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Abstract

Reviewed Title: *The Boole-De Morgan Correspondence: 1842-1864* by Gordon C. Smith. London, New York (Oxford University Press, Clarendon). 1982. 156 pp.

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The Boole–De Morgan Correspondence: 1842–1864. By Gordon C. Smith. London, New York (Oxford University Press (Clarendon)). 1982. 156 pp. $44

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This book makes available a fascinating correspondence between the two mathematicians George Boole and Augustus De Morgan. A number of letters apparently have been lost, but what remains and is published here is still a good-sized collection of some 90 items written between late 1842, shortly after Boole began publishing in mathematics, and mid-1864, approximately one-half year before Boole died. There are 64 letters written by Boole (the text mistakenly claims 66); the remaining 26 plus an earlier draft of a letter are by De Morgan. Brief passages from several other letters, books, and manuscripts are occasionally quoted to illuminate points made in the correspondence, though more might have been done in this regard. The testimonial written by De Morgan to accompany Boole's application for a mathematics professorship in the Queen's Colleges, Ireland (September 1, 1846) and the more accessible but seemingly still unknown two-page obituary of Boole by De Morgan (***Macmillan's Magazine*** **XI**, February 1865) are neither cited nor used.

The letters are presented in chronological order and are broken up in a natural way into seven groups. A helpful listing of the letters giving date and authorship is placed in the manuscript portion of the Bibliography. The topics discussed range from matters of research in the areas of calculus, differential equations, mathematical logic, and probability to a variety of personal and social issues, such as homeopathic medicine, the plight of the Jews, and psychic phenomena and theories ("spiritualism"). De Morgan's humor and likable irascibility contrast nicely with Boole's earnestness, which evolves from a very formal and rather hesitant tone to a warmer and more self-confident one as the correspondence progresses.

It is possible to follow the gist of the correspondence merely by reading the letters, even if one is not very familiar with the details of Boole's and De Morgan's work or the broader context of the mathematics and logic of the period. There are times, however, when some background information is necessary, particularly when the discussion involves technical points of mathematics or logic. This is provided by Smith with varying degrees of success. At times his commentary is quite commonplace, pointing out what the reader can just as easily gather for himself from the correspondence. Moreover, there are several significant passages, such as the one in letter 32, from Boole to De Morgan, mentioning the relationship between Boole's system of logic and his work in probability, which beg for explication but which are left untouched. On the other hand, there are many times when Smith's explanation elucidates a viewpoint or helps the reader to appreciate an otherwise obscure reference or allusion. Also appended is a series of biographical notes on all the people mentioned by Boole or De Morgan. Though the descriptions are brief, they seem to be fairly accurate and enable the interested reader to locate more information on them elsewhere. An exception to this is the entry "Lloyd, B. C. (1808-72)," which should be "Lloyd, Bartholomew (1772-1837)"; this mistake does not present any problem, however, for Lloyd is nowhere mentioned in the text, either in the letters or the commentary. A number of the dates and some of the letter references given in this section, however, are incorrect, sometimes amusingly so (J. L. F. Bertrand, for example, is not due to die for another 900 years).

The poor editing which one finds in the Biographical Notes is unfortunately not an isolated occurrence; passages throughout the work contain mistakes that are annoying enough to be mentioned. One can amend most of the errors without too much trouble, but given the price of the book and the reputation of the publisher, one certainly expects better. There are a number of syntactical and typographical errors, a few of them occurring in the letters themselves and two of

those making the meaning of the text just the opposite of what was intended (pp. 55, 83). Letter 64 (p. 79) contains what I believe is an exponent (3), but which is readily mistaken for a duplicate footnote having no referent. As I interpret the passage, De Morgan is playfully considering medical danger (of disease) as an operation which can be repeated several times or exponentiated. De Morgan seems to imply in this passage that danger cubed is less of a threat than simple danger. In so saying, De Morgan may also be having some fun with one of Boole's laws of logic, the fundamental "index law" for exponentiation of terms (any power of a term is equal to the term itself) and with Boole's refusal after his initial work in 1847 to accept powers higher than 2 (cf. Boole's 1854 ***Laws of Thought***, p. 50 n); in which case the passage probably deserves a footnote in addition to the exponent. Other editorial problems can be mentioned as well—incomplete or awkward phrases and sentences (pp. 24, 41), misquoted passages in the commentary (pp. 80, 85, 95), misspelled or wrongly identified authors (Halperin should be Hailperin; Joan L. Richards 1980b should be John Richards 1980), and so on. A final error that should be singled out is a systematic one that occurs in the Index; this one can only be corrected once the error pattern is recognized. Though the Index is fairly complete (except for a few key terms, such as "Hamilton, W." and "logic"), it is unfortunately almost useless if the page numbers are taken at face value. All references to page numbers following 50 or so seem to be wrong; I was able to compensate by adding 1 to the page number for approximately every 50 pages.

A more substantial criticism of the book regards the focus and breadth of the commentary. The Boole-De Morgan correspondence will undoubtedly find readers among various groups of people, but it will probably be read primarily by those interested in mid-19th-century mathematical logic, since both Boole and De Morgan are known as innovators in this field. The correspondence does not document the genesis or development of either system of logic, but the 25 letters or so that deal directly with logic do offer some interesting glimpses into the independence of the two systems of logic; into Boole's use of logic as a basis for probability; and into De Morgan's ongoing, almost obsessive, spat with William Hamilton and his followers. Smith recognizes all this at the outset, remarking that "the major interest in the correspondence must be the exchange of ideas on logical matters" (p. 1). One therefore expects the book to concentrate heavily on logic; yet this is the weakest aspect of the commentary. Smith appears quite at home when he is elaborating the mathematics, and he has done a good job in chasing down various obscure references or allusions of a literary or more general nature, but his discussion of logical points is inadequate. Since De Morgan's logical notation was peculiarly his own, Smith realizes his obligation to tell the reader precisely what De Morgan's symbols and arguments mean. Where this is done, however, principally in connection with letters 12 and 64, the commentary is flawed.

In the case of letter 12, Smith first explains what most of De Morgan's symbols mean (two of them are left for the reader to decipher from the context in which they are used), and he then provides a transcription of De Morgan's argument into contemporary logical symbolism. Particularly the latter is faulty and, what is worse, historically misleading. While Smith notes that it would be improper to use quantifiers or predicate logic to explicate De Morgan's argument. he continues by mixing together class logic and propositional logic. He correctly uses set notation to indicate class containment, but he then uses the symbols for the propositional connectives "and," "or," and "not" in place of set intersection, union, and complementation. The resulting argument not only combines two different systems of logic; it also gives the reader the mistaken impression that De Morgan, like Boole, had in mind a propositional interpretation for logic in addition to the usual class interpretation. The transcription thus obscures a key point on which one wants clarity. The discussion prior to letter 64 (pp. 76-77) is also defective. Here Smith shows how De Morgan's notation can be used to infer a conclusion from given premises. Unfortunately, the

argument with which he chooses to illustrate the process is invalid, something he seems not to realize.

On a less technical and more historical level, the book makes little effort to present a coherent picture of the logic of the time. Smith presents very little commentary on logical issues, often referring to the ideas of others instead of giving his own analysis or making his own synthesis of their viewpoints. Naturally, there would be little point in once again dragging out the entire debate between De Morgan and Hamilton over quantifying the predicate or in repeating what others have said before about it, but I think the reader deserves some discussion of the historical significance of the debate. Moreover, beyond Boole, De Morgan, and Hamilton, Smith fails to discuss any of the other logicians of the period, though many of them are mentioned in the correspondence. Here the book skimps too much, in my opinion. While Smith provides the immediate context for the letters by discussing some of the issues they raise, he fails to give a more global context in which one can place Boole's and De Morgan's work.

Mathematics fares no better than logic in this respect. Smith does discuss the mathematics contained in the letters, but once again he adheres too closely to the details of the correspondence, elaborating particular results rather than placing them in a broader historical context. The reader never gets to see the larger mathematical and institutional contexts in which both Boole and De Morgan worked. Peacock, for instance, is not even mentioned. The analytical movement in British mathematics, of which Boole, De Morgan, Ellis, and others were a part, receives only scant mention in a couple of places and then in a rather unhelpful way. De Morgan is mistakenly said (p. 3) to have been a member of the Analytical Society at Cambridge (called the Cambridge Analytical School here), though he arrived at Cambridge a decade after its demise as a society. De Morgan did belong to the "invisible college" of the analytical movement, however, which continued long after the Analytical Society broke up, and in this capacity he promoted a fairly formal, continental approach to calculus and algebra. It is precisely this approach to mathematics, however misguided it appears from our side of Cauchy and Weierstrass, which stimulated Boole to develop logic as a branch of "analysis" or algebra. One therefore expects Smith to defer somewhat to this trend because of its historical importance for logic and mathematics, but he merely passes judgment upon it as being technically backward (p. 9).

From a historical point of view, then, the book is rather disappointing; one wishes that the supporting remarks for the letters had been less narrowly exegetical and more broadly historical in their focus. To understand the historical significance of the ideas discussed by Boole and De Morgan, one would have to consult a number of other works. Most of these are cited in the book or appear in the Bibliography, but some works are omitted that definitely deserve to be included, such as the 1935 article by Nagel on "Impossible Numbers" and the 1955 "Celebration of the Centenary of the ***Laws of Thought***," to name just two. Yet whatever its shortcomings, the book renders a valuable service to those of us interested in Boole, De Morgan, and mid-19th-century British mathematics and logic. Due to Smith's efforts we now possess a large number of letters between Boole and De Morgan in a readily accessible form. For the serious scholar, that would probably be the principal value of any book containing their previously unpublished correspondence.

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