

CHEMISTRY *of* CARBON COMPOUNDS

A modern comprehensive treatise

Edited by

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VOLUME III PART A
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PREFACE TO VOLUME III

The importance of the part which the study of the chemistry of benzene and its derivatives played in the development of structural theories of organic chemistry has been equalled in the last thirty years by that of the electronic theory of valency and wave mechanical theory, which have assumed growing significance for the interpretation of structure and properties of carbon compounds. Arthur Lapworth and (Sir) Robert Robinson were pioneers in applying the new electron theory of valency to interpret the phenomena of substitution in benzenoid compounds and the subject was advanced in many directions by other workers, especially by C. K. Ingold and his collaborators. It is fitting, therefore, that Professor Ingold should contribute to the Introduction to this volume a historical survey of the theoretical ideas which have advanced the understanding of aromatic chemistry from the time of Kekulé to the middle of the present century.

It is not, however, the purpose of these volumes to discuss in detail the profounder theories of organic chemistry, but to present in orderly fashion established knowledge of the different classes of compounds and their inter-relationships, whether they originate in nature as products of animal and vegetable life or in the laboratory. The order of presentation of the main part of this volume is essentially that of Richter (compare the preface to Vol. I) with some slight modifications in detail. The heavy task of revision of the sections dealing with benzene derivatives has been largely the work of Dr. W. J. Hickinbottom, who has made it his purpose to select from the enormous amount of material available that which is important and typical of the different classes of compound. If a reader finds that some group of compounds, some research of note, to which he attaches importance is not even mentioned, he may reflect that for every compound described in Vol. I there are possible an uncountable number of derivatives having aryl and substituted aryl groups and that, to keep this volume within reasonable bounds, drastic selection and compression have been necessary. It may be said that the editor has more often found it necessary to suggest additions than to use the blue pencil. In general, the more complex the parent hydrocarbon the more briefly must its derivatives be discussed, unless they have some special significance; this is an unavoidable paradox. No claim can therefore be made that the literature for any particular section is covered

completely to a certain date. Nevertheless we have not hesitated to add mention of very recent work even at the proof stage when this seemed justified. Part of the work of revision has been undertaken by Dr. Chatt, Dr. Jolles and others, to all of whom our grateful thanks are due for their labours and their willing collaboration in the preparation of Vol. IIIA, which is entirely concerned with benzene derivatives. In Vol. IIIB the description of benzene derivatives will be concluded and will be followed by that of the pseudo-aromatic and the multinuclear aromatic compounds in the widest sense.

For nomenclature and numbering the usage of the Chemical Society of London has been adopted unless otherwise stated. Care is taken in the text to make clear the system of numbering used for any particular ring system. It is not always possible to keep in step with the Chemical Society, for modifications in its usage are not infrequently made. Such changes, and difficult or novel points concerning nomenclature, are discussed in the editorial reports which accompany the Society's annual index. A recent change (1953) which affects simple benzene derivatives abandons the long established practice of putting $\text{CH}_3 = 1$ in methyl derivatives and gives the number 1 to the functional group; so 2-nitro-*p*-cresol becomes 3-nitro-*p*-cresol and vice versa. In this volume the old usage is retained.

December, 1954

E. H. RODD

LIST OF PERIODICALS

The figure in brackets after the title is the first ascertainable year of publication

Acta Acad. Aboensis, math. phys.	Acta Academiae Aboensis; mathematica et physica (1922)
Acta Chem. Scand.	Acta Chemica Scandinavica (1947)
Amer. chem. J.	American Chemical Journal (1879)
Amer. J. Pharm.	American Journal of Pharmacy (1829)
Anal. Chem.	Analytical Chemistry (see Ind. Eng. Chem. Anal. Ed.)
Analyst	The Analyst (1877)
Angew. Chemie	Zeitschrift für angewandte Chemie (1888), name changed 1942 to Die Chemie, discontinued 1944, resumed 1947 as Angewandte Chemie
Ann.	Annalen der Chemie, Justus Liebig's (1832)
Annali Chim. appl.	Annali di chimica applicata (1914)
Ann. Chim.	Annales de chimie, before 1914 Annales de chimie et de physique, before 1816 Annales de chimie ou Recueil de Mémoires etc. (1789)
Ann. Physik	Annalen der Physik (1824-1899 und Chemie) (1799)
Ann. Rep. appl. Chem.	Annual Reports on the Progress of Applied Chemistry, London (1917)
Annual Reports	Annual Reports on the Progress of Chemistry, London (1904)
Arch. Pharm.	Archiv der Pharmazie, Berlin (1822)
Arkiv Kemi	Arkiv för kemi, mineralogi och geologi (1903) (divided 1949 into Arkiv för kemi, and Arkiv för mineralogi och geologi)
Atti Accad. Sci. Torino	Atti della [R.] Accademia della scienze di Torino. Tomo I, Classe di scienze fisiche, matematiche e naturali (1865/66)
Atti Accad. Lincei	Atti della reale Accademia dei Lincei (1884)
Atti X Congr. Internaz. Chim., Rome	Atti del congresso internazionale di chimica. 10th Congress Rome, 1938 (Pub. 1939)
Australian J. Sci. Res.	Australian Journal of Scientific Research (1948)
Ber.	Berichte der deutschen chemischen Gesellschaft (1868), since 1947 Chemische Berichte
Biochem. J.	The Biochemical Journal (1906)
Biochem. Soc. Symposia	Biochemical Society Symposia (1948)
Biochem. Z.	Biochemische Zeitschrift (1906)

- Brennstoff-Chem.
 Brit. chem. Abstr.
 Brit. J. Pharmacol.
 Bull. Acad. roy. Sci. Belg.
 Bull. Acad. Sci. Cracow
 Bull. chem. Soc. Japan
 Bull. Imperial Inst.
 Bull. Inst. phys. chem.
 Research, Tokyo
 Bull. Soc. chim. Belg.
 Bull. Soc. chim. Fr.
 Bull. Soc. Ind. Mulhouse
 Bull. Soc. chim. Romania
 C.A.
 Canad. J. Chem.
 Canad. J. Res.
 Chem. Eng. Prog.
 Chem. met. Eng.
 Chem. News
 Chem. Reviews
 Chem. Weekbl.
 Chem. Ztbl.
 Chem. Ztg.
 Chem. & Ind.
 Chimia
 Chim. et Industr.
 Coll. Czech. Chem. Comm.
 Compt. rend.
 Brennstoff-Chemie (1926)
 British Chemical Abstracts, London, 1926
 (Since 1945, British Abstracts; ceased 1953)
 British Journal of Pharmacology and Chemo-
 therapy (1946)
 Bulletin de l'Académie royale des sciences et
 belles-lettres de Belgique (1832)
 Bulletin international de l'Académie (polo-
 naise) des sciences de Cracovie (1889)
 Bulletin of the Chemical Society of Japan
 (1926)
 Bulletin of the Imperial Institute (1903)
 Bulletin of the Institute of Physical and
 Chemical Research, Tokyo (1921) (Rikwagaku-
 kenkyu-jo iho, since 1949 Kagaku Kenkyu-Jo
 Hokoku)
 Bulletin de la Société chimique de Belgique et
 Recueil des travaux chimiques belges (1887)
 Bulletin de la Société chimique de France
 (1859)
 Bulletin de la Société industrielle de Mulhouse,
 France (1826)
 Buletinul Societatii de chimie din Romania.
 A. Mémoires; B. Documentation et comptes
 rendus (1919)
 Chemical Abstracts (1907)
 Canadian Journal of Chemistry (contin. of
 Canadian Journal of Research. Sect. B)
 (1951)
 Canadian Journal of Research (1922)
 Chemical Engineering Progress with Trans-
 actions of American Institute of Chemical
 Engineers (contin. of Transactions of American
 Institute of Chemical Engineers) (1947)
 Chemical and Metallurgical Engineering (1902)
 Chemical News (1860)
 Chemical Reviews (1924)
 Chemisch Weekblad (1903)
 Chemisches Zentralblatt (1830; from 1945-
 1949 two competing editions were published
 in the Eastern and Western zones of Germany
 which were combined in 1950)
 Chemiker-Zeitung (1877)
 Chemistry & Industry (London) (1923)
 Chimia (Switzerland) (1947)
 Chimie et Industrie (1918)
 Collection of Czechoslovak Chemical Commu-
 nications (1929)
 Comptes rendus hebdomadaires des séances de
 l'Académie des Sciences, Paris (1835)

- C.r. Acad. Sci. U.R.S.S. Comptes rendus (Doklady) de l'Académie des Sciences de l'U.R.S.S. (1922)
- Dict. appl. Chem. Thorpe's Dictionary of Applied Chemistry
- Disc. Faraday Soc. Discussions of the Faraday Society, Gr. Br. (1947)
- Doklady Acad. Nauk, S.S.S.R. Doklady Akademii Nauk S.S.S.R. (1935) (since 1948 Comptes rendus (Doklady) de l'Académie des Sciences de l'U.R.S.S.)
- Frdl. Fortschritte der Teerfarbenfabrikation und verwandter Industriezweige (Friedländer) (1877)
- Gazz. Gazzetta Chimica Italiana, Roma (1871)
- Giorn. Chim. ind. & appl. Giornale di Chimica industriale e applicata (1920)
- Helv. Helvetica Chimica Acta (1918)
- Ind. Eng. Chem. Industrial and Engineering Chemistry, before 1923 Journal of... (1909)
- Ind. Eng. Chem. Anal. Ed. Industrial and Engineering Chemistry, Analytical Edition (1929), name changed 1947 to Analytical Chemistry
- Iowa State Coll. J. Sci. Iowa State College Journal of Science (1926)
- J. agr. chem. Soc. Japan Journal of the Agricultural Chemical Society of Japan (1924)
- J. agric. Sci. Journal of Agricultural Science (1905)
- J. Amer. chem. Soc. Journal of the American Chemical Society (1879)
- J. Amer. med. Assoc. Journal of the American Medical Association (1883)
- Japan J. Chem. Japanese Journal of Chemistry (1929)
- J. appl. Chem. Journal of Applied Chemistry (London) (1951), contin. of Journal of the Society of Chemical Industry
- J. applied Chem. U.S.S.R. Journal of Applied Chemistry U.S.S.R. (1928)
- J. Bact. Journal of Bacteriology, Baltimore (1916)
- J. Biochem. The Journal of Biochemistry, Japan (1922)
- J. biol. Chem. The Journal of Biological Chemistry (1905)
- J. chem. Phys. Journal of Chemical Physics (American Institute of Physics) (1933)
- J. chem. Soc. Journal of the Chemical Society, London (1849)
- J. Chim. phys. Journal de chimie physique et Revue générale des colloïdes (1903)
- J. Chin. chem. Soc. Journal of the Chinese Chemical Society (1933)
- J. econ. Entomol. Journal of Economic Entomology, U.S.A. (1908)
- J. gen. Chem. U.S.S.R. Journal of General Chemistry U.S.S.R. (1931)
- J. Indian chem. Soc. Journal of the Indian Chemical Society (1924)
- J. Inst. Pet. Journal of the Institute of Petroleum, London (1914) (up to 1938, Journal of the Institution of Petroleum Technologists)
- J. opt. Soc. Amer. Journal of the Optical Society of America (1917)
- J. org. Chem. Journal of Organic Chemistry (1936)

- J. pharm. Soc. Japan Journal of the Pharmaceutical Society of Japan (1881)
 J. phys. Chem. Journal of Physical Chemistry, New York (1896)
 J. pr. Chem. Journal für praktische Chemie (1834)
 J. Proc. roy. Soc. N.S. Wales Journal and Proceedings of the Royal Society of New South Wales (1876)
 J. Res. nat. Bur. Stand. Journal of Research of the National Bureau of Standards. Formerly Bureau of Standards Journal of Research (1928)
 J. roy. tech. Coll. Glasgow Journal of the Royal Technical College (Glasgow); suspended 1940, resumed 1950
 J. Soc. chem. Ind. Journal of the Society of Chemical Industry (1881)
 J. Soc. chem. Ind. Japan Journal of the Society of Chemical Industry of Japan (1898)
 J. Soc. Dy. Col. Journal of the Society of Dyers and Colourists (1884)
 J. Soc. phys.-chem. Russe Journal of the Russian Physical-chemical Society (1869/70, discontinued 1930)
 Mem. Manchester phil. Soc. Memoirs (since 1888: and Proceedings) of the Manchester Literary and Philosophical Society (1785)
 Monatsh. Monatshefte für Chemie und verwandte Teile anderer Wissenschaften (1880)
 Nature Nature, London (1870)
 Naturwiss. Die Naturwissenschaften, Berlin (1913)
 N.Z. J. Sci. Tech. New Zealand Journal of Science and Technology. A. Agricultural Research Section, B. General Research Section (1918)
 Oil Gas J. Oil and Gas Journal, Tulsa, Okla. (1901)
 Org. chem. Ind. U.S.S.R. Organic Chemical Industry (Promyshlennost Organicheskoi Khimii) merged with Journal of Chemical Industry (Zhurnal Khimicheskoi Promyshlennosti) in 1941
 Org. Reactions Organic Reactions, New York (1924)
 Org. Synth. Organic Syntheses, New York (1921)
 Philos. Trans. Philosophical Transactions of the Royal Society of London (1665)
 Proc. Camb. Phil. Soc. Proceedings of the Cambridge Philosophical Society, Gr. Br. (1843)
 Proc. Koninkl. Nederland. Akad. Wetenschap. Proceedings Koninklijke Nederlandsche Akademie van Wetenschappen (Formerly Proceedings of the Royal Academy of Sciences of Amsterdam) (1898)
 Proc. Leeds phil. lit. Soc. Sci. Sect. Proceedings of the Leeds Philosophical and Literary Society, Scientific Section (1925)
 Proc. roy. Irish Acad. Proceedings of the Royal Irish Academy. Sect. A, Mathematical, astronomical and physical science; Sect. B, Biological, geological and chemical science (1836)

- Proc. roy. Soc. Proceedings of the Royal Society of London (1885)
 Proc. roy. Soc. Edinburgh Proceedings of the Royal Society of Edinburgh.
 Section A, Mathematical and physical sciences;
 Section B, Biology (1832)
 Quart. Reviews Quarterly Reviews of the Chemical Society,
 London (1947)
 Rec. Trav. chim. Recueil des travaux chimiques des Pays-Bas
 (1882)
 Research Research, London (1947)
 Rev. Chim. ind. Revue de Chimie industrielle (1890), suspended
 1941
 Roczn. Chem. Roczniki Chemii, Warsaw (1921)
 Science Science (American Association for the Ad-
 vancement of Science) (1883)
 Sci. Papers Inst. phys. chem. Scientific Papers of the Institute of Physical
 Research, Tokyo and Chemical Research, Tokyo (1928)
 Trans. electrochem. Soc. Transactions of the Electrochemical Society
 (1902). Before 1931 Transactions of the Ameri-
 can Electrochemical Society
 Textilber. Textilberichte über Wissenschaft, Industrie
 und Handel, Germany (1920); from 1922 Mel-
 liand's Textilberichte
 Tids. Kjemi Tidsskrift for Kjemi, Bergvesen og Metallurgi
 (1941), formerly Tidsskrift for Kjemi og
 Bergvesen
 Trans. Faraday Soc. Transactions of the Faraday Society (1905)
 Trans. Kansas Acad. Sci. Transactions of the Kansas Academy of
 Science, U.S.A. (1868/72)
 Trans. roy. Soc. Canada (Proceedings and) Transactions of the Royal
 Society of Canada (1882)
 Z. ang. Chem. Zeitschrift für angewandte Chemie, see Ange-
 wandte Chemie
 Z. anorg. Chem. Zeitschrift für anorganische und allgemeine
 Chemie (1892)
 Z. Elektrochem. Zeitschrift für Elektrochemie und angewandte
 physikalische Chemie (1894)
 Z. Farben-Ind. Zeitschrift für Farben-Industrie, Germany
 (1902)
 Z. ges. Schiess- u. Sprengstoffw. Zeitschrift für das gesamte Schiess- und Spreng-
 stoffwesen (1906)
 Z. Naturforsch. Zeitschrift für Naturforschung (1946)
 Z. Physik Zeitschrift für Physik (1926)
 Z. physik. Chem. Zeitschrift für physikalische Chemie (1887)
 Z. physiol. Chem. Hoppe-Seyler's Zeitschrift für physiologische
 Chemie (1877)

OFFICIAL PUBLICATIONS

B.P.	British Patent
Dutch P.	Dutch Patent
F.P.	French Patent
G.P.	German Patent
U.S.P.	United States Patent
B.I.O.S.	British Intelligence Objectives Sub-Committee Reports, H.M. Stationery Office, London
F.I.A.T.	Field Information Agency. Technical Reports of U.S. Group Control Council for Germany

LIST OF COMMON ABBREVIATIONS AND SYMBOLS USED

Å	Ångström units
at.	atmosphere
<i>as</i> or <i>asym</i>	asymmetrical
b.p.	boiling point
conc.	concentrated
crit.	critical
<i>d</i>	density
dec. or decomp.	decomposing
deriv.	derivative
f.p.	freezing point
g.	gram
<i>K</i>	dissociation constant
kcal.	kilocalories
kg.	kilogram
<i>lin</i>	linear
max.	maximum

mg.	milligram
ml.	millilitres
mm.	millimetres
mol.	molecule, molecular, mole
m.p.	melting point
M.R.	molecular refraction
$m\mu$	10^{-8} mm.
n	refractive index
<i>s</i> or <i>sym</i>	symmetrical
soln.	solution
T	absolute temperature
temp.	temperature (in degrees centigrade)
$[\alpha]_D$	specific rotation, sodium D line
ϵ	molecular extinction coefficient
μ	dipole moment
χ	magnetic susceptibility
Ac	acetyl
Alk	alkyl
Ar	aryl
Bu	butyl
Bz	benzoyl
Et	ethyl
Me	methyl
Mesyl	methanesulphonyl
Ph	phenyl
Pr	propyl
Tosyl	<i>p</i> -toluenesulphonyl
Trityl	triphenylmethyl

Homo- as prefix signifies next higher homologue.

Nor- as prefix signifies next lower homologue.

Optical rotations are in water unless otherwise stated.

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