notes on nomenclature



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Derivatives of Oxo Acids

Names for derivatives of oxo acids involve many of the same problems as are encountered with the parent oxo acids *(1)*. In addition, there are problems unique to the derivatives themselves. Many derivatives are named as substitution products of the parent acids. However, in doing so the inorganic chemist has committed what is, to the organic chemist, a cardinal sin because he is substituting for oxygen or hydroxyl and not hydrogen. Some significant conflicts in nomenclature are a result of this failure of two groups to play by the same rules.

Peroxo Acids. The prefix peroxo-, when used in conjunction with the trivial names of acids, indicates substitution of —O— by —O—O—; example: $HOONO_2$, peroxonitric acid. For phosphoric and sulfuric acids there are two types of peroxo derivatives: one in which HOO— takes the place of HO— and one in which —O—O— acts as a bridge between two atoms of the characteristic element. The names indicate whether one or two such atoms are involved.

$HOO(HO)_2PO$	peroxomonophosphoric acid
$(HO)_2OP\text{-}O\text{-}OPO(OH)_2$	peroxodiphosphoric acid
$HOO(HO)SO_2$	peroxomonsulfuric acid
$(HO)O_2S\text{-}O\text{-}O\text{-}SO_2(OH)$	peroxodisulfuric acid

No one seems to have given any thought as to a suitable name for $HOO(HO)P(O)—O—P(O)(OH)_2$. According to the principles of nomenclature for isopoly acids the compound would be called (hydroperoxo)diphosphoric acid.

Thio Acids. By current usage, the affix thio is sufficient to designate a thio acid where the replacement proceeds no further than one atom of oxygen by sulfur. However, even in such cases, the use of mono is preferred.

$H_2S(S)O_2$	monothiosulfurous acid
$H_2S(S)O_3$	monothiosulfuric acid
HSCN	thiocyanic acid

When more than one oxygen atom can be replaced by sulfur the number of sulfur atoms should be indicated.

H_3PO_3S	monothiophosphoric acid
$H_3PO_2S_2$	dithiophosphoric acid
H_2CS_3	trithiocarbonic acid
H_3AsS_3	trithioarsenious acid
H_3AsS_4	tetrathioarsenic acid

The affixes seleno and telluro are used in a manner similar to thio.

K_3SbSeS_3	potassium selenotrithioantimonate

Chloro Acids, etc. Acids containing ligands other than oxygen and sulfur are generally designated according to coordination nomenclature.

$HAuCl_4$	hydrogen tetrachloroaurate(III) or tetrachloroauric-(III) acid
H_2PtCl_4	hydrogen tetrachloroplatinate(II) or tetrachloroplatinic(II) acid
H_2PtCl_6	hydrogen hexachloroplatinate(IV) or hexachloroplatinic(IV) acid
$H_4Fe(CN)_6$	hydrogen hexacyanoferrate(II) or hexacyanoferric(II) acid
$H[PFHO_2]$	hydrogen fluorohydridodioxophosphate or fluorohydridodioxophosphoric acid
HPF_6	hydrogen hexafluorophosphate or hexafluorophosphoric acid
H_2SiF_6	hydrogen hexafluorosilicate or hexafluorosilicic acid
H_2SnCl_6	hydrogen hexachlorostannate(IV) or hexachlorostannic(IV) acid
HBF_4	hydrogen tetrafluoroborate or tetrafluoroboric acid
$H[BF_2(OH)_2]$	hydrogen difluorodihydroxoborate or difluorodihydroxoboric acid
$H[B(C_6H_5)_4]$	hydrogen tetraphenylborate or tetraphenylboric acid

At times a change in coordination number in the progressive replacement of hydroxyl and oxo groups produces an apparent discontinuity especially among fluoro acids. For boron the following acids are known

$(HO)_3B$	boric acid
$(HO)_2BF$	monofluoroboric acid
$H[(HO)_2BF_2]$	difluoroboric acid
$H[(HO)BF_3]$	trifluoroboric acid
$H[BF_4]$	tetrafluoroboric acid

For phosphorus the following acids are well characterized

$(HO)_3PO$	phosphoric acid
$(HO)_2PFO$	monofluorophosphoric acid
$(HO)PF_2O$	difluorophosphoric acid
$H[PF_6]$	hexafluorophosphoric acid

IUPAC Publications on Nomenclature

The initial note of this series *(2)* described the publications of the International Union of Pure and Applied Chemistry which deal with nomenclature. Several of these have appeared recently so this is an appropriate time to list them. Where IUPAC reports have been reprinted, the references are included.

Definitive Recommendations. These are always published in the official journal *Pure and Applied Chemistry.* Subsequently, where appropriate, they are then incorporated into the next edition of the Green Book (Manual of Symbols and Terminology for Phsicochemical Quantities and Units), Red Book (Nomenclature of Inorganic Chemistry) or Blue Book (Nomenclature of Organic Chemistry). (A compendium for nomenclature of analytical chemistry is under discussion.) Copies of the Green, Red and Blue

Books can be purchased from Messrs. Butterworths' U.S. Agent Crane, Russak, and Co. In addition, as an experiment, the IUPAC Secretariat recently purchased from Butterworths 250 reprints of those definitive nomenclature recommendations which are designated below by an asterisk. These are being sold by the Secretariat. If the experiment proves successful, it may be extended to other reprints of final nomenclature recommendations published in *Pure and Applied Chemistry*.

"Nomenclature of Organic Chemistry, Sections A, B, and C," (3rd Ed.) The Butterworth Group, London, **1971,** 352 p. For the first time these rules are available in a single volume. For a summary of the changes from the earlier rules see *J. Chem. Doc.*, **12** (2), 132 (1972).

"Nomenclature of Inorganic Chemistry, Definitive Rules 1970," (2nd Ed.) Butterworths, London, **1971,** 110 p. Also published in *Pure Appl. Chem.*, **28** (1), 1 (1971). Discussed in a previous note *(3)*.

"Recommendations on Ion Exchange Nomenclature." Commission on Analytical Nomenclature, *Pure Appl. Chem.* **29** (4), 619 (1972).

"Recommendations for the Presentation of NMR Data for Publication in Chemical Journals." Commission on Molecular Structure and Spectroscopy, *Pure Appl. Chem.*, **29** (4), 625 (1972).

"Atomic Weights of the Elements." Commission on Atomic Weights, *Pure Appl. Chem.*, **30** (3-4), 639 (1972).

*"Nomenclature, Symbols, Units and Their Usage in Spectrochemical Analysis—I. General Atomic Emission Spectroscopy." Commission on Spectrochemical and Other Optical Procedures for Analysis, *Pure Appl. Chem.*, **30** (3-4), 653 (1972).

"Nomenclature of Inorganic Boron Compounds." Commission on Nomenclature of Inorganic Chemistry, *Pure Appl. Chem.*, **30** (3-4), 683 (1972).

*"Definitive Rules for Nomenclature of Steroids." IUPAC Commission on the Nomenclature of Organic Chemistry and IUPAC-IUB[1] Commission on Biochemical Nomenclature, *Pure Appl. Chem.*, **31** (1-2), 285 (1972).

*"Definitions, Terminology and Symbols in Colloid and Surface Chemistry." Commission on Colloid and Surface Chemistry, *Pure Appl. Chem.*, **31** (4), 577 (1972).

"A Guide to Procedures for the Publication of Thermodynamic Data." Commission on Thermodynamics and Thermochemistry, *Pure Appl. Chem.*, **29,** [1-3], 395 (1972).

"Catalogue of Physicochemical Standard Substances." Commission on Physicochemical Measurements and Standards, *Pure Appl. Chem.*, **29**(4), 597 (1972).

"A One-Letter Notation for Amino Acid Sequences." IUPAC-IUB Commission on Biochemical Nomenclature, *Pure Appl. Chem.*, **31**(4), 639 (1972).

"Definitive Rules for Naming Synthetic Modifications of Natural Peptides." IUPAC-IUB Commission on Biochemical Nomenclature, *Pure Appl. Chem.*, **31**(4), 647 (1972).

Tentative Recommendations. These are issued as a series of "Appendices on Tentative Nomenclature, Symbols, Units, and Standards" (yellow booklets) to the IUPAC *Information Bulletin.* They are available free by writing IUPAC Secretariat, Bank Court Chambers, 2-3 Pound Way, Cowley Centre, Oxford OX4 3YF, U.K. Also they are sent automatically on publication to all subscribers to the Bulletin (subscription price: $9.00).

No. 1. "Nomenclature, Symbols, Units, and Their Usages in Spectrochemical Analysis. I." Commission on Nomenclature, Symbols, Units and Their Usage in Spectrochemical Analysis, December, **1969.**

No. 2. "Catalog of Physicochemical Standard Substances." Commission on Physicochemical Measurements and Standards, December, **1969.**

No. 3. "Manual of Definitions, Terminology and Symbols in Colloid and Surface Chemistry." Commission on Colloid and Surface Chemistry, January **1970.**

No. 4. "Recommendations for the Presentation of NMR Data for Publication in Chemical Journals." Commission on Molecular Structure and Spectroscopy, January **1970.**

No. 5. "Recommendations on Ion-Exchange Nomenclature." Commission on Analytical Nomenclature, January 1970.

No. 6. "Nomenclature for Vitamins B_6 and Related Compounds." IUPAC-IUB Commission on Biochemical Nomenclature, September, 1970. Also published in *Arch. Biochem. Biophys.*, **145**(1), 422(1971); *Biochemistry,* **9**(20), 4019(1970); *Biochem. J.*, **119,** 1(1970); *Biochim. Biophys. Acta,* **222,** 1(1970); *Eur. J. Biochem.*, **17**(1), 1(1970); Hoppe-Seyler's *Z. Physiol. Chem.*, **351**(10), 1165(1970); *J. Biol. Chem.*, **245**(17), 4229(1970); *Mol. Biol.*, **5**(6), 931(1971) (Russian).

No. 7. "Carbohydrate Nomenclature—1." IUPAC Commission on Nomenclature of Organic Chemistry and IUPAC-IUB Commission on Biochemical Nomenclature, September, 1970. Also published in *Biochem. J.*, **125**(3), 673(1971); *Biochemistry,* **10**(21), 3983(1971); Errata **10**(26), 4995(1971); *Biochim. Biophys. Acta,* **244** (2), 233-302(1971); *Eur. J. Biochem.*, **21,** 455(1971); Corrections **22,** 592(1971); **25,** 1(1972); *J. Biol. Chem.*, **247**(3), 613(1972).

No. 8. "Nomenclature of Inorganic Boron Compounds." Commission on Nomenclature of Inorganic Chemistry, September **1970.**

No. 9. "Abbreviations and Symbols for Nucleic Acids, Polynucleotides and Their Constituents." IUPAC-IUB Commission on Biochemical Nomenclature, February 1971. Also published in *Arch. Biochem. Biophys.*, **145**(1), 425(1971); *Biochemistry,* **9**(20), 4022(1970); *Biochem. J.*, **120**(3), 449(1970); *Biochim. Biophys. Acta,* **247**(1), 1(1971); *Eur. J. Biochem.*, **15**(2), 203(1970); Corrections **18,** 558(1971); **25,** 1(1972); Hoppe-Seyler's *Z. Physiol. Chem.* **351**(9), 1055(1970); *J. Biol. Chem.*, **245**(20), 5171(1970); *J. Mol. Biol.* **55**(3), 299(1971); *Mol. Biol.*, **6,** 167(1972) (Russian).

No. 10. "Abbreviations and Symbols for the Description of the Conformation of Polypeptide Chains." IUPAC-IUB Commission on Biochemical Nomenclature, February 1971. Also published in *Arch. Biochim. Biophys.*, **145**(1), 405(1971); *Biochemistry,* **9**(18), 3471(1970); *Biochem. J.*, **121**(4), 577(1971); *Biochem. Biophys. Acta,* **229,** 1(1970); *Eur. J. Biochem.*, **17**(2), 193(1970); Correction **18,** 151(1971); *J. Biol. Chem.*, **245,** 6489 (1970).

No. 11. "Recommendations for the Presentation of Raman Spectra for Cataloging and Documentation in Permanent Data Collections." Commission on Molecular Structure and Spectroscopy, February **1971.**

No. 12. "List of Abbreviations for Synthetic Polymers and Polymeric Materials." Macromolecular Nomenclature Commission, February **1971.**

No. 13. "Basic Definitions of Terms Relating to Polymers." Macromolecular Nomenclature Commission, February **1971.**

No. 14. "Recommendations on Nomenclature for Contamination Phenomena in Precipitation from Aqueous Solutions," Commission on Analytical Nomenclature, February **1972.**

No. 15. "Recommendations on Nomenclature for Chromatography," Commission on Analytical Nomenclature, February **1972.**

No. 16. "Recommendations for Nomenclature of Thermal Analysis," Commission on Analytical Nomenclature, February **1972.** Also published as Pt. I in *Talanta,* **16,** 1227 (1969); Pt. II in *Talanta,* **19,** 1079(1972) and *J. Thermal Anal.*, **4,** 343(1972).

No. 17. "Recommendations for Nomenclature of Mass Spectrometry," Commission on Analytical Nomenclature, February **1972.**

No. 18. "Recommendations on Nomenclature of Scales of Working in Analysis," Commission on Analytical Nomenclature, February **1972.**

No. 19. "Rules for the Nomenclature of Carotenoids," IUPAC Commission on Nomenclature of Organic Chemistry and IUPAC-IUB Commission on Biochemical Nomenclature, February 1972. Also published in *Biochemistry,* **10**(26), 4827(1971); *Biochem. J.*, **127**(5), 741(1972); *Eur. J. Biochem.*, **25**(3), 397(1972); *J. Biol. Chem.*, 247(9), 2633(1972).

No. 20. "Quantities and Units in Clinical Chemistry," IUPAC Commission on Quantities and Units (Clinical Chemistry) and IFCC[2] Expert Panel on Quantities and Units in Clinical Chemistry, February **1972.**

No. 21. "List of Quantities in Clinical Chemistry," IUPAC Commission on Quantities and Units (Clinical Chemistry) and IFCC Expert Panel on Quantities and Units in Clinical Chemistry, February **1972.**

No. 22. "Nomenclature of Multiple Forms of Enzymes," IUPAC-IUB Commission on Biochemical Nomenclature, June 1972. Also published in *Arch. Biochem. Biophys.*, **147**(1), 1(1971); *Biochemistry,* **10**(25), 4825(1971); *Biochem. J.*, **126**(4), 769(1972); *Biochim. Biophys. Acta,* **258**(1), 1(1972); *Biochemie,* **54**(2), 123(1972); *Eur. J. Biochem.*, **24**(1), 1(1971); *Hoppe-Seyler's Z. Physiol. Chem.*, **353**(6), 852(1972) (Ger.); *J. Biol. Chem.*, **246**(20), 6127(1971).

No. 23. "Symbols for Amino-Acid Derivatives and Peptides." IUPAC-IUB Commission on Biochemical Nomenclature, June 1972. Also published in *Arch. Biochem. Biophys.*, **150**(1), 1(1972); *Biochemistry,* **11**(9), 1726(1972); *Biochem. J.*, **126**(4), 773(1972); *Biochim. Biophys. Acta,* **263**(2), 205(1972); *Bull. Soc. Chim. Biol.*, **49,** 121(1967) (Fr.); *Eur. J. Biochem.*, **27**(2), 201(1972); *J. Biol. Chem.*, **247**(4), 977(1972); *Mol. Biol.*, **2,** 282(1968) (Russian).

No. 24. "Recommended Names and Symbols for Light and Related Electromagnetic Radiation," Commission on Physicochemical Symbols, Terminology, and Units, June **1972.**

No. 25. "Recommendations on Nomenclature for Nuclear Chemistry." Commission on Analytical Radiochemistry, June **1972.**

No. 26. "Nomenclature, Symbols, Units and Their Usage in Spectrochemical Analysis-II. Terms and Symbols Related to Analytical Functions and Their Figures of Merit." Commission on Spectrochemical and Other Optical Procedures for Analysis, November **1972.**

No. 27. "Nomenclature, Symbols, Units and Their Usage in Spectrochemical Analysis-III. Analytical Flame Spectroscopy and Associated Procedures." Commission on Spectrochemical and Other Optical Procedures for Analysis, November **1972.**

No. 28. "Electrochemical Definitions and Symbols." Commission on Electrochemistry, November **1972.**

No. 29. "Nomenclature of Regular Single-Strand Organic Polymers." Commission on Macromolecular Nomenclature, November **1972.**

Other International Reports

"Tentative Rules for Generic Descriptors and Trivial Names for Vitamins and Related Compounds," IUNS[3] Committee on Nomenclature. Published in *Arch. Sci. Physiol.*, **25**(2), 1(1971); *J. Nutr.*, **101**(1), 133(1971).

"Recommendations for the Nomenclature of Human Immunoglobulins," IUIS[4] Subcommittee for Human Immunoglobulins, *Biochemistry,* **11,** 3311(1972).

SI Units

The International System of Units is closely related to nomenclature. Three recent U.S. publications describing these units have appeared *(4-6)*. They should be consulted for details and additional references. The IUPAC report is entitled "Manual of Symbols and Terminology for Physicochemical Quantities and Units" and is available from Butterworths, London, **1970,** p. 44. It also appeared in *Pure Appl. Chem.*, **21**(1), 1(1970).

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(1) Fernelius, W. C., Loening, K., Adams, R. M., J. CHEM. EDUC., **50,** 123 (1973).
(2) Fernelius, W. C., Loening, K., Adams, R. M., J. CHEM. EDUC., **48,** 434(1971).
(3) Ferneliusn W. C., Loening, K., Adams, R. M., J. CHEM. EDUC., **49,** 489(1972).
(4) Paul, M. A., *J. Chem. Doc.*, **11**(1), 3(1971).
(5) Paul, M. A., *Chemistry,* **45**(9), 14(1972).
(6) Norris, A. C., J. CHEM. EDUC., **48,** 797(1971).

[1]IUB = International Union of Biochemistry.

[2]IFCC = International Federation of Clinical Chemists.

[3]IUNS = International Union of Nutritional Sciences.

[4]IUIS = International Union of Immunological Societies.