The Evolution of the Text-Book

Introductory College Physics. By Blackwood. (John Wiley & Sons, Inc., New York, Chapman & Hall, London), 1938. Pp. 47. Price 17*sh.* 6*d.*

TO be called upon to review an elementary text-book is at once an easy and a difficult task. It is easy, if the conventional short notice is all that is required. One studies the table of contents, occasionally glancing at the book itself to see how the familiar subject-matter is presented. One may actually read a chapter here and there to discover whether the author has a reasonable style. Consideration is given to the printing, binding, and (last but not least) the published price, after which the reviewer, according to his taste in text-books, either solemnly warns the scientific public against the pernicious influence of the work in question, or commends it to them as a shining example of what a text-book ought to be.

It may be observed first of all that the volume now under review passes such tests as these. It is to all appearances the work of a diligent and able author, excellently produced by the publishers, and, considering everything, not unreasonably priced at 17*sh.* 6*d.* But one is tempted to take the opportunity of enquiring a little more deeply into the whole matter. What, after all, is a "text-book", and by what canons of judgment should it be appraised? This is a difficult question to answer, but text-books are in many ways so important that it is worth taking a little time to consider such a singular by-product of the modern age.

The scientific text-book must be classed as a relatively modern development, belonging to the past century or so. In the early days of science there were no text-books to mediate between the mind of the creative thinker and that of the student. The student learned directly from the teacher to whom he attached himself, or from the writings of the masters, which were in no sense text-books. Lucretius' *De Rerum Natura* is not a text-book, neither is Galileo's *Dialogue on the Two Chief Systems of the World,* nor Newton's *Opticks*, nor Faraday's *Experimental Researches.* Even Maxwell's *Treatise on Electricity and Magnetism* is not a text-book in the modern sense of the term. These works are rather store-houses, containing wisdom and knowledge which the author has garnered over a long period of years. They record the author's mind, and are not primarily manuals of instruction for the student. Treasures are gathered in from every quarter with evident enthusiasm. Thus Maxwell, in 1855, writes to William Thompson: "I do not know the Game-laws and Patent-laws of science. Perhaps the Association may do something to fix them but I certainly intend to poach among your electrical images".[1]

These works, and others like them at the present day, are, in the truest sense of that much-abused word, 'literature', and are of permanent value. The text-book of modern days is usually not literature and does not pretend to be. The material is mostly second-hand, selected, often enough, to agree with an external and ill-assorted list of topics known as a syllabus, and, most baneful of all, it is too obviously 'intended for' someone. True literature is not 'intended for' anyone. One cannot imagine on the title-page of 'Hamlet'—"Intended for students of the Inter Arts", however much the hack commentator, who lowers Shakespeare's greatness to a level suitable to our intelligence, may wish it there.

The text-book writer, therefore, necessarily works against great odds. He cannot follow his fancy, nor, often, his better judgment. He must consider his work as a commercial proposition. He is in the market with his wares and they must be saleable. If the public prefers hoary fallacies, the truth will be unpopular, and must either be avoided or suitably disguised. He must remember that his reviewers may be staid and old-fashioned, but their words will be weighed in gold. If he wants his book to sell, particularly in an examination-ridden land like India, the book must contain the syllabus, the whole syllabus, and nothing but the syllabus. His illustrations must be the official illustrations, his definitions the inaccurate formularies honoured by long usage. Otherwise ponderous professors will write to him: "Your book is of no use to me, it does not cover the syllabus, you have not distinguished the three kinds of lever". The whole stock-in-trade of traditional scientific pedagogy must be there, and nothing else.

And so it comes about that India at the

[1] *Origins of Clerk Maxwell's Electrical Ideas,* Larmore, p. 18.

present time is flooded by books which do cover the syllabus, but which ought themselves to be covered by six feet of good earth. For this reason we do well to examine books which come to us from abroad, such as this *Introductory College Physics* by Professor Blackwood of Pittsburgh. One gets the impression that the evolution of the text-book has entered on a new and more interesting phase in recent years. There is evidence of a change of purpose. The older text-books, even the good ones, were dry and dull compendiums of information. The newer kind seek to stimulate the student's interest and enthusiasm, and are sedulously careful not to quench any spark of natural curiosity which the student may still retain. Professor Blackwood is an enthusiast for the new method, and indeed remarks: "The first requirement of such a course is that it shall stimulate the interest of the general student". Maxwell would have agreed with this; when he began Electricity he wrote to Thompson: "Suppose a man to have a popular knowledge of electrical show experiments and a little antipathy to Murphy's Electricity, how ought he to proceed in reading and working so as to get a little insight into the subject....?"[2] The objectionable Murphy has passed into the limbo of forgotten things, but his successors are still with us.

Here, then, is a criterion of judgment. Does the book interest, stimulate, and inspire? This is of infinitely more importance than the table of contents, and several recent publications come to mind which are admirable when judged by this criterion. The thing is achieved in a variety of ways. Firstly there is a wealth, some might say a superfluity, of illustration. On page 61, Prof. Blackwood has the old problem of the monkey hanging on a rope, which passes over a pulley, the monkey being balanced by an equal weight on the other end of the rope. What happens when the monkey climbs the rope? This engaging problem is accompanied by a life-like delineation of the monkey himself, solemnly contemplating his image in a mirror. One may not admire the monkey, but one cannot help admire the enthusiasm which put him there. And so throughout the book everything is illustrated that can be illustrated, and many of the diagrams and photographs are admirably suited to their purpose.

The second way of arousing interest is to look for the applications of physics not so much in the time-worn examples of the older writer but in things more closely related to the life of to-day. So the automobile (more familiar to us as a 'motor car') is pressed into service to provide an almost unlimited number of illustrations in all fields of Physics. The clutch and brakes illustrate friction, the transmission and the gear box make clear the principles of mechanics. The engine is an excellent piece of thermodynamics, and most of what a student needs to know about electric currents is exemplified in the ignition system. Even optics finds applications, as in the use of polaroid discs to avoid glare. Another such example is that of the refrigerator, which illustrates the conditions governing the transfer of heat. The treatment in this instance, though brief, is particularly clear and instructive.

The third development, likewise exemplified in this book, is that the author permits himself (to borrow a phrase of Eddington's) to talk "more or less like a human being and not like an Act of Parliament". The sterner critics of an earlier age would have regarded this as an unpardonable lapse. Undoubtedly it can be over-done, but dignity of language is not incompatible with freshness, and even vivacity. So, comparing the common and scientific notions of work, Prof. Blackwood remarks: "A golf caddy is 'working' when he stands idly while the perspiring player tries to hit a golf ball". One feels that Murphy, to whom Maxwell conceived such an antipathy, would never have permitted himself such a sly remark. But it makes the book live for all that. The language throughout is clear and vigorous, but one may perhaps note that the American idiom occasions difficulties now and again to the foreigner. The Indian student might be puzzled to know who the ten 'sophomores' are who apply a force to a rope on page 11. And, to the uninitiated, a pleasing flavour of mystery attaches to such a problem as "In knocking out flies, a baseball's speed changed from 0 ft./sec. to 80 ft./sec. in 1050 sec. What was the average acceleration?" One wonders for a moment what the flies have to do with it.

In conclusion, one or two criticisms may be permissible. One would like to see the hackneyed phrase 'mass is the quantity of matter in a body' die out entirely, especially as it happens to be untrue. In his treatment of specific gravity, Prof. Blackwood very properly recognises the distinction between

[2] *Origins of Clerk Maxwell's Electrical Ideas*, Larmore, p. 3.

specific mass or density, and specific weight or weight per unit volume. The latter he terms weight-density, or (in a footnote) weightivity. Surely it would be better to use the term specific gravity itself in its proper sense of weight per unit volume. By this means extra nomenclature is avoided, and a long-standing confusion is removed. German writers (Westphal, Tomaschek, etc.) already follow this practice, but the dead hand of tradition still keeps it out of the English books.

A further criticism might be that in ranging over the whole field of Physics, including very recent work, the treatment is often rather summary and sketchy. The answer is, of course, that an exhaustive treatment is not intended. One cannot blame a book for not being something which it does not pretend to be. Still, it is undoubtedly over-concise in places. There is also a distinct tendency for new ideas to slip in without proper definition, merely on the strength of some analogy, and a little more exactness at these points would not be incompatible with the purpose of the book. Torque, Rotational Inertia and Electrical Resistance are examples of this.

There are one or two small errors of fact, and a few printing errors, which perhaps are almost inevitable in a first edition.

When all such criticisms have been made, it remains true that the book is an admirable introduction to Physics, for all except those whose heads are buried in the sands of tradition. But whether it is likely to be read much in India is open to considerable question. For the students in our universities, alas, read for the most part only what is prescribed, and a book which has such a flavour of originality is unlikely, one fears, to be brought to the notice of those who need it most.

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Theory of Statistical Estimation

THE fundamental stages in a statistical appreciation of a problem are, its specification through means of a hypothetical population, the distribution, particularly of the statistics which we put forward as estimating our parameters, and finally the problem of estimation itself. While great advances have been made in each of these aspects, there is no doubt that the most striking progress in recent times has been in the researches on the theory of estimation. The notable contributor to this progress is Professor R. A. Fisher himself who chose, quite naturally, the statistical theory of estimation for his Calcutta University Readership Lectures, 1938, "an orderly presentation of the material in book form" having been brought up by Professor Mahalanobis and his colleagues at the Calcutta Statistical Laboratory.

We seek in the problem of estimation the exact properties of a population from its practical model, the sample, and it is inevitable therefore that uncertainty or probability, should attach to all operations from the very beginning namely from even the selection of the sample. The problem of obtaining presumable values was attacked as long ago as 1763 by Bayes, whose theory based upon the "principle of insufficient reason" supplies one answer, though an insufficient one, since the assumed constant probability of a parameter falling within any interval of fixed size is *not* a probability of the kind related to the empirical law of large number. Gauss-Markoff's ideas implied in the "best unbiassed estimated" later adumbrated is one result of a search for something better than the principle of insufficient reason. But the chief difficulty in this method as Dr. Neymann says, is our sophistication in taking as the best what is called the best. Undoubtedly great advances have since been made and the new principle of maximum likelihood estimate, originally due to Karl Pearson himself, and later refined by Professor R. A. Fisher now holds the field. Its chief justification lies, as even the justification for Markoff's unbiassed estimates lies, in that, under certain limiting conditions, when all the observations are mutually independent and their number n indefinitely increases, then it becomes less and less probable that the *m. l.* estimate will differ by so much from the parameter that is being estimated. Dr. Fisher's lectures to the Calcutta University reviews this position, in particular in sections 6, 7 and 8 of these lectures. His argument is as follows:—

"If, then, we disclaim knowledge *a priori*, or prefer to avoid introducing such knowledge as we possess into the basis of an exact mathematical argument, we are left only with the expression