of mercurous nitrate. The succeeding chapters describe the estimation in turn of the elements which usually occur. The methods for the direct combustion of carbon are comparatively slow, and it would have been advantageous to add a description of the rapid methods, using small electrically heated tubes, which were devised during the war for the enormous number of shell steel samples which had to be analysed in the Admiralty and other laboratories. In such rapid methods soda lime is used with advantage in place of the more cumbrous potash bulbs. In the Volhard estimation of manganese the simple method of precipitation with zinc oxide and titration without removal of the iron, which is very convenient in the analysis of ferro-manganese, is not mentioned. The estimation of sulphur and phosphorus in steels, about which disputes are most frequent, is treated very thoroughly.

The analysis of ores, refractories, slags, fuels, and boiler waters is dealt with in later chapters. The section on slags suffers somewhat from its brevity, and many chemists would welcome a fuller account of this important subject. Thus in the analysis of basic slags no mention is made of the distinction between total and available phosphoric acid, on which the value of the slag so largely depends, and it would also have been well to include some account of the estimation of fluorine in such slags; the addition of fluorspar in the basic open-hearth process is frequently practised, and its effect is to convert a part of the phosphoric acid into an inert form.

Mr. Ibbotson's work may be confidently recommended to the analyst and student as a trustworthy guide to the subject by an author of ripe experience in the field in which he has worked so long.

Relativity and Gravitation.

Relativity: The Electron Theory and Gravitation. By E. Cunningham. Second edition. (Monographs on Physics.) Pp. vii+148. (London: Longmans, Green, and Co., 1921.) 10*s.* 6*d.* net.

THE second edition of Mr. Cunningham's book, like the first, aims at presenting the problems of relativity in a form suitable for the general physicist. More than half the book deals with the special theory, giving the fullest account of the experimental side in any English book. This part is practically unchanged from the first edition—too little changed, for one would have liked to see the author's views on Majorana's experiments, which are not mentioned.

In discussing the general theory, he follows the historical order of development, commencing with Eötvös's experiment, which showed that the weights of two bodies of different constitution in the same gravitational field are proportional to their inertias within 5 parts in 10^8. From this he advances by a series of generalisations. First, light has inertia; if Eötvös's result is true for it, it must also have weight. Therefore it cannot travel in straight lines in a gravitational field. Therefore the differential ds, which is intimately related to the behaviour of light in the special theory, must, if it is still to maintain this relation to light, have a form in a gravitational field that takes the field into account. It has also a relation to the motion of a particle in the special theory; we knew already that it would have to be modified in form to maintain this in a gravitational field.

It is therefore assumed that the same form will still answer both purposes. Previously, again, the law of gravitation satisfied a condition that was unaltered by any displacement of the origin or rotation of the axes. Suppose, then, that the coefficients in the new ds satisfy a condition that is unaltered by any change in the co-ordinates used; the class of changes admitted is to be as wide as will permit some such condition to be satisfied. This leads at once to the irrelevance of the mesh system, and appears to the reviewer to be the best reason yet advanced for attributing to this principle any appreciable prior probability.

The crucial tests of the theory are described, and a chapter is devoted to Weyl's theory of electric and magnetic forces. The book is well arranged and written. Enough does not seem to be made, however, of the crucial tests. For anything that any professed exponent of the theory has said, there might be a million other theories, all as probable as Einstein's, which would give the same predictions. It may be pointed out that on p. 114 the assumptions given are not enough to ensure that the coefficient of $drdt$ shall be zero, which is assumed a few lines later; that in the footnote on p. 107 it is implied that a purely imaginary quantity can have a true minimum; and on p. 120 that the mere fact that the resultant velocity of an object is known is not enough to determine its path. But in the main the book is a careful and sound analysis, and can be recommended to all students of the theory.

H. J.