Babbage's presentation of the calculating machines: notation and description

Maurice Wilkes, one of the 'pioneers' not only of twentieth-century computing, but in the investigation of the design archive left by Charles Babbage, makes a rather interesting claim in a 1977 paper about communication of ideas:

> In writing of Babbage as a computer pioneer one must at once admit that his work, however brilliant and original, was without influence on the modern development of computers. The principles that Babbage elucidated but regrettably failed to communicate, had to be rediscovered by the men who, 100 years later, built the first automatic computers. (emphasis added)[1]

How is it possible that Babbage, who published or sponsored approximately 80 papers or monographs in his lifetime, of which circa a quarter concerned calculation machinery or notation, and who throughout his life kept up a professional correspondence with engineers and scientists not only in England but abroad, and who very regularly received at his house, which was also his engineering and design laboratory, persons of influence in all walks of life, to view and discuss various models and designs, can have 'failed to communicate'?[2]

Wilkes, well-qualified to assess the engineering principles involved, is of course writing from that point of view "why did we have to reinvent?". He adds weight to the remark with a claim of even more significance – that the association of failure with Babbage actually delayed the development of automatic computers.[3]

In these statements Wilkes identified the central research problem in Babbage studies. The problem has been and is being attacked from several points of view, including the technical, cultural, and biographical. Bruce Collier and Allan Bromley separately pursued an understanding Babbage's designs and their logical development via research in the massive design archive; the ongoing Plan 28 project, which aims to build an Analytical Engine, is currently pursuing a similar, wider, goal by organising, indexing, and publishing the archive as a first step to enabling a wider understanding of its architecture.[4]

---

[1] Maurice Wilkes, 'Babbage as a computer pioneer' *Historia mathematica* 4 (1977): 415–440 at 415; Wilkes reiterates the point in a biographical article a quarter of a century later ('Charles Babbage and his world' *Notes Rec R.Soc London* 56.3 (2002): 353–365 at 353). Wilkes was director of the Mathematical Laboratory at Cambridge immediately after World War 2, when he projected and designed the UK's first computer the EDSAC, modelled on the Moore School's EDVAC (Martin Campbell-Kelly, 'Wilkes, Sir Maurice Vincent (1913–2010)' *Oxford Dictionary of National Biography*, https://doi.org/10.1093/ref:odnb/103346).

[2] For Babbage's professional and social circle see in the first place Anthony Hyman, *Charles Babbage: Pioneer of the Computer*, Oxford University Press, 1982, especially pp28–30 & 164–189. Hyman supplies a list of Babbage's publications on pp256–260, based on Babbage's own list in *Passages*, pp493–6 and A. W. van Sinderen *AnnHistComp* 2.2 (1980): 169–185; for the milieu in general see, for example, Alexandra Buchanan, *Robert Willis (1800-1875) and the Foundation of Architectural History*, Woodbridge, Suffolk, Boydell & Brewer, 2013, chapter 2.

[3] Wilkes, 'Computer pioneer', p415; the point is taken up by Doron Swade '"It will not slice a pineapple": Babbage, miracles and machines' in Francis Spufford & Jenny Uglow (eds.), *Cultural Babbage*, London, Faber, 1996, pp34–52 at 39–41.

[4] Bruce Collier, *The little engines that could've: The calculating machines of Charles Babbage*, New York, Garland, 1990 (from a PhD thesis well-known for 20 years before); Allan Bromley's publications are referred to in the *IEEE Annals of the History of Computing*, issue 4 of 2000, dedicated to him; Plan 28 is reported at https://plan28.org/; the blog entries (http://blog.plan28.org/), which begin in 2013, are infrequent but informative. Actually the 'Analytical Engine' is better thought of as a 'class of machines' or a concept, rather than a (design for) a single artifact (Hyman, *Babbage*, p255).

In this paper I address specifically the 'communication' which Babbage is said to have failed in.

Sometime before 1826, but after the start of DE No. 1 development B invented a new symbolic language, the Mechanical Notation (MN), which, he claims, he then applied retrospectively to the DE No. 1, to good effect. The MN was addressed to the needs of engineers, to enable them to describe concrete mechanism, and to 'explain and demonstrate construction', the principles being to specify definitively:

1 shape and relative position of machine elements
2 time and duration of every motion
3 connection of each moveable piece[5]

A comparison of Robert Willis's use and adaptation of Babbage's MN in *Principles of Mechanism* published in 1841 is instructive. While speaking with great respect of Babbage's MN, Willis, though he uses a great deal of the 1826 paper verbatim, nevertheless exchanges Babbage's examples for his own, and replaces some of Babbage's text with standard terms.[6]

Apart from the MN, addressed to engineers, Babbage was very much alive to the need to communicate the working of the Difference and Analytical Engines to the general public. He had wanted to exhibit the DE at the Great Exhibition of 1851 in the Crystal Palace when it was refused published a polemic on how to organise (or not organise) an exhibition. The DE was exhibited in the 1861 exhibition, but unsatisfactorily in Babbage's view, which provoked him to set out in *Passages* the ideal situation. Here Babbage reveals most straightforwardly his conviction that the public had a great interest in his Engines and, taking this as given, sets out how he would communicate with them.[7]

Apart from having the machine working, his proposed form of display included '700 –800 square feet' of diagrams available for visitors to view as they watched the machine work: a situation which he expected would enable all comers to understand it. This is an admirable expectation and one which many present-day systems designers, whose work is always done in a team of analysts and users, will sympathise with.

Not only does his interest in exhibited at the world fairs show his wish to communicate directly with potential users of the technology he had invented, it shows that Babbage was in some fundamental way persuaded (probably the one area of his own thinking he never minutely examined) that everything in his universe – not excluding his own AE – was capable of explanation. And in making his explanations Babbage chose, as he did in all his design and construction work, his own method of approach: he chose tone (informal), narrative form (story), and technical vocabulary (preference for none). These aspects of his communication strategy are analysed.

---

[5] Charles Babbage, *Passages from the Life of a Philosopher*, Augustus M. Kelley, 1969 [1864], pp142–3.

[6] Willis pronounces, at least of one facet of the MN, that 'it is impossible to speak too highly' (Robert Willis, *Principles of Mechanism*, John W. Parker, London, 1841, p345; cf. p342 & p352).

[7] Babbage, *Passages*, pp147–167.