and reaction, the laws of polarization, the effect of heat, current density, the state of the surface, etc., upon *storage power*.

The Planté, Kabath, Houston and Thomson, and Sutton batteries are briefly sketched, and the salient points of many others are also touched upon, but the chief attention is directed to the Brush storage system, the advantages of which are set forth in such a manner as to impress the reader with the opinion that this system is the best.

The descriptions are popular and readable, and much information is given in a compact form.

Winds and Ocean Currents. By C. A. M. Taber. (Boston: A. Williams & Co.)

In this work, Mr. Taber propounds a theory explaining the principal causes which produce the great prevailing winds and ocean currents.

N. B.—It should have been stated in the last number that the illustration on page 113, viz., "Mountain Homes," was taken from "Building," edited by W. T. Comstock, New York.—*Ed.*

Engineering, Metallurgy, &c.

ENGINEERING EDUCATION.

BY PROF. C. H. McLEOD, M.A.E.

(*An address to the Graduating Class of 1883, Faculty of Applied Science, McGill University*).

Gentlemen, Bachelors of Applied Science :

It is my pleasing duty to address you this day on behalf of the Faculty of Applied Science as Graduates of the University.

It is unnecessary for me to state to you that you have the best wishes of your Professors for your future welfare, and I do not propose to offer you any of the stereotyped advice so common on occasions like this. The best of advice or assistance that we can give is always at your command. Your progress and advancement in life is one with the progress and advance of our practical science school. You have, with us, deeply at heart, I feel assured, the development and perfection of engineering education in Canada. It is to this I would refer, and I trust that the friends of the University assembled here to-day to honor you and your fellow-graduates in Arts will pardon me if I depart somewhat from the usual practice and address you as gentlemen who, in graduating from the University, have taken upon yourselves responsibilities which involve not only the honor and fame of the profession to which you are about to unite yourselves, but also the adequate provision for the education of those who are to come after you in the study of engineering. We, of McGill, are of course chiefly interested in the perfection of our own methods and appliances of education. In order that we may more clearly understand our present position, let us briefly trace the development of modern engineering education.

Our early Engineers, both in America and the mother country, were largely self-taught men ; men who rose from the ranks—carpenters, masons, bricklayers, blacksmiths—men having little of what is now called education, but men of courage and patience ; men possessing judgments well trained in the observation of nature's laws ; these were the men who, by years of persistent toil, founded the profession of engineering. We must always bear in mind that they were men who had to feel their way cautiously through unknown paths, and who only mastered some of the facts and principles which are now familiar to every student of engineering, after much labor and loss of time. There was no such thing as a school of engineering in those days ; it was the dawn time of the science of engineering. As public works became more numerous and the demand for Engineers became greater, young men of a practical turn of mind were drawn to the craft—it had not then the rank of a profession—and found occupation as assistants to the older Engineers. In this way the system of apprenticeship arose, under which a young man upon payment of a premium or otherwise entered an Engineer's office to learn what he could. No attempt was made to teach him. He—the engineer of the future—had even yet to rise by self-teaching, but he was given an opportunity to see work being done ; to acquire knowledge by observation.

Engineering literature presently began to appear and the apprentice had access to such works as, Pambour on Locomotives, Vicat on Cements, Wood on Railroads ; books which were valuable because they had chiefly reference to actual works, being mainly descriptive. This was a time of fact, not of theory, a time when it had not yet begun to be fully understood that theory and practice are one.

While in England the system of apprenticeship continued to be the national school of engineering, the French people set about the education of their engineers in a different way. They established a polytechnic school. In this school, says Professor Vose, "it was recognized that civil engineering was largely a mathematical business, and it seemed to be assumed at the start, that if a little mathematics was good, more mathematics was better, and the most mathematics was the best ; many leading minds in that eminently mathematical nation, set to work to reduce engineering to a mathematical science, and volume after volume, upon the location of roads, the stability of retaining walls, the transportation of earth, the application of descriptive geometry to the construction of masonry, and other like matters appeared, in which all the resources of the higher mathematics were exhausted, and which showed the authors to possess every accomplishment except, perhaps, a little common sense." But this statement, though no doubt true, is not the whole truth ; the discussion of applied mechanics soon fell into the hands of men having practical as well as scientific skill, and finally the harmony of theory and practice in mechanics was reached and the science of engineering established by such men as Rankine, Weisbach, Willis, Reuleaux.

Professor Vose also informs us that the early American engineering schools were based on the model of the French school which he describes, and intimates that the ideal school was the one which could stuff into its students a maximum of mechanics, practical or unpractical. Here we find the other extreme in engineering education. Too much theory, too little observation and practice.

It is to-day recognized on all hands that mathematical skill must be tempered with a good deal of judgment and practical knowledge before it can be of any great use. But it is equally true that ever so sound a judgment, ever so much common sense, is quite at sea in an attempt to overcome even the simplest