

❖ ANTOINE LAVOISIER ❖

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FAMOUS
NAMES IN
CHEMICAL
HISTORY



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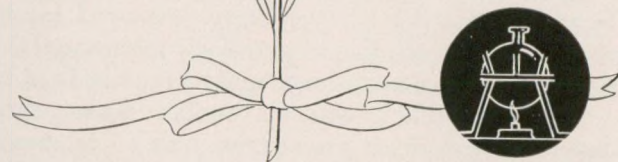
NAMES

IN

CHEMICAL

HISTORY

ANTOINE
LAVOISIER



LABORATORY AND PHARMACEUTICAL DIVISION
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ANTOINE LAVOISIER

“Father of Modern Chemistry”

“IT took but a moment,” wrote Lagrange, the great mathematician and member of the French Academy of Science, “to cut off his head, but another like it cannot be produced in a hundred years.”

This head, which rolled off the guillotine block of the French Revolution, was that of the “Founder of Modern Chemistry.” A head that had absorbed a prodigious amount of knowledge and had continued, up to the end, ever to seek more.

It was the head of a “rebel in science” who cared nothing for traditions or theories that were not based on facts. It was the head of Antoine Laurent Lavoisier—scientist and humanitarian—one of the greatest of all Frenchmen.

Ignorance and doubt, the evils that Lavoisier had fought all his life to overcome, destroyed his body. But they could never efface Lavoisier’s monumental contributions to the world of science and to chemistry in particular.

Priestley, Black and Cavendish made startling discoveries. But these discoveries had to be analyzed and explained—experiments had to be devised to prove them.

Only a great man could accomplish this task of making facts agree with theories. Such a man was Lavoisier.

Lavoisier found the true and modern explanation of combustion and blasted into oblivion the then universally accepted phlogiston theory which, incidentally, was the first general principle advanced in Chemistry.

He also worked out the law of the conservation of matter—that nothing is lost in the economy of this universe since the substances taking part in any chemical change equal in weight the products formed.

A third important contribution which Lavoisier made to present-day Chemistry was the development of the basic language of Chemistry.

Antoine Laurent Lavoisier was born in Paris, France, on August 26, 1743. The Lavoisier family had had a humble origin in Villers-Cotterets, birthplace of Alexander Dumas, but had risen gradually in the social scale.

The father of Antoine was a lawyer, who although without a fortune had married into a family of means.

Antoine started his studies in the field of law. Later, at the age of 20, he was attracted to mathematics and the physical sciences. His father then sent him to Mazarin College. There Antoine supplemented his schooling by tutoring in mathematics, astronomy and chemistry. His brilliant mind and his extremely serious and intense application to scientific study brought him fame at an early age. In 1768, he was admitted to the Academy of Science. Among his earliest scientific projects which gained him this honor were his suggestions for lighting the streets of Paris at night, for supplying fresh drinking water to the city, and for providing fire protection through a system of hydrants.

The bounds of his interests and investigations were practically limitless. How widely diversified his activities

were may be seen from his work in the fields of mesmerism, invalid chairs, divining rods, and currency that could not be counterfeited. In versatility he has been compared to Benjamin Franklin.

At about the same time that he won membership in the Academy of Science, Lavoisier took the step that eventually led to his execution on the guillotine. He joined the "Ferme General" (General Farm) as an assistant to the "Fermier General" (Farmer General) Baudon. The "Ferme" was a tax-collecting company. For a stipulated annual payment to the State of France, the "Ferme" was given the power of collecting all kinds of taxes—duty on salt, tobacco and imported goods, for example. All money collected in excess of the State's levy was kept by the Farmer Generals.

Such an assignment of taxing power led, naturally, to flagrant abuses by agents who imposed oppressive levies on the people. The excessive demands of the organization and the extravagance of many of its members caused adverse public opinion which grew into intense hatred.

It was to Lavoisier's credit, however, that he was serious in his duties connected with the "Ferme" and introduced many reforms to ease the hardships on the people from whom he collected taxes. He even experiment-



ed with scientific agriculture on a model farm, the results of which were of benefit to the surrounding farmers.

As an assist-

ant to Baudon, Lavoisier was given a one-third interest in the tax collections. His share in the profit supplemented considerably the income he was receiving from the moderate fortune inherited from his mother. Much of Lavoisier's income went into equipping his scientific laboratory and carrying on his experiments.

Lavoisier's marriage in 1771 to Marie Anne Pierette, the only daughter of Farmer General Jacques Paulze, was a most fortunate alliance. This gifted lady was a skillful artist and engraver. The plates for Lavoisier's "Traite de Chimie," published in 1789 were made by her. In many ways her association etched deep, lasting lines of helpful influence on his whole life.

Lavoisier directed his brilliant mind into experiments to prove, or disprove, long standing theories. His scales and balances and his confidence in them—for quantitative analysis by weighing—were the means of proving and establishing some of his most important contributions to Chemistry, one of which was the discovery of the true explanation of combustion.

For the greater part of the century prior to Lavoisier's time, the world had accepted the Phlogiston Theory of Combustion, which was advanced by Georg Ernest Stahl, one-time physician to the King of Prussia and which was based on the idea of a German chemist, Johann Joachim Becher. According to this theory, a combustible substance was thought to be composed of two parts—a calx (Latin: ash) and phlogiston (Greek: anything set on fire). During the burning process, phlogiston escaped giving a flame appearance while the calx remained.

The theory, however, could not satisfactorily explain the fact that a metal heated in air gained in weight. The explanation advanced was that the imaginary phlogiston possessed the property of negative weight. Thus, when a

body lost this buoyancy, it would weigh more. But, opposed to this was the fact that ashes from coal weighed less than the coal.

It was Priestley's discovery and isolation of oxygen in 1774 which led Lavoisier to his important explanation of combustion that exploded the false phlogiston theory.

While in Paris shortly after he isolated oxygen, Priestley explained to Lavoisier and other acquaintances his famous experiment of heating red mercury by a sun glass. "Dephlogisticated air" (air with the phlogiston removed), was the name Priestley had given to the gas that he had collected in a bottle placed over a trough of mercury. This air had shown most unusual properties, according to Priestley. When he had inserted a lighted candle in the bottle, the flame had burned brighter than ever.

Lavoisier repeated Priestley's experiment a month later, and followed it up with others to show how the "dephlogisticated air," which Lavoisier named "oxygen," was the chief supporter of combustion. In one of his classic experiments on combustion, he heated a quantity of tin for a considerable time in a sealed glass vessel, thus oxidizing the metal. He had weighed the container, including the tin, before the experiment; after the heating he again weighed the container and found no change in its weight had taken place. Upon opening the vessel, however, he heard the air rush in. The tin, he concluded, had absorbed something in the air inside the container. Then, upon weighing the vessel he found that it weighed more than before. The additional weight equalled exactly the increase in weight of the tin itself. He likewise discovered that the air from which the above "something" (oxygen) was removed would not support combustion.

Combustion, then, Lavoisier decided was the generation of heat and light by the combination of a substance with

oxygen. From this principle was developed the fact that oxygen entered into chemical combination with a metal or non-metal to form calces of metals and to produce acids. For this reason he called this most abundant element of the earth, this vital part of the air we breathe, "oxygen" from the Greek word which means "acid former."

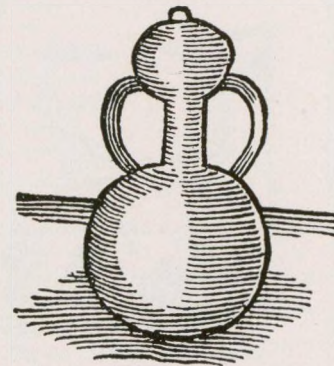
This theory of Lavoisier's, that chemical action takes place in combustion, disproved the phlogiston theory and led to the introduction of a new system of chemical nomenclature and a revised language of chemistry.

With three other scientists—Berthollet, de Morveau, and Fourcroy—Lavoisier worked out the system of chemical names which, almost unaltered, is still used. They gave us such words as oxide, sulfide, and phosphide to denote compounds of oxygen, sulfur and phosphorous. As a result of their work, we now use the various terminations of acids to denote their acidifying proportions, such as nitric and nitrous acids and sulfuric and sulfurous acids. Likewise, for the salts of these acids, we have nitrates and nitrites, sulfates and sulfites. Elements were named for their most characteristic properties.

The word "hydrogen," Lavoisier made up from the Greek word "Hydor," meaning water, with the suffix "gen," meaning to produce, because experiments proved to him that water was a compound of oxygen and the "water former" hydrogen.

Lavoisier also invented the word "caloric" for the agent which causes heat.

At various times of his life Lavoisier published volumes

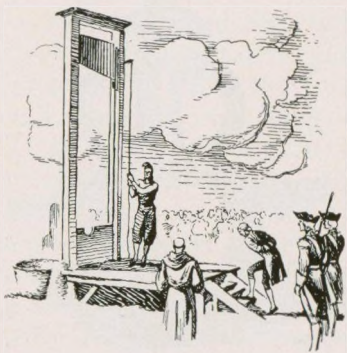


and papers setting down his experiments and observations. Among these publications are: *Memoirs of the Academy of Science* (1775), *Opuscles Physiques et Chimiques* (1774), and *Traite Elementaire de Chimie* (1789).

Still another of Lavoisier's quantitative analyses, which place him up front among the famous names in chemical history, was his investigation into the then current belief that water was transformed into earth. A description of this experiment is an excellent example of the thoroughness, the intensity, and the hard work which Lavoisier put into his research.

After having carefully weighed a glass vessel, he put water in it and applied heat to it. The water vaporized and rose to the neck of the vessel where it condensed and flowed back into the body of the apparatus. Night and day, for more than three months, heat was applied to the glass container. At the end of the period, the vessel was again weighed and found to have lost weight. The water, of course, had evaporated to dryness leaving a residue. The weight of this residue was found to equal exactly the loss of weight by the glass. Lavoisier's conclusion was that water, during the extended boiling, attached and dissolved a small part of the glass. By experiment Lavoisier destroyed another false belief.

Many of the tests by weight in Lavoisier's experiments, at the same time that they proved other truths, also showed that "all is saved and nothing is lost" in the quantitative economy of our universe. In other words, Lavoisier gave us the explanation of why the world



	Noms nouveaux.	Noms anciens correspondans.	
<i>Substances simples qui appartiennent aux trois règnes & qu'on peut regarder comme les élémens des corps.</i>	Lumière.....	Lumière. Chaleur. Principe de la chaleur.	
	Calorique.....	Fluide igné. Feu. Matière du feu & de la chaleur.	
	Oxygène.....	Air déphlogistiqué. Air empiréal. Air vital. Base de l'air vital.	
	Azote.....	Gaz phlogistiqué. Mofete. Base de la mofete.	
	Hydrogène.....	Gaz inflammable. Base du gaz inflammable.	
	<i>Substances simples non métalliques oxidables & acidifiables.</i>	Soufre.....	Soufre.
		Phosphore.....	Phosphore.
		Carbone.....	Charbon pur.
		Radical muriatique.	Inconnu.
		Radical fluorique.	Inconnu.
Radical boracique.		Inconnu.	
Antimoine.....		Antimoine.	
Argent.....		Argent.	
Arsenic.....		Arsenic.	
Bismuth.....		Bismuth.	
<i>Substances simples métalliques oxidables & acidifiables.</i>	Cobolt.....	Cobolt.	
	Cuivre.....	Cuivre.	
	Etain.....	Etain.	
	Fer.....	Fer.	
	Manganèse.....	Manganèse.	
	Mercure.....	Mercure.	
	Molybdène.....	Molybdène.	
	Nickel.....	Nickel.	
	Or.....	Or.	
	Platine.....	Platine.	
<i>Substances simples salifiables terreuses.</i>	Plomb.....	Plomb.	
	Tungstène.....	Tungstène.	
	Zinc.....	Zinc.	
	Chaux.....	Terre calcaire, chaux.	
	Magnésie.....	Magnésie, base du sel d'Épsom.	
	Baryte.....	Barote, terre pesante.	
	Alumine.....	Argile, terre de l'alun, base de l'alun.	
	Silice.....	Terre siliceuse, terre vitrifiable.	

moves along in its cycle of "dust to dust and ashes to ashes" and does not wear out. For in this cycle, the products formed in any chemical change are equal in weight to the substances taking part in it.

Lavoisier's life, too, had to complete its cycle. His end was a tragic one for so great a scientist and humanitarian. Yet it was the sort of ironic end with a trick quirk of fate—the sort of "trick of fate" ending that the French masters of literature have used so successfully in some of their fiction. All his life Lavoisier had been a revolutionist, a rebel whose experiments revolutionized the study of chemistry. Yet it was the revolutionists of France who executed him because they had "no need for scientists."

Being a revolter against theories and traditions not backed by facts, Lavoisier naturally held no sympathy for false doctrines and even showed contempt for the men who advocated them. Likewise, his acknowledged success as a scientist aroused some jealousy.

In 1789 the French Revolution began. In spite of the fact that Lavoisier was ready to work loyally for the new government, his enemies were endeavoring to undermine him. Marat, who had hoped to record his name among the famous men of science, had become a spokesman for the revolutionary mobs. He took every excuse to attack Lavoisier.

Fourcroy, a fellow Academician who had been associated with Lavoisier in developing the new and simplified nomenclature for chemistry, had succeeded in persuading the "Convention" to suppress the Academy of Science and confiscate the properties. Fourcroy even denounced Lavoisier as a counter revolutionist.

In addition to these personal enmities, hatred of the revolutionists for the Farmer Generals grew more intense. In March 1791, the Assembly abolished the General Farm.

Accusations against the former Farmer Generals multiplied. Lavoisier, with others, was arrested. Repeated pleas that he be permitted to continue his laboratory work were of no avail.

The Farmer Generals were accused of many offenses against the people of France and were brought to trial before Coffinhal, vice-president of the revolutionary tribunal. Defense was futile. They were speedily convicted.

It was then only a matter of hours before Lavoisier and his fellow Farmer Generals were on their way to the Place of the Revolution. Following his father-in-law, Lavoisier was the fourth to fall beneath the guillotine.

Lavoisier was not afraid to die. He faced his violent end with the serene nobility of the great man he was—one of the three or four greatest men France ever produced. He had lifted Chemistry to a place alongside mathematics, astronomy, and physics in importance.

"Chemistry is a French science," wrote Wurtz, "It was founded by Lavoisier of immortal memory."

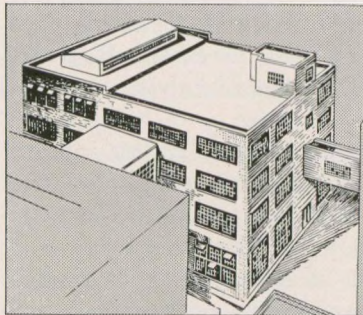
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CORNING

*Means
Research in
Glass*

“HE is twice tired who works without the right tools,” says an old proverb; and no one had better reason to know its truth than the early pioneers in chemistry.

For some two hundred years after the beginnings of modern chemistry, laboratory ware was made by hand and was very costly.

One of the most fundamental forward steps in the evolution of standardized laboratory glassware was the development, by Corning scientists, of heat resistant glass, following the outbreak of World War I.

The result was “PYREX” brand glassware—laboratory glassware that not only offered thermal resistance, but was chemically stable and mechanically strong.

Corning research in glass, however, did not cease with the development of “PYREX” Laboratory Ware. Recently, for example, Corning introduced the new “VYCOR” brand Laboratory Glassware fabricated from 96% silica glass No. 790. This newest research achievement is a glass of ultra-low expansion—the lowest of any commercial glass other than fused quartz.

And so, Corning Research carries on—on into new discoveries in glass—new improvements in specific apparatus—new economies in manufacture.



FAMOUS
IN
CHEMICAL
HISTORY

CORNING
means
Research in Glass

AMERICAN INVENTION