SIR BENJAMIN THOMPSON, COUNT RUMFORD
AND THE ROYAL INSTITUTION

by

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SUMMARY

On 19 September 1798, there arrived in London from Munich a 45-year-old, tall, blue-eyed, handsome, American-born, opportunistic man of action. A former soldier and statesman, he was, by all accounts, ruthless and arrogant, callously cunning and devious, an unprincipled spy and a calculating womanizer, but he was also a philanthropist, a brilliantly effective social reformer, an ingenious inventor and an exceptionally innovative scientist. His name was Benjamin Thompson, better known as Count von Rumford of the Holy Roman Empire. He would found the Royal Institution.

INTRODUCTION

Born in 1753 in Woburn, Massachusetts, Benjamin Thompson, whose parents were simple farmer folk, founded many things, including the Rumford Professorship at Harvard, and the Rumford prizes and medals of both the Royal Society, London, and the American Academy of Arts and Sciences. The Royal Institution of Great Britain owes its origin entirely to Benjamin Thompson: his career and character determined its original form. And the story of how it came to be created, what functions it was originally intended to serve, as well as the interaction between its founder and Sir Joseph Banks, President of the Royal Society from 1778 to 1820, is a fascinating one.

Today, the Royal Institution is part research laboratory, part theatre, part television studio, part museum, part school classroom, part library, part London Club: a truly remarkable place. And it was the brainchild of Count Rumford ‘whose obscurity’ nowadays in North America ‘is widespread’. Yet, according to Franklin D. Roosevelt, Rumford, with Benjamin Franklin and Thomas Jefferson ‘were the three greatest intellects America ever brought forth’.

Rumford was something of a scoundrel and undoubtedly an incorrigible opportunist. When contemplating the many and varied actions of Rumford, one recalls Bertrand Russell’s remark that ‘man is a strange amalgam of saint and sinner’. In Rumford’s case there was more sinner than saint. He relented and mellowed somewhat in later life, but throughout his career he devoted considerable energy to evolving ways of bettering the
conditions of the poor and adding to the comforts of mankind, although to quote Cuvier’s words, ‘it was without loving or esteeming his fellow creatures that he had done all these services’. He was, however, an outstanding natural philosopher who uncovered many universal truths. Truth is independent of the stimulus that has provoked its discovery, and the conditions that have guided its expression.

In an age when the natural philosopher tended to belittle the engineer and treat him as an artisan or common labourer, and the inventor, in turn, regarded the natural philosopher as an intellectually snobbish dreamer, Rumford wrote, argued and practised—well ahead of his contemporaries—a scientific philosophy which cogently stated that fundamental research in a problem is a prerequisite to technological development. Furthermore, Rumford described his work with elegance and charm: he was a beautiful stylist who introduced a perspective and an aura of Chekovian timelessness to his discourses.3 Rumford also knew that scientific research is a passionate undertaking and he expressed his feelings in terms that ring true with all those who have been gripped by obsessional preoccupation: ‘The ardour of my mind is so ungovernable that every object that interests me engages my whole attention and is pursued with a degree of indefatigable zeal which approaches to madness’.

EARLY LIFE: SOLDIER, STATESMAN AND SCIENTIST

In rather quick succession in his middle teens, Benjamin Thompson tried his hand at commerce, medicine and schoolteaching; he also attended some courses at Harvard, and in July 1772 he took up a position as schoolmaster in the town of Concord (formerly called Rumford), New Hampshire. Four months after arriving there, he married the wealthiest widow in the province. She was 14 years his senior. He thereby became not only a wealthy gentleman-farmer but gained entry into the political and social circle surrounding the Royalist Governor, John Wentworth.

He soon became extremely unpopular in Concord because of his overt espousal of the American Tory cause in the gathering strain between the British Crown and the American Colonies. So, less than 18 months after his arrival in Concord, he fled to Boston to serve General Gage as a Tory spy.4 His wife, with their baby daughter in her arms, was left to the mercy of the angry citizens. He never saw his wife again. After having been arrested for spying, then released owing to lack of evidence, he sailed for London (in 1776) to report directly to King George III on the situation in America.

This self-assured, 23-year-old expert on the American Army around Boston, holding the rank of major in the New Hampshire Militia, was made private secretary to the Secretary for the Colonies. He ingratiated himself to the aristocracy, and he was soon dining and relaxing in the stately homes of England.5 But he also began experimenting in the field of natural philosophy at Stoneland Lodge in Sussex, a country seat of Lord George Germain’s. It was in the grounds of the Lodge, assisted by the Reverend Bale, Rector of Withyham, that Thompson undertook his first real experimental investigation, published in Philosophical Transactions.6

He developed a technique based primarily on the ballistic pendulum method

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devised by Benjamin Robins some 40 years earlier. Robins’s experiment was to fire a missile from a small cannon into a heavy wooden block supported as a pendulum and to measure the momentum exchange between the bullet and the heavy pendulum. Using the principle of the conservation of momentum, the velocity of the bullet as a measure of the force of the gunpowder could be computed. Thompson’s improvement was to argue that the windage around the ill-fitting bullets of the day caused large errors in a measurement taken in this manner and that measuring the recoil velocity of the gun was a great improvement. This experimental study so impressed his scientific colleagues, especially the influential President of the Royal Society, Sir Joseph Banks, that Thompson was elected F.R.S. in March 1779.

In 1780, he was made Under-Secretary for the Northern Department in the British Government, a post which put him directly in touch with the American scene. In 1781 he abruptly left his post and sailed for America as Lieutenant Colonel of the King’s American Dragoons. His conduct and general behaviour in his native land was nothing short of despicable.

He returned to England at the close of the Revolution, transferred his regiment to the Regular British Army and applied for, and obtained, the rank of full Colonel. This secured for him a pension for life at half pay. At this time (1783) he sat for his portrait (which now hangs in the Fogg Art Museum, Harvard University), and became the only American-born to be painted by Gainsborough (figure 1).

Figure 1. Thomas Gainsborough’s portrait of Benjamin Thompson aged 30. Reproduced by kind permission of the Fogg Art Museum, Harvard University.
Almost immediately thereafter he left London to seek his fortune in Europe, and he entered the service of Karl Theodor, the Elector of Bavaria, and settled down to his most productive and spectacularly successful years of invention, scientific endeavour and social reconstruction. While negotiating with Karl Theodor to become his aide-de-camp, he realized that his rank in the Bavarian Court would exceed his standing as a British subject. This presented him with another opportunity for advancement. In a quick visit to London he persuaded King George, for whom he had earlier agreed to spy on the Bavarians, to confer upon him a knighthood; so that it was as Colonel Sir Benjamin Thompson that he entered the foreign prince’s service.

His actual job in 1784, at the outset of his 11-year stint in Munich, was to advise the Elector of ways of reorganizing and modernizing the Bavarian Army. He negotiated for himself a highly favourable financial deal if he succeeded to increase the efficiency, morale and fighting ability of the army. He quickly identified that the major item of expense in the military budget was for clothing. As a result, he turned his attention towards the basic physics of insulation, so that he could subsequently direct the manufacture of more efficient protection of the soldiers. To this end, he invented the so-called cylindrical passage thermometer, which he used to discover that the insulating properties of a cloth results from the air caught in its interstices. (In the process of using his cylindrical passage thermometer, Thompson also discovered convection currents.)

Having solved the fundamental physics of the problem, he set about trying to manufacture cloth which conformed to his discovered principles, but no manufacturer in Munich and its environs was interested in such an advanced idea. He decided to set up his own factory to make clothes for the Bavarian Army, but the labour force was simply not there. So he turned to a radical solution which, at the same time, transformed the social fabric of Munich. In those days, the city was overrun with beggars and vagrants—one in 30 of all adults were mendicants. On 1 January 1790, using the dictatorial powers invested in him by the Elector, he ordered the city garrison into the streets to arrest every one of the tatterdemalion horde in Munich and threw them into the great stone city prison, which he promptly renamed a House of Industry. All the beggars and their wives and children were employed in making uniforms for the Bavarian Army. He clothed them, housed them comfortably and fed them well, using his own recipe for soup, a premier constituent of which was the potato, which he was responsible for introducing as a staple food.

Other products of Thompson’s fertile mind that emerged during his period in Munich as the Elector’s supremo are listed in table 1.

He was fascinated by the whole technology of cooking. Indeed, many regard him as a founding father of domestic and culinary science. He was, for example, the first to introduce the use of baking soda; he was also responsible for the first really efficient fireplaces and chimneys.

In the House of Industry in Munich, the small amount of natural light that was available resulted in great inefficiency among the workers, who worked 12 to 14-hour
The products of Rumford’s mind

- Kitchen range
- Pressure cooker
- Convection oven
- Rumford stove
- Rumford lustre pots
- Drip coffee maker
- Fireplace damper
- Double pane glass
- Efficient oil lamps
- Photometer
- Cylindrical passage thermometer

Table 1. Rumford as inventor and technologist.

days. Benjamin Thompson therefore turned his attention to increasing the efficiency of lamps and candles. First, he had to devise a method of measuring the intensity of light, and the photometer which he invented still bears his name. The candle used as a standard in his experiments on luminosity he defined very carefully. Indeed his definition of the standard candle was used for over 100 years as the international standard candle. He so improved the oil lamps of the day that many examples of his improved lamps are still to be found in antique shops and museums.

Having discovered convection currents, Thompson properly analysed the requirements of the control of hot and cold gases in fireplaces and chimneys. Prior to his innovations, chimneys were perfectly straight holes from the fireplace upwards. By introducing a smoke shelf and a throat to the chimney, cold air comes down the back of the chimney and up its front without turbulence.

Another of Thompson’s fundamental experiments was the study of radiation from black and shiny surfaces. He demonstrated that good reflectors were poor radiators and vice versa.

While on the subject of his practical inventions we should also note his contributions to pure science, some of which were to come later in his career. These are listed in table 2.

By housing, feeding and clothing the poor (of Munich), he incorporated their endeavours constructively into the scheme of things and enhanced social stability and contentment. His approach to social reform is captured in the following passage written by him:

To make vicious and abandoned people happy, it has generally been supposed necessary first to make them virtuous. But why not reverse the order? Why not make them first happy, and then virtuous?

The pleasure-grounds and park with artificial lake, refreshment saloons and Chinese pagoda known as the English Garden in Munich, was designed and created by
Rumford’s scientific contributions

- Demonstration of the nature of heat
- Measurement of heats of combustion of fuels (and devising a calorimeter to do so)
- Development of techniques for measuring intensity of radiation and defining ‘candle power’
- Determination of properties of gunpowder and contributions to ballistics
- Measurement of specific heats of many materials
- Discovery of convection currents in liquids
- Measurement of thermal conductivity of many gases and heat lost by radiation from surfaces

Table 2. A selection of Rumford’s contributions as a scientist.

Thompson in 1790. It became and remains attractive as a retreat and sanctuary to all strata of Bavarian society.

In 1791, Sir Benjamin was so powerful that he was simultaneously Minister of War, Minister of Police, Major-General, Chamberlain of the Court and State Counsellor. In the following year, during an interregnum in the succession of emperors of the Holy Roman Empire, The Elector Karl Theodor was Vice-Regent, and having for a short while the power to create nobility himself, conferred on his brilliant minister the rank of Count.

Rumford’s amorous adventures in Munich, as elsewhere, were complicated and numerous. Countess Baumgarten, the mistress of the Elector, became a long-standing companion and she bore Rumford a daughter. Her sister, Countess Nogarola, also became his mistress. Rumford visited her frequently in Verona and other parts of northern Italy, where he also had an affair with the English aristocrat, Lady Palmeston, whom he first met in Milan. For five years in Munich he had a young housekeeper and mistress (Victoire Lafevre) who bore him a son when Rumford was 60 years of age.14

Throughout his time in Bavaria, Rumford’s irrepressible scientific curiosity was fully exercised, especially in regard to the nature of heat. Through his observations of the drillings of cannons in the Arsenal that he had built, he concluded that heat is not an igneous fluid (as he put it) which flows in and out of bodies, but was an immaterial substance. The drilling of cannon could clearly deliver an inexhaustible supply of heat. He thereby demolished the caloric theory of heat, although it still had its champions for a decade or so after Rumford’s paper appeared in Philosophical Transactions.

In 1795 he took a two-year leave of absence from the Elector to enable him to return to England to publish his Essays15 and to communicate his important results to the Royal Society, Fellowship of which he greatly valued. The next two years in London were the happiest of his life. He had short trips to places such as Dublin and Edinburgh (where he was festooned with honours), Bath and Harrogate, living the life of a famous natural philosopher and philanthropist.
An important practical achievement which earned him enhanced admiration at that time was the improvement he made to domestic heating. As stated earlier, his studies of convection currents and heat radiation led him to revolutionize the design of fireplaces and chimneys, and he claimed to have modified over 250 fireplaces in London alone in a single two-month period on 1796. His fame led to a famous Gillray cartoon, showing Rumford in a state of almost maniacal contentedness, standing in front of his stove. (In Jane Austen’s novel Northanger Abbey (1817), General Tilney is described standing in front of a Rumford stove.)

In 1796, he made his famous, generous bequests to the Royal Society of London and the American Academy of Sciences in Boston. He gave to each body $5000 to finance the award of a medal for outstanding work done in the fields of heat and light.

With Rumford’s dynamic personality out of the way in England, his numerous adversaries in Munich worked unceasingly to undermine his power so that when he returned to Bavaria it was obvious that his days were numbered. Even the Elector decided to forswear him, but he did so by letting him go with a great honour: as Minister Plenipotentiary to the Court of St James in England. Karl Theodor did this without first consulting George III who, it is alleged, was incandescent with rage when Rumford appeared to present his credentials. King George refused to have as a foreign minister one of his own beknighted subjects who, it had transpired earlier, had been accused of spying (for France) on his Government. And so here was Rumford in 1798, aged 45—and this is where we began—temporarily unemployed in London.

WEST POINT OR ALBEMARLE STREET?

Rumford set many schemes in motion, one of them being to offer his services to President John Adams, as the Superintendent of the Military Academy at West Point. At first, Rumford’s suggestion was accepted by President Adams. But some months later, after some delicate investigations by Rufus King, the American Ambassador, it was discovered that he had been a spy on the American Army. Great manoeuvring then went on so that all parties could save face: Count Rumford was formally invited to come and accept the position after proper assurance had been given that he would decline the honour.

Rumford had many influential friends in London, among them the powerful President of the Royal Society, Sir Joseph Banks; Henry Cavendish, known to his contemporaries as ‘the wisest of the rich and the richest of the wise’; the second Earl Spencer, William Wilberforce, the social reformer; and Thomas Bernard, a rich former barrister, whose entire life turned around philanthropy. Many of these had been involved in forming in 1796 the Society for Bettering the Conditions and Increasing the Comforts of the Poor.

It was decided at a meeting in Joseph Banks’s home in Soho in March 1799 that Rumford should draw up the plans for forming a new Institution. And so we have his proposals:
… for forming by subscription, in the Metropolis of the British Empire, a Public Institution for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching by courses of philosophical lectures and experiments the application of sciences to the common purposes of life.

Note, in particular, the aims to:

(i) spread a knowledge of new and useful mechanical improvements
(ii) teach the application of scientific discoveries to the improvement of arts and manufactures and to the increase of domestic comfort and convenience.

Note, too, there was no mention whatsoever of pure science in Rumford’s vision. In his Institution, science was primarily intended to make itself useful.

His first aim was to be achieved by setting up a permanent exhibition consisting of what one would now regard as a hybrid between a Museum of Science and a World Fair in miniature. The second was to be achieved by lectures on applied science backed by a laboratory for chemical and other experiments.

Rumford’s Proposals, of which many hundreds of copies were published, were given wide publicity—one of them reached the American Philosophical Society at Philadelphia—and subscriptions were invited. All who gave 50 guineas or more were to become perpetual Proprietors of the Institution. Fifty-eight influential people quickly agreed to subscribe, including one duke, six earls, seven lords, 11 knights, one bishop and 18 Members of Parliament.

Rumford devoted all his considerable energies and acumen to his new foundation and worked indefatigably on its behalf. He framed its constitution and saw to it that a Royal Charter was solicited, and that a house in Albemarle Street, in the heart of London’s West End, was purchased and laid out according to his plans, with a capacious lecture theatre (which he designed), a repository (or model room) for the exhibition of mechanical inventions, including stoves and fireplaces, and with kitchens and workshops. In due course several additions were made, including a library and reading room.

As its first Professor, Rumford enticed the estimable physician and scientist Thomas Garnett from Anderson’s Institution that had been set up in Glasgow two years earlier. When the dynamic Rumford was present at the Institution in Albemarle Street the whole place hummed with a feverish activity. But he worked so hard that he was absent ill for five months. In the time that he was away dissent festered and Sir John Cox Hippisley and his fellow managers began to ventilate their fundamental differences of opinion with Rumford. In early 1800, Rumford returned with renewed vigour, assumed total control of the Institution and lived in the house, where he held weekly progress meetings and galvanized all and sundry into action.

But some of the other officers thought Rumford dictatorial and overbearing; they resented his bullying and felt that his whole manner was irksome. Rumford’s financial profligacy troubled Bernard profoundly, and soon these two protagonists were at daggers drawn. Moreover, Rumford’s plans and convictions increasingly fell foul of the other managers. And prominent industrialists such as Matthew Boulton, felt it would be ruinous to enterprising manufacturers and inimical to British interests if every spectator were to be allowed to examine useful equipment in the proposed repository.
To compound Rumford’s difficulties, Karl Theodor died suddenly in 1799, so he felt it necessary to return briefly to Munich to be reassured about his pension by Maximilliam Joseph, the Elector’s nephew and successor. On his return journey he went to Paris for a vacation and was so well-received (by Napoleon, Laplace, Lagrange, Talleyrand and others, and especially by Madame Lavoisier) that he stayed there for two months. His prolonged absences from the Royal Institution and the increasing ascendancy of his adversaries there distressed Joseph Banks who told Rumford that his Institution was in the hands of the profane.

Meanwhile Rumford had fallen out with Thomas Garnett, whom he treated with singular lack of understanding and no scintilla of compassion. Garnett soon resigned. But before that happened Rumford had identified a 23-year-old Cornishman then working in the Pneumatic Institute, Bristol, and who was destined to become the brightest star in the European scientific firmament for the next 20 years—Humphry Davy. Davy was appointed a lecturer; and in Garnett’s place as professor, Rumford chose another West Country Englishman, Thomas Young, of Young’s modulus fame.

But things were proceeding so much at variance with his proposals at the Royal Institution that Rumford openly declared, after a three-month visit to Munich and Paris from October 1801 to January 1802, that he would leave it and England for France, forever.

The attraction in Paris was a wealthy widow and a very famous one, Madame Lavoisier, whose distinguished husband had been guillotined in the French Revolution. Rumford and Madame saw in each other a chance to settle down to an idyllic life of amusement and pleasure. After encountering many initial legal difficulties, eventually they married in October 1805. But there were immediate marital difficulties, which led to permanent separation in 1807. Acrimonious and vituperative rows between them flared up in public to the embarrassment of their hosts or guests. She went so far as to sabotage his garden. Greater hate hath no wife than to pour boiling water on her husband’s flowers. He fled from the centre of Paris to his new abode on its outskirts, where, in his house in Auteuil, he carried out scientific work of far-reaching importance, until the time of his death there in 1814.

And what of Rumford’s remarkable creation, the Royal Institution? Paradoxically, pure research, the very activity that Rumford had excluded from his proposals, was to prove one of its principal saving graces. The other was the personality and genius of Davy.

Thomas Young was a brilliant all-rounder: a physicist, a physician, a physiologist and a philologist. His ‘Young’s fringes’ experiment, carried out at the Royal Institution (1802), resurrected the wave theory of light. And his scientific reputation was further enhanced by an impressive paper on capillarity as well as many important articles on physiological optics, his outstanding contributions to the decipherment of Egyptian hieroglyphics and his work on the Rosetta Stone.

Humphry Davy had, at the age of 20, demonstrated how nitrous oxide, otherwise
known as laughing gas, could be used as an anaesthetic. He had also convinced himself, on reading Alessandro Volta’s famous letter to Joseph Banks in 1800, that chemical action was responsible for the production of electricity (when two dissimilar metals were brought into contact). He became one of the founders of electrochemistry.

On reaching the Royal Institution at Rumford’s invitation, Davy, metaphorically, set the place alight. In contrast to Young, who was a narcoleptically boring speaker, Davy was coruscatingly brilliant. His carefully prepared, well-rehearsed, fluently delivered performances and breathtaking demonstrations to lay audiences rapidly became important social functions and added greatly to the prestige of science and the Royal Institution. He combined elegance of literary expression (which sometimes achieved lapidary form) with brilliant scientific discovery. For example, using an array of Voltaic cells combined with his own brand of intuitive, almost poetic flair, Davy discovered sodium, potassium, calcium, barium, strontium and magnesium. Later he isolated boron and clarified the nature of iodine. He invented the carbon arc and the technique of cathodic protection (which is still used to suppress the corrosion of seagoing vessels and metallic structures on land). The miner’s safety lamp was also invented by him.

On 3 March 1810, Davy gave a lecture on the ‘Plan which it is proposed to adopt for improving the Royal Institution and rendering it permanent’. As a record of the Royal Institution in its earlier and existing state, and as a reflection of Davy and his full power, this lecture is of surpassing interest. A few paragraphs from it merit reproduction here.

Besides the diffusion of knowledge by popular philosophical lecture, and by other more elementary and more scientific lectures, the new plan will also embrace a design for the promotion of knowledge by experiments and original investigations. It is proposed that the members of the body shall meet at least once every week for the purpose of inquiry and discussion. At these meetings any new facts that have arisen in the progress of science will be stated … and in the progress of investigation those subjects will be most particularly attended to which promise to increase the perfection of arts and manufactures.

Our doors are to be open to all who wish to profit by knowledge; and I may venture to hope that even the female part of our audiences may not diminish… It is not our intention to invite them to assist in the laboratories, but to partake of that healthy and refined amusement which results from a perception of the variety, order and harmony existing in all the kingdoms of nature, and to encourage the study of those more elegant departments of science which at once tend to exalt the understanding and purify the heart.

Let them make it disgraceful for men to be ignorant, and ignorance will vanish, and that part of their empire founded upon mental improvement will be strengthened and exalted by time, will be immortal in its youth.

Even in the common relations of society how much must be referred to the conduct of the female mind. The mother gives most of the early impressions to the child, and his future habits may depend in some measure upon her influence. It may in some measure depend upon her whether he become an honour or a disgrace to his country. Her power of enforcing instruction is the most effectual, as flowing from love. We know that without feeling the human being is mere clay, the dust of the earth without the living soul. How much more efficacious must instruction be when communicated by an object beloved and venerated, and in infancy almost adored, and when, instead of being afforded with an effort of pain and of labour, it is carried into the heart by kindness and made delightful by caresses and smiles.

The extraordinary enthusiasm and admiration which Davy’s lectures, replete with such
imagery, evoked among men and women of the first rank and talent in literary, practical scientific and fashionable circles were not without their ill effects. He was lionized and was much in evidence at social gatherings and in the mansions of the dukes and duchesses of England. As a result of all this he lost much of his modest country charm. The bloom of his simplicity was dulled by the breath of adulation. Time which would have been more profitably spent in the study or in his Royal Institution laboratory (by now one of the best in Europe) or in the society of his intellectual fellows, was frittered away in the frivolities of London society or at the soirées or in the salons of the smart set of the period. He became snobbish and vain. But he saved the Royal Institution, not only through his scientific and his popular lectures, but also because he, as he put it, made his greatest ever discovery there: Michael Faraday.

The story of Michael Faraday, the London bookbinder apprentice who went to the Royal Institution to listen to Humphry Davy lecturing in 1812, and the way it led to his becoming first a bottle washer, then a laboratory and lecturer’s assistant, and then growing to be arguably one of the greatest experimentalists of all time, has been told frequently. According to Einstein, he was also responsible, along with Clerk Maxwell, for the greatest change in the theoretical basis of physics since Newton. Such was the prodigality of his output and the diversity of his skills that modern chemists, no less than physicists, engineers and materials scientists, regard him as one of the founders...
of their subjects: some sciences and technologies owe their very existence to his work. He bequeathed to posterity a greater body of pure scientific achievement then any other physical scientist, and the practical consequences of his discoveries have profoundly influenced the nature of civilized life.

In the mid-1820s, Faraday initiated at the Royal Institution two brilliantly successful educational ventures in the public understanding and popularization of science: the Friday Evening Discourses (the germ of which is explicitly stated in Davy’s 1810 lecture, quoted above) and the Christmas lectures for children, both of which still continue. (Faraday gave the Christmas lectures on 19 occasions.25) Since the early 1970s, the Royal Institution Christmas Lectures have been televised nationally by the BBC; and since 1990 an abbreviated version of each series has been presented in the succeeding summer in Japan and part-televised in that country.

Faraday’s successors, John Tyndall (who discovered the greenhouse effect), Lord Rayleigh (who discovered argon\(^5\) and much else) and Sir James Dewar (who gave the world the thermos flask), as well as Clerk Maxwell, J.J. Thomson and T.H. Huxley (all of whom were professors at and very active in the Royal Institution), made some of the greatest contributions to nineteenth-century science.

Building on Faraday’s early educational adventures with children, in the mid-1950s Sir Lawrence Bragg and his associate Ronald King introduced regular series of lecture-demonstrations (figure 2) for schoolchildren.

These days, some 40,000 children from primary and secondary school attend such events annually at the Royal Institution, which also organizes popular periodic scientific lunchtime talks, curriculum enhancement seminars for schoolteachers, computational science seminars, and a centre for the history of science and technology. Saturday morning Mathematics Masterclasses are held regularly (for 11–14-year-olds) during school term times both at the Royal Institution and, for the last 10 years, at some 50 other centres nationwide.

Research activity has continued since the days of Davy. In the first half of this century, the Davy Faraday Research Laboratory (founded in 1896 in the Royal Institution by Ludwig Mond) has been successively a centre of excellence in cryoscience, X-ray crystallography and in the science of photo-assisted processes. Since the mid-1980s, experimental and computational solid-state chemistry and catalysis, to which Davy and Faraday each made seminal contributions, and more recently magnetism and superconductivity have been major themes of investigation. Currently some 40 research workers, including over a dozen PhD students, are full-time members of the Davy Faraday Research Laboratory.

All this has happened in a converted private residence in Albemarle Street, adjacent to Bond Street, that citadel of sophistication and extravagance, in the centre of fashionable Mayfair. Throughout its history, the Royal Institution has frequently been on the brink of financial bankruptcy (it is not in receipt of direct government support). It remains, however, a beacon for civilized scientific values: one of Rumford’s most remarkable creations.
Count Rumford and the Royal Institution

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NOTES

1 Letter to the author from the present holder of the Rumford Professorship, Harvard University, Dr M. Tinkham, 3 April 1998.


3 A good example is the opening of his important paper, which has become a classic in the annals of science, ‘An inquiry concerning the sources of the heat which is excited by friction’ (Phil. Trans. R. Soc. Lond. 1798, p. 80): ‘It frequently happens, that in the ordinary affairs and occupations of life, opportunities present themselves of contemplating some of the most curious operations of nature; and very interesting philosophical experiments might often be made, almost without trouble or expense, by means of machinery contrived for the mere mechanical purposes of the arts and manufacturers.’ Rumford continues in this vein and expatiates on ‘the playful excursions of the imagination’ which led him inexorably to the conclusion, described in this paper, that the boring of cannon generates an inexhaustible supply of heat (see later).

4 There is proof (see note 2) of the excellence of Thompson’s scientific techniques in the secret ink which he used to communicate to the blockaded British Army in Boston. He used gallo-tannic ink developed by ferrous sulphate, which is said to have been as good as many of the secret inks used during the First World War.

5 ‘The Memoir of Sir Benjamin Thompson’, by G.E. Ellis, published in 1871 (Boston) by the American Academy of Arts and Sciences, contains an interesting description (pp. 56, 57) of Thompson’s oleaginous tendencies: ‘Young Thompson was essentially a courtier. He manifested in early manhood the tastes, aptitudes, and cravings which prompt their possessor, however humbly born, and under whatever repression from surrounding influences, to push his way in the world by seeking the acquaintances and winning the patronage of his social superiors, who have favors and distinctions to bestow’. This passage refers to Thompson’s period in Concord and Boston (1773–75).

6 B. Thompson, ‘New experiments upon gun-powder with occasional observations and practical inferences ...’, Phil. Trans. R. Soc. Lond. LXXI, 230 (1781).

7 In July 1781 London witnessed a spectacular trial of a French spy named La Motte, who had been caught with details of British naval secrets which he was selling to the French. He never revealed the identity of ‘a friend in a certain office’, but there were strong suspicions that that friend was Benjamin Thompson.

8 Thompson’s activities on the battlefield of America were negligible, but we gain an insight into his vindictive personality from the many stories (see note 2) recorded of his bivouacking his troops in the village of Huntingdon, Long Island in the winter of 1782–83. He razed the village church for material to build his barracks, cut down apple trees for firewood and built ovens of the gravestones.
A fellow voyager was the historian Edward Gibbon, who had just lost his sinecure at the Board of Trade. In a letter to Lord Sheffield describing the crossing, Gibbon spoke of ‘the soldier, the philosopher and the statesman, Thompson’.

Thompson’s cylindrical passage thermometer is now in the possession of The Royal Institution.

Rumford soup is still talked of and prepared in continental Europe.

The Royal Institution owns the photometer head of one of Rumford’s own instruments.

The trouble with the oil lamps of his day was that the oil was very thick and viscous, so that the lamp burned brightly at first, when filled, but was almost useless when nearly empty. Thompson overcame this problem by simply placing the oil reservoir at the same height as the wick.

He had many other affairs and mistresses. Princess Taxis, Baroness deKalb and Madame Laplace, among others, were associated with him at various times.

Rumford’s Essays were published at different times between 1796 and 1802. His first gave an account of an establishment for the poor in Munich; the second was on establishments for the poor in general; the third was on ‘Food and feeding the poor: Rumford soup and soup-kitchens’; the fourth on ‘Chimney fire-places’; the fifth on ‘Several public institutions founded in Bavaria’. There were several others dealing with such topics as ‘Management of fire and the economy of fuel’, and ‘Propagation of heat in fluids’.

Matthew Boulton, who partnered James Watt’s ventures with the steam engine, was quite scathing in his criticism of Rumford’s grandiose plans concerning the Repository with its exhibits. ‘Your object is one every practical inventor should discountenance … Suppose a man, by a great devotion of time and labour, by skill and ingenuity, has made an important combination in chemistry and mechanics, your object is to publish the details of his labour, to enable every spectator to profit would be ruinous to individuals and would ultimately interfere with the prosperity of Britain, for your enemies would profit by such disclosure …’.

What Sir Joseph Banks thought of the Royal Institution, which had mounted lectures by the poet Samuel Taylor Coleridge, by Landseer the painter, and by the religious divine Reverend Sydney Smith, may be gauged from his letter to Rumford in April 1804: ‘Your not appearing in England last year … has been a material disappointment to me and a great detriment to the Royal Institution. It is now entirely in the hands of the profane. I have declared my dissatisfaction at the mode in which is is carried on and my resolution not to attend in future’.

Count Rumford was elected a member of the American Philosophical Society (APS) in 1803.

There was one serious difficulty with Rumford and Madame Lavoisier’s plans. Rumford was a British colonel and Napoleon had no wish to have such people, especially those who had a reputation for espionage activities, within the bounds of the French Empire. The couple, therefore, had to spend most of their time in Bavaria travelling around other countries of Europe, hoping for the First Consul to change his mind, which he ultimately did by the spring of 1804 when, to his horror, Rumford encountered another hurdle. Under French law the Count had to produce documentary proof that his first wife was dead. It took over a year, owing to the hazards of war, for Rumford to be able to produce the required documents to enable them to be married.

Writing to his daughter from Paris on 24 October 1806, on the first anniversary of his marriage to Madame Lavoisier he says: ‘I am sorry to say that experience only serves to confirm me in the belief that in character and natural propensities Madame de Rumford and myself are totally unlike, and never ought to have thought of marrying … Very likely she is as much disaffected towards one as I am towards her. Little it matters with me, but I call her a female Dragon—simply by that gentle name!’. A year later, from his home in Rue d’Anjou, Paris, he writes in ever more despairing terms to ‘My Dear Child’, and his letter ends by saying ‘After that she goes and pours boiling water on some of my beautiful flowers’.
21 In 1806 and 1807 Rumford sought relief by the pursuit of science. Although his personal relationships were miserable, he published eight papers in the Memoirs of the Institute (Paris): (1) A description of a new differential thermometer; (2) Research on heat, showing the effect of difference of surface on radiation; (3) Further experiments on the effect of blackening the surface; (4) Different properties of bodies with respect to radiation and to conducting powers; (5) The passage of heat through solids; (6) On the heat of solar rays; (7) On the cooling of liquids in vases of porcelain, gilt or not gilt; and (8) Dispersion of the light of lamps by serceus of ground glass, silk, and so forth with a description of a new lamp. His experiments on the temperature of water at the maximum density, which he also carried out during this period, he published in Phil. Trans. R. Soc. Lond.

22 Young was Foreign Secretary of the Royal Society from 1804 to 1829.

23 The precocious Davy was also interested in friction. In 1799 he used a clockwork to make a metal wheel turn against a wax-coated metal plate. The wax was melted even though the entire system was held below freezing. In later years, during one of his spectacular lecture-demonstrations in the Theatre of the Royal Institution, Davy rubbed two pieces of ice together, again keeping the ice below freezing, yet the ice melted. Such results could not be accommodated by the caloric theory of heat, and Davy concluded, independently of, but shortly after Rumford, that heat was kinetic in nature, a form of motion.


25 This remarkable fact has daunted all succeeding Directors of the Royal Institution.

26 In 1904 the Nobel Prize in Physics was awarded for the first time to a British scientist, Lord Rayleigh. Rayleigh was the first of 15 professors of the Royal Institution to become Nobel Laureates.

27 Bill Coates, a former paratrooper and largely self-taught technician was a brilliant lecturer’s demonstrator and assistant. He devised and illustrated demonstrations for Friday evening discourses, Christmas lectures, and other public events organized and given by five Directors of the Royal Institution: E.K. Rideal, E.N. da C. Andrade, W.L. Bragg, G. Porter and J.M. Thomas.