

# ELSEVIER'S ENCYCLOPÆDIA *of* ORGANIC CHEMISTRY

Edited by F. RADT

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*Series III*

CARBOISOCYCLIC CONDENSED COMPOUNDS

*Volume 14 - Supplement*

*Pages 1869 S—2214 S*

STEROIDS

Substituted Monohydroxyl Compounds

Polyhydroxyl Compounds

Edited by A. GEORG

with the assistance of M. Georg-Plant, Dora Stern, and J. Meyer

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(The late) E. JOSEPHY AND F. RADT

## of

# ORGANIC CHEMISTRY

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## PREFACE

The present part of the Supplement to Volume 14 continues the description of the steroids. It comprises the halogen and nitrogen substituted monohydroxylated compounds with one OH in the ring system, and all polyhydroxylated compounds, having at least one OH in the ring system, with or without halogen or nitrogen substituents.

The reader is referred to the preface to the preceding part of this Supplementary Volume for details concerning the period covered, the date and extent to which information from later publications has been included, and for the manner of treatment of degradation products, of material from the literature prior to 1937, and of patents, all of which apply to the present part also.

The nomenclature and notations used, the treatment of the physiology of the steroids, and the sequence of compounds, are those described in the Introduction to the previously published part of this Supplementary Volume (p. 1347 *s et seq.*). As before, a few reaction schemes and numerous summaries of closely related compounds, including data taken from the Main Volume, have been inserted in order to facilitate a rapid comprehension of the matter described.

In conformity with the practice adopted in this Encyclopædia for acid anhydrides, lactones, methylene ethers of dihydroxy-compounds, etc. (cf. General Outline, p. XV), the steroid epoxides are considered as internal ethers of the corresponding dihydroxy-compounds and described as their derivatives, and not in the section of heterocyclic compounds with 1 O.

Subject and Formula Indexes cover both the Main and Supplementary Volumes. Page numbers followed by an "s" refer to the Supplement, those without an "s" to the Main Volume.

A list of Additions and Corrections relating to the Main and Supplementary Volumes is to be found on pp. 2212, 2213 s.

We reiterate our thanks to various libraries and institutions for assistance rendered by virtue of facilities accorded or for the loan of books and periodicals, especially to the Koninklijke Akademie van Wetenschappen, Amsterdam, the University of Southern California, Los Angeles, the California Institute of Technology, Pasadena, and the Ecole de Chimie de l'Université, Geneva. We gratefully acknowledge the help accorded by numerous authors, by whose private communications (some as recent as November 1955) we have been enabled to clear up obscurities and contradictions in the literature.

Geneva, December, 1955

A. GEORG

## GENERAL SURVEY

### SERIES I. ALIPHATIC COMPOUNDS

- Vol. 1. Hydrocarbons, halogen, and nitrogen compounds
- „ 2. Hydroxy- and keto-compounds
- „ 3. Carboxylic acids, S-, Se-, Te-, P-, As-, and metal compounds

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- „ 6. Nitro-, nitroso-, hydroxylamino-, amino-, hydrazino-, diazo-, azo-, azoxy-, triazo-, triazeno-, and other nitrogen compounds
- „ 7. Hydroxy-compounds
- „ 8. Keto-compounds
- „ 9. Carboxylic acids
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#### B. POLYCYCLIC NON-CONDENSED SIX-MEMBERED RING COMPOUNDS

- „ 11. Biphenyl, diphenylmethane, etc.; terphenyl, triphenylmethane, etc.; compounds with 4 phenyl groups, etc.

### SERIES III. CARBOISOCYCLIC CONDENSED COMPOUNDS

- Vol. 12. Bicyclic compounds
- „ 13. Tricyclic compounds
- „ 14. Tetra- and higher cyclic compounds

### SERIES IV. HETEROCYCLIC COMPOUNDS

- Vol. 15. Heterocyclic compounds with 1 N
- „ 16. Heterocyclic compounds with 2 and more N
- „ 17. Heterocyclic compounds with 1 and more O
- „ 18. Heterocyclic compounds with N and O; with S, Se, or other elements

### GENERAL INDEXES

- Vol. 19. General Subject Index and Group Index
- „ 20. General Formula Index

## GENERAL OUTLINE OF THE PLANNING OF THE ENCYCLOPÆDIA AND INDICATIONS TO FACILITATE ITS USE

Elsevier's Encyclopædia of Organic Chemistry has been compiled on the basis of the carbon skeleton. Compounds whose carbon skeleton is broken by other atoms\*, e.g., esters, ethers, alkyl- and acyl derivatives of amines, hydrazines, etc., are described as derivatives of the corresponding carboxylic acid, hydroxy-, amino-, and hydrazino-compounds, etc., generally under the component which is latest in order of systematic sequence; acetyl-, benzoyl-, phthaloyl-, toluenesulphonyl-, and similar derivatives, however, are dealt with under the corresponding hydroxy- or N-compound. As far as possible, derivatives of any given substance have been grouped together, maintaining at the same time the systematic classification by cross references, or by repetition where necessary. Compounds which contain a six-membered ring as well as one of the rings described in Vol. 4 are dealt with in the latter volume. Thus, for example, phenylcyclopropane will be found with the homologues of cyclopropane in Vol. 4, and not, as a cyclopropyl derivative of benzene, in Vol. 5.

Aliphatic compounds (Vols. 1-3) and compounds with the ring systems described in Vols. 4 and 12-18 have been arranged in the same manner as the compounds with six-membered rings in Vols. 5-10. The polycyclic non-condensed compounds of each ring system are also arranged in the same manner as those of the 6-ring range (see Vol. 11), and immediately follow the respective metal compounds of the ring system in question. Accordingly,

\* This does not refer to heterocyclic compounds.

examples for the following general rules can be limited to benzene compounds.

1. Compounds differing only in their degree of saturation are described in immediate succession.

2. Functional groups in the side chain have precedence over similar functional groups in the nucleus; e.g., benzyl alcohol, bis-hydroxymethyl-benzene, etc. precede phenol.

3. Hydrocarbons and compounds having the same functional groups are arranged according to the number of side chains, compounds with one side chain preceding those with two side chains, etc.

4. Compounds containing the same functional group only once are followed by those compounds which, in addition, contain a functional group treated earlier in the system. After these substances are listed the compounds in which the first-named functional group is represented twice. Hence we have the sequence: phenol and its homologues — monohalogenophenols — dihalogenophenols, etc. — nitrophenols — halogenonitrophenols — aminophenols — halogenoaminophenols — nitroaminophenols — halogenonitroaminophenols — hydroxybenzyl alcohol, etc.; dihydroxybenzenes — halogenodihydroxybenzenes, etc. In accordance with this, phenolsulphonic acid will be found in Vol. 10, and not with the hydroxy-compounds in Vol. 7.

5. In the case of tautomers preference has been given to that formulation which most adequately interprets the principal reactions of the compound. In each case, however, a cross reference has been inserted at that place where the alternative tautomeric form belongs in the system.

6. Anhydrides of dicarboxylic acids should be looked for under the latter, not under the heterocyclic compounds with 1 O. Methylene ethers of dihydroxy-compounds are considered as derivatives of the latter, not as heterocyclic compounds with 2 O; thus, piperonal, for example, will be found in Vol. 8.

7. Natural products whose constitution has not been elucidated completely but whose carbon skeleton is known to some extent are dealt with immediately following all other compounds with

the same skeleton. Other natural products are described in connexion with the first product of known composition obtained in their degradation. These natural products which are scattered throughout the various volumes of the Encyclopædia are systematically collected in the Group Index in Vol. 19.

The above instructions, if carefully followed, will in every case ensure a quick decision as to the volume in which to look for a particular compound. Once the right volume has been chosen, it is easy to find the compound wanted, either by consultation of the alphabetical index and the formula index at the end of the volume, or with the aid of the table of contents of the volume or of the individual skeleton systems. After the completion of the whole work, every compound described in the literature may be found irrespective of its systematic location by means of the General Subject Index (Vol. 19) and the General Formula Index (Vol. 20).

Finally, the following points should be observed:

a. The year of publication and the name of the first author are given after each item of information; in cases where several statements regarding one compound are taken from the same paper, the reference is given after the last statement. The full references are listed at the end of short sections.

b. The more important systems are preceded by a detailed survey of the various methods of formation of the nucleus concerned. First their occurrence in nature and in technical products (coal-tar, lignite-tar, etc.) is dealt with. This is followed by syntheses from systems with fewer carbon atoms, then formation by rearrangement of systems with an equal number of carbon atoms, and finally by methods of formation by degradation of more complicated systems.

# TABLE OF ABBREVIATIONS EMPLOYED IN THE TEXT

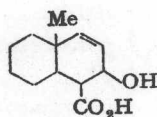
|              |                                                                     |             |                                                                                          |
|--------------|---------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------|
| [ $\alpha$ ] | specific rotation ( $[\alpha]_{D}^{20}$ , for 20° and sodium light) | ca.         | about                                                                                    |
| Å            | Ångström unit(s)                                                    | cal.        | calorie(s)                                                                               |
| abs.         | absolute                                                            | calcd.      | calculated                                                                               |
| absorpt.     | absorption                                                          | c.c.        | cubic centimetre(s)                                                                      |
| Ac           | acetyl (AcCl, acetyl chloride; Ac <sub>2</sub> O, acetic anhydride) | cf.         | compare                                                                                  |
| addn.        | addition                                                            | cm.         | centimetre(s)                                                                            |
| alc.         | alcohol, alcoholic                                                  | coeff.      | coefficient                                                                              |
| alk.         | alkaline                                                            | compd.      | compound                                                                                 |
| alkali       | caustic alkali                                                      | compn.      | composition                                                                              |
| Am           | amyl                                                                | conc.       | concentrated                                                                             |
| amp.         | ampere(s)                                                           | concn.      | concentration                                                                            |
| amt.         | amount                                                              | cond.       | conductivity                                                                             |
| anh.         | anhydrous                                                           | condens.    | condensation                                                                             |
| approx.      | approximate, approximately                                          | const.      | constant                                                                                 |
| aq.          | aqueous                                                             | contg.      | containing                                                                               |
| assoc.       | associate(s)                                                        | cor.        | corrected                                                                                |
| assocd.      | associated                                                          | corresp.    | corresponding                                                                            |
| assocn.      | association                                                         | crit.       | critical                                                                                 |
| asym.        | asymmetrical                                                        | cryst.      | crystalline, crystals                                                                    |
| at.          | atom(s), atomic                                                     | crystd.     | crystallized                                                                             |
| atm.         | atmosphere(s), atmospheric                                          | crystn.     | crystallization                                                                          |
| av.          | average                                                             | D           | Debye unit (10 <sup>-18</sup> e.s.u. x cm.)                                              |
| b.           | (followed by a figure denoting temperature) boils at, boiling at    | d           | density (d <sub>4</sub> <sup>13</sup> , specific gravity at 13° referred to water at 4°) |
| bacteriol.   | bacteriological                                                     | dec.        | decomposed, decomposition                                                                |
| biol.        | biological                                                          | deriv.      | derivative                                                                               |
| b.p.         | boiling point                                                       | det.        | determine                                                                                |
| Bu           | n-butyl                                                             | detd.       | determined                                                                               |
| Bz           | benzoyl (BzCl, benzoyl chloride)                                    | detn.       | determination                                                                            |
|              |                                                                     | dextroroty. | dextrorotatory                                                                           |
|              |                                                                     | diazotd.    | diazotized                                                                               |
|              |                                                                     | diazotn.    | diazotization                                                                            |
|              |                                                                     | dil.        | dilute                                                                                   |

|                                |                                        |              |                                                                                                                                |
|--------------------------------|----------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------|
| dild.                          | diluted                                | lb.          | pound(s)                                                                                                                       |
| diln.                          | dilution                               | m.           | molar                                                                                                                          |
| dispn.                         | dispersion                             | M            | (with subscript) molecular refraction                                                                                          |
| dissoc.                        | dissociate(s)                          | m.           | (followed by a figure denoting temperature) melts at, melting at; also metre(s)                                                |
| dissocd.                       | dissociated                            | ma.          | milliampere(s)                                                                                                                 |
| disso.cn.                      | dissociation                           | max.         | maximum, maxima                                                                                                                |
| distd.                         | distilled                              | Me           | methyl (MeOH, methanol)                                                                                                        |
| distg.                         | distilling                             | meth.        | methyl alcoholic                                                                                                               |
| distn.                         | distillation                           | mg.          | milligram(s)                                                                                                                   |
| elec.                          | electric, electrical                   | min.         | minimum; also minute(s)                                                                                                        |
| e.m.f.                         | electromotive force                    | mixt.        | mixture                                                                                                                        |
| equil.                         | equilibrium                            | ml.          | millilitre(s)                                                                                                                  |
| equiv.                         | equivalent                             | mm.          | millimetre(s)                                                                                                                  |
| Et                             | ethyl (Et <sub>2</sub> O, ethyl ether) | mμ           | 10 <sup>-6</sup> mm. (10 Å)                                                                                                    |
| evap.                          | evaporate                              | mmt.         | moment                                                                                                                         |
| evapd.                         | evaporated                             | mol.         | molecule, molecular, mole                                                                                                      |
| evapg.                         | evaporating                            | m.p.         | melting point                                                                                                                  |
| evapn.                         | evaporation                            | mutarotn.    | mutarotation                                                                                                                   |
| evoln.                         | evolution                              | mv.          | millivolt(s)                                                                                                                   |
| examn.                         | examination                            | n            | index of refraction ( $n_D^{20}$ , for 20° and sodium light); also number of molecules in the crystallographic elementary cell |
| expt.                          | experiment                             | N            | normal (as applied to concn.)                                                                                                  |
| exptl.                         | experimental                           | neg.         | negative                                                                                                                       |
| extrd.                         | extracted                              | No.          | number                                                                                                                         |
| extrg.                         | extracting                             | obtd.        | obtained                                                                                                                       |
| extrn.                         | extraction                             | occ.         | occurrence                                                                                                                     |
| fluoresc.                      | fluorescence                           | opt. act.    | optically active                                                                                                               |
| fmn.                           | formation                              | org.         | organic                                                                                                                        |
| f.p.                           | freezing point                         | oxid.        | oxidized                                                                                                                       |
| fwd.                           | followed                               | oxidn.       | oxidation                                                                                                                      |
| g.                             | gram(s)                                | p.           | page                                                                                                                           |
| γ                              | microgram(s)                           | Pat.         | Patent; see Table of Periodicals under country of issue                                                                        |
| H <sub>2</sub> SO <sub>4</sub> | conc. sulphuric acid                   | pathol.      | pathological                                                                                                                   |
| hr.                            | hour                                   | petrol.ether | petroleum ether                                                                                                                |
| hydrol.                        | hydrolysis                             | Ph           | phenyl                                                                                                                         |
| hydrold.                       | hydrolysed                             | pharmacol.   | pharmacological                                                                                                                |
| inorg.                         | inorganic                              | phys.        | physical                                                                                                                       |
| insol.                         | insoluble                              | physiol.     | physiological                                                                                                                  |
| isold.                         | isolated                               | pos.         | positive                                                                                                                       |
| isoldn.                        | isolation                              |              |                                                                                                                                |
| °K.                            | °Kelvin                                |              |                                                                                                                                |
| kg.                            | kilogram(s)                            |              |                                                                                                                                |
| kg.-cal.                       | kilogram calorie(s)                    |              |                                                                                                                                |
| kv.                            | kilovolt(s)                            |              |                                                                                                                                |
| kw.                            | kilowatt(s)                            |              |                                                                                                                                |
| l.                             | litre(s)                               |              |                                                                                                                                |
| lævoroty.                      | lævorotatory                           |              |                                                                                                                                |

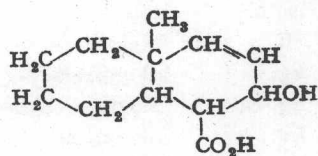
|             |                       |         |                      |
|-------------|-----------------------|---------|----------------------|
| powd.       | powdered              | sapong. | saponifying          |
| pp.         | pages                 | satd.   | saturated            |
| ppt.        | precipitate           | satg.   | saturating           |
| pptd.       | precipitated          | satn.   | saturation           |
| pptg.       | precipitating         | sec.    | second(s), secondary |
| pptn.       | precipitation         | sepd.   | separated            |
| Pr          | propyl                | sepg.   | separating           |
| prepd.      | prepared              | sepn.   | separation           |
| prepg.      | preparing             | sol.    | soluble              |
| prepn.      | preparation           | soln.   | solution             |
| prim.       | primary               | soly.   | solubility           |
| priv. comm. | private communication | sp.     | specific             |
| prod.       | product               | sp. gr. | specific gravity     |
| pyr.        | pyridine              | spectr. | spectrum             |
| qual.       | qualitative           | sq. in. | square inch          |
| quant.      | quantitative          | subl.   | sublimes             |
| rac.        | racemic               | subln.  | sublimation          |
| recrystd.   | recrystallized        | subst.  | substance            |
| recrystn.   | recrystallization     | sym.    | symmetrical          |
| red.        | reduced               | synth.  | synthesis            |
| redn.       | reduction             | temp.   | temperature          |
| ref.        | references            | tert.   | tertiary             |
| resoln.     | resolution            | unsatd. | unsaturated          |
| resp.       | respectively          | v.      | volt(s)              |
| rn.         | reaction              | vac.    | vacuum, vacuo        |
| rotn.       | rotation              | vol.    | volume               |
| roty.       | rotatory              | w.      | watt(s)              |
| sapon.      | saponification        | wt.     | weight               |
| sapond.     | saponified            |         |                      |

## REPRODUCTION OF STRUCTURAL FORMULÆ

In the structural formulæ a single line always means a single bond; e.g., the formula



represents



For the expression of stereochemical configuration by the use of dotted and wavy lines, see the Introduction, p. 1357 s.

## TABLE OF PERIODICALS

### ABBREVIATED TITLE

*Abhandl. deut. Bunsen Ges.*  
*Acta Acad. Aboensis, Math. Phys.*  
*Acta Brevia Neerland.*

*Acta Chem. Scand.*  
*Acta Dermatol.*

*Acta Forestalia Fennicae*  
*Acta Lit. Sci. Univ. Hung.*  
*Sect. Chem. Mineral. Phys.*

*Acta Lit. Sci. Univ. Hung. Sect.*  
*Sci. Nat.*

*Acta Med. Scand.*  
*Acta Physicochim. U.R.S.S.*  
*Acta Physiol. Scand.*  
*Acta Phys. Polon.*  
*Acta Phytochim.*  
*Acta Polon. Pharm.*  
*Acta Schol. Med. Univ. Imp.*

*Kioto*  
*Acta Unio Intern. contra Cancrum*  
*Acta Univ. Latviensis, Kim.*  
*Fakult. Serija*  
*Acta Univ. Szegediensis,*  
*Sect. Sci. Nat.*

*Akust. Z.*  
*Am. Ch. J.*  
*Am. Dyestuff Reprtr.*  
*Am. Gas Assoc., Proc.*

*Am. Gas J.*  
*Am. J. Botany*  
*Am. J. Cancer*  
*Am. J. Hyg.*  
*Am. J. Med. Sci.*  
*Am. J. Obstet. Gynecol.*  
*Am. J. Ophthalmol.*  
*Am. J. Path.*  
*Am. J. Pharm.*  
*Am. J. Physiol.*

### FULL TITLE

Abhandlungen der deutschen Bunsen-Gesellschaft  
 Acta Academiae Aboensis, Mathematica et Physica  
 Acta Brevia Neerlandica de Physiologia, Pharmacologia, Microbiologia, e.a.  
 Acta Chemica Scandinavica  
 Acta Dermatologica (Dermatologia, Syphilidologia et Urologia) (Japan)

Acta Forestalia Fennicae  
 Acta Litterarum ac Scientiarum Regiae Universitatis Hungaricae Francisco-Josephinae. Sectio Chemica, Mineralogica et Physica, Acta Chemica, Mineralogica et Physica

Acta Litterarum ac Scientiarum Regiae Universitatis Hungaricae Francisco-Josephinae. Sectio Scientiarum Naturalium

Acta Medica Scandinavica  
 Acta Physicochimica U.R.S.S.  
 Acta Physiologica Scandinavica  
 Acta Physica Polonica  
 Acta Phytochimica (Japan)  
 Acta Poloniae Pharmaceutica

Acta Scholae Medicinalis Universitatis Imperialis in Kioto

Acta. Unio Internationalis contra Cancrum  
 Acta Universitatis Latviensis, Kimijas Fakultates Serija

Acta Universitatis Szegediensis, Sectio Scientiarum Naturalium (*Acta Chem. Mineral. et Phys.* = Acta Chemica, Mineralogica et Physica)

Akustische Zeitschrift  
 American Chemical Journal  
 American Dyestuff Reporter  
 American Gas Association, Proceedings of the Annual Convention

American Gas Journal  
 American Journal of Botany  
 The American Journal of Cancer  
 The American Journal of Hygiene  
 American Journal of the Medical Sciences  
 American Journal of Obstetrics and Gynecology  
 American Journal of Ophthalmology  
 The American Journal of Pathology  
 American Journal of Pharmacy  
 The American Journal of Physiology

## ABBREVIATED TITLE

*Am. J. Sci.*  
*Am. Mineralogist*  
*Am. Paint J.*  
*Am. Perfumer Essent. Oil Rev.*  
*Am. Rev. Tuberc.*  
*Anal. Chem.*  
*Anales asoc. quim. Argentina*  
*Anales fs. quim.*  
*Anales soc. cient. argentina*  
*Anales soc. españ. fs. quim.*  
*Analyst*  
*Anat. Record*  
*Anesthesiology*  
*Angew. Botan.*  
*Angew. Ch.*

*Ann.*

*Ann. Acad. Sci. Fennicae*  
*Ann. acad. sci. tech. Varsovie*

*Ann. Applied Biol.*  
*Ann. Botany*  
*Ann. chim.*

*Ann. chim. anal.*  
*Ann. chim. anal. chim. appl.*

*Ann. chim. applicata*  
*Ann. combustibles liquides*  
*Ann. faculté sci. Marseille*  
*Ann. fals.*  
*Ann. inst. anal. phys.-chim.*  
 (U.S.S.R.)

*Ann. inst. Pasteur*  
*Ann. Internal Med.*  
*Ann. jardin bot. Buitenzorg*  
*Ann. méd. légale*

*Ann. méd. (Paris)*  
*Ann. mines & carburants*  
*Ann. N. Y. Acad. Sci.*  
*Ann. Philosophy*  
*Ann. phys.*  
*Ann. Physik*

*Ann. Rept. Agr. and Hort.*  
*Research Sta., Long Ashton,*  
*Bristol*  
*Ann. Rept., East Malling*  
*Research Sta., Kent*  
*Ann. Rev. Biochem.*  
*Ann. sci. École normale*

## FULL TITLE

American Journal of Science  
 The American Mineralogist  
 American Paint Journal  
 The American Perfumer and Essential Oil Review  
 The American Review of Tuberculosis  
 Analytical Chemistry  
 Anales de la asociación química Argentina  
 Anales de física y química (Madrid)  
 Anales de la sociedad científica argentina  
 Anales de la sociedad española de física y química  
 The Analyst  
 The Anatomical Record  
 Anesthesiology  
 Angewandte Botanik  
 Angewandte Chemie; before 1932 Zeitschrift für angewandte Chemie; between 1942 and 1944 incl. Die Chemie  
 Annalen der Chemie, Justus Liebig's; before 1840 Annalen der Pharmacie; from 1840-1874 (Vol. 172)  
 Annalen der Chemie und Pharmacie  
 Annales Academiae Scientiarum Fennicae  
 Annales de l'académie des sciences techniques à Varsovie  
 The Annals of Applied Biology  
 Annals of Botany  
 Annales de chimie; before 1914 Annales de chimie et de physique  
 Annales chimie analytique  
 Annales de chimie analytique et de chimie appliquée et Revue de chimie analytique réunies  
 Annali di chimica applicata  
 Annales de l'office national des combustibles liquides  
 Annales de la faculté des sciences de Marseille  
 Les annales des falsifications et des fraudes  
 Annales de l'institut d'analyse physico-chimique (U.S.S.R.)  
 Annales de l'institut Pasteur  
 Annals of Internal Medicine  
 Annales du Jardin botanique de Buitenzorg  
 Annales de médecine légale de criminologie, police scientifique, médecine sociale, et toxicologie  
 Annales de médecine (Paris)  
 Annales des mines & carburants  
 Annals of the New York Academy of Sciences  
 Annals of Philosophy  
 Annales de physique  
 Annalen der Physik; before 1900 Annalen der Physik und Chemie (Poggendorff; Wiedemann)  
 The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol  
 Annual Report, East Malling Research Station, near Maidstone, Kent  
 Annual Review of Biochemistry  
 Annales scientifiques de l'École Normale Supérieure

| ABBREVIATED TITLE                                                                    | FULL TITLE                                                                                                                     |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <i>Ann. sci. univ. Jassy</i>                                                         | Annales scientifiques de l'université de Jassy                                                                                 |
| <i>Ann. soc. sci. Bruxelles</i>                                                      | Annales de la société scientifique de Bruxelles                                                                                |
| <i>Ann. Surgery</i>                                                                  | Annals of Surgery                                                                                                              |
| <i>Ann. Trop. Med. Parasitol.</i>                                                    | Annals of Tropical Medicine and Parasitology                                                                                   |
| <i>Ann. univ. Lyon</i>                                                               | Annales de l'université de Lyon                                                                                                |
| <i>Ann. zymol.</i>                                                                   | Annales de zymologie                                                                                                           |
| <i>Annual Reports</i>                                                                | Annual Reports on the Progress of Chemistry,<br>London                                                                         |
| <i>Apoth. Ztg.</i>                                                                   | Apotheker Zeitung                                                                                                              |
| <i>Arb. biol. Reichsanstalt Land- u.<br/>Forstw.</i>                                 | Arbeiten aus der biologischen Reichsanstalt für Land-<br>und Forstwirtschaft, Berlin-Dahlem                                    |
| <i>Arb. kais. Gesundh.</i>                                                           | Arbeiten aus dem kaiserlichen Gesundheitsamte                                                                                  |
| <i>Arb. Pharm. Inst. Univ. Berlin</i>                                                | Arbeiten aus dem Pharmazeutischen Institut der Uni-<br>versität Berlin                                                         |
| <i>Arb. physiol. u. angew. Entomol.</i>                                              | Arbeiten über physiologische und angewandte Ento-<br>mologie aus Berlin-Dahlem                                                 |
| <i>Arb. Reichsgesundh.</i>                                                           | Arbeiten aus dem Reichsgesundheitsamte                                                                                         |
| <i>Arb. Staatsinst. exptl. Therap. u.<br/>Georg Speyer-Hause Frankfurt<br/>a. M.</i> | Arbeiten aus dem Staatsinstitut für experimentelle<br>Therapie und dem Georg Speyer-Hause zu Frank-<br>furt a. M.              |
| <i>Arbeitsschutz</i>                                                                 | Arbeitsschutz, Unfallverhütung, Gewerbehygiene.<br>Sonderausgabe des Reichsarbeitsblattes                                      |
| <i>Arch. Anat. Physiol. u. wiss. Med.</i>                                            | Archiv für Anatomie, Physiologie und wissenschaft-<br>liche Medizin                                                            |
| <i>Arch. belges dermatol. et syphiligr.</i>                                          | Archives belges de dermatologie et de syphiligraphie                                                                           |
| <i>Arch. Biochem.</i>                                                                | Archives of Biochemistry                                                                                                       |
| <i>Arch. Biol. Hung.</i>                                                             | Archiva Biologica Hungarica                                                                                                    |
| <i>Arch. Chem. i Farm.</i>                                                           | Archiwum Chemji i Farmacji (Warsaw)                                                                                            |
| <i>Arch. Dermatol. Syphilol.</i>                                                     | Archives of Dermatology and Syphilology                                                                                        |
| <i>Arch. Dermatol. u. Syphilis</i>                                                   | Archiv für Dermatologie und Syphilis                                                                                           |
| <i>Arch. exptl. Path. Pharmacol.</i>                                                 | Archiv für experimentelle Pathologie und Pharma-<br>kologie                                                                    |
| <i>Arch. exptl. Zellforsch.</i>                                                      | Archiv für experimentelle Zellforschung                                                                                        |
| <i>Arch. farmacol. sper.</i>                                                         | Archivio di Farmacologia sperimentale e Scienze<br>affini                                                                      |
| <i>Arch. farm. y bioquím. Tucumán</i>                                                | Archivos de farmacia y bioquímica de Tucumán                                                                                   |
| <i>Arch. fisiol.</i>                                                                 | Archivio di fisiologia                                                                                                         |
| <i>Arch. ges. Physiol.</i>                                                           | Archiv für die gesamte Physiologie des Menschen und<br>der Tiere (Pflügers)                                                    |
| <i>Arch. Hyg. Bakt.</i>                                                              | Archiv für Hygiene und Bakteriologie                                                                                           |
| <i>Arch. Internal Med.</i>                                                           | The Archives of Internal Medicine                                                                                              |
| <i>Arch. intern. pharmacodynamie</i>                                                 | Archives internationales de pharmacodynamie et de<br>thérapie                                                                  |
| <i>Arch. intern. physiol.</i>                                                        | Archives internationales de physiologie                                                                                        |
| <i>Arch. ital. biol.</i>                                                             | Archives italiennes de biologie                                                                                                |
| <i>Arch. Math. Naturvidenskab</i>                                                    | Archiv for Mathematik og Naturvidenskab                                                                                        |
| <i>Arch. néerland. physiol.</i>                                                      | Archives néerlandaises de physiologie de l'homme et<br>des animaux                                                             |
| <i>Arch. Ophthalmol. (Chicago)</i>                                                   | Archives of Ophthalmology (Chicago)                                                                                            |
| <i>Arch. Path.</i>                                                                   | Archives of Pathology                                                                                                          |
| <i>Arch. Pharm.</i>                                                                  | Archiv der Pharmazie; before 1832 Archiv des Apo-<br>theker-Vereins im nördlichen Deutschland                                  |
| <i>Arch. phys. biol.</i>                                                             | Archives de physique biologique et de chimie-physique<br>des corps organisés; before 1930 Archives de physi-<br>que biologique |

## ABBREVIATED TITLE

## FULL TITLE

|                                                     |                                                                                                                                                                                                                             |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Arch. Schiffs- u. Tropen-Hyg.</i>                | Archiv für Schiffs- und Tropen-Hygiene, Pathologie und Therapie exotischer Krankheiten                                                                                                                                      |
| <i>Arch. sci.</i>                                   | Archives des sciences, Genève; before 1948 Archives des sciences physiques et naturelles, Genève                                                                                                                            |
| <i>Arch. sci. biol. (Italy)</i>                     | Archivio di scienze biologiche (Italy)                                                                                                                                                                                      |
| <i>Arch. sci. biol. (U.S.S.R.)</i>                  | Archives des sciences biologiques (U.S.S.R.)                                                                                                                                                                                |
| <i>Arch. sci. phys. nat.</i>                        | Archives des sciences physiques et naturelles, Genève                                                                                                                                                                       |
| <i>Arch. Surg.</i>                                  | Archives of Surgery                                                                                                                                                                                                         |
| <i>Arch. wiss. u. prakt. Tierheilk.</i>             | Archiv für wissenschaftliche und praktische Tierheilkunde                                                                                                                                                                   |
| <i>Arhiv Hem. i Farm.</i>                           | Arhiv za Hemiju i Farmaciju                                                                                                                                                                                                 |
| <i>Arkiv Kemi Mineral. Geol.</i>                    | Arkiv för Kemi, Mineralogi och Geologi                                                                                                                                                                                      |
| <i>Arkiv Zool.</i>                                  | Arkiv för Zoologi, utgivet av K. Svenska Vetenskapsakademien                                                                                                                                                                |
| <i>Asphalt u. Teer, Strassenbautech.</i>            | Asphalt und Teer, Strassenbautechnik                                                                                                                                                                                        |
| <i>Astrophys. J.</i>                                | The Astrophysical Journal                                                                                                                                                                                                   |
| <i>Atti accad. Italia, Rend.</i>                    | Atti della reale accademia d'Italia. Rendiconti della classe di scienze fisiche, matematiche e naturali                                                                                                                     |
| <i>Atti accad. Lincei</i>                           | Atti della reale accademia dei Lincei. Rendiconti della classe di scienze fisiche, matematiche e naturali; since 1921 Atti della reale accademia nazionale dei Lincei; since 1946 Atti della accademia nazionale dei Lincei |
| <i>Atti accad. Lincei, Mem.</i>                     | Atti della reale accademia dei Lincei. Memorie della classe di scienze fisiche, matematiche e naturali                                                                                                                      |
| <i>Atti accad. Lincei, Transunti</i>                | Atti della reale accademia dei Lincei. Transunti                                                                                                                                                                            |
| <i>Atti accad. Torino</i>                           | Atti della reale accademia delle scienze di Torino                                                                                                                                                                          |
| <i>Atti Congr. intern. chim.</i>                    | Atti del congresso internazionale di chimica                                                                                                                                                                                |
| <i>Atti Congr. nas. chim. pura applicata</i>        | Atti del congresso nazionale di chimica pura ed applicata                                                                                                                                                                   |
| <i>Atti ist. veneto sci. lettere ed arti</i>        | Atti del (reale) istituto veneto di scienze, lettere ed arti                                                                                                                                                                |
| <i>Atti soc. nat. e mat. Modena</i>                 | Atti della società dei naturalisti e matematici di Modena                                                                                                                                                                   |
| <i>Australian Chem. Inst., J. &amp; Proc.</i>       | The Australian Chemical Institute Journal & Proceedings                                                                                                                                                                     |
| <i>Australian J. Exptl. Biol. Med. Sci.</i>         | The Australian Journal of Experimental Biology and Medical Science                                                                                                                                                          |
| <i>Australian Pat.</i>                              | Australian Patent                                                                                                                                                                                                           |
| <i>Austrian Pat.</i>                                | Austrian Patent                                                                                                                                                                                                             |
| <i>Automobiltech. Z.</i>                            | Automobiltechnische Zeitschrift                                                                                                                                                                                             |
| <i>Auto-Tech.</i>                                   | Auto-Technik                                                                                                                                                                                                                |
| <i>Beitr. ch. Physiol. Pathol.</i>                  | Beiträge zur chemischen Physiologie und Pathologie                                                                                                                                                                          |
| <i>Beitr. pathol. Anat. u. allgem. Pathol.</i>      | Beiträge zur pathologischen Anatomie und zur allgemeinen Pathologie                                                                                                                                                         |
| <i>Belg. Pat.</i>                                   | Belgian Patent                                                                                                                                                                                                              |
| <i>Ber.</i>                                         | Berichte der deutschen chemischen Gesellschaft; since 1947 Chemische Berichte                                                                                                                                               |
| <i>Ber. Afdeel. Handelsmuseum Ver. Kolon. Inst.</i> | Berichten van de Afdeeling Handelsmuseum van de Koninklijke Vereeniging Koloniaal Instituut                                                                                                                                 |
| <i>Ber. deut. botan. Ges.</i>                       | Berichte der deutschen botanischen Gesellschaft                                                                                                                                                                             |
| <i>Ber. deut. pharm. Ges.</i>                       | Berichte der deutschen pharmazeutischen Gesellschaft                                                                                                                                                                        |
| <i>Ber. Ges. Kohlenesch.</i>                        | Berichte der Gesellschaft für Kohlentechnik                                                                                                                                                                                 |
| <i>Ber. ges. Physiol. exptl. Pharmakol.</i>         | Berichte über die gesamte Physiologie und experimentelle Pharmakologie                                                                                                                                                      |

| ABBREVIATED TITLE                                          | FULL TITLE                                                                                                                                                                                                                                                          |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Ber. K. Sächs. Ges. Wiss. Math.-phys. Kl.</i>           | Berichte über die Verhandlungen der Königl. Sächsischen Gesellschaft der Wissenschaften zu Leipzig, Mathematisch-physische Klasse: since 1919 Berichte über die Verhandlungen der Sächsischen Akademie der Wissenschaften zu Leipzig, Mathematisch-physische Klasse |
| <i>Ber. Schimmel &amp; Co.</i>                             | Bericht der Schimmel & Co. Aktien-Gesellschaft Miltitz Bz. Leipzig über ätherische Öle, Riechstoffe usw.                                                                                                                                                            |
| <i>Ber. ungar. pharm. Ges.</i>                             | Berichte der ungarischen pharmazeutischen Gesellschaft                                                                                                                                                                                                              |
| <i>Berlin. klin. Wochschr.</i>                             | Berliner klinische Wochenschrift                                                                                                                                                                                                                                    |
| <i>Berlin. tierärztl. Wochschr.</i>                        | Berliner tierärztliche Wochenschrift                                                                                                                                                                                                                                |
| <i>Berlin. u. Münch. tierärztl. Wochschr.</i>              | Berliner und Münchener tierärztliche Wochenschrift                                                                                                                                                                                                                  |
| <i>Berzelius-Jahresber.</i>                                | Jahresberichte über die Fortschritte der physischen Wissenschaften 1822-'41, Jahresberichte über die Fortschritte der Chemie 1842-'51 von Jacob Berzelius                                                                                                           |
| <i>Bihang K. Svenska Vetenskaps-Akad. Handl.</i>           | Bihang till Kongl. Svenska Vetenskaps-Akademiens Handlingar                                                                                                                                                                                                         |
| <i>Biochem. J.</i>                                         | The Biochemical Journal                                                                                                                                                                                                                                             |
| <i>Biochem. Preparations</i>                               | Biochemical Preparations                                                                                                                                                                                                                                            |
| <i>Biochem. Z.</i>                                         | Biochemische Zeitschrift                                                                                                                                                                                                                                            |
| <i>Biochim. Biophys. Acta</i>                              | Biochimica et Biophysica Acta                                                                                                                                                                                                                                       |
| <i>Biochim. e terap. sper.</i>                             | Biochimica e terapia sperimentale                                                                                                                                                                                                                                   |
| <i>Biokhimiya</i>                                          | Biokhimiya                                                                                                                                                                                                                                                          |
| <i>Biol. Bull.</i>                                         | The Biological Bulletin                                                                                                                                                                                                                                             |
| <i>Biol. Reus. Cambridge Phil. Soc.</i>                    | Biological Reviews of the Cambridge Philosophical Society                                                                                                                                                                                                           |
| <i>Biol. Zentr.</i>                                        | Biologisches Zentralblatt                                                                                                                                                                                                                                           |
| <i>BIOS, Docs</i>                                          | Documents deposited with British Intelligence Objectives Sub-committee                                                                                                                                                                                              |
| <i>BIOS Final Report</i>                                   | Report prepared by British Intelligence Objectives Sub-committee                                                                                                                                                                                                    |
| <i>Boissiera</i>                                           | Boissiera (Geneva)                                                                                                                                                                                                                                                  |
| <i>Bol. inst. med. exptl. estud. cáncer (Buenos Aires)</i> | Boletín del instituto de medicina experimental para el estudio y tratamiento del cáncer (Buenos Aires)                                                                                                                                                              |
| <i>Boll. chim. farm.</i>                                   | Bollettino chimico-farmaceutico                                                                                                                                                                                                                                     |
| <i>Boll. ist. sieroterap. milan.</i>                       | Bollettino dell'istituto sieroterapico milanese                                                                                                                                                                                                                     |
| <i>Boll. lega Ital. lotta contro cancro</i>                | Bollettino della lega Italiana per la lotta contro il cancro                                                                                                                                                                                                        |
| <i>Boll. sci. fac. chim. ind. Bologna</i>                  | Bollettino scientifico della facoltà di chimica industriale di Bologna                                                                                                                                                                                              |
| <i>Boll. soc. adriatica sci. nat. Trieste</i>              | Bollettino della società adriatica di scienze naturali in Trieste                                                                                                                                                                                                   |
| <i>Boll. soc. ital. biol. sper.</i>                        | Bollettino della società italiana di biologia sperimentale                                                                                                                                                                                                          |
| <i>Bot. Ztg.</i>                                           | Botanische Zeitung                                                                                                                                                                                                                                                  |
| <i>Botan. Gaz.</i>                                         | The Botanical Gazette                                                                                                                                                                                                                                               |
| <i>Braunkohlenarch.</i>                                    | Das Braunkohlenarchiv                                                                                                                                                                                                                                               |
| <i>Brennstoff-Ch.</i>                                      | Brennstoff-Chemie                                                                                                                                                                                                                                                   |
| <i>Brit. Assoc. Advancement Sci., Rept.</i>                | British Association for the Advancement of Science, Report of the Annual Meeting                                                                                                                                                                                    |
| <i>Brit. J. Dermatol. Syphilis</i>                         | The British Journal of Dermatology and Syphilis                                                                                                                                                                                                                     |
| <i>Brit. J. Exptl. Path.</i>                               | The British Journal of Experimental Pathology                                                                                                                                                                                                                       |
| <i>Brit. J. Ind. Med.</i>                                  | British Journal of Industrial Medicine                                                                                                                                                                                                                              |
| <i>Brit. J. Ophthalmol.</i>                                | The British Journal of Ophthalmology                                                                                                                                                                                                                                |
| <i>Brit. Med. J.</i>                                       | The British Medical Journal                                                                                                                                                                                                                                         |

| ABBREVIATED TITLE                                         | FULL TITLE                                                                                                                                                                                             |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Brit. Pat.</i>                                         | British Patent                                                                                                                                                                                         |
| <i>Bul. chim. soc. romând stiinte</i>                     | Buletinul de chimie pură si aplicată societatea română de stiinte                                                                                                                                      |
| <i>Bul. chim. soc. române chim.</i>                       | Buletinul de chimie pură si aplicată al societății române de chimie                                                                                                                                    |
| <i>Bul. soc. chim. România</i>                            | Buletinul societății de chimie din România                                                                                                                                                             |
| <i>Bul. soc. române stiinte</i>                           | Buletinul societății române de stiinte, Bucuresti-România                                                                                                                                              |
| <i>Bul. soc. stiinte Bucuresci</i>                        | Buletinul societății de stiinte din Bucuresci, România                                                                                                                                                 |
| <i>Bul. soc. stiinte Cluj</i>                             | Buletinul societății de stiinte din Cluj                                                                                                                                                               |
| <i>Bull. acad. imp. sci. St. Pétersbourg</i>              | Bulletin de l'académie impériale des sciences de St. Pétersbourg                                                                                                                                       |
| <i>Bull. acad. méd.</i>                                   | Bulletin de l'académie de médecine                                                                                                                                                                     |
| <i>Bull. acad. roy. méd. Belg.</i>                        | Bulletin de l'académie royale de médecine de Belgique                                                                                                                                                  |
| <i>Bull. acad. roy. sci. Belg.</i>                        | Bulletins de l'académie royale des sciences, des lettres et des beaux-arts de Belgique                                                                                                                 |
| <i>Bull. acad. sci. Russie</i>                            | Bulletin de l'académie des sciences de Russie                                                                                                                                                          |
| <i>Bull. Acad. Sci. United Provinces Agra Oudh, India</i> | Bulletin of the Academy of Sciences of the United Provinces of Agra and Oudh, Allahabad, India                                                                                                         |
| <i>Bull. acad. sci. U.R.S.S.</i>                          | Bulletin de l'académie des sciences de l' Union des Républiques Soviétiques Socialistes, Classe des sciences mathématiques et naturelles                                                               |
| <i>Bull. Agr. Ch. Soc. Japan</i>                          | Bulletin of the Agricultural Chemical Society of Japan                                                                                                                                                 |
| <i>Bull. assoc. franç. étude cancer</i>                   | Bulletin de l'association française pour l'étude du cancer                                                                                                                                             |
| <i>Bull. biol. méd. expil. U.R.S.S.</i>                   | Bulletin de biologie et de médecine expérimentale de l'U. R. S. S.                                                                                                                                     |
| <i>Bull. Ch. Soc. Japan</i>                               | Bulletin of the Chemical Society of Japan                                                                                                                                                              |
| <i>Bull. classe sci., Acad. roy. Belg.</i>                | Bulletin de la classe des sciences, Académie royale de Belgique (Mededeelingen van de Klasse der Wetenschappen, Koninklijke Belgische Academie)                                                        |
| <i>Bull. Imp. Inst.</i>                                   | Bulletin of the Imperial Institute                                                                                                                                                                     |
| <i>Bull. inst. océanog.</i>                               | Bulletin de l'institut océanographique                                                                                                                                                                 |
| <i>Bull. Inst. Phys. Ch. Research</i>                     | Bulletin of the Institute of Physical and Chemical Research (Tokyo)                                                                                                                                    |
| <i>Bull. inst. pin</i>                                    | Bulletin de l'institut du pin                                                                                                                                                                          |
| <i>Bull. inst. recherches biol. Perm</i>                  | Bulletin de l'institut des recherches biologiques de Perm                                                                                                                                              |
| <i>Bull. intern. acad. polon.</i>                         | Bulletin international de l'académie polonaise des sciences et des lettres, Classe des sciences mathématiques et naturelles; before 1919 Bulletin international de l'académie des sciences de Cracovie |
| <i>Bull. Jardin bot. Buitenzorg</i>                       | Bulletin du Jardin botanique de Buitenzorg                                                                                                                                                             |
| <i>Bull. Johns Hopkins Hosp.</i>                          | Bulletin of the Johns Hopkins Hospital                                                                                                                                                                 |
| <i>Bull. mat. grasses</i>                                 | Bulletin des matières grasses de l'institut colonial de Marseille                                                                                                                                      |
| <i>Bull. sci. acad. roy. Belg.</i>                        | Bulletin de la classe des sciences, académie royale de Belgique                                                                                                                                        |
| <i>Bull. sci. école polytech. Timisoara</i>               | Bulletin scientifique de l'école polytechnique de Timisoara                                                                                                                                            |
| <i>Bull. sci. ind. Roure-Bertrand fils</i>                | see <i>Recherches Roure-Bertrand fils</i>                                                                                                                                                              |
| <i>Bull. sci. pharmacol.</i>                              | Bulletin des sciences pharmacologiques                                                                                                                                                                 |
| <i>Bull. sect. sci. acad. roumaine</i>                    | Bulletin de la section scientifique de l'académie roumaine                                                                                                                                             |
| <i>Bull. soc. chim.</i>                                   | Bulletin de la société chimique de France                                                                                                                                                              |
| <i>Bull. soc. chim. Belg.</i>                             | Bulletin de la société chimique de Belgique et Recueil des travaux chimiques belges                                                                                                                    |