

It should be stated, however, that some attempt is made to introduce quantitative notions into the qualitative methods by using roughly weighed amounts of the substances; but the effect is somewhat discounted by the frequent omission of the quantity and strength of the reagents. I refer more particularly to the use of "drops," which may vary considerably in bulk, and to the omission of the strength of the acids.

Prof. Liversidge attaches great importance to the study of qualitative analysis as a means as well as an end of chemical education. It is an opinion very widely held, and is well worth discussing.

The fact is sometimes lost sight of that chemistry is a handicraft as well as a science, and that its science is as yet not exact.

Perhaps there is no branch of chemistry wherein the skill of the craftsman is in greater demand, or the inexactness of the science more clearly emphasised, than in chemical analysis.

A student may study intelligently the reactions for individual elements, and so learn their properties; but he finds that when they are mixed they behave differently, and the more observant and careful he is the more will these subtle influences, which conform to no equation, become apparent.

No substance is insoluble; mass action is a powerful factor; a precipitate will carry down a substance which should, for all he knows, remain in solution, and a substance will retain another in solution which, for equally occult reasons, should form a precipitate.

Tables for the analysis of mixtures, which are based on the behaviour of single substances by a process of simple logic, become artificial and illusory, and give a sense of false security which subsequent experience alone can dispel.

Is this a subject for extended study on the part of a beginner in chemistry? In the opinion of the writer the preparation of simple substances and a careful study of their properties, into which the general principles of qualitative and quantitative analysis are introduced, is his proper sphere of work. The host of reactions and elaborate tables of separations, and still more the countless precautions, *Kunstgriffe*, and manipulative details of practical analysis are a part of the handicraft of the specialist in chemistry. To thrust this work upon a beginner who is not to be a specialist is almost equivalent to expecting a student of mechanics, who is not to be an engineer, to work a lathe or use a planing machine.

The crux of the whole question lies in this, that qualitative analysis is a branch of practical work, calling itself chemistry, which can be easily adapted to the process of examination. Were the practical examination banished from the syllabus and replaced by notebooks supervised, signed and submitted by the responsible demonstrator or teacher of recognised standing, the mass of ill-digested analytical tests and tables would soon vanish from the curricula of schools and colleges, and its place supplied by a series of rational exercises.

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#### OUR BOOK SHELF.

*Les Lois naturelles.* By Félix Le Dantec. Pp. xvi+308. (Paris: Félix Alcan, 1904.) Price 6 francs.

Just as "anyone can play the piano" with a piano-player, so anyone can write a book on the philosophy of science. The result gives satisfaction and pleasure to the performer in one case and to the writer in the other, but whether his particular interpretation is equally satisfying to an outsider is another question. The effects are, however, more lasting in the case of the author, for we are getting such an enormous accumulation of books on space, matter, force, the ether, and laws of nature that it is becoming a wonder who finds time to read them or even to cut their pages, if the publisher has failed to attend to his proper duties in this respect.

Let us examine how M. Le Dantec deals with thermodynamical considerations. In commencing he supposes bodies to have definite thermic masses, and he defines quantities of heat by the products of these masses into the changes of temperature. He also enunciates the principle of conservation of heat according to which the heat gained by one body is equal to that lost by another. But in the first place the quantities which he calls thermic masses are not constant for the same body between the same limits of temperature, but they also depend on whether the changes take place at constant pressure or constant volume; and, in the second place, his equation of conservation of heat is contrary to common experience of what happens when two rough bodies rub against each other. In the next chapter the author goes on a different tack, and speaks of the equivalence of quantities of work and quantities of heat, quite regardless (to all outside appearances) of the fact that the term "quantity of heat" is meaningless except in the case of passage of heat from one body to another. In the next chapter the author condemns the use of the term "quantity of heat" altogether. What ideas can a reader form of the nature of physical laws after perusing such a series of chapters as this?

*Nature Teaching.* By F. Watts and W. G. Freeman. Pp. xi+193. (London: Murray, 1904.) Price 3s. 6d.

This little book forms a welcome change from the many appearing under similar titles in that it is avowedly based upon experiments, and treats of things about which the writers really know and have not merely read up. Dealing in the main with the life of the plant, it describes a simple series of experiments within the capacity of an elementary school or an evening continuation class, illustrating the function of seed, root, stem, leaf, &c., and amplifying the knowledge thus obtained with further examples drawn from the practice of the garden or the farm. A certain lack of definiteness in the description of experiments militates at times against the spirit in which the book has been conceived; in a subject where everything depends upon the cultivation of accurate observation and rigorous scientific method the authors should not allow themselves to fall into the slipshod generalised accounts of things which are the bane of so much of the current teaching of this nature. For instance, in their account of striking cuttings, the authors do not direct attention to the differences in the management of herbaceous and woody cuttings, the time of year at which they should be struck, and so forth, so that the teacher without experience would be apt to fumble over the matter at first, and would in real life be discouraged from trying any experiments in this particular direction unless