Aesthetics in Science, as Practised by Quakers in the Eighteenth and Nineteenth Centuries

Geoffrey Cantor
University of Leeds

Quaker Studies 4 (1999): 1-20

Abstract:
Drawing on examples from the eighteenth and nineteenth centuries, it will be argued that the sciences - but particularly observational sciences such as astronomy, botany and meteorology - were highly acceptable to Quakers. Moreover, the study of nature was vested with an aesthetic that emphasised God as the Creator of nature and of order and beauty in the natural world. While many wealthy Quakers participated in these sciences, botany also provided employment for Quakers from less affluent backgrounds. Hence a number Quakers made careers as botanical lecturers, writers, publishers and illustrators. The role of the botanical illustrator is explored to show that the aim was to portray nature - God's Creation - with integrity. This made botanical illustration, as opposed to most other forms of art, an acceptable activity.

Keywords: Aesthetics; Botany; Design Argument; Botanical Illustrators.

> Altho' nature in herself is grand beyond the feeble power of speech to describe, yet ... when presented to the a mind capable of contemplation [natural scenery] produces the most exalted ideas of the unlimited, and incomprehensible greatness of Him, who in infinite wisdom created the heaven and the earth. (Joshua Richardson 1819: 4)

With the 1998 QSRA conference devoted to art, aesthetics and creativity, I would like to examine how science, as pursued by Quakers, can be related to these three equally extensive topics. Although individual scientists are often

described as creative, I want to suggest that 'scientific creativity' is particularly difficult to defme and I shall only engage this issue towards the end of the paper. Instead, much of my discussion will be concerned with the aesthetic dimensions of science. Readers will be familiar with the application of aesthetic criteria to the products of artists - to paintings, sculpture and architecture. However, the term can readily be applied to science in many different ways. For example, scientists often use terms like beauty or harmony when referring to nature, to scientific theories, and even to their own experiments. Thus every chemistry student must have marvelled at the modern theory of atomic structure which explains many chemical reactions so beautifully. Likewise, the apparatus developed by American physicist A.A. Michelson to measure the speed of light was celebrated by his contemporaries as a breath-taking piece of precision engineering. If mental or material constructions are often described in aesthetic terms, we are far more familiar with aesthetic judgements being applied to 'nature'. When we observe the colouring and intricate structure of flowers or the teeming worlds exposed by the microscope the language of aesthetics seems most apposite.

Although it is widely accepted that aesthetics play an important role in science (see, for example, Tauber 1996), few commentators have examined the ways in which aesthetic opinions can mediate between science and religion. However, as John Brooke and I have argued elsewhere, aesthetic judgements frequently enable scientists to integrate their scientific work with their religious beliefs (Brooke and Cantor 1998). For example, the early-eighteenth-century Anglican cleric William Derham commenced his *Physico-Theology* by proclaiming that God's works are '*Great* and Noble; inasmuch, as they are made with the most exquisite Art, contrived with the utmost Sagacity, and ordered with plain wise Design, and ministring to admirable Ends' (Derham 1723: 2). Indeed, to think of nature as God's works is the exploit the familiar analogy between God and a skilled craftsman.

Before turning to Quaker scientists and their deployment of aesthetics, I should clarify a number of points. First, since I am currently writing a book on the ways in which British Quakers of the eighteenth and nineteenth centuries engaged science, the ensuing discussion will be based on examples from this period. Some of the points I shall be making may not, however,

Quaker Studies 4 (1999):1-20

apply to the seventeenth or the twentieth centuries. Second, the term science is open to many different and contradictory defmitions. For both pragmatic and historiographical reasons I shall distinguish science from both technology and medicine. Much of the ensuing discussion will engage astronomy, meteorology and botany (although the themes of this paper can be extended to several other sciences). Third, the terms 'science' and 'scientist' are somewhat anachronistic when applied to earlier periods. I shall however use them below rather than subject the reader to the multiplicity of other (if more appropriate) terms. Finally, although we tend to think of scientists as paid professionals, in the period covered by this paper those who engaged in science included many amateurs - often bankers, merchants and manufacturers - who viewed science as an acceptable activity for Quakers.

Let me start by emphasising one important social point. In the early decades of the eighteenth century a small number Quakers pursued science and some even became Fellows of the Royal Society of London. These early Quaker Fellows tended to be wealthy merchants who traded with America. While not ignoring their scientific researches, it is important to recognise that science served a social function by enabling these Quaker Fellows to fmd common ground with many non-Quakers who possessed similar scientific interests. Unlike so many other activities science provided a domain in which Quaker and non-Quaker could meet on equal terms (Cantor 1997). The point is worth generalising, since throughout the eighteenth and nineteenth centuries science served this social function by acting as a bridge connecting the Quaker community with like-minded scientists drawn from many confessional traditions. Thus, despite occasional differences in emphasis or interpretation, Quakers and Anglicans, even Catholics and atheists, could work closely together on many (but by no means all) aspects of science.

Quakers were drawn primarily towards the observational sciences and away from the more theoretical and mathematical ones. Thus Quakers flocked to astronomy, meteorology and various branches of natural history, especially botany. By contrast, until late in the nineteenth century very few Quakers pursued mathematics, physics and the more theoretical aspects of chemistry. As we shall see shortly, this Quaker emphasis on the observational sciences relates to values - especially aesthetic values - prevalent in the Quaker

community. Indeed, one reason why Quakers were particularly attracted to these subjects was the significance attributed to observing nature.(1)

Quaker attitudes to the natural world can be seen in their educational writings. Beginning in the early decades of Quakerism we find nature study being urged as particularly suitable for the young. For example, in 1675 George Fox instructed a Friend that he should found a school for teaching languages, 'together with the nature of herbs, roots, plants and trees' (Braithwaite 1921: 528). Again, in his *Some Fruits of Solitude* William Penn provided some three hundred aphorisms, several of which encouraged the reader - particularly the young reader - to appreciate the natural environment. 'The *World*', he wrote, 'is certainly a great and stately *Volume* of natural Things.... This ought to be the *Subject* of the Education of our *Youth*' (Penn 1926: 2). Appreciation of nature and its uses received positive encouragement from Fox and other leading Quakers and natural history was later extensively studied at such schools as Ackworth and Bootham. Indeed, by the early nineteenth century Quakers schools offered far more science than most contemporary schools.

It is also important to note that many of the Quakers who contributed to the observational sciences were wealthy or from wealthy backgrounds. Wealth is not unconnected with the scientific activities they pursued since certain projects were expensive and were thus beyond the means of the vast majority of the population. By the middle of the nineteenth century much front-line astronomical research - such as the study of double stars - fell into this category; observatories with high-quality telescopes being very expensive. Several wealthy Quakers possessed their own observatories, joined the Royal Astronomical Society and published papers in its journal. The cousins John Fletcher Miller (1816-56) and Isaac Fletcher (1827-79) provide illuminating examples. Miller, the son of a Whitehaven tanner, pursued extensive researches in both meteorology and astronomy, while his younger cousin concentrated on astronomy at his home not far from Cockermouth. Both men constructed observatories and purchased high-quality telescopes from Thomas Cooke at York, the best optical instrument maker of the day. In the late 1840s and early 1850s they made extensive observations, especially of double stars which required telescopes of high resolving power. Several of

their papers were published in the *Monthly Notices of the Royal Astronomical Society* (e.g. Miller 1851-2). However their eminence in astronomy came at a price since each must have invested well over £1000 in their pastime. Two further examples are the bankers Thomas William Backhouse (1842-1919), who made detailed observations at West Hendon House Observatory, Sunderland, for half a century, and Joseph Gurney Barclay (1816-98), who not only constructed a fine observatory at Leyton but paid for a full-time assistant to make observations and calculations (Barclay 1865).

It is certainly true that many branches of natural history could be pursued without much financial outlay. Thus a healthy walk in the country often enabled Quakers to collect botanical and (sometimes) ornithological specimens for their cabinets. However, a number of Quakers did invest considerable sums in their gardens. An early and particularly important example is provided by John Fothergill (1712-80), one of the most affluent and sought-after physicians in London. In 1762 he purchased a thirty-acre estate at Upton, to the east of London, which became one of the outstanding gardens of Georgian England. Indeed, Sir Joseph Banks, whose judgement on botanical matters carried much weight, considered that Upton contained more rare and valuable plants than any contemporary garden in England. John Coakley Lettsom, who compiled the catalogue of Fothergill's hot-house plants after his death, described how the visitor could enter the 'suite of hot and greenhouse apartments' from the house through glass doors. These 'apartments' were 'nearly 260 feet in extent, containing upwards of 3400 distinct species of exotics, whose foliage wore a perpetual verdure' (Corner and Booth 1971: 17-20).

While many rich Quakers turned to science, astronomy and botany also provided Quakers, often from less affluent backgrounds, with 'innocent' careers. Peter Collinson (1693-1768) was the key figure in importing exotic plants from America. His main sources of exotics were the Quaker collectors John and William Bartram. Fothergill was one of his clients (Raistrick 1968: 243-75; Slaughter 1996). Other Quakers, such as William Curtis (1746-99), were involved in publishing works on botany. Later, with the opening of the new civic colleges and universities, many Quakers accepted teaching

positions, especially in botany. For example, Daniel Oliver (1830-1916) from Newcastle was appointed to the Chair of Botany at University College London in 1861, a post he held until his retirement in 1888. As we shall see, below, botanical illustration also provided a highly acceptable career for several Quakers possessing artistic talent.

Aesthetic Values

Although aesthetic judgements are crucially important in all branches of science, we will be particularly concerned with how aesthetics apply to the observational sciences. In particular, in this section I will establish some of the values that Quakers evoked when discussing natural history. (As we shall see some of these values are not specific to science but coloured Quaker attitudes to other activities, including the arts (Homan 1998).) When they observed nature they engaged God through His works. Thus botany readily shaded into theology. As Fothergill wrote, after instructing one of his American correspondents on how to pack botanical specimens, 'in the midst of all this attention, forget not the one thing needful. In studying nature forget not its author' (Corner and Booth 1971: 393). Although in this passage Fothergill moves directly from botany to God, a more familiar argument evokes aesthetics as the middle term connecting nature and its Creator. Thus, through the beauty we perceive in a flower may be discerned the glow of the divine (Brooke and Cantor 1998: 207-43). I shall now develop this theme by citing three examples.

Let us first consider how Luke Howard (1772-1864) analysed the beauty he perceived in nature. Howard was a manufacturing pharmacist whose scientific investigations were directed primarily to meteorology; his *Essay on the Modification of Clouds*, first published in 1804, being a seminal work in the history of meteorology. Here we find a classification of cloud types - described by such Latin terms as 'cirrus', 'cumulus', 'nimbus' and 'stratus' - that has now come to form the standard nomenclature. An avid meteorologist, Howard later published a two-volume work on the *Climate of London* (1818-20) which contained extensive observations made at his residences in Plaistow and (later) in Tottenham over a ten-year period. It is clear that for Howard the study of meteorology enabled him to appreciate in detail how God had designed the physical world. Meteorological phenomena

were not capricious; even storms did not arise without a proper cause. Instead, all physical phenomena were divinely ordained 'in measure, number and weight'. The aim of meteorology was to 'discover a chain of causes and effects, demonstrative like the rest of creation, of the infinite wisdom and goodness of its Author'. Thus in writing of clouds he noted that fair-weather clouds are beautiful, whereas cirrostratus offers 'a frowning sky'. Again, when contemplating the rainbow he was affected by a 'double pleasure' in appreciating that 'He who formed the world, was pleased, to attach the character of a perpetually recurring sign, that He would no more overwhelm it with the watery element' (Howard 1818-20: vol. 1, 334 and 337-8).

Howard insisted on the classic congruence between beauty and truth. In a short essay on beauty, written in 1829 and published several years later in *The Yorkshireman* (which he edited), he argued: 'Beauty, then, is in that which is great, in that which is true - in that which God, when he had formed it, pronounced good and blessed it!' Science was one means of seeking truth and truth in the physical world was manifested through the aesthetic of beauty. Hence every natural phenomenon is duly proportioned and what we see as beautiful speaks of God's design (Howard 1835).

Peter Collinson's botanical work illustrates further aspects of Quaker aesthetics. The study of botany, he believed, led to the sublime appreciation of the Creator, and he frequently expressed his attraction to botany in terms of its relevance to the design argument. Although the structure of his argument was far from original, Collinson found its conclusion all the more persuasive when applied to plants from America which were more ornate, luxurious and often considerably larger than their European counterparts. Writing to Thomas Story, who after many years travelling in the Quaker cause had retired in order to tend his garden in Carlisle, Collinson admitted that when he surveyed plants from America 'my Soul is fil[le]d with Adoration to our Great Creator for his Goodness[,] Mercy & Blessings to Mankind'.(2) But there is another respect in which this was more than a restatement of the conventional design argument. In writing about his soul being filled with adoration for the Creator Collinson was expressing the immediacy of religious experience as exemplified in the doctrine of the 'inner light'. Unlike the more esoteric aspects of science, botany offered an

immediate experience of God's Creation. Moreover, this passage accords with the Quaker emphasis on the simplicity of language and the avoidance of rhetoric and rationalisation.

Similar values were incisively expressed in our third example. In a letter of 1880, the eminent surgeon Jonathan Hutchinson (1828-1913) expressed his enthusiasm for natural history: 'Botany', he wrote, 'is really a knowledge of the works of the Deity in plant life: what plants are, and how they have become so; and is full of the beautiful and wonderful' (Hutchinson 1946: 145). Once again, aesthetic judgements constituted by 'the beautiful and wonderful' provide the link between botany and the deity. Numerous similar assertions can be found in the writings of Quakers, particularly Quaker botanists and astronomers.

The examples so far have been confined to practising scientists who appreciated the importance of religious aesthetics in studying nature. Priscilla Wakefield's writings offer a very different kind of source and, moreover, she was one of the few Quaker women who wrote on scientific subjects.(3) Wakefield (1751-1832) wrote a number of educational works directed particularly to young women, one of which was her *Introduction to Botany, in a Series of Familiar Letters*, first published in 1796. Theological aspects of natural history were evident in her preface where she urged the study of botany as 'the most familiar means of introducing suitable ideas of the attributes of the Divine Being, by exemplifying them in the order and harmony of visible creation'. For young people who could not be expected to understand abstruse theological disquisitions, the 'structure of a feather or a flower' were particularly appropriate for impressing on their minds God's power and wisdom. Moreover as Felicia - the girl who writes these letters to her sister - noted, 'persons of true taste and observation ... clearly perceive the traces of infinite Wisdom and intelligence, in the structure of every leaf and blossom' (Wakefield 1818: iii-iv and 42-3). Such design arguments are typical of the period and are not confined to Quakers. However, their use in these letters and the appeal to immediate experience is a modality of natural theology particularly favoured by Quaker writers.

Wakefield's *Botany* also displays some other prevalent Quaker social values (that were commensurate with those often espoused by the potential upper middle class readership). Thus although Felicia accepted that the study of botany would be beneficial to her health and also interesting, she insisted that it is not a frivolous amusement but an 'innocent enjoyment' that required perseverance and patience and helped train the mind and the eye. Moreover in her preface Wakefield argued: 'May it [the study of botany] become a substitute for some of the trifling, not to say pernicious objects, that too frequently occupy the leisure of young ladies of fashionable manners, and by employing faculties rationally, act as an antidote to levity and idleness' (Wakefield 1818: v). Her great grandfather, Robert Barclay, author of the *Apology*, would have found the study of botany perfectly acceptable. Yet Barclay, writing in an age when Quakers were sorely persecuted, could not have envisaged that a little over a century later there would be wealthy, fashionable female Quakers who sought rational entertainment from botany.

The initial letters in the sequence provide a general description of the structure of plants but Wakefield was suitably decorous in avoiding sexual terms. In later letters she moved to a more technically demanding topic, arguing that the system of plant classification had to be learnt, for otherwise 'Botany would be indeed a most fatiguing and almost unattainable science' if we simply had to memorise details of each plant type. Urging the Linnaean system, Felicia proceeded to describe to her sister the twenty four orders of plant based on the number of stamens and pistils they possess.

From its eighth (1818) edition, Wakefield's Botany concluded with a poem by Sarah Hoare entitled 'The pleasures of botanical pursuits'. Many of the verses, like the one that follows, celebrated the values extolled in Wakefield's letters:

> The search repays by health improv'd,
> Richly supplies the mind with food
> Of pure variety,
> Awak'ning hopes of brighter joy,
> Presents us sweets that never cloy,
> And Prompts the happiest employ
> Of praise to Deity (Wakefield 1818: 182).

One of the earliest references to gardens and gardening in Quaker literature occurred in the minutes of the Leinster Provincial Meeting for 1705. Members of the Meeting expressed concern about the danger of possessing 'too great superfluity of plants and too great nicety of gardens'. A resolution was passed requiring that 'all Friends in planting gardens do it in a lowly mind, and keep to plainness and the serviceable part, rather admiring the Wonderful hand of Providence in causing such variety of unnecessary things to grow for the use of man, than seeking to please the curious mind' (Braithwaite 1921: 510). This passage emphasises the two uses of gardens that were acceptable to these (and indeed later) Quakers - gardens were to be prized for their utilitarian value, in producing food and medicines, and as impressive evidence of God's handiwork. The advice that gardening should not be a source of pleasure for 'the curious mind' coheres with the recurrent warnings against engaging in speculative thought and in frippery. The quotation also draws attention to the oft-repeated requirement that Quakers should value plainness in all aspects of their lives; not only in dress and in speech, but also in planting their gardens. Just as brightly-coloured clothing should be avoided, so should plants that are grown for their outward splendour in order to impress one's neighbours.

It is not known why Irish Quakers in 1705 were concerned to moderate gardens and gardening; presumably one or more of their number had been indulging in conspicuous consumption. However, I have not encountered any subsequent minutes that warn against the excesses of gardeners and even gardens containing exotic plants (such as Fothergill's) became not only acceptable but highly prized. Yet there is one related issue that deserves mention. A number of strict Quakers were concerned that if they became too involved in their scientific pursuits they might thereby overlook their religious and social duties. For example, when William Allen (1770-1843) first joined the Plough Court Pharmacy, he was cautioned by Joseph Gurney Bevan to be 'ever watchful lest the allurements of science should beguile his [Allen's] heart from love of God, or adherence to the simple truths of the gospel' (Allen 1846-7: vol. 1, 3). Whatever its positive values, science should not be pursued so singlemindedly as to displace religion.

In the above examples we see that the study of nature - particularly through botany, astronomy and meteorology - was for many Quakers associated with an aesthetic that enabled the observer to perceive the hand of God in the Creation. Moreover, provided science did not become too demanding, its pursuit was commensurate with Quaker values of simplicity and sobriety.

Botanical publishers and artists

If botany and the other observational sciences were acceptable pursuits for Quakers, botany also offered careers that were suitable for Quakers. As already noted Collinson became a leading importer and distributor of seeds and plants from America. The example of William Curtis (1746-1799), from a respected medical family living in Alton, Hampshire, shows some of the other career paths that botany offered. Curtis was first apprenticed to his grandfather before moving to London where he became assistant to Thomas Talwin, a Quaker pharmacist. Since Talwin practised in Gracechurch Street, it is not surprising that he 'enjoyed extensive practice, especially in families of his own religious principles'. However, Curtis appears to have found natural history much more enticing than pharmacy and he soon started publishing on entomology. Moreover, he commenced a number of ventures that enabled him to make a living from botany. Thus he began lecturing on botany and was appointed Demonstrator of Botany to the Society of Apothecaries. Another venture was a series of three botanical gardens located in the environs of London. Entry was by subscription and subscribers were also permitted access to a well-stocked botanical library. Several of the 121 subscribers to his garden at Brompton were Quakers and the library also contained works by a number of Quaker authors (Noblett 1987).

In 1777 the first part of his magnum opus, *Flora Londinensis*, appeared in print. This beautifully illustrated folio work severely strained his finances and a friend - probably Friend Lettsom - had to mount a rescue operation. Only about three hundred copies were sold and as the subscription list to the first part indicates a number of his subscribers were Quakers (Curtis 1777; Anon. 1799).(4) Although the *Flora Londinensis* was a botanical work of the highest quality, financially it was a failure. A decade later Curtis devised a far more successful project that attracted a much wider readership. The *Botanical Magazine* displayed ornamental foreign plants and was intended

for '*such Ladies, Gentlemen, and Gardeners, as wish to become Scientifically Acquainted with the Plants they Cultivate*'. Each octavo volume contained approximately three dozen beautifully coloured plates - which are said to have required thirty colourists - with facing descriptions and other information gleaned from leading authorities, especially Linnaeus. According to Curtis's obituarist, who was soon to take over as editor, the *Botanical Magazine* 'had such a captivating appearance, was so easily purchaseable, and was executed with so much taste and accuracy, that it at once became popular'. Sales soon passed the three thousand mark and Curtis was able to make a reasonable living from his botanical activities (Curtis 1777; Anon. 1799).

Unfortunately little is known about the production of the illustrations in the early volumes of the *Botanical Magazine*. Few were signed but it is generally assumed that Curtis drew some of the unsigned illustrations. This periodical publication also required colourists among whom were at least two Quakers, William Graves (c.1754-1840) and George Graves (1784-1839). Following Curtis's death in 1799, Samuel Curtis (1779-1860) became proprietor of the journal, while John Sims (1749-1831), an Edinburgh-trained physician, took over as editor and continued until 1826. Thus several Quakers were employed on this successful venture. A later example of a Quaker who earned his income primarily from natural history periodicals is Edward Newman (1801-76) who published *The Entomologist* (1840-2) and *The Zoologist* (1843-76) and also frequently contributed to *The Friend* (Newman 1876).(5)

Perhaps the best-known Quaker illustrator was Sydney Parkinson (1745?-1771). The son of Edinburgh Friends he was apprenticed to a woollen-draper but it was soon recognised that he possessed exceptional artistic skill, especially for drawing natural history specimens. Probably with help of Fothergill, at the age of nineteen or twenty he and his mother moved to London where he was employed by James Lee, to give drawing lessons to his daughter. Through Lee, a Scottish-born Quaker, Parkinson was introduced to the young Joseph Banks the great impresario of British science. Banks hired Parkinson to work on some of the zoological specimens he had collected during a recent expedition to Newfoundland and Labrador.

Banks was also planning a further expedition with James Cook on board the *Endeavour*. Among his party of eight were Parkinson and another artist. Departing from Plymouth in the summer of 1768 the *Endeavour* sailed first to Rio de Janeiro and then down the coast of South America and into the Pacific. The next few months were spent on various Pacific islands before heading off to New Zealand and the West Coast of Australia. On the return journey the *Endeavour* called at Batavia (Java) where dysentery claimed the lives of many members of the crew, Parkinson included.

Parkinson was fully employed; indeed, the amount of material accumulated far exceeded the capacity of the two artists. The death of his fellow artist at Tahiti added to Parkinson's work load later in the voyage. Over an intense two and a half year period he produced a vast quantity of drawings and paintings. Although birds, fish, landscapes, humans and boats figure in some of Parkinson's pictures the vast majority and certainly the most deftly executed were his botanical illustrations. Plant illustration was his forte and he drew numerous plants with draughtsman-like clarity and assurance (Carr 1983). Rarely did he draw humans or land animals, and then often as rough pencil sketches. One can but surmise that as a Quaker he found botanical illustrations far more acceptable than portraiture. While the former sought to capture the truth of the Book of Nature, portraits were liable to reflect the vanity of the sitter (Homan 1998). This ethic might in turn have encouraged Parkinson to hone his skills at botanical illustration and to ignore portraiture.(6)

In line with the artists and architects discussed by Roger Homan, Parkinson was an artisan rather than a creative artist. For him, as for other Quaker illustrators discussed above, botanical art was a skilled trade. This is not to denigrate their achievements but to emphasise that asceticism, truth and accuracy were of prime importance for the botanical artist and conveyed aesthetic values acceptable to the contemporary Quaker community.

Creativity

I engage the subject of creativity in science with some misgivings since I know of no adequate theory of creativity. Instead I shall offer a few general comments arising from the preceding sections.

It is tempting to attribute creative leaps only to those scientists, such as Newton and Darwin, who introduced major innovations. A few Quakers were creative in this sense, most notably John Dalton (1766-1844) who developed the theory of chemical atomism. Although atomism possesses a long history, Dalton envisaged a way of making sense of chemical combinations in his papers and particularly in his *New System of Chemical Philosophy* (1802). Drawing extensively on Newton's ideas about how particles interrelate, Dalton conjectured that each chemical element corresponds to particles of specific weights. Thus (to cite his figures) if each hydrogen particle is of weight '1', the oxygen particle would weigh '7' and the sulphur particle '13'. He also offered insights into how these particles combine in chemical reactions (Greenaway 1966; Thackray 1972).

Dalton's atomism is difficult, if not impossible, to relate to his Quakerism.(7) His papers on gases and on atomism were written after he had moved to Manchester, taken up a post at New College and become part of the thriving local scientific community centred on the Manchester Literary and Philosophical Society. By contrast, his earlier researches in meteorology date from his time as a schoolteacher. In that earlier period Dalton and his work can there be firmly located in the Quaker community and in the Quaker meteorological tradition that flourished in Cumbria (of which John Fletcher Miller provides an example).

We should also recognise many other forms of scientific creativity. Those who laid out ornamental gardens or collected cabinets of fossils or identified new species were being creative, but their activities were different both in type and possibly in degree from those who framed innovative scientific theories. The term 'creativity' is also highly problematic in another sense. Much of the natural history pursued by Quakers and others in the eighteenth and nineteenth centuries was not intended to be creative in the sense of imposing some novel, pleasing perspective on nature. Since nature was God's creation it had to be represented - both visually and verbally - with integrity. The issue of accurate representation is more complex than the foregoing discussion may lead us to expect. When asked to portray a chrysanthemum the botanical artist will paint an attractive specimen and not one ravaged by

insects. Again, the artist will picture the plant at one stage in its growth and not be able to capture all the changes in an individual plant's life-cycle. Through limitations in the palates of both the artist and the colourist changes may be introduced. Nevertheless, it is important to recognise that botanical writers and artists like Curtis and Parkinson sought accuracy in their portrayal of nature rather than 'creative innovation'.

Since God created the natural world the botanist's main aim was to observe carefully what God has created without imposing her/his own hubristic interpretation. As emphasised above in respect to Parkinson, the botanical artist likewise sought to represent plants with visual accuracy. The artist was in this sense a draughtsman providing the reader with a clear picture of the plant so that, book in hand, the reader could readily identify a example on the next visit to a botanical garden or on a woodland walk. In support of this contention I shall conclude with two quotations from Curtis's works. First, part of the sub-title of Curtis's *Botanical Magazine*, which reads: '*in which the most Ornamental Foreign Plants ... will be Accurately Represented in their Natural Colours*' (Curtis 1787). Second, in the preface to his *Flora Londinensis* he stated that his aim was to 'facilitate a knowledge of the plants of our own country'. To achieve this he would

> take the greatest pains in the examination of those plants which he figures; to have them drawn from living specimens most expressive of the general habit or appearance of the plant as it grows wild; to place each plant, as much as is consistent, in the most pleasing point of view; and to be very particular in the delineation and description of the several parts of the flower or fruit, more specially where they characterize the plant. (Curtis 1777)

Epilogue

It would have been appropriate to end this paper by a comparison between Quaker aesthetics and that of other religious groups, both Anglican and Dissenter. Unfortunately the secondary literature on this topic does not permit

such comparisons. However, I shall conclude with a few tentative comments concerning the significance to Quakers of aesthetics in science.

During its long history the design argument has manifested many different forms. In some contexts the rationality of the argument has been stressed and therefore the inductive strength of the inference from aspects of the physical universe to its Creator. Such rationality has often been stressed by Anglicans; most famously by William Paley in the opening sections of his *Natural Theology* (1802). By contrast, one might expect that Dissenters, who opposed the Anglican church, its clergy and its educational system, would have used forms of design argument that appealed more to the emotions evoked by observing nature than to rationality; more to the heart than to the head. A reasonable amount of evidence confirms this conjecture including the examples used above, such as Collinson's claim that when observing exotic plants from America his soul was filled with adoration of God.(2) It would also appear that Quakers possessed an additional motivation for emphasising the observational sciences and their associated aesthetics. Instead of seeking a rational theology they emphasised the workings of the 'Inner Light' as a major source of religious understanding.

This argument can be extended in a further direction. Since eighteenth- and nineteenth-century Quakers did not encourage ornate forms of artistic production, their visual aesthetics was directed to a limited range of objects. In contrast to such arts as painting and sculpture (encouraged by Anglicans and many Dissenters), plants were not products of human art but were natural. Thus, no matter how intricate the plant or how brightly coloured, it was conceived as 'plain' since no human artist had added ornamentation (Collins, 1996). Botany and the other observational sciences were not forbidden; instead, they were positively encouraged because they displayed 'the incomprehensible greatness of Him, who in infinite wisdom created the heaven and the earth' (Richardson 1819: 4). Thus the practice of science including careers associated with natural history (particularly horticulture and botanical illustration) were not just acceptable to Quakers but commensurate with this form of religious aesthetics. It would appear that Quakers, for whom many other forms of aesthetic experience were proscribed, were more

strongly drawn to these aesthetically-loaded topics than were Anglicans and members of many other denominations.

Notes

(1) Another factor was the Test Acts, repealed in 1871, that effectively excluded Quakers from Cambridge University, which became the main centre for mathematical physics in the early nineteenth century.

(2) P. Collinson to T. Story, 4th day, 6th Month, 1729: Friends House Library, London, MS 337, f.33.

(3) For recent discussions on Wakefield's writings see Shteir 1996 and Shteir 1997.

(4) Among the Quakers and ex-Quakers who subscribed to the *Flora Londinensis* were John Barclay, Robert Barclay, J. Beck (of Urie), Joseph Beck, Richard Bright, Thomas Collinson, Baron T. Dimsdale, Baron N. Dimsdale, William Fothergill, Bartlett Gurney, Jonathan Hoare, Joseph Harford, John Scanderet Harford, William Hoare, John C. Lettsom, Daniel Mildred and John Till Adams.

(5) Some of these naturalists were not consistent in their religious commitments. William Curtis was disowned in 1791 for 'having long neglected out religious Meetings' and Sims, who had been an Elder, was disowned in 1790 for marrying a non-Quaker. Newman married out in 1840 but was reinstated in 1865. Information from 'Dictionary of Quaker Biography' in the Library of Friends House, London.

(6) William Blunt describes an 'alleged self-portrait' of Parkinson as 'a very amateur affair'. If Parkinson was indeed the artist, this picture seems to indicate that 'portraiture was not his *métier*' (Carr 1983: 16).

(7) I am stuck by the innovative quality of the science pursued by several ex-Quakers, such as Benjamin Robins (1707-51) and Thomas Young (1773-1829). Robins, who moved from Bath to London in his teens, soon distanced himself from his Quaker heritage and was disowned. Moreover, his career was decidedly un-Quakerly. He was one of the best mathematicians in the eighteenth-century Britain and turned this talent to researching the trajectory of shells fired from cannon. Later he gained a commission in the Navy. His highly sophisticated work on ballistics drew on the theories of Newton and other writers in mechanics (a subject in which no eighteenth-century Quaker showed

much interest) (Steele 1994). Unfortunately although is little biographical information on Robins, I am inclined to interpret his science and especially his work on ballistics as involving a conscious rejection of Quaker norms.

Thomas Young, from Somerset, severed his connections in his mid twenties. His career in science and medicine and his marriage into the minor gentry can be interpreted as an attempt to repudiate his Quaker upbringing and to become accepted within the social establishment. Although not a profound thinker, Young revived the wave theory of light in a series of papers published in the opening years of the nineteenth century. In one sense these optical papers challenged contemporary norms, since he urged the wave theory in place of a corpuscular theory of light that was widely attributed to Newton. However, he can also be read as extending the dominant Newtonianism since he portrayed his account of the wave theory as a development of Newton's discussions about the role of an ubiquitous ether (Cantor 1983: 129-46). By adopting this latter reading we see that both Robins and Young were innovative in areas where they developed aspects of the Newtonian system. Moreover, both Robins and Young were experimentalists, in the strong sense, as opposed to observers of the natural world.

References

Life of William Allen, with Selections from his Correspondence. 3 vols., London: Charles Gilpin, 1846-7.

Anon. Obituary notices of William Curtis in *Gentleman's Magazine* 69 (1799): 628-9 and 635-9.

Barclay, J.G. *Astronomical Observations taken ... at the Private Observatory of Joseph Gurney Barclay, Esq., FRAS, Leyton, Essex*, vol. 1, London: Williams & Norgate, 1865.

Braithwaite, W.C. *The Second Period of Quakerism*. London: Macmillan, 1921.

Brooke, J., and Cantor, G. *Reconstructing Nature. The Engagement of Science and Religion*. Edinburgh: T & T Clark, 1998.

Cantor, G. *Optics after Newton*. Manchester: Manchester University Press, 1983.

-------- 'Quakers in the Royal Society 1660-1750.' *Notes and Records of the Royal Society of London* 51 (1997): 175-193.

Carr, D.J., ed., *Sydney Parkinson. Artist of Cook's Endeavour Voyage*. London: Croom Helm, 1983.

Collins, P.J. '"Plaining": the social and cognitive practice of symbolisation in the Religious Society of Friends (Quakers).' *Journal of Contemporary Religion* 11 (1996): 277-87.

Corner, B.C. and Booth, C.C. *Chain of Friendship. Selected Letters of Dr. John Fothergill, 1735-1780*. Cambridge MA.: Harvard University Press, 1971.

Curtis, W. *Flora Londinensis: or Plates and Descriptions of such Plants as Grow Wild in the Environs of London: with their Places of Growth, and Times of Flowering; their Several Names according to Linnaeus and other Authors: with a Particular Description of each Plant in Latin and English. To which are Added, their Several Uses in Medicine, Agriculture, Rural Oeconomy, and other Arts*. London: W. Curtis, 1777.

-------- *The Botanical Magazine; or, Flower-Garden Displayed: in which the most Ornamental Foreign Plants, Cultivated in the Open ground, the Green-House, and the Stove, will be Accurately Represented in their Natural Colours. To which will be added, their Names, Class, Order, Generic and Specific Characters, according to the Celebrated Linnaeus; their Places of Growth, and Times of Flowering: together with the most approved Methods of Culture. A Work Intended for the Use of such Ladies, Gentlemen, and Gardeners, as wish to become Scientifically Acquainted with the Plants they Cultivate*. 1 (1787).

Derham, W. *Physico-Theology: or, a Demonstration of the Being and Attributes of God, from His Works of Creation*. 6th edn., London: W. and J. Innys, 1723.

Greenaway, F. *John Dalton and the Atom*. London: Heinemann, 1966.

Homan, R. 'They said, if you want the trimmongs, you can go nex door.' Paper delivered at the QSRA conference, Woodbrooke College, 7 April 1998.

Howard, L. *The Climate of London, Deduced from Meteorological Observations, Made in Different Places in the Neighbourhood of the Metropolis*. 2 vols., London: W. Phillips, 1818-20.

-------- 'On beauty, in the Creation and in the mind.' *The Yorkshireman* 4 (1835): 79-80.

Hutchinson, H. *Jonathan Hutchinson. Life and Letters*. London: Heinemann Medical, 1946.

Miller, J.F. 'Micrometrical measurements of the binary star ξ Ursœ Majoris, and the double star Struve 1263, made at the Observatory, Whitehaven.' *Monthly Notices of the Royal Astronomical Society* 12 (1851-2): 170.

Newman, T.P. *Memoir of Life of Edward Newman* [1876]. London: Faringdon Classey, 1980.

Noblett, W. 'William Curtis's botanical library.' *The Library* 9 (1987): 1-22.

Penn, W. *Some Fruits of Solitude* [1693]. London: Constable, 1926

Raistrick, A. *Quakers in Science and Industry*. Newton Abbot: David & Charles, 1968.

Richardson, J. *A Speech Delivered at a Meeting of the Literary Association, Sunderland, 30th of 9th Month, 1819; Containing many Useful Remarks on Natural History, Botany, &c. Selected from the Most Eminent Writers. With Moral Reflections*. Sunderland: G. Summers, 1819.

Shteir, A. *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760-1860*. Baltimore: Johns Hopkins University Press, 1996.

-------- 'Elegant recreations? Configuring science writing for women', in Lightman, B., ed., *Victorian Science in Context*. Chicago: University of Chicago Press, 1997: 236-55.

Slaughter, T.P. *The Natures of John and William Bartram*. New York: Knopf, 1996.

Steele, B.D. 'Muskets and pendulums: Benjamin Robins, Leonard Euler and the ballistics revolution.' *Technology and Culture* 35 (1994): 348-82

Tauber, A.I. editor. *The Elusive Synthesis: Aesthetics and Science*. Dordrecht: Kluwer, 1996.

Thackray, A. editor. *John Dalton. Critical Assessments of his Life and Work*. Cambridge, MA.: Harvard University Press, 1972.

Wakefield, P. *An Introduction to Botany, in a Series of Familiar Letters*. 8th edn., London: Darnton & Harvey, 1818.