less apparent, however, that if in the expansion of education in Britain already proceeding the full benefits are to accrue, to the individual and to the community, there must be clear conceptions as to the exact functions of our educational institutions, the purposes they are to serve and their relations to one another. These must be in harmony and the resources placed at their disposal appropriate to the function to be served, if we are to avoid either waste of effort and resources or to achieve such a standard of education and supply of trained men and women as Britain needs to use the opportunities that confront us in this age of rapid technological change.

JOHN DALTON

The Biographical Approach to John Dalton

By Frank Greenaway. *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, Vol. 100, 1958–59. Pp. vi + 98 + 11 plates. (Manchester: Manchester Literary and Philosophical Society, 1958.) 21*s*.

THE hundredth volume of the *Memoirs and Proceedings* of the Manchester Literary and Philosophical Society consists of a memoir by Frank Greenaway on "The Biographical Approach to John Dalton". It deals with the older biographies written by Henry, Angus Smith, Lonsdale, and Roscoe, and also gives, for the first time, a connected account of the newer work of Roscoe and Harden, Meldrum, and Gee, Coward, and Harden, as well as of some later publications.

This essay is very interesting, and a good deal of painstaking work has evidently gone into it; but it fails, in my opinion, to do justice to Dalton. It includes too much which is irrelevant and omits too much which is essential to a proper understanding of the place of Dalton in the history of chemistry. Some justification for the last statement can first be given.

It has often been said that before the enunciation of his atomic theory Dalton did little or nothing of importance. In fact, Dalton had published work on the theory of mixed gases and the state of water vapour in the atmosphere, on the conduction of heat in liquids, on the vapour pressure of water, and on the expansion of gases by heat; and if he had done nothing else he did, and would still, rank high. Mr. Greenaway says that in his early meteorological work, "Dalton slipped into a groove of study which led him to a position he never fully understood". It led him to the discoveries mentioned above and to ideas which, unless we knew that they were first published by Dalton and were initially received with incredulity, we might think are self-evident.

It has also often been said that after the publication of his atomic theory Dalton did no work of importance; he was, says Mr. Greenaway, "an anachronism". Yet some of his later work, such as that on the combustion of hydrocarbons, on the vapour density of ether, and on the isomeride of ethylene in coal gas is really important.

Another old error which is repeated is that Dalton was a coarse and inaccurate experimenter. His work on gas analysis, which (as everybody who has done any knows) is difficult, is quite exceptionally good, and although Mr. Greenaway dismisses the third volume (II, ii) of the "New System" in a word or two as of no interest, it contains some surprisingly accurate work on the equivalents of metals which has been pointed out by Trengrove. A mention of Dalton's "undeserved reputation as a chemist" is unnecessarily severe on the judgment of contemporary chemists.

Dalton's early work on the aurora is given but it is not mentioned that Faraday later proposed the same theory without naming Dalton; no reference is made to Dalton's later experiments on the composition of the higher atmosphere and his explanation of the results, quite recently proposed again as original.

Dalton did not read many books, but the suggestion that "his often-quoted claim to be independent of them may well have been an impromptu attempt to conceal a feeling of inferiority in the face of those who were more accustomed to them", is one of those random guesses which sometimes pass for biography. One of the books Dalton read in his early period is Bishop Watson's "Essays", on which F. Sherwood Taylor's over-clever statement that it could have been written in a year and "smells more of the lamp than the laboratory" is quoted. This book (in five volumes) records Watson's visits to mines and factories extending over many years, and contains some extensive research of his own which is known to physical chemists. Watson's work on gunpowder is also well known. This sort of history simply will not do.

Dalton's mentality seems to have been relatively straightforward as compared with personalities such as Newton, Priestley and Lavoisier. Mr. Greenaway gives an anecdote (p. 7) about Granville (who is otherwise little known) revisiting Dalton in old age and finding him busy trying to loosen a stuck glass stopper. Dalton gently resisted an attempt to assist and finally released the stopper himself. Then, although obviously busy, he had a few courteous words with his unrecognized visitor and got rid of him. This was typical of Dalton, but all Mr. Greenaway gets out of it is that "there was a little glow still in the grey ash of the man".

The section on the origin of Dalton's atomic theory is one of the best, but it too fails to bring out some important matters. Mr. Greenaway thinks that earlier writers have been inconsistent in saying that the origin goes back to Newton while Dalton used a theory of heat different from Newton's. A little might have been said about Newton's own use of this theory of heat, and why Dalton adopted a different one. The influence of Lavoisier's "Traité" could have been considered, and particularly how Dalton's criticism of an erroneous theory of mixed gases contained in it was related to the development of his own theory.

The final section of the essay is a rather confused assembly of some recent pronouncements on the philosophy of making discoveries; it is not easily understood.

If I were asked to hazard an opinion I would say that Dalton has been too much for many of his biographers; the most successful of these was probably Roscoe, largely because he was a chemist, had read Dalton carefully, and had a good knowledge of the state of physics and chemistry when Dalton began his work. The same qualifications are needed in a future biographer of Dalton, who will have the advantage of new knowledge which has accumulated since Roscoe wrote.

Mr. Greenaway's essay gives a good if incomplete summary of this new knowledge, and he has added a few new morsels—no mean achievement in the field, since much of the material has been lost. He deserves thanks for what he has done. J. R. PARTINGTON