although it is unattainable, for the same reason we ought to accept the reality of the absolute zero. We know now that Gay-Lussac was wrong in supposing the increment of temperature arising from a given gaseous compression would produce a corresponding decrement from an identical expansion. After this time the zero of temperature was generally recognized as a fixed ideal point, but in order to show that it was hypothetical a distinction was drawn between the use of the expressions, zero of absolute temperature and the absolute zero.

The whole question took an entirely new form when Lord Kelvin, in 1848, after the mechanical equivalent of heat had been determined by Joule, drew attention to the great principles underlying Carnot's work on the 'Motive Power of Heat,' and applied them to an absolute method of temperature measurement, which is completely independent of the properties of any particular substance. The principle was that for a difference of one degree on this scale, between the temperatures of the source and refrigerator, perfect engine should give the same amount of work in every part of the scale. Taking the same fixed points as for the Centigrade scale, and making 100 of the new degrees cover that range, it was found that the degrees not only within that range, but as far beyond as experimental data supplied the means of comparison, differed by only minute quantities from those of Regnault's air thermometer. The zero of the new scale had to be determined by the consideration that when the refrigerator was at the zero of temperature the perfect engine should give an amount of work equal to the full mechanical equivalent of the heat taken up. This led to a zero of 273 degrees below the temperature of freezing water, substantially the same as that deduced from a study of the gaseous state. It was a great advance to demonstrate by the application of the laws of thermodynamics not only that the zero of temperature is a reality, but that it must be located at 273 degrees below the freezing-point of water. As no one has attempted to impugn the solid foundation of theory and experiment on which Lork Kelvin based his thermodynamic scale, the existence of a definite zero of temperature must be acknowledged as a fundamental scientific fact.

JAMES DEWAR.

(To be concluded.)

SCIENTIFIC BOOKS.

Essays in Historical Chemistry. By T. E. THORPE, LL.D., F.R.S., Principal of the Government Laboratory, London. London and New York, Macmillan Co. 1902. 8vo. Pp. 582.

This book, as explained in the preface, consists mainly of lectures and addresses given at various times to audiences of very different type during the last twenty-five years. Although the author says his book has no pretensions to be considered a history of chemistry, even of the time to which the narratives relate, it is in reality a most interesting and charmingly written account of chemical discovery and of the development of chemical theory of the past century as connected with the lives of the great men who have made the science of chemistry what it is to-day.

It is true that none of these essays deals directly with Black, Dalton, Berzelius or Liebig, yet there is so much incidental mention of the work of these investigators that their places in the growing science are amply indicated.

Boyle, Priestley, Cavendish, Watt, Faraday and Graham are the English subjects of these addresses, and from the Continent we have Scheele, Lavoisier, Wöhler, Dumas, Kopp, Victor Meyer, Mendeleeff and Cannizzaro, and the latter group are as sympathetically treated as the former.

The author has the happy gift of making the subjects of his study stand out vividly as individuals, and we follow their careers,

from their student days to the high positions which they all attained, with an interest which never flags. The personal relations of those who were contemporaries are also happily stated, and the book, as a whole, gives us a living picture of the growth of chemical science which differs, most fortunately, from most of the systematic treatises on the history of chemistry.

In the controversial address, inspired by Berthelot's 'La Révolution Chimique,' in which he claimed for Lavoisier the right to the discovery and coordination of those general ideas relating to the composition of air and water, Dr. Thorpe is a sturdy and convincing defender of the claims of Priestley and Cavendish. And yet we cannot help feeling that his task would have been an easier one if the English chemists had not held on so tenaciously to the fantastical idea of phlogiston, which prevented them from grasping the true and simple relation of oxygen and nitrogen in air and oxygen and hydrogen in water. That this controversy does not blind the author to seeing Lavoisier in his true position as the founder of modern chemistry is shown in his article on Lavoisier in the *Contemporary Review* of December, 1900, in which he speaks of him as 'the dominant figure in the chemical world of the last century.'

The addresses are all of such great interest and value that it is not easy to select one or more of especial merit. And yet it is perhaps noticeable that the author is most attracted by the personality of Graham among the English chemists and of Wöhler, Kopp and Victor Meyer among the German. Admirable they all are, and well worthy of collection in the permanent form now before us.

The concluding addresses on 'The Rise and Development of Synthetic Chemistry,' 'On the Progress of Chemistry in Great Britain and Ireland during the Nineteenth Century,' and 'On the Development of the Chemical Arts during the Reign of Queen Victoria' are worthy of a place in the volume, but they lack the life of the addresses which deal with the personality of the masters of the science.

The history of chemistry is not often successfully taught in our technical schools, for the reason, perhaps, that not many teachers are able to make it interesting. With this collection of essays as a basis for reading, the average teacher would find his students much more receptive of systematic instruction in the subject.

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SCIENTIFIC JOURNALS AND ARTICLES.

Contents of September, 1902, number of *Terrestrial Magnetism and Atmospheric Electricity:*

DISCUSSION AND CORRESPONDENCE.

INVESTIGATION VERSUS ERUDITION.

To the Editor of Science: It is very natural and desirable that scientific men of experience should give counsel upon the education of those to whom their labors, finished and unfinished, must be bequeathed. On the other hand, it will be a misfortune if they who have surrounded themselves with facilities for investigating their respective subjects forget the condition of the beginner and mislead him either with vain hopes or with unwarranted discouragement. Both these dangers seem to inhere in a proposition advanced in many of the addresses before scientific bodies, with which the columns of Science abound. Professor Thurston's able paper furnishes a recent and excellent example of the bogus educational axiom to which exception is taken.