Biography: Sir Benjamin Thompson, Count Rumford

Much of what we know today about heat began with the ideas of Count Rumford which he developed in the late eighteenth century in Munich, Germany. That, however, is not all for which Rumford is famous. He originated the study of human nutrition and the insulating properties of clothing, created the soup kitchen, and invented thermal underwear, the coffee percolator, the kitchen oven, and central heating, to mention but a few of his many innovations. Rumford was not born with that name and not in Germany. In 1753, in the town of Woburn, Massachusetts, USA, Ruth and Benjamin Thompson became the proud parents of a baby boy, whom they named Benjamin. This biography is about Benjamin who, at the age of 39, became Count Rumford of the Holy Roman Empire.

Benjamin's father died when the child was only two years old. His mother's hasty remarriage provided Benjamin with a stepfather whom he disliked. Fortunately, unlike most other children his age, Benjamin was sent to grammar school at age eight. By age 13, having acquired a mastery of advanced algebra, geometry, astronomy, and even higher mathematics, he left school and was sent to a nearby town to learn a trade, as an apprentice. He tried many different jobs, but none of them held his interest. He spent most of his spare time conducting experiments on electricity and gunpowder and creating inventions.

The young Ben, as his mother called him, was different from other children his age, and the passions and habits he developed at that time contributed to his becoming a great scientist later in life. Benjamin meticulously organized all the details of his life, from his daily schedule, accounting for every hour of the day, to his expenses, keeping a record of every purchase he made for his experiments. Moreover, he was keenly interested in science and liked to invent machines and to study from science books. His scientific exploits, too, were always organized and practical.

Finally, at age 18, his apprenticeships ended when he was offered a job as a schoolmaster in Concorde, New Hampshire. There he met the wealthy widow, Sarah Walker. With Sarah's encouragement, the two were soon married, thereby considerably raising the social status of Thompson. Sarah bought Benjamin a flashy crimson coat, and they travelled in a fashionable, two-horse carriage. Through his newfound status, Thomson formed an association with the Governor that culminated in him being appointed a major in the New Hampshire military at 19 years of age.

Military life in 1773 was dangerous and tense. War was brewing between the British and Americans, which eventually resulted in the American Revolutionary War. Both civilians and the military were choosing sides. During his time, Thompson began spying and recruiting for the British in New Hampshire and was the first person to use invisible ink as he passed information to the British. Local activist groups fighting against British rule accused him of being a British spy and pursued him. When an angry mob came to his home, he was already well on his way to Boston. Soon, it grew too risky for British loyalists to remain in America, and, in April of 1776, Thomson was evacuated to London, England. He left his wife and two-month-old daughter behind. As he had never developed a close bond with his wife, his departure proved to be the end of their marriage.

In London, Thompson supplied military intelligence to the British and was rewarded with a salaried position at the level of Lieutenant Colonel in the British army, which involved no work. He used his leisure time to pursue scientific experiments for the military. Over the next few years, he invented a device for measuring the power of gunpowder, which was used for over a century. He also performed experiments to determine the recoil of guns in different situations. The income of his position, however, was not sufficient, and Thompson made plans to venture to the European continent in search of military opportunities and advancement. In preparation for his departure from Britain in 1783, he successfully lobbied for promotion to full colonel and, with his splendid new, crimson uniform, travelled to Strasbourg as a staging point for his ambitions. It so happened that a military review was taking place in Strasbourg when he arrived in September, affording him the opportunity to present himself in his full regalia. The reviewer of the parade, the nephew of the Elector of Bavaria, was so impressed with Thompson that he invited him to Munich with a letter of introduction to the Elector. Through a series of efforts on Thompson's part, he first secured a knighthood from the King of England and then an entry-level military position from the Elector in Munich.

Sir Thompson devised a comprehensive reform plan for the military in Bavaria. In 1789, he presented the plan, which was not only accepted but resulted in his promotion to the rank of major general and appointment to the Bavarian Privy Council. Thompson's plan addressed two of the biggest expenses that any military has in peacetime—food and clothing. In an effort to save money, he began to conduct experiments to find the cheapest and most efficient way of providing food and clothing. He also started a clothing workhouse to produce clothing for the military. The impressed Elector rewarded Thompson's efforts by conferring on him the title of Count Rumford of the Holy Roman Empire.

Thompson's first experiment involved testing different types of material to determine how well they conduct heat. To do so, he placed the material he wished to test around a hollow, metal cylindrical container that was closed at both ends, except for a hole at one end. He mounted the container on a wooden stand and filled it with hot water nearly at the boiling point, then inserted the end of a thermometer through a stopper in the hole so that it extended to the center of the container. Then, he measured the amount of time it took for the thermometer to cool from 21° to -12°C. The experiment told him how quickly heat left the material and, thereby, which materials he should use to clothe the army.

The goal of his second experiment was to create the most cost-effective and nutritious soup to feed the military and the workers in the clothing-production workhouse. Using low-cost ingredients, such as potatoes and barley, he began a long series of tests with farm animals to see which combinations of ingredients kept the animals healthiest with the lowest costs. Eventually, every meal fed to the employees at his workhouse was a kind of soup. His soup recipes were very specific, and his attention to detail was very evident in every recipe, recording the cooking time, ingredient preparation, and utensils used. His work was some of the first in the science of nutrition, and Rumford Soup became famous throughout Europe and can still be found in modern cookbooks.

Another area of science that fascinated Rumford was the theory of heat. At the time, scientists thought that heat was a fluid-like substance, called caloric, which entered an object when it was warmed and left when it cooled. The hotter the object, the more caloric fluid it had. This fluid, according to the caloric theory, could not be created or destroyed. Since this fluid had volume, objects expanded when heated and contracted when cooled. Rumford's observations contradicted the theory of caloric, and he set about trying to disprove it.

Through his role in the military, Rumford had noticed that intense heat was created during the process of cannon boring, in which a large hole is drilled into a cannon to create the cannon barrel. According to caloric theory, the metal from the cannon should eventually run out of caloric and stop producing heat. In his most famous experiment, Rumford arranged for a cannon to be bored under water, with a blunt drill. After two-and-a-half hours, the water began to boil. Since heat kept getting produced by the cannon-boring process and its production did not drop or stop over time, Rumford argued that heat could not be a caloric fluid.

Rumford also investigated whether or not heat had weight. For this experiment, he used three nearly identical glass bottles. He filled one bottle halfway with water, a second bottle with an equal amount of wine, and a third with mercury. After sealing the bottles, he added weights to make them all exactly equal in weight. He then placed the bottles on a balance in a room with a consistent temperature of 16°C. Once the bottles and their contents had reached that temperature, he moved the balance to a much colder room. After two days, he measured the bottles to find that, even with the water frozen, they were all the same weight as before. He moved the balance back into the warm room and allowed the ice to melt. Based on the heat lost in the first bottle during freezing, different amounts of caloric fluid should have left each bottle; yet, after returning to room temperature, their weights remained exactly the same. With this experiment, Rumford concluded that heat does not have weight.

In the last twenty years of his life, Rumford continued to make new inventions and improve upon existing ones. He invented the modern fireplace and chimney, the double boiler, a portable stove, and the drip coffeepot.

Count Rumford died suddenly of typhoid fever on August 21, 1814, at 62 years of age, leaving a monumental legacy. He helped remove beggars from the streets by inventing the soup kitchen and feeding soup to the poor of Bavaria. Most notably, he created the public park, the first and most famous of which is the English Garden in Munich, still serving as a place of public enjoyment to this day.

References

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