LAVOISIER AND THE 'ANNALES DE CHIMIE': A MEDIUM FOR THE PROPAGATION OF THE NEW CHEMISTRY BEYOND THE EIGHTEENTH CENTURY

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It is customary to take Lavoisier's *Traité élémentaire de chimie* of 1789 as the focus of his new chemistry. Not only did it serve to summarise his earlier research leading to the oxygen theory but, as a textbook, it served to introduce his view of chemical composition and chemical reactions to students. But Lavoisier's *Traité* was only one of several textbooks of the new chemistry. Perhaps in some respects it may have been superior to the parallel works of such regular authors as Fourcroy and Chaptal; perhaps in other respects it was inferior.[1] What is clear is that Lavoisier's *Traité* was in no way unique. Like other textbooks it went through several editions but, again like most textbooks, it presented essentially a static body of knowledge. Lavoisier's *Traité* represents the point of view of one individual.

We may contrast the *Traité* with another project associated with Lavoisier, the *Annales de chimie*, the work of a whole school of chemistry rather than simply an individual. As a periodical it was no by means static; it was an ongoing work, continuing into the nineteenth century and beyond. In an effort to propagate his new chemistry Lavoisier had assembled an impressive editorial board including his three former collaborators in the reform of nomenclature: Guyton de Morveau, Berthollet and Fourcroy. Also included were the mathematician Monge, the Strasbourg mineralogist Baron Dietrich and two more junior collaborators, Hassenfratz and

Adet, who had recently attempted to complement the new nomenclature with a system of chemical symbols.

It was Adet who originally had had the idea in 1787 of a French chemical journal which would be based on translations from the *Chemische Annalen* which Crell had been publishing monthly from Helmgtadt since 1784. Adet was supported by Lavoisier who is turn obtained the help of Baron de Breteuil to obtain permission for publication from the keeper of the royal seals. The latter was willing to give permission only for a simple translation of Crell's *Annalen* and insisted that this could not appear more often than quarterly. Here was an indication of the fear of the royalist government of the potentially subversive influence of periodical publications. Although Adet was discouraged and the idea of a French chemical journal was temporarily abandoned, the developing political situation was to lead to a relaxation in censorship. When Louis XVI announced the convocation of the Estates General in 1788 to deal with the country's serious financial crisis, he called on "all *savants* and educated persons" to contribute their views. This invitation prompted a flood of pamphlets.

By the winter of 1788-89 Lavoisier and his colleagues were convinced that the climate of relaxation in censorship was more favourable to the production of a completely independent French journal of chemistry. They would only need the approval of the Academy of Sciences. Accordingly we learn from recently discovered manuscript minutes that on 14 January 1789 they agreed on a surprisingly formal list of regulations for a new organisation they called the 'Société des Annales de chimie'.[2] They were to meet fortnightly and the main business of each meeting would be to hear the reading of memoirs in order to approve their insertion in their new periodical. The contents were largely memoirs by the members of the editorial board supplemented by extracts from other sources. It would no longer have been appropriate simply to provide translations from Crell's *Annalen* because this journal was publishing articles critical of the new

French chemistry

The contents of the first volume were submitted to the Academy for approval and a commission of three headed by Jean d'Arcet was appointed to examine the work. On 3 April the commission was ready with its report which was both long and cautious but generally favourable. It concluded that the standard of the work justified its

publication under the privilege of the Academy. Volumes 2, 3 and 4 also appeared 'under the privilege of the Academy' but by the spring of 1790, when volume 5 was published, this was no longer necessary. These early volumes appeared at quarterly intervals but from the beginning of 1791 (volume 8) the *Annales* was to appear monthly. The editors argued that this was an important step in encouraging communication between *savants*.

The *Annales* was to continue publication without interruption up to volume 18 although the inferior paper used in that volume provides a reminder that all was not well on the economic front by the summer of 1793. On the political front things were even worse. In September 1793 Lavoisier was arrested and the September issue of the *Annales* was to be the last for some time. One might suppose that at the height of the Terror (April 1793 - July 1794) most scientific journals would be suspended. Although this is generally true, an apparent exception is the periodical *Observations sur la physique* edited by La Métherie. The most interesting aspect of the editorial policy of this journal was its persistent hostility to Lavoisier's new chemical theory and nomenclature. Indeed this must have been one of the motives for the founding of an alternative journal by Lavoisier in 1789. Although the editors claimed that memoirs which did not accept the oxygen theory would be equally admissible, in practice the *Annales* was clearly the journal of the new chemistry.

Something that has not previously been noted by historians is the attempt made by La Métherie's journal to take advantage of the cessation of publication of the *Annales* to claim for itself to be a journal of chemistry. January 1794, in the middle of the Terror, was a strange time to start a new journal. Yet not only did the *Observations sur la Physique* change its title to become the *Journal de physique* (a trivial change) at that time, but this was labelled volume one, a description soon to be forgotten by the resumption of the former numerical sequence.[3] The most significant feature of the new series was the addition of the word 'chemistry' to the title so that it became the *Journal de Physique, de chimie et d'histoire naturelle.* It is true that the old meaning of the term 'physique' was so vague and general that chemistry had been regularly included in the journal under the old title of *Observations sur la physique.* But La Métherie had developed an obsession to defend the old chemistry and to attack everything connected with Lavoisier. Now that the *Annales* had been forced to close he was in a unique position to represent chemistry in France. He even managed, although with understandable delays, to

complete the volume for 1794 before the *Journal de physique* too was forced to cease publication.

Although 1795 marks the beginning of a more constructive period when the National Institute was founded, it was not until the end of the following year that there was any question of reviving the *Annales*. Lavoisier had been the guiding light of the journal, although he himself contributed very little directly to it. It was Guyton de Morveau (now calling himself Citoyen Guyton) who took the initiative at a meeting on 27 December 1796 to discuss the resumption of publication. Also present were Fourcroy, Vauquelin and Pelletier. Berthollet and Monge were absent, being in Italy on government business. The meeting agreed to resume publication and drew up a contract with a new publisher, Guillaume. Pelletier died from consumption in July 1797 but other members were added to the editorial board which often met in Guyton's house.

Yet the *Annales* was not to become simply Guyton's journal. To believe that one would have to disregard the influence and the different interests of Fourcroy which included pharmacy. In August 1796 a group of Paris pharmacists had founded the Société libre des pharmaciens de Paris. Fourcroy was interested in the society and it invited him to become the editor of the society's journal. Fourcroy therefore had a foot in two camps and, when the *Journal de pharmacie* suffered from financial problems in 1799, it was Fourcroy who persuaded his colleagues on the editorial board of the *Annales* to take on board the ailing pharmaceutical journal. From the beginning of 1800, therefore, the title of the journal was expanded to include pharmacy: *Annales de chimie ou Recueil de mémoires concernant la chimie, les arts qui en dépendent et spécialement de pharmacie.* At the same time three new members with a pharmacy interest were added to the editorial board: Deyeux, Parmentier and Bouillon-Lagrange. There was, therefore in the early 1800s a distinct pharmacy faction among the editors of the *Annales*. Such a situation would not have received the support of Lavoisier if he had still been alive. No doubt he would have agreed that pharmacy had played an honourable part in the earlier history of chemistry but the new approach to chemistry which he had championed depended on a physical approach to chemistry. He had himself helped to found the section of *Physique générale* in the Paris Royal Academy of Sciences in 1785. This physical approach was more congenial to Guyton and his follower Prieur du Vernois.

It was even more acceptable to Berthollet, the one remaining coauthor of the *Méthode de nomenclature chimique*, whom we have so far mentioned only in passing. Although Berthollet was away from Paris when the *Annales* resumed publication and again from May 1798 to September 1799, when he was with Bonaparte in Egypt, he attended a fair number of meetings of the editorial board of the *Annales* in the early 1800s. Yet probably his heart was not in it. He had recently bought a spacious house at Arcueil, then in the country just outside Paris and gathered round him a group of young man whom he encouraged to work in his laboratory. Gay-Lussac and Thenard were among these protégés. In 1807 they announced that they had formed themselves into a small scientific society and they published the first of three volumes of memoirs of the society. At first Gay-Lussac was encouraged to publish in the latter rather than in the *Annales*. It was only when Fourcroy died in December 1809 that Berthollet saw an opportunity to alter the balance of power within the editorial board of the *Annales*. He introduced Gay-Lussac and Thenard, then at the most productive stage of their careers, as valuable potential contributors to the *Annales*. It is notable that from 1810 Berthollet's own attendance at the meetings of the editorial board greatly improved.

From 1810, therefore, we can detect a significant overlap between the personnel and interests of the editorial board of the *Annales* and the Society of Arcueil. The full implications of this overlap was not to be realised before 1815, the year of the final defeat of Napoleon and the demise of the Society of Arcueil which had depended indirectly on Napoleon's patronage of Berthollet.[4] But what had this to do with the *Annales*? By 1815 the number of volumes of the *Annales* was approaching a hundred. With a change of political regime there was also a feeling that this was an appropriate time to make a fresh start. This feeling was accentuated by the actions and health of the senior editor Guyton, then in his late seventies, who for some time had been exasperating his colleagues with a never-ending series of memoirs on the use of chlorine for fumigation. In December of 1815 he became seriously ill and died on 2 January 1816. Meanwhile on 11 December 1815 an extraordinary meeting of the editorial board had been called at which Berthollet was the senior member and guggested that a new series of the *Annales* should be started in which chemistry would be formally associated with physics since the development of the two subjects had brought them go close together. This argument from the author of the *Essai de statique chimique* would surely have been welcomed by Lavoisier. Yet Berthollet had had to wait such a long

time to put this stamp on the *Annales*. Not only did he outlive the other senior members of the editorial board but, through the Society of Arcueil, he had two protégés who were able to put his ideas into practice. Gay-Lussac, already a member of the editorial board, would be responsible for chemistry articleg and Arago, another former member of the Society of Arcueil, would be the editor responsible for physics.

The new series beginning in 1816 would be called the *Annales de chimie et de physique*. By the use of smaller type it would be able to increase the material presented in the same number of pages by 30% and thus not require any substantial increage in price.[5] The second series had begun with a large editorial board inherited from the first series of the *Annales* but the publisher complained that, when responsibility was shared between so many, no individual felt any great commitment. Hence the previous editorial board of some 17 members was reduced to two and Gay-Lussac and Arago ran the *Annales* as a private business. In the new world of the nineteenth century their authority wag to become nearly as great as that of Lavoisier and Guyton in the late eighteenth century.

We have briefly summarised the history of the *Annales de chimie* over the period 1789-1816. What had begun very much as Lavoisier's journal was resumed after his death as the journal of the new chemistry but with certain differences of opinion about the direction it should take. I have drawn particular attention to the conflict between the old idea of chemistry as the companion of pharmacy and the new concept of chemistry as the ally of physics. Yet I would not want to give the impression that the history of the first series of the *Annales* was mainly one of conflict between different personalities and ideologies. All the members of the editorial board were united in wishing to propagate the new chemistry even if they differed in their interpretation of what that chemistry was.

The main source of conflict in the publication of the *Annales* was with publishers. The *Annales* had been launched as a business venture. Contracts were drawn up between the editorial board on the one hand and the publisher on the other. The publisher agreed to produce a certain number of printed copies of the *Annales* at specified dates and to hand over a proportion of the profits to the board. The editorial board for its part agreed to provide manuscript material regularly at specified dates. They would hold regular meetings (normally twice a month) to discuss material for future

issues. The *Annales* was unusual in that a large proportion of the material published was by members of the board who were paid in proportion to the number of pages they contributed. This might be an original memoir or a translation, since the *Annales* saw itself as an international journal, keeping readers up to date with recent research from different parts of the world which, at that time, meant effectively different parts of Europe.

It may be of some interest to consider how Lavoisier's oxygen theory featured in the first series of the *Annales*. One of the subjects on which Lavoisier had been working in the last years of his life was respiration. His former collaborator in these experiments was Armand Séguin who, as a member of the editorial board of the *Annales*, published in that journal in 1797 a report of experiments carried out in the previous decade and originally presented to the Société de Médecine in 1790.[6] After paying a passing tribute to his former colleague,[7] Séguin summarised Lavoisier's work on the composition of air, his experiments on respiration, animal heat and the change of colour of oxygenated blood. Soon after this Séguin lost interest in the *Annales* but he returned in 1814 to publish a joint memoir by Lavoisier and himself on transpiration.[8] This is a memoir which had been presented to the Académie Royale des Sciences in 1792 but never published. The following issue of the *Annales* contained a second memoir on respiration by Lavoisier and Séguin[9] -also left over from the ancien regime. Although there may be some uncertainty about Séguin's motives, it is clear that he made an indirect contribution to perpetuating the memory of Lavoisier in the twenty years after hig death.

Lavoisier had also pioneered the quantitative analysis of organic compounds. Gay-Lussac and Thenard were able to take this further, using potassium chlorate as an oxidising agent.[10] As regards Lavoisier's oxygen theory of acidity, Berthollet had felt free during his colleague's lifetime to publish in the *Annales* some conflicting evidence.[11] It was however, Gay-Lussac who was to publish a more definitive study of acidity in the *Annales*.[12] This was a revisionist interpretation of the theory, introducing important modifications in the light of later evidence of the existence of several hydracids. Thus the influence of Lavoisier continued in the *Annales* but it never constituted a straightjacket.

This was a period of great self-confidence in chemistry when chemists were claiming territory which would now be classified as

physics. Lavoisier had helped to give chemistry a new vitality and coherence at a time when physics hardly had a clear identity. With his table of elements Lavoisier had indirectly established a research programme although it must be admitted that, when new elements were discovered, it was usually in the traditional context of painstaking analysis rather than the triumphant addition of another entry in the Lavoisier table. By 1800 the basic oxygen theory was generally accepted, gases no longer had the importance they had acquired in the late 18th century and the new phenomenon of electrolysis was turning mind in new directions. Addressing young chemists in his *Traité*, Lavoisier had told them "to endeavour rather to do well than to do much" ("de s'attacher plutôt à faire bien qu'à faire beaucoup").[13] The quantitative aspect was brought out. It was important that future experiments should be sufficiently exact and rigorous. Probably Berzelius, an important contributor to the *Annales*, can be seen as a follower of Lavoisier but it cannot be said that the name of Lavoisier was regularly invoked in the journal. Rather his achievement was taken for granted. Perhaps the best example of a paper is the *Annales,* following explicitly the ideas of Lavoisier in the generation after his death, is provided by Gay-Lussac's memoir of 1819 on the solubility of salts. He paid tribute to Lavoisier who, he said, was the first to give a satisfactory explanation of the influence of temperature on solubility.[14] He felt it appropriate to give a page-long quotation on the subject from Lavoisier's *Traité*. Subsequent examination of Gay-Lussac's library has shown that his own copy of Lavoisier's textbook had this passage clearly marked.

The infrequency of reference to Lavoisier in the chemical literature in the several decades following his death may be explained in a number of different ways. It may be, as I have suggested earlier, that chemistry had passed on and it was no longer necessary to make a fuss about the oxygen theory. But there was also some residual embarrassment about Lavoisier's death which is illustrated by the failure even of the Academy of Sciences to deliver the customary *éloge*, even though such *éloges* were composed for many lesser men of science. Some of Lavoisier's former colleagues may well have felt that they might have done more to save him. They may have felt a sense of guilt that, unlike their former colleague, they had survived the revolution and had even prospered.

Although Madame Lavoisier made an effort to keep alive the memory of her husband, we may consider the early 19th century to have been a period of general neglect of his work. When, therefore, J.B. Dumas

took up the cause of Lavoisier in 1836, he felt that it was his duty to rescue his reputation from the obscurity into which it had fallen. This explains some of the exaggeration with which Dumas put forward Lavoisier's claims. The other nineteenth-century French chemist who did most to promote the cause of Lavoisier was Marcellin Berthelot who, as secretary of the Academy of Sciences in 1889, finally used the centenary of the 1789 revolution as a platform for a long overdue éloge of Lavoisier.[15] It may be noted that both Dumas and Berthelot were in turn not only secretaries of the Academy of Sciences but leading members of the editorial board of the *Annales de chimie*. Neither used the *Annales* to commemorate Lavoisier. That was the responsibility of other organisations whereas the *Annales* was concerned to present the most recent scientific research.

This brings me back to the function of the *Annales de chimie*. The censors of the ancien régime were right to fear that a periodical might exert more influence than a book. A periodical like the *Annales* which appeared monthly from 1791 could hammer home a message by repetition and by endless variations on a theme. Apart from the truth of the new theory, a major theme in the first series of the *Annales* was the wide *applicability* of chemistry. Its title proclaimed that it was concerned not only with chemistry but also with 'les arts qui en dépendent'. A periodical, unlike a textbook, is able to provide news. The *Annales* could report the latest developments in chemistry not only in France but in other countries. In so far as there would be regular overlaps between the research reported by one chemist and another there would be a presentation of different points of view and sometimes discussion. Correspondence was a regular feature of the first series and this all helped to build up a scientific community with a special interest in chemistry. In the early years in particular provincial pharmacists and others on the fringe of scientific activity would be flattered to have a summary of their work published in the *Annales* side by side with memoirs of some of the most famous chemists of the age. Such people were likely to become regular subscribers to the *Annales*, hence at the same time keeping themselves informed about recent developments and helping to guarantee the financial future of the journal.

Unlike the traditional state-subsidised, ponderous and expensively produced *Mémoires* of the various academies with sumptuous binding, compiled at a leisurely pace by an elite for the admiration of posterity, the *Annales* was a private initiative intended for immediate consumption by a wider audience. Nor was the readership

expected to be necessarily passive. Readers were encouraged to think of themselves as potential contributors to the *Annales*, which soon changed from a quarterly to a monthly publication. It was, therefore, an important source of scientific news and its modest price helped to make it available to most members of the growing community of chemists and others interested in the new science. Its very existence must have served to recruit many new adherents to the new chemistry.

NOTES

1. Thus Fourcroy included an important historical dimension which Lavoisier ignored.
2. The full regulations are reproduced in Maurice Crosland, *In the shadow of Lavoisier. The 'Annales de chimie' and the establishment of a new science*, Oxford, 1994..
3. Thus vols. 1 - 4 are now usually referred to as vols. 44 - 47.
4. Maurice Crosland, *The Society of Arcueil. A view of French science* at the time of Napoleon I, London, 1967.
5. The logic of this statement depends on the relatively high price of paper compared with the low wages of printers at the time.
6. 'Mémoire sur la respiration et la chaleur animale', *Annales de chimie*, *21* (1797), 225-
7. "Lavoisier, auquel les sciences sont si redevables", ibid., p.226.
8. 'Second mémoire sur la transpiration par Lavoisier et A. Séguin', *Annales de chimie*, 90 (1814), 5-28.
9. 'Second mémoire sur la respiration par Lavoisier et Armand Séguin', *Annales de chimie*, 91 (1814), 318-334.
10. *Annales de chimie*, 74 (1810), 47-64.
11. *Annales de chimie*, 2(1789), 54-72.
12. *Annales de chimie*, 91 (1814), 130-152.
13. *Traite élémentaire de chimie*, Paris, 1789, p.187. *Elements of chemistry*, Edinburgh, 1790, p.172.
14. *Annales de chimie et de physique*, 11 (1819), 296-315.
15. Maurice Crosland, 'Lavoisier, le "mal-aimé", *La Recherche*, 14 (1983), 785-791.