

Benjamin Franklin

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BENJAMIN FRANKLIN

By R. V. JONES, F.R.S.

[Plates 3 and 4]

BENJAMIN FRANKLIN was, at the age of 70, the oldest man to sign the Declaration of Independence. He had done more than anyone else to keep America within the British Empire; and now he was to play a key part in the War that won Independence for the American Colonies. On any one of these counts he would deserve a place in any Celebration of that Independence; but in this audience of science and learning he has a very special claim as a man of science and wisdom who had a warm social conscience, deep in loyalties and affection both for the Colonies in which he was born and for the motherland from which his forebears had come. Of the many facets of his life, I shall not concentrate on one alone, for that would be misleadingly unbalanced: nor shall I cover them all, for that would be impossible. Instead, I shall mention just a few in the hope of giving some impression of that interplay of the natural philosopher and the public servant which, combined with his shrewdness and his robust sense of humour, makes him such a fascinating subject of study, especially in the context of his scientific and political contemporaries.

The Franklins came from Northamptonshire and Oxfordshire. His father, Josiah, emigrated from Banbury in about 1685 with his wife Anne; after Anne's death in America giving birth to her seventh child, Josiah married again, this time to Abiah Folger of Nantucket. Of their ten children, our Benjamin, born on 6 January 1706 Old Style, was the eighth. Josiah had been a dyer in Banbury, and became a tallow chandler in Boston. He had a mechanical genius and a solid judgement, qualities which Benjamin both recognized and inherited. Apprenticed at 10 to his father's business, which he did not enjoy, Benjamin dreamed of the sea: his father, fearful of losing him, then apprenticed him at 12 to his half-brother James, who was a printer in Boston, for five years. Later, working in Philadelphia, he was noticed by the Governor, William Keith, who persuaded him in 1724 to go to London to complete his training as a printer and to collect the materials for setting up a press in Philadelphia.

Franklin found himself in the London of Newton, Swift, Defoe, Fielding and Samuel Richardson. As a young printer, he aroused the admiration of his fellow journeymen with his physical strength, one of his feats being to swim from Chelsea to Blackfriars. He began to question the validity of what he was asked to print, and was therefore moved to write a book of his own on liberty

and religion. The hundred copies that he then printed brought him to the notice of the coffee houses, and he thereby nearly realized an ambition to meet Newton. He was already beginning to thrust himself forward and, by offering some North American curiosities to Hans Sloane (1660–1753), the Secretary of the Royal Society, he won an invitation to see the latter's treasures at his house in Bloomsbury Square.

After nineteen months in London, Franklin returned to Philadelphia in 1726 and within two years he set up a press that over the next decade became the most flourishing in the Colonies. With his lively outlook and a press at his disposal, he began to write his own material; and by 1732 he had produced his first edition of *Poor Richard's Almanack*, which made his fortune. He became public printer to the State of Pennsylvania, married, and started to publish his own political studies such as *A Modest Enquiry into the Nature and Necessity of a Paper Currency* (1729). Over the years he cultivated a reputation for diligent respectability: 'In order to secure my credit and character . . . I took care not only to be in reality industrious and frugal but to avoid all appearance to the contrary. I dressed plainly: I was seen at no place of idle diversions. I never went out a-fishing or shooting . . .' (1).

In 1736 he became Clerk to the Pennsylvania Assembly, and in 1737 Postmaster at Philadelphia. In 1743, observing that the first drudgery of settling the new Colonies was over, he started a proposal to form the American Philosophical Society as a focal point for the furtherance of learning in America; and his scientific bias now emerged, for the Philadelphia members, who were to form the nucleus of the Society, should always include a physician, a botanist, a mathematician, a chemist, a mechanic, a geographer, and a general natural philosopher. The Society was founded in 1744, with Franklin as its first Secretary; in its *Journal* he published an account of the stove that he had invented a few years earlier.

In 1746 he met a Dr Spence who had just arrived from Scotland, and who showed him some electrical experiments. Fascinated, Franklin bought Spence's apparatus, and then he asked Peter Collinson (1694–1768, F.R.S. 1728) to send him more from London. Collinson, a Quaker mercer and a naturalist, had built up a business with the American Colonies, and had been helpful to Franklin and his friends in sending them books for one of Franklin's earliest projects, a library for Philadelphia. By 25 May 1747, as shown in a letter to Collinson (2), he had made two important steps; the first was his concept of electricity as a single fluid rather than two, as had been earlier supposed, and the second the substitution of 'positive' and 'negative' for what had hitherto been called vitreous and resinous electricities.

These important concepts had come from an original experiment which Franklin had performed, and which turned out to be one of the most fundamental in physics. It was done with three observers, two of whom stood on insulating wax. If one of these held and rubbed a glass tube (actually supplied by Collinson) electric charge was generated on the glass, and this could be communicated to the second observer by getting him to touch the glass. After this, Franklin found that both observers were capable of giving a spark to the third observer, standing on the ground, so that they both appeared to be electrified. But if the two insulated observers were allowed to make bodily contact before the third observer approached them, neither could give him a spark. From this Franklin deduced that the action of rubbing the glass gave a charge to the first observer that was opposite to that which he generated on the glass, and equal to it in amount. In other words, the generation of any amount of electrical charge was always balanced by the simultaneous generation of an equal amount of charge of the opposite kind. Thus, if the sum total of electric charge was zero before the rubbing, it was still zero afterwards, so that Franklin had discovered the great law of conservation of charge.

He went on to explain his results by assuming that normal matter was electrically neutral, containing equal and opposite amounts of electric charge, the one kind being associated with the fixed matter and the other with the fluid part: the rubbing process involved the transference of a single electrical fluid, of which one body, say the rubbed one, now had excess, and the other a deficiency, the latter revealing itself as a charge of opposite sign because this was the inherent charge of the immobile matter. This led him to the concept of positive and negative charges, and for good experimental reasons, such as the resinous electricity seeming to flow away from points into the surrounding air, he decided that the mobile fluid had the positive charge, although a century and a half later it was found that it was the negative charge, consisting of electrons, that was the mobile one.

Franklin was also enthusing about the 'wonderful effects of pointed bodies, both in drawing off and throwing off the electrical fire' (3) which were later to suggest the lightning conductor. In 1749 he catalogued the similarities between lightning and man-made electrical discharges; on 2 March 1750 he wrote to Collinson 'The doctrine of points is very curious, and the effects of them truly wonderful; and, from what I have observed on experiments I am of the opinion that houses, ships, and even towers and churches may be effectively secured from the strokes of lightning by their means' (4).

On 29 July 1750 he again wrote (5) to Collinson proposing an experiment to the Royal Society:

To determine the question, whether the clouds that contain lightning are electrified or not, I would propose an experiment to be tried where it may be done conveniently. On the top of some high tower or steeple, place a kind of sentry-box [as in Figure 9*] big enough to contain a man and an electrical stand. From the middle of the stand let an iron rod rise and pass bending out of the door, and then upright 20 or 30 feet, pointed very sharp at the end. If the electrical stand be kept clean and dry, a man standing on it when such clouds are passing low, might be electrified and afford sparks the rod drawing fire to him from a cloud. If any danger to the man should be apprehended (though I think there would be none) let him stand on the floor of his box, and now and then bring near to the rod the loop of a wire that has one end fastened to the leads, he holding it by a wax handle; so the sparks, if the rod is electrified, will strike from the rod to the wire, and not affect him.

The Society did not publish his paper in full, although it was read and received in a friendly manner; Franklin records in his autobiography that John Mitchell (d. 1768, F.R.S. 1748) told him that it had been 'laughed at by the connoisseurs' (6), but the contemporary evidence contradicts this (7). John Fothergill (1712-1780, F.R.S. 1763, M.D. Edinburgh, who first identified diphtheria) urged that Franklin's letters to Collinson should be published, and Edward Cave (1694-1754) produced them as a pamphlet with a preface by Fothergill. A translation was made in France, and Buffon, the Keeper of the Jardin du Roi, and others determined to try Franklin's lightning experiment: and on 10 May 1752 they succeeded. Sparks jumped between the rod and the wire, as Franklin had expected. The King of France himself sent the news to the Royal Society, and the experiment was now successfully repeated in England. Franklin was famous in Europe before he, in America, knew that it had worked.

Franklin himself appears in the meantime to have devised and tried the famous kite experiment. Later in the year (19 October) he published an account in his *Gazette* (8); and *Poor Richard's Almanack* for 1753 gave Franklin's first positive statement of how to secure houses, etc., from lightning by means of earthed lightning conductors. His account (9) of the kite was read at the Royal Society, and printed in its *Transactions* for 1752; it awarded him its Copley Medal in 1753, and in 1756 made him a Fellow. Franklin's acknowledgement of the Medal is worth quoting:

The very great Honour you have done me in adjudging me your Medal for 1753 demands my grateful Acknowledgements, which I beg you would accept as the only return at present in my Power.

* See figure 1 in this paper.

terrible & useless.

The Question, Whether
 Lightning are electrical
 propose an Experiment
 to be done conveniently,
 high Tower or Steeple,
 Box big enough
 to an electrical
 side of the Stand
 and pass bending
 then upright 20 or
 there at the End.
 be kept clean
 being on it
 & passing
 tied, and



afford

FIGURE 1. Franklin's proposed 'Sentry Box' experiment reproduced from the Bowdoin MS in the American Academy of Arts and Sciences. The Bowdoin MS is a manuscript copy of Franklin's early letters and papers on electricity which he had made for James Bowdoin, first President of the American Academy of Arts and Sciences, and the first American Fellow (1788) of the Royal Society

I know not whether any of your learned Body have attained the ancient boasted Art of *multiplying* Gold; but you have certainly found the Art of making it infinitely *more valuable*.

You may easily bestow your Favours on Persons of more Merit; but on none who can have a higher sense of the Honour, or a more perfect Respect for your Society and Esteem of its excellent Institution, than

Gentlemen,

Your most obliged
and most obed^t Servant

B. Franklin.

The foregoing account gives but the barest idea of the exciting state of electricity at the time, in which Franklin played so great a part. The Leyden Jar had been discovered by Musschenbroek as recently as 1746, and the effects of electrical shock were almost as much a subject of popular attention as the nuclear bomb has been in our own day. As Priestley (10) records in *The History and Present State of Electricity* (1767): 'It seems that in France experiments were first made to try how many persons might feel the shock of the same phial (i.e. Leyden Jar). The Abbé Nollet, whose name is famous in electricity, gave it to one hundred and eighty of the guards, in the King's presence; and at the grand convent of the Carthusians in Paris, the whole community formed a line of nine hundred toises, by means of iron wires between every two persons (which far exceeded the line of one hundred and eighty of the guards) and the whole company, upon the discharge of the phial, gave a sudden spring, at the same time, and all felt the shock equally'. So with demonstrations such as these where neither military uniform nor the cloth conferred immunity from electric shock, Europe was well prepared to receive the electrician from the American Colonies when in 1757 he came for his second visit.

The events leading up to this visit were not, however, scientific, but political; and for the background we must revert to the part that Franklin was playing in Philadelphia, where his scientific activities were merely an absorbing sideline. Besides his work with the American Philosophical Society and the Library, and as Postmaster of Philadelphia, he had in 1749 founded an Academy in which the central themes were to be the English language and practical studies; but to his annoyance English was gradually ousted by Latin through local pedagogic snobbery (11). In 1750 he became a member of the Assembly of Pennsylvania, and he represented the Colony in various activities. In 1751 came the first of his warnings to the British Government for, as later with Botany Bay, it was exporting convicts to America. Writing as 'Americanus' in his

Gentlemen,

Philad May 29. 1754.

The very great Honour you have done me, in adjudging me your Medal for 1753, demands my grateful Acknowledgements, which I beg you would accept, as the only Return at present in my Power. —

I know not whether any of your learned Body have attain'd the ancient boasted Art of multiplying Gold; but you have certainly found the Art of making it infinitely more valuable.

You may easily bestow your Favours on Persons of more Merit; but on none who can have a higher Sense of the Honour; or a more perfect Respect for your Society and Esteem of its excellent Institution, than

Gentlemen,

Your most obliged
& most devoted servant

B. Franklin

Presid. Council of
the Royal Society.

FIGURE 2. Franklin's letter of 29 May 1754, acknowledging the award of the Copley Medal.

Gazette for 9 May, he urged that America should offer something in repayment. If felons were the scourge of Britain, rattlesnakes were the scourge of America. Instead of putting them to death, the Americans should therefore export them to Britain: 'There I would propose to have them carefully distributed in St James's Park, in the Spring Gardens and other places of pleasure about London; in the gardens of all the nobility and gentry throughout the nation; but particularly in the gardens of the prime ministers, the lords of trade, and members of Parliament, for to them we are most particularly obliged' (12).

Struck by the danger from the French, he published in 1754 his *Plan for a Union of the English Colonies in America*, for the western borders of the Colonies were threatened by the French and the Indians, the focus of activity being a fort which George Washington was attempting to build. Before he could complete it his workmen were driven out and he himself had to surrender to the French, who completed it as Fort Duquesne. In 1755, the English tried to take it back, with a force commanded by General John Braddock of the Coldstream Guards; Franklin assisted him nominally as Communications Officer by virtue of his office as Postmaster General, but in practice as Transport Officer as well. In addition, he raised the Pennsylvania Militia and was elected their colonel. Braddock was heavily defeated and killed, and the Colonies lay open to attack from the west by the French and the Indians. Franklin observed that British Army tactics were quite mismatched to the American terrain, a lesson which the colonists took to heart. A line of seventeen forts was built under his direction, to hold the mountain gaps; and in 1758 a further expedition under General John Forbes took Fort Duquesne which was re-named Fort Pitt; and the log settlement around it grew into Pittsburgh. It was in this war, incidentally, that the tune 'Yankee Doodle' emerged as an American Colonial March (13), one of the alleged origins of 'Yankee' being what the Indians called the English, from trying to imitate the French 'Anglais'. The danger from the French now receding, the Colony sent him to London in 1757 to see whether he could negotiate for the Penn family to give up their proprietary right not to pay taxes.

Franklin's two principal friends in London were Peter Collinson and William Strahan (1715-1785) the printer of Johnson's Dictionary and also of the works of Hume, Adam Smith and Gibbon. Taking lodgings at No. 7 (later 36) Craven Street, off The Strand, Franklin had his first direct contact with the Royal Society through its Dining Club, where he was a guest as early as 25 August: the list of members and their guests, and the menu (where one of the puddings appears to have been named in anticipatory honour of an eminent contributor to this Celebration) is shown at Figure 4. On 7 September 1757 he attended a meeting of the Society of Arts, to which in the previous year he had

Benjamin Franklin Esq
of Philadelphia,

a gentleman, who has very eminently distinguished himself by various discoveries in natural philosophy, & who first suggested the experiments to prove the analogy between lightning & electricity, being desirous of being elected a fellow of the royal Society, is recommended by us in consideration of his great merit, & of his many communications as highly deserving the hon our he desires.

Macclesfield

Parker

Willoughby

Sturton
Watson.

Mr. Birch.

Jam. Paine

J. Canton

Order 29 January 1756.

1 Feb. 5.

2 --- 12.

3 --- 19.

4 --- 26.

5 March 4.

6 --- 11.

7 --- 18.

8 --- 25.

9 April 1.

10 --- 8.

Ballotted & Elected

May 29. 1756.

FIGURE 3. Franklin's proposal form for the Society

sent twenty guineas to be used in premium for encouraging technical improvements. His first formal meeting of the Royal Society was on 24 November, and he attended the Annual Dinner six days later.

In the meantime he had fallen ill, and was attended by Fothergill, who had urged the publication of Franklin's letter about lightning and who now became his doctor throughout his stay in England. He also became friendly, through his study of the effects of electricity on paralytics, with a second medical man, John Pringle (1727–1782, F.R.S. 1745) the pioneer of military medicine who was later (1772–1778) to be President of the Royal Society and physician to George III. Another of his Royal Society contacts was the great clockmaker, James Ferguson (1710–1776, F.R.S. 1763) who made a clock incorporating features of a design by Franklin which showed hours, minutes, and seconds, with a gear train of only three wheels (14).

In July 1758, Benjamin and his son William visited their ancestral homes at Ecton in Northamptonshire and Banbury, and also travelled to Tunbridge Wells and East Anglia. In February 1759 the University of St Andrews awarded Franklin the Honorary Degree of Doctor of Laws, for which he was always grateful since it gave him the title 'Doctor'. Later in the year he visited Scotland, meeting amongst others Adam Smith, William Cullen, John Anderson, and David Hume. There he formed a close friendship with Lord Kames, Judge of Session in Edinburgh, the man whose life Boswell wanted most to write after Johnson's. Subsequently Franklin wrote to Kames on 3 January 1760, and made a comment which shows his feelings about Britain and America: 'I have long been of the opinion that the foundations of the future grandeur and stability of the British empire lie in America; and though, like other foundations, they are low and little seen, they are nevertheless broad and strong enough to support the greatest political structure human wisdom ever yet erected' (15).

In the same year, 1759—Pitt's *annus mirabilis*—the British defeated the French at Quebec, and the question arose of whether France should cede Canada or Guadeloupe; Franklin was influential in determining the choice of Canada as providing further scope for a complete occupation of North America. He thought that there was no danger of the Colonies ever uniting against Britain, pointing out that they had never even united for their defence against the French and the Indians. Only the most grievous tyranny and oppression could bring about such a union for 'The waves do not rise but when the winds blow' (16).

In correspondence with Hume, Franklin argued the merits of a living language, when Hume had criticized his tendency to invent words such as 'colonize' and 'unshakeable', even wanting to replace inaccessible by 'uncomeatable';

Aug. 25 1757
 Earl of Macclesfield Mr Stanhope
 Mr Paper — vis^r Dr Squire
 Mr Franklin — Do Dr Muncckley
 Dr Hinckley — Do Mr Wray
 Mr Wilson — Do Dr Knight
 Dr Birch

Dinner.

Salmon & Smelts	Trout & flat fish
Fowles & Bacon	Roast Beef
Goose Roast	Pidgeon pye
Pease	Plumb pudding
Codling pye Creamed	Haunch of venison
Currant & Cherry pye	Butter & Cheese

The Company being entertained with a
 Haunch of Venison by Mr Wray his health
 was drunk in Claret

FIGURE 4. Record of the Royal Society Club for 25 August 1757, showing Franklin's first attendance

and he hoped that 'We shall always in America make the best English of this island our standard, and I believe it will be so. I assure you it often gives me pleasure to reflect how greatly the audience (if I may so term it) of a good English writer will, in another century or two, be increased by the increase of English people in our colonies' (17). Struck by this argument, Hume seven years later urged Gibbon to write in English and not in French. Gibbon answered that he did not aim 'to instruct or amuse our posterity on the other side of the Atlantic Ocean' (18) but he nevertheless wrote his great history in English.

In 1760 Franklin was elected to the Council of the Royal Society; he was elected again in three later years, 1765, 1766, and 1772. The Royal Society became almost a club for him, and he regularly attended meetings of its Dining Club. He also became co-Chairman in 1760 of the Society of Arts Committee on Colonies and Trade. And in 1762 Oxford recognized his eminence by making him an honorary Doctor of Civil Law.

Later in the same year he returned to Philadelphia, where he became Speaker of the Assembly; but there was still trouble with the Governor, John Penn, and so the Assembly sent Franklin back to England again in November 1764 to petition the King on its behalf. Even troubles with the Governor, however, were eclipsed by those which arose from the passage of the Stamp Act which, insensitive to Colonial feeling, Parliament passed in March 1765. It was a means of taxing the American Colonies. A large variety of transactions now had to have a stamp affixed to be legal—for example, the award of a university degree had to be franked by a stamp costing £2. This was greatly resented, and in the Virginian Assembly in May, Patrick Henry challenged the right of Britain to tax the Colonies.

Franklin was shocked by how little was known in London of the situation in America, and sublimated some of his annoyance in humour. Calling himself 'A Traveller' he wrote to *The Public Advertiser* a letter (19) which was published on 22 May 1765, ribbing Englishmen for their ignorance, and telling them that for example 'The very tails of the American Sheep are so laden with Wool that each has a Car or Waggon on four little Wheels to support and keep it from trailing on the Ground' and 'The grand Leap of the Whale in that Chase up the Fall of Niagara is esteemed by all who have seen it, as one of the finest spectacles in nature!'

In October delegates from nine Colonies attended the Stamp Act Congress in New York and drew up a declaration of rights and liberties. It fell to Franklin to put the American case before the British Parliament, and he was called in February 1766 before the Bar of the House. He drew his support from the Twelfth Clause of Magna Carta, of which a translation runs:

No 'Scutage' or aid may be levied in our kingdom without its general consent.

and the Bill of Rights of 1688, to argue that taxation without representation was illegal. His patient argument carried the day to the extent that in March 1766, Parliament repealed the Stamp Act by 275 to 161 votes; but a week later it passed a Declaratory Act, declaring that Britain nevertheless had a right to tax its American Colonies.

America and Britain were rapidly drifting apart. On 11 April 1767 Franklin wrote (20) to Lord Kames 'I have lived so great a part of my life in Britain, and formed so many friendships in it, that I love it and sincerely wish it prosperity; and therefore wish to see that union, on which alone I think it can be secured and established. As to America, the advantages of such a union to her are not so apparent. She may suffer at present in the arbitrary power of this country; she may suffer a while in a separation from it; but these are temporary evils that she will outgrow.'

As for his own position between Britain and America, he wrote (21) in 1768: 'Being born and bred in one of the countries, and having lived long and made many agreeable connections of friendship in the other, I wish all prosperity to both.' But, he added, 'I do not find that I have gained any point in either country, except that of being suspected of my impartiality; in England of being too much an American and in America of being too much an Englishman.'

His attempts to preserve the union now took exclusive priority over his science, for he found himself in a position that he had foreshadowed in a letter (22) of 11 October 1750 to Cadwallader Colden (1688-1776, yet another Scottish graduate—M.D. Edinburgh—Surveyor General and Lieutenant Governor of Pennsylvania), whom he had advised 'let not your love of philosophical amusement have more than its due Weight with you. Had Newton been Pilot but of a single common Ship the finest of his Discoveries would scarce have excus'd or atton'd for his abandoning the Helm one Hour in Time of Danger; how much less if she carried the Fate of the Commonwealth.'

We may in passing contrast Franklin's attitude with that of Thomas Jefferson, who in 1778 urged the astronomer David Rittenhouse to resume the scientific studies that he had deserted for revolutionary politics, declaring 'nobody can conceive that nature ever intended to throw away a Newton upon the occupation of a crown' (23).

It was at this stage, when Franklin was much occupied by his country's problems, that Joseph Priestley (1733-1804, F.R.S. 1766) was introduced to him. Priestley, a Unitarian Minister with a nascent interest in science, came to

London at the end of 1765 with a letter of introduction to John Canton (1718–1772, F.R.S. 1749), and a request for an introduction to Franklin. This was evidently effected, for on 14 February 1766 Priestley wrote to Canton telling him that he had informed Franklin of his intention to write a *Treatise on the History of Electricity* (24). In the course of writing it Priestley repeated Franklin's experiments, including one that Franklin told him that he had done more than ten years before. He had in fact described it in a letter (25) of 18 March 1755 to John Lining (1708–1760, M.D. Edinburgh, who settled at Charleston, S.C., and first described Yellow Fever); Franklin had electrified a silver pint can on an insulated stand, and found that a cork ball on a silk thread could be lowered into it without being attracted to one side or the other. 'You require the reason; I do not know it. Perhaps you may discover it, and then you will be so good as to communicate it to me.' He continued with the wise comment 'I find a frank acknowledgement of one's ignorance is not only the easiest way to get rid of a difficulty but the likeliest way to obtain information, and therefore I practise it: I think it an honest policy. Those who affect to be thought to know everything, and to undertake to explain everything, often remain ignorant of many things that others could and would instruct them in, if they appeared less conceited'.

Priestley produced his great *History* of 736 pages before the end of 1767, and on pages 731–733 he described his stop press repetition of Franklin's experiments with the electrified cup, which demonstrated that there is no resultant electrostatic force inside a hollow charged conductor; and he therefore concluded 'May we not accept from this experiment that the attraction of electricity is subject to the same laws as that of gravitation, and is therefore according to the squares of the distances, since it is easily demonstrated, that were the earth in the form of a shell, a body in the inside of it would not be attracted to one side more than another?' This was a first statement of the inverse square law of electrostatics, which was afterwards verified by direct measurement by John Robison (1735–1805) and Coulomb (1736–1806).

Priestley and Franklin became close friends, and on Franklin's recommendation the Royal Society awarded Priestley the Copley Medal for 1772. Priestley was also a member of Franklin's favourite Club, the *Honest Whigs* (26), which had a strong philosophical bias; Richard Price (1723–1791, F.R.S. 1765) like Priestley, was a Dissenting Minister and one of its members. Others were Canton, Collinson, Fothergill, Pringle, William Watson (1715–1787, F.R.S. 1741) and Matthew Maty (1718–1776, F.R.S. 1751, Foreign Secretary 1762–1766, and Secretary 1765–1773).

From the later attitudes of its members, we can imagine that much of their



Mezzotint by James McArdell of portrait of Franklin painted by Benjamin Wilson F.R.S., who was later to argue against pointed lightning conductors

talk was taken up with the problems of the American Colonies, but Franklin found a little time for scientific amusement. Remembering Pliny's statement that seamen of his time poured oil on the seas to still the waves, he had tried out the idea for himself on the pond on Clapham Common, and was surprised how effective it was. He also demonstrated it on the lake in the Green Park. Once, when he was staying with Lord Shelbourne at Wycombe, he claimed that he could quieten the waves on a small stream that was being whipped by the wind. He went 200 paces upstream, made some seemingly magic passes over the waves, and waved his bamboo cane three times in the air. The waves gradually died down and the stream became mirror-smooth. He had worked the seeming miracle by carrying oil in the hollow point of his cane (27).

Inevitably Franklin met Boswell, who on 15 September 1769 called on Pringle and found Franklin with him playing chess. 'Sir John, though a most worthy man, has a peculiarly sour manner. Franklin again is all jollity and pleasantry. I said to myself: Here is a prime contrast: acid and alkali' (28). Pringle's portrait in the Society's possession certainly confirms Boswell's assessment; but despite his Tory views (which contrast with his membership of the Honest Whigs) he courageously spoke up for Franklin when the split with America came.

When the Society was asked for its advice in 1772 concerning the installation of lightning conductors on the powder magazine at Purfleet, Pringle was its President. The Society appointed a Committee, and the majority supported Franklin in recommending the installation of pointed lightning conductors (29). One member, however, dissented. This was Benjamin Wilson (1721-1788, F.R.S. 1751) who was primarily a portrait painter. He did in fact paint one of the most famous portraits of Franklin, and he succeeded Hogarth as Serjeant Painter. He became interested in electricity and distinguished himself to such an extent that he was made Copley Medallist in 1760; the reasons for his dissent might therefore merit greater attention than would otherwise be attached to them. Briefly, his argument (30) was that since electricity is attracted to points, the installation of a pointed lightning conductor is a direct invitation to lightning to strike the building. Franklin's idea was that it would strike the point first and then be harmlessly conducted down to earth; and he could also have argued that the intense electric field around the point would relieve some of the electric stress before it built up to breaking point. He was able to show that pointed lightning conductors had already been installed on such buildings as St Paul's Cathedral; and the rest of the Committee sided with him. However, the argument went on until after Independence had been declared and at this point (1777) George III entered the lists, because the issue had now become a political one. Those who

believed in points were considered to side with Franklin and therefore to be supporters of the American rebels, while those who believed in 'blunts' were on the side of the King, who had been annoyed by the part that Franklin was playing in the rebellion. Moreover, the Board House at Purfleet, which had been protected by a pointed lightning conductor as a result of the 1772 deliberations, had now been struck, and Wilson was quick to seize on his vindication: 'Behold! This very Board House which was never before struck by lightning, hath now been struck!' (31). The King tried to get Pringle, as its President, to persuade the Royal Society to reverse its decision in favour of points, to which Pringle is said to have replied that His Majesty could change the laws of the land at will, but could not reverse or alter the laws of nature (32). Although Pringle entirely opposed the rebellion of the Colonies, such was the feeling over points and blunts that he was forced to resign as President; he was succeeded by Joseph Banks. The King decreed that blunt conductors should replace the pointed ones at Purfleet, and also those on his own Palace (33).

Reverting to 1770, the situation in America was growing worse, despite everything that Franklin and his friends in Britain could do. On the day of the Boston Massacre (5 March 1770) Parliament instituted the tax on tea. This was much more a matter of principle than of substance, but Franklin held that 'it is bad surgery to leave splinters in a wound which may prevent its healing or in time occasion it to open afresh' (34). It led, of course, to the Boston Tea Party in December 1773, and by this time Franklin himself was in trouble.

He had acquired some letters from Thomas Hutchinson and Andrew Oliver, who were at that time Governor and Lieutenant Governor respectively of the Colony of Massachusetts, but the letters appeared to have been written between 1767 and 1769, when they held rather less senior appointments. The letters advocated that Britain should use a firm hand in keeping the Colony in order and Franklin thought that it might ease tension between the Colonists and the Westminster Government if they could see that some of what they regarded as harsh treatment did not emanate from Westminster but from fellow Americans. Franklin had, of course, enemies in London who resented his efforts to keep the peace, and they made much of the way in which the letters had come into Franklin's hands. Arguing that he was guilty of practices unworthy of an official of the Crown (he was still Deputy Postmaster General for the Colonies) they demanded his removal. Franklin refused to divulge the method by which he had acquired the letters, and was accordingly dismissed from his post in January 1774 (35).

He stayed in England until March 1775, one of his later acts being to provide a letter of introduction for Thomas Paine, who left London for America in the

autumn of 1774. Once in America, Paine produced his famous *Common Sense*, which argued infectiously for American Independence. He sent Franklin the first copy.

Before he sailed for Portsmouth on about 21 March Franklin spent some hours in London with Burke who on 22 March made his great but unavailing speech on conciliation with America; and the last day of all in London was spent alone with Priestley.

In November 1775 Franklin joined with four others in the Committee of Secret Correspondence which had 'the sole purpose of corresponding with our friends in Great Britain, Ireland and other parts of the world' (36). It was the origin of the State Department.

Among those with whom Franklin corresponded, there was of course Priestley. On 3 October 1775, he wrote to Priestley 'Britain, at the expense of three millions, has killed 150 Yankees this campaign which is £20000 a head. And at Bunkers Hill she gained a mile of ground, half of which she lost by our taking post on Ploughed Hill. During the same time 60000 children have been born in America. From these data any mathematical head will easily calculate the time and expense necessary to kill us all, and conquer our whole territory' (37). To this early example of operational research he added an excursion into weapon design. The Committee of Safety, on which Franklin also served, considered that pikes might be useful for those of their Infantrymen who could not match the British with the bayonet. Franklin therefore designed a pike.

Franklin's comment to Priestley about 150 Yankees being killed reflects the fact that on 19 April 1775 the War of Independence had finally broken out, despite the efforts of many, including Franklin on the American side and Chatham and Burke in London. One year later Thomas Jefferson (1743-1826) was drafting the Declaration of Independence, with—to an Englishman at any rate—its measured sense of abject tragedy. Jefferson had come under the influence of William Small (1716-1775, and like Richard Price, a graduate of Aberdeen, where he inclined towards Moral and Natural Philosophy) at William and Mary College to such an extent that, as we have seen, he valued Newton above any king. Jefferson recorded in his Autobiography that Small 'probably fixed the destinies of my life'. And in passing we may note that Franklin introduced Small to Matthew Boulton (1728-1809, F.R.S. 1789) and Small in turn introduced James Watt (1736-1819, F.R.S. 1785) to Boulton (38).

But for all this Scottish influence, the Declaration of Independence shows that Jefferson was an Englishman at heart; for his draft (39) at one point charges England with sending over 'not only soldiers of our common blood, but Scotch and foreign mercenaries to deluge us in blood' and it also at another point taxes

George III with bringing in 'large armies of Scotch and other foreign mercenaries'.

Jefferson's draft was revised by the other four members of the Committee, a process which could have been painful but which was clearly tempered by Franklin's sense of humour. In fact, when it was submitted to Congress, Franklin consoled Jefferson with a story from his days as a journeyman printer when one of his companions was about to open a hat shop. He proposed to paint a signboard reading 'John Thompson, Hatter, makes and sells hats for ready money' with a figure of a hat subjoined. As a result of the criticisms of his friends, who struck out words one by one, the signboard was finally reduced to 'John Thompson' and the figure of a hat.

Of the few amendments that were made before the draft was submitted to Congress, Franklin's included the substitution of 'self-evident' for the truths that Jefferson had described as 'sacred and undeniable'. Perhaps in view of the fact that some of the signers of the Declaration had been born in Scotland, and still more were of Scottish ancestry, the passages about 'Scotch Mercenaries' were dropped from the final Declaration. For Ireland and Scotland could be recognized as sources, along with England, both for the spirit of America and for the tunes played by the American forces on Fifes and Drums. One of these, for example (40) was 'The Sentry Box'. Whether or not this had anything to do with Franklin's Sentry Box in the lightning experiment, its connexion with Scotland is unmistakable: and every American rebelling against the mess created by George III's Government would approve of the title of the same tune to which the Gordon Highlanders now march to it: 'The Muckin' of Geordie's Byre'. That we can so easily recognize the tune which, even when Independence was declared, was already old, would gratify Franklin for in 1762 he had written (41) to Lord Kames about his theory of harmony saying 'The reason why Scotch tunes have lived so long and will probably last for ever (if they escape being stifled in modern affected ornament) is merely this, that they are really compositions of melody and harmony united, or rather that their melody is harmony'.

Within three months of the Declaration Franklin was made one of the three Commissioners to France to enlist the aid of the French. He sailed on 3 December 1776 at the age of 70, risking winter gales and the British Navy. He was warmly welcomed in Paris where his reputation had been high ever since the lightning experiments, and he succeeded in bringing about the Franco-American Alliance of 1778 and negotiating a gift of 10 million livres and a loan of 40 million livres to aid the prosecution of the war.

His activities were diverse; with his predilection for hoaxing he concocted such propaganda as the Sale of the Hessians (1777), a bogus letter from the

Count de Schaumbergh rejoicing at the increased glory he had gained because so many of his Hessian troops had been killed in America. Franklin also forged in 1782 a Statement to the Boston Independent Chronicle purporting to publish a letter describing the interception of packages of some hundreds of American scalps, taken from both men and women, and sent by the Seneca Indians to the Governor of Canada as a present for George III.

Nor were his clandestine activities confined to propaganda: he knew that he had sympathisers in England and he kept sufficiently in touch with them to operate an intelligence service. We have already seen that in the case of the Hutchinson letters he had not cared to disclose the way in which they had come into his hands, and so he was already attuned to covert action. One of his informants was Mrs Patience Lovell Wright, born at Philadelphia in 1726 and a niece of John Wesley. She was a forerunner of Madame Tussaud, and her modelling of wax heads of the King and Queen and the aristocracy gave her opportunities for picking up gossip in the best places (42). Franklin's grandson, William Temple Franklin, said of her (43):

As soon as a general was appointed, or a squadron begun to be fitted out, the old lady found means of access to some family where she could gain information, and thus, without being at all suspected, she contrived to transmit an account of the number of troops and the place of their destination to her political friends abroad. She at one time had frequent access to Buckingham House, and used, it was said, to speak her sentiments very freely to their Majesties, who were amused with her originality. The great Lord Chatham honored her with her visits, and she took his likeness, which appears in Westminster Abbey.

Mrs Wright came to London in 1772; Franklin was in correspondence with her there until May 1779 when she wanted to return to America via Paris. Elkanah Watson (1758-1842) noted 'I saw her frequently in Paris in '81, and in various parts of England from '82 to '84' (44). She died in 1786.

Franklin also came into contact with Pierre-Augustin Caron de Beaumarchais, the entrepreneur and creator of Figaro (and a watchmaker sufficiently skilled to make a watch for Madame Pompadour), who acted as under-cover agent for the French government, and he sometimes used the Pot de Vin bathhouse on the Seine as a rendezvous for secret meetings, where naked men would be difficult to identify in the clouds of steam (45). Benjamin Vaughan (1751-1835) was one of those he met in this way. Vaughan, who came as an unofficial British emissary, was a friend of Priestley, and subsequently edited Franklin's works.

In turn, Franklin was spied upon by the British Intelligence Service, organized by William Eden, later Lord Auckland; and in our present context, we may note that one of the most effective British spies was a Fellow of the Royal Society, Edward Bancroft (1744–1821, F.R.S. 1773). Born in Massachusetts and coming to Britain, where he took an M.D. at Aberdeen in 1774, he had at one time been a pupil of Franklin's fellow Commissioner Silas Deane, and regularly received money from him for providing information on the British to the Americans. But according to the *Dictionary of American Biography*, Bancroft then contracted to supply information to the British for £400—later increased to £1000—a year. He thus became a double agent, and the confidant of Franklin, many of whose confidences he then passed back to the British Intelligence, enabling it to intercept many of the ships sailing from French ports with supplies for America. Writing his messages for the British in invisible ink, he deposited them in a sealed bottle in a hole in a tree in the Tuileries, where they were picked up at half-past nine every Tuesday evening by a messenger who in turn left any further briefings for Bancroft (46). To quell any doubts about his pro-British activities, Bancroft made occasional trips to London to collect secrets for Franklin and—to add plausibility to his posture—was even arrested there in 1777 for corresponding with Deane. Since it might be inappropriate for me to criticize one who was not only a Fellow of the Royal Society but a graduate of the University in which I teach, I will simply advance for him the same defence as Francis Bacon did for himself: that he maintained his impartiality by taking bribes from both sides.

It is possible that Franklin and Bancroft were not the only Fellows of the Royal Society to be involved in espionage, for there is at least a suspicion that Benjamin Thompson (1753–1815, F.R.S. 1779) was a British agent in America in the pre-war years (47). He came to England in 1775 and acted as consultant on American affairs to Lord Germain, Secretary of State for the Colonies. Afterwards, of course, he became Count Rumford, and founded the Royal Institution.

If Franklin's clandestine activities are inevitably obscure, there were passages from his Paris years that are clearer. In 1781 he met Edward Gibbon at an Inn, although Gibbon had said that—much as he admired Franklin as a man and a philosopher—he could not converse with a rebel. Franklin is said to have replied that when Gibbon came to write the *Decline and Fall of the British Empire* Franklin would be happy to furnish him with ample material (48).

One of the happiest of his actions was when he wrote (49) a 'passport' to all commanders of armed American ships in 1779 requesting free passage for Captain James Cook's ship on his expected return from the Antipodes. Although

unfortunately Cook was never to come back the British Admiralty in 1784 gratefully sent Franklin a copy of Cook's *Voyage to the Pacific Ocean* and the Royal Society sent him one of its medals commemorating Cook and his discoveries (50). Franklin's gesture so impressed Joseph Banks, now President of the Royal Society, that he was later inspired to solicit similar gestures of goodwill from Napoleon to protect men of science from molestation in times of war (51).

As Minister Plenipotentiary in Paris, Franklin had a big say in maritime affairs. He commissioned the American privateers which operated from French ports against British shipping, and acted as prize judge. Paul Jones (1747-1792) was one whom he commissioned, and Jones named his famous flagship *The Bonhomme Richard* in honour of the hero of Franklin's almanack. One of Franklin's first commissions to Jones was to escort a French force commanded by Lafayette to raid England, and on 22 March 1779 he sent Lafayette a list of English towns that might be captured and ransomed, including Bristol, Bath, Liverpool, Lancaster, Whitehaven, Newcastle, Scarborough, Kings Lynn and Yarmouth, with ransoms ranging from two million pounds for Bristol and Liverpool to 250 thousand pounds for Lancaster. At the same time he charged Jones with not burning English towns unless a ransom had been refused, and he was then to give timely notice so that the sick and aged could be first removed (52). Later the raid was cancelled.

Franklin's duties in Paris were relieved by lighter affairs, particularly with the opposite sex. His wife Deborah having died in 1773, he became much attached to Madam Helvetius, the widow of Johan Anton Helvetius (F.R.S 1763) the farmer-general; on one occasion she is said to have reproached him for putting off a visit only to receive the reply 'Madam I am waiting till the nights are longer!'

There was also a little time for philosophical correspondence: across the barriers of war he wrote (53) to Priestley in England on 8 February 1780:

The rapid progress true science now makes occasions my regretting sometimes that I was born so soon. It is impossible to imagine the height to which it may be carried in a thousand years, the power of man over matter . . . O that moral science were in as fair a way of improvement that men would cease to be wolves to one another and that human beings would learn what they now improperly call humanity.

At last, on 3 September 1783, the War of Independence came to an end with Franklin having played his usual part in the negotiations. He was now 77, and he wrote to Congress wishing 'for the little time I have left to be my own

Master' (54). But although his duties lightened, it was another two years before he was able to sail for America. In the meantime, just as the War was ending, the first balloon flights were taking place in France. On 5 June 1783, the Montgolfier brothers sent up an un-manned hot-air balloon, and on 27 June Charles (of the Law) sent up a hydrogen balloon over Paris. Franklin witnessed the latter event and three days later wrote to Joseph Banks to acquaint the Royal Society with this new development. When on 21 November 1783, de Rozier and d'Arlandes made the first manned flight in a hot-air balloon, and on 1 December 1783 Charles and Robert were the first men to go up in a hydrogen balloon, Franklin was an eyewitness of both flights, and on each occasion wrote a description to Banks the same day. And on 16 January 1784 he wrote (55) to Jan Ingenhousz (1730–1799, F.R.S. 1769):

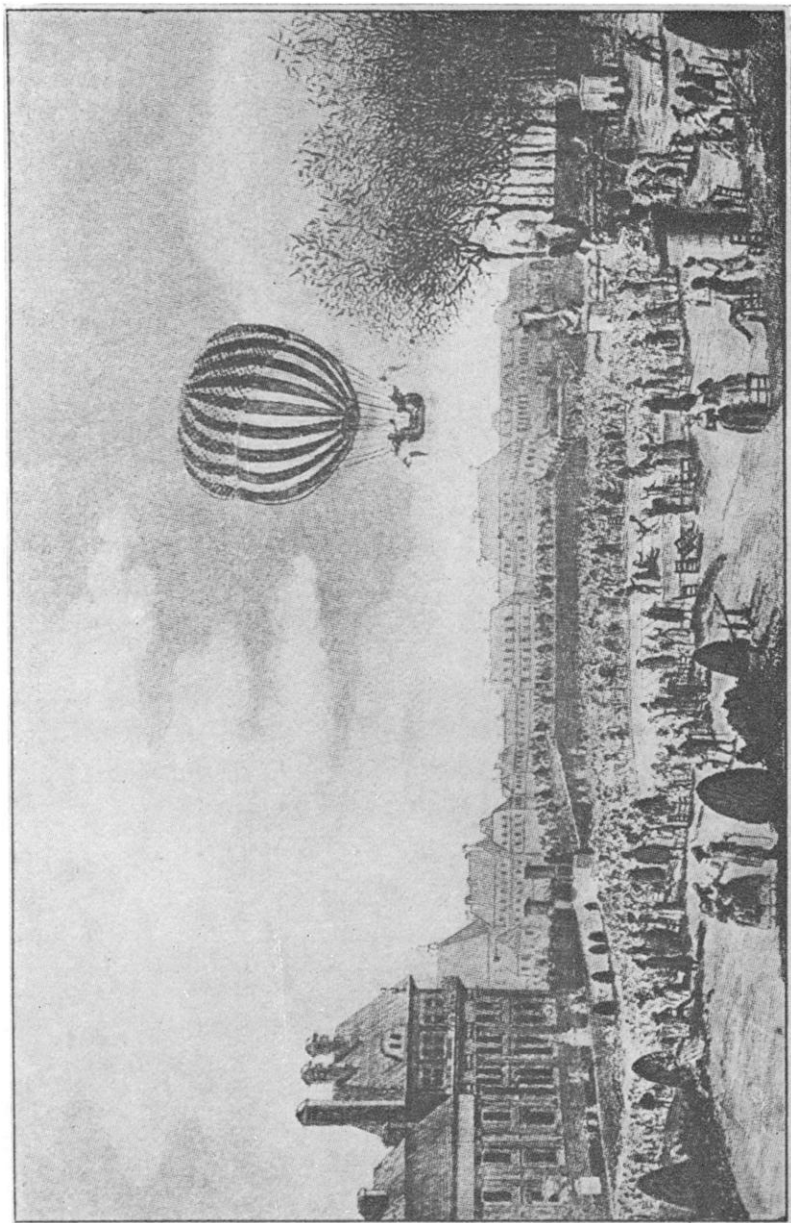
It appears to be a discovery of great importance, and what may possibly give a new turn to human affairs. Convincing Sovereigns of the folly of wars may perhaps be one effect of it, since it will be impracticable for the most potent of them to guard his dominions. Five thousand balloons, capable of raising two men each, could not cost more than five ships of the line, and where is the prince who can afford so to cover his country with troops for its defence as the ten thousand men descending from the clouds might not in many places do an infinite deal of mischief before a force could be brought together to repel them? It is a pity that any national jealousy should, as you imagine it may, have prevented the English from prosecuting the experiment, since they are such ingenious mechanicians, that in their hands it might have made a more rapid progress towards perfection, and all the utility it is capable of affording?

So once again Franklin's English sympathies were in the ascendant. And this was the occasion of a famous epigram. 'What good', a sceptic asked, 'could a balloon be?' 'What good', Franklin replied, 'was a new born baby?' (56).

Incidentally, Franklin's surmise about airborne forces fascinated General Hyde Brereton, who commanded the First Allied Airborne Headquarters during the Arnheim operation in 1944, so much that he kept it framed on his desk throughout his tenure of command (57).

On 22 July 1785 Franklin sailed for America from le Havre, calling at Southampton, and crossing the Atlantic for the last time. On the way he added to the observations that he had made on previous voyages of the Gulf Stream, which he appears to have been the first man of science to study.

We can leave him to his last five years, most of them still spent in public service as President of the State of Pennsylvania. The early news of the French



The Balloon Ascension of CHARLES and ROBERT, Paris, December 1, 1783.
The Second Balloon Journey of Human Beings and the First in a Hydrogen-Filled Balloon.

From a wash drawing by Duperreaux in the Musée Carnavalet, Paris

Revolution reached him before he died on 17 April 1790, but in it he saw hope (85):

God grant that not only the love of liberty but a thorough knowledge of the rights of man may pervade all the nations of the earth, so that a philosopher may set his foot anywhere on its surface and say: 'This is my country.'

If his hopes for liberty and philosophy seem even remoter as regards the world in general than they did when he died, he had ensured by his own actions that our common intellectual heritage was preserved across the havoc of the War of Independence. We may well ask if there is any parallel in history for such a breach and yet for such a reconciliation; and if that reconciliation is unique, its first architect was Benjamin Franklin.

NOTES ADDED IN PROOF

The statement that Patience Lovell Wright was a niece of John Wesley comes from W. T. Franklin (Reference 43). But C. C. Sellars in *Benjamin Franklin in Portraiture* (Yale University Press 1962) states that W. T. Franklin confused Patience Wright with Mehitabel Wright, the daughter of William Wright and John Wesley's sister, Hetty.

Franklin's London residence at 36 Craven Street is now Franklin House, the home of the British Society of International Understanding.

Franklin's experiments on the effect of oil in damping waves on water are described in his letter to William Brownrigg (see this Issue p. 261) which was published in *Philosophical Transactions* **64**, 447-455, 1774.

NOTES

In the following notes, major works of reference are denoted as follows:

- A. *The Works of Benjamin Franklin*, Vols. I-XII, edit. J. Bigelow. (New York: Putnam, 1904.)
- B. *The Papers of Benjamin Franklin*, Vols. 1-19, edit. L. W. Labaree, W. J. Bell & W. B. Willcox. (Yale Univ. Press, 1959-75.)
- C. *Benjamin Franklin*, C. van Doren. (London: Putnam, 1939.)
- D. *Benjamin Franklin's Experiments*, edit. I. B. Cohen. (Harvard Univ. Press, 1941.)
- E. *Franklin and Newton*, I. B. Cohen. (Philadelphia: American Philosophical Society, 1956.)

(1) A Vol. I, p. 66. C p. 99.

(2) B Vol. 3, pp. 126-135. D pp. 171-178.

(3) B Vol. 3, p. 127. C p. 155.

(4) B Vol. 3, pp. 172-173. C p. 157.

- (5) B Vol. 4, pp. 9–34. C pp. 158–159. D pp. 213–244.
- (6) C p. 160.
- (7) D pp. 77–84.
- (8) B Vol. 4, pp. 360–369. C p. 163.
- (9) *Phil. Trans.* **47**, 565–567 (1752).
- (10) J. Priestley, *The History and Present State of Electricity* (London: Dodsley, 1767), p. 97.
- (11) C pp. 187–191.
- (12) B Vol. 4, pp. 131–133. C pp. 199–120.
- (13) F. Fennell, 1975, *The Spirit of '76: Music for Fifes and Drums*, Golden Import Record No. SR1 75048.
- (14) E. Henderson, *The Life of James Ferguson* (Edinburgh: Fullarton, 1870), pp. 231–235.
- (15) B Vol. 9, pp. 5–11. C pp. 280–281.
- (16) B Vol. 9, p. 91. C p. 287.
The Interest of Great Britain considered with regard to her Colonies (London: Beckett, 1764).
- (17) B Vol. 9, pp. 227–230. C p. 291.
- (18) C p. 292.
- (19) B Vol. 12, pp. 132–135. C pp. 321–322.
- (20) B Vol. 14, pp. 64–71. C p. 361.
- (21) V. W. Crane, *Benjamin Franklin Englishman and American* (Baltimore: Williams & Wilkins 1936), p. 3.
- (22) B Vol. 4, p. 68.
- (23) J. B. Boyd, *The Papers of Thomas Jefferson*, vol. II, p. 203.
- (24) R. E. Schofield, *A Scientific Autobiography of Joseph Priestley* (Cambridge, Mass.: M.I.T. Press, 1966), pp. 15–17.
- (25) D p. 336.
- (26) C p. 421.
- (27) C p. 418. See also C pp. 432–436, for a letter from Franklin to William Brownrigg (1712–1800, F.R.S. 1742).
- (28) C pp. 400–401.
- (29) H. Cavendish, W. Watson, B. Franklin & J. Robertson, *Phil. Trans.*, **63**, 66 (1773).
C p. 429.
- (30) B. Wilson, *Phil. Trans.*, **63**, 49–65 (1773).
P. A. Tunbridge, *Notes & Records R. Soc. Lond.*, **28**, 207–219 (1774).
- (31) B. Wilson, *Phil. Trans.*, **68**, 239–242 (1778).
- (32) D p. 137.
- (33) C p. 429.
- (34) C p. 381.
- (35) C pp. 440–478.
- (36) C p. 538
- (37) A Vol. 7, p. 85. C p. 536.
- (38) R. V. Jones, 1970, *Notes & Records R. Soc. Lond.*, **24**, 194–220 (1970).
- (39) D. Malone, *The Story of the Declaration of Independence* (Oxford U.P., 1954), pp. 73–76.
- (40) F. Fennell, 1975, *The Spirit of '76. Supra.*
- (41) C p. 323.
- (42) C. C. Sellers, *Benjamin Franklin in Portraiture* (Yale U.P., 1962).
- (43) A Vol. VIII, p. 60.

- (44) Elkanah Watson, *Memoirs*, Ed. Winslow C. Watson (New York: Dana, 1857).
- (45) C. B. Curry, *Code Number 72, Ben Franklin: Patriot or Spy* (New Jersey: Prentice-Hall, 1972).
- (46) C pp. 581-582.
- (47) A. French, *General Gage's Informers* (New York: Greenwood Press, 1968), pp. 115-143.
 W. J. Sparrow, *Ann. Sci.*, 11, 320-330 (1955).
 S. C. Brown & E. W. Stein, *Am. J. Police Sci.*, 40, 627 (1950).
- (48) C p. 578.
- (49) A Vol. VII, pp. 447-448. C p. 620.
- (50) C p. 719.
- (51) J. G. Crowther, *Scientists of the Industrial Revolution* (London: Cresset Press, 1962), p. 329.
- (52) A Vol. VIII, pp. 14-15 and 44-45.
- (53) A Vol. VIII, pp. 174-175. C p. 660.
- (54) C p. 705.
- (55) A Vol. X, pp. 266-269.
- (56) C p. 702.
- (57) Cornelius Ryan, *A Bridge Too Far* (London: Hamilton, 1974), p. 78.
- (58) A Vol. VII, p. 163. C p. 775.

ADDITIONAL BIBLIOGRAPHY

- D. I. Duveen & H. S. Klickstein, 'Franklin and Lavoisier', *Ann. Sci.*, 11, 103-128 and 271-308 (1955).
- J. P. Greene, 'The Alienation of Benjamin Franklin—British American', *J. R. Soc. Arts*, 124, 52-73 (1976).
- The Writings of Benjamin Franklin*, edit. A. H. Smyth (New York: 10 vols., 1901-1907).
- List of the Benjamin Franklin papers in the Library of Congress*, W. C. Ford (Washington D.C., 1905).
- Calendar of the papers of Benjamin Franklin in the Library of the American Philosophical Society*, I. M. Hays (Philadelphia: 6 vols., 1906).