PRACTICAL PROOFS OF CHEMICAL LAWS. A COURSE OF EXPERIMENTS UPON THE COMBINING PROPORTIONS OF THE CHEMICAL ELEMENTS

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Trieste

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A COURSE OF EXPERIMENTS
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THE CHEMICAL ELEMENTS

BY

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PREFACE

THESE experimental proofs (or more properly *verifications*) of quantitative laws were undertaken by pupils after the qualitative composition of the principal substances employed had been carefully dealt with in the accompanying lecture course.

Practical Physics went on side by side with the practical chemistry course.

The pupils whose results are quoted in the text were mostly between twelve and eighteen years of age. A book of results was kept so that each pupil could compare his results with others obtained under similar conditions.

The pupils had 1½ hour at a time in the laboratory, and attended twice a week.

I have not been satisfied with quantitative experiments unless they yield good results in the hands, not only of the teacher but of the pupils. The results quoted in the text are those obtained by the pupils.

I am not aware that a satisfactory standard as to the accuracy required for such experiments has yet been laid down. Within 1 per cent. is certainly sufficient, but the standard may vary to some extent according to the nature of the law or problem investigated.

Perhaps the standard is best determined by historical considerations, for the history of a science is recapitulated by the learner. If the pupil can verify a law to such a degree of approximation as first served to convince the scientific world of its truth, he may generally be satisfied with his work. I have quoted in the text the results of early historic experiments side by side with those obtained by pupils. Although in these early experiments the error is often large, yet there is less difference than the learner may have supposed

between the accuracy of the *first approximations* which have obtained the provisional assent of the scientific world at the beginning and towards the end of the nineteenth century, respectively.

As far as possible no numerical data, whether chemical or physical, were *assumed*. The density of hydrogen and the proportion by weight in which hydrogen and oxygen combine are neither assumed nor determined in these experimental verifications of the Laws of Combining Proportions. It is not *necessary* that equivalent weights should be referred to that of hydrogen, and the experiments cannot be done with the same accuracy as is attainable in the case of other elements.

The use of atomic and molecular formulæ is inadmissible in an examination of the facts upon which the atomic and molecular theory is based. Chemical equations and formulæ have therefore been excluded.

The course is, I believe, suitable for first-year's students at colleges as well as for the upper forms of schools.

I have to acknowledge valuable suggestions received from other chemists while this course was in preparation. My thanks are due more particularly to Dr. J. B. COHEN, of the Yorkshire College, Leeds, and to Mr. G. STALLARD, of Rugby.

VAUGHAN CORNISH.

August 1895.

PRACTICAL

PROOFS OF CHEMICAL LAWS

CHAPTER I

STATEMENT OF DALTON'S ATOMIC THEORY AND OF THE LAWS OF COMBINING PROPORTIONS

DALTON'S atomic theory of chemical action may be stated as follows :—

When a chemical action takes place, what we observe on the large scale is the total effect of a vast number of similar actions occurring between ultimate particles, or atoms, of the substances. The atom of each chemical element has its own specific mass. These chemical atoms are beyond our powers of vision, and we have no means of dealing with them individually. Dalton's theory remains therefore a theory only, and has not been raised to the rank of a statement of observed facts. The theory is, however, based upon observed facts ascertained by experiment.