

connection with the strict minimum, and various other topics. Finally, there is a note on implicit functions.

Various interesting special theorems occur, by the way; as an instance, we have the theorem that if  $y$  vanishes for  $x=a$  and  $x=b$ , the integral

$$\int_a^b \left\{ (a-b)^2 \left( \frac{dy}{dx} \right)^2 - \pi^2 y^2 \right\} dx$$

is never negative.

It will be seen that this treatise is more for the advanced student than for the beginner; in fact, as the author expressly takes the theory of the differential and integral calculus for granted, the reader should be prepared with a good knowledge of analysis, including function-theory. In any case, the subject is intrinsically difficult, owing to the vagueness of the data when the problem is put in its general form; it is rather a matter of surprise that so much has been done, without unduly restricting the nature of the functions involved.

In conclusion, it should be stated that the treatise is based upon a course of lectures at the Collège de France, and that the *redaction* has been carried out by M. Fréchet, to whom M. Hadamard makes his acknowledgments  
G. B. M.

#### HYDROELECTRIC ENGINEERING.

*Hydroelectric Developments and Engineering. A Practical and Theoretical Treatise on the Development, Design, Construction, Equipment, and Operation of Hydroelectric Transmission Plants.* By F. Koester. Pp. xxv + 454. (New York: D. van Nostrand Company; London: A. Constable and Co., Ltd., 1909.) Price 21s. net.

**H**YDROELECTRIC power plants do not call for the same attention in this country as in America and on the European continent. Yet what English engineer who has visited such installations has not a store of vivid recollections and happy experiences? The mountains and the forests, the streams and the waterfalls—for the generating stations of hydroelectric plants are usually away out among the beauties of nature—all bring back memories of pleasant tours and the like, whilst so far from destroying the attractiveness of their surroundings by harnessing nature's forces in this way, the author of the present work maintains that the scenery has at times been made more interesting, when proper attention has been paid to the architecture and situation of the buildings. This opinion is well upheld by many of the splendid photographs reproduced so well in this large volume.

The title of the book, however, is certainly ambitious, and, criticised from this point of view, we fear that the treatment on the whole is too general and descriptive, even to the point at times of being meagre, to be of great service to those directly connected with hydro-power plant installations. This will be further understood from the table of contents, which comprises chapters on dams, headrace, penstocks, power plant, mechanical equipment, electrical equipment, electrical transmission, substations, line protection, and a long list of developments, any one

of which could occupy such a volume by itself. Hence it is almost inevitable that only a bird's-eye view could be given when all these subjects were brought within the compass of one book. It may be recalled that this popular mode of treatment appears to meet with more favour in America than in countries this side of the Atlantic. With this one reservation, however, we have nothing but praise for the general excellence of the book, the care devoted to its arrangement, and the high quality of its illustrations.

To show that the writer is well up-to-date, it is only necessary to refer to a few of the new features in hydroelectric developments which are dealt with in their respective chapters:—Airshafts and equalising chambers in connection with pressure tunnels; seamless welded, flangeless, telescoping penstocks to facilitate shipment and to eliminate expansion joints; siphon system, in contradistinction to the inverted siphon; impulse wheels with draft tubes and multiple, non-water-wasting nozzles; compound turbine on a single shaft, the discharge of one being the supply of the other; rapid and complete turbine tests by certain methods and autographic recording device; 30,000-volt generators and their efficient protective devices against lightning. Unique combination of single and three-phase high-tension transmission systems from three-phase generators; wagon-panel switchboard systems; segregation and decentralisation of switchboards; continuous water-flow grounders and horn gaps with micrometric setting. Two-legged transmission towers and line-crossing protection.

At the end of each chapter is appended a bibliography of works and papers to which the student may turn for further information; this compilation is by no means the least valuable feature of the book.

Occasionally the author's treatment includes matter where his judgment seems to have been less sound. Thus in discussing electric generators, he states there are three types—the inductor, the revolving armature, and the revolving field. But surely there is no reason for treating all these at equal length?—indeed, little harm would have been done if the discussion of the first two types had been omitted completely in describing modern high-tension machines, unless, of course, the author intended to enter into the province of the designer in order to bring out certain advantages in the older types which have recently become prominent. Nor is sufficient attention paid to the development of high-speed water-turbine sets of large output. It would have been well to have supplied a table giving outputs and speeds of modern turbine sets for the various classes of turbines.

Here and there an error has been allowed to remain in the text, whilst at times important questions, such as the effect of capacity in transmission lines, have been omitted.

Following a very useful and well-written chapter on line protection (lightning arresters), the last section of the book is devoted to a detailed description of eight modern American and European hydroelectric developments, which serve well to show the immense advance made in water-power installations during recent years.

STANLEY P. SMITH.