterial blood. It runs darker. The first time Mayer opened a vein in Djakarta, blood ran far too red. He thought he'd hit an artery. Then he found that this is normal in the tropics. He concluded that in warm climates the body needs less energy to maintain body temperature. People burn less of the food they eat. They generate less heat.

In 1841 he settled in Heilbronn to practice medicine, and married. However, physics became his new passion. In June of 1841, he completed his first scientific paper entitled, "On the Quantitative and Qualitative Determination of Forces." It was submitted to Johann Christian Poggendorf's (1796-1877) Annalen der Physik.

In this paper, Mayer postulated an Erhaltungssatz der Kraft, by which he meant a conservation law for energy. However, owing to Mayer's lack of advanced training in physics, it contained some fundamental mistakes and was not published. Mayer continued to pursue the idea steadfastly and argued with the Tübingen physics professor Johann Gottlieb Nörremberg, who rejected his hypothesis. Nörremberg however, gave a number of valuable suggestions on how it could be examined experimentally. If kinetic energy transforms into heat energy, water must be warmed up by vibrating.

Mayer not only performed this demonstration, but determined also the quantitative factor of the transformation, the mechanical equivalent of heat. The result of his investigations was published 1842 in the May edition of Justus von Liebig's Annalen der Chemie und Pharmacie. In his booklet Die organische Bewegung im Zusammenhang mit dem Stoffwechsel (The Organic Movement in Connection with the Metabolism (1845) he specified the numerical value of the mechanical equivalent of heat: at first as 365 kgf•m/kcal, later as 425 kgf•m/kcal; the modern values are 4.184 kJ/kcal (426.6 kgf•m/kcal) for the thermochemical calorie and 4.1868 kJ/kcal (426.9 kgf•m/kcal) for the international steam table calorie.

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This relation implies that work and heat are equivalent to each other and are different forms of energy which can be transformed. This law is called the first law of the caloric theory and led to the formulation of the general principle of conservation of energy, definitively stated by Hermann von Helmholtz in 1847.

Mayer was also the first person to describe the vital chemical process now referred to as oxidation as the primary source of energy for any living creature.

Mayer later received the position of Oberamtswundarzt and city physician in his native town of Heilbronn. However, misfortune caused him to become mentally ill. This was caused by the loss of two of his children in rapid succession in 1848, the political events of 1848/1849, and most of all because of his lack of recognition; his well-deserved credit was given to James Joule. On May 18, 1850, he attempted suicide and was committed to a mental institution. He spent the period from 1852 to September 1853 hospitalized in the mental asylums at Göppingen and Winnenthal, where he was treated with old method of compulsory chair and straitjacket. He spent thirteen months there before he was released in 1854. He then experienced the satisfaction that his discovery was recognized in all the important circles. When he was released in 1860 he was a broken man and only timidly re-entered public life.

In the meantime, his scientific fame had grown and he received a late appreciation of his achievement, although perhaps at a stage where he was no longer able to enjoy it. However, he continued to work vigorously as a physician until his death. Mayer was awarded an honorary doctorate in 1859 by the philosophical faculty at the University of Tübingen. His overlooked work was revived in 1862 by fellow physicist John Tyndall in a lecture at the London Royal Institution.

In July of 1867, Mayer published Die Mechanik der Warme. This publication dealt with the mechanics of heat and its motion. In November of 1867, Mayer was awarded personal nobility (von Mayer) which is the German equivalent of a British knighthood. He received numerous awards of honour from academies and universities; he was raised to personal nobility, and in 1869 received an honourable invitation to lecture at the Naturforscher-Versammlung in Innsbruck.

His early works were printed at his own expense in order to maintain his views. In all of his works Mayer maintains the indestructibility of energy, and the equivalence of heat and work, a principle he shrewdly applied also to astronomy and the physiology of man. Mayer was the first person to develop the law of the conservation of energy. This is one of the most significant achievements in the history of physics.

Julius Robert von Mayer died from tuberculosis on March 20, 1878 in Germany.

The Robert-Mayer-Gymnasium and the Robert-Mayer-Volks- und Schulsternwarte in Heilbronn bear his name.