misslewsky read Ostromisslensky. "Roberite" (p. 108) is usually written "roburite"—at least on this side of the Atlantic; and "Anallen" in the list of references should be "Annalen." These are blemishes which should not occur in a book written by an instructor in general chemistry in so important a school as the Carnegie Institute of Technology.

THE PRINCIPLES OF RADIO-COMMUNICATION.

The Principles of Electric-wave Telegraphy and Telephony. By Prof. J. A. Fleming. Fourth edition, revised. Pp. xvi+707. (London: Longmans, Green, and Co., 1919.) Price 42s. net.

IT is no easy task to keep a large treatise on electric wave telegraphy and telephony abreast of the advances that have been made during the last few years. In this fourth edition the author has been very successful. He does not load up the book with descriptions of all kinds of technical apparatus, or attempt to describe all the methods used in practice. There is now quite a small library of highly technical works which give the required detailed information to the engineer, and to these Prof. Fleming refers the reader. What he does give is a comprehensive view of the subject, particularly on its scientific side. He also dwells fully on quantitative measurements and their theory, which he himself has done so much to develop.

In part i. a discussion is given of electrical oscillations. The mathematical proofs given are rigorous and straightforward, and will be appreciated even by those who are beginning to forget their knowledge of the calculus. The mathematical formulæ for the high-frequency resistance and inductance of circuits are given, and the author's successful experimental methods of testing these formulæ described. When the wires are curved, the mathematical difficulties in the way of computation are so great that engineers will welcome the experimental verification of the formulæ.

The tables given of spark-voltages between spherical electrodes are somewhat antiquated. The reviewer had occasion recently to analyse the experimental results on spark voltages published in the standardisation rules of the American Institute of Electrical Engineers (1918). The Institute used spheres varying in diameter from 3.125 cm. up to 50 cm., and the spark voltages go up as high as 400 kv. The results plainly show that when the voltages of the electrodes are equal and opposite at the instant of discharge, the maximum electric stress, R , at this instant, the temperature being 25°C . and the pressure 76 cm., is given by

$$R = 27.4 + 14.1/\sqrt{a}$$

kilovolts per centimetre, where a is the radius of either spherical electrode in centimetres. It was of interest, therefore, to see whether the

results (p. 188) obtained by Heydweiller in 1893 on spheres of 0.5, 1, 2, and 5 cm. were in agreement with this formula. We find that when we correct for temperature and pressure they are in most excellent agreement. It follows, therefore, that if V be the spark voltage when the distance between the electrodes is x , we have

$$V = (R/f)x,$$

where f is a mathematical factor depending on x and a , a table of the values of which is given on p. 145 of this book. This is at least true for spheres varying in diameter from 0.5 up to 50 cm., values of x less than about a millimetre being excluded. Various theories have been given to explain why R should be the sum of two terms as shown above, but in the reviewer's opinion those theories which neglect the effects of the convection currents of air flowing round the electrode prior to the discharge are wrong.

In part ii. electric waves are discussed, and a very complete account is given of methods of measuring and detecting them. The remainder of the book is devoted to radio-communication. It begins with a short history of the subject. Then various long-distance telegraphic stations are described, the salient points of the systems of working being pointed out. The theory of transmission is given. Full descriptions are given of several of the latest developments of the art, such, for instance, as the Marconi military set for wireless apparatus, and the Marconi sets used in aircraft.

The final chapter treats of radio-telephony, and is perhaps the most interesting in the book. It is extraordinary what rapid progress is being made in this branch of the subject, and how different are the methods employed by the various experimenters. Marvellous results have been obtained by the Fleming oscillation valve. The almost incredible sensitivity attained in receiving apparatus by the use of thermionic amplifiers warrants the most sanguine hopes for the future of radio-telephony.

We ought to mention that, although additions have been made to the book to bring it up to date, yet by the deletion of antiquated matter and the use of smaller type the total bulk of the volume has been reduced. This is an advantage, as the earlier editions were beginning to get unwieldy. We can recommend this book to everyone interested in radio-telegraphy. To the scientific radio-telegraphist it is a necessity.

A. RUSSELL.

GEOGRAPHICAL ASPECTS OF WORLD POLITICS.

Democratic Ideals and Reality. A Study in the Politics of Reconstruction. By H. J. MacKinder. Pp. 272. (London: Constable and Co., Ltd., 1919.) Price 7s. 6d. net.

THERE is no lack of ideas in this book. From beginning to end it is full of striking conceptions which arrest attention even if some of