A HISTORY OF CHEMISTRY

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PREFACE

THIS volume deals with the development of chemistry in the nineteenth and part of the twentieth centuries, as shown in the table of contents. The part concerned with the twentieth century comprises the lives and work of chemists, including American, not previously treated in detail in histories of chemistry. Very recent work, to be found in the current text-books, is not included, but indications of the present state of a subject are usually given. The book is almost entirely based on original sources, references to which and to works containing relevant information are given. It is primarily addressed to chemists, but the first part at least should be intelligible to readers having less specialised scientific knowledge.

The choice of material, the order of arrangement, and the method of treatment are the result of deliberation; some readers would probably have proceeded differently if they had undertaken the work. The text is about equally divided among physical, inorganic, and organic chemistry, and a thread of continuity runs through the whole work. Very few theories proposed in the period have been completely discarded; at some times progress has been achieved by emphasising one theory and neglecting another apparently conflicting one, but nearly all, in some form or other, find a place in modern chemistry.

The author wishes to thank those who answered enquiries on particular points or sent him observations on previous volumes: these include Dr. A. G. Debus, Mgr. H. Ducros (Toulouse), Dr. E. Farber, Dr. F. W. Gibbs, Prof. L. Glaser (Paris), Mr. H. H. Kjølsen (Copenhagen), M. M. Lemaire (Lille), Dr. W. Oberhummer (Vienna), Dr. B. W. Petley (National Physical Laboratory), Dr. Nathan Sivin (Cambridge, Mass.), Dr. W. H. Smeaton, Mr. K. Speyer, and the staffs of the Libraries of the Facultés Catholiques of Lyons, the University of Edinburgh, and the Chemical and Pharmaceutical Societies. In reading the proofs the author has had valuable assistance from Dr. R. G. Partington and Mr. A. J. V. Gale. The text was completed in August, 1962, but a few later references have been added.

CAMBRIDGE, *June 1963*

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ABBREVIATIONS IN REFERENCES

IN footnotes references are given to periodical publications in the order: year of publication, volume number in small roman numerals, page (see below, (a)). In some cases the title of a book or periodical is given in full. In other cases abbreviated titles are given, as in (a) below, or simply a name, with or without a number, as in (b). The full titles will be found in the list of authors and publications beginning on p. xvii. Again, in separate chapters or sections dealing with one person, a list of his publications in which they are denoted by numbers (or sometimes letters) is given towards the beginning of the section, and these abbreviations (c) are used throughout that part only. Examples of the types of abbreviation are shown below:

- (a) Ladenburg, *Chem. Ztg.*, 1907, xxxi, 184. See list of publications for *Chem. Ztg.*
- (b) Liebig, (1), ii, 145. See list of authors, p. xvii, under Liebig.
- (c) Berzelius, IX (a), 29 f. in footnote 4, p. 163 in ch. V on Berzelius. See the list of publications on p. 147. In other parts of the book the publications of Berzelius are referred to according to the list of authors, p. xvii.

Titles given in full are not reproduced in the lists of authors and abbreviations. Places of publication, unless otherwise given, are London, Paris, and Berlin for works in English, French, and German. The size of a book is usually octavo (8°) unless otherwise stated. Biographical details are given in a standard form with the places and dates of birth and decease, e.g. Humphry Davy (Penzance, 17 December 1778–Geneva, 29 May 1829). The spelling of Russian names is mostly that given in the item of literature consulted. The hyphens separating French Christian names have usually been omitted.

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- BM. British Museum (Library), London.
- BN. Bibliothèque Nationale, Paris.
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- Cat. Catalogue.*
- CG. *Correspondance de Charles Gerhardt*, publiée et annotée par Marc Tiffeneau, 2 vols., 1918-25.
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- CRELL — see p. xxvi, and Vol. III, p. 598.
- CUL. Cambridge University Library.
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- DNB. Dictionary of National Biography.
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- Ency. Brit.* Encyclopaedia Britannica.
- Ency. Brit. Suppl.* Supplement to the Encyclopaedia Britannica, 3 ed. Edinburgh, 1801.
- Ency. Method.* Encyclopédie Méthodique, department Chimie (Chymie).
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- RSC. *Royal Society Catalogue of Scientific Papers 1800-1900, 1867-1925* (19 vols. incl. suppl.).
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- SOTHERAN, H. *Cat. An Annotated Catalogue of Works* [for sale], q. by number, date, number of items (or page).
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(2) *Ib.*, new ed. by H. F. Morley and M. M. P. Muir, 4 vols., 1890-4.
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LIST OF PERIODICAL PUBLICATIONS

Abhl. Abhandlungen.

Abhl. Akad. Berlin. Abhl. K. Preuss. Akad. Wiss. Abhandlungen der Königlich Preussischen Akademie der Wissenschaften, physikalisch-mathematische Klasse. Berlin.

Abhl. D. Bunsen Ges. Abhandlungen der Deutschen Bunsen Gesellschaft für angewandte physikalische Chemie. Halle.

Abhl. K. Ges. Göttingen. Abhandlungen der Königlichen Gesellschaft der Wissenschaft zu Göttingen, mathematisch-physikalische Classe. Göttingen.

Abhl. Naturforsch. Ges. zu Halle. Abhandlungen der Naturforschenden Gesellschaft zu Halle. Halle.

Abhl. Sächs. Ges. Abhandlungen der Königlich Sächsischen Akademie der Wissenschaften, physikalisch-mathematische Klasse. Leipzig.

ACR. Alembic Club Reprints. Edinburgh.

Acta Soc. Sci. Fenn. Acta Societatis Scientiarum Fennicae. Helsinki.

AdS, h and m. Histoire de l'Académie [Royale] des Sciences. Avec les Mémoires de Mathématique et de Physique (see Vol. III, p. 10).

AdS *Mém. div. Sav.* Mémoires présentés par divers Savants à l'Académie [Royale] des Sciences (see Vol. III, p. 10).

Allgem. J. Chem. — see *J. Chem.*

A. Med. Archiv für die Geschichte der Medizin. Leipzig.

Amer. Chem. J. American Chemical Journal. Baltimore.

Amer. J. Sci. American Journal of Science (Silliman's Journal). New Haven.

An. Fis. Quim. Anales de la Sociedad Española de Física y Química. Madrid.

Anal. Chim. Acta. Analytica Chimica Acta. Amsterdam.

Angew. Chem. Angewandte Chemie.

A. Nat. Archiv für die Geschichte der Naturwissenschaften und der Technik. Leipzig.

Ann. (a) Annalen der Pharmacie. Lemgo and Heidelberg, 1832-9, vols. i-xxxii.

(b) Annalen der Chemie und Pharmacie. Heidelberg, 1840-73, vols. xxxiii-clxviii, and Supplementebände (*Ann. Suppl.*), 1861-72, vols. i-viii. *(c)* Justus Liebig's Annalen der Chemie. Leipzig, 1873-, vols. clxix- (see Bolton, (1), 1074).

Ann. Chim. Annales de Chimie (see Vol. III, p. 495).

Ann. de Phys. Annales de Physique.

Ann. di Chim. — see *Annali*.

Ann. École Normale. Annales Scientifique de l'École Normale Supérieure.

Ann. Med. Hist. Annals of Medical History. New York.

Ann. Mines. Annales des Mines.

Ann. Mus. Hist. Nat. Annales du Muséum d'Histoire Naturelle.

Ann. Pharm. — see *Ann.*

Ann. Phil. Annals of Philosophy (ed. T. Thomson, 1813-20, vols. i-xvi; 2 ser., ed. R. Phillips, 1821-6, vols. i-xii).

Ann. Phys. Began as *J. der Phys.* and *N. J. der Phys.*, ed. Gren (see these). Continued as:

(a) *Annalen der Physik*, ed. L. W. Gilbert. Halle, 1799–1808, vols. i–xx; Neue Folge, 1809–18, vols. xxi–lx (also renumbered i–xxx; Supplement to xii, 1803); (b) *Annalen der Physik und der physikalischen Chemie*, ed. L. W. Gilbert. Dritte Reihe (Neueste Folge). Halle, 1819–24, vols. lxi–lxxvi (renumbered i–xvi). (c) *Annalen der Physik und Chemie*, ed. J. C. Poggendorff. Berlin, six series (i) 1824–33, vols. lxxvii–cvi (renumbered i–xxx), (ii) 1834–43, vols. cvii–cxxxvi (renumbered i–xxx), (iii) 1844–53, vols. cxxxvii–clxvi (renumbered i–xxx), (iv) 1854–63, vols. clxvii–cxcvi (renumbered i–xxx), (v) 1864–73, vols. cxcvii–ccxxvi (renumbered i–xxx); (vi) 1874–7, vols. ccxxvii–ccxxvi (renumbered i–x). (d) *Annalen der Physik und Chemie*, ed. G. Wiedemann. Leipzig, 1877–99, vols. ccxxvii–cccv (renumbered i–lxix). (e) *Annalen der Physik*, ed. P. Drude, etc. Leipzig, 1900–, ccxvi– (renumbered i, etc.) to date.

Ann. Phys. Ergzb. Annalen der Physik Ergänzungsbände, vols. i (1842), ii (1848), iii (1853), iv (1854), v (1871), vi (1874), vii (1876), viii (1878). Jubelbd. Poggendorff Jubelband, 1874. Since the references were collected at various times, the alternative volume numeration occurs, sometimes on the same page. The year and *either* volume number fixes the volume without ambiguity.

Ann. Rep. Chem. Soc. Annual Reports on the Progress of Chemistry. (The Chemical Society, London.)

Ann. Rep. Smithsonian Inst. Annual Reports of the Smithsonian Institution. Washington.

Ann. Sci. Annals of Science.

Ann. Sci. Univ. Jassy. Annales Scientifique de l'Université de Jassy. Jassy, Rumania.

Annali. Annali di Chimica, ed. L. Brugnatelli. Pavia.

Anzeiger — see *Bull. Acad. Cracovie*.

Arch. exper. Pathol. Archiv für experimentelle Pathologie und Pharmakologie. Leipzig.

Arch. Néerl. Archives Néerlandais des Sciences Exactes et Naturelles. Sér. Sciences Exactes. The Hague.

Arch. Sci. Phys. Nat. Archives des Sciences Physiques et Naturelles. Geneva (contin. of *Bibl. Univ.* and at first bound with this).

Archeion. Archeion. Archivio di Storia della Scienza, etc. Rome.

Archiv f. d. ges. Naturlehre. Archiv für die gesamte Naturlehre, ed. C. W. G. Kastner. Nürnberg.

Archives. Archives Internationale d'Histoire des Sciences (cont. of *Archeion*).

Archivio — see *Archeion*.

Astrophys. J. The Astrophysical Journal. Chicago.

Atti R. Accad. Lincei. Atti della Reale Accademia dei Lincei. Rendiconti. Classe di Scienza Fisiche, Matematiche e Naturali. Rome.

Atti R. Accad. Torino. Atti della Reale Accademia della Scienza di Torino. Turin.

Atti Ist. Veneto. Atti della adunanze dell' I.R. [Imperiale Reale] Istituto Veneto di Scienze, Lettere ed Arti. Venice.

B.A. Rep. British Association for the Advancement of Science. Reports of Meetings.

Ber. Berichte der Deutschen Chemischen Gesellschaft.

Ber. Akad. Berlin. Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin (1836–55; see *Monatsber.*).

Ber. Deutsch. Bot. Ges. Berichte der Deutschen Botanischen Gesellschaft.

Ber. Deutsch. Pharm. Ges. Berichte der Deutschen Pharmazeutischen Gesellschaft.

- Ber. Naturforsch. Ges. Freiburg.* Bericht der Naturforschenden Gesellschaft zu Freiburg im Breisgau. Freiburg im Breisgau.
- Ber. Sächs. Ges.* Berichte über die Verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften zu Leipzig. Berlin.
- Beschäft. Berlin. Ges. naturforsch. Freunde.* Beschäftigungen der Berlinischen Gesellschaft naturforschender Freunde.
- Bibl. Brit.* Bibliothèque Britannique. Geneva.
- Bibl. Univ.* Bibliothèque Universelle. Geneva.
- Bihang KAH.* Bihang till Kongliga Svenska Vetenskaps-Akademiens Handlingar. Stockholm.
- Biochem. J.* Biochemical Journal. Cambridge.
- Biochem. Z.* Biochemische Zeitschrift.
- Biogr. Mem. F.R.S.* Biographical Memoirs of Fellows of the Royal Society (London).
- Brandes' Archiv.* Archiv [der Pharmacie] des Apotheker-Vereines im nördlichen Teutschland, ed. R. Brandes.
- British J. Hist. Sci.* The British Journal of the History of Science.
- Brit. Med. J.* British Medical Journal.
- Bull. Acad. Bruxelles.* Bulletin de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles. Brussels.
- Bull. Acad. Cracovie.* Bulletin Internationale de l'Académie des Sciences de Cracovie. Série A. Sciences mathématiques. Cracow. (In German as *Anzeiger der Akademie der Wissenschaften in Krakau.*)
- Bull. Acad. Roy. Belg.* Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique (contd. as *Bulletin de la Classe des Sciences. Académie Royale de Belgique*). Brussels.
- Bull. [later Phys. Math.] Acad. St. Pétersb.* Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg. St. Petersburg (Leningrad).
- Bull. Chem. Soc. Japan.* Bulletin of the Chemical Society of Japan. Tokyo.
- Bull. Sci. Pharmacol.* Bulletin des Sciences Pharmacologiques.
- Bull. Soc. Chim.* Bullétin de la Société Chimique de Paris (from 1906, de France).
- Bull. Soc. Chim. Belg.* Bulletin de la Société Chimique de Belgique. Ghent.
- Bull. Soc. Ind. Min.* Bulletin de la Société de l'Industrie Minérale de St. Étienne.
- Bull. Soc. Min.* Bulletin de la Société Française de Minéralogie.
- Bull. Soc. Philomath.* Bulletin des Sciences par la Société Philomathique.
- Bur. Stand. Bull.* Bulletin of the Bureau of Standards. Washington.
- Canad. J. Res.* Canadian Journal of Research. Ottawa.
- Chem. Age.* Chemical Age.
- Chem. and Ind.* Chemistry and Industry.
- Chem. Gaz.* Chemical Gazette.
- Chem. Ind.* Die chemische Industrie. Leipzig.
- Chem. News.* Chemical News.
- Chem. Weekbl.* Chemisch Weekblad, Amsterdam.
- Chem. Ztg.* Chemiker-Zeitung. Cöthen.
- Chim. et Ind.* Chimie et Industrie.
- Comment. Acad. Petropol.* Commentarii Academiae Scientiarum Imperialis Petropolitanae. St. Petersburg (Leningrad).
- Comment. Soc. Gott.* Commentarii Societatis Regiae Scientiarum Gottingensis. Göttingen.
- Comment. Soc. Phys. Med. Univ. Mosquensem.* Commentationes Societatis Physico-Medicae apud Universitatem Mosquensem institutae. Moscow.

- Compt. Rend.* Comptes Rendus hebdomadaires de l'Académie des Sciences. Paris.
Compt. Rend. des Trav. Comptes Rendus des Travaux Chimiques (see p. 408).
Conseil Solvay. Institut International Solvay. Rapports et Discussions du Conseil de Chimie.
Copenhagen Univ. Festskrifter. Festskrifter utgivne i Anledning af Universitetets Firhundredaarsfest. Copenhagen (5 vols. 1879).
 Crell's *Ann.* Chemische Annalen, ed. L. F. F. von Crell. Helmstädt.
 Crell's *Chym. Archiv.* Chymisches Archiv, ed. Crell, Leipzig.
 Crell's *N. Entdeck.* Neuesten Entdeckungen in der Chemie, ed. Crell. Leipzig.
Denkschr. Acad. Wiss. Munich. Bayerische Akademie der Wissenschaften. Denkschriften. Munich.
Denkschr. K. Akad. Wiss. Wien. Math.-naturwiss. Cl. Denkschriften der Kaiserlichen Akademie der Wissenschaften. Wien. Mathematisch-naturwissenschaftlichen Classe. Vienna.
Dingl[er's]. J. Dingler's Polytechnisches Journal. Stuttgart.
Dublin J. Med. Sci. Dublin Journal of Medical Science. Dublin.
Edin. J. Sci. Edinburgh Journal of Science. Edinburgh.
Edin. Med. and Surg. J. Edinburgh Medical and Surgical Journal. Edinburgh.
Edin. N. Phil. J. Edinburgh New Philosophical Journal. Edinburgh.
Edin. Phil. J. Edinburgh Philosophical Journal. Edinburgh.
Elektrotechn. Z. Elektrotechnische Zeitschrift.
Forhandlinger i Vidensk.-Selskab. i Christiania — see p. 589.
Fortschr. Min. Krist. Petr. Fortschritte der Mineralogie, Kristallographie und Petrographie. Jena.
 Froriep — see Notizen.
Gazz. Gazzetta Chimica Italiana. Rome.
Gen. Elec. Rev. General Electric Review. Schenectady, New York.
Ges. Abhl. Gesammelte Abhandlungen.
Giorn. Fis. Med. Giornale Fisico-Medico, ed. Brugnattelli. Pavia.
Glasgow Med. J. Glasgow Medical Journal. Glasgow.
Gött. Nachr. Nachrichten der Akademie der Wissenschaften zu Göttingen. Mathematisch-physikalische Klasse. Berlin.
 Gren — see *J. der Phys.* and *N. J. der Phys.*
Helv. Chim. Acta. Helvetica Chimica Acta. Basel.
Ind. Eng. Chem. Industrial and Engineering Chemistry. Easton, Pa. (also News Edition).
Institut L'. L'Institut. Journal Universel des Sciences et des Sociétés Savantes en France et à l'Étranger, 1^{re} Section.
Isis. Isis, old, ed. by Oken; new, ed. by G. Sarton, etc.
J. Amer. Chem. Soc. Journal of the American Chemical Society. Easton, Pa.
J. Amer. Pharm. Assoc. Journal of the American Pharmaceutical Association. Baltimore, and Easton, Pa.
J. Chem. [Phys.]. This periodical comprises five sets:
 - (1) *Allgem. J. Chem.* Allgemeines Journal der Chemie, ed. A. N. Scherer. Leipzig. 1798–1803, vols. i–x.
 - (2) *N. Allgem. J. Chem.* Neues allgemeines Journal der Chemie, ed. A. F. Gehlen. Leipzig. 1803–6, vols. i–viii.
 - (3) Journal für die Chemie [, Physik from vol. iv] und Mineralogie, ed. Gehlen. Berlin. 1806–10, 9 vols.
 - (4) Journal für Chemie und Physik, ed. J. S. C. Schweigger. Nürnberg. 1811–33, 69 vols. with some changes of title (see Bolton, (1), 1071).

- (5) *Journal für praktische Chemie*. Leipzig. 1834– (also having alternative vol. numbers).
- J. Chem. Educ.* Journal of Chemical Education. Easton, Pa.
- J. Chem. Soc.* Journal of the Chemical Society (London).
- J. Chim. Méd.* Journal de Chimie Médicale.
- J. Chim. Pharm.* — see *J. de Pharm.*
- J. Chim. Phys.* Journal de Chimie Physique.
- J. Franklin. Inst.* Journal of the Franklin Institute. Philadelphia.
- J. Gen. Physiol.* Journal of General Physiology. Baltimore.
- J. Inst. Fuel.* Journal of the Institute of Fuel.
- J. Mines.* Journal des Mines.
- J. Pharm.* Journal of Pharmacy.
- J. Phys. Chem.* Journal of Physical Chemistry. Ithaca and Easton, Pa.
- J. Physiol.* Journal of Physiology.
- J. prakt. Chem.* — see *J. Chem.* (5).
- J. Roy. Agric. Soc.* Journal of the Royal Agricultural Society of England.
- J. Roy. Dublin Soc.* Journal of the Royal Dublin Society. Dublin.
- J. Roy. Inst.* Journal of the Royal Institution of Great Britain.
- J. Roy. Inst. Chem.* Journal of the Royal Institute of Chemistry.
- J. Roy. Soc. Arts.* Journal of the Royal Society of Arts.
- J. Russ. Phys. Chem. Soc.* Journal of the Russian Physical and Chemical Society (in Russian). St. Petersburg (Leningrad); C = chemical section.
- J. Sci. Arts.* Journal of Science and the Arts. Royal Institution (London); from 1819, vol. vii, Quarterly Journal of Science and the Arts (see page 104).
- J. Soc. Arts.* Journal of the Society of Arts.
- J. Soc. Chem. Ind.* Journal of the Society of Chemical Industry.
- J. Washington Acad.* Journal of the Washington Academy of Science. Washington.
- J. de l'École Polytechn.* Journal de l'École Polytechnique.
- J. de Pharm.* Journal de Pharmacie et de Chimie.
- J. de Phys.* Journal de Physique.
- J. der Pharm.* Journal der Pharmacie für Aerzte und Apotheker, ed. J. B. Trommsdorff. Leipzig.
- J. der Phys.* Journal der Physik, ed. F. A. C. Gren. Halle and Leipzig.
- J. des Math.* Journal des Mathématiques pures et appliquées.
- J. des Sav.* Journal des Savants.
- Jahrb. Min.* Jahrbuch für Mineralogie, Geognosie, Geologie und Petrafaktenkunde. Heidelberg.
- Jahrb. Radioakt. Elektronik.* Jahrbuch der Radioaktivität und Elektronik.
- Jahrbücher für Botanik.* Jahrbücher für wissenschaftliche Botanik, ed. N. Pringsheim.
- Jahresb.* Jahresbericht über die Fortschritte der Chemie, etc. Giessen.
- Jahresb. Phys. Ver. Frankfurt.* Jahres-Bericht des Physikalischen Vereins zu Frankfurt am Main. Frankfurt am Main (1859–62).
- Jahres-Ber.* — see Berzelius, (4) (a).
- Jenaische Zeitschr. f. Med. und Naturwiss.* Jenaische Zeitschrift für Medicin und Naturwissenschaften. Leipzig.
- KAH. Kongliga Svenska Vetenskaps-Academiens Handlingar. Stockholm.
- K. *Danske Vidensk. Selskabs Forhl.* Kongelige Danske Videnskabernes Selskabs Forhandlingar. Copenhagen.
- K. *Dansk. Vidensk. Selsk[abs]. Meddel.* Det Kongelige Danske Videnskabernes Selskabs Mathematisk-fysiske Meddeleser. Copenhagen.

- K. Danske Vidensk. Selsk[ab]. Skr.* Det Kongelige Danske Videnskabernes Selskabs Skrifter (Skrifter). Naturvidenskabelig og Mathematisk Afdeling. Copenhagen.
- Kastner — see *Archiv f. d. ges. Naturlehre*.
- Koll. Beih.* Kolloidchemische Beihefte (from 1931 Kolloid Beihefte). Dresden.
- Koll. Z.* Kolloid Zeitschrift (earlier vols. Zeitschrift für Chemie und Industrie der Kolloide). Dresden.
- Krakau Acad. Anzeiger* — see *Bull. Acad. Cracovie*.
- Leipzig Ber.* — see *Ber. Sächs. Ges.*
- L'Institut* — see *Institut L'*.
- Mag. f. d. neuesten Zustand d. Naturkunde.* Magazin für den neuesten Zustand der Naturkunde. Ed. J. H. Voigt. Jena and Weimar, 12 vols., 1797-1806.
- Mag. Pharm.* Magazin für die neueste Erfahrungen im Gebiete der Pharmacie. Karlsruhe (1823-31).
- Manchester Mem. (Proc.)*. Memoirs (Proceedings) of the Manchester Literary and Philosophical Society. Manchester.
- Med. Chirurg. Trans.* Medico-Chirurgical Transactions.
- Meddel. [K. Vetensk.] Nobelinst.* Meddelanden från K. Vetenskapsakademiens Nobelinstitut. Stockholm.
- Mém. de l'Acad.* — see AdS.
- Mém. Acad. Berlin.* Histoire [et Mémoires] de l'Académie Royale des Sciences et des Belles-Lettres de Berlin.
- Mém. Acad. Roy. Belg.* Mémoires de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 4°. Brussels.
- Mém. Acad. St. Pétersb.* Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg. St. Petersburg (Leningrad).
- Mem. [R.] Accad. Torino.* Memorie della Reale Accademia di Scienza di Torino. Turin.
- Mém. Acad. Turin.* Mémoires de l'Académie Royale des Sciences à Turin. Turin.
- Mem. Chem. Soc.* Memoirs of the Chemical Society.
- Mém. de l'Inst.* Mémoires de l'Institut de France. Classe des Sciences Mathématiques et Physiques.
- Mem. Mat. Phys. Soc. Ital. Sci.* Memorie di Mathematica e di Fisica della Società Italiana delle Scienza, residente in Modena. Modena.
- Mem. R. Istituto Veneto.* Memorie dell' I.R. Istituto Veneto di Scienze, Lettere ed Arti. Venice.
- Mém. Mus. Hist. Nat.* Mémoires du Museum d'Histoire Naturelle.
- Mém. Soc. Arcueil.* Mémoires de Physique et de Chimie de la Société d'Arcueil.
- Mém. Soc. Impér. des Naturalistes de Moscou.* Memoirs de la Société Impériale des Naturalistes de Moscou. Moscow.
- Mém. Soc. [Phys. Hist. Nat.] Genève.* Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Geneva.
- Mém. Soc. Roy. Sci. Lille.* Mémoires de la Société Royale des Sciences, de l'Agriculture et des Arts de Lille. Lille.
- Mém. Soc. Sci. Phys. Nat. Bordeaux.* Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux. Bordeaux.
- MGM. Mitteilungen zur Geschichte der Medizin und der Naturwissenschaften. Hamburg and Leipzig.
- Min. Petr. Mitt.* Mineralogische und petrographische Mitteilungen, ed. Tschermak. Leipzig, Vienna.
- Miscell. Acad. Nat. Curios.* Miscellanea curiosa sive Ephemerides Medico-Physicæ Germanicæ Academiae Naturæ Curiosorum. Nürnberg.

- Monatsber. Akad. Berlin.* Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin (1856–81; see *Sitzb. Berlin Akad.*).
- Monatsh.* Monatshefte für Chemie. Vienna.
- Moniteur; Monit. Scient.* Le Moniteur Scientifique. Journal des Sciences Pures et Appliquées, ed. Quesneville, 1857–. (The old *Moniteur* quoted in earlier chapters is different.)
- Munich Ber.* — see *Sitzb. Akad. Munich.*
- N. Allgem. J. Chem.* — see *J. Chem.*
- N. J. Pharm.* Neues Journal der Pharmacie, ed. Trommsdorff. Leipzig.
- N. J. der Phys.* Neues Journal der Physik, ed. F. A. C. Gren. Halle and Leipzig (1794–8, 4 vols.).
- N. Jahrb. Min.* Neues Jahrbuch für Mineralogie, Geologie und Paläontologie. *Ib., Beil. B.,* Beilage-Band. Stuttgart.
- Naturwiss.* Die Naturwissenschaften. Leipzig.
- Nicholson's J.* Journal of Natural Philosophy, Chemistry, and the Arts, ed. W. Nicholson.
- Notizen.* Notizen aus dem Gebiete der Natur- und Heilkunde, ed. L. F. von Froriep. Erfurt.
- Nouv. Bull. Soc. Philomath.* Nouveau Bulletin des Sciences par la Société Philomathique.
- Nouv. Mém. Acad. Dijon.* Nouveau Mémoires de l'Académie des Sciences [etc.] de Dijon. Dijon.
- Nuov. Cim.* Il Nuovo Cimento. Pisa and Bologna.
- Obit. Not. F.R.S.* Obituary Notices of Fellows of the Royal Society.
- Obs. Phys.* Observations sur la Physique, sur l'Histoire Naturelle et sur les Arts.
- Öfversigt KAF.* Öfversigt af K. Vetenskaps Akademiens Förhandlingar. Stockholm.
- Oversigt K. Dansk. Selskabs Forhl.* Oversigt over det Kongelige Danske Videnskabernes Selskabs Forhandlingar. Copenhagen.
- Österr. Chem. Ztg.* Österreichische Chemiker Zeitung. Vienna.
- Ostwald's Klassiker.* Klassiker der exacten Naturwissenschaften, ed. W. Ostwald. Leipzig.
- Pflüger's Archiv.* Archiv für die gesamte Physiologie des Menschen und die Tiere, ed. E. F. W. Pflüger.
- Pharm. J.* Pharmaceutical Journal.
- Phil. Mag.* Philosophical Magazine.
- Phil. Trans.* Philosophical Transactions of the Royal Society of London (sect. A unless B specified).
- Phys. Rev.* Physical Review. New York; Lancaster, Pa.
- Phys. Z.* Physikalische Zeitschrift. Leipzig.
- Proc. Amer. Acad.* Proceedings of the American Academy of Arts and Sciences. Boston.
- Proc. Amer. Phil. Soc.* Proceedings of the American Philosophical Society. Philadelphia.
- Proc. Amsterdam Acad.* — see *Proc. K. Akad. Wetens. Amsterdam.*
- Proc. Ashmolean Soc.* Proceedings of the Ashmolean Society. Oxford.
- Proc. Belfast Nat. Hist. and Phil. Soc.* Proceedings of the Belfast Natural History and Philosophical Society. Belfast.
- Proc. Cambr. Phil. Soc.* Proceedings of the Cambridge Philosophical Society. Cambridge.
- Proc. Chem. Soc.* Proceedings of the Chemical Society (London).

- Proc. K. Akad., Wetens. Amsterdam.* Proceedings of the Section of Sciences, Koninklijke Akademie van Wetenschappen te Amsterdam. Amsterdam.
- Proc. Nat. Acad. [Sci.]* Proceedings of the National Academy of Sciences of the United States. Washington.
- Proc. Phil. Soc. Glasgow.* Proceedings of the Royal Philosophical Society of Glasgow. Glasgow.
- Proc. Phys. Soc.* Proceedings of the Physical Society (London).
- Proc. Roy. Inst.* Notices of the Proceedings at the Meetings of the Members of the Royal Institution of Great Britain.
- Proc. Roy. Irish Acad.* Proceedings of the Royal Irish Academy. Dublin.
- Proc. Roy. Soc.* Proceedings of the Royal Society of London (sect. A unless B specified).
- Proc. Roy. Soc. Edin.* Proceedings of the Royal Society of Edinburgh. Edinburgh.
- Quart. J. Sci.* Quarterly Journal of Science, ed. J. Samuelson and W. Crookes.
- Rec. Trav. Chim.* Recueil des Travaux Chimiques des Pays-Bas. Leyden.
- Répert. Chim. pure.* Répertoire de Chimie pure, ed. A. Wurtz (9 vols., 1859-62).
- Repert. Pharm.* Repertorium für die Pharmacie, ed. J. A. Buchner and C. W. G. Kastner. Nürnberg.
- Rev. Deux Mondes.* Revue des Deux Mondes.
- Rev. gén. Chim.* Revue générale de Chimie Pure et Appliquée.
- Rev. gén. Sci.* Revue générale des Sciences Pures et Appliquées.
- Rev. Mod. Phys.* Reviews of Modern Physics. Lancaster, Pa.
- Rev[ue]. Sci[ent].* Revue Scientifique et Industrielle, ed. Quesneville.
- Roy. Inst. Chem. Lectures.* Royal Institute of Chemistry Lectures.
- Samml. chem. u. chem.-techn. Vorträge.* Sammlung chemischer und chemisch-technischer Vorträge. Stuttgart.
- Sci. Progr.* Science Progress.
- Sitzb. Akad. Munich.* Sitzungsberichte der Königlich Bayerischen Akademie der Wissenschaften zu München. Munich.
- Sitzb. Akad. Wien* — see *Wien Ber.*
- Sitzb. Berlin Akad.* Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin. Physikalisch-mathematische Klasse (from 1882).
- Sitzb. phys.-med. Soz. Erlangen.* Sitzungsberichten der physikalisch-medizinischen Sozietät in Erlangen. Erlangen.
- Svensk Kem. Tid.* Svensk Kemisk Tidskrift. Stockholm.
- Tidsskrift Phys. Chem.* Tidsskrift for Physik og Chemi. Copenhagen.
- Trans. Amer. Electrochem. Soc.* Transactions of the American Electrochemical Society. New York.
- Trans. Amer. Phil. Soc.* Transactions of the American Philosophical Society. Philadelphia.
- Trans. Cambr. Phil. Soc.* Transactions of the Cambridge Philosophical Society. Cambridge.
- Trans. Connecticut Acad.* Transactions of the Connecticut Academy of Arts and Sciences. New Haven.
- Trans. Faraday Soc.* Transactions of the Faraday Society.
- Trans. Inst. Mining Eng.* Transactions of the Institution of Mining Engineers.
- Trans. Microscop. Soc.* Transactions of the Microscopical Society.
- Trans. Oil and Colour Chemists' Assoc.* Transactions of the Oil and Colour Chemists' Association.
- Trans. Roy. Dublin Soc.* Scientific Transactions of the Royal Dublin Society. Dublin.

- Trans. Roy. Geol. Soc. Cornwall.* Transactions of the Royal Geological Society of Cornwall. Truro.
- Trans. Roy. Irish Acad.* Transactions of the Royal Irish Academy. Dublin.
- Trans. Roy. Soc. Arts.* Transactions of the Royal Society of Arts.
- Trans. Roy. Soc. Edin.* Transactions of the Royal Society of Edinburgh. Edinburgh.
- Trans. Soc. Arts* — see *Trans. Roy. Soc. Arts*.
- Trommsdorff — see *N. J. Pharm.*
- Verh. d. D. Phys. Ges.* Verhandlungen der Deutschen Physikalischen Gesellschaft.
- Verh. K. Akad. Wetens Amsterdam.* Verhandelingen der Koninklijke Akademie van Wetenschappen te Amsterdam. Amsterdam.
- Verh. Nat[urhist]. Med. Vereins [zu] Heidelberg (Verh. Heidelberg Nat. Med. Vereins).* Verhandlungen des Naturhistorischen-Medizinischen Vereins zu Heidelberg. Heidelberg.
- Verh. Naturwiss. Vereins in Karlsruhe.* Verhandlungen des Naturwissenschaftlichen Vereins in Karlsruhe.
- Virchow's Archiv.* Archiv für pathologische Anatomie und Physiologie und für klinische Medizin, ed. R. Virchow.
- Wien Ber.* Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien. Mathematisch-naturwissenschaftliche Klasse. Vienna.
- Wiss. Abhl. Phys. Techn. Reichsanstalt.* Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt.
- Z. anal. Chem.* Zeitschrift für analytische Chemie. Wiesbaden.
- Z. angew. Chem.* Zeitschrift für angewandte Chemie.
- Z. anorg. Chem.* Zeitschrift für anorganische Chemie. Leipzig.
- Z. Elektrochem.* Zeitschrift für Elektrochemie. Halle.
- Z. f. Biol.* Zeitschrift für Biologie. Munich.
- Z. f. Chem.* Zeitschrift für Chemie. Göttingen.
- Z. f. Phys. u. verwandte Wiss.* Zeitschrift für Physik und verwandte Wissenschaften. Vienna.
- Z. Instr.* Zeitschrift für Instrumentenkunde.
- Z. Phys.* Zeitschrift für Physik. Brunswick.
- Z. phys. Chem.* Zeitschrift für physikalische Chemie. Leipzig (A series unless B specified).
- Z. phys. chem. Unterricht.* Zeitschrift für den physikalischen und chemischen Unterricht.
- Z. physiol. Chem.* Zeitschrift für physiologische Chemie, ed. Hoppe-Seyler. Strasbourg, etc.

ERRATA

The first figure in the list denotes the page of the book, the second the line of text from the top of the page or, if asterisked, the foot of the page not counting footnotes; these are indicated by an obelisk (†). The faulty word is not repeated. The correct reading will be obvious.

VOLUME II

18, 3, revive.	315, 10* a σ.	645, 12* fossilibus.
69, 12 fumes.	324, 3* pref. signed Fludd.	744, 3 Leydensi.
126, 20 J[ames]. H[owell].	325, 18† answer unto.	759, 9† 2 ed. 1767.
192, 18 probably James Howell.	334, 1 di alcune.	762, 11 educated at Cambridge; 20-1 delete (by another W. Lewis).
297, 5† <i>artificum</i> (1 ed. Modena, 1700).	449, 12* ventriculum.	786 add galletyle 402.
	512, 8† <i>Discorsi e Dimostrazioni Matematiche</i> .	

VOLUME III

xvix, add <i>A. Med.</i> , <i>A. Nat.</i> , see Vol. II, p. xxi.	98, 13* Procédés.	in 1783 that it was not this nor native antimony (as von Rupperecht thought) but contained gold.
13, 6 (Villefranche-sur-Saône, 1621-Paris, 15 December 1699).	148, 1 dealt with.	723, 5*-6* Anderson's College, later Royal College of Science and Technology.
17, 3 b. Sedan, c. 1610.	174, 12 til.	833 after Hausmann add 547; after Hermann delete J. M. 547.
19, 3* $\frac{3}{4}$ ft.	375, 16* Schönfärberei.	835 read Macquart, L. C. H., for Marquardt.
24, 3* (Basel, 7 January 1628-Paris, end of 1672).	524, 3* metals.	836 Proust, L. J.
25, 1-3 delete.	536, 1*-2* delete.	493, 541, 559, 562, 570-3, 578-9, 617-18, 623, 633, 637, 723.
27, 2 17 or 21 January.	538, 16, see Vol. IV, p. xviii.	
44, 1* (Paris; c. 1652-23 February 1729).	547, 5 J. M. Hausmann.	
66, 11 d. 24 July 1723? or 7 April 1732?	553, 16 L. C. H. Macquart, <i>J. de Phys.</i> , 1789, xxxiv, 389; disc. of chromic acid by Vauquelin, <i>ib.</i> , 1794, xlv, 393.	
72, 17 Caen, 29 June 1701.	657, 3 (Nagyszeben (Herrmanstadt), Transylvania, 1 July 1740-Vienna, 12 October 1825 or 1826).	
73, 2 15 or 16 September.	657, 4 was bismuth sulphide;	
76, 13 baptised 13 February.		