and practice. When the book comes to be revised (and this should not be long delayed) someone should also see that no apparent contradictions appear, as indeed they do at present.

As evidence of *naïveté* only one example may be quoted:

> "People may think up what they consider to be suitable answers through the very human weakness of pride. Unless *Interviewers* are aware of these failings and are trained to recognize them, they will not check the replies given, with the result that they will be given without qualification" (p. 19).

In another place Mr. Delens says, more reasonably, that too much responsibility must not be left to field staff. Surely the design of all questions to be used is the task of the research editor, and should never be left to the several interviewers?

Perhaps some reason for the errors is revealed by the following quotation (p. 28):

> "By survey methods it is comparatively simple to test the effectiveness of particular advertisements by measuring the reactions of consumers to them, the extent to which they are noticed and remembered and their influence on purchases".

Mr. Delens seems unaware that people will "recognize" posters and advertisements which have never appeared. Far from being any simple matter, there is little doubt amongst practitioners of market research that advertisement research is one of the more difficult and controversial fields of inquiry.

The author gives a short list of sources of statistical data of value in market research, but fails to mention the *Monthly Digest of Statistics*, although he refers to the Annual Abstract. It would surely have been better to refer the "perambulator manufacturer" to the Quarterly Returns of the Registrar-General than to imply that he should write to that department to obtain birth rates in "various places".

A selection of only one or two statistical points can be given. On page 81 there is a diagram showing two curves—the y-axis being "number of samples", and the x-axis the "proportion of respondents giving an answer A". One curve is normal and the other platykurtic, almost rectangular. It is stated below this diagram, "Both are normal curves . . .," and later, "In market research the curves approximate to normal for samples of more than about 50". Nothing in this discussion is said about the values or limits of p, and for some reason the x-axis ("proportion") ranges from 0 to 150. The reader is also informed that the "curve is symmetrical so that proportions less than p are just as likely to occur as proportions greater than p".

A chapter which in fact deals with the accuracy of the mean is headed "Accuracy of σ".

On page 82 the formula $\sigma = \sqrt{\frac{\bar{p}\bar{q}}{N}}$ is given, and the reader is informed that "this formula will give the standard error for any sample".

Quota sampling we are told is the same thing as a "stratified sample", and the modern methods of stratified random sampling are not mentioned at all. "It is seldom possible," continues Mr. Delens, "to conduct the survey by personal interview where a random sample has been selected unless the universe is fairly limited and the area concerned fairly small". Again, on page 80, the author states when referring to a "stratified sample" (i.e., a quota sample in his terminology), "This procedure makes the results very much more accurate than when a strictly random sample is taken, but it also makes it extremely difficult to work out the exact size of the error which is likely to occur". It would be instructive if the author would quote the formula for calculating the error of a quota sample "exactly", however difficult it might be. L. T. WILKINS.

12.—*Calculating Instruments and Machines.* By D. R. Hartree. First edition to be published in England. Cambridge University Press, 1950. ix + 138 pp. $9\frac{3}{4}''$. 21*s*.

This book consists essentially of a short series of lectures delivered by the author at the University of Illinois in 1948. The book can be confidently recommended as an introduction to modern methods of large-scale calculation, and even the expert will be glad to possess a copy.

In Chapter 1 non-human computers are classified into "instruments" (continuous computers) and "machines" (discrete computers). Chapters 2 to 4 deal with the differential analyser and with other continuous computers, and Chapters 5 to 9 with general-purpose digital computers (mainly electronic and relay). There is ample discussion of numerical methods in relation to machines, and there are several interesting historical remarks, including, for example, some concerning Byron's daughter, Lady Lovelace. There are 68 diagrams and photographs, including a photograph of the useful Mecanno differential analyser built by Hartree and Potter. There are no ordinary electrical circuit diagrams. This is because the book is more concerned with "physiology" than with "anatomy".

In Chapter 2 it is made clear how the use and flexibility of the differential analyser depends on the possibility of topological rearrangements of its basic units, so to speak. It is therefore

not surprising to be told that differential analysers which have electrical connections rather than mechanical ones are at a considerable advantage.

In Chapter 3 the fundamental effect of the boundary conditions of ordinary and partial differential equations is emphasized. An example is given to show how the boundary conditions of a partial differential equation can influence whether one or another continuous independent variable should be replaced by a discrete variable (for differential analyser purposes). The use of "characteristics" of partial differential equations is also considered.

In Chapter 4 some miscellaneous continuous computers are briefly described, including Mallock's machine, the Isograph, Fourier synthesizers, and special types of integrators.

Chapter 5 is an introduction to large automatic digital computers. The author is careful in his choice of technical terms. He expresses dissatisfaction with the term "judgment", but uses it occasionally. Perhaps "decision" or "ability to decide" (according to context) would be better. As a matter of fact decisions can be made even by some electrical desk computers (when carrying out divisions), and for these computers the term "judgment" is particularly inappropriate. The distinction, however, between a "judgment" and a "conditional selection" is not entirely clear to the reviewer.

Chapter 6 deals briefly with the "Analytical Engine" designed by Charles Babbage a century ago (but never completed).

Chapter 7 is concerned mainly with the Harvard Mark I Calculator, which is electromechanical and controlled by 24-hole tape, and with the Eniac, which is electronic, but in 1948 had no really modern methods of storage. It is pointed out that the Eniac is a good machine for the purpose for which it was built, in spite of its limitations when regarded as a general-purpose computer. In particular the manual plugging of instructions makes it easy to correct minor errors in the instructions. At the end of this chapter the necessity is pointed out of taking a "machine's-eye view" when programming a calculation.

Chapter 8 is concerned with the more modern developments. In particular a control circuit of the intriguing Ace type is given in the McCulloch-Pitts-von Neumann-Turing notation. The distinction between serial and parallel machines is made. A typical remark is that in a serial machine the adder is comparatively simple, and that one can therefore afford to duplicate it in order to obtain a check on all additions. This chapter concludes with a short section on "programming and coding". The last paragraph of this section is very important, though it is slightly out of place.

The last chapter is concerned with numerical analysis in relation to high-speed computers. The value of iterative processes is stressed.

On page 61 a prediction is made that the decimal representation of numbers will probably oust the binary representation in general-purpose computers, partly because of the greater ease of "trouble-shooting" when the decimal representation is used. This may well be true for computers in the strict sense, but in general-purpose machines intended for logic, for pure mathematics in general, for the theory of numbers in particular, and for the analysis of the nervous system, the binary representation is liable to remain more convenient (except perhaps for multi-valued logics). It cannot be predicted for any of these subjects that their mechanization will not ultimately become of great practical importance.

The author has an open mind on the "exciting" question of whether machines will be constructed which will "think for themselves", i.e., which will handle symbols in a non-predictable but useful manner. If this will be possible for future machines, then it is presumably also possible (though perhaps inconvenient) for machines designed before 1948, a fact which the author has apparently overlooked. It is a question of producing a suitable programme. This question has received some attention from Turing and others. A randomizing device would be required, and could be supplied by placing random numbers in the store. The author is clearly right in using the word "exciting", since a machine which was so nearly human (or perhaps superhuman) could become a modern oracle. The threshold between a machine which was the intellectual inferior or superior of a man would probably be reached if the machine could do its own programming. Such speculations would be contrary to the matter-of-fact style of the book.

The brevity of the style often stimulates thought. For example, on page 65 there is a suggestion that a compromise between a floating and a fixed binary point may be advisable, and the reader's intelligence is complimented by the omission of specific details.

There are naturally some additional matters which could have been included with advantage. For example (i) some estimates of relative costs, though these estimates may become out of date rather quickly. (ii) A mention in the historical remarks of D. H. Lehmer's photo-electric factorization machine. (iii) Titles of the articles in the References. (iv) Approximate numbers of valves (tubes) required to produce a threshold-n element. (v) Insertion of Mallock in the name index.

I. J. Good.