

obvious what these constructions should be. On the other hand, we can easily get covariant sets of points by construction, but it is then troublesome to find their analytical equivalents. The results for the cubic and quartic are so simple and elegant that one would like to have some development, if possible.

It should be noted that Prof. Glenn has given, as an appendix, forty-eight very good and instructive exercises; and we may add that, in spite of its conciseness, the book seems as easy to read as the subject will permit.

G. B. M.

THE GROWTH OF TELEPHONY.

The Telephone and Telephone Exchanges: their Invention and Development. By J. E. Kingsbury. Pp. x+558. (London: Longmans, Green and Co., 1915.) Price 12s. 6d. net.

THIS book covers most of the ground relating to telephony from its earliest stages to the present time. It may, indeed, be regarded as a "Short History" of telephony, and, as a matter of fact, the author's original intention was to write a history, but circumstances were not favourable to the project. However, the future historian will find in Mr. Kingsbury's volume much useful historical matter and many finger-posts indicating different avenues of development which merit much fuller treatment than has been possible in this work.

A marked and valuable feature of the book is the numerous extracts from circulars of early telephone companies and from unpublished reports of experts and of telephone conferences, held principally in the United States. Only a person very intimately connected with the industry from its infancy could have obtained this exclusive information and made such judicious selection of material. Telephone engineers interested in the growth and development of their instruments and systems will feel indebted to Mr. Kingsbury for the masterly way in which the subject is dealt with in the work under review. If ever "scissors and paste" can be justified, this is a case in point; for here one gets the views of inventors and pioneers in their own words, "hot from the anvil" as it were, and free from any form of distortion due to narration by a second party. The work is not of the text-book order; persons desiring technical details of the latest instruments and appliances should consult other treatises, but those who wish to study early telephonic devices and the way they developed into present-day models will find in the volume much that they require presented in a very readable form.

The book is conveniently divided into thirty-three chapters and two appendices, one of the latter giving telephone statistics of the world, and the other relating to the increased telephone rates in Great Britain. In the first six chapters—headed, respectively, i., Introductory; ii., The Spoken Word; iii., The Growth of an Idea; iv., The Undulating Current; v., The Solution of the

Problem; and vi., Development and Demonstration—the author traces the early uses of the word "telephone" for speaking-trumpets and speaking-tubes, for instruments depending on the transmission of sound through rods of glass, wood, etc., as in the "enchanted lyre," to the electrical transmission and reproduction of musical sounds, and eventually of human speech, by currents of varying strengths.

Subsequent chapters relate how the beautiful scientific instrument patented by Alexander Graham Bell in 1876 was, by the prevision and business acuity of the inventor and his American associates, made the basis of a new branch of electrical industry of enormous benefit to the public, and in a few decades permeated all parts of the civilised world and utilised capital amounting to some 400 millions sterling. The headings of these chapters are as follows:—vii., The Production of a Commercial Instrument; viii., The Application to Commercial Uses; ix., The Telephone Exchange; x., The Battery or Variable Resistance Transmitter; xi., The Microphone; xii., Philipp Reis and his Work; xiii., Call Bells; xiv., The Telephone Switchboard; xv., The Organisation of the Industry in the United States; xvi., Competition, Consolidation, and Development; xvii., Introduction of the Telephone in Europe and Abroad; xviii., Public Apathy and Appreciation; xix., The Multiple Switchboard; xx., Outside or Line Construction; xxi., Ten Years' Progress; xxii., The Development of Dry-core Cable; xxiii., Early Exchange "Systems"; xxiv., Telephone Engineering on a Scientific Basis; xxv., The "Branching" System; xxvi., The Common Battery System; xxvii., Automatic and Semi-Automatic Switchboards; xxviii., Long-Distance Service; xxix., Instruments; xxx., Rates; xxxi., The Economics of the Telephone; xxxii., The Telephone and Governments; xxxiii., Conclusion.

Chap. xii., on Reis's work, should, chronologically, be near the beginning of the book, but it is put later because "its consideration is facilitated by the preceding chapters." On the question of priority the author maintains that Reis invented a musical telephone and not a talking telephone, and that "his work had no direct effect on the invention of the speaking telephone, for Bell fortunately went on entirely independent lines and without any reference to the prior work of Reis." Throughout the book the work of Bell and his colleagues is given especial prominence, sometimes to the detriment of others, such as Reis, Hughes, Gray, and Edison. In fact, the "pro-Bellism" of the author is a feature to which some exception might be taken. In a similar way, when dealing with long-distance service, Pupin's work is highly and deservedly appreciated, whilst that of O. Heaviside (who made the discovery that by increasing the inductance of lines their speaking qualities could be improved) is insufficiently recognised. These, however, are minor blemishes in an exceptionally valuable book.

T. MATHER.