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THE STUDY
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THE STUDY
OF
CHEMICAL COMPOSITION

AN ACCOUNT OF ITS METHOD AND HISTORICAL DEVELOPMENT

WITH ILLUSTRATIVE QUOTATIONS

BY

IDA FREUND

STAFF LECTURER AND ASSOCIATE OF NEWNHAM COLLEGE, CAMBRIDGE

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Frontmatter
More information

PREFACE.

THE study of composition, constituting as it does so fundamentally important a part of the science of chemistry, may be considered a subject well suited for separate treatment. In my presentation of the doctrine of chemical composition I have tried to show how the empirical knowledge comprised in it has been obtained, what the initial discoveries were and how these have been established. It has been my aim to demonstrate in the earlier part of the book that the notation by which we represent chemical composition can be developed from a purely empirical basis, independent of any hypothesis concerning the ultimate constitution of matter. In the subsequent treatment of the subject of composition on the basis of the atomic and molecular theory, I have endeavoured to keep sharp and clear the boundary between facts and hypotheses, to direct attention to the existence and position of this separating line, and to emphasise those special features of the argument which bring out the nature and function of hypotheses, their place and importance in the science of chemical composition. Although anxious to trace separately the *historical development* in the discovery and in the establishment of certain laws and classes of phenomena, I have made no attempt to produce anything sufficiently complete or even sufficiently proportioned to deserve the name of *history*. I have preferred to deal in greater detail with a few researches, especially such as I could repeatedly utilise from various points of view, than to treat a greater number more cursorily, believing in the truth and wisdom of what Lavoisier said more than a century ago, that "in such matters as these the choice of proofs is more important than their number."

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More information

In my desire to render the account I had to give real and vivid, I have made special use of two means. *First:* In dealing with quantitative researches—and from the nature of the case these constitute the greatest and most important part of my subject—I have not merely stated the final results, but have reproduced the values obtained in the actual measurements made, so as to indicate in each case the scope of the work involved and the degree of accuracy attained. *Second:* I have quoted extensively from classical memoirs and from great writers on the science, and, restricting within the narrowest possible limits my own share in the exposition, I have given the actual words of those who have announced discoveries, who have described their own experimental investigations or who have propounded new theoretical views. The series of reprints of important papers on chemistry which are being published in different countries are a proof of the growing interest in the history of the science and of the increased importance assigned to first-hand study. I venture to hope that the form of treatment adopted in this book may be found to be in conformity with these tendencies. My presentation cannot take the place of extensive reading of the actual papers; but there are students who have not access to libraries, whilst others whose time is limited may derive some compensating advantage from being taken by means of important and striking extracts over a far greater amount of ground than they could cover by direct recourse to the originals. In quotations from foreign authors of which English translations recognised as standard exist, I have often availed myself of these. Of the translations specially made for the purposes of this book, those of the quotations from Aristotle's works (other than the Metaphysics, Book I) were kindly provided by Miss E. M. Sharpley, Classical Lecturer of Newnham College, to whom I wish to express my thanks.

I have made considerable use of explanatory interpolations and footnotes, in order that those with little or no previous knowledge of chemistry, but with mental training otherwise acquired, might be able to follow the argument; and I have also had in mind possible readers who without intending to make a study of chemistry are interested in the fundamental problems

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of physical science. I can only hope that these incidental explanations may not prove a source of annoyance to students who are not in need of such help.

A few words remain to be said concerning the scope of the subjects included under the title "The Study of Chemical Composition." In my omission of a chapter dealing with the determination of molecular weight on the basis of the laws of dilute solutions, I was guided by the following considerations: the kind of historical treatment adhered to throughout the book seemed in this case unsuitable; space was an object; and as a matter of fact this subject is adequately dealt with in a number of recent text-books on physical chemistry, besides which a reprint renders the important original papers easily accessible. On the other hand, the part of Chapter XV which deals with crystallography has been introduced because the average student of chemistry is as a rule ignorant of this subject, and does not find in the current text-books even the minimum amount of information required to appreciate the results obtained in the study of the relation between crystalline form and chemical composition.

Finally I wish to express my best thanks to Mr F. H. Neville, one of the editors of the series, for the corrections and improvements suggested by him in reading the proofs, and to Mr A. Hutchinson, Demonstrator in Mineralogy, for valuable help given me with the chapter on Isomorphism.

IDA FREUND.

Newnham College Laboratory,
Cambridge.
November, 1904.

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ABBREVIATIONS OF REFERENCES TO JOURNALS

(THE FORM BEING USUALLY THAT ADOPTED IN THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE).

Ann. chim. phys., Paris. Annales de chimie et de physique, Paris.
Ann. Phil. (Thomson). Annals of Philosophy (Thomson).
Ann. Physik. Annalen der Physik, Leipzig.
Baltimore, Md., Amer. Chem. J. American Chemical Journal, Baltimore, Md.
Bruxelles, Bull. Acad. Belgique. Bulletin de l'Académie royale de Belgique, Bruxelles.
Bull. Min. Bulletin de la société française de minéralogie, Paris.
Chem. News, London. Chemical News and Journal of Science, London.
Edinb. J. Sci. Edinburgh Journal of Science, Edinburgh.
Geneva, Bibl. Univ. Archives. Archives des sciences physiques et naturelles, Suppt à la Bibliothèque Universelle, Genève.
J. phys., Paris. Journal de physique théorique et appliquée, Paris.
J. prakt. Chem., Leipzig. Journal für praktische Chemie, Leipzig.
Liebig's Ann. Chem., Leipzig. J. v. Liebig's Annalen der Chemie, Leipzig.
London, J. Chem. Soc. Journal of the Chemical Society, London.
London, Phil. Trans. R. Soc. Philosophical Transactions of the London Royal Society.
London, Proc. R. Soc. Proceedings of the London Royal Society.
Paris, C.-R. Acad. Sci. Comptes-rendus hebdomadaires des séances de l'académie des sciences, Paris.
Phil. Mag., London. London, Edinburgh, and Dublin Philosophical Magazine, and Journal of Science.
Poggend. Ann., Leipzig. Annalen der Physik und Chemie, v. J. C. Poggendorff, Leipzig.
Zs. Chem. Zeitschrift für Chemie, Leipzig.
Zs. physik. Chem., Leipzig. Zeitschrift für physikalische Chemie, Leipzig.

ERRATA.

p. 145, line 10 from end; *for* "Chap. XVI" *read* "Chap. XIX."
p. 178, line 13; *for* 1827 *read* 1825.
p. 190, footnote; *for* 1827 *read* 1825.

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IDA Freund
Frontmatter
More information

TABLE OF CONTENTS.

Introduction. The Method of the Inductive Sciences. Observation, Generalisation and Law. Hypothesis and Theory . . Page 1

Scope of the Natural Sciences, 1. Province of Chemistry, 2. Method of the Natural Sciences. I. Study of Facts; Observation and Experiment, 3. Facts must be correct, 4. Facts traced to their Causes, 5. (*a*) Lavoisier on Change of Water to Earth, 6. (*b*) Davy on Acid and Alkali produced in Electrolysis of Water, 10. (*c*) Rayleigh and Ramsay on Discrepancies in Densities of Nitrogen of different Origin, 14. Steps in Process of referring an Effect to its true Cause, 17. (*a*) Hypotheses made, 17. (*b*) Adequacy of these Hypotheses tested, 18. (*c*) Crucial Experiments, 19. II. Classification and Generalisation, 20. Result of Generalisation termed Law, 21. Quantitative Laws, 22. III. Hypotheses to account for Facts and Laws, 24. Good Hypothesis must be: (1) Inductively true, 25. (2) Applicable to future Discoveries, 26. (3) Deductively suggestive, 26. Hypothesis and Theory, 28.

Chapter I. Theories of Combustion 31

Phlogistic Theory an Example of Development and Abandonment of a Theory, 31. Metals classed with Combustible Substances, 32. Becher's Views on Combustion, 32. Stahl's Extension of Becher's Views, 33. Phlogistic Hypothesis, 33. Difficulties encountered by Phlogistic Theory, 35. (1) Increase of Weight on Calcination, 36. (2) Air necessary for Combustion, 38. (3) Gas discovered by Priestley a better Supporter of Combustion than Air, 39. (4) Phlogiston identified with Hydrogen, 40. (5) Regeneration of Mercury from its Calx by Action of Heat alone, 41. Bayen's Explanation of Weight Increase in Calcination, 43. Rey's Explanation of Calcination, 43. Hooke's Explanation of Combustion, 45. Lavoisier on: Weight Increase in Burning of Phosphorus and Sulphur, 46; Calcination of Tin, 46; Burnt Mercury, 50; Quantitative Synthesis and Analysis of Mercury Calx, 51; Quantitative Synthesis of Iron Calx, 53; Nature of Combustion, 54. Lavoisier's Criticism of the Phlogistic Theory, 55. Solution of Difficulties unexplained by the Phlogistic Theory, 55. Whewell's Appreciation of the Phlogistic Theory, 56.

Chapter II. Lavoisier and the Law of Conservation of Mass . 58

Lavoisier's Use of Quantitative Methods, 58. Black's and Cavendish's Quantitative Work, 59. Lavoisier always guided by Principle of Conservation of Mass, 60. Recognition of Imponderable Nature of Heat, 61. Lavoisier's Experiments showing Conservation of Mass in Chemical Change, 61. Enunciation of the Principle,

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978-1-107-69030-1 - The Study of Chemical Composition: An Account of its Method and Historical Development: With Illustrative Quotations
IDA Freund
Frontmatter
More information

61. History of the Establishment of the Law, 63. The Law tested by the Results of Complete Analyses and Syntheses, 64. Stas' Complete Syntheses of Silver Iodide, 65. Stas' Complete Analyses of Silver Iodate, 69. Morley's Complete Syntheses of Water, 72.

Chapter III. Exact and Approximate Laws 76

Experimental Results always affected by Errors, 76. Errors Classified according to their Cause, 77. (1) Errors due to Chemical Causes: (*a*) Faulty Method, 77; (*b*) Impurities and Mechanical Loss, 78. (2) Errors due to Physical Causes: (*a*) Instruments, 80; (*b*) Conditions, 81. (3) Errors due to Observer: (*a*) Mistakes, 82; (*b*) Limited Sensitiveness of Sense Organs, 82. Errors Classified according to their Effect; Constant and Accidental Errors, 83. The Arithmetical Mean, 83. Weighting of Experiments and the General Mean, 84. Interpretation of Discrepancies between repeated Measurements of a Quantity supposed the same: (*a*) Morley's Determination of Density of Oxygen, 86; (*b*) Rayleigh's Determination of Density of Nitrogen, 89. Interpretation of Discrepancies between Experimental and Theoretical Numbers: (*a*) Boyle's Law. Dulong and Arago's Results, 92; Regnault's Results, 93; Measurements at High Pressures, 95; Boyle's Law not Exact but Approximate, 96; Boyle's Law and the Kinetic Hypothesis, 97; Van der Waals' Formula, 99. Characteristics of Approximate Law and Exact Law, 100. (*b*) Law of Conservation of Mass. Stas' and Morley's Indirect Proofs of Exact Nature of the Law, 101. Provisional Nature of Classification of Laws as Exact, 102. Landolt's Proof of Exact Conservation of Mass, 103. Summary, 106.

Chapter IV. Berthollet and the Law of Mass Action. . . 108

Limitations to our Power of modifying Matter, 108. Affinity, 109. Stahl's Recognition of Definite Order of Affinity and of Influence of Temperature on this Order, 110. Geoffroy's Tables, 111. Bergman's Work, 112. Affinity in the Moist Way and in the Dry Way, 113. Experimental Determination of Order of Affinities, 113. Bergman's Tables, 114. Salient Points of Bergman's Results summarised, 116. Berthollet's Work. Attack on Bergman's Views, 117. Experimental Evidence for the Influence of (1) Mass, 119; (2) Physical Conditions, 119. Berthollet's Inability to measure Affinity as conceived by him, 122. Distribution of Acids and Bases in Solution of Salts cannot be measured by Chemical Methods, 123. Berthollet's Results summarised, 124. Causes of Original Neglect of Berthollet's Work and Subsequent Recognition, 125.

Chapter V. Proust and the Law of Fixed Ratios . . . 127

Variability of Composition asserted by Berthollet, 127. Theoretical Deduction of Principle from Law of Mass Action, 127. Experimental Evidence. (1) Explanation of Apparent Exceptions, 129. Influence of Physical Conditions made to account for Cases of Limited Variability and Fixity of Composition, 130. (2) Instances of Variable Composition: Solutions, Alloys, and Glasses, 133; Oxides of Non-volatile Metals, 134. Fixity of Composition asserted by Proust. (1) Instances of Fixed Composition: Native and Artificial Substances, 135; Minerals of Different Origin, 137. (2) Refutation of Instances of supposed Variable Composition, 139. Distinction between Compounds and Mixtures, 142. Formulation of the Law, 143. Is the Law Exact or Approximate? 144. Marignac's

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Cambridge University Press
978-1-107-69030-1 - The Study of Chemical Composition: An Account of its Method and Historical Development: With Illustrative Quotations
IDA Freund
Frontmatter
More information

Suggestion that the Law is only Approximate, 145. Stas' Experimental Investigation: Synthesis of Silver Chloride under Different Conditions, 146; Analysis of Ammonium Chloride produced in Different Ways, 148. The Law classed as Exact, 151.

Chapter VI. Dalton and the Law of Multiple Ratios . . . 152

Calculation of Quantities of a substance *A*, which combines in Different Ratios with a substance *B*, to Same Amount of *B*, 152. Dalton's Discovery of the Law, 153; his Experimental Evidence: Combination between Nitrous Air and Oxygen, 155; Heavy and Light Carburetted Hydrogen, 155; Oxides of Nitrogen, 156; Oxides of Carbon, 157. Th. Thomson's Evidence, 157. Wollaston's Independent Discovery of the Law, 159; his Experimental Evidence, 160. Berzelius' Evidence: Independent Discovery of the Law, 162; Composition of Oxides of Lead, Sulphur, Copper, Iron, 164; of two Sulphides of Iron, 165. Is the Law Exact or Approximate? 165. No special Investigation on the Subject, 167. Indirect Evidence: Dumas' and Stas' Syntheses of Carbonic Acid from Carbon and Oxygen; Stas' Syntheses of Carbonic Acid from Carbonic Oxide and Oxygen, 167. The Law classed as Exact, 169.

Chapter VII. Richter and the Law of Equivalent Ratios . . 171

Introduction by Cavendish of Term "Equivalent." Observations and Discussions by Bergman and Lavoisier, 171. Richter's Discoveries in the Quantitative Study of Salt Formation. (1) Maintenance of Neutrality after Double Decomposition, 173. (2) Proportionality of the Neutralisation Equivalents of Acids or Bases, 175. (3) Maintenance of Neutrality in Precipitation of one Metal by another, 176. Fischer's Reduction of the Number of Richter's Tables, 176. Berzelius' Estimate of Richter's Discoveries, 177. Wollaston and Thomson on Richter's Work, 178. Berzelius' Work on Richter's Law, 179. Calculation of the Composition of some Substances from that of others, 179. Experimental Verification of the Law: (1) Constancy of the Ratio $A : B$ in the Compounds AC, BC, AD, BD, etc., 180; (2) Constancy of the Ratio $A : B$ in the Compounds AB and ABC, 180; (3) Constancy of the Ratio $A : B$ in the Compounds AC, BC, AB, 181. Formulation of the Law, 182. Effect of the Law on Relation between Composition of all possible Compounds, 183. Is the Law Exact or Approximate? 183. Stas' Investigation, 184. Change of Silver Iodate to Iodide, 185. The Law classed as Exact, 186.

Chapter VIII. Combining or Equivalent Weights. Symbol Weights 187

Laws of Chemical Combination lead to the Conception of the Combining Weight, 187. Definition of Combining Weight, 187. Direct or Indirect Reference to Standard, 188. Selection of the Standard, 188. Standards used in succession, 190. More than one Value for Combining Weight and Relation between these, 193. Symbolic Notation, 193. Symbol Weights, 194. Laurent on Combining Weights, 194. Guiding Principle in Selection of Symbol Weights and in assignation of Formulae, 196. Equivalent Weights, 199. Relation between Combining and Equivalent Weights, 200. Definition of Combining and Equivalent Weight, 201. Determination of Combining Weights: General Principle, 201; Examples of different General Methods, 202; Stas' Determination of the Combining Weights of Silver, Chlorine, Potassium, and of Iodine, 205.

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Cambridge University Press
978-1-107-69030-1 - The Study of Chemical Composition: An Account of its Method and Historical Development: With Illustrative Quotations
IDA Freund
Frontmatter
More information

Appendix. A Selection of Combining Weight Values . . . 213

Discrepancies between Combining Weight Values obtained by Different Methods and Different Observers, 213. Combining Weight of Arsenic from Chloride and Bromide respectively, 213. Combining Weight of Bismuth from Oxide synthesised by two Different Observers, 214. Formulae for calculating General Mean and Probable Error, 215. Calculation of General Mean and Probable Error from Measurements of Same Ratio by Different Observers, 216. Combination of Results obtained for Same Element by Different Methods, 217. The Combining Weight of Lithium, 218. Relation of Combining Weight to Atomic Weight, 219. Table showing Methods used and Results obtained in the Determination of a number of Combining Weights, 220.

Chapter IX. The Ultimate Constitution of Matter. Hypotheses prior to 1800 226

Speculations concerning Ultimate Constitution of Matter go back to Antiquity, 226. Characteristics of Modern Method, 226. Different Estimates of Value of ancient Atomic Hypothesis, 228. Indian Speculations; Kanada's Atomistic Philosophy, 229. The Ionian Philosophers: Thales, Anaximander, Anaximenes, 231. The Pythagoreans, 233. The Eleatics, 234. Heraclitus, 235. Empedocles, 236. Anaxagoras, 237. The Atomistic Philosophers: Leucippus, Democritus, Epicurus, 239. Lucretius' Exposition of the Atomistic Philosophy, 240. Tenets of the Atomistic School: I. The Existence and Properties of Atoms, 240; II. The Motion of Atoms, 244; III. The Existence of Void, 245. Plato, 246. Views on the Structure of Matter expressed in the Timaeus, 247. Aristotle, 250; Method, 252; Views on the Structure of Matter, 253. Evaluations of Greek Natural Philosophy, 255. Transmission of Aristotelian Philosophy to the West, 256. Geber's Two Principles, 257. Paracelsus and the Theory of Three Principles, 258. Relation between Three Principles and Four Elements Theories, 258. Rebellion against Aristotelian and Paracelsian Systems, 259. Bacon, 260; Method, 261; Views on the Structure of Matter, 264. Descartes, 266; Method, 267; Views on the Structure of Matter, 268. Gassendi, 273. Boyle, 274; Criticism of Aristotelian and Paracelsian Philosophies, 275; Definition of Element, 276; Views on the Structure of Matter, 276. Newton, 280; Recognition of Existence of Vacuum, 280; Views on Atomistic Constitution of Matter, 282. Atomistic Conception of Matter generally accepted at End of Eighteenth Century, 283.

Chapter X. Dalton and the Atomic Hypothesis 284

Atom recognised in Physics and Chemistry before Dalton's time, 284. Atomic Hypothesis used to explain Quantitative Laws, 285. Sequence in Formulation of Atomic Hypothesis and Discovery of Law of Multiple Ratios, 285; Account of Dalton's Contemporaries, 285; Dalton's own Testimony, 286; Conclusion that the Hypothesis preceded the Empirical Law, 287. The Main Points of Dalton's Atomic Hypothesis, 288. Determination of relative Atomic Weights, 290. Insufficiency of Data is the Cause of the Devising of Rules of Chemical Synthesis, 290. Symbolic Notation, 291. Application of the System: Formulae assigned to the Oxides of Nitrogen, 294; Composition of Ammonia Found and Calculated, 297; Atomic Weight Tables, 298. Atomic Hypothesis accounts for all Laws of Chemical Combination, 299.

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CAMBRIDGE

Cambridge University Press
978-1-107-69030-1 - The Study of Chemical Composition: An Account of its Method and Historical Development: With Illustrative Quotations
IDA Freund
Frontmatter
More information

Chapter XI. Gay-Lussac and the Law of the Combining Volumes of Gases 301

Volumetric Composition of Water: earliest Results, 301; Gay-Lussac and Humboldt's Results, 302. The Volume Relations between the Gaseous Constituents of Compounds, 303. The Volume Relations between the Gaseous Constituents and the Gaseous Compounds, 305. Summary of Results, 305. Gay-Lussac's Tables, 306. Formulation of the Law, 308. Connection between Gay-Lussac's Law and Dalton's Atomic Hypothesis, 308. Inference from Gay-Lussac's Law, 309. Division of Atoms constituting Elements, 310. Is the Law Exact or Approximate? 312. Accurate Determination of the Volumetric Composition of Water, 312. The Law classed as Approximate, 313. Accuracy of the Law under Conditions approximating to those of an Ideal Gas, 315. Value for Combining Weight of Nitrogen by Physical and Chemical Method, 315.

Chapter XII. Avogadro and the Molecular Hypothesis . . 317

Required Modification of Daltonian Hypothesis, 317. Distinction between two Orders of Finite Particles, 318. Avogadro's Hypothesis, 318. Divisibility of Elementary Molecules, 319. Avogadro's Extension and Modification of Dalton's Hypothesis, 320. Main reasons for present universal Acceptance of Avogadro's Views: (1) Gaseous Laws Accounted for, 322; (2) Hypothesis follows as Deduction from Kinetic Theory, 323; (3) Evidence for Complexity of Elementary Molecules, 324; (4) Hypothesis leads to Formulae identical with those chosen on Chemical Grounds, 326; (5) Explanation of certain Chemical Reactions, 327.

Chapter XIII. Cannizzaro and the Application of Avogadro's Hypothesis to the Determination of Molecular and Atomic Weights 330

Theory of Chemical Composition in 1814, 330. Reasons for Neglect of Avogadro's Work, 331. Berzelius' Atomic Weight Determinations, 331; Criteria in the Selection of Formulae, 332; Indivisibility of Elementary Particles in Chemical Change, 334; Dualistic System, 335. Dumas' Atomic Weight Determinations from Gaseous Densities of Elements, 335. Abandonment of hypothetical Atomic Weights. Wollaston's Equivalents, 339; General Use of Gmelin's Equivalents, 340. Laurent and Gerhardt's return to Atomic Weights, 340. Differentiation between Atom, Molecule, and Equivalent, 341. Gerhardt's Molecular Formulae, 342. Diversity in Symbols and Formulae used, 344. Cannizzaro's Work in the Promotion of Agreement, 345. Paramount Importance assigned to Avogadro's Hypothesis, 345. Determination of Molecular Weights by Avogadro's Law, 346. Cannizzaro's Exposition of the Principle, 347. Points involved in such Determinations: (1) The Standard, 348; (2) Measurement, 349; (3) Experimental Work required, 350; (4) Accuracy of the Result, 351. Determination of Atomic Weights by Avogadro's Law, 354. Cannizzaro's Exposition of the Principle, 354. Points involved in such Determinations, 358.

Chapter XIV. Petit and Dulong and the Law of Atomic Heat . 361

Atomic Weight and Physical Properties, 361. Petit and Dulong's Discovery of the Relation between Atomic Weight and Heat Capacity of Solid Elements, 362. Law of Constant Atomic Heat Capacity, 363. Regnault's Share in establishing the Law, 363. Kopp's Specific Heat Measurements; Carbon, Boron, Silicon classed as Exceptions to the Law, 365. Weber brings these Elements within the Compass of the Law, 367. Dependence of Atomic Heat Value on Physical

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CAMBRIDGE

Cambridge University Press
978-1-107-69030-1 - The Study of Chemical Composition: An Account of its Method and Historical Development: With Illustrative Quotations
IDA Freund
Frontmatter
More information

Conditions, 369. Is the Law Exact for any special Conditions? Tilden's Measurement of the Atomic Heats of Cobalt and Nickel, 370. Dulong and Petit's Law classed as a rough Empirical Rule, 373. Application of the Law to Atomic Weight Determinations, 373. Relation between Heat Capacities of Compound and Constituents. Neumann's Law, 376. Heat Capacity recognised by Kopp as an Additive Property, 377. Experimental Evidence for Kopp's Law, 378. Kopp's Law applied to: (1) Indirect Determination of Atomic Heats, 380; (2) Determination of Relative Molecular Complexity, 382. Bearing of Dulong and Petit's Law on Ultimate Structure of Elements, 383.

Chapter XV. Mitscherlich and the Connection between Crystalline Form and Chemical Composition 385

Matter Classified into Homogeneous and Heterogeneous, Amorphous and Crystalline, 385. Definition of Crystal, Face, and Zone, 387. Constancy of Angles, 387. Symmetry, 388. Simple Forms and Combinations, 389. Elements of Symmetry, 390. Crystallographic Axes, 393. Law of Rational Indices, 394. Crystallographic Constants, Symbols, 395. Crystallographic Classes and Systems, 395. Hemihedrism, 396. Anorthic System, 397. Oblique System, 399. Rhombic System, 400. Tetragonal System, 400. Rhombohedral System, 402. Hexagonal System, 403. Cubic System, 405. Isomorphism. **A.** Discovery and Establishment of the Law. Berzelius' Establishment of Analogies in Composition and Properties of Phosphates and Arsenates, 409; Mitscherlich's Discovery of corresponding Crystallographic Analogies, 411. Name Isomorphism given to Occurrence of Chemically Different Substances in Same Crystalline Form, 413. Mitscherlich's Recognition of Deviations from Identity of Form, 413; Tutton's Investigations, 414. **B.** Application of the Law. I. Classification of the Elements, 417. (1) Agreement with Periodic Law Classification, 418; (2) Formulae for Manganic Acids, 420; (3) Discovery of Selenic Acid. II. Atomic Weight Determinations. (1) Examples: Selenium, Chromium, Vanadium, 421. (2) Experimental Work involved: Analysis of the Isomorphous Compounds, 424. Recognition of the Existence of Isomorphism. (*a*) Similarity of Crystalline Form, 426; (*b*) Analogous Composition, 427; (*c*) Complete Miscibility, 427; (*d*) Isomorphous Overgrowth, 429; (*e*) Proportionality between Composition and Properties of Mixed Crystals, Retgers' Law, 430. (3) Applicability of the Method, 437. (4) Accuracy of the Results, 437. Polymorphism. Definition and Examples, 438. Establishment of Occurrence by Mitscherlich, 439. Prevalence proved by Lehmann, 441. Classification of Distinguishing Properties of Polymorphs, 441. Theory of Polymorphism, 444. Isodimorphism. Definition; Direct and Indirect Evidence for the Occurrence, 446. Retgers' Law in the Discovery of Cryptic Isodimorphism, 447. Relative Importance of Isomorphism and Isodimorphism, 451. Morphotropy, 452.

Chapter XVI. Mendeleeff and the Periodic Law 454

Extended Classification of Elements consequent on Adoption of Atomic Weight Notation, 454. Principle of the Classification of Elements, 455. Doebereiner's Triads, 456. Newlands' Law of Octaves, 457. Lothar Meyer and the Relation between Chemical Nature and Atomic Weight of Elements, 459. (1) Method of Arrangement; Gaps and Transpositions, 461. (2) Results of Arrangement, 461. (3) Change of Properties with Change of Atomic Weight: Valency, Atomic Volume, Physical Properties, 462. (4) Application of the Law; Relation between Equivalent

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CAMBRIDGE

Cambridge University Press
978-1-107-69030-1 - The Study of Chemical Composition: An Account of its Method and Historical Development: With Illustrative Quotations
IDA Freund
Frontmatter
More information

and Atomic Weight, Correction of Stoichiometric Constants, 466. Mendeleeff's Selection of Atomic Weight as Basis of Classification, 468. Periodic Law, Series and Groups, 469. (1) Proof that Properties of Elements are a Periodic Function of their Atomic Weights: Valency, Chemical Nature and Formulae of Oxides and Hydrides, Atomic Volume, Volatility, 469. (2) Length and Character of Periods; Odd and Even Series, Transition Periods, Typical Elements, 472. (3) Mendeleeff's Application of the Law, 474. (i) Classification of the Elements, 475. (ii) Determination of Atomic Weights, 477. (iii) Prediction of New Elements, 479; Eka-silicon and Germanium, 480. (iv) Correction of Atomic Weights, 482. Extension of Scope of Law by Carnelley, 483. Para- and Dia-Magnetism, 484. Occurrence of the Elements, 485. Physical Properties of Compounds, 487. Application of the Law. (1) Calculation of Melting Points of Halides, 489. (2 & 3) Atomic Weight of Beryllium: from Melting Point of Chloride, 489; from Density of Chloride Solution, 490. (4) Accurate Atomic Weight: of Gallium and Germanium, 490; of Radium, 495. New Group made for the Inert Gases, 497. Formula for Periodic Law Function: Mendeleeff on the Special Nature of the Curve, 500; Johnstone Stoney's Logarithmic Spiral, 502. Wyruboff's Criticism of the Law, 504.

Chapter XVII. Kekulé and the Doctrine of Valency . . . 506

Choice of Symbol Weights with View to suitable Formulae for Compounds, 506. Composition and Possible Metamorphoses represented by Rational Formulae, 507. Compound Radicles in Rational Formulae, 508. Substituting and Combining Power of Radicles, 510. Substituting Power of Elementary Atoms; Frankland, 513. Tetravalency of the Carbon Atom: Kekulé, 515; Couper, 517. Arrangement of Atoms in Molecule represented by Structural Formulae, 518. **I.** Definition of Valency, 519. Hydrogen the Standard, 520. Compounds suitable for the Determination of Valency, 521. **II.** Experimental Determination, 522. **III.** Classification of Elements according to Valency, 524. **IV.** Constant or Variable Valency. Explanation of Exceptions to Constant Valency: (1) Multiple Linking of Carbon Atoms, 528; Unsaturated Compounds, 530. (2) Molecular Compounds, 530. Pentavalence of Phosphorus in PF_5, 532. Pentavalence of Nitrogen in NH_4Cl, 533. Tri- and Pentavalence of Phosphorus in Derivatives of PCl_3O, 534. **V.** Theory of Valency, 535. Van 't Hoff's Conjecture, 536. Helmholtz's View concerning Electrical Nature of Valency, 538. Electron Theory of Valency, 540. Lodge's Explanation of Different Grades of Chemical Union, 542. Importance of Doctrine of Valency in Organic Chemistry, 544.

Chapter XVIII. Berzelius and Isomerism 545

Identity of Composition supposed to involve Identity of Properties, 545. Composition of Cyanic Acid and Fulminic Acid found the same, 545. Discovery of a Gas different in Properties from Olefiant Gas, same in Composition, 546. Composition of Racemic Acid found the same as that of Tartaric Acid, 549. Berzelius' Recognition of the Existence of Substances same in Composition, different in Properties, 549. Nomenclature: Isomerism, Polymerism, Metamerism, 551. Allotropy, 553. Theory of Polymerism and of Allotropy, 555. Classification of Polymers, 558. Possible Causes of Isomerism, 560. Isomerism and Rational Formulae; Kolbe's Prognosis of Isomeric Alcohols, 561. Isomerism and Structural Formulae, 565. Isomers theoretically possible, 566. Number of Isomeric Derivatives of Benzene according to Kekulé's Formula, 568. Denotation

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IDA Freund
Frontmatter
More information

of Terms Isomerism, Polymerism, Metamerism, 570. Carius and Physical Isomerism, 571. Wislicenus and Geometrical Isomerism, 572. Pasteur and Molecular Asymmetry, 574. Isomerism of Substances of same Structural Formula; Le Bel and Van 't Hoff's Explanation, 576. Stereochemistry, 577. Experimental Confirmation of Van 't Hoff's Hypothesis of Asymmetric Carbon Atom: (1) Character of Isomerism, 580; (2) Stereoisomerism always co-existent with required Constitution, 581; (3) Explanation of Optical Inactivity of some Asymmetric Compounds, External and Internal Compensation, 584; (4) Theoretical and known Number of Isomers, 586. Tautomerism, 587. Keto-form and Enol-form, 589. Theory of Tautomerism, 591.

Chapter XIX. The Ultimate Constitution of Matter and the Genesis of the Elements 593

One kind of Primitive Matter. Early Philosophical Speculations, 593. Prout's Hypothesis; Hydrogen the Primitive Matter, 594. Th. Thomson's Support of the Hypothesis, 596. Berzelius' Criticism of Thomson's Experimental Work, 597. Thomson's Equivalents proved inaccurate by Turner, 598. Approximation of Atomic Weights to Integers, 599. Division of Prout's Atomic Weight Unit by Marignac and Dumas, 600. Stas' Proof of the Inaccuracy of Prout's Law, 601. Marignac's Defence of Prout's Law, 601. Unity of Matter denied by Stas, 603. Philosophical Reasons against Indivisibility of Elementary Atoms, 604. Experimental Evidence for Complexity of Atoms and for Identity of the Ultimate Constituents: (i) Crookes' Fractionation of Yttria, 604; (ii) Zeeman Effect, 605; (iii) Lockyer's Comparative Study of Terrestrial and Stellar Spectra, 608; (iv) The Mass of the Negatively Electrified Particles in Gases at Low Pressures, J. J. Thomson's Corpuscles, 609; (v) Radio-active Changes, Atomic Disintegration, 613. The Genesis of the Elements. Philosophical Speculations, 617. Experimental Evidence for Inorganic Evolution: (i) Successive Appearance of Elements in Cooling Stars, 618; (ii) Transmutation of Radium into Helium, 619; (iii) Atomic Weight Relations of the Periodic Law, 619. Crookes' Speculations concerning Mode of Genesis of Elements, 619. J. J. Thomson's Theory of Corpuscular Aggregation, 622. The Structure of the Atom, 622. Present Position of the Atomic Theory, 624.

Index 625

Table showing the Influence of the Atomic Weight of the Substituting Element on the Crystallographic Constants and the "Habit" of Crystals of the Isomorphous Series $R_2SO_4 . MSO_4 . 6H_2O$.

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