

**LECTURE
DEMONSTRATIONS IN
PHYSICAL CHEMISTRY**

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Lecture Demonstrations in Physical Chemistry by Henry S. van Klooster

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HENRY S. VAN KLOOSTER

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Lecture Demonstrations

IN

PHYSICAL CHEMISTRY

BY

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CONTENTS.

	PAGE
Preface.....	v
CHAPTER I.	
General Properties of Matter in the Liquid and Solid State...	1
CHAPTER II.	
Diffusion	15
CHAPTER III.	
Osmosis	24
CHAPTER IV.	
Vapor Pressure and Determination of Molecular Weights.....	31
CHAPTER V.	
Chemical Equilibrium and the Law of Mass Action	38
CHAPTER VI.	
Catalysis	55
CHAPTER VII.	
Electrochemistry and Ionic Theory	67
CHAPTER VIII.	
Solubility and Its Changes.....	108
CHAPTER IX.	
Colloids and Adsorption.....	114
CHAPTER X.	
Actino-chemistry	149
CHAPTER XI.	
Flame, Combustion and Explosion	159
CHAPTER XII.	
Liquid Air Experiments.....	179
Bibliography	188
Index of Authors	190
Index of Subjects.....	193

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*"Quoniam menti humanae nulla corporum
"vel qualitatum corporearum est innata
"cognitio: omnia, quae ad corpora perti-
"nent, observationibus, vel experimentis
"addiscenda sunt."*

*—PETRUS VAN MUSSCHENBROEK,
Introductio ad Philosophiam
Naturalem, p. 4 (1742).*

TO VINI
CALIFORNIA

PREFACE.

This volume of lecture demonstrations has been prepared with the idea that it would be of service to have a set of experiments at hand, suitable to be shown in the lecture for the illustration of our present conceptions on physical chemistry.

Arrhenius, in the introduction to his "Theory of Solutions" states "that there are very few doctrines in exact science, where so few lecture experiments are shown as in physical chemistry." This is, of course, partly due to the fact that *quantitative measurements* are needed on which the general laws must be based, while lecture experiments, as a rule, can only illustrate the principles involved in a *qualitative* way. It may be said, however, that quite a number of experiments well adapted to illustrate the different chapters of physical chemistry can be performed. Some of these are found in any of the well-known standard works of Heumann, Arendt, Newth and Benedikt, but little or no attention is paid in these text-books to physical chemistry as a separate branch of teaching, as the connecting link between chemistry and physics. In fact, the interesting topics of physical chemistry such as osmosis, diffusion, catalysis are treated in connection with some element or compound, the properties of which are under discussion, thereby unconsciously and perhaps unwillingly introducing the idea, that these phenomena are typical or especially characteristic of certain elements or compounds. To take a few instances out of many: absorption is a standing property of charcoal, colloids are discussed in connection with silicon, allotropy is taken up with oxygen and ozon a. s. o. The scope of this volume is diametrically opposed to this system in so far that relationships, rather than distinctions are emphasized, the general character of the different topics is stressed and the all-embracing grip of physical or—as it is frequently called—*general chemistry* underlined.

It is interesting to note as can be seen from the references, which have been given wherever available, that many experiments along this line originate from the great masters, which

have given to the science of physical chemistry a place in the front ranks of exact sciences. The very fact, that chemists like Faraday, Graham, Ostwald, Fischer and others have spent part of their time in devising suitable demonstrative experiments is sufficient proof for the usefulness of lecture experiments, wherever practicable, even in the case of such a "theoretical" subject as physical chemistry. However important the theoretical part may be, the experimental side will remain our first and our final resort; to quote the words of an early Dutch physicist, cited on a preceding page in the original version: "Since the human mind has no innate knowledge of matter or its properties, everything pertaining to matter must be learned by observation and experiment."

It is hoped that this volume will be useful in the preparation of lecture experiments and stimulate the interest of the students in "practical" physical chemistry.

Any remarks or suggestions as to changes or additions will be gladly welcomed.

The author takes pleasure in stating his indebtedness to Prof. Bingham, of Lafayette College, for the help received in correcting the manuscript and giving valuable additions (Nos. 1, 14, 170, 171, 172 on pp. 1, 12-14, 138 and 139). Acknowledgment is also expressed to Prof. Hart and Dr. Hunt Wilson, both of Lafayette College, and to Dr. van Rossen, of Bryn Mawr College, for a number of suggestions. In the reading of the proof sheets the writer was assisted by Miss M. S. Cline, of the Moravian College for Women, and by Mr. Ch. F. Fryling and in the preparation of the cuts by Mr. R. Resnikoff, to whom full credit for their painstaking labor is hereby given.

v. K.

WASHINGTON, D. C.,
August, 1918.