Die wissenschaftlichen Grundlagen der analytischen Chemie elementar dargestellt. Von W. Ostwald. Dritte Auflage. Pp. xi+221. (Leipzig: Engelmann, 1901.) Price M. 7.

THE services that Prof. Ostwald has rendered to physical science during the last quarter of a century are so numerous and so valuable that his writings cannot fail to exert considerable influence. In working out and extending the theories of van 't Hoff and Arrhenius he played a leading part in laying the foundations of physical chemistry; and in applying these principles to the consideration of the problems of analytical chemistry, he has effected a complete revolution in the methods of approaching that subject. In 1894 he published the first edition of the "Wissenschaftliche Grundlagen," and thus furnished us with scientific explanations of much that up till that time had been little more than mere empiricism; analytical processes were interpreted by him in the light of the theory of solutions and the ionic hypothesis, and thus new life was infused into a branch of science that had become almost moribund.

It is gratifying to think that Prof. Ostwald's efforts have been appreciated; and the fact that a third edition of this striking work has been called for is sufficient evidence of its success. The new ideas are beginning to take a firm root, and are already finding their way into the latest text-books on the subject.

It is to be hoped that teachers of practical chemistry will study the pages of this last edition of the "Grundlagen der analytischen Chemie," and arrange their methods of instruction on the new lines it suggests. With this end in view Prof. Ostwald has added a chapter containing descriptions of a number of experiments illustrating some of the more important principles on which analytical chemistry is based.

In conclusion, we would draw attention to the closing words in which the author advocates the use of as simple apparatus as possible, that the attention of the student may be concentrated on the chief features of the experiment. Coming from so brilliant an experimenter and so popular a teacher, the advice is worthy of special emphasis.

An Introduction to Modern Scientific Chemistry. By Dr. Lassar-Cohn. Translated by M. M. Pattison Muir, M.A. Pp. viii + 348. (London: H. Grevel and Co.)

THE German original of this book has already been noticed in these columns (vol. lxi. p. 51, 1899). It has been translated into smooth English by Mr. Pattison Muir, and it may be cordially recommended as a clear exposition of the leading facts and principles of chemistry, well adapted to the class of readers for whom it was written, namely, University extension students and general readers. It must be borne in mind that the book is not intended for those who are able to study chemistry with their own *hands*. The fifty-eight illustrations in the book are its worst feature, but they are by the author, and no doubt the translator had no choice but to reproduce them. A. S.

First Aid to the Injured. By H. Drinkwater. Pp. 104. (London: J. M. Dent and Co.; no date.) Price, 1s. net.

THE number and excellency of the illustrations are special features of this little book, and increase its interest and clearness, doing away also with the need of lengthy explanations. The proportion between the theoretical and practical parts is well maintained. The anatomical details are not by any means unduly prominent, but are only introduced in so far as they are necessary to enable the practical directions to be intelligently followed. The book can be strongly recommended as a clear and trustworthy instruction in "first aid."

LETTERS TO THE EDITOR.

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Solution of Cubic and Biquadratic Equations.

THE historical note in your last number by Sig. Vacca regarding the graphical solution of a cubic, given by Mr. T. Hayashi, reminds me that I had intended, when Mr. G. B. Matthews published his suggestion for the graphical solution of a biquadratic by means of two parabolas (NATURE, Nov. 16, 1899), to point out that he too had been anticipated, as will be seen by referring to a paper by Mr. R. E. Allardice in the *Proceedings* of the Edinburgh Mathematical Society (April 7, 1890), where it is shown that, with the exception of the case where the roots of the biquadratic are equal in pairs, the real roots of the general biquadratic can be found graphically by means of two equal parabolas having their axes at right angles, the one fixed and the other movable; and also that every cubic can be reduced to the form $y^3 \pm y + r = 0$; and then solved graphically by means of the fixed curve $y = x^3$ and the movable straight line $x \pm y = r$.

I may take this opportunity of calling the attention of elementary teachers to the fact, also dwelt upon in Mr. Allardice's paper, that the most convenient method of discussing the algebraic solution of the general biquadratic, and of testing whether any particular biquadratic is soluble by means of quadratics or not, depends on the familiar theorem that $ax^2 + 2hxy + by^2 + 2gx + 2fy + c$ is decomposable into linear factors if $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$, and not unless. Along with the biquadratic $x^4 + px^3 + qx^2 + rx + s = 0$ (1) consider the equation $x^2 - y = 0$ (2). By interequational transformation it is obvious that the system (1), (2) is equivalent to the system composed of (2) and $qx^2 + pxy + y^2 + rx + s = 0$ (3). Again, the system (2), (3) is equivalent to the system composed of (2) and $(q - \lambda)x^2 + pxy + y^2 + rx + \lambda y + s = 0$ (4), where λ is a constant at our disposal. If λ be so chosen that the left hand side of (4) breaks up into linear factors; that is, if λ be a root of the cubic

$$\lambda^3 - q\lambda^2 + (pr - 4s)\lambda + 4qs - r^2 - p^2 s = 0 \qquad (5),$$

then the system (2), (4) will be equivalent to two systems $y + \mu x + \nu = 0$, $y = x^2$, and $y + \rho x + \sigma = 0$, $y = x^2$. In other words, the four roots of (1) are the roots of the two quadratics $x^2 + \mu x + \nu = 0$, $x^2 + \rho x + \sigma = 0$.

The cubic (5) is not in general soluble by means of quadratics without the adjunction of a cube root: hence the solution of a biquadratic in general depends on the solution of a cubic and two quadratics.

The necessary and sufficient condition that the cubic be soluble by means of quadratics is that it have a commensurable root, which, if it exist, can be readily found by finding an integral root of another cubic of the form $x^3 + ax^2 + bx + c$, where a, b, c are all integral. The determination of μ, ν, ρ, σ then requires, in addition to rational operations with p, q, r, s, λ, merely the extraction of a square root.

To the tyro who is familiar with the elements of the coordinate geometry of the conic sections the rationale of the above process can be made evident by the consideration of the two line-pairs which contain the four points of intersection of two conics. It may be noted that, instead of the parabola $y = x^2$, we may use the rectangular hyperbola $xy = 1$, the only difference being that we are led to a different cubic resolvent.

Considering the space usually given in English text-books of algebra to the discussion of equations which are soluble by means of quadratics, it is strange that few, if any, of their authors emphasise the fundamental fact that the reduction of a biquadratic which is soluble by means of quadratics can be effected by finding the rational root of a cubic equation. I fear that I too must plead guilty to this omission, which among other things I propose to make good in the next edition of vol. i. of my "Algebra." G. CHRYSTAL.

Edinburgh, April 26.

Electro-Chemistry.

ALLOW me to point out an omission unnoticed by your reviewer of Mr. Bertram Blount's book on practical electrochemistry (p. 582). Mr. Blount refers to the electrolysis of gold ore as a failure (Haycraft's method).