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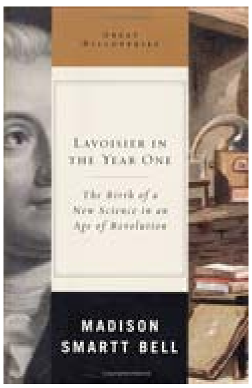
Lavoisier's Legacy

LAVOISIER IN THE YEAR ONE: The Birth of a New Science in an Age of Revolution, by Madison Smartt Bell, Norton/Atlas, 2005, 214 pages, $22.95 (ISBN 0-393-05155-2)

Reviewed By Philip Ball

Antoine Lavoisier concurred with the alchemists about one thing: There is power in naming. The victory of his new system of chemistry, in which oxygen supplanted phlogiston and the emphasis was less on what the elements were and more on how they combined, was secured by the masterful plan of renaming chemical substances so that one could not even talk about them without endorsing Lavoisier's view. He was not content to let chemistry assimilate oxygen, but proposed to reinvent the discipline with oxygen at its core.



And he was quite explicit about it. Of the system of names that he set out in his "Méthode de Nomenclature Chimique" in 1787, he said that chemists "must either reject the nomenclature or irresistibly follow the route it has marked." Needless to say, there were plenty who preferred the former course. Lavoisier's compatriot Jean-Claude de Lamétherie complained that only the consensus arrived at through general usage had the authority to replace old names with new ones. Outside of France, the opposition was even stiffer, often for unscientific reasons. "These names," said the Scotsman Joseph Black, whose "fixed air" (carbon dioxide) had been one of the key substances Lavoisier had struggled with in developing his oxygen theory, "have evidently been contrived to suit the genius of the French language."

Henry Cavendish, another of Lavoisier's British rivals, had a more reasonable objection. Imagine what state chemistry would fall into, he said, if everyone who had a new theory came up with a new system of nomenclature to go with it. Before long, the discipline would become a Tower of Babel, and no one would be able to understand anyone else.

Lavoisier's scheme nevertheless carried the day. And rightly so, for as Madison Smartt Bell explains in his new book "Lavoisier In the Year One: The Birth of a New Science in an Age of Revolution"--the curious title refers to the revision of the calendar by the French Revolutionaries--Lavoisier was proposing much more than an exercise in relabeling.

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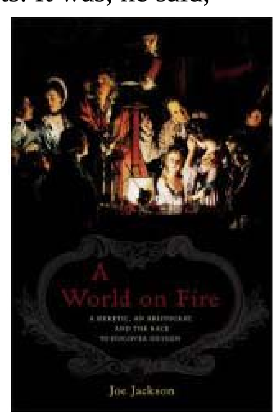
He wanted to do away with the arbitrariness of old chemical names, which were often more fanciful than informative: butter of antimony, flower of zinc. In its place would be a rational system that not only told you clearly what a compound contained, but also provided a framework for naming as-yet-undiscovered combinations of elements. It was, he said, "rather a method of naming than a nomenclature."

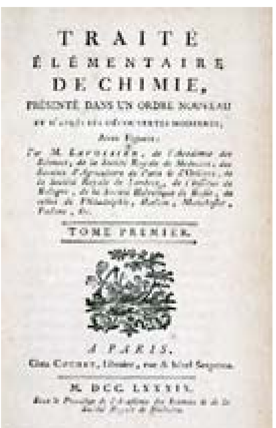


Antoine Lavoisier wasn't the only 18th-century chemist on the trail of oxygen. Five-time Pulitzer Prize nominee Joe Jackson explores whether Lavoisier or the English scientist Joseph Priestley can claim credit for the discovery in "A World on Fire: A Heretic, an Aristocrat, and the Race to Discover Oxygen," Viking, 2005, 432 pages, $27.95 (ISBN 0-670-03434-7).

Lavoisier's victory was not complete, at least outside of academic chemistry. Even today, one can (rather delightfully) buy from the hardware store "spirit of salts," which is the alchemical name for hydrochloric acid. Maybe it is appropriate that this is one of the substances to have resisted Lavoisier's revolution--not only because he himself knew it by another archaic term, muriatic acid, but because it was the Achilles' heel in his oxygen theory of acids. Oxygen means "begetter of acids," for Lavoisier believed this element to be the fundamental constituent of all acids. But there is none in muriatic acid, and Cavendish caused Lavoisier some discomfort by pointing that out.

Bell's short, intelligent account of Lavoisier's chemical revolution is one of the "Great Discoveries" series of books commissioned by W. W. Norton & Co. Other titles cover Einstein's theory of relativity, Gödel's incompleteness theorem, Rutherford's atom, and Darwin's evolutionary theory. It makes perfect sense to include Lavoisier in such a roster, but there are dangers in telling the history of science as a sequence of "discoveries." In Lavoisier's time, there was indeed much still to discover about the fundamentals of chemistry, but as Nobel Laureate Roald Hoffmann has pointed out, the subject has long been more about synthesis than discovery: more about combining the elements than discovering what they are.

But then, Lavoisier was never a typical chemist, as historian Mi Gyung Kim has convincingly argued in "Affinity: That Elusive Dream: A Genealogy of the Chemical Revolution." Lavoisier was inclined toward physics and mathematics, and complained that chemistry did not share their exactitude. Perhaps such outsiders are needed at the crucial stages of a field's advancement--Lavoisier's passion for precision led him to advertise the benefits of writing chemical changes in terms of balanced equations, of making careful measurements in his experimental work, and of formulating the first clear expression of the conservation of matter. He was a disciple of the Enlightenment enthusiasm for a "Newtonisation" of all the sciences, which led his colleagues Laplace, Condorcet, and Turgot to lay the foundations for a quantitative approach to sociology and economics.



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Lavoisier was also different because he was wealthy. Born into a bourgeois family, he rose to an essentially aristocratic status through his influential roles in the French government's tax authority and gunpowder administration. These associations were, of course, ultimately to precipitate Lavoisier's downfall during the French Revolution's Reign of Terror, but before that they enabled him to finance an elaborate laboratory, which gave him an advantage over his chemical competitors such as Joseph Priestley and Carl Wilhelm Scheele, both also on the trail of oxygen. Even back then, funding made all the difference.

But that was not the only reason for Lavoisier's success. His acute mind was coupled to a driving ambition, which saw him constantly scribbling semicoherent notes to the French Academy of Sciences to lay claim to his discoveries. Bell soft-pedals the common charge that Lavoisier was both arrogant and ruthless, but he artfully comments that the French chemist "took steps to protect the priority of his discoveries, somewhat in advance of actually making them."

Bell does a good job of showing just how difficult those discoveries were. The oxygen theory looks obvious now; but faced, for example, with the fact that wood, metals, and nitre behave so utterly differently when heated in air, it was hard to see how any single idea could make sense of it all. Phlogiston had its problems, but it was not without its virtues, and Bell illustrates that Lavoisier's path toward a better idea was tortuous and confused. That he got there in the end is a wonder, and a testament to a genius who unquestionably earned a place alongside Einstein and Darwin. He was no angel, but Lavoisier's untimely end among the shabby anarchy of the French Revolution is a reminder that science can still be noble in ignoble times.

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