Space might have been saved by the exclusion of special subjects, *e.g.* lighthouse apparatus, &c., which could not be treated at adequate length.

A short glossary of uncommon terms would have been decidedly useful, *e.g.* alveus, bollard, kant, pawl, scend, staith.

These blemishes are, however, small compared with the great merit of the work as a whole, which deals with the difficult and important subject of harbours in a thoroughly masterly manner.

ALLAN CUNNINGHAM, (Major, R.E.)

OUR BOOK SHELF

A First Course of Physical Laboratory Practice. By A. M. Worthington, M.A., late Assistant Master at Clifton College. (London: Rivingtons, 1886.)

PROBABLY no one has so successfully carried on practical science teaching in schools as the author whose excellent work at Clifton College has done so much to gain for that institution an enviable reputation. He therefore is specially fitted to write a "First Course of Physical Laboratory Practice" which shall contain just that which the schoolmaster who is endeavouring to supplement mere lectures with the necessary practical work requires.

In the introduction the author explains the system of science teaching at Clifton. He insists on the importance of from the first making boys themselves measure and experimentally confirm geometrical, mechanical, and physical laws, not necessarily with expensive and elaborate apparatus, such as may be best suited for making determinations of the greatest accuracy, but by the most simple and obvious methods, which are likely to lead to results quite accurate enough to show the truth of the law being examined. The pupil is thus from the first taught to learn the value of simple and often extemporised apparatus, instead of acquiring the very general distrust in anything that has not been highly finished by the professional instrument maker.

Here much that is of great value to those intending to introduce practical science teaching into schools will be found, such as descriptions of fittings, original and working cost, and the time that the several courses of instruction should occupy.

The book is divided into nine parts as follows:—1, Mensuration, 23 experiments; 2, Hydrostatics, 15 experiments; 3, Barometer and Boyle's Law, 3 experiments; 4, Mechanics, 39 experiments; 5, Elasticity, 20 experiments; 6, Heat, 42 experiments; 7, Magnetism, 55 experiments; 8, Statical Electricity, 57 experiments; 9, Current Electricity, 16 experiments. The two branches of physics, light and sound, are not included.

The first part is especially valuable as an introduction to laboratory practice of any kind. It is full of examples in which a good way of observation is contrasted with one or more bad ways, so that the pupil soon learns, or ought to learn, method in observation, to choose that way in which error of observation shall least affect the result.

If it is possible to point out any parts as being more excellent than the rest, the chapters on mechanics and elasticity may be mentioned. It is shown how, by means of one or two boxwood scales, a few weights, some pieces of catapult india-rubber (but for sufficient reasons it is not called catapult india-rubber), and some other equally simple and easily obtained articles, a course of experiments of the utmost value can be performed. A pupil must, if he gives his mind to the subject, learn more of the principles of mechanics, of the reasons of things—not the mere "pulley, wedge, and lever" mechanics of the ordinary text-books—than as yet the majority of people have ever acquired.

There is only one sentence which might with advantage be modified as being not strictly correct, though any false impression which it would produce might be removed by the more exact statements five pages later. Having shown that the bending of a lath depends on its length, the author proceeds to show that thickness affects the bending. He says:—"Now take a lath of double the thickness, or, what is the same thing, lay on the first lath a second similar one, and put on the same weight, . . ." This would be a serious blunder to make if the effect of depth were not well shown later. As the fact that the stiffness of a beam is directly proportional to its width is explained by considering it as equivalent to beams side by side, the opportunity is lost, when the effect of depth is considered, of showing that a beam is *not* equivalent to beams lying above one another, and why.

As a text-book for school use, Worthington's "First Course of Physical Laboratory Practice" is highly to be recommended.

Lectures on Heat, Sound, and Light. By Richard Wormell, D.Sc., M.A., Head Master of the City of London Middle-Class Schools. (London: Thomas Murby.)

THE distinguishing feature of this book is its gradually progressive character. The subjects are supposed to be taken in the order in which they are given. "*Heat* being far simpler in itself, and so much easier to explain, is placed first, while *Light*, being essentially more intricate than either *Sound* or *Heat*, is placed last." The lectures on *Heat* are adapted to the minds of pupils when first receiving instruction in a scientific subject; as the mind develops the lectures advance in character, so as to make full use of the increased intelligence of the pupil, and ultimately, when light is reached, the perfection of the undulatory theory can be presented with some hope of its being appreciated.

After each of the three parts questions are given, and, what is far more valuable, a few pages of instruction in laboratory practice.

The book is illustrated by many figures, which are often explanatory diagrams rather than pictures. Such diagrams have far more educational value than cuts from photographs of apparatus, but the want of proportion may be carried so far as to give a misleading idea of what a thing is really like—thus, the gridiron pendulum is shown nearly as wide as it is long.

There is a curious slip in Fig. 30, which shows how waves travelling along paths differing by half a wave-length come together again in opposite phases, and so neutralise one another; while, if there is a difference of one or more complete wave-lengths, the phase is the same, and they reinforce one another. The slip—it can hardly be called more than a slip—consists in showing the *same* number of wave-fronts in the longer as in the shorter path.

That the book should contain much that is excellent is only to be expected of an author of such experience, while the necessity for turning to such trivial details for criticism is sufficient to show that fault of a serious kind cannot be found.

Une Expérience sur l'Ascension de la Sève chez les Plantes. Par Léo Errera, Professeur à l'Université de Bruxelles. *Comptes rendus* de la Société Royale de Botanique de Belgique, tom. xxv. 2ième partie, 1886.

THIS paper contains an interesting contribution to the question of the course taken by the sap of vascular plants on its way from the roots to the leaves. The view taken by Sachs, that the current passes through the substance of the lignified cell-walls, has, as is well known, been disputed by Böhm, Elfving, and many others, who maintain that it ascends through the cavities of the vessels and tracheides. Various observers have endeavoured to bring the question to an experimental decision by stopping up,

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