

Guest editorial

The Bains of psychology

Two Scots, both called Alexander Bain, played instrumental roles in the formative years of psychology, touching on perception, and they have often been confused. One, Alexander Bain (1810–1877, hereafter referred to as ABain) was instrumental in the literal sense of devising an electromagnetic chronoscope and a means of electrically encoding images. The other Alexander Bain (1818–1903, referred to as Bain) is better known because of his textbooks and the development of neural net concepts; his influence was theoretical. Present-day dictionaries of biography almost always have an entry for Bain, but few include ABain. It was not always so. The *Dictionary of General Biography* (Cates 1885) reversed this situation, with an entry for ABain but not for Bain, and the same applied to the *Dictionary of National Biography* (Stephen and Lee 1908), where ABain is described as an inventor and watchmaker.

ABain (figure 1) was born near Watten, between Thurso and Wick in Caithness (see Aked 1974, for details of his life). It seems unlikely that he received any secondary education, but learned the mechanical skills of clockmaking and watchmaking in Wick. A turning point in his life was attending a lecture on light, heat, and electricity,

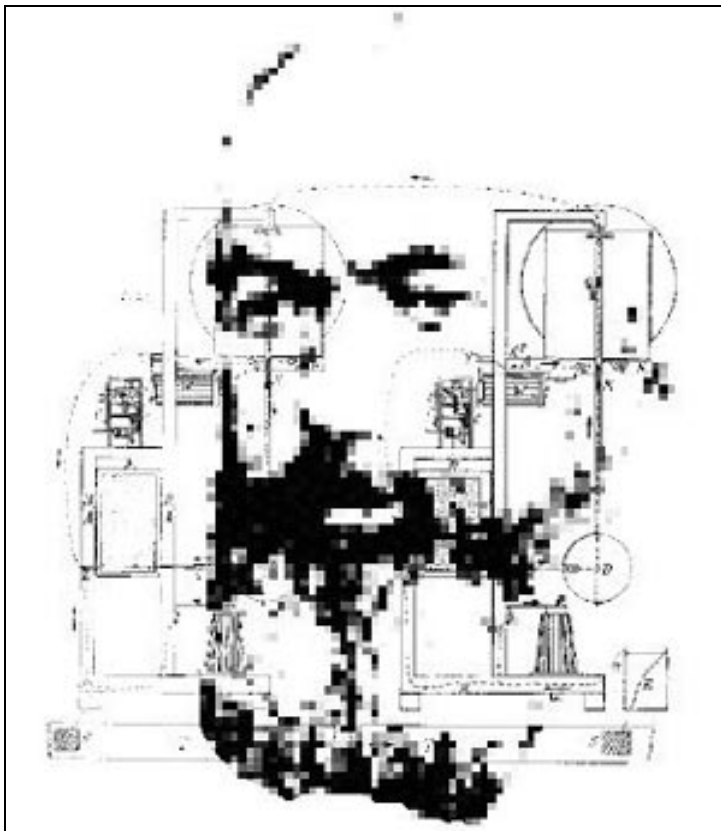


Figure 1. Facsimile. Alexander Bain (1810–1877) together with a diagram of his facsimile machine. The portrait is after a photograph taken in 1874.

given at Thurso around 1830. He moved first to Edinburgh and then, in 1837, to London where he worked as a journeyman clockmaker in Clerkenwell. He attended lectures at the Polytechnic Institution and at the Adelaide Gallery, and was particularly attracted by the demonstrations of electromagnetism. In his own words, written in 1852, he noted: “For many years I have devoted myself to rendering electricity practically useful, and have been extensively engaged, not only in this country, but in America and on the Continent, in the construction and working of the Electric Telegraph; while at the same time, the employment of electricity in the measurement of time has also engaged my attention” (page 3). In the latter regard, ABain is considered as the pioneer of electrical timekeeping in a book celebrating a century of electrical clocks (Hope-Jones 1940). A plaque over the door of his Edinburgh workshop was unveiled in the same year (figure 2).



Figure 2. The plaque above the door that was ABain’s workshop in Edinburgh, probably between 1844 and 1847; it was then at 11 (now 21) Hanover Street. The plaque was unveiled in 1940, to celebrate the centenary of his invention of the electric clock.

ABain’s first patent was lodged in 1840 and it incorporated electrical with pendular mechanisms in timekeeping. This was an exciting and inventive period in the practical application of the electric telegraph (see Kieve 1973), and he was involved in several aspects of it. In that decade he filed a series of patents and in one he described a system for the electrical transmission of images. Accordingly, he is generally considered as the father of fax, as modern facsimile machines are based on essentially the same principle. The system involved a sending machine which employed a pendulum with an attached stylus passing over moving raised type. Current was passed when the stylus moved over raised letters. The scanned image was transmitted by telegraph to a receiver which transferred the electrical charges to chemically treated paper moving beneath a similar pendulum. The principal problem was synchronising the sender and receiver. ABain is important historically both in telegraphy and electrical horology. As Hackmann (1973) remarked: “He invented an electromagnetic printing telegraph, the earth circuit, a single-needle telegraph, an electromagnetic engine, an electric fire-alarm and electric sounding apparatus for ships, and his famous electro-chemical telegraph” (page v).

A contemporary source, the worthy *Circle of the Sciences* (Wylde 1860), described his endeavours thus:

“Amongst the earliest inventors in connection with electro-telegraphy, Mr. Bain is well known. We believe that he was one of the first to produce a printing telegraph, which, however, was constructed with ordinary types. These were moved by means of a mechanism actuated by electro-magnets, and each letter was successively brought to its proper

place by complicated arrangements. After being inked, it was pressed on a receiving surface, which, when finished presented a similar appearance to ordinary printed matter. A model of this arrangement was first publicly produced and explained by its inventor, many years ago, at the Polytechnic Institution, Regent-street, London; but we are not aware that it ever came into extensive use. Mr. Bain was also well known for his ingenious arrangement of electro magnetic clocks, one of which was for some time in operation at the above-named institution. His electro-chemical telegraph is constructed on somewhat similar principles ... Mr. Bain obtains marks on a prepared cloth, intercepting the surface of the transmitting arrangement by means of non-conductors; producing, however, dots and dashes, instead of continuous lines” (page 268).

Considering that ABain was exploring phenomena that were testing the most accomplished scientific minds of the day, his achievements were remarkable. “Bain’s sophisticated mechanical solutions to difficult problems established him as a very ingenious instrument maker, and demonstrated what can be achieved by a natural talent with little formal education” (Hackmann 1973, page v). One of these accomplished scientific minds with which ABain came into close contact was Charles Wheatstone (1802–1875), better known to psychologists for his invention of the stereoscope (see Wade 1983). Wheatstone’s fertile mind was not restricted to a single area; he invented a variety of devices, from musical instruments to electrical apparatus. He also measured the velocity of electricity. In the year (1837) that ABain moved to London, Wheatstone patented (with William Fothergill Cooke, 1806–1879) a form of electric telegraph. ABain was introduced to Wheatstone on 1 August 1840, and the two seemed to get on well with one another. Both saw the advantages of synchronising many slave clocks electrically from a master clock. At a second meeting on 18 August, ABain showed some of his models to Wheatstone, who purchased much of his apparatus for printing telegraphs (Hope-Jones 1940). Wheatstone described it otherwise, as he stated that “Alexander Bain was a working mechanic who had been employed by him between the months of August and December, 1840” (Bowers 1975, page 139). Wheatstone presented a paper to the Royal Society on 26 November of that year and demonstrated an electrical clock. The paper was not published in the *Philosophical Transactions*, and ABain served an injunction against Wheatstone exhibiting the electrical clock at the Adelaide Gallery in January of the next year. So commenced the bitter conflict between the two inventors. Wheatstone was able to marshal the scientific luminaries of the day to his cause, whereas ABain was only able to pen his protests through the pages of the *Mechanic’s Magazine*. Thereafter, Wheatstone (unsuccessfully) opposed all ABain’s patents dealing with chronometers and telegraphy. ABain returned to Edinburgh in 1844 and completed the erection of the first telegraph line between Edinburgh and Glasgow in 1846.

Wheatstone and Cooke sold their patents to the Electric Telegraph Company in 1846. When the bill for incorporation of the company was presented to Parliament it was opposed by ABain, on account of infringing his own patents. He also claimed that he had discussed his inventions informally with Wheatstone, who had misappropriated them. The bill passed through the House of Commons, but during its third reading at a committee stage of the House of Lords, ABain’s case was considered to be sufficiently strong for the bill to be blocked unless some accommodation was reached. The Electric Telegraph Company offered ABain a directorship and shares, which he accepted. Wheatstone severed his uneasy ties with the entrepreneurial Cooke in 1846, wishing to concentrate on his scientific research, although he filed a number of further patents relating to telegraphy (Bowers 1975). ABain resigned his directorship and soon disposed of his shares, but received further payments from the Electric Telegraph Company; for example, in 1851 he was paid £20 486 (Kieve 1973). Despite benefiting financially from the sale of patents, ABain dissipated most of his wealth through litigation.

He travelled to the United States in 1848 and again in 1860. His electrochemical telegraphs were employed extensively, as in the line from New York to Boston, with an alphabet also compiled by him. However, his adversary in that country was Samuel Morse (1791–1882), who opposed ABain's patents and vice versa. Eventually, the larger companies obtained injunctions against ABain's telegraphs, the use of which dwindled, as did his financial resources. By 1872 he was working in an opticians shop in Glasgow. In that year he did receive a government pension of £80, and in the following year the Royal Society awarded him £150 for his pioneering work in telegraphy. These acts of recognition were most probably instigated by Sir William Thomson (1824–1907, later to become Lord Kelvin). ABain died in poverty at the Broomhill Home for Incurables at Kirkintilloch, in 1877. Thomson was instrumental in arranging for a tombstone to be erected for him in the local Old Aisle Cemetery (figure 3).



Figure 3. ABain's tombstone in the Old Aisle Cemetery, Kirkintilloch. It was said to be in a state of disrepair in the early twentieth century and was restored in 1959. The date of death had initially been carved erroneously as 1876, but this was later corrected to 1877.

The younger Bain (figure 4) was also from the north of Scotland—Aberdeen—and of similarly humble origins. The son of a weaver, Bain won a bursary to study at Marischal College, Aberdeen, and after graduating taught moral and mental philosophy there. His radical views prevented him from securing a permanent academic post in Scotland, and he moved to London where he lectured and lived off his pen. He returned to Aberdeen University in 1860, as Professor of Logic and Rhetoric, after the positive reception of his books *The Senses and the Intellect* (1855), in which he placed physiology at the heart of psychology, and *The Emotions and the Will* (1859). His textbooks on psychology were to provide the prototypes for subsequent writers.

Bain integrated sensory-motor physiology with traditional associationist philosophy to espouse an independent discipline of psychology “conceiving that the time has now come when many of the striking discoveries of Physiologists relative to the nervous

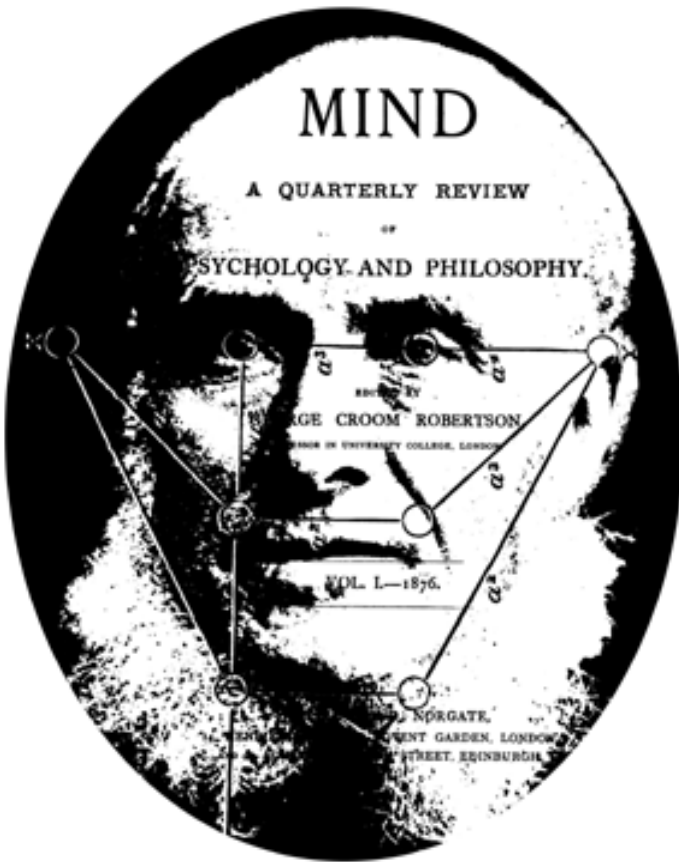


Figure 4. *Bain's Mind*. Alexander Bain (1818–1903) together with the first volume of *Mind*, which he founded, and his diagram of neural nets.

system should find a recognised place in the Science of Mind” (1855, page v). He extended the union to an associationist treatment of higher mental processes and voluntary action, emphasising the importance of sensory feedback in the control of movement: “In treating of the Senses, besides recognising the so-called muscular sense as distinct from the five senses, I have thought proper to assign to Movement and the feelings of Movement a position preceding the Sensations of the senses; and have endeavoured to prove that the exercise of active energy originating in purely internal impulses, independent of the stimulus produced by outward impressions, is a primary fact of our constitution” (1855, pages v–vi). By stressing the motor component of perception he was the harbinger of behaviourism: “action is a more intimate and inseparable property of our constitution than any of our sensations, and in fact enters as a component part into every one of the senses” (1855, page 67). Bain also appreciated those actions connected with the alleviation of pain or the increase of pleasure would occur with greater frequency.

In addition to Bain’s articulation of a bond between philosophical associationism and sensory-motor physiology, his *Mind and Body* (1873) set out an account which related the processes of associative memory to the distribution of activity in neural groupings—or neural nets as they are now called. Bain anticipated certain aspects of connectionist ideas that are normally attributed to twentieth century authors—most notably Hebb (see Wilkes and Wade 1997). As Bain stated in his autobiography “The whole subject had been simmering for a number of years. More particularly was the attempt made

to deal with the connexion of mind and brain by numerical estimates; namely by taking, on the one hand, the number of psychical situations, and, on the other hand, the nervous groupings rendered possible by the approximately assignable number of nerve cells and fibres ... The chief novelty consisted in the treatment of the intellect upon the method of innumeration just referred to" (1904, pages 312–313).

Thus, Bain presented an early version of the principles enshrined in Hebb's (1949) neurophysiological postulate. His words were: "I can suppose that, at first, each one of the circuits would affect all others indiscriminately; but that, in consequence of two of them being independently made active at the same moment (which is the fact in acquisition), a strengthened connexion or diminished obstruction would arise between these two, by a change wrought in the intervening cell-substance; and that, afterwards, the induction from one of these circuits would not be indiscriminate, but select; being comparatively strong towards one, and weaker towards the rest" (1873, page 119). This can be compared with the postulate proposed by Hebb: "When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased" (1949, page 62). Bain even provided schematic diagrams of neural connections, and this was before the neuron doctrine had been firmly established.

In addition to his texts on psychology Bain wrote books on English grammar, ethics, logic, rhetoric, and phrenology. He was more sympathetic to phrenology than many of his contemporaries, at one stage acknowledging the breadth of Gall's theory: "The number of points relating to the human mind that have been raised by Gall and his followers is so great that one might, in discussing them, go over nearly the whole debateable ground of mental science" (1861, page 14). On the one hand, phrenology became a popular pursuit, developing absurdly specific 'cranioscopic inferences' and making extravagant claims which led to its eventual ridicule and demise. On the other hand, it focused attention on functions carried out in local regions of the brain, in contrast to earlier views of its equipotentiality. Again Bain summarised the situation well: "Phrenology, notwithstanding its onesidedness, has done good service, by showing with more emphasis than had ever been done before, that human beings are widely different in their mental tastes and aptitudes, and by affording a scheme for representing and classifying the points of character, which is in many respects an improvement upon the common mode of describing individual differences" (1861, page v). Bain might have been somewhat optimistic when he stated that "Phrenology is no longer a subject of party heat or violent altercation. Men can support or impugn it with the composure becoming a purely scientific controversy" (1861, page 14). However, it should be remembered that nineteenth century scientific disputes were not noted for their restraint.

Such was certainly the case in the dispute between ABain and Wheatstone over the invention of the electromagnetic clock. As was noted above, both appreciated the advantages of controlling individual and multiple clocks electrically, and both devised such instruments. However, "both these men were inclined to quarrel about the priority of their special patents" (Hackmann 1973, page ix). A frequent characteristic of scientific discovery is that similar ideas can be expressed in similar ways independently of one another. An unenviable consequence is that the resolution of priorities following such expression generally reflects the pettiness of the protagonists. Following arbitration over ABain and Wheatstone's rival claims regarding the electromagnetic chronoscope, the Electric Telegraph Company were instructed to pay ABain half the profits from the electric clocks it manufactured. It was also required to acknowledge ABain's priority on all the instruments. To this end, Wheatstone enlisted the talents of the finest engraver in London so that ABain's name could be engraved in letters that were so minute as to be almost illegible!

At least the controversy prepared Wheatstone well for the bitter and very public dispute with David Brewster, a decade later, over priority of invention of the stereoscope (see Wade 1983). Wheatstone referred to Brewster as a disputatious antagonist, but the term could be applied to both ABain and Wheatstone with regard to the invention of the electric clock. They would have done well to note the words of Sir William Thomson, delivered in a different context: “Questions of personal priority, however interesting they may be to the persons concerned, sink into insignificance in the prospects of any gain into the secrets of nature” (Thompson 1910, page 602).

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