

References and Notes

1. A similar expression, "the legacy of his achievement" is included in a valuable appraisal of Lavoisier's place in chemistry by A. Donovan, "Lavoisier and the Origins of Modern Chemistry", *Osiris*, **1988**, *4*, 214-231.
2. A. L. Lavoisier, *Mémoires de Chimie*, Vol. 2, Paris, 1805, p. 87. This work was published in 1805 by Lavoisier's widow. See W. A. Smeaton, "Madame Lavoisier, P. S. and E. I. du Pont de Nemours and the Publication of Lavoisier's 'Mémoires de chimie'", *Ambix*, **1989**, *36*, 22-30.
3. See B. B. Chastain, "Books of the Chemical Revolution. Part 1. Méthode de Nomenclature Chimique", *Bull. Hist. Chem.*, **1989**, *3*, 7-11. Chastain (p. 8) points out that the authors were listed in decreasing order of age, Guyton being the oldest.
4. A. F. Fourcroy, *Encyclopédie Méthodique, Chimie*, Vol. 2, Panckoucke, Paris, 1792, p. 54.
5. E. J. B. Bouillon-Lagrange, "Rapport sur les Progrès de la Chimie, et sur ce qu'elle doit aux Travaux de Lavoisier", in L. Scheler, *Lavoisier et la Révolution Française. I. Le Lycée des Arts*, revised ed., Hermann, Paris, 1957, pp. 66-76. The report originally appeared in 1796 in the very scarce *Journal du Lycée des Arts*.
6. M. Boas, "Structure of Matter and Chemical Theory in the 17th and 18th Centuries", in M. Clagett, Ed., *Critical Problems in the History of Science*, University of Wisconsin, Madison, 1959, pp. 494-512.
7. A. L. Lavoisier, *Elements of Chemistry*, trans. R. Kerr, Creech, Edinburgh, 1790 (facsimile reprint, Dover, New York, 1965), pp. 155-156.
8. *Ibid.*, p. xxiv.
9. R. Siegfried and B. J. T. Dobbs, "Composition: A Neglected Aspect of the Chemical Revolution", *Ann. Sci.*, **1968**, *24*, 275-293; R. Siegfried, "The Chemical Revolution in the History of Chemistry", *Osiris*, **1988**, *4*, 34-50.
10. D. I. Duveen, "Madame Lavoisier", *Chymia*, **1953**, *4*, 13-29.
11. For a full discussion of the caloric theory see R. Fox, *The Caloric Theory of Gases From Lavoisier to Regnault*, Clarendon Press, Oxford, 1971.
12. R. Siegfried, "Lavoisier and the Phlogistic Connection", *Ambix*, **1989**, *36*, 31-40 (especially p. 34). It was thought that the word "acidifiable" applied to metals was a mistake and that it should have read "salifiable", by J. R. Partington, *A History of Chemistry*, Vol. 3, Macmillan, London, 1962, p. 485. However, there is no doubt that this is one of the rare occasions when Partington was wrong.
13. Reference 7, pp. 289-290.
14. A. F. Fourcroy *Système des Connaissances Chimiques*, Baudouin, Vol. 9, Paris, 1800, p. 92.
15. T. Thomson, *A System of Chemistry*, 2nd ed. Bell and Bradfute, Edinburgh, 1804, pp. 3-4 (acids in general) and p. 183 (prussic acid).
16. In modern terms, muriatic acid is HCl and oxymuriatic acid gas is Cl₂. In solution, Cl₂ + H₂O → HCl + HOCl and on exposure to light 2HOCl → 2HCl + O₂.
17. A good account of the work on chlorine is given by J. R. Partington, reference 12, Vol. 4, pp. 51-55 (my quotation from p. 55).
18. W. A. Smeaton, "The Chemical Work of H. B. de Saussure, With the Text of a Letter Written to him by Madame Lavoisier", *Ann. Sci.*, **1978**, *13*, 1-16.
19. W. A. Smeaton, *Fourcroy, Chemist and Revolutionary*, Smeaton, London, 1962, pp. 136-138.
20. See three works by M. P. Crosland: *Les Héritiers de Lavoisier*, Paris, 1963 (a lecture delivered at the Palais de la Découverte); *The Society of Arcueil*, MIT, Cambridge, MA., 1967; and *Gay-Lussac, Scientist and Bourgeois*, Cambridge University Press, Cambridge, 1978.
21. A full account of Lavoisier's work on organic chemistry, with many references to his unpublished manuscripts, is given by F. L. Holmes, *Lavoisier and the Chemistry of Life*, University of Wisconsin, Madison, 1985.
22. Reference 19, pp. 136-176.
23. W. A. Smeaton, "Michel Eugène Chevreul", *Endeavour*, **1989**, *13*, 89-92.
24. Reference 2, *Mémoires*, p. 87.
25. The explosion was mentioned in a letter from Madame Lavoisier to Saussure, 2 January 1789, and is discussed in reference 18, pp. 11-13.
26. The du Pont correspondence is published by B. G. du Pont, Ed., *Life of Eleuthère Irénée du Pont from Contemporary Correspondence*, 11 Vols. + Index, Newark, Delaware, 1923-27. For a discussion of relevant extracts, see W. A. Smeaton, reference 2. In 1789 P. S. du Pont was elected to the Estates-General as a deputy of the Third Estate for the town of Nemours, about 90 kilometres south of Paris. After the French Revolution the family adopted the name du Pont de Nemours.

Dr. William A. Smeaton is member of the Department of History and Philosophy of Science at University College London, London WC1E 6BT, England. Best known for his biographical study of A. F. Fourcroy, he is interested in 18th century French chemistry and is currently studying the life and work of L. B. Guyton de Morveau, one of the first converts to Lavoisier's system.

LAVOISIER'S POLITICS

Arthur L. Donovan, U.S. Merchant Marine Academy

Antoine Lavoisier, one of history's greatest scientists, was also a prominent public administrator during the final decades of the Old Regime. Several of his involvements in public affairs are fairly well known. For years he served on commissions and committees of the Academy of Sciences, as a Director of the National Gunpowder Administration, and as a tax farmer

and financial advisor to the crown. His contributions to these activities all deserve further study and we must hope that in time administrative historians will undertake them. My goal in this brief paper is biographical, however. My purpose is to provide a sketch of what we might call Lavoisier's ethic of public service. How did he view his responsibilities as a citizen, a term that was widely used before the outbreak of political revolution, and to what extent did his personal ethics of public service reflect the political culture of his time? My subject, then, is Lavoisier the public administrator, not 18th century chemistry as such, nor the nature of his contributions to the revolution in which modern chemistry was forged.

Antoine Lavoisier was born into a well-to-do professional family. His father, while a young man, had come to Paris to study law, and in 1741 he had the good fortune to inherit an uncle's estate, which included a house and a position as barrister at the Parlement of Paris. A year later he married the well-dowered daughter of an attorney at the Paris law courts and she bore them two children before her own untimely death in 1748. Antoine, born in 1743, and his younger sister, who died while in her teens, were then reared by their father, at all times a devoted and attentive parent, and by a maternal aunt who lavished adoring care on the children.

Lavoisier's sense of his place in the world and of the opportunities open to him naturally reflected the circumstances of his youth. While many of the most notable writers and philosophers of the Enlightenment were bright provincial lads who had come to Paris to make their marks, Lavoisier was born and educated in the capital. His family, while well-off, had neither the landed wealth nor the taste for luxury displayed by the leaders of aristocratic society. And Antoine, as the scion of a prosperous but relatively new family in Paris, acquired and was guided by a powerful sense of responsibility, purpose and ambition. His vision of himself and his duties was therefore shaped far more by what he aspired to achieve than by the advantages he enjoyed. More specifically, the Lavoisiers belonged to the social group that historians now call the bourgeoisie of the Old Regime, a group made up primarily of lawyers, judicial officials, administrators, and technicians serving in royal or provincial administration. This service bourgeoisie was everywhere integrated into established society and, along with the service elite of the nobility of the sword, they formed the dynamic core of French public life (1). Service to the state, and the expectation of personal advancement through such service, were as much a part of Lavoisier's heritage as were his family name and his religion. His later commitment to science would have been unthinkable had it not provided an additional way of fulfilling this compelling vision of his responsibilities to family and nation.

What strategies did Lavoisier follow in seeking to fulfill his responsibilities and satisfy his ambitions? Today we think of him primarily as a chemist, but if we are to render his involvements in public affairs intelligible, we need to take a more



A late 19th century pen drawing of Lavoisier from the 1904 edition of A. Rebière's *La Vie et les Travaux des Savants Modernes*. Supposedly based on a painting by David.

comprehensive view of his interests. I therefore suggest that we not cast Lavoisier as a scientist, a term that in any case was not coined until the early 19th century, but rather as an 18th century philosophe who was especially interested in and adept at scientific investigation. He was, in other words, one of the independent-minded, politically-engaged men of letters committed to the program of cultural reform known then and now as the Enlightenment. Indeed, I would argue that Lavoisier should be thought of as one of France's foremost philosophes in the last generation to reach maturity before the collapse of the Old Regime.

The Enlightenment itself should be thought of as a program of reform that adapted to changing circumstances as it developed through time. When Lavoisier set out to make a place for himself in Paris, the Enlightenment had already achieved a high level of visibility and acceptance. Voltaire's *Philosophical Letters*, written from exile in England and designed to demonstrate the advantages of English liberalism and Newtonianism, was published ten years before Lavoisier's birth, and the first volume of Diderot's and D'Alembert's great *Encyclopédie* was issued when he was eight years old. Thus by the time Lavoisier arrived at center stage, the high Enlightenment's program of naturalism in science, literature, art and manners was a well-developed philosophical movement, not a radical perspective awaiting articulation. If Lavoisier was to succeed in making a name for himself, he had to do more than announce that he preferred scientific naturalism to religious authority and the unadorned beauty of nature to the artificiality of courtly society. Such attitudes had become

commonplace by the 1760's and were beginning to look slightly archaic in their abstractness. To carry the program of reform forward, the younger men had to develop strategies capable of making the principles of the Enlightenment part of the political, social and cultural fabric of the nation. Lavoisier and the philosophes of his generation faced a challenge of engagement, a challenge that called for doing more than opposing authority with assertions of universal rights. Their task was to put advanced ideas into action.

Lavoisier was enrolled as a day student at the Collège Mazarin in 1754, shortly after his 11th birthday. The imposing buildings of the Collège stand opposite the Louvre, where the Academy of Sciences held its meetings, and today house the constituent societies of the Institut of France. In the 18th century the Collège had many prominent scientists on its faculty and offered a first-class education in the sciences and the humanities. The normal course of study lasted nine years. Lavoisier was a highly successful student and after seven years he transferred to the faculty of law. Two years later, at age 20, he received his law degree and the following year he was admitted to the bar at the Parlement of Paris. Yet long before qualifying to follow his father's career, he had decided to devote a large part of his energy and time to science. While reading law he had continued to work with the Abbé de Lacaille, who had introduced him to mathematics and astronomy as a student. He also attended the private lectures of such prominent teachers as the chemist G. F. Rouelle and the experimental physicist the Abbé de Nollet, and he geologized on field trips with the Academician and family friend J. E. Guettard. Although Lavoisier studied chemistry in the early 1760's, nearly another decade passed before he formulated the program of research that led to the oxygen theory of combustion. Thus while in the 1760's Lavoisier made a serious commitment to physical science, he had not, so far as we know, set himself the task of effecting a revolution in chemistry.

From 1764 to 1768 Lavoisier campaigned vigorously for a place in the national Academy of Sciences. He sought to advance his candidacy by presenting three memoirs: an essay on how best to illuminate city streets, a two-part paper on the mineral gypsum, and a three-part paper on mineral waters. These papers reveal a good deal about Lavoisier's views on science and its practical applications, yet they hardly constitute first steps toward a revolution in chemistry. They served their intended purpose admirably, however, and in 1768, shortly before his 25th birthday, Lavoisier was installed as an assistant chemist in the Academy of Sciences.

Let us take a look at the events that occupied Lavoisier during the next few years before considering the significance of his election to the Academy of Sciences. Lavoisier's mother had left him a considerable legacy and, upon reaching his majority, he was eager to invest in a venture capable of providing the additional income he needed to pursue a career in science. He therefore followed the advice of a family friend

and in 1768 purchased a share in the Tax Farm, a private corporation that collected certain taxes for the government. This was not a passive investment, however, and during much of 1769 and 1770 Lavoisier was obliged to travel widely outside Paris while inspecting the collection of duties and the manufacture and sale of tobacco at locations under his jurisdiction. His immediate supervisor in these matters was the senior tax farmer Jacques Paulze. In 1771 Lavoisier and Paulze's daughter were married. This justly famous union occurred a year before Lavoisier began his epochal experiments in pneumatic chemistry. Following the wedding, Lavoisier, who was then 28, moved out of the house in which he had been reared and, together with his 13-year-old bride, established a home of his own. Twenty years later he was to recall that at that time "I was young; I had just entered on my career in science; [and] I was hungry for glory" (2). Financially independent, happily married, and intellectually vigorous, Lavoisier was searching for opportunities to employ his talents on the stages provided by the Academy of Sciences and in the King's service. He was eager to put advanced ideas into action and he was exceptionally well prepared to do so.

In 1771 Lavoisier began drafting an eulogy of Jean Baptiste Colbert, the great 17th century minister of finance. He planned to submit the essay to a prize competition announced by the Academie Française, but he never completed it. A manuscript copy of his draft survived, however, and was published in his collected works. It is a most revealing essay, for like many of Lavoisier's drafts, it is more forthright than the works he sent to press. One passage from the final section particularly deserves attention. Lavoisier is assessing the role of royal academies in the cultural life of the nation. It may be, of course, that the view he expresses is nothing more than an attempt by a junior member of the Academy of Sciences to flatter the immortals of the Academie Française, but I am inclined to think that it accurately represents Lavoisier's true feelings about the function of the academies. He begins by crediting Colbert with founding the Academy of Sciences and, more generally, for linking the patronage of high culture to the glorification of the King. The academies, he continues, function like little republics that perpetuate their power from age to age (3):

These institutions, the greatest gift that mankind has ever received, are above all monuments erected against ignorance and barbarism. These bodies, rich with vitality, not only conserve from age to age the initial impulse that a great minister gave them, but their vitality overwhelms the resistance that ignorance, superstition and barbarism present to them. I am happy to compare these bodies to the immense bodies that revolve overhead and to which the creator imparted the initial motion that they have conserved since the beginning of the universe.

Three of Lavoisier's assertions about academies are especially noteworthy: 1. They are "little republics." I take this to

mean that in the republic of science, as in the republic of letters, one establishes one's standing by producing notable work and, having obtained recognition as a member of the republic, one is treated as an equal. 2. They are bastions against ignorance, superstition and barbarism, which rather nicely captures Lavoisier's unexceptional views on the beliefs of the unenlightened. 3. They succeed admirably as institutions. The academies serve their purposes generation after generation without requiring the intervention of enlightened ministers or other patrons. Note also that the academies he is praising are *royal* institutions. Lavoisier, like most other philosophes, evidently believed that only institutions under the control of the monarchy were capable of putting enlightened ideas into action.

Lavoisier's views on the social structure and function of academies are revealing for several reasons. As a scientist he saw the Academy of Sciences as the arena in which he could distinguish himself by presenting his theories and experiments before his peers and by serving on numerous highly visible commissions and committees. As an administrator, Lavoisier was especially interested in the organization and internal governance of the Academy. Even before he entered the Academy he was drafting proposals for its reorganization, and he struggled mightily to save the Academy of Sciences before it was abolished, along with the other academies, in 1793. The academies also served as representatives of the more general program of reform championed by Lavoisier and others, most notably A. R. Turgot and the Marquis de Condorcet. This program was simultaneously royalist, rational and republican. While quite radical in the political context of the Old Regime, this program came to appear centrist as the revolution became increasingly radical, and it was ultimately cut down in the cross fire of left and right extremism.

What were the distinctive features of this comprehensive program of reform? Historians of the French Revolution still consider the answer provided by Alexis de Tocqueville in his classic *The Old Regime and the French Revolution* the best starting point for any exploration of this complex question (4). In the Old Regime, de Tocqueville argues, France was undergoing a wrenching administrative centralization. This transfer of power threatened to transform a national polity organized around local and regional judicial courts into a centralized absolutism in which the functions previously performed by these courts would be brought under royal administrative control. Traditionalists viewed their ancient privileges, which came to be condemned as feudal, as the legitimate rights and responsibilities of local corporations, the most notable of which were the regional courts of law called Parlements. Those who, with Tom Paine, think of the French Revolution as a great liberation from the dead hands of feudalism and absolutism consider this aristocratic defense of pre-revolutionary French politics reactionary. But those who, like Edmund Burke, are troubled by the revolution's legitimization of un-

bounded national autonomy consider the particularism of pre-revolutionary politics essential to the defense of individual liberty. For in fact, prior to the mobilization of the nation in defense of the revolution, the power of the French state was quite limited. The Bourbon kings, despite their claims to divine sanction and absolute authority, could do little more than hold together a nation that in its daily life was profoundly divided by diverse social customs and dispersed political authority. The King's political power was largely symbolic, for it rested on his claim that he alone represented the nation as a whole. His will was public will, but he could only work his will if he could obtain the support and cooperation of regional authorities.

The central drama of pre-revolutionary politics revolved around the contest between the King's ministers, who sought to subordinate political particularism to administrative centralization, and the local aristocrats, who sought to defend what they deemed their ancient liberties. The issue was clearly drawn in the crisis of 1771, the same year in which Lavoisier drafted his eulogy of Colbert. Chancellor Maupeou, in an attempt to break the power of the Parlements that were opposing reforms proposed by the King, "abolished venality of parliamentary office, reorganized parliamentary jurisdictions, limited the judicial right of remonstrance, and staffed his remodeled "parlements" with men willing to exercise their functions on condition of removability subject to the royal will" (5). The parliamentary judges thrown out of office objected strenuously to this "reform," which they considered a despotic usurpation of power. They responded by leading the first of the "aristocratic" revolts that, by rendering France ungovernable, finally forced the calling of the States General in 1788 and all that followed.

Familiarity with this axis of political tension helps render intelligible the suspicion with which Lavoisier's efforts to apply his scientific knowledge to the needs of the nation were sometimes greeted (6). For Lavoisier was above all else one of the King's men, an administrator ready to serve the nation by exercising authority in the King's name. Consider, for instance, his long and successful service in the Gunpowder Administration, to which Turgot appointed him in 1775. Previously the production of gunpowder had been farmed out, like the collection of taxes, and France had produced less than half of the powder she required. Lavoisier centralized the collection of raw materials and the production of powder, and his reforms were so successful that in 1776 and 1777 France was able to supply the American patriots with powder for their war of independence. By 1788 France had achieved self-sufficiency in powder production and her powder was considered the best in Europe (7). It is therefore only just to note that the success of France's revolutionary armies owed a good deal to Lavoisier's reforms. It would be simpleminded, however, to think that politically alert Frenchmen judged Lavoisier's efforts in strictly national/utilitarian terms. The central

question at issue was not how much gunpowder was being produced, but which locus of authority was being strengthened. In fact, the more Lavoisier rationalized gunpowder production, the more suspicious those opposed to the King became. In other words, his efforts on behalf of the nation were judged in terms of the political vision they served rather than for their technical efficacy.

Lavoisier's commitment to centralized and rationalized administration put him at odds with the defenders of a political order based on the particularist liberties of local corporations. At the same time, his allegiance to the King was equally offensive to those on the political left. The issue here is essentially constitutional, the central question being: How did the legitimation of power at the national level come to be separated from the person of the King and vested in the collective will of the people as expressed through their representatives? Contemporary historians of the French Revolution describe this shift as the emerging hegemony of public opinion, a subject that is still of disturbing centrality in modern democracies. Of course the political concept of a General Will had been spelled out by J. J. Rousseau well before the Revolution put it into practice, and the role of public opinion and the problem of representation were much discussed in the decades before 1789. The issue was a difficult one for centralizing ministers like Turgot, for while they considered respect for the authority of the King fundamental to national cohesion, they were hardly advocates of what they condemned as "oriental despotism". The trick was to provide all citizens with meaningful forms of political participation while maintaining the political stability and administrative integrity of the state as a whole.

This problem had an analogy in the world of science and there Lavoisier opted for the republican resolution. According to this view, the authority vested in the Academy of Sciences rests with those who by virtue of talent and achievement have been assigned responsibility for determining what is and what is not good science. Within this community of peers, only reason and evidence are considered persuasive. In its relations with others, the community of science speaks with the authority granted to it by the nation. But this assignment and exercise of authority was resented by those who, like the radical and would-be scientist Jean-Paul Marat, had been denied a place in the Academy. Therefore, when the opportunity presented itself, they were quick to condemn as the abuse of privilege what Lavoisier saw as the proper use of authority grounded in reason and merit. To the radical Jacobins, only voluntary associations, as opposed to those invested with royal privileges, were legitimate, and it was this view that sealed the fate of the royal academies. Utilitarian arguments proved to be without force in this contest between the meritocratic principles that informed the republican image of the world of learning and the democratic interpretation of how one should go about pursuing and applying scientific knowledge in a

society devoted to the principles of liberty, equality, and fraternity.

Lavoisier for years operated with notable success in a highly stressed and rapidly changing political culture. The tensions within that culture were not simply ideological expressions of the antagonism between two opposed social classes - that view, central to Marxist historiography, emerged later from a social analysis of the effects of industrialization and a political analysis of the French revolution. Nor was the revolutionary transformation of French politics simply a progressive liberation achieved through the destruction of the old order. Lavoisier and his colleagues in reform were neither reactionary absolutists nor revolutionary democrats. Rather, they sought to alter radically the way the French state functioned while preserving its unity and promoting its prosperity. Although in the short run their program failed dramatically, and at terrible personal cost, in the long run their vision of the relations between scientific knowledge and political power came to prevail. But it did so only after the people of France, speaking first through their revolutionary leaders and then either through their Emperor, or through plebiscites, or through their legislative representatives, had replaced the King as the embodiment of the nation.

References and Notes

1. See K. M. Baker, "Enlightenment and Revolution in France: Old Problems, Renewed Approaches", *Journal of Modern History*, 1981, 53, 281-303.
2. A. L. Lavoisier, *Oeuvres*, 6 Vols., Paris, 1862-1893, Vol. 2, p. 102.
3. *Ibid.*, Vol. 6, p. 124.
4. See F. Furet, *Interpreting the French Revolution*, Cambridge University Press, Cambridge, 1985.
5. K. M. Baker, "French Political Thought at the Accession of Louis XVI," *Journal of Modern History*, 1978, 50, 282.
6. See, for example, the suspicion concerning Lavoisier's intent that nearly cost him his life at the hands of a Paris mob in 1789, as described in D. McKie, *Antoine Lavoisier*, Collier Books, New York, 1962, pp. 133-135.
7. C. C. Gillispie, *Science and Polity in France at the End of the Old Regime*, Princeton University Press, Princeton, 1980, p. 65.

Dr. Arthur L. Donovan teaches in the Department of Humanities of the United States Merchant Marine Academy, King's Point, New York 11024-1699. He is author of "Philosophical Chemistry in the Scottish Enlightenment" and editor of the special edition of "Osiris" on the Chemical Revolution. He is currently editing a selection of Lavoisier's chemical writings for use in college courses and is in the early stages of writing a biography of Lavoisier.
