Ancestral figure of computing

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The Mathematical Work of Charles Babbage. By J. M. Dubbey. Pp. 235. (Cambridge University Press: Cambridge, London and New York, 1977.) £12.50.

CHARLES BABBAGE is the great ancestral figure of computing. Where modern pioneers worked with colleagues and were part of a substantial movement, Babbage had to deal with all aspects of the problem himself: mathematics, technology, programming, applications, stating all the problems; even conceiving of the idea in the first place. And when he required finance (those who have difficulties with bodies offering grants might care to note) Babbage had to deal with the Prime Minister of the day.

Although he lived and worked in London and ample documentary evidence remains, most writing about Babbage's life and work has been muddled almost beyond belief. Thus, in discussing Babbage's life, without extensive study of widely distributed manuscript material, it is impossible to avoid errors, and this book contains its quota. Dr Dubbey says that Babbage was "almost certainly . . . a far different person from the one represented by popular misconception". One might go further: most of the pictures presented of Babbage have been little more than clumsy caricature.

The first years of Babbage's working life were devoted to pure mathematics. The history of this pioneering work, by Babbage and his friends Herschel and Peacock, which laid the foundations of the modern school of English mathematics, has hitherto been only sketchily known. Dr Dubbey's book, which is primarily concerned with Babbage's mathematical work before the commencement of the project to construct the first Difference Engine, does much to fill in the details of the picture.

At the beginning of 1812 Babbage took the initiative in founding the Analytical Society, which became the centre for his undergraduate work. Dr Dubbey refers to a letter from Bromhead to Babbage suggesting that there was a meeting of the Analytical Society as late as 20 December, 1817. However, I suspect this is merely Bromhead's graphic way of writing. He was feeling isolated in the country and was suggesting that it would be nice to revive the society: there was no-one at that 'meeting' but Bromhead himself. As an organisation the Analytical Society functioned for a year and a half and produced only one publication, the Memoirs, whose cost was defrayed by the active members. Publication of the other books mentioned was solely the responsibility of the authors.

Dr Dubbey analyses Babbage's early mathematical work in considerable detail, making for his achievement bold claims which will long be discussed. He notes that before Babbage, " . . . problems arising from functional equations of higher order than the first had been almost overlooked. Babbage must be given full credit as the inventor of a distinct and important branch of mathematics". Dubbey claims that although the approach of Abel, Stokes, Weirstrass, Darboux and Hilbert to functional

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equations ". . . is undoubtedly more rigorous than that of Babbage, it is doubtful if any of these could rival him in surpassing his contemporaries by the sheer ingenuity of method and generalisation of results". Dr Dubbey also implies that Babbage's papers on the theory of functions, of which he sent copies to Cauchy, stimulated Cauchy to solve the equations: $f(x+y) = f(x)+f(y)$; $f(x+y) = f(x).f(y)$; $f(xy) = f(x)+f(y)$; $f(xy) = f(x).f(y)$; which have been considered basic in subsequent theory.

The importance of Babbage's work on notation has long been recognised, but this book adds a good deal to what has been at all widely known.

Dr Dubbey shows convincingly that the basic ideas of the modern concept of algebra put forward by George Peacock in 1830 can be found in earlier work of Babbage's which Peacock had read in manuscript. In view of the habit which Babbage and his friends had of discussing such topics on every possible occasion when they met, there can be little doubt of the actual transmission of the ideas.

Of Babbage's rough draft *The Philosophy of Analysis*, abandoned when work on the calculating engines commenced, Dubbey concludes: "If he had developed the very fruitful ideas contained in the book . . . mathematical philosophy, modern algebra, the theory of games and stochastic mathematics [might well have been] developed many decades before they actually were". Babbage's influence on later English mathematicians, including De Morgan and Boole, and perhaps Continental mathematicians, may well have been greater than Dr Dubbey allows. I think he underestimates the importance of informal discussions at that time. Such channels of transmission are difficult for the historian to document but can be important.

This book treats other aspects of Babbage's work more sketchily. A discussion of the problems of Babbage's relations with government requires historical analysis, and that Dr Dubbey does not attempt.

His discussion of the Analytical Engine is based on the common misunderstanding that the Analytical Engine was a single machine. Actually, it was a class of machines, as is the Computer. A list of the classes of Analytical Engines was published a year and a half ago, perhaps too late for Dr Dubbey to take into account. He does not distinguish sufficiently clearly between a programmable calculator and a stored program computer. And his claim that "It has been described in chapter 8, how [the Analytical] engine was in every way comparable to a modern computer" really cannot be sustained. The Analytical Engine as described in this book is a calculator, albeit a powerful and versatile calculator, not a computer. A good case can indeed be made that Babbage did plan a computer, but the case rests on work of Babbage's which is not mentioned by Dr Dubbey.

There is a further difficulty in the illustrations. The Analytical Engine, the mill of which is shown here, is rather different from the Engine as it is described in this book. For example, it was probably not planned to use a punched-card system at all. Unhappily, the Analytical Engine is labelled "Difference Engine", and *vice versa*; and the transmission racks are shown sticking out wildly in positions they could never have reached in use.

The first seven chapters are the result of a great deal of painstaking work, well organised and clearly presented. Cambridge University Press is to be congratulated on publishing this study of Babbage's early mathematical work. One hopes that other detailed studies of crucial developments in the history of science will follow. □

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