John Marshall: the making of true spectacles

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In 1693 John Marshall of London devised a novel method of grinding batches of identical, good quality, lenses of a specified focal length. Its commendation by the Royal Society led to a trade war between Marshall and rivals in the Worshipful Company of Spectacle Makers. Despite initial opposition the method was rapidly adopted by London opticians and, though much modified, it forms the unrecognised basis of present day practice.

Background

Spectacles were invented in the 13th century but their effectiveness was limited. The frame was perched on the nose and the customers selected the lenses that seemed to suit them best, a practice that has recently been reintroduced. The worst problem was that the lenses were poorly ground and made from poor quality glass despite the efforts of scientists and craftsmen to improve both material and technique.

There were several stages in producing lenses. Templates for shaping the grinding tools were made in pairs with an identical radius of curvature—one convex, the other concave. Pairs were turned to give a range of focal lengths. The templates and tools were normally made of iron and smoothed as far as possible. The processes of grinding and polishing were similar. The glass blank was cemented to the top of the convex tool. This was placed on a pole while the operator worked the concave tool in bold strokes by swinging the whole body, trying to cover the whole surface in every direction and at all angles. An abrasive material such as emery and water was used to grind the glass until the surface showed a semi-polish. For polishing,

the tool was covered with a heavy woollen cloth without its nap and with its pores filled with calcined tin (putty powder).

Man of vision

John Marshall (?1659-1725) was a freeman of the Turners' Company and optician to George I. He was interested in machines and theoretical knowledge and had designed a compound microscope. This work made him aware that better lenses were necessary to improve the effectiveness of optical instruments.

Marshall announced his method for improving lenses to the Royal Society at a meeting late in 1693 and requested a testimonial. He claimed that it would produce batches of lenses of a given focal length without damaging the tool. The society wisely chose Halley and Robert Hooke as assessors since both were seeking improvements to lenses. Hooke, the author of *Micrographia*, was probably the best person to recognise Marshall's achievement. The two men satisfied themselves and the society that Marshall's technique was original and effective, and Marshall promptly advertised the society's commendatory letter (fig 1).

Marshall's method was never published, so the changes he introduced are uncertain. Whatever they were, John Yarwell and his partner Sterrop (Marshall's main rivals) claimed that the difference in quality could be seen by the naked eye. Marshall used "crystal-glass" (clear agate), a natural material that is harder than optical glass. One crucial change seems to have been replacing iron tools, which caused the irregularities in the lenses, with brass ones, which take and retain a smoother finish. The most important innovation, however, was in grinding a number of blanks at the same time, increasing output by producing a batch of similar lenses. Holtzappel, in a mid-19th century description of glass grinding, stated that glass blanks were placed symmetrically on the tool, either about a central lens or about four placed near the top, and that much skill was required to cement the lenses in place. At least an equivalent competence must have been required in Marshall's day. By Holtzappel's time, lathes turned the tools, but a Venetian painting of a slightly earlier period shows that handturning was still done.

The Worshipful Company of Spectacle Makers

In 17th century London most opticians were members of the Worshipful Company of Spectacle Makers, which was founded 1629. It tried to maintain quality control over its trades and to protect the interests of members. Despite threats, Marshall and some other practitioners could not be persuaded to join. Marshall could trade in London because, as a member of the Turners' Company, he was immune from prosecution by the spectacle makers, though he had to comply with their regulations.

Some of the spectacle makers were outraged by an

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THE ROYAL SOCIETY'S LETTER.

I Have (by Order of the Royal Society) seen and examined the method used by Mr JOHN MARSHALL, for grinding Glasses; and find that he performs the said Work with greater Ease and Certainty than hitherto has been practised; by means of an Invention which I take to be his own, and New; and whereby he is enabled to make a great number of Optick-Glasses at one time, and all exactly alike; which having reported to the Royal Society, they were pleased to approve thereof, as an Invention of great use; and highly to deserve Encouragement.

London, Jan. 18.
1693, 4.

By the Command of the
Royal Society;

EDM. HALLEY.

FIG 1—The Royal Society's letter. From Marshall's advertisement on a handbill of about 1707

FIG 2—"He was the Inventor of true Spectacle Grinding, & the only person who had the Approbation of the Royal Society." From a handbill, after 1714

outsider claiming a radically improved technique and having that claim supported by the prestige of the Royal Society. Their delegation to the Royal Society complained "That the Invention was not new, nor his, nor of the use pretended by him." Both Marshall and the spectacle makers submitted written comments. The spectacle makers were told "That the Society Conceived their Certificate was well Grounded, and that if Mr Marshall did Act Against their Charter, they might Right themselves by Law." They never did. Unfortunately, the submissions are lost; they almost certainly contained the gist of Marshall's method and how it differed from previous practices.

Subsequent history

Marshall made no attempt to patent or keep secret his new method. In fact, he trained and sold suitable

tools to gentlemen amateurs. It was easy for his journeymen and apprentices to pirate the method, and within months trade rivals advertised that they were using a method approved by the Royal Society. Marshall therefore added to some of his trade cards and advertisements that he alone had that approbation. It gained him nothing; no one ever acknowledged that it was his invention.

Ironically, long after his death, London opticians proudly announced to the public that their spectacles and other instruments were made with lenses ground by the method approved of by the Royal Society. The society could take comfort from the use of its name, since it signified that the public accepted that the Royal Society stood for disinterested evaluation.

Not only did batch manufacture mean that good quality identical lenses could be made at least as cheaply as inferior ones but it may also have contributed to a change in the nature of the optical trade. Although more specialised instruments continued to be commissioned, tradespeople began to make and keep batches of the less expensive optical goods to be sold off the shelf rather than as bespoke pieces. This change is confirmed by advertisements containing French, German, and Dutch descriptions; foreign visitors would normally buy on the spot.

Although Marshall's innovation may have been only a minor technical achievement, it resulted in a considerable increase in comfort and pleasure for those who needed spectacles. Jonathan Swift, soon afterwards, and Jane Austen, at the end of the century, commented on the effectiveness of spectacles in the novels *Gulliver's Travels* and *Emma*. In combination with the focus mark, introduced by Edward Scarlett, Marshall's method established the superiority of English spectacles over their continental rivals for a long period. Nevertheless, without methods of testing the defects of the eye, the competence of the optician remained paramount, and complaints were made that eyes were being damaged by faulty or wrong lenses.

Much modified by a succession of improvements, the batch method remains the basis of present day practice. On its 300th anniversary, it is surely time to restore Marshall's name to his method.

1 Bryden, DJ, Simms DL. Spectacles improved to perfection and approved of by the Royal Society. *Annals of Science* 1993;50:1-32.

Dr Doubledose: a taste of one's own medicine

Roy Porter

Jokes, Freud taught us, are the acceptable face of aggression. Humour has, not surprisingly, provided a way for the people to fight back against the powerful; and, on account of their own highminded aspirations, the liberal and learned professions traditionally laid themselves particularly open to lampoon. Anti-priest and anti-doctor satire was not only a form of revenge, it was also designed to deflate, exposing pretension and humbug.

Medical satire was particularly near the bone since its humour was black. Laughter was a way of keeping the dread of death at bay—of handling the insidious suspicion that the medical profession might not after all be fighting death but could prove a double agent.

Such themes became specially prominent from the 18th century with the spread of fairly cheap prints and engravings alongside traditional verbal expressions like proverbs, riddles, and rhymes. Hogarth's com-

mercial talents led the way from the 1730s. The decades around 1800 brought the golden age of the cartoon with Rowlandson, Gillray, and the Cruikshank family. The verbal and the visual joined forces to produce maximum impact in an age notably uninhibited in its depiction of sex and violence in political prints and professional satire alike.

The standing of early modern medics was precarious and it is not hard to see why. Disease and death still held sway. Faced with hordes of waterborne, airborne, and bugborne fevers, medicine had little power to cure the sick or save the dying. Doctors had to do their feeble best in a cut-throat trade, exposed to non-stop vilification. "If the world knew the villainy and knavery (beside ignorance) of the physicians and apothecaries," the gossipy antiquarian John Aubrey was told by a doctor, "the people would throw stones at 'em as they walked in the streets." Scepticism ran high: "God heals

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