AN ENGLISHMAN ABROAD: CHARLES BLAGDEN’S VISIT TO PARIS IN 1783

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SUMMARY

Once the preliminaries of peace had been signed in January 1783, after the war of American independence, exchanges between British and French men of science resumed their normal course. On a visit to Paris in 1783, the francophile Charles Blagden (with the encouragement of Joseph Banks) made a number of contacts that fostered relations between the Royal Society and the Académie royale des sciences. In the course of this and several subsequent visits to France, Blagden became especially intimate with the chemist Claude-Louis Berthollet. His correspondence, now in the Royal Society, is a rich source for our understanding of some of the leading scientific debates of the day, in particular concerning the nature of water, which forms the main subject of this article.

Keywords: Royal Society; Académie royale des sciences de Paris; nature of water; Charles Blagden; Antoine Lavoisier; scientific correspondence

The year 1783 was notable in a number of respects. It was first and foremost a year of peace. The battle of Yorktown on 19 October 1781 had put an end to the war in America, and it was now left for diplomats to make the running. In Paris, after the signing of the preliminaries of peace in January 1783, people rejoiced, acclaiming Benjamin Franklin and the Marquis de Lafayette as champions of liberty. Commercial exchanges with Britain resumed, and correspondence became easier and more regular. At the same time, discussions leading to the peace treaty that was to be signed in Paris meant that a sizeable British community established itself in the French capital. Visitors from Britain, although never uncritical, were attracted by Parisian cultural life, the refined lifestyle of French aristocratic society and the upper bourgeoisie, and the spirit of Enlightenment which they saw as a facet of the wider Republic of Letters. In turn, many in France were fascinated by Britain’s constitutional monarchy and other forms of government, by the spirit of enterprise that seemed to thrive across the Channel, and by a simplicity that brought nature to the heart of everyday life. An Anglophilia, often

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amounting to Anglomania, encouraged the French to embark on tours of Britain, to witness the opulence of the manufacturing areas of London, Manchester, and above all Birmingham.

**Blagden’s World: London and Paris**

Charles Blagden (1748–1820), now in his mid-thirties and fresh from service in the American conflict as a physician on the hospital ship HMS *Pigot*, was a key figure in these exchanges. A friend of Sir Joseph Banks, he was already known for several scientific studies and had been elected a Fellow of the Royal Society in 1772. From 1780 he had been stationed at Plymouth. But there he had missed the scientific life of London, so that when Henry Cavendish appointed him his secretary and assistant, he was glad to settle finally in the capital in 1782 and to throw himself more energetically into the life of the Society. It was soon after this that he made his first visit to Paris, arriving there early in June 1783 and leaving during August of the same year. In that time he witnessed the experiment of Antoine Lavoisier and Pierre-Simon Laplace on the synthesis of water and was welcomed in the best Parisian society. He met, in addition to Lavoisier and Laplace, the marquis de Condorcet, Jean-Baptiste Bochard de Saron, and both César-François Cassini de Thury and his son Jean-Dominique, comte de Cassini. The cultivated circles in which he moved would also have such foreigners as Benjamin Franklin and David Hartley. When he returned to London, therefore, he left behind many friends, with whom he remained in contact for the rest of his life.

Blagden’s visit in 1783 was the first of several. In 1787, as both a personal friend and a representative of the Royal Society, he was in Calais, collaborating with French astronomers; there he contributed much to the good relations between the English and French groups working on the determination of the difference in longitude between the observatories of Paris and Greenwich. In the following year he was back in Paris, staying with the chemist Claude-Louis Berthollet, whom he had met in 1783; on that occasion he visited the Wendel factory at Le Creusot. He returned to Paris in 1792, again during the peace of Amiens in 1802, and then in 1815, after the defeat of Napoleon. Finally, it was during yet another visit to France that he died, at Berthollet’s house in Arcueil, on 26 March 1820. He was buried in the Parisian cemetery of Père Lachaise.

The letters that Blagden addressed to Banks during his visit of 1783 and those that French savants sent to Blagden between 1783 and 1788 throw much light on the relations between the scientific communities of France and Britain during the last years of the Ancien Régime. The subjects most commonly discussed included the nature of water, experiments on heat, balloon ascents, the exchange of books and papers, recommendations for colleagues and friends, and enquiries (in both directions) about ways of securing election to foreign membership of the Académie royale des sciences or the Royal Society. These subjects were not, of course, original. Similar interests and preoccupations appear not only in letters to and from Banks but also in those between James Watt and Joseph Black and between Richard Kirwan and Guyton de Morveau and in Lavoisier’s correspondence, to cite only those relevant to the main theme of this article. The Blagden letters therefore have to be read as part of a wider context of vigorous cross-channel communication.

**Spring 1783**

The early months of 1783 were particularly interesting ones within the Royal Society. Among the topics under discussion were the recent experiments of Cavendish and those of Joseph
Priestley. Cavendish had begun reading a paper on a new eudiometer on 20 February 1783 and completed it a week later. In the paper he described a form of the instrument adapted for measuring the ‘phlogistication’ or ‘purity’ of air. This method of determining the quality of air had been invented by Priestley and then adopted and developed by several others, including Lavoisier. In this paper, Cavendish compared his instrument with other eudiometers and detailed the experimental procedures for its use.

At about this time, there was also much talk of the transformation of water into air and the transformation of air into water. The source of this interest was Priestley, who wrote to Banks on 21 April 1783 describing his observations on phlogiston and what he interpreted as the conversion of water into air. He supported his contention that such conversion was possible by referring to experiments he had performed on metals. His analysis rested on the common belief that a metal was a compound of a calx and phlogiston, in contrast with Lavoisier’s view that metals were simple substances. In the letter to Banks, Priestley recounted his latest observations on the conversion, indicating that he had mentioned his ideas to Watt. Watt did indeed write to Priestley on the subject on 26 April, and a well-known priority dispute between Watt and Priestley was to follow, culminating in the Royal Society’s publication of Watt’s letter in the following year.

These exchanges turned on the then prevalent belief that the four elements of the Ancients (earth, air, fire and water), and hence water and air, were (to use modern terminology) simple substances. However, the question of the transformation of one element into another was under constant discussion. As early as 1768 Lavoisier had claimed to have shown that water could not be changed into earth, so that Priestley’s claim that water could be converted into air attracted inevitable interest. In late April 1783, the debate raged keenly in London, and news of it quickly spread to Paris. There, on Wednesday 7 May, the duc de La Rochefoucauld read to the Académie des sciences an account that his designated correspondent Edmond-Charles Genest had sent him of experiments performed by Priestley in Genest’s presence. At the next meeting of the Académie, on Wednesday 14 May, a two-page letter from London, dated 6 May and unsigned (but attributed to Genest), was read: ‘M. Priestley elaborated on his earlier experiments, which led him to believe that he had converted water into air’. In the first of these experiments Priestley had placed a mixture of clay pounded with quartz and soaked in water in a closed vessel. Over a moderate heat, he had obtained exceptionally pure dephlogisticated air. In a second experiment he had used a eudiometer in which an electric spark was used to ignite a mixture of one third dephlogisticated air and two thirds inflammable air. In the words of the report that survives in the Académie des sciences, ‘l’air se décompose et en essuyant exactement le tube avec un morceau de papier, celui-ci contracte en humidité une pesanteur égale à celle du volume d’air enfermé dans le tube’.

Lavoisier and Gaspard Monge were not present at the meeting of 14 May (although Laplace was present). However, they were there on 21 May, and it was immediately after this that Monge returned to the military engineering school at Mézières in eastern France, where he repeated Priestley’s experiments. Lavoisier, too, took a keen interest in the report on Priestley’s work. Commenting on 31 May, he stated that the gas obtained by Priestley was not the result of a transformation of water into air but rather of air that had entered through the walls of the containing vessel. By then Priestley had repeated his experiments and modified some of his conclusions. His report on this work was read to the Royal Society on 26 June and published immediately in the Philosophical Transactions. We can be sure that Blagden was familiar with all these exchanges.
Another subject of interest in Royal Society circles during the spring of 1783 was a paper by Thomas Hutchins, the governor of Fort Albany on Hudson Bay, on attempts to establish a scale of extreme low temperatures. This paper, which ran to almost 70 printed pages, was read on Hutchins’s behalf at successive meetings on 1, 8 and 15 May. It described experiments that Hutchins had performed in the winter of 1781/2 at the request of the Society. Using thermometers provided by the Society, the first five experiments, to determine the freezing point of mercury, were conducted in strict accordance with a procedure laid down by the Society in the light of earlier experiments that Hutchins had reported in 1779. The figure for the freezing point that Hutchins observed in 1781/2 was 40 degrees below zero on an unspecified but almost certainly Fahrenheit scale.

It was on 22 May, at the meeting following the reading of the last part of Hutchins’s paper, that Blagden began reading a paper of his own on studies of the freezing of mercury. The paper, one of the most important and certainly the longest by Blagden, began with a respectful account of the experiments by Hutchins, whose value of −40 degrees for the freezing point was significantly higher than any of the other figures advocated at the time, and it praised both the experimental procedures recommended by the Royal Society and Hutchins’s application of them, before reviewing earlier attempts to determine the freezing point. Blagden’s paper, like Hutchins’s, occupied almost 70 pages in Philosophical Transactions, and its composition must have been well advanced by the time Hutchins’s paper was read to the Society between 1 and 15 May. In its thoroughness, Blagden’s study surpassed previous attempts to determine whether mercury froze and, if so, at what temperature. It was evidently well received, and Blagden’s own satisfaction is reflected in his decision to take away several copies of the printed text for distribution to the savants he would meet in France.

The reading of Blagden’s paper was completed on 5 June, after which the Society did not meet again until 19 June. With his departure imminent, we may suppose that Blagden met Banks for a last dinner and pipe in a London tavern and that he discussed with Banks what was expected of him during his stay in Paris. Among the good wishes that Blagden received for his journey were those of his brother, Thomas, a physician in Bristol. To an account of the newly fashionable electrical treatments that he had used with his patients, Thomas added ‘I most sincerely wish you every happiness & pleasure during your stay in France’. With these and other farewells duly exchanged, Blagden made his departure.

**Blagden’s Parisian welcome**

In Paris, Blagden lodged at the Hôtel d’Espagne in the rue Guénégaud on the left bank of the Seine. The street ran alongside the French mint, the Hôtel des Monnaies, where the permanent secretary of the Académie royale des sciences, Condorcet, lived. The location set Blagden at the heart of the Faubourg Saint-Germain and the Latin Quarter, where many booksellers, instrument makers and printers had their premises. The Hôtel d’Espagne was also near to the Procope, the café associated with the great names of the French Encyclopédie and still favoured in the 1780s by writers, philosophers, savants and academicians, and it backed onto the Cour du commerce, whose uneven paving stones, shops and architecture evoke even today the spirit of the siècle des lumières. Most importantly, Blagden found himself close to the Académie royale des sciences, which held its meetings in a building of the Cour carrée in the Louvre, on the other bank of the Seine. He had therefore only to cross the Pont-Neuf to be at the centre of French scientific life.
Blagden had reached Paris by 11 June at the latest. It was on this date that he wrote his first letter to Banks, recounting his initial contacts and his impressions of Parisian society. Among those he had already met were Jérôme de Lalande and Lavoisier. He reported to Banks that Lalande had received him well ‘with the appearance of wishing to promote my views’, although he added, with obvious disappointment, that since their first meeting he had heard nothing further from Lalande. Relations with Lavoisier were more successful. Blagden commented that, like Lalande, Lavoisier had received him well. Even though the welcome had been ‘without any warmth’, Lavoisier had invited him to dine on the following day: ‘he then shewed me some of his new experiments’, identified by Blagden as those on respiration and heat. Blagden described Laplace as working with Lavoisier, adding that it was Laplace who was responsible for the calculation of their results. His view of Laplace and Lavoisier was unambiguous: ‘[Laplace] is evidently a very able man, but one of the most self-sufficient I have ever seen. M. Lavoisier has certainly a good opinion of himself also, but not carried to such a degree of extravagance’. During his encounter with Lavoisier and Laplace, Blagden evidently spoke about his work on the freezing point of mercury, a subject (‘new to them in detail’) in which his French colleagues seem to have shown a keen interest.

In his second letter to Banks, dated 18 June, Blagden continued his account of his activities in Paris. The duc de Chaulnes had shown him his collections; he had seen nothing more of Lalande; and he had dined with Lavoisier. He had also attended at least one further meeting of the Académie des sciences, where he had been warmly welcomed. In a busy and varied week, Blagden (as a good Englishman) had been particularly amused by automata in the royal collection that recited the phrase: ‘le Roi donne la paix à l’Europe.’

The Royal Society and the Académie Royale

The themes of the correspondence between Blagden and Banks were relatively limited. Blagden certainly did not talk about everyone he met or everything he did or saw, as is evident from the letters he subsequently received once he was back in London. The emphasis of what he wrote to Banks tended to be on their shared scientific interests and on the ‘business’ of science; these were not primarily exchanges between intimate friends. As his first letter to Banks suggests, Blagden went to Paris with a well-defined purpose that shows through in the letter he wrote on 18 June: ‘This afternoon, I go to the Academy, & hope there to know better what the people are at here, & what I have to expect here that may be useful to our future plans.’ The references in the correspondence to elections to foreign membership of the Royal Society and the Académie royale des sciences suggest what these plans would have been. Blagden and Banks were evidently seeking to establish a special relationship with the Académie and with certain of its members.

In response, the presence in the French capital of Blagden, who was known to be close to Banks and hence to the most senior Fellows of the Royal Society, encouraged French interest in a closer association with London. Blagden conveyed the interest in a letter to Banks on 27 June 1783: ‘some members of the Academy of sciences have intimated to me how much they would welcome a fair and honourable correspondence with the Royal Society for the communication of our respective ideas and discoveries’. The request, if implemented, would require the procedures to be strictly determined. There would be two members, one in each society, who would be responsible for maintaining the passage of information. The letters that were exchanged would be lodged in the archives in London and Paris, with each of the two correspondents keeping an additional copy. Such an initiative represented a major
new departure, one that required Blagden, who could not take a decision on his own, to consult Banks. Writing to Banks on 1 July, he took up the subject again: ‘The plan of correspondence between the Royal Society & the French Academy of Sciences was well received by the gentlemen to whom it was mentioned.’

Immediately after his election as Secretary of the Royal Society on 5 May 1784, Blagden returned to the idea of a formal system of correspondence with the Académie. One sign of his renewed enthusiasm was the effort he made to secure his own election to corresponding membership of the Académie. Unable to request such an honour himself, he proceeded to exploit his French contacts. The most notable of these was with the comte de Catuélan, who now assumed a central role in Blagden’s plans. Jacques du Merdy de Catuélan was a fervent Anglophile and a frequent visitor to England whose connections extended to the highest levels of English society. His most important literary achievement was a 20-volume
translation of the works of Shakespeare, which he undertook with two other translators, Le Tourneur and Jean Fontaine-Malherbe. From the moment it began to appear, in 1777, the translation attracted much attention. Dedicated to the king and available only to subscribers, the work had a subscription list that included such prominent figures as the Empress of Russia, members of the French and British royal families, ministers, and diplomats, as well as many others in both Britain and France.46

Catuélán’s importance among Blagden’s correspondents is reflected in six letters that he wrote to Blagden between 2 November 1783 and 22 September 1784. The letters show how well placed Catuélán was in scientific circles, as a friend of Lavoisier and Laplace and, more particularly, of another academician, Jean-Baptiste Le Roy.47 The correspondence between Catuélán and Blagden, who first met in Paris, seems to have grown from Blagden’s hopes of establishing a regular exchange of letters between their countries’ scientific communities, using the chevalier de Fleurieu as an intermediary. The plan was pursued cautiously, and the language of the letters was reserved. Assuring Blagden of his complete discretion in November 1783, Catuélán promised to use his diplomatic skills and contacts in support of what had evidently become a shared objective.48 But Blagden, preoccupied with current tensions within the Royal Society, had still not replied three months later,49 and Catuélán wrote again, sending news from Paris and conveying his good wishes.50 Blagden did not reply until May, by which time he could report his election as secretary of the Royal Society. The implication that he would welcome anything that Catuélán could do to arrange for him to become a corresponding member of the Académie des sciences was unmissable, and on 24 May Catuélán replied from his Normandy chateau to assure Blagden that he would spare no effort to facilitate the desired election.

Catuélán was as good as his word. He had already used the opportunity of a letter to Le Roy, in which he spoke of Blagden’s appointment as secretary of the Royal Society, to press the case: ‘The Académie des sciences would be taking a worthy step if it endorsed the choice of its sister society by admitting him as a correspondent’. The matter required negotiation, but Catuélán assured Blagden of the ‘great pleasure’ that he would take in pursuing the matter, notably by engaging the support of Lavoisier and Laplace, who could be relied upon to be as enthusiastic as he was himself.51 The elections were not to take place for another three months.52 However, by July Catuélán was already able to report on his contacts with Condorcet, Lavoisier and Laplace,53 and on 1 September the Académie voted unanimously to elect Blagden and designate him formally as Berthollet’s correspondent.

On the following day, Catuélán wrote to convey the good news to Blagden54 (see figure 1). As it happened, the letter was delayed through an oversight on the part of the (unknown) messenger, with the consequence that Catuélán received no acknowledgement. His disappointment showed in the letter of 22 September, in which he replied to one that Blagden had written to him on 3 September to accompany copies of two of his papers. These letters of 3 and 22 September were the last that the two men are known to have exchanged.55 However, the ending of the correspondence did nothing to weaken Blagden’s links with Parisian savants. These remained as strong as ever, especially with Berthollet who had written almost immediately to inform Blagden of his election56 and whose connection through the Académie reinforced the friendship that had begun in 1783.57

Even if the relations between the Royal Society and the Académie royale des sciences did not advance to the stage of the regular formalized exchanges that Condorcet as secretary of the Académie58 had wished for, the bonds between the two societies were strengthened through Banks’s admission to the Académie as a ‘foreign associate’ in 1787,59 followed by the election of Lavoisier60 and Guyton de Morveau (in 1788) and Laplace (in 1789) as
Foreign Members of the Royal Society. Other, more material forms of collaboration also served to bring the French and British communities together. Banks, for example, lent instruments from James Cook’s voyages for use in the circumnavigation of the globe that began, under Jean-François de Galaup de La Pérouse, in Cherbourg in 1785. The ‘adventure’ of the determination of the meridian in 1787 provided another occasion for cooperation. In August 1788, Jérôme de Lalande’s visit to England continued the rapprochement, although the events of the following year meant that this was to be one of the last illustrations of the strengthening bonds between the Royal Society and the Académie in these closing years of the Ancien Régime.

WATER IS NOT A SIMPLE SUBSTANCE

Blagden was present when Lavoisier and Laplace described their experiments on heat before the Académie on 18 June 1783. Then, six days later, he joined a group of academicians to witness the experiment in which Lavoisier and Laplace produced water by burning inflammable air (hydrogen) in dephlogisticated air (oxygen). In Lavoisier’s laboratory notebook, the experiment appears as an isolated one: it is recorded as having been performed on 24 June, but no mention of it appears in the notebooks either before or after that date.

The main part of the apparatus was a pair of pneumatic vessels invented by Lavoisier and improved by Jean-Baptiste Meusnier, who worked with him in his laboratory. One of the vessels contained the inflammable air, the other the dephlogisticated air. Tubes led the two gases in a continuous flow into a bell-jar, presumably inverted over mercury, where a spark from an electrostatic machine was used to effect the combustion. About 11.5 grams (3 gros) of water were produced, the mass of gas consumed being approximately 35 grams (one once, one gros and 12 grains). In the notebook, Lavoisier wrote: ‘We must suppose that about two-thirds of the air has been lost or that there has been a loss of weight.’ In the Académie on the following day, it was simply stated that pure water had been produced. Hitherto, the liquid had generally been attributed to the dampness normally present in the atmosphere. But the quantities of the gases that were used and of the water that was produced had always been too small to allow a reliable interpretation of the results. Now, by contrast, Lavoisier and Laplace were no longer using fixed quantities of gas: they had in place a ‘dynamic’ arrangement able to supply a continuous controlled flow.

The record of the meeting of 25 June 1783 indicates that Lavoisier and Laplace had ‘repeated’ (répété) ‘the combustion of combustible air with dephlogisticated air’ in the presence of several members of the Academy. They stated simply that they had used ‘about sixty pintes’ of the combining gases and that the reaction had taken place in a closed vessel. In their words, ‘the result was very pure water’. There was no mention of the quantitative aspects of the experiment or of its theoretical implications. The announcement was evidently made simply to establish their priority. The word ‘repeated’ suggests that the experiment was not a first attempt. In fact, the procedure could not have been set in train quickly. It called for assistants and careful calibration and, with reliable witnesses to be impressed, a degree of preparation that made improvisation out of the question. As to how long Lavoisier and Laplace had been engaged in preparing the experiment, it is impossible to be certain. Perhaps since Genest’s letter in May? Perhaps since their meeting with Blagden? We simply do not know.

On the day of the meeting in the Academy, 25 June, Blagden reported to Banks what he described as a repetition of Cavendish’s experiment:
Yesterday the important experiment of M. Cavendish’s relative to the production of water from the combustion of dephlogisticated & inflammable air was repeated at Mr Lavoisier’s, in consequence of the account I had given of it from Dr Priestley’s paper, and Mr Cavendish’s verbal information; several members of the Academy of Sciences were present; & we obtained near three drams of water which was very pure, neither impregnated with fixed air, nor in any other way acidulated. The deflagration was performed gradually.

After a detailed description of the experimental set-up, Blagden stated that the results did not allow the proportions of air and water to be determined and that the only firm conclusion was that the water was pure. As he wrote, Lavoisier and Laplace intended to continue their experiments ‘with the necessary precision for determining the weights’.

Within the Academy, the paper of 25 June evidently caused a stir. The excitement was reflected in Blagden’s letter to Banks: ‘I thought it right to send you the earliest possible information, which should be communicated to Mr Cavendish and Dr Priestley, if you have an opportunity’. Blagden emphasized the surprise of those who had witnessed the experiment at seeing so much water, and water alone, trickling into the collecting vessel. Lavoisier’s theory would have predicted the production of an acid, but as Blagden recounted it, the opinion of most academicians was that the water must have been contained, in solution, in the gases that had been consumed, ‘an opinion which I hope will soon be brought to the test of weight and measure’. Blagden’s letter of 25 June is important for the summary it gives of the various opinions circulating in the European chemical community. It conveys vividly the doubts that Lavoisier’s interpretations aroused and some of the key issues that were at stake in the famous ‘water controversy’, an episode that began with the experiment on 24 June and ended, as far as France was concerned, in the spring of 1785.

From the start, the controversy became bound up with the momentous events of 4 June 1783, when the first hot-air balloon rose into the skies above Annonay. The exploit of the Montgolfier brothers was on everyone’s lips, and in the Académie it led to the setting up of a special committee, to which Lavoisier and, later, Meusnier were appointed. The connection with the water controversy resulted from the innovation of filling balloons with inflammable air rather than ordinary heated air, a technique first implemented by Jacques Charles and the brothers A.-J. and N.-L. Robert on 27 August 1783. Lavoisier’s theory was involved in the new departure through the method he developed, with Meusnier, for producing the inflammable air by passing steam over a red-hot gun barrel. Opinions on what was happening in this process were divided. Berthollet gave his interpretation in a letter of 10 April 1784 to Blagden:

Mr Lavoisier believes that the water in this experiment has been decomposed, that its dephlogisticated air has combined with the iron, and that its inflammable air has escaped. My own opinion is that the inflammable air is simply being given off by the iron. But we must await the experiments on which they [Lavoisier and Meusnier] are still engaged to determine the issue and which they are to make public at the meeting of the Académie to be held on the 21st of this month. Meanwhile, it will very probably be possible for the process to be used on a large scale.

In his next letter, of 6 September 1784, Berthollet described the reading of two papers by Lavoisier on the decomposition of water:

[Lavoisier] has claimed to have proved that all the inflammable gas that is obtained when metals are dissolved in acids comes neither from the metals nor from the acids; rather, the metals take hold of [s’emparent de] the dephlogisticated air in the water and are thereby
reduced to a calx, making them soluble in the acids. Then the other part of the water, the inflammable air, is given off.\textsuperscript{75}

Berthollet’s summary of Lavoisier’s position was accurate. But he remained unconvinced, as the words ‘claimed to have proved’ indicate.

In the journal \textit{Observations sur la physique}, the attacks on Lavoisier’s interpretation were virulent.\textsuperscript{76} In response to Lavoisier’s view that water was a compound substance, the editor published a translation of a paper that Cavendish had begun reading at the Royal Society on 15 January 1784. In this paper, entitled ‘Experiments on air’, Cavendish claimed that it was he who had first shown that water was the sole product when inflammable air (hydrogen) was burned in dephlogisticated air (oxygen), and that the water so produced (a simple substance in Cavendish’s view) resulted from the condensation of the two gases. Cavendish also stated that his earliest experiments on the subject dated from the summer of 1781 and that he had told Priestley about them. He then added: ‘it was during last summer [that is, the summer of 1783] that a friend of mine passed the information to M. Lavoisier and told him of my conclusion that dephlogisticated air is water deprived of phlogiston’.\textsuperscript{77} According to Cavendish, Lavoisier had not believed the interpretation until he had repeated the experiment himself. The friend in question can only have been Blagden. Hence, in Cavendish’s opinion, it was Blagden who conveyed the information to Lavoisier and his circle. The subsequent publication of the translation of Cavendish’s paper in the \textit{Observations sur la physique}, beginning in December 1784 and continuing, in parts, through the first half of 1785, completed the process, making all the elements of the debate of 1785 available to the French community.

Lavoisier and Meusnier began preparing for what has come to be known as the ‘great water experiment’ in December 1784. On 27 and 28 February 1785 they decomposed water into its constituents and recomposed them in the presence of specially appointed witnesses, who then formally sealed the products. The last of a series of verifications was conducted on 12 March,\textsuperscript{78} helping to make 1785 a year of conversions, Berthollet’s among others.\textsuperscript{79} Among the British, Cavendish came over to Lavoisier’s view in 1787.\textsuperscript{80} Priestley never did.

A number of other letters to Blagden, besides Berthollet’s, help to build a picture of the course of the water controversy. On 7 March 1785 (when the academicians completed their analyses of the products), Laplace wrote promising to send Blagden information in forthcoming correspondence.\textsuperscript{81} This followed a letter in the previous year in which Laplace had already conveyed his opinion:

\begin{quote}
Allow me to mention to you the decomposition of water, which I believe to be highly probable and which has been the object of a number of experiments here. Reflecting on the nature of the inflammable air released from metals when they are subjected to the action of acids, I had great difficulty in attributing this either to the acids or to the metals.\textsuperscript{82}
\end{quote}

Jean Darcet’s conversion to the new chemistry is also reflected in the correspondence. The experiment of 1785 was probably decisive in bringing him to a view that he had been far from accepting a year earlier, when Cavendish’s paper seems to have first alerted him to a possible new interpretation. On 19 July 1784, he had written to Blagden: ‘M. Cavendish’s discovery is certainly very important, since it leads us towards an understanding of the analysis of water, something from which we had previously been far removed’.\textsuperscript{83}
Letters reached their destination by varied and sometimes circuitous routes. Where possible, writers avoided the postal service, which was costly. Instead, they took advantage of couriers working for wealthy families or travelling on official governmental service. Claude de La Blancherie advised Blagden to send his correspondence with that of Calonne, the French controller of finance. But when writing to Banks from Paris, Blagden sent his letters via the House of Orléans. Individual travellers also took with them letters or parcels on behalf of friends and family. Peter Woulfe, for example, carried a letter of Darcet’s for Blagden, along with a copy of a book by Victor-Aimeé Gioanetti that Blagden wanted. In the other direction, Woulfe took correspondence and other items destined for the French community. Travellers also transported books that had been ordered, purchasing them and then seeking reimbursement or favours in return.

Communication could be rapid. Letters between Blagden and Banks took a week or so to cross the Channel. On occasions, though, items were lost or were delivered only after considerable delay, as happened with Catueán’s message to Blagden, mentioned above. Such mishaps could cause anxiety or even indignation. A short work by Laplace was a victim of this type of misfortune. On 24 February 1784 Laplace advised Blagden that he was sending him a parcel containing two packages via the Parisian bookseller Barrois l’aîné, who was to have it delivered to Joseph White, a bookseller in London. One of the packages contained 11 copies of Laplace’s ‘brief physical astronomy’ for Blagden to distribute to friends and colleagues. The work in question was Laplace’s *Théorie du mouvement de la figure elliptique des planètes*, to which the Academy had given its formal approval on 31 January. By 8 June the books had still not reached their destination. They had clearly been lost en route or mislaid in White’s shop, and Laplace was obliged to send extra copies.

No correspondence between Blagden and Lavoisier has survived from this period, apart from a letter of 30 April 1785 from Lavoisier introducing Charles Gossard de Virly, a man who had (in Lavoisier’s words) ‘already travelled almost the whole of Europe, attended Bergmann’s lectures on chemistry, and accompanied Morveau on a [balloon] ascent’. Quite a lot of the Blagden correspondence is concerned with such introductions, of which Blagden himself must have been a beneficiary. In 1784 we find Pierre-Marie-Auguste Broussonet writing to introduce the count of Castiglioni. And in the following year Étienne Anisson, the son of the director general of the royal printing office, wrote to Blagden to thank him for the welcome he had received during a visit to London and to invite Blagden to visit him during any forthcoming visit to Paris.

As we have seen, many letters conveyed news of current research or requested news of work in progress. As part of this exchange, Blagden gathered information about light phenomena: his source was the academician Jean-Baptiste Le Roy, who also suggested the possibility of a translation of Blagden’s paper on the freezing of mercury. Temperaments, irritations, and marks of friendship all shone through in the letters, revealing much about the social and intellectual milieu in which they were written. As Patrice Bret has observed, correspondence of the period provides us with a privileged view of the conduct of science, if only because letters were the fastest means of communication, much faster than the process of publication, which could take anything from a few weeks to several years.

Although letters invariably obeyed the conventions of the Republic of Letters, in the restrained tone that was *de rigueur* at the time, friendship could sometimes take second place to espionage or what contemporaries believed to be espionage. Certainly the visit to Britain
by Georges-Louis Leclerc de Buffon’s friend Barthe`lemy Faujas de Saint-Fond in 1784 was also the occasion for Faujas to gather technological and other information bearing on Britain’s economic success. In 1788, in the other direction, Blagden regretted that he had been unable to obtain an introduction from Lavoisier that would have secured him entry to the ironworks at Le Creusot. Instead, he turned to Guyton de Morveau, and that approach seems to have worked. The founder of Le Creusot, Wendel, welcomed Blagden warmly.

In his book *The sciences were never at war* (1960), Sir Gavin de Beer used correspondence between British and foreign men of science from the time of Hans Sloane to that of Humphry Davy to show that although the pace of correspondence diminished somewhat in time of war, exchanges continued through even the most intense periods of conflict and regained their intensity undimmed as soon as peace returned. The pattern of Blagden’s contacts with his French peers illustrates the point well. Immediately on the signing of the short-lived peace of Amiens in 1802, he returned to France. There he was even invited by one of the three consuls who ruled the country at the time, the consul in question being almost certainly the First Consul Bonaparte. Now, as through his life, Blagden’s world was one without frontiers. It was quintessentially the world of the *siecle des lumie`res*, a world whose life-blood was the free communication of news, both scientific and non-scientific, and the sharing of opinions and experiences. As a citizen of that world, Blagden was in his element.

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**NOTES**

1 Charles Blagden’s letters, in six volumes in the archives of the Royal Society (cited hereafter as RSA), are arranged in alphabetical order by correspondent. I refer to the correspondence as CBC. For a study of Blagden’s work, see Frederick H. Getman, ‘Sir Charles Blagden’, *Osiris* 3, 69–87 (1937).

2 Biographical information throughout the article is taken from national biographical dictionaries, the *Dictionary of scientific biography* (ed. Charles Gillispie) and the *Index biographique de l’Académie des sciences, 1666–1978* (Institut de France, Gauthier-Villars, 1979). I also draw on Warren R. Dawson’s calendar of the correspondence of Joseph Banks: *The Banks letters. A calendar of the manuscript correspondence of Sir Joseph Banks* (Trustees of the British Museum,
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8 For a first-hand account of Blagden’s funeral, see the letter from Robert Chenevix to Charles Hatchett, 3 April 1820 (RSA, MS, 859/2/33). I am grateful to Keith Moore for drawing my attention to this letter.

9 The first flight of a hot-air balloon, built by the Montgolfier brothers, took place on 4 June 1783 at Annonay in the Ardèche. The first ascent of a hydrogen balloon dated from 27 August 1783 from the Champ de Mars in Paris. The first hot-air montgolfière to be demonstrated in Paris, on 12 September, was destroyed by rain, but an ascent on 19 September was a success. Blagden had therefore returned to England by the time of the Parisian trials. See *OLC*, vol. IV (1784–1786), introduced by M. Goupil, annex II, p. 293 (Belin, Paris, 1986). See Charles C. Gillispie, *The Montgolfier brothers and the invention of aviation, 1783–1784* (Princeton University Press, 1983).


13 RSA, MS, Journal Book, vol. 31. In *Philosophical Transactions*, the words ‘read January 16, 1783’ appear at the head of the article: ‘An Account of a new eudiometer’, *Phil. Trans. R. Soc.* 73,
106–135 (1783). In fact, the paper was received on that date. As the Society’s Journal Book confirms, it was read on 20 and 27 February. The original manuscript of the paper (RSA, Letters and Papers, Decade VIII, no. 18) shows how easily the word ‘rec’d’ could be misread as ‘read’.

The procedure was conceived in the context of the theory of phlogiston, an inflammable principle that could never exist in a free state but which was present in many substances. When a substance rich in the principle reacted with one that was not, phlogiston was assumed to pass from one to the other. In Cavendish’s experiment, phlogiston passed from ‘nitrous air’ to ‘common air’, which was thereby ‘phlogisticated’. The test for ‘nitrous air’ (NO) could only indicate the degree of phlogistication of common air; it conveyed nothing about the nature of gas or (for opponents of the phlogiston theory) its composition: in Cavendish’s words, ‘But it must be observed, that the nitrous test shews the degree of phlogistication of air, and that only’ (Cavendish, op. cit. (note 13), p. 135). In modern terminology, we should say that nitric oxide combines with the oxygen of the air, liberating nitrogen (phlogisticated air).


Joseph Priestley, ‘Experiments relating to phlogiston, and the seeming conversion of water into air’ [communicated by Sir Joseph Banks, and read on 26 June 1783], *Phil. Trans. R. Soc.* 73, 398–434 (1783), esp. p. 399.


18 James Watt, ‘Thoughts on the constituent parts of water and of dephlogisticated air; with an account of some experiments on that subject’ [letter to Jean-André Deluc, 26 November 1783, read 29 April 1784], *Phil. Trans. R. Soc.* 74, 329–353 (1784).

19 A corresponding member of the Académie royale des sciences was an elected member attached to a named academician. The diplomat and botanist Edmond–Charles Genest (usually known as Genet) had been a correspondent of the duc La Rochefoucauld d’Enville since 21 August 1782. See *Registres manuscrits des procès-verbaux des séances de l’Académie royale des sciences* (cited hereafter as *RMARS*) for 1783, p. 115v. These registers are available on the Gallica site of the Bibliothèque nationale de France, under the title ‘Procès-verbaux/Académie royale des sciences’ (http://gallica.bnf.fr/ark:/12148/cb375720275/date).

20 *RMARS* (1783), p. 117r.

21 Dephlogisticated air and inflammable air corresponded to oxygen and hydrogen, respectively.

22 Archives de l’Académie des sciences de Paris (cited hereafter as ArAS), envelope for the meeting on 14 May 1783.


24 *RMARS* (1783), p. 138. See also William A. Smeaton, ‘Is water converted into air? Guyton de Morveau acts as arbiter between Priestley and Kirwan’, *Ambix* 15, 73–83 (1968). Guyton de Morveau responded cautiously to this idea of Priestley’s: see especially p. 77. See also Grison et al., *op. cit.* (note 11), letter from Guyton to Kirwan, 10 April 1783, and letters from Kirwan to Guyton, 14 and 22 May 1783, pp. 59–73.

25 See note 16.

26 RSA, MS, Letters & Papers, Decade VIII, no. 29.


28 Thomas Hutchins, ‘Experiments for ascertaining the point of mercurial congelation’, *Phil. Trans. R. Soc.* 73, 303–370 (1783), see p. 307 and pl. p. 370.

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32 Ibid., 303–304. Today’s value is –38.9°C. On the Fahrenheit scale, 40°F ‘under cypher’ corresponds almost exactly to –40°C. Some of the thermometers were built by Nairne and Blunt and others by Troughton.

33 Ch. Blagden, ‘History of the congelation of quicksilver’, Phil. Trans. R. Soc. 73, 329–397 (1783).


35 RSA, MS, Blagden’s Diary, 3rd notebook, esp. 30 January 1783, p. 57. This diary shows that Blagden and Banks often dined at the Crown and Arms, for example on this 30 January 1783, the day after he had dined in the more formal environment. For the dinner at Banks’s house, see Barthélemy Faujas de Saint-Fond, Voyage en Angleterre, en Écosse et aux îles Hébrides (2 volumes), pp. 6–7 (H.-J. Jansen, Paris, 1797); translated by A. Geikie as A Journey through England and Scotland to the Hebrides in 1784 (2 volumes) (Glasgow, 1907). See also Allibone, op. cit. (note 3).


37 The new Hôtel des Monnaies was built in 1775. In its laboratories, the head of the royal assaying services, Mathieu Tillet, worked with precious metals. See M. Tillet, ‘Sur les méthodes qu’employent les essayeurs pour fixer le titre des matières d’or’, in Histoire de l’Académie royale des sciences pour 1776, avec les mémoires (cited hereafter as HARS), Mémoires, pp. 377–430 (Imprimerie royale, Paris, 1779).


39 Blagden to Banks, 11 June 1783, in Dawson, op. cit. (note 2), p. 56, and Chambers, op. cit. (note 2), vol. 2, pp. 86–88. The quotations that follow are from these sources.


47 See also CBC, vol. IV, L.31: Jean-Baptiste Le Roy to Blagden, 10 February 1784.


49 The tensions in the Royal Society are alluded to in CBC, vol. II, B.331: Pierre-Marie-Auguste Broussonet to Blagden, 12 October 1784. See also Lyons, op. cit. (note 44); also Chambers, op. cit. (note 2), vol. 1, General introduction, pp. XXIII–XXVI.


54 CBC, vol. III, C.13: Catueulan to Blagden, 2 September [1784]. Blagden’s election was reported in RMARS (1784), 1 September 1784, p. 228v.
57 See M. Sadoun-Goupil (1977), op. cit. (note 5); idem, ‘Inventaire et analyse de la correspondance inédite de Berthollet’, typescript in Berthollet’s file (ArAS).
64 ArAS, dossier Lavoisier, laboratory notebook, no. VIII.
65 RMARS (1782), 5 June, p. 102. Lavoisier had used them since 1782 to obtain the high temperatures required for melting refracting substances. See Jean-Baptiste Meusnier, ‘Description d’un appareil propre à manoeuvrer différentes espèces d’air’, HARS pour 1782, Mémoires, pp. 466–475, pl. 475 (Paris, 1784).
66 RMARS (1783), 25 June, p. 144.
68 For Lavoisier, the reaction of the oxygen principle with another substance necessarily led to the formation of an acid. This was conveyed in the etymology of oxygen, signifying ‘acid-producer’.
69 See note 67.
73 J.-B. Meusnier and A. Lavoisier, ‘Mémoire où l’on prouve par la décomposition de l’eau, que ce fluide n’est point une substance simple, etc.’ [read by Meusnier on 21 April 1784], HARS pour 1781, Mémoires, pp. 259–283 (Paris, 1784).
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77 Translated from Bertrand Pelletier’s French translation of Cavendish’s paper, ‘Experiments on air’, Phil. Trans. R. Soc. 74, 119–153 (1784). See the French translation in OP, vol. 26 (1785), esp. p. 39; cf. the original sentence in Phil. Trans. R. Soc., op. cit., p. 134: ‘During the last summer also, a friend of mine gave some account of them to M. Lavoisier, as well as of the conclusion drawn from them, that dephlogisticated air is only water deprived of phlogiston.’ Inflammable air (hydrogen), in contrast, was water saturated with phlogiston. In the reaction between the two gases, the production of water was accompanied by the escape of phlogiston, manifested by the release of a large quantity of heat. The French translation was published under the title, ‘Expériences sur l’air’, OP, vol. 25, pp. 417–429 (1784); idem, vol. 26, pp. 38–51 (1785); idem, vol. 27, pp. 107–116 (1785). Cavendish was so dissatisfied with Pelletier’s translation that he arranged for a new translation to be published in London in 1785.

78 ArAS, dossier Lavoisier, the last entry in laboratory notebook no. X.


80 See Grison et al., op. cit. (note 11), p. 167. Letter from Kirwan to Guyton, 2 April 1787: ‘PS. Mr Cavendish a renoncé au phlogistique.’


82 Ibid., L.17: Laplace to Blagden, 8 June 1784.

83 Ibid., L.17: Laplace to Blagden, 8 June 1784.


86 CBC, vol. II, B.166: Blagden to Banks, 27 June 1783. Berthollet was a physician to the House of Orléans, and this provided a means of transmitting correspondence that was frequently used by Blagden. The Orléans household had close relations with several prominent figures in Britain.


88 See note 54.


CBC, vol. IV, L.17: Laplace to Blagden, 8 June 1784.

CBC, vol. III, D.4: Lavoisier to Blagden, 30 April 1785. The letter is wrongly identified in the catalogue of the Royal Society as signed by ‘Dannuit’. In fact, the signature is Lavoisier’s. The catalogue also gives the date wrongly as 30 April 1789. Patrice Bret has identified the letter as corresponding to the draft in the archives of the Académie des sciences, published in OLC (1986), op. cit. (note 9), p. 115. Charles Gossart de Virly was a prominent citizen of Dijon, and a member of the city’s Academy of Dijon.

CBC, vol. II, B.331: Broussonet to Blagden, 12 October 1784. The style of Broussonet’s letters suggests a very close friendship with Blagden.


La Blancherie complains about Faujas de Saint-Fond in a letter to Blagden, in CBC, vol. IV, L.1, 13 July 1785, and idem, L.2, 18 July 1785.


