SCIENCE LECTURING AT BATH, 1724-1800

Trevor Fawcett

Early in May 1724 some eleven to twelve hundred curious visitors travelled to Bath to observe a total eclipse of the sun. Among them came Dr J.T.Desaguliers, F.R.S., perhaps the most active and well-connected science lecturer in London, who in the run-up to the eclipse explained the coming event to thirty or forty three-guinea subscribers. Some of the audience on this occasion were surely freemasons, since Desaguliers, in his other character of deputy grandmaster of the Grand Union Lodge, used his visit to receive into Bath's fledgling Queen's Head Lodge several new members, including Viscount Cobham, Lord Hervey and Beau Nash.[1]

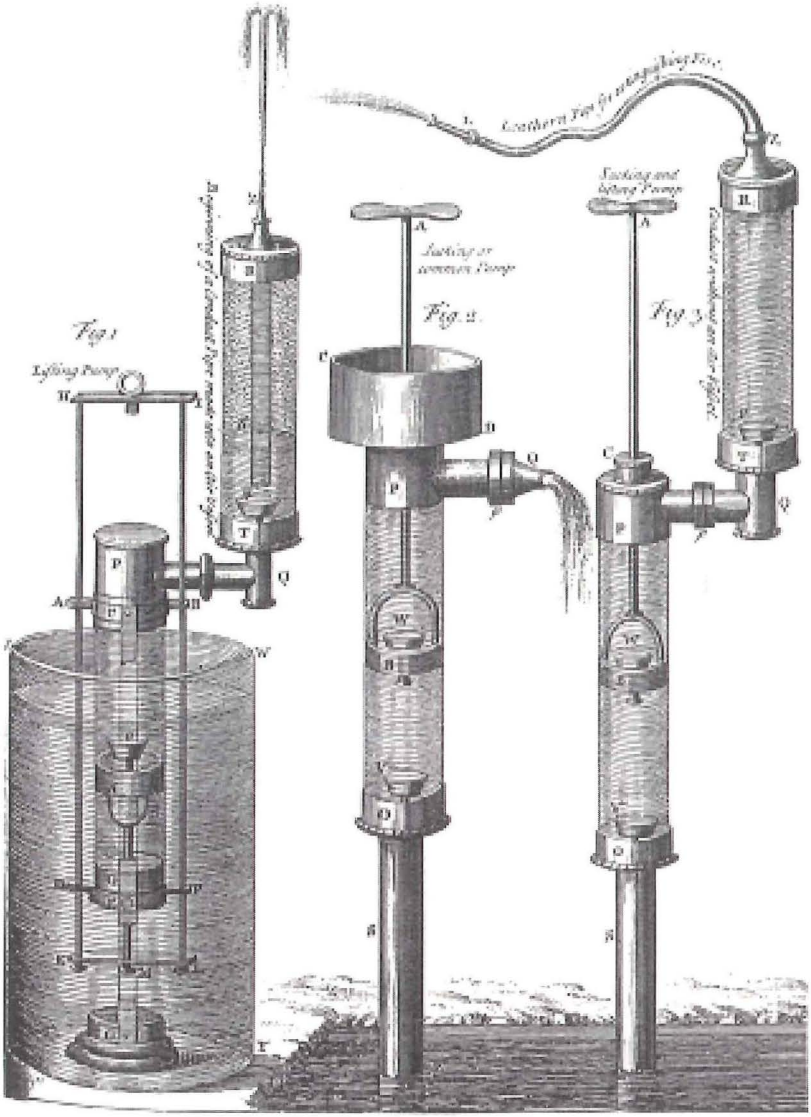
At this date public instruction in astronomy or any other branch of 'natural philosophy' (i.e. the experimental and natural sciences) was still a novelty outside the select confines of the Royal Society and the universities, or the handful of London coffee houses and academies where lecture courses were periodically held. Desaguliers' explanation of the eclipse not only marked the start of scientific education at Bath, it helped initiate the practice of itinerant lecturing more generally. From the 1720s and 1730s onwards scientific demonstrators would increasingly take to the road on extensive provincial tours, advertising and delivering series of paid experimental lectures as they went. Even though a growing genre of popular science books and periodicals also contributed to public enlightenment, the itinerant 'philosophers' were perhaps the chief means by which scientific knowledge, new discoveries, and technological improvements were communicated and disseminated. Furnished with an imposing array of scientific instruments, mechanical devices and working models, they were able to convey abstract principles through vivid practical demonstration and to enact experiments directly in front of their audience. Public educators at large, they were at the same time skilled performers, providers (in their own words) of 'rational entertainment'. Since they depended on science for a living, they had to rouse public curiosity, attract subscribers, and then put on a good show. Most lecturers were practical men (often instrument-makers themselves), largely self-taught, and of ambiguous social status – to some extent bearing a similar class relationship to the elitist fellows of the Royal Society as an apothecary (the general practitioner of his day) did to a contemporary

university-educated physician.[2] Some enjoyed long careers, gradually modifying their syllabus of lectures as the field of science and technology developed from its early domination by Newtonian physics, optics and astronomy (an essentially mechanical view of the universe), through to the mid-century excitements about the phenomenon of electricity, the development of chemistry (and a new understanding of gases) from the 1770s, and the rising interest in biology, geology and, once again, astronomy in the final decades. Not infrequently it was the stimulus of visiting and resident lecturers that led to the formation of local science societies up and down the country. The establishment of the Bath Philosophical Society in 1779 is arguably a case in point.

After his 1724 début Desaguliers may have lectured regularly at Bath, where his chief patron, the Duke of Chandos, began financing a set of superior lodging houses to John Wood's design in 1727. Certainly he delivered courses in 1729 and 1730:

> Bath, Septem.3 [1730]. This Day Dr. Desaguliers came here in order to have Courses of Experimental Philosophy during the Season: He has brought down, besides the common Apparatus usual in his Courses of Experiments, several new Machines for the Entertainment of his Subscribers. He will have his Lectures at Mr. Harrisons Room, where he was last Year, at the same Price of three Guineas, one Guinea at Subscribing, and the other two the first Day of the Course. Subscriptions are taken in by Mr. Leake, Bookseller in Bath.[3]

References to the 'Season' and Harrison's Assembly Room suggest that Desaguliers was directing his publicity more at visitors than Bathonians, and we know that Viscount Percival for one was among the subscribers to this typically expensive series.[4] But the encouraging reference to 'Entertainment' did not imply any lack of didactic rigour. While not taxing his listeners (women among them) with difficult mathematics, Desaguliers did expect their close attention, common sense and just a little arithmetic, as he launched into proving a chain of axioms through experiments and demonstrations.[5] Disciple of the late Sir Isaac Newton, he was also a convinced Baconian, believing – like his fellow-freemasons – in the application of scientific knowledge to bettering the world. The apparatus he had specially carried down from London included therefore not only measuring and optical instruments, prisms to split light, an air pump, a device to simulate the motions of heavenly bodies, and other laboratory equipment, but also levers, model engines and machines,



1. Examples of water pumps from J.T. Desaguliers, *A Course of Experimental Philosophy* (1734), Vol.2, plate 15. Desaguliers would explain the theory and applications of such devices in his lectures, a topic of some relevance at Bath where the hot mineral waters had to be pumped from underground sources for drinking in the appositely named Pump Room.

the visible evidence of 'natural philosophy' in action. Much engaged himself in practical projects, from curing smoky chimneys to improving water supply, Desaguliers was impressed at Bath by Ralph Allen's horse-cranes and innovatory tramway, and subsequently published accounts of both.[6]

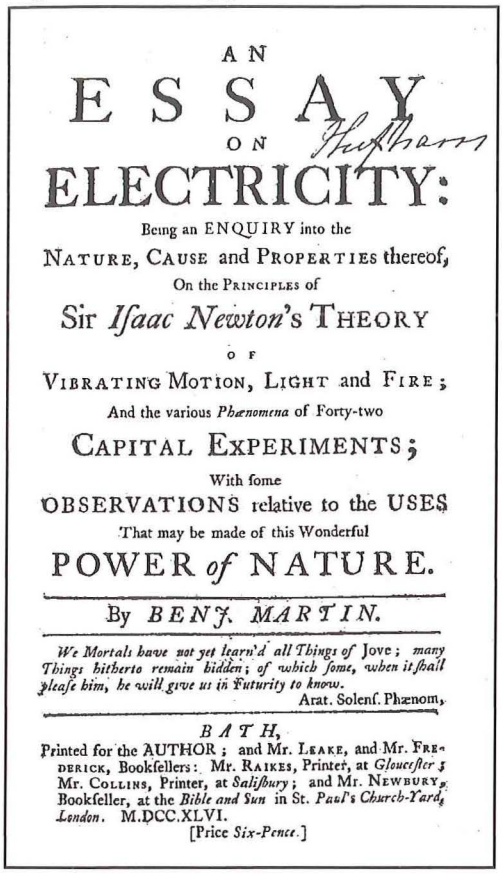
Documentation of his courses in the 1730s remains patchy, but he undoubtedly performed at the spa in 1731 and 1737-8 as well as adding Bristol and Worcester to his West Country circuit. In fact he recorded in verse the tender-hearted incident at one of the 1731 lectures when Prince William's governess, Amanda Smith, unable to bear the gradual suffocation of the experimental fish during a trial of the air pump, had them rescued and thrown back into the nearby Avon.[7] In 1737, on top of his standard demonstrations of the principles of mechanics, hydrostatics and optics, he expounded the phenomenon of tides with a brand-new piece of clockwork, and illustrated the solar system on an improved planetarium – probably the costly 4-foot apparatus he devised with the instrument-maker George Graham.[8]

Before Desaguliers' death in 1744, another itinerant Newtonian philosopher had arrived on the West Country scene. Benjamin Martin's agenda too had a serious ring. His lecture course was far from being 'a Shew, for Amusement only; but is intended as a Science to exhibit a just Idea of the true Nature, Reason, and State of Things, as far as they can be known'.[9] While still a Chichester schoolmaster Martin had published a *Philosophical Grammar* and embarked on instrument making, and by summer 1743 his touring equipment included an orrery (for explaining the solar system), a cometarium, celestial globe, reflecting telescope, air pump, a 'very precise' baroscope, various other measuring devices, and models of a forcing pump and marine depth-gauge.[10] No electrical machine figured in the list, nor did Martin rush to add electricity to his lecture syllabus in the following years despite, as the *Gentleman's Magazine* put it in April 1745, the recent discovery of phenomena 'so surprising as to waken the indolent curiosity of the public ... who never regard natural philosophy but when it works miracles'. The discovery of the electrical capacitor or Leyden jar turned curiosity into a craze. Everyone wished to see the sparks igniting a dish of alcohol or watch a line of people jump as they felt the transmitted shock. Yet Martin's two successive courses at the Bath Assembly Rooms in late 1744, and others in autumn 1745 and spring and autumn 1746, seem to have ignored electrical phenomena altogether and concentrated on traditional useful science, both theory and practice. In these lectures:

the true System of the *World*; the various Properties, Affections, and appearances of *Natural Bodies*; the Principles and most considerable Machines in the *Mechanical* and *Philosophical Arts* and *Sciences*, are Exhibit'd, Explain'd and Illustrated, by a very large and curious Apparatus of Instruments, and a great Variety of Instructive and Entertaining Experiments, accommodated to the various Uses of Life, and easy to be understood by all Capacities.[11]

Privately, however, Martin conducted his own electrical trials, employing a variant of Monnier's machine, and convinced himself it was all explicable in terms of Newtonian effluvia. But though his *Essay on Electricity*, published at Bath in October 1746, outlined 42 'capital' experiments, it appears he still refrained from showing them in public. The appetite for electrical drama was met instead by a visiting instrument-maker from London, one Smith, who in September 1746 hired a room at the *Queen's Head* accessible to all 'Judges of Experimental Philosophy' and guaranteed a showman's performance: 'Electrical Commotions to be felt by every Person in the Room, and the Fire to come out of any Part of the Body'.[12]

Martin knew the dangers of playing the magician or indulging in quack showmanship. Even Desaguliers, who unlike Martin had Royal Society credentials and rich backers, had sometimes met hostility



AN

ESSAY

ON

ELECTRICITY:

Being an ENQUIRY into the

NATURE, CAUSE and PROPERTIES thereof,

On the PRINCIPLES of

Sir *Isaac Newton*'s THEORY

OF

VIBRATING MOTION, LIGHT and FIRE;

And the various *Phænomena* of Forty-two

CAPITAL EXPERIMENTS;

With some

OBSERVATIONS relative to the USES

That may be made of this Wonderful

POWER *of* NATURE.

By *BENJ. MARTIN.*

We Mortals have not yet learn'd all Things of Jove; *many Things hitherto remain hidden; of which some, when it shall please him, he will give us in Futurity to know.*

Arat. Solens. Phænom.

BATH,

Printed for the AUTHOR; and Mr. LEAKE, and Mr. FREDERICK, Bookfellers: Mr. RAIKES, Printer, at *Gloucester*; Mr. COLLINS, Printer, at *Salisbury*; and Mr. NEWBURY, Bookfeller, at the *Bible and Sun* in St. *Paul's Church-Yard, London*. M.DCC.XLVI.

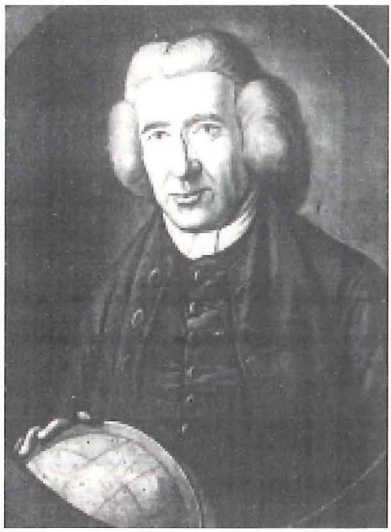
[Price *Six-Pence*.]

2. Title-page from one of Benjamin Martin's works published in 1746 during his residence at Bath.

and misrepresentation. The difficulty for peripatetic professionals like Martin, whose income depended on attracting customers (and on promoting sales of textbooks and instruments), lay in achieving a balance between high-minded science, popular education and cheap trivialisation. In attempting to reveal the wonders of natural phenomena they were also open to the theological criticism that prying into divine creation was itself a blasphemous act. Electricity was a high-risk topic in both respects, as Martin learned to his cost in the sudden polemic that blew up in the autumn of 1746 with John Freke, F.R.S. and London surgeon, who not only castigated itinerant lecturers as mercenary 'Country ... Showmen' but attacked the very basis of electrical research, arguing that to release this mysterious life spirit in casual experiments was literally and metaphorically to play with fire.[13] Hence the ensuing war of words had deeper meaning for both contestants than simply the morality of lecturing for money or the authority of a Fellow of the Royal Society against a mere pretender, for it pitted a particular Pietist view of divine creation against the usual argument of natural theology that scientific investigation, far from being sacrilege, actually heightened the sense of religious awe and led the mind, in Pope's often-quoted phrase, 'through Nature up to Nature's God'. In sharp contrast Freke and his fellow Pietists (who included the novelist Samuel Richardson and the recently deceased Bath physician George Cheyne) believed that profane enquiry had its limits, and that the phenomenon of electricity belonged in the spiritual, not the scientific, domain. Martin responded by labelling his opponent a scientific Don Quixote, but the controversy between them must have rumbled on for some time at Bath, especially in the circles of James Leake's bookshop and at Prior Park.[14]

By now Martin was living at Bath off the north side of Orange Grove, his 'Experimental Room' in Orange Court becoming the new site of his public demonstrations. His announcement of a course beginning January 1748, though firmly emphasising '*Newtonian*' philosophy and his rich new equipment, still made no overt reference to electricity, and the same went for further series a year later which did however touch on chemistry and magnetism. Between these dates he delivered a course of uncertain content which may possibly have broached the topic at last.[15] Unable to manage by lecturing at Bath alone, he also undertook tours – the summer of 1750, for example, being spent on a sweep through East Anglia. Otherwise he probably continued working on scientific instruments while his wife took in lodgers and ran a haberdashery business across the Grove in Wade's Passage. Here in November 1751 she significantly had on sale James

3. An engraving of Benjamin Martin (1704-82), based on an earlier portrait and printed posthumously in the *Gentleman's Magazine* (1785), Vol.55, part 2, p.583.



4. James Ferguson (1710-76) in an engraving of 1776, with his hand apparently resting on a sidereal globe. His passion for astronomy helped to enthuse William Herschel.

Ferguson's 'Portable CARD-DIALS' and 'LUMINARIUM', an almanac device.[16] Since Ferguson likewise lectured for a living, it must be assumed that Martin was allowing him to take over, and indeed within a year or two Martin removed to London (his wife selling off in Wade's Passage early in 1753) to concentrate on publishing and setting up what proved a successful Fleet Street instrument shop.

Ferguson may first have lectured at Bath around Christmas 1747, though it has been suggested this initial sortie was more to do with his alternative occupation of Indian ink portraiture.[17] A self-taught Scot, Ferguson specialised in astronomy which for Martin had been only a component topic in a much broader curriculum. His five-lecture, five-shilling courses at Wiltshire's Assembly Rooms in the autumns of 1750 and 1751 were wholly astronomical, meaning in effect that they covered the solar system in some detail but almost ignored outer space, which until Herschel's vast improvements of the telescope was little studied or known. Ferguson's key piece of equipment was therefore an elaborate orrery of his own making which could represent the movement of Sun, Moon and

planets, and help to explain the calendar and the causes of eclipses and tides. He had this and other apparatus on daily view at his lodgings, where during his stay he also gave private lessons and made ink drawings on vellum at 12s.6d. – perhaps still his mainstay activity.[18]

Whatever his success at Bath, Ferguson did not return until the 1760s, leaving the field mainly to William Griffiss who included the spa in his lecturing tours of 1752 and 1755-6. Griffiss is a less familiar figure than most of the itinerant natural philosophers, yet he travelled assiduously, covered all the physical sciences except electricity, and owned a considerable quantity of apparatus. His first Bath series (following nine at Bristol and one at Pensford) opened at the *Pineapple*, Orchard Street, in April 1752 – once he had attracted a minimum of thirty subscribers (at a guinea each) through his printed prospectus of experiments and his comment: 'N.B. Subscribers are free to propose any Questions, and the Apparatus being finished with the latest Improvements on Instruments, is allowed to be the compleatest and most extensive in Britain'. Returning in December 1755 for Bath's burgeoning winter season, Griffiss more ambitiously hired Wiltshire's Assembly Rooms and now required at least forty names on his list. In ten sessions he would then cover natural philosophy in general ('to illustrate and confirm Sir Isaac Newton's Principles'), mechanics, hydrostatics and hydraulics, pneumatics, chemistry, the useful applications of science, optics, military architecture ('illustrated by a large Model of a fortified Town'), geography, and astronomy.

> In these Lectures, besides the usual Experiments, will be explained (by Models) the Nature and Construction of the most considerable Engines now in being, with their Application to the various Purposes of Life. What Opinion the greatest Men have had of these Lectures, is well known to those who have heard Professor Bradley, of Oxford's Recommendation of them. – This Course consists of all the most curious and entertaining Parts of Philosophy ... being particularly calculated for such Gentlemen and Ladies as would chuse to be acquainted with the more rational and sublime Parts of Knowledge, in the most expeditious and familiar Manner, with the least Expence.[19]

And because such a packed programme demanded much pre-planning, 'Mr. GRIFFISS hopes none will take it ill if they are not personally waited on, as he will be greatly engaged on Account of the necessary Preparations'. The course went well, however, and Griffiss advertised a repeat performance with a reminder of how 'exceedingly beautiful as

well as accurate and compleat' all his equipment was, and how up-to-date his information. He welcomed the attendance of women, but seemed to be angling too for more technologically-minded subscribers – 'the Quality and Gentry expressing great Satisfaction with the Variety of Experiments which are universally allowed by all who have seen them, to be not only highly entertaining, but extremely useful to all Sorts of Persons, especially those well read or employed in Mechanicks, &c.'.[20] This fairly broad public appeal suggests that the predominantly gentry composition of the audience before 1750 was beginning to include subscribers from the professional and commercial classes, even plain middle-class tradesmen and their families. Later in the century some of the more theatrical performances were certainly directed at the general public, though not yet specifically at artisans who would have to await the rise of mechanics' institutes in the 1820s.

In spring 1756, having meanwhile lectured in Ireland, Griffiss travelled through the West Country for the last time, giving a final series at Bath on the eve of the Seven Years' War which, causally or not, was to coincide with a general dip in the market for science lectures.[21] Locally the dearth lasted even longer, for even a claimed lecturing visit by James Ferguson in 1763 has not been substantiated.[22] He did turn up at Christmas 1766, however, on a trip arranged by his bookseller Andrew Millar to promote a reissue of the popular *Lectures in Mechanics* and *Astronomy Explained*. Ferguson, now a F.R.S., had extended his range and probably had with him many working models of cranes, wheel-carriages, mills, pumps, and other mechanical devices besides his faithful orrery. At the start of his second twelve-lecture course he offered an evening course, presumably for people with daytime occupations, before gradually packing his apparatus for the London waggon. His final session with the orrery touched on the seasons, eclipses, and 'Saturn's Ring', and ended on a dramatic note: 'The Year of our SAVIOUR's Crucifixion will be Astronomically ascertained, and the Darkness at the Time of his Crucifixion proved to have been out of the common Course of Nature'. Astronomy was still Ferguson's strongest suit with the public, for two months later a proposed dozen lectures employing his full battery of model machinery had to be abandoned in favour of a further short course on the solar system.[23] Only once more was he recorded at Bath, when in April 1774 he ran a double series of twelve lectures. Then aged 64, he still had the curiosity to calculate the weight of air in the ballroom of the new Upper Assembly Rooms and to determine it would keep 900 people alive and 100 candles burning for just 23 hours 49 minutes.[24]

A new generation of lecturers dominated the last third of the century at Bath, notably John Arden (who settled for a time there), Benjamin Donn (or Donne) of Bristol, John Warltire, Henry Moyes, Walker junior, and John Lloyd. Expounding science was now a reputable activity and took place against a surge of fresh discoveries and interest in astronomy, electricity, the chemistry of gases, geology and botany. British skills in inventions and instrument-making – which had already produced Knight's artificial magnets, Dollond's achromatic lens, Ramsden's scale-divider and Harrison's chronometer – remained unsurpassed, and before 1780 Bath had acquired its own specialist 'optical, philosophical and mathematical' instrument-makers in Ribright & Smith. The scientific public was expanding. In a growing market for popular instruction, women were specially targetted in publications like the *Lady's Diary*, and children too in the *Museum for Young Ladies and Gentlemen* (which passed through fifteen editions by c.1800), Benjamin Martin's *General Magazine of Arts and Sciences* (1755-65), and the miniature *Newtonian System of Philosophy adapted to the Capacities of Young Gentlemen and Ladies* (1761).[25] Fringe activities such as the ballooning craze (1783-4), electric medical therapy, and the vogue for Mesmerism (from the 1780s) stirred further interest, while at Bath popular adult education was stimulated by public lectures on topics other than science, ranging from elocution, literature and the visual arts to medicine, veterinary science and dietetics.

John Arden and Benjamin Donn both sought a Bath audience from the late 1760s. Arden, with much experience of teaching and lecturing in the North and Midlands, first tried his luck in winter 1768-9 with two successive long courses covering physics, astronomy and geography, in which he promised to make the experiments 'as plain and intelligible as possible, even to those who have not applied Time or study this Way' and with the aid of an extensive apparatus incorporating 'the latest Improvements'. For twenty lectures he charged one guinea, where Desaguliers had once asked three. Arden's custom would be more middle-class, and he could exploit his stay besides by giving private lessons to young people on elementary astronomy and geography: 'Attendance for one Hour in a Day, for ten Days, or a Fortnight, is sufficient', he noted. His subsequent visits in late 1769 and early 1770 kept to the same pattern.[26]

Meanwhile Donn had also started to lecture. Stemming from a gifted family of Bideford mathematics teachers, he moved to Bristol about 1759-60, becoming assistant at the King Street Library and later opening a mathematical academy geared in part to Bristol concerns in navigation

and shipping. At Bath he advertised a first course in December 1769 together with details of his academy and publications (including his important *Navigation Scale Improved,* and excellent maps of Devon – for which he won a Society of Arts award – and of 11 miles round Bristol). It is uncertain whether this course ran, but next spring he offered another 'whereby any one with only common Sense and a moderate Degree of Attention' could easily grasp the principles involved:

> The *First Lecture* will contain some some introductory Theorems in Geometry – Of Matter, its Divisibility – Laws of Motion – Composition and Resolution of Forces – Attraction of Cohesion – Solution of Bodies in Mediums – Rise of Water in Capillary Tubes, Vegetables, &c. // The *other Lectures*. The Attractions of Magnetism and Gravity – Laws of falling Bodies – Nature of Pendulums – Centre of Percussion, Expansion of Metals – Mechanic Powers, and compound Machines – Equilibrium and Pressure of Fluids – Properties of the Air – Some Electrical Experiments – The Nature of Vision, Origin of Colours – Geography, with the sublime Science of Astronomy, more fully explained than is commonly done, &c. &c.

Provided he had thirty subscribers by the first lecture, he would undertake the course and furthermore, given encouragement, would mount a course at Bath every Christmas. Enough support must have been forthcoming since he returned in December and tentatively began with three discourses on astronomy, hoping it would swell into a full series.[27] The regular Christmas series never materialised, however, and Donn left the spa alone until spring 1773 when he seems to have lectured at both the *Queen's Head* in Cheap Street and the Ladies' Coffee Room beside the Pump Room, sometimes twice a day.[28]

About this time Joseph Priestley arrived in Calne to look after the Earl of Shelburne's Bowood library, and the Bath music master William Herschel purchased Ferguson's *Astronomy Explained* and some months later obtained from 'a Quaker resident at Bath, who had formerly made attempts at polishing mirrors, all his rubbish of patterns, tools, hones, polishers, unfinished mirrors, &c ... '[29] Both events had major scientific consequences. Over the next few years Priestley took a huge stride in the understanding of atmospheric and other gases; he isolated 'dephlogisticated air' (oxygen), explained plant and animal respiration, and hinted at medical uses for the new pneumatic chemistry. Herschel, doubtless further enthused by Ferguson's lecture courses at Bath in 1774,

was meanwhile labouring to build the powerful reflecting telescopes that would reveal the planet Uranus and penetrate the night sky as never before. Bath in the late 1770s stood near the frontier of scientific research.

Benjamin Donn's series on experimental philosophy at the Upper Assembly Rooms in June 1776 (thirteen plus an extra three lectures) included electricity but nothing yet on gases – which it aptly fell to John Warltire to introduce.[30] 'Aptly' because Warltire was in the forefront of recent discoveries in this area. He had collaborated with Priestley, obtained pure chemical samples for him, worked with him at Calne, and continued to pass on his personal observations – which in January 1777 came close to proving the chemical constituents of water.[31] An experienced lecturer with close links to the industrial Midlands, Warltire reached Bath about the end of August 1776. He announced courses of 'New Experiments upon Air' at the Lower Rooms, each of three meetings, at 5s. for the course or 2s.6d. a meeting, which he was called on to repeat at least four times. Systematically he dealt with atmospheric gases, artificial gases, and the actions of gases in organic life and industrial processes, repeating each 11 a.m. 'discourse' at 7 p.m. to suit different audiences.

> Mr.WARLTIRE flatters himself these Experiments claim attention the most of any discoveries since the introduction of *Experimental Philosophy*; because they are highly interesting to the ladies as well as gentlemen, and are the most entertaining, and the easiest understood of any in the circle of Philosophy – besides, they are quite new discoveries, and the chief part of them never yet published ... The discourses open precisely at the above times – and it is requested that no part of the apparatus may be moved, and that the company will not require gold to be changed.[32]

There can be little doubt the topic must also have appealed to medical practitioners, some of whom would in the 1790s try out carbon dioxide and nitrous oxide in treatments. More immediately the discoveries were relevant to the spa's literal source of wealth, the effervescent hot waters whose potency had always been agreed to be greatest when drunk straight from the pump before their vital gases had evaporated. Deploying their limited knowledge of chemistry, local and visiting physicians and apothecaries had often – and controversially – analysed the springs, but Priestley's discovery of dissolved carbon dioxide

('fixible air') in the waters made it possible not merely to reconstitute Bath water gone flat but, more threateningly, to produce artificial waters from scratch.[33]

Warltire's success at Bath induced him to come back in October 1777 to give another state-of-the-art series, this time with four lecture-demonstrations in which he undertook to manufacture each gas as his audience watched (with an entire session on nitrous oxide and another partly devoted to acid compounds). Nodding invitingly towards the recently formed Bath [and West] Agricultural Society he proposed further lectures that would treat the still embryonic science of agricultural chemistry. It is likely John Arden attended Warltire's lectures. After some years' absence he had settled at Bath and in late 1776 resumed lecturing to select audiences of a score or more at his own house in St James's Street. By next April he was already into his third course when he had to recruit replacements for subscribers leaving Bath early, with lectures still to come on electricity and magnetism, mechanics, hydrostatics, astronomy, optics, and – a first venture onto Warltire's ground – the properties of air. Later in the year that advance was more definite as he offered sixteen lectures 'in the course of which will be exhibited Dr. Priestley's new experiments upon different kinds of air. Such Lectures will require about one hour and half attendance and no more'.[34]

Early in 1778 competition was keen. Arden's third winter series clashed directly with Donn's six lectures 'on the most entertaining Parts of NATURAL PHILOSOPHY' (astronomy, pneumatics and electricity) which he would repeat in a separate evening course to 'accommodate People in Business'. And Warltire that April, facing a rival course on the genius of Milton and another one forthcoming – in French – on the the humanities and sciences, seasoned his five lectures at a room on George Street with a few novelties. In addition to many experiments he would reveal 'an application to the doctrine of fossils, minerals, &c' and display an opaque solar microscope, 'an instrument of an entire new construction' capable of explaining many recent discoveries.[35] The somewhat cryptic reference to fossils and minerals is noteworthy in view of the specific local interest in geology[36] and its rising significance as a science. Ancient shells, corals, sea urchins, belemnites ('thunderbolts') and spectacular ammonites ('snakestones') abounded in the nearby lias and oolite quarries, and several Bath residents made collections – including Edmund Rack, secretary not only of the Agricultural Society but of the new Bath Philosophical Society whose formation in late 1779 may well have been precipitated by John Arden's latest course of lectures. On 22 December

Rack noted in his 'Disultory Journal' that he had begun attending

> a Course of Philosophical Lectures on Electricity – the Air, Chemistry, Astronomy, Hydrostatics, & the Globes – these Lectures are given by Wm [actually John] Arden of this City, a very Ingenious Man, & who has a Noble Apparatus of the best Instruments. Entertainments of this kind are the most truly Rational & instructive of any that can Employ the Human mind. And a few Lectures explaind by experiments convey more lasting instruction than many volumes of theory. We have them read here all winter. At these Lectures were many Men of great scientific Knowledge ...[37]

150 EXPERIMENTS WITH

SECTION II.

ENTERTAINING EXPERIMENTS PERFORMED BY MEANS OF THE LEYDEN PHIAL.

NO electrical experiments anſwer the joint purpoſe of pleaſure and ſurprize in any manner comparable to thoſe that are made by means of the Leyden phial. All the varieties of electrical attraction and repulſion may be exhibited, either by the wire, or the coating of it; and if the knobs of two wires, one communicating with the inſide, and the other with the outſide of the phial, be brought within four or five inches of one another, the electrical ſpider above mentioned will dart from the one to the other in a very ſurpriſing manner, till the phial be diſcharged. But the peculiar advantage of the Leyden experiment is, that, by this means, the electrical flaſh, report, and ſenſation, with all their effects, may be increaſed to almoſt any degree that is deſired.

WHEN the phial, or the jar, is charged, the ſhock is given through a perſon's arms and breaſt, by directing him to hold a chain communicating with the outſide in one hand, and to touch the wire of the phial, or any conductor communicating with it, with the other

THE LEYDEN PHIAL. 151

other hand. Or the ſhock may be made to paſs through any particular part of the body without much affecting the reſt, if that part, and no other, be brought into the circuit through which the fire muſt paſs from one ſide of the phial to the other.

A GREAT deal of diverſion is often occaſioned by giving a perſon a ſhock when he does not expect it; which may be done by concealing the wire that comes from the outſide of the phial under the carpet, and placing the wire which comes from the inſide in ſuch a manner in a perſon's way, that he can ſuſpect no harm from putting his hand upon it, at the ſame time that his feet are upon the other wire. This, and many other methods of giving a ſhock by ſurprize, may eaſily be executed by a little contrivance; but great care ſhould be taken that theſe ſhocks be not ſtrong, and that they be not given to all perſons promiſcuouſly.

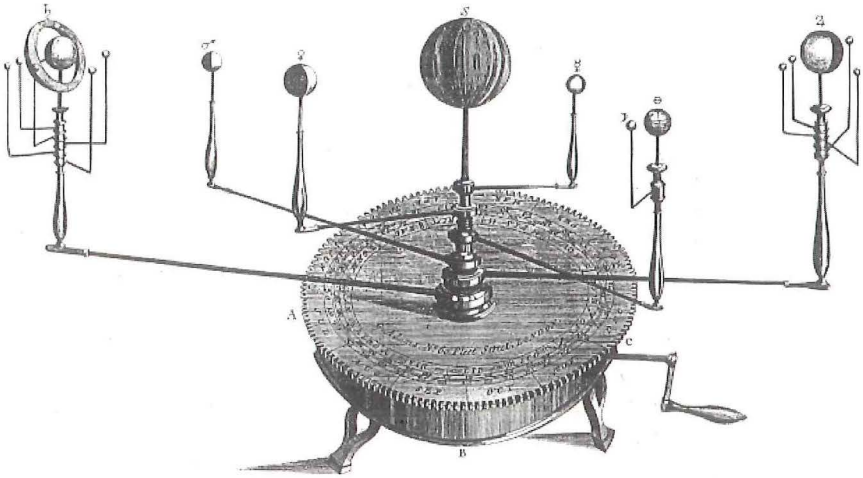
WHEN a ſingle perſon receives the ſhock, the company is diverted at his ſole expence; but all contribute their ſhare to the entertainment, and all partake of it alike, when the whole company forms a circuit, by joining their hands; and when the operator directs the perſon who is at one extremity of the circuit to hold a chain which communicates with the coating, while the perſon who is at the other extremity of the circuit touches the wire. As all the perſons who form this circuit are ſtruck at the ſame time, and with the

 ſame

5. The Leyden jar as vehicle of popular entertainment, from Joseph Priestley's widely read treatise, *The History and Present State of Electricity*, first issued in 1767 and reproduced here from the 3rd edition of 1775.

Several days later Rack was approached by Thomas Curtis, one of the Hospital governors, and together they drew up a list of prospective members for what was to be in effect a rather distinguished, scientific gentlemen's club. Most of them had probably frequented lectures at Bath, Arden was himself a lecturer, and another member, Benjamin Smith, was about to make his début. Smith was the junior and probably active partner in a firm dealing in optical, scientific and mathematical instruments, Ribright & Smith, which in 1780 removed to a fashionable address in Bath's [Old] Bond Street. As well as hiring out and selling electrical machines, they installed one on the premises for treating cases of rheumatism, paralysis, spasm, deafness and other complaints 'by Shock, Spark, or passing the Electric Matter through the human frame locally or generally'. Partly because of this kind of medical promotion, electricity was in vogue again and in spring 1781 Smith charged 2s.6d. a time for regular lectures on the subject after shop hours. Arden, however, abandoned lecturing at Bath after 1780 except for a long return visit in 1786-7 when, with Smith's co-operation, he gave three lecture courses while seeking a buyer for his scientific library and apparatus.[38]

The 1780s and 1790s resembled earlier decades in the unpredictability of offerings on scientific topics. Smith seldom lectured, other than to publicise a solar microscope in 1784 and to explain the considerable apparatus he had on permanent display. Donn came intermittently from Bristol (1781, 83, 85, 95-6) with a syllabus adaptable to any current vogue, so that one lecture in December 1783 for example, at the height of the Montgolfier craze, was partly devoted to making 'inflammable air' (i.e. hydrogen) 'wherewith AIR BALLOONS are filled'. Otherwise it depended mainly on the chance arrival of itinerant performers. Warltire's tours brought him back to the spa in 1786 and 1788, on the second occasion to focus on the useful applications of modern chemistry.[39] Chemistry was similarly the theme of the blind lecturer Henry Moyes when he proposed an extraordinarily long course of 28 one-hour lectures (four per week) for a mere guinea in 1781. This was still early in his career, before his American tour, but the amiable Moyes was already an impressive performer. Priestley in 1783 considered him superior even to most sighted lecturers – 'and tho' he cannot himself make many experiments, he gets them made for him by an assistant, so that none of his hearers ever complain on that account'.[40] Priestley also thought well of the London lecturer, Adam Walker, who had begun by purchasing William Griffiss' famous equipment in 1766 but had greatly supplemented it since, notably by his 'Eidouranion', a huge transparent orrery. This his son William brought to Bath in 1783 for



6. A mechanical orrery used to display the relative motions of planets and satellites about the Sun. This example, built by the instrument-maker George Adams the younger, was advertised in his *Astronomical and Geographical Essays* (1789), plate 17. The same work (p.542) pays generous tribute to Adam Walker's more spectacular, large-scale orrery, the Eidouranion, demonstrated at Bath in 1783.

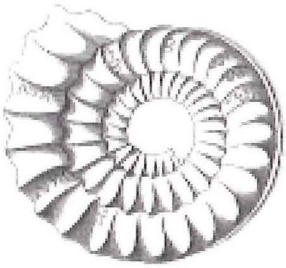
an almost theatrical demonstration of astronomical phenomena. The fifth and final scene in what Walker junior called a daring imitation of 'the sublime and awful simplicity of nature' showed 'every planet and satellite in annual and diurnal motion at once; a comet descends in the parabolic curve from the top of the machine, and turning round the sun, ascends in like manner; its motions being accelerated and retarded according to the laws of planetary motion'. Moreover, he told the Bath public, all Herschel's recent discoveries would be woven into the exposition, not forgetting 'the georgian or new planet', Uranus.[41]

The Eidouranion set a fashion. With Benjamin Smith's technical assistance, Abraham Didier, a former actor with Bath's theatre company, constructed a small, glass 'Lilliputian orrery' or 'Aetheroides'. Claiming the mechanism created an unparalleled illusion of 'suspended Orbs' and had an 'inconceivably smooth' movement, he used it – and two similar glass globes, the 'Tellurium' and 'Cometarium' – in lectures to small groups in 1788 and late 1789. His temporary monopoly was challenged, though, in autumn 1788 by John Lloyd, a well-known metropolitan lecturer, who likewise explained the solar system by means of a model, much larger than Didier's, the so-called 'New Eidouranion'. But Didier

promised most. His exhibition was 'a Theatre on which Astronomical Talents may be fully exercised, whilst the eye is gratified with a truly pleasing spectacle', yet it was 'neither tedious, nor grave enough to make a Lady yawn', might even at times be interspersed 'with apt and approved Poetic Passages', and was well within the comprehension of children.[42]

There was a perennial risk of confusing the wonders of real science with its showy trappings. What, for instance, was the status of Mr Bradberry's travelling exhibition of Newton's philosophical experiments – 'with a variety of deceptions' – in 1787? How should the curious react to the expensive tuition offered by John Holloway and his local disciple John Giles in 1790-1 on the contentious subject of 'animal magnetism' or Mesmerism, in which its mysteries and medical effectiveness would be divulged, in the strictest secrecy, during five-guinea lectures lasting eight hours over two days? No wonder that before soliciting subscriptions a Mr Burton, a new face at Bath, felt obliged to flourish a testimonial from Priestley stating that he had an elegant set of apparatus, spoke well, came of good family, had suffered from the late American war, and deserved patronage.[43]

Even such established lecturers as Henry Moyes grew more cautious in the 1790s as paranoia about radical subversion intensified and the whole Enlightenment project of disinterested science was at times called into question for introducing Illuminist doctrines and undermining Christian faith.[44] Assisted by his nephew, and always giving generous value of around twenty lectures for a guinea, the blind Moyes was now the most constant of the visiting lecturers at Bath. Several times at the Lower Assembly Rooms in 1793, 1796 and February 1798 he repeated his wide-ranging series on the relatively safe theme of 'natural history', in which he discussed celestial bodies, the Earth's geography, the plant and animal kingdoms, and the natural economy and health of humans. But in February and December 1797, switching to chemistry, he must have felt it prudent to cover himself with a pre-emptive defence in the local press, signed 'B', pointing out that he avoided all 'cabbalistic jargon' and addressed his audience in plain language:



7. In the later eighteenth century lecturers paid increasing attention to geology as a branch of natural history and at Bath helped to inspire fossil-collecting. This common ammonite from the Bath and Keynsham district was engraved for a Bath publication of 1779, Joseph Walcott's *Descriptions and Figures of Petrifactions found in Quarries, Gravel-Pits, &c. near Bath*, plate 40.

> When science is administered in such delightful vehicles, it cannot fail to produce the most rational of all amusements, and at the same time it improves the understanding and amends the heart. How different is this system to that of modern scepticism ...

Later in the year he encountered a different sort of sceptic who took the mild Moyes heatedly to task after one lecture, telling him that heaven was in the Sun and that Newton was quite mistaken on many points.[45]

Astronomy was nevertheless the subject most capable of evoking feelings of sublimity and religious awe and (next to electricity) the one most suitable to dramatic presentation. Both John Lloyd, from the stages of the Lyceum and Royalty Theatre in London, and William Walker, from the Haymarket Theatre Royal, paid return visits to Bath as the century closed. In 1799 and 1800 Lloyd was accompanied by his *pièce de résistance*, the 'Dioastrodoxon', a huge transparent orrery 21 feet in diameter and 'richly decorated with appropriate scenery', on which to demonstrate in a course of three lectures 'the sublime Economy of the SOLAR SYSTEM'.

> In this awful and animated transcript of creation, the *mind* contemplates scenes beyond the ken of *mortal eye*, divinely winged; shakes off the cumbrous lumber of contracted worlds, and 'soars through Nature up to NATURE's GOD!'

The whole complex apparatus, which by 1800 permitted over forty scene changes had, Lloyd intimated, cost him more than £500, was expensive to transport and set up, and naturally deserved liberal support. That year he hired Potter's large auction room in Monmouth Street, dubbed it the 'Theatre of Astronomy' and delivered four 3-day courses, morning and evening, probably to a hundred or more subscribers a time. Later in the year Walker, whose current Eidouranion measured a mere 15 feet across, went one better by taking the Theatre Royal itself, which besides admitting a bigger audience enabled him to heighten his effects with staging, curtains, and the aetherial strains of a celestina. This was science lecturing turned into polished, mannered, self-conscious performance.[46]

Yet the more everyday style was also represented at Bath in 1800, when Dr Raphael Gillum, a physician from the Bath Dispensary, provided the first public botanical course at the spa, a month-long series on the Linnaean system and its applications, held at the Agricultural Society's rooms.[47] The very existence of this Society dedicated to agricultural innovation, plus the revival of the Philosophical Society in late 1798[48] and the fact

that Gillum borrowed specimens for his lectures from an eminent local apothecary's botanic garden, all point to the continued presence of scientifically inclined, improvement-minded people in and around Bath.

8. The Bath apothecary William Sole ran a botanical garden, arranged on Linnaean principles, which furnished specimens for Dr Raphael Gillum's lecture series in 1800. Sole's important book systematising the mint family, *Menthae Britannicae* (Bath, 1798), included many fine plates by the local artists Thomas Robins junior and William Hibbert.

While the place was no Birmingham, Manchester or even Bristol, humming with manufacturing enterprise, it was no stranger either to industry and technology, despite the guidebooks' pretence otherwise.[49] And the fact that local financial investment went into buildings, leisure and transportation rather than factories did not rule out commercial, let alone cultural and intellectual, curiosity about scientific progress and applications.[50] The hot springs alone made it a congregating ground for medical practitioners whose calling required the exercise of close observation, rational deduction and practical trial, but scattered evidence indicates an active interest in science well beyond the health profession and quite widely spread among both residents and visitors. Admittedly few were quite so obsessive as the natural philosopher depicted in *Bath Anecdotes and Characters* (1780) who valued an antediluvian bone more than a fine woman:

> He lets fall a guinea and a feather in an air-pump. His room is hung with glasses which invert, enlarge, and diminish ... [and] furnished with mattrasses [flasks], alembics, crucibles, and cucurbits [distillation vessels]; in one corner halfpence are dissolving in aqua fortis; in another, guineas in aqua regia; while the spaces are filled up with thermometers, barometers, globes, and a thousand curious baubles and nicknacks.[51]

But nor on the other hand can most of those attending science lectures have been quite so obtuse as the ageing Mrs Thrale (later Mrs Piozzi) suggested after attending a course by Dr Clement Archer, chemist to the Agricultural Society, in 1806:

> Doctor Archer has been trying to teach us Chymistry by Lecture, this Season at Bath; but I learned nothing except that where the Sphere of Attraction ceases, the Sphere of Repulsion begins ... We had much Talk ... concerning Oxygen, & much Talk concerning the Analogy between our Animal & Vegetable Kingdoms ... A Lady at ye Lecture ask'd me if ye 3 Kingdoms Dr Archer talked so of were England Scotland & Ireland.[52]

Lecturers deserved better than that. Over some eighty years they presumably found Bath worth cultivating for the lucrative returns alone, but their efforts at painless popular instruction were not simply mercenary. Often experimenters and instrument-makers themselves, they were practised communicators in touch with every latest development. Enthusiastic, entertaining, competitive and professional, they kept the spa *au fait* with scientific and technological advance through successive generations.

Notes

1 Printed letter from Bath, 11 May 1724, in *Weekly Journal or British Gazetteer*, 16 May 1724. The Queen's Head Lodge, founded 1723, was the first outside London to come under the Grand Union: see George Norman, 'The masonic lodges of Bath', *Transactions of the Somerset Masters Lodge, No.3746*, Pt.3 (1919).

2 Desaguliers and, eventually, James Ferguson were among the few itinerants who became Fellows of the Royal Society (F.R.S.).

3 *Gloucester Journal*, 9 Sep 1730. According to *The Dictionary of National Biography* the Newcastle lecturer John Horsley visited Bath in 1727, but there is no evidence he lectured there.

4 Hist. MSS. Comm. Rpt 63, Egmont, Diary of Viscount Percival, Vol.1, 14 Sep 1730.

5 See J.T. Desaguliers, *A Course of Experimental Philosophy*, 2nd ed., 2 vols. (1745); Vol.1, p.xi for his basic expectations.

6 *Ibid.*, Vol.1, pp.283-8, pls.12 and 21-2.

7 See Larry Stewart, *The Rise of Public Science* (Cambridge, 1992), p.131.

8 *Gloucester Journal*, 20 Sep 1737. J.F. von Bielfeld describes the planetarium in action during a London lecture in 1741 in *Letters of Baron Bielfeld*, trans. Hooper, 4 Vols. (1768-70), Vol.4, pp.83-6.

9 *Gloucester Journal* 26 Apr 1743. The key publication on Martin is John R. Millburn, *Benjamin Martin: Author, Instrument-Maker, and 'Country Showman'* (Leyden, 1976), with its *Supplement* (1986).

10 *The Oracle or Bristol Weekly Miscellany*, 6 Aug 1743.

11 *Bath Journal*, 29 Oct 1744.

12 *Ibid.*,10 [misdated, actually 8] Sep 1746. Meanwhile another metropolitan instrument-maker, John Bennett, put on electrical displays at Bristol, followed by Thomas Wilks: *Bristol Oracle*, 20 Sep, 4 Oct and 27 Dec 1746. Electrical showmanship is discussed in Simon Schaffer, 'Natural philosophy and public spectacle in the eighteenth century', *History of Science* (1983), Vol.21, pp.1-43.

13 The episode is discussed in Simon Schaffer, 'The consuming flame: electric showmen and Tory mystics in the world of goods', *Consumption and the World of Goods*, ed. John Brewer and Roy Porter (London and New York, 1993), pp.489-526. See also Benjamin Martin, *A Supplement Containing Remarks on a Rhapsody of Adventures of a Modern Knight-Errant in Philosophy* (Bath, 1746).

14 Leake, one of Martin's publishers, was after all Richardson's brother-in-law and a former intimate of Dr Cheyne. All three had been guests of Ralph Allen, whose protégé and Richardson's arch rival, Henry Fielding, nevertheless introduced a slightly mocking mention of Freke into *Tom Jones* (Book 4, ch.9), just then being penned.

15 *Bath Journal*, 11 Jan and 26 Sep 1748, 23 Jan 1749.

16 *Ibid.*,18 Nov 1751. In *ibid.*,12 Dec 1748, Martin explained the circumstances following the death of a lodger.

17 John R. Millburn, 'James Ferguson's lecture tour of the English Midlands in 1771', *Annals of Science* (1985), Vol.42, p.400.

18 *Bath Journal*, 22 Oct and 12 Nov 1750, 18 and 25 Nov 1751. In 1750 he also showed a model pile-driving engine.

19 *Bath Advertiser*, 27 Dec 1755. Dr James Bradley, F.R.S., was Savilian professor of astronomy at Oxford and also Astronomer-Royal.

20 *Bath Journal*, 5,19 and 26 Jan, 2 Feb 1756.

21 *Bath Journal*, 3 and 10 May 1756. The dip was also evident in London where some established lecturers gave up: A.Q.Morton, 'Lectures on natural philosophy in London, 1750-1765', *British Journal for the History of Science* (1990), Vol.23, pp.411-34. At Bath the number of visitors dropped in the war years, but it would be hard to prove an exact correlation between the prevalence of science lecturing and the statistics of visitors.

22 According to Nicholas Hans, *New Trends in Education in the Eighteenth Century* (repr.1966), pp.145-6, he made £100 on a 6-week tour to Bath and Bristol in spring 1763, but no lectures were advertised in the Bath press.

23 Millburn, 'James Ferguson', *op.cit.*, p.406. *Bath Chronicle*, 22 Jan,12 Feb, 26 Mar, 16 and 23 Apr 1767.

24 *Ibid.*, 31 Mar 1774. Calculation from Ferguson's 'Common Place Book' communicated by J.R.Millburn, now in Bath Central Library clippings file under 'Martin, Benjamin'. In 1774 Ferguson had 118 subscribers at Bath and c.90 at Bristol: J.R.Millburn, *Benjamin Martin, op.cit.*, p.52.

25 Patricia Phillips, *The Scientific Lady* (1990); Marina Benjamin, ed., *Science and Sensibility: Gender and Scientific Enquiry, 1780-1945* (Oxford, 1991); James A. Secord, 'Newton in the nursery', *History of Science* (1985), Vol.23, pp.127-51.

26 *Bath Chronicle*, 1 and 29 Dec 1768, 5 Jan, 23 Nov 1769, 22 Feb 1770. For Arden see Holburne Museum, *Science and Music in Eighteenth Century Bath* [exhibition catalogue by A.J.Turner *et al*] (Bath, 1977), pp.83-6.

27 *Ibid.*, 28 Dec 1769, 5 Apr and 6 Dec 1770. For Donn see also Hans, *New Trends, op.cit.*, pp. 99-100; Eric Robinson, 'Benjamin Donn (1729-1798), teacher of mathematics and navigation', *Annals of Science* (1963), Vol.19, pp.27-36.

28 And also possibly at the *Christopher Inn*: *Bath Chronicle*, 4 Mar, 29 Apr, 6 and 13 May 1773.

29 *The Herschel Chronicle*, ed. C.A. Lubbock (Cambridge, 1933), pp.59-60; Mrs John Herschel, *Memoir and Correspondence of Caroline Herschel* (1876), p.35; and for Herschel's Bath setting see Holburne Museum, *Science and Music, op.cit.*, and W.J.Williams and D.M.Stoddart, *Bath – Some Encounters with Science* (Bath, 1978). Priestley's eagerness to publicise his discoveries through lectures, etc. is shown in Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (Cambridge, 1992).

30 *Bath Chronicle*, 16 May, 3 and 27 Jun, and 28 Nov 1776 for more astronomical lectures.

31 Douglas McKie, 'Mr Warltire, a good chymist', *Endeavour* (1951), Vol.10, pp.46-9. The composition of water was finally proved by Cavendish in 1784.

32 *Bath Chronicle*, 5 Sep 1776.

33 Trevor Fawcett, 'Selling the Bath waters', *Somerset Archaeology and Natural History* (1990), Vol.134, pp.193-206.

34 *Bath Chronicle*, 23 Oct 1777 (Warltire), 19 Dec 1776, 3 and 10 Apr, 13 Nov, 25 Dec 1777 (Arden).

35 *Ibid.*, 1 Jan (Arden and Donn), 26 Feb (Arden's fourth course), 2, 9 and 16 Apr 1778 (Warltire *et al*).

36 H.S.Torrens, 'Geological communication in the Bath area in the last half of the eighteenth century' in *Images of the Earth*, ed. L.J.Jordanova and R. Porter (Chalfont St Giles, 1979), pp.215-47.

37 Edmund Rack, 'A Disultory Journal of Events &c at Bath, 1779-80', Bath Central Library, MS. B920. Arden advertised in *Bath Chronicle*, 18 Nov 1779.

38 *Ibid.*, 6 Jan, 3 Feb, 6 Apr, 16 Nov 1780; 3 May 1781; 26 Oct, 16 Nov, 28 Dec 1786; 1-29 Mar 1787.

39 *Ibid.*, 17 Jun 1784, 14 Jan 1790 (Smith); 8 Mar 1781, 9 Jan and 25 Dec 1783, 6 and 13 Jan 1785, 31 Dec 1795, 7 and 14 Jan 1796 (Donn); 7 Sep 1786, 6 [misdated, actually 7] and 21 Mar 1788 (Warltire).

40 *Ibid.*, 13 Dec 1781; J.A.Harrison, 'Blind Henry Moyes', *Annals of Science* (1957), Vol.13, pp.109-25.

41 *Bath Chronicle*, 2 and 9 Jan 1783.

42 *Ibid.*, 1 Nov 1787, 21 Feb, 28 Mar, 10 Apr, 10 Jul, 13 Nov 1788, 3 Dec 1789 (Didier); 20 and 27 Nov 1788 (Lloyd). It is uncertain whether this is the John Lloyd who belonged to the Bath Philosophical Society.

43 *Ibid.*, 5 Apr 1787 (Bradberry); 5 Aug and 23 Sep 1790, 6 Jan 1791 (Lloyd, etc.); 25 Nov, 8 Dec 1791 (Burton). On the cult of Mesmerism see Roy Porter, 'Under the influence: Mesmerism in England', *History Today* (Sept 1985), pp.22-9.

44 The Unitarian Priestley was particularly suspect: e.g. John Robison, *Proofs of a Conspiracy against all the Religions and Governments of Europe*, 4th ed. (1798), pp.482-6.

45 *Bath Chronicle*, 14 and 21 Nov 1793;1 Dec 1796, 26 Jan, 16 Feb (when Moyes requested that dogs be not brought into lectures), 30 Nov and 14 Dec 1797; 8 Feb 1798.

46 *Ibid.*, 18 and 25 Apr, 2 and 16 May 1799; 6, 13 and 20 Feb 1800 (Lloyd); 16 and 23 Oct, 6 Nov 1800 (Walker).

47 *Ibid.*, 15 May 1800. The botanical garden referred to in the next sentence was William Sole's, just off the London road. Sole was a recognised authority on British grasses and mints.

48 Hugh Torrens, 'The four Bath philosophical societies', *A Pox on the Provinces*, ed. Roger Rolls and Jean and John R. Guy (Bath, 1990), p.183.

49 Trevor Fawcett, 'Mechanical enterprise in eighteenth-century Bath', *BIAS Journal* (Bristol Industrial and Archaeological Society, 1998), No.30, pp.8-10.

50 The close link between the earlier science lecturers and practical projects has been highlighted in Larry Stewart, *The Rise of Public Science*, *op.cit.*

51 *Bath Anecdotes and Characters*, by the Genius Loci [Dr Henry Harington] (1782). For real examples of Bath philosophers see Rack, 'A Disultory Journal', *op.cit.*

52 *Thraliana: the Diary of Mrs. Hester Lynch Thrale (later Mrs. Piozzi)*, ed. K.C. Balderston, 2 vols. (Oxford, 1942), pp.1073-4.

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