History with your knowledge and consent," they state: "We answer No! These electrotypes had *not* been sold by us to Messrs. S. E. Cassino & Co., and were used without our permission in the said works. Besides, we are still at issue with Messrs. Estes & Lauriat, Boston, on account of this affair."

C. Hart Merriam.]

SCIENTIFIC LITERATURE.

Report on Water Supply; Geological Survey of New Jersey. By Cornelius Clarkson Vermeule, Consulting Engineer. Vol. III. of the Final Report of the State Geologist. 1894.

The Geological Survey of New Jersey has just issued a report bearing the above title, the interest and value of which are not limited by State lines. Its author, under whose direction the topographic map of the State was made, has had the best of opportunities for studying the questions involved, and has not failed to avail himself of them. The results of his study have been put in as simple and available form as possible, considering the complex nature of the problems.

The range of interests touched by the report is great. It will be of inestimable value to cities and communities which draw or may draw their supply of water from the streams of the State, and to manufacturers who use or may use the power afforded by them. Less directly, but not less certainly, the report will be of great value in the same lines outside the State, since many of the principles developed are of general and some of them of universal application. The report also contains discussions and suggestions which have a bearing on agriculture and forestry, the latter of which is just now attracting wide attention in this and other States. The educational value of the report is great, not only to those whose financial and sanitary interest are touched by it, but also to students of hydrography and geology, and to intelligent citizens in general. From this standpoint, its value lies not only in what it proves and affirms, but also in what it disproves and denies. It is scarcely too much to say that there is not a community or a class in the State which may not be benefited by the intelligent study of the volume before us.

The study of the water resources of the State was begun by Professor Cook long ago. As early as 1868 the subject was discussed by him, and the annual reports of the State Geologist have since made frequent reference to the subject, and have reported the progress of the work, the results of which are now embodied in this volume. Interest in the questions of which it treats has been stimulated by the rapid growth in population, especially in the vicinity of New York and Philadelphia. In 1882, 587,760 people in New Jersey were dependent for water upon systems of public supply. In 1894 this number had nearly doubled, while the amount of daily consumption had increased from about 49,000,000 gallons to about 108,000,000. Of this amount, 100,000,000 gallons were drawn from streams. If the population of the State continues to increase at the present rate for another half century, and if the demand for water keeps pace with the increase in population, as is sure to be the case, it is evident that another half century will make heavy demands upon the available supply of water which the State affords. On the basis of the recent rate of increase in population, it is estimated that by 1950 that part of New Jersey adjacent to New York City will need 547,000,000 gallons of water daily; and the author remarks that "since fifty years cannot be considered a long time in the future for which to make provision, it is evident that the time has come for us to know what our resources are and to provide for their preservation and wise development" (p. 6).

The investigation of the water resources

of the State has involved a careful study of the relation between precipitation and stream flow. This study has led to some very important conclusions, the data for which are drawn not merely from within the State of New Jersey, but from all available sources. The analysis of the facts has led Mr. Vermeule to the conclusion that a formula may be adopted which shall express with approximate accuracy the relation between rainfall and evaporation, within the basins of the streams studied. This formula is E=15.50+.16 R, in which E= total annual evaporation, R= annual precipitation, and 15.50 stand for inches of water. R minus E will equal the annual flow of the river in question. A modification of the formula for mean annual temperature is suggested, and in this modified form it becomes universal. In this connection it is stated that a careful study of the annual precipitation and flow of variously widely separated streams "has practically demonstrated that the difference in amount discharged (by streams) for given rainfalls is due almost entirely to increase or decrease of evaporation owing to increased or decreased annual temperature" (p. 75); and that temperature is 'a much more potent factor than forests, topography, or the other causes usually assigned' (p. 77) to account for the variations in the discharges of streams. So thoroughly is evaporation believed to be dependent on temperature that "the (river) gaugings (representing the rainfall which does not evaporate) actually indicate the mean temperature of the water sheds more closely than we can obtain it from available temperature observations" (p. 334). It will be readily seen that the formulæ noted above, and the principles which go along with them, greatly simplify the whole question of the relation of rainfall and stream flow, and are of the greatest importance to all interests dependent on streams, or effected by them. Formulæ are deduced for calculating the proportion of rainfall which disappears by evaporation for each month, and for determining the flow of a stream for any given month, the rainfall and temperature of its basin being known.

Of immediate practical value to the citizens of the State are the detailed data concerning the streams of New Jersey. These data include the total, the average and the minimum flow of each stream of the state, the available and the utilized power, etc., etc. The data are combined in various ways with a view to making them useful in various directions.

Popular ideas to the contrary notwithstanding, statistics show that there has been a slow but steady increase in the use of water power within the State. While many small powers have been abandoned, this loss has been made more than good by the establishment of larger ones. The total amount now in use is about 31,000 horse power. Pertinent suggestions are offered as to the further utilization of the power afforded by the streams.

Forests are thought not to influence the annual evaporation or stream flow to any marked extent, nor to influence particularly extreme floods. With deforesting, however, comes increased irregularity of stream flow, including more frequent moderate floods, lower flow of streams during periods of drought, and more protracted periods of low flow (page 344). Care is taken to emphasize the beneficial effects of forests in preserving soil on slopes, in creating absorbent matter (humus, etc.), which holds the water and helps to equalize its flow.

Cultivation is thought not to greatly affect the total stream flow, though it affects its regularity. It increases the absorbent capacity of the soil, and so the total flow from underground water, while under drainage tends to produce irregularity of flow. "As between cultivated and barren water-

sheds, * * the cultivated will show the steadiest conditions and the best-sustained dry-season flows, but as between cultivated and forested water sheds the forested will produce the best results. * * It follows also that floods will be most severe upon barren areas." Hence there exists * * 'the urgent necessity of preserving forests upon slopes, and all areas which are not adapted to agriculture' (p. 348).

Enough has been said to indicate the scope of the volume; which can hardly fail to become a hand-book on the question of water supply. It is probably not too much to say that this report alone is worth more to the State of New Jersey than its geological survey has ever cost. Other States of dense population would do well to follow the example of New Jersey, not only in studying their water resources, but in putting the work under the direction of their geological surveys; for the relation between the geology of a region and the availability of its water supply is so intimate that no other organization is better qualified to direct the work. The U. S. Geological Survey has work of this sort in progress in some parts of the semi-arid regions of the West, from which good results are sure to come.

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John Dalton and the Rise of Modern Chemistry. By Sir Henry E. Roscoe. New York and London, Macmillan & Co. 8vo. Pp. 216. Price, $1.25.

It is one of the greatest achievements of modern chemistry to have shown that for each chemical element there is a measurable quantity which, throughout all the transformations that the element undergoes, remains unchanged, and is, therefore, to be regarded as a constant. The laws of definite, multiple and reciprocal proportions of gas volumes and of specific heats, of mass action and of the periodicity of properties, all give converging evidence that for each element there is a definite constant quantity which, in all the changes that the element undergoes, acts like a unit. This constant is the one unchanging, and, therefore, the most characteristic property of the element. The chemical and physical properties of an element, its behavior under different conditions, its possibility of undergoing change under given circumstances, in short its whole character, is dependent upon the magnitude of this constant. A large part of theoretical chemistry is taken up with a consideration of the general methods that are available for the determination of this important quantity, and it is customary to express it by means of a number which indicates its magnitude in terms of the characteristic quantity of some one element, usually hydrogen, taken as a unit. To this number the name Atomic Weight has been given, and to John Dalton, indisputably, belongs the great credit of having first introduced into chemistry the idea of atomic weights. He transformed the Newtonian corpuscular theory of the constitution of bodies into a workable chemical hypothesis, and the subsequent development of his idea, that the atoms of different elements have different constant masses, has given us our present system of atomic weights. But, whether we associate with this term the conception of an atomic constitution of matter or not, the fact remains that these constants stand to-day independent of any hypothesis, and are to be regarded as mathematical quantities that can be deduced from the general laws and principles of the science.

In this book Sir Henry Roscoe has given us a most interesting account of the life and work of the great Manchester chemist. Dalton's life, like that of many scientific workers, was not an eventful one, but he was a man of marked personality, of positive traits of character, and our author has