The second half of this volume is given up to a discussion of equilibrium in systems containing one solution phase and at least one solid phase.

Volume IV. is devoted to what Duhem calls 'double mixtures' and to general equilibrium in heterogeneous systems. By 'double mixtures' Duhem means two component systems containing at least two phases of variable composition. Under this head come fractional distillation, critical states of mixtures, liquefaction of mixed gases and systems containing two liquid phases. A great deal of space is devoted to a consideration of the alleged law that the vapor-pressure of a dineric system is the same as that of the more volatile component. The volume closes with a general discussion of the phase rule, in the course of which it is pointed out that the classification followed throughout the four volumes has been based on the phase rule and that all good classifications must be so based. This is very satisfactory, but it would have been more satisfactory if we had been told this at the beginning of the first volume instead of at the end of the fourth. One great fault in all of Duhem's writings is his refusal to tell the reader what is to be proved. The result is that the reasons for the single steps do not become clear until the second reading. From the Baconian point of view it is very pretty to marshal the facts in a splendid array and then to point out the general law of which they are special illustrations, but Bacon is not famous as a successful writer of text-books. It would have been very much simpler to have deduced the phase rule and then to have pointed out the way in which it should be applied. As far as the qualitative equilibria are concerned, this is also the historical method. Gibbs deduced the phase rule as a general theorem, and Roozeboom has, since then, shown its value as a guide.

These four volumes of Duhem's constitute a monumental work and will be of immense service. On the other hand, it would easily be possible to overestimate their value. What we have is an exhaustive study of chemical equilibrium put into mathematical form and expressed in terms of the thermodynamic potential. This application of mathematics to chemistry is unfortunately more ornamental than useful. There are myriads of formulas, but very few can be applied to any concrete case. The book is really only a mathematical outline in which formulas are indicated. The equations contain unknown functions. To the experimental theorist the book is a joy and a sorrow, a joy because it points out so much and a sorrow because it always stops short of becoming practical. One of the most striking features about Helmholtz was the fact that he cast his theoretical speculations into such a form that they could be tested quantitatively. Duhem has never done this in physical chemistry. He has done brilliant work, but his theory has always been qualitative and not quantitative theory. If anyone doubts this he has only to read the four volumes of the *Mécanique chimique* and he will be convinced.

Wilder D. Bancroft.

Le céramique ancienne et moderne. Par E. Guignet et Edouard Garnier. Paris, Felix Alcan, 108 Boulevard Saint-Germain. 1899. 8vo. 69 figs. Pp. 311.

This volume is No. 90 of the series 'Bibliothéque Scientifique Internationale,' edited by M. Em. Alglave. Its authorship is in collaboration by MM. E. Guignet and Edouard Garnier. The work consists of two grand divisions, the first, by the Director of the Dyeing and Coloring Department of the Gobelin and Beauvais Tapestry Manufactories, relates to the fabrication of ceramics; the second, by the Conservateur of the Museum of the Pottery and Porcelain Manufactories at Sevres, is on the history of Ceramics.

The first part deals with the material of which pottery and porcelain is made, describes it at length, shows the differences between the different products, gives by analysis the component parts of the various materials required for these products, and describes their mode of treatment and preparation for use. It presents by elaborate definitions the different kinds of ceramics, and shows principally by chapters, the differences between pottery, faience and porcelain. It represents by description and diagram the machinery used in the treatment of the material, in the fabrication and forming of the objects, and the ovens in which they are baked.

This part of the work is interesting and valuable, showing, as it does in detail, the different kinds of ceramics and wherein that difference consists, a branch of the art which has been neglected by amateurs generally and for whose enlightenment this part of the work will be specially valuable.

The second part deals with the history of ceramics. Its primary divisions are by the different kinds of pottery: mat, varnished, enamelled, fine, and ends with porcelain. Within the purview of each of these chapters, geographic subdivisions are made and the ceramics of the respective countries described. The processes of manufacture are not touched upon in the second part.

THOMAS WILSON.

A Short History of Freethought, Ancient and Modern. By JOHN M. ROBERTSON. London, Swan Sonnenschein & Co., Ltd.; New York, The Macmillan Co. 1899. Pp. xv + 447.

Those who know Mr. Robertson mainly for that perfervid, not to say intemperate, though able book, 'Buckle and his Critics,' will likely enough be swift to shun this new work. Its title and Mr. Robertson's previous performance certainly give ground for summary suppositions as to to the contents of the 'Short History.' It ought, therefore, to be said at once that our author contrives to keep his balance here, for the most part, and has produced a book which is well worth reading and studying. Of course, like the majority of self styled 'freethinkers,' he is not nearly so fundamental as he supposes, and still occupies a standpoint which, though fashionable and influential more than a century ago, does little to further 'freethought' to-day, and much to discredit it. Nevertheless, he does attempt to maintain a scientific attitude, and, on the whole, he does not allow preconceptions to run away with him completely. This at least is somethiug to be thankful for. His careful citations, too, are much to be commended, even although he often contrives to cite as authorities some curiously lop-sided performances.

The book covers an enormous range. This is due to the definition of 'freethought' proposed in the introduction and faithfully upheld throughout. "For practical purpose, then, 'freethought' may be defined as a conscious reaction against some phase or phases of conventional or traditional doctrine in religion—on the one hand, a claim to think freely, in the sense not of disregard for logic, but of special loyalty to it, on problems to which the past course of things has given a great intellectual and practical importance; on the other hand, the actual practice of such thinking (5)."

Following out this definition, the work consists of sixteen chapters; these deal with primitive 'freethinking,' with 'freethought' in the ancient religions, in Israel, in Greece and Rome, in early Christianity, in Islam, in the Middle Ages, the Renaissance and the Reformation. Thence the author passes to modern 'freethought'; deals with the English deistic movement, Cartesianism, and the conditions preceding the French Revolution; takes a peep at the United States, and then, in a long chapter, the most interesting of all, discusses the 'culture forces' of the nineteenth century. The conclusion is a brief, and inadequate (in the sense of being sadly out of perspective), review of the present state of thought in the nations. Considering the range covered, and the extent to which secondary authorities are necessarily relied upon, the author's management of his material is deserving of the highest praise. It would be a good thing were the average 'orthodox' to peruse the book carefully—nay, to have it beside them. It might open their eyes to not a little which, as matters now stand, they seem never to fathom.

Naturally, in so extended a study Mr. Robertson has his lapses, and it is interesting to note that these accumulate precisely in the period which he knows best—the modern. Bias here plays its unavoidable part. Of Voltaire we are told that his 'sheer influence on the general intelligence of the world has never been equalled by any one man's writing' (338). On p. 344 we are informed that Rousseau, 'though not an anti-Christian propagandist, is distinctly on the side of Deism'; on p. 354, when another purpose is on hand, we are surprised to learn that he was 'devoutly theistic.' The 'Critique of Pure Reason' is said to be 'definitely antireligious' (388), a statement sufficiently extra-