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Abstract: The article reviews the early life chemist Antoine Lavoisier. According to the author, Lavoisier's discovery of oxygen destroyed the "plogiston" theory of combustion and helped to bring chemistry out of the realm of the unknown and into the world of science. The author reviews Lavosier's family life and upbringing in Paris and the development of his career in science.

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Antoine Lavoisier

Background and Early Life

French chemist Antoine Lavoisier is regarded as the founder of modern chemistry. His discovery of oxygen destroyed the "phlogiston" theory of combustion, and helped to bring chemistry out of the realm of the unknown and into the world of science. In addition, he developed a chemical nomenclature, defined what an element is, and studied the nature of chemical compounds. He is also credited with the law of conservation of mass, which states that chemical reactions do not either create or destroy mass.

Lavoisier conscientiously tried to apply the results of science to benefit the people. He supported the cause of reform in France, and helped reform the country's system of taxation. Because he was a tax collector and a member of the aristocracy, he was guillotined during the French Revolution.

Antoine-Laurent de Lavoisier was born in Paris on August 26, 1743, the first child of Jean Antoine and Emilie Punctis Lavoisier. His father was a lawyer and a member of the prestigious Order of Barristers. The Lavoisier family had risen from humble origins through service to the kings of France. His grandfather was Clement Punctis, another member of

the Order of Barristers.

Antoine's sister, Marie Marguerite Emilie, was born in 1745. Their mother died when Antoine was five years old. Their father, though only in his early thirties, never remarried. Instead, the widower moved in with his children's maternal grandmother, also recently widowed. Antoine's twenty-two-year-old aunt, Marie Marguerite Constance Punctis, remained unmarried to help raise the youngsters. The family was tightly-knit, and Antoine had an especially close relationship with his father. The death of Antoine's sister at the age of fifteen drew the family closer together.

When he was eleven years old, Lavoisier entered the College des Quatre-Nations, more commonly known as Mazarin College in honor of Cardinal Mazarin (1602-1661), who founded it. Initially, Lavoisier wanted to be an author, and he won several awards for his compositions in French, Latin and Greek. He also submitted several essays in provincial competitions. His literary dreams, however, soon gave way to an interest in science.

Lavoisier had to choose a profession, so upon leaving Mazarin College, he entered law school. He earned his bachelor's degree when he was seventeen, and his licentiate (master's degree) the following year. That same year he was admitted to the Order of Barristers.

Even as a student, Lavoisier had a tendency to risk his safety for science. At one point, he decided to test the effects of diet on health. He proposed to ingest nothing but milk for a month. A friend sent him some gruel with a letter reminding Lavoisier that it was better to live than to be remembered as a great dead man.

At the same time Lavoisier was studying law, he took science courses from leading teachers. After completing his studies, he worked with botanist Bernard de Jussieu, and for a few years with geologist Jean-Etienne Guettard.

On his expeditions with Guettard, Lavoisier gathered specimens and assembled geological and mineralogical data. He used a barometer to measure mountain heights, and he observed the inclination of mineral strata.

Experiments in Combustion

In Lavoisier's first original research, conducted when he was twenty-one years old, he demonstrated that when gypsum is heated, it loses water. When recombined with water, the mineral re-crystallizes to form plaster. This proved that water could be fixed in solids.

The research was finally published in 1768. That year, Lavoisier was a candidate for the French Academy of Sciences. The vacancy, however, was awarded to Gabriel Jars, an older man. Jars died a year later, and Lavoisier was appointed to replace him.

When his grandmother died, Lavoisier used his share of the inheritance to buy a half-share in the Ferme Générale. This private tax-collecting agency paid the Crown for the right to collect taxes. The difference between monies collected and taxes submitted to the Crown provided a lucrative living for the collectors, or "fermiers généraux."

With the proceeds from his position as a fermier, Lavoisier furnished his own laboratory and several others. One of his partners in the Ferme Générale was Jacques Alexis Paulze, a widower. Lavoisier, twenty-eight years old, and Paulze's thirteen-year-old daughter, Marie-Anne, became friends despite their age difference. The fifty-year-old Count de Amerval, who had powerful friends, had asked to marry Marie-Anne, and Paulze was

looking for a way out. He proposed that Marie-Anne and Lavoisier should marry. The young couple wed soon after.

Lavoisier's father bought the couple a house and bought his son the position of King's Secretary, which included a title. Lavoisier rarely used the title, though. The marriage was evidently a happy one, though the couple never had children. Marie-Anne studied English and chemistry in her teen years. She also studied art with Jacques-Louis David, who was later commissioned to paint a portrait of the couple.

With this knowledge, Marie-Anne assisted her husband in his work. She translated scientific books, wrote schedules for chemical experiments, drew detailed pictures of the apparatus used, and took notes on the experiments. She also ran a popular intellectual salon.

In 1772, the year after their marriage, Lavoisier began experiments in combustion and calcination (rust). He noticed that metals that were calcinated first gained weight, then lost it as they were reduced to rust powder. He realized that the weight gain was caused by the absorption of air into the metal. The weight lost during reduction, then, must be caused by the release of air.

Testing his theory, Lavoisier burned various organic substances. He collected and weighed all the carbon dioxide and water produced by burning. These were the first experiments in quantitative organic analysis. Through these experiments, he was able to determine that a substance in air combines with burnable materials to cause combustion. He called this substance "oxygen."

The discovery of oxygen discredited the popular theory that burnable materials contained a substance called "phlogiston," which was lost when combustion occurred. Lavoisier's experiments with oxygen also demonstrated that water is composed of a combination of oxygen and hydrogen.

Marie-Anne Lavoisier translated Richard Kirwan's "An Essay on Phlogiston" into French so her husband could refute each section. Although her name is not on the first French edition, the later editions name her as translator.

Chemistry and Politics

As part of Lavoisier's duties with the Ferme Générale, he devised a chemical test to detect ashes added to tobacco by retailers to increase bulk. He also proposed that France's special tax on Jews be eliminated.

In 1775, Controller-General A.J.M. Turgot appointed Lavoisier to the Gunpowder Administration. Due in part to Lavoisier's improvements in the manufacture and delivery of gunpowder, France was able to send large quantities to the American colonies during the Revolutionary War.

In 1778, Lavoisier was made a pensioner (salaried member) of the Academy of Sciences.

Two years later, Lavoisier blocked the membership application of Jean-Paul Marat, an action that would lead to tragedy. Not long after that, the Ferme Générale began construction on a wall around Paris (the city's seventh) as a customs barrier.

Meanwhile, Lavoisier's chemical experiments continued. After studying respiration, he believed that oxygen combines with blood in the lungs and displaces air that is already

there. He also concluded that the combination of hydrogen and carbon compounds in the blood creates heat in the lungs, explaining how heat is spread throughout the body.

Also in 1778, Lavoisier bought an old farm so he could research ways to improve agricultural production on farms with poor soil and few animals. After nine years of experiments, he reluctantly concluded that because of the high cost of rehabilitating farmland, fiscal reform was required.

With Benjamin Franklin, Lavoisier designed and conducted experiments which discredited Anton Mesmer, who claimed to heal sick people through "animal magnetism." His name is the root of the modern English word "mesmerize."

Some of Lavoisier's experiments involved fermentation. He concluded that during fermentation, sugar is converted to carbonic acid gas (carbonation) and what he called "spirit of wine" (alcohol). He believed that putrefaction, or decomposition, was a form of fermentation. He found that putrefaction occurred more quickly in the presence of nitrogen and certain other elements. These studies were the beginning of organic chemistry.

In 1789, the year the French Revolution began, Lavoisier published "Traite de Chimie" ("Treatise on Chemistry"), listing all the known elements. Lavoisier defined an element as a substance that cannot be further analyzed, or broken down. Working with Guyton de Morveau and Fourcroy, he devised a new system of nomenclature for chemistry. Marie-Anne Lavoisier drew the watercolor sketches and engraved the thirteen copper plates used to illustrate the book.

Lavoisier was still hard at work in 1794, when Marat got revenge for Lavoisier's refusal to admit him to the Academy of Sciences. The young revolutionary accused Lavoisier of cutting off the circulation of air with the customs wall around Paris. A prominent political figure, Lavoisier was arrested with his father-in-law and twenty-six other members of the Ferme Générale, and was beheaded on May 8, 1794.

Marie-Anne Lavoisier spent sixty-five days in jail. Her husband's books had been confiscated. When she was released, she retrieved the books and made sure that they remained in print.

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By Ellen Bailey

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