Progress Report of Subcommittee[1] on Nomenclature of the Standards Committee, AOCS

Introduction

G. E. Goheen
Southern Regional Research Laboratory[2]
New Orleans, Louisiana

The Subcommittee on Nomenclature has set up the following objectives to guide its activities:

1) To define nomenclature as related to the chemistry of fats and oils.

2) To study existing systems of nomenclature applicable to the chemistry of fats and oils and related substances and to recommend acceptable systems of nomenclature.

3) To make recommendations to the Editorial Board of the Journal of the American Oil Chemists' Society regarding nomenclature policy to be followed by authors who publish in the Journal.

1. Definition of Nomenclature

Nomenclature is defined as (Webster): "The system of names used in a particular branch of knowledge or art, or by any school or individual; especially the names used in classification as distinguished from other technical terms."

A name is "the title by which any person or thing is known or designated; a distinctive specific appelation whether of an individual or a class."

Since the main concern of the members of the AOCS is organic chemistry, especially in the fields of oils and fats, the systems of designating organic compounds, especially oils and fats and related substances, are considered the primary concern of the Subcommittee.

Systematic nomenclature in organic chemistry generally refers to such systems as the Geneva, the IUC or IUPAC, or *Chemical Abstracts*. In many respects these are similar and historically dependent.

2. Existing Systems

Organic compounds may be designated in many cases by several names, ranging from very brief symbols and trivial names to completely descriptive terms. The names may be formulated to imply the source of the compound, the process by which it was synthesized or perhaps its structural relationship to other compounds of an established type. Although this attests to the versatility of the chemist, it produces much confusion. This is true not only in the recording, indexing and correlation of chemical data but also in publications, patents, and daily communications in research, development, production, analytical, testing and related activities.

To remedy this situation, the Council of the International Union of Chemistry in 1922 appointed a Commission on the Reform of the Nomenclature of Organic Chemistry. The results and conclusions of this worldwide investigation were unanimously adopted by the Commission and the Council in 1930. They were published in the form of a Definitive Report with Comments by Austin M. Patterson in 1933 [J. Am. Chem. Soc. *55,* 3905 (1933)]. These results represent a thorough study of the original Geneva system (1892) with extensive additions formulated by outstanding chemists representing many countries.

They were supplemented by reports from the meetings at Lucerne in 1936 and at Rome in 1938. However, the International Union of Pure and Applied Chemistry at London in 1947 embarked upon a further extensive revision of the nomenclature rules for organic chemistry.

The Commission's progress in the period 1947 to 1962, inclusive, has been reported in successive issues of the Comptes Rendus of the Conferences of the Union.

Definitive Rules for the Nomenclature of Organic Chemistry (1965) were printed in 1966 (Butterworth, London).

The Commission has had the active support and help, through its United States Delegates, of the studies of the American Chemical Society's Committee on Nomenclature, Spelling, and Pronunciation, and Organic Division's Nomenclature Committee.

The general principles guiding the Commission in these studies are given in the Report of the IUPAC 1957 Rules [J. Am. Chem. Soc. *82,* 5545 (1960)]. Some of these are: "The Commission believes that differences in nomenclature frequently hinder the accurate and intelligible conveyance of information from one chemist to another, so tending to hamper understanding and progress. The Commission urges conformity with internationally agreed nomenclature even when this nomenclature may not seem the best possible from the point of view of the chemists of a particular nation or group.

"As few changes as possible should be made in existing nomenclature, though utility is more important than priority; rules and names should be unequivocal and unique, both simple and concise; records in journals, abstracts, compendia, and industry should be used to assess the relative extent of past use of various alternatives; rules should be consistent with one another, yet aid expression in the particular field of chemistry involved and be capable of extension with the progress of science; trivial names, and names having only a very small systematic component, cannot be eliminated when in very common use, but those of less value should be replaced by systematic (or at least more systematic) ones, and the creation of new trivial names should be discouraged by provision of extensible systematic nomenclature; names should be adaptable to different languages."

Many of these decisions were already being observed in *Chemical Abstracts* and other publications of the American Chemical Society. Additional provisions are being incorporated at convenient periods. *Chemical Abstracts* makes use of the well known common names which have been widely used in the chemical literature.

Consequently, the *Chemical Abstracts* system of nomenclature offers many advantages. In many cases it makes possible by referring to the Index the definite selection of one accepted name at the time a research project is instigated or when the compound is synthesized or isolated. This name is then one which can be used satisfactorily for all future work on that compound. Thus, cross references and duplicate indexing can be kept to a minimum. This is a very valuable asset to the indexing and correlation of data obtained both from periodical and patent literature and from future research and developmeent activities. It is also conducive to a minimum number of errors and the greatest efficiency in communications. Correct spelling and form of the name may be easily determined even by those who are not professional chemists.

Furthermore, *Chemical Abstracts* provides a name which, for a chemically pure compound, either in itself or by cross references, describes the chemical constitution. If the compound is mentioned in the available contemporary

---

[1] Subcommittee on Nomenclature comprises: G. E. Goheen, Chairman; H. P. Dupuy, both of the Southern Regional Research Laboratory, headquarters of the Southern Utilization Research and Development Division, ARS, USDA; Carter Litchfield, Texas A&M University; H. J. Harwood, Durkee's Famous Foods; R. M. Burton, Washington University.

[2] Southern Utilization Research and Development Division, Agricultural Research Service, US Department of Agriculture.

chemical literature practically anywhere in the world, the reference to it may be readily located in the indexes of *Chemical Abstracts* by the use of this name. Also, these indexes provide, on a semiannual basis, abundant cross references to other names for the same compound. This fact represents an advantage over all other systems of nomenclature.

Since *Chemical Abstracts* must of necessity deal with all branches of organic chemistry in detail, it is to be expected that the system may not be the ideal one for any specific branch such as fats and oils. It should be noted, however, that many firmly established common and trade names are recognized and used by *Chemical Abstracts.*

While the *Chemical Abstracts'* system of nomenclature offers advantages, it takes some study to learn to use it correctly, either to locate a given name or to apply the system in naming a new compound. For example, some knowledge should be acquired as to the meaning of such terms as functions (simple or complex), order of precedence of functions, index compounds, radical names, multivalent radicals, conjunctive names, and the treatment of like things alike.

In order to facilitate the use of the *Chemical Abstracts'* system of nomenclature, the indexes to *Chemical Abstracts* itself should be consulted, especially for questions concerning specific compounds. Also for more definite information in regard to general policy of *Chemical Abstracts,* and to the arrangement of the indexes themselves, the "Introduction to its Subject Indexes" should be consulted, especially for Volume *56* (1962). Reprints of this under the heading of "The Naming and Indexing of Chemical Compounds from *Chemical Abstracts*" are available from *Chemical Abstracts* Service.

When revisions of past practice are to be made in *Chemical Abstracts* they are almost always introduced in the first annual or semiannual index following the last year of a collective index period. For this reason it is well to keep in mind that some forms and radicals appearing in the current annual indexes may be slightly different from the similar ones used in the last collective index. Thus, many changes were noted in the Introduction to the Subject Index of Volume 31 (1937). For example oxo replaced keto, -ylidene replaced -al in certain cases and in some acid radicals -oyl replaced -yl. Also, the use of bis- was limited to prefix only complex expressions or to cases where the use of di- would be confusing. In addition a large number of the hydrocarbon and heterocyclic ring systems were renumbered.

A word of caution should be given against confusing nomenclature with the method of inversion used in *Chemical Abstracts'* subject index for indexing purposes. The nomenclature applies to the assigning of a complete chemical name to a compound. In normal writing this name is generally arranged so that the radicals or substituents appear first in an alphabetical order followed by the index compound and finally the modifying phrases. For *indexing purposes* the *name* is *inverted*; that is the index compound is placed first, followed by a comma, and then the substituents in alphabetical order (followed by another comma and modifying phrases in light-face type, if necessary). This is in agreement with the general policy of *Chemical Abstracts* of alphabetically indexing subjects instead of words. It is somewhat analogous to listing a personal name as Doe, John W. instead of John W. Doe. Thus, 2-butyloctanoic acid is indexed at Octanoic acid, 2-butyl-.

The AOCS Subcommittee will recommend changes in *Chemical Abstracts* nomenclature where it believes they are warranted. Common names which are recommended will be listed. Trivial names (those names which do not have a structural connotation) will be discouraged. In general, authors will be encouraged to use systematic names. These generally provide complete chemically descriptive and unambigous designations which can be formulated or interpreted according to some rule or principle. This decreases the need for a "chemical dictionary."

The AOCS Subcommittee has underway plans to study and recommend names for the following classes of organic compounds of interest to the chemistry of fats and oils:

Acyclic Hydrocarbons (to serve as the base for systematic names)
Carboxylic Acids and Radicals (In review)
Alcohols and Esters (In preparation)
Glycerides (In preparation)
Nitrogen Compounds (In preparation)

In these studies close contact will be maintained with the activities of the National Academy of Science—National Research Council in regard to nomenclature studies.

3. Recommendations

Acyclic Hydrocarbons

Formula	Recommended name	Formula	Recommended name
CH_4	Methane	$C_{24}H_{50}$	Tetracosane
C_2H_6	Ethane	$C_{25}H_{52}$	Pentacosane
C_3H_8	Propane	$C_{26}H_{54}$	Hexacosane
C_4H_{10}	Butane	$C_{27}H_{56}$	Heptacosane
C_5H_{12}	Pentane	$C_{28}H_{58}$	Octacosane
C_6H_{14}	Hexane	$C_{29}H_{60}$	Nonacosane
C_7H_{16}	Heptane	$C_{30}H_{62}$	Triacontane
C_8H_{18}	Octane	$C_{31}H_{64}$	Hentriacontane
C_9H_{20}	Nonane	$C_{32}H_{66}$	Dotriacontane
$C_{10}H_{22}$	Decane	$C_{33}H_{68}$	Tritriacontane
$C_{11}H_{24}$	Undecane	$C_{40}H_{82}$	Tetracontane
$C_{12}H_{26}$	Dodecane	$C_{50}H_{102}$	Pentacontane
$C_{13}H_{28}$	Tridecane	$C_{60}H_{122}$	Hexacontane
$C_{14}H_{30}$	Tetradecane	$C_{70}H_{142}$	Heptacontane
$C_{15}H_{32}$	Pentadecane	$C_{80}H_{162}$	Octacontane
$C_{16}H_{34}$	Hexadecane	$C_{90}H_{182}$	Nonacontane
$C_{17}H_{36}$	Heptadecane	$C_{100}H_{202}$	Hectane
$C_{18}H_{38}$	Octadecane	$C_{101}H_{204}$	Henhectane
$C_{19}H_{40}$	Nonadecane	$C_{102}H_{206}$	Dohectane
$C_{20}H_{42}$	Eicosane	$C_{110}H_{222}$	Decahectane
$C_{21}H_{44}$	Heneicosane	$C_{120}H_{242}$	Eicosahectane
$C_{22}H_{46}$	Docosane	$C_{132}H_{266}$	Dotriacontahectane
$C_{23}H_{48}$	Tricosane	$C_{200}H_{402}$	Dictane

The Nomenclature of Carboxylic Acids[1]

H. P. Dupuy
Southern Regional Research Laboratory[2]
New Orleans, Louisiana

I. Introduction

The primary chemical function known as the carboxyl functional group is indicated by the following four procedures:

1) In the "oic" nomenclature the aliphatic carboxylic acids are named by adding "oic acid" or "dioic acid" to the name of the hydrocarbon, with elision of the terminal "e" (if present) before "oic." The acids are regarded as derived from hydrocarbons of the same number of carbon atoms (CH_3 being replaced by COOH).

2) In the "carboxylic" nomenclature the aliphatic or aromatic carboxylic acids are named by the substitutive use of the suffix "carboxylic acid." In the aliphatic series, the numbering of the carbon atoms in the chain does not include the carbon atom of the carboxyl group; however, the simple aliphatic acids should preferably be named according to the first procedure.

3) In the "carboxy" nomenclature the aliphatic or aromatic carboxylic acids are named by the substitutive use of the prefix "carboxy." When the carboxyl group or groups cannot be indicated by either the first or second procedure above, the prefix "carboxy" with the appropriate multipliers and locants may be used. However, when only the carboxyl functional group is present, it is best to represent it by a suffix rather than a prefix.

---

[1] This paper is part of the overall nomenclature program of the AOCS Nomenclature Subcommittee.

[2] Southern Utilization Research and Development Division, Agricultural Research Service, US Department of Agriculture.

TABLE I

Saturated Aliphatic Monocarboxylic Acid Nomenclature

Formula	Recommended name[a]	Other acceptable name
$HCOOH$	Formic acid	Methanoic acid
CH_3COOH	Acetic acid	Ethanoic acid
CH_3CH_2COOH	Propionic acid	Propanoic acid
$CH_3(CH_2)_2COOH$	Butyric acid	Butanoic acid
$CH_3(CH_2)_3COOH$	Valeric acid	Pentanoic acid
$CH_3(CH_2)_4COOH$	Hexanoic acid	
$CH_3(CH_2)_5COOH$	Heptanoic acid	
$CH_3(CH_2)_6COOH$	Octanoic acid	
$CH_3(CH_2)_7COOH$	Nonanoic acid	Pelorgonic acid
$CH_3(CH_2)_8COOH$	Decanoic acid	
$CH_3(CH_2)_9COOH$	Undecanoic acid	
$CH_3(CH_2)_{10}COOH$	Lauric acid	Dodecanoic acid
$CH_3(CH_2)_{11}COOH$	Tridecanoic acid	
$CH_3(CH_2)_{12}COOH$	Myristic acid	Tetradecanoic acid
$CH_3(CH_2)_{13}COOH$	Pentadecanoic acid	
$CH_3(CH_2)_{14}COOH$	Palmitic acid	Hexadecanoic acid
$CH_3(CH_2)_{15}COOH$	Heptadecanoic acid	
$CH_3(CH_2)_{16}COOH$	Stearic acid	Octadecanoic acid
$CH_3(CH_2)_{17}COOH$	Nonadecanoic acid	
$CH_3(CH_2)_{18}COOH$	Eicosanoic acid	Arachidic acid
$CH_3(CH_2)_{19}COOH$	Heneicosanoic acid	
$CH_3(CH_2)_{20}COOH$	Docosanoic acid	Behenic acid
$CH_3(CH_2)_{22}COOH$	Tetracosanoic acid	Lignoceric acid
$CH_3(CH_2)_{24}COOH$[b]	Hexacosanoic acid	Cerotic acid

[a] Systematic names (IUPAC) are used for substituted acids, except C_1 to C_5.

[b] Systematic names are used for higher fatty acids.

4) In the "trivial" nomenclature only acids of long standing and wide usage are designated by common names. The "trivial" names for C_1 to C_5 saturated normal aliphatic monocarboxylic acids are used for both the unsubstituted and substituted acids, whereas systematic names (as defined in (1)–(3) above) are used for other substituted acids.

II. Recommended Nomenclature Practice

Aliphatic monocarboxylic acids are preferably named by eliding the final "e" of the name of the hydrocarbon and then adding the suffix "oic acid." In this system, the carboxyl carbon is the terminal carbon of the principal chain, and it is assigned the number "1" even though this might result in a shorter principal chain than the longest hydrocarbon chain.

Aliphatic dicarboxylic acids are named by adding the suffix "dioic acid" to the name of the corresponding hydrocarbon. The principal chain is chosen as the one terminating with the carbons of the two carboxyl groups.

In aliphatic polycarboxylic acids with three or more carboxyl groups, in alicyclic and aromatic compounds with a carboxyl group or groups attached to the ring moiety, the presence of a carboxyl group or groups is indicated by the suffix "carboxylic" with the appropriate locant or locants and multiplier. The principal chain of polycarboxylic acids is chosen from the longest chain with the maximum number of carboxyl groups, and the carboxyl group is given the lowest possible number over other substituents groups such as chloro or methyl in choosing the numbering for the principal chain.

When the carboxyl group or groups cannot be indicated by either the "oic" or the "carboxylic" nomenclature in side chains or in subordinate ranking, the "carboxy" nomenclature is used. In this system, the carboxyl group or groups is indicated by the prefix "carboxy" with the appropriate locant or locants and multiplier.

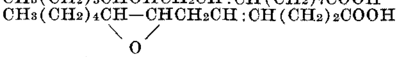
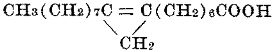
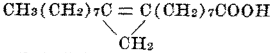
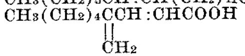
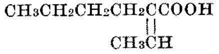
III. Discussion

With a few exceptions, the recommendations given above are in accordance with the "IUPAC Tentative Rules for the Nomenclature of Organic Chemistry" and "The Naming and Indexing of Chemical Compounds from *Chemical Abstracts*."

(Continued on page 394A)

TABLE II

Unsaturated Aliphatic Monocarboxylic Acid Nomenclature

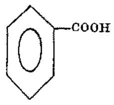
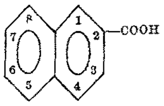
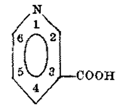
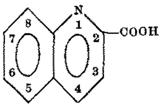
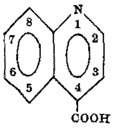
Formula	Recommended name[a]	Other acceptable name
$CH_2{:}CHCOOH$	Acrylic acid	Propenoic acid
$CH_2{:}C(CH_3)COOH$	Methacrylic acid	2-Methylpropenoic acid
$CH_3CH{:}CHCOOH$	Crotonic acid	*trans*-2-Butenoic acid
$CH_3CH{:}CHCOOH$	Isocrotonic acid	*cis*-2-Butenoic acid
$CH_3CH{:}CHCH{:}CHCOOH$	Sorbic acid	*trans*-2,*trans*-4-Hexadienoic acid
$CH_2{:}CH(CH_2)_8COOH$	10-Undecenoic acid	
$CH_3CH_2CH{:}CH(CH_2)_7COOH$	*cis*-9-Dodecenoic acid	Lauroleic acid
$CH_3(CH_2)_3CH{:}CH(CH_2)_7COOH$	*cis*-9-Tetradecenoic acid	Myristoleic acid
$CH_3(CH_2)_5CH{:}CH(CH_2)_7COOH$	*cis*-9-Hexadecenoic acid	Palmitoleic acid
$CH_3(CH_2)_7CH{:}CH(CH_2)_7COOH$	Oleic acid	*cis*-9-Octadecenoic acid
$CH_3(CH_2)_7CH{:}CH(CH_2)_7COOH$	Elaidic acid	*trans*-9-Octadecenoic acid
$CH_3(CH_2)_{10}CH{:}CH(CH_2)_4COOH$	*cis*-6-Octadecenoic acid	Petroselinic acid
$CH_3(CH_2)_{10}CH{:}CH(CH_2)_4COOH$	*trans*-6-Octadecenoic acid	Petroselaidic acid
$CH_3(CH_2)_5CH{:}CH(CH_2)_9COOH$	*trans*-11-Octadecenoic acid	
$CH_3(CH_2)_5CHOHCH_2CH{:}CH(CH_2)_7COOH$	Ricinoleic acid	12-Hydroxy-*cis*-9-octadecenoic acid
$CH_3(CH_2)_5CHOHCH_2CH{:}CH(CH_2)_7COOH$	Ricinelaidic acid	12-Hydroxy-*trans*-9-octadecenoic acid
 $CH_3(CH_2)_4\underset{\diagdown\;O\;\diagup}{CH\text{—}CH}CH_2CH{:}CH(CH_2)_2COOH$	*cis*-12,13-Epoxy-*cis*-9-octadecenoic acid	Vernolic acid
 $CH_3(CH_2)_7\underset{\diagdown\;CH_2\;\diagup}{C=C}(CH_2)_6COOH$	Malvalic acid	2-Octyl-1-cyclopropene-1-heptanoic acid
 $CH_3(CH_2)_7\underset{\diagdown\;CH_2\;\diagup}{C=C}(CH_2)_7COOH$	Sterculic acid	2-Octyl-1-cyclopropene-1-octanoic acid
$CH_3(CH_2)_4CH{:}CHCH_2CH{:}CH(CH_2)_7COOH$	Linoleic acid	*cis*-9,*cis*-12-Octadecadienoic acid
$CH_3(CH_2)_4CH{:}CHCH_2CH{:}CH(CH_2)_7COOH$	*trans*-9,*trans*-12-Octadecadienoic acid	
$CH_3(CH_2)_4CH{:}CHCH{:}CHCHOH(CH_2)_7COOH$	9-Hydroxy-*trans*-10,*trans*-12-octadecadienoic acid	Dimorphecolic acid
$CH_3CH_2CH{:}CHCH_2CH{:}CHCH_2CH{:}CH(CH_2)_7COOH$	Linolenic acid	
$CH_3CH_2CH{:}CHCH_2CH{:}CHCH_2CH{:}CH(CH_2)_7COOH$	*trans*-9,*trans*-12,*trans*-15-Octadecatrienoic acid	*cis*-9,*cis*-12,*cis*-15-Octadecatrienoic acid
$CH_3(CH_2)_3CH{:}CHCH{:}CHCH{:}CH(CH_2)_7COOH$	α-Eleostearic acid	*cis*-9,*trans*-11,*trans*-13-Octadecatrienoic acid
$CH_3(CH_2)_3CH{:}CHCH{:}CHCH{:}CH(CH_2)_7COOH$	β-Eleostearic acid	*trans*-9,*trans*-11,*trans*-13-Octadecatrienoic acid
$CH_3(CH_2)_3CH{:}CHCH{:}CHCH{:}CH(CH_2)_7COOH$	*cis*-9,*trans*-11,*cis*-13-Octadecatrienoic acid	Punicic acid
$CH_3(CH_2)_3(CH{:}CH)_3(CH_2)_4CO(CH_2)_2COOH$	4-Oxo-*cis*-9,*trans*-11,*trans*-13-Octadecatrienoic acid	α-Licanic acid
$CH_3(CH_2)_3(CH{:}CH)_3(CH_2)_4CO(CH_2)_2COOH$	4-Oxo-*trans*-9,*trans*-11,*trans*-13-Octadecatrienoic acid	β-Licanic acid
$CH_3(CH_2)_4(CH{:}CHCH_2)_4(CH_2)_2COOH$	Arachidonic acid	*cis*-5,*cis*-8,*cis*-11,*cis*-14-Eicosatetraenoic acid
$CH_3(CH_2)_5CH{:}CH(CH_2)_{11}COOH$	Erucic acid	*cis*-13-Docosenoic acid
$CH_3(CH_2)_5CH{:}CH(CH_2)_{11}COOH$	*trans*-13-Docosenoic acid	
 $CH_3(CH_2)_4\underset{\underset{CH_2}{\Vert}}{C}H{:}CHCOOH$	4-Methylene-2-nonenoic acid	4-Pentyl-2,4-pentadienoic acid[b]
 $CH_3CH_2CH_2CH_2\underset{\underset{CH_3CH}{\Vert}}{C}COOH$	2-Ethylidenehexanoic acid	2-Butyl-2-butenoic acid[b]

[a] Systematic names (IUPAC) are used for all substituted unsaturated acids.

[b] This name must be entered as a cross-reference or daggered entry to express the maximum unsaturated linkages and carboxyl group regardless of chain length for indexing purposes.

TABLE III

Carbocyclic and Heterocycle Carboxylic Acids

Formula	Recommended name	Other name
	Benzoic acid	Benzenecarboxylic acid
	2-Naphthoic acid	2-Naphthalenecarboxylic acid
	Nicotinic acid	3-Pyridinecarboxylic acid
	Quinaldic acid	2-Quinolinecarboxylic acid
	Cinchoninic acid	4-Quinolinecarboxylic acid

(Continued from page 392A)

Although Geneva names are preferred to common or trivial names, many carboxylic acids have common names of such long standing and wide usage that the trivial names are still retained. A list of acceptable common names will be illustrated throughout this discussion section.

In addition to the nomenclature systems described above, the following criteria should be used in selecting the best nomenclature for carboxylic acids:

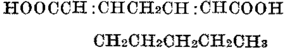
1) For the first five members of the series of saturated aliphatic monocarboxylic acids, use common names rather than Geneva names for both the unsubstituted and the substituted acids. The common names lauric, myristic, palmitic, and stearic acids are also retained but only for the unsubstituted acids. Substituted derivatives of these acids are entered at the proper Geneva names, dodecanoic, tetradecanoic, hexadecanoic, and octadecanoic acids, as shown in Table I.

2) For branched-chain aliphatic monocarboxylic acids, use common names for unsubstituted isobutyric (2-methylpropionic) acid, isovaleric (3-methylbutyric) acid, and pivalic (2,2-dimethylpropionic) acid, but use Geneva names for the substituted derivatives of these acids. Example: 3-Methyl-4-nitrobutyric acid. For other branched-chain aliphatic monocarboxylic acids, the longest chain possible in which the carboxyl group is at one end is chosen in naming these acids. Example: 2-Butyloctanoic acid, not 2-hexylhexanoic acid.

(Continued on page 396A)

TABLE IV

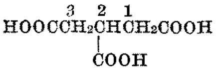
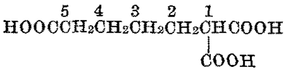
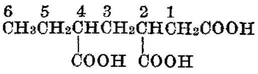
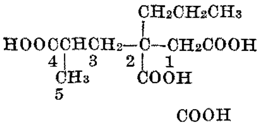
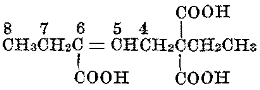
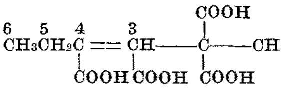
Aliphatic Dicarboxylic Acid Nomenclature

Formula	Recommended name[a]	Other acceptable name
$HOOCCOOH$	Oxalic acid	Ethanedioic acid
$HOOCCH_2COOH$	Malonic acid	Propanedioic acid
$HOOCCH_2CH_2COOH$	Succinic acid	Butanedioic acid
$HOOCCH{:}CHCOOH$	Maleic acid	*cis*-2-Butenedioic acid
$HOOCCH{:}CHCOOH$	Fumaric acid	*trans*-2-Butenedioic acid
$HOOC(CH_2)_3COOH$	Glutaric acid	Pentanedioic acid
$HOOC(CH_2)_4COOH$	Adipic acid	Hexanedioic acid
$HOOC(CH_2)_5COOH$	Pimelic acid	Heptanedioic acid
$HOOC(CH_2)_6COOH$	Suberic acid	Octanedioic acid
$HOOC(CH_2)_7COOH$	Azelaic acid	Nonanedioic acid
$HOOC(CH_2)_8COOH$	Sebacic acid	Decanedioic acid
$HOOC(CH_2)_9COOH$	Undecanedioic acid	....
$HOOC(CH_2)_{10}COOH$	Dodecanedioic acid	....
$HOOC(CH_2)_{11}COOH$	Tridecanedioic acid	....
$HOOC(CH_2)_{12}COOH$	Tetradecanedioic acid	....
$HOOC(CH_2)_{13}COOH$	Pentadecanedioic acid	....
$HOOC(CH_2)_{14}COOH$	Hexadecanedioic acid	....
$HOOC(CH_2)_{15}COOH$	Heptadecanedioic acid	....
$HOOC(CH_2)_{16}COOH$	Octadecanedioic acid	....
$HOOC(CH_2)_{17}COOH$	Nonadecanedioic acid	....
$HOOC(CH_2)_{18}COOH$	Eicosanedioic acid	....
 $\begin{array}{l} HOOCCH{:}CHCH_2CH{:}CHCOOH \\ \qquad\quad CH_2CH_2CH_2CH_2CH_3 \end{array}$	3-Pentyl-2,5-heptadienedioic acid	....

[a] Systematic (IUPAC) names are used for all substituted acids.

TABLE V

Aliphatic Polycarboxylic Acids

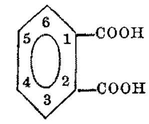
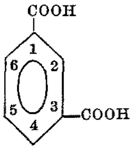
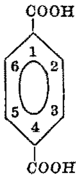
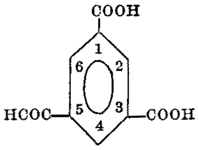
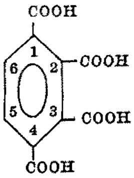
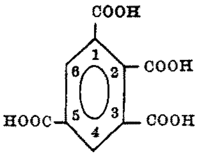
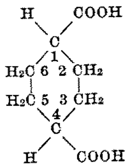
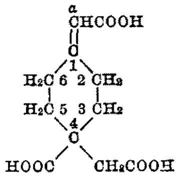
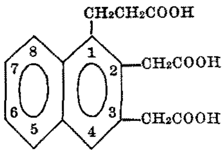
Formula	Recommended name	Other acceptable name
 $\begin{array}{l} \qquad\ \ 3\ \ 2\ \ 1 \\ HOOCCH_2CHCH_2COOH \\ \qquad\qquad\ \ \vert \\ \qquad\qquad COOH \end{array}$	1,2,3-Propanetricarboxylic acid	....
 $\begin{array}{l} \quad\ 5\quad 4\quad 3\quad 2\quad 1 \\ HOOCCH_2CH_2CH_2CH_2CHCOOH \\ \qquad\qquad\qquad\qquad\quad \vert \\ \qquad\qquad\qquad\qquad COOH \end{array}$	1,1,5-Pentanetricarboxylic acid	....
 $\begin{array}{l} 6\quad 5\quad 4\ \ 3\quad 2\ \ 1 \\ CH_3CH_2CHCH_2CHCH_2COOH \\ \qquad\quad \vert\qquad\quad \vert \\ \qquad COOH\ \ COOH \end{array}$	1,2,4-Hexanetricarboxylic acid	....
 $\begin{array}{l} \qquad\qquad\qquad CH_2CH_2CH_3 \\ \qquad\qquad\qquad \vert \\ HOOCCHCH_2{-}C{-}CH_2COOH \\ \qquad 4\,\vert\ \ 3\quad 2\,\vert\ \ 1 \\ \qquad CH_3\qquad COOH \\ \qquad 5 \end{array}$	2-Propyl-1,2,4-pentanetricarboxylic acid	....
 $\begin{array}{l} \qquad\qquad\qquad\qquad COOH \\ 8\quad 7\quad 6\quad 5\ \ 4\ \ \vert \\ CH_3CH_2C = CHCH_2CCH_2CH_3 \\ \qquad\quad \vert\qquad\qquad \vert \\ \qquad COOH\qquad COOH \end{array}$	5-Octene-3,3,6-tricarboxylic acid	....
 $\begin{array}{l} \qquad\qquad\qquad\qquad COOH \\ 6\quad 5\quad 4\qquad 3\qquad \vert \\ CH_3CH_2C = CH{-\!-}C{-\!-}CH_3 \\ \qquad\quad \vert\qquad \vert\qquad \vert \\ \qquad COOH\,COOH\ COOH \end{array}$	3-Hexene-2,2,3,4-tetracarboxylic acid	....

(Continued from page 394A)

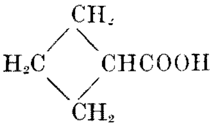
3) For unsaturated aliphatic monocarboxylic acids, use the Geneva system with the exception of the common acids listed in Table II. The substituted derivatives of these common acids, however, are entered under the name of the proper straight-chain acid. In forming Geneva names for unsaturated aliphatic monocarboxylic acids, the longest chain (with or without unsaturation) containing the carboxyl group is chosen as the fundamental chain. If there is any choice, this longest chain should include the maximum of unsaturated linkages (double bonds being given preference over triple bonds). If the name so chosen does not express all the unsaturation in the parent stem, then a cross-reference or a daggered entry is made to express the carboxyl group and the maximum of unsaturated linkages regardless of chain length for indexing purposes. For example *2-ethylidenehexanoic acid* is indexed as 2-butyl-2-butenoic acid. To prevent any confusion, use numbers to indicate locants for common names as well as Geneva names.

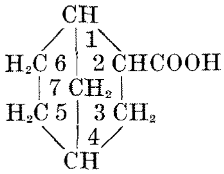
TABLE VI

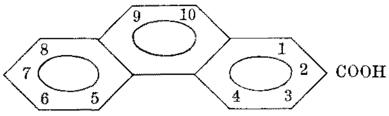
Carbocyclic and Heterocyclic Polycarboxylic Acids

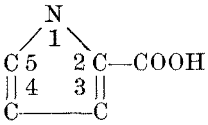
Formula	Recommended name	Other acceptable name
	Phthalic acid	*o*-Benzenedicarboxylic acid
	Isophthalic acid	*m*-Benzenedicarboxylic acid
	Terephthalic acid	*p*-Benzenedicarboxylic acid
	1,3,5-Benzenetricarboxylic acid	Trimesic acid
	1,2,3,4-Benzenetetracarboxylic acid	Mellophanic acid
	1,2,3,5-Benzenetetracarboxylic acid	
	1,4-Cyclohexanedicarboxylic acid	
	4-Carboxy-$\Delta^{1,\alpha,4}$-cyclohexanediacetic acid	
	1-(2-Carboxyethyl)-2,3-naphthalenediacetic acid	

4) Carboxylic acid names for monocarboxylic acids are used as cross-references to Geneva names for aliphatic acids and as index compound names for acids of cyclic compounds with the carboxyl group attached to the ring. The carbon atom to which the carboxyl group is attached is numbered "1" unless the ring system has a fixed numbering, in which case the carboxyl group takes a number as low as possible. Examples:


Cyclobutanecarboxylic acid

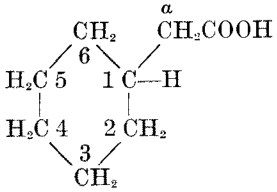

2-Norbornanecorboxylic acid

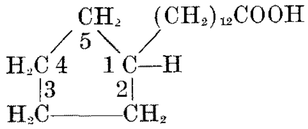

2-Phenanthrenecarboxylic acid


2-Pyrrolecarboxylic acid

5) Some common names are used for carboxylic acids of carbocyclic and heterocyclic compounds; and for these compounds, the "carboxylic" nomenclature should be entered as a cross-reference, as shown in Table III.

6) Conjunctive names may be formed from any common or Geneva name of a saturated aliphatic monocarboxylic acid, from a common name of an unsaturated monocarboxylic acid, or from malonic or succinic acid of the dicarboxylic series. The functional group in such conjunctive index compounds is always on the end of the chain, and positions on side chain are designated by Greek letters. Conjunctive names from Geneva names of unsaturated acids and from other dicarboxylic acids are avoided because of numbering difficulties. Examples:


Cyclohexaneacetic acid


Cyclopentanetridecanoic acid

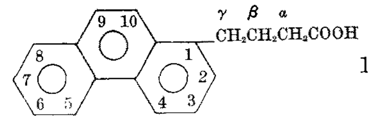
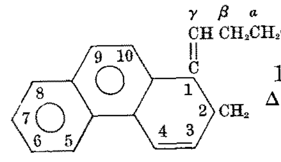

1-Phenanthrenebutyric acid

TABLE VII

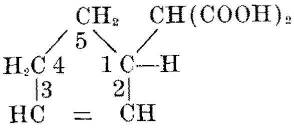
Alkyl Radical Nomenclature

Formula	Recommended name[a]
CH_3CH_2—	Ethyl
$CH_3CH_2CH_2$—	Propyl
$CH_3(CH_2)_2CH_2$—	Butyl
$CH_3(CH_2)_3CH_2$—	Pentyl
$CH_3(CH_2)_4CH_2$—	Hexyl
$CH_3(CH_2)_5CH_2$—	Heptyl
$CH_3(CH_2)_6CH_2$—	Octyl
$CH_3(CH_2)_7CH_2$—	Nonyl
$CH_3(CH_2)_8CH_2$—	Decyl
$CH_3(CH_2)_9CH_2$—	Undecyl
$CH_3(CH_2)_{10}CH_2$—	Dodecyl
$CH_3(CH_2)_{11}CH_2$—	Tridecyl
$CH_3(CH_2)_{12}CH_2$—	Tetradecyl
$CH_3(CH_2)_{13}CH_2$—	Pentadecyl
$CH_3(CH_2)_{14}CH_2$—	Hexadecyl
$CH_3(CH_2)_{15}CH_2$—	Heptadecyl
$CH_3(CH_2)_{16}CH_2$—	Octadecyl
$CH_3(CH_2)_{17}CH_2$—	Nonadecyl
$CH_3(CH_2)_{18}CH_2$—	Eicosyl
$CH_3(CH_2)_{19}CH_2$—	Heneicosyl
$CH_3(CH_2)_{20}CH_2$—	Docosyl

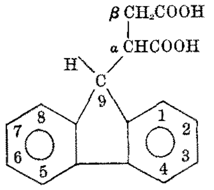
[a] Systematic (IUPAC) names are used for substituted radicals.



1(2H),γ-Phenanthrenebutyric acid
Δ



2-Cyclopentenemalonic acid



Fluorene-9-succinic acid

7) For saturated and unsaturated aliphatic dicarboxylic acids, use the Geneva system with the exception of common acids listed in Table IV.

The Geneva system, however, is used for the substituted derivatives of these common acids. In forming Geneva names, the longest chain containing the two carboxyl groups as terminals is chosen.

8) Aliphatic polycarboxylic acids containing more than two carboxyl groups are named by the "carboxylic" nomenclature. The longest chain to which the greatest number of carboxyl groups are attached is chosen as the index compound. If there is unsaturation, then the double or triple bonds are included in the chain if possible. See Table V. The lowest number is given first to the carboxyl group then to double and triple bonds.

9) Carbocyclic and heterocyclic polycarboxylic acids are indexed under their common names or the "carboxylic" nomenclature; however, if trivial names are used, then carboxylic names are always entered as cross-references to the common names. Polycarboxylic acids should conform with the rule for multiple functions; that is, all or as many as possible of the carboxyl groups should be expressed together in the name. If it is not possible to include all of the carboxyl groups in the index compound name, the remaining carboxyl groups are treated as prefixes to the name used, which should be the largest compound possible containing the maximum number of carboxyl groups. See Table VI.

TABLE VIII

Acyl Radical Nomenclature

Formula	Recommended name[a]	Other acceptable name
CH_3CO—	Acetyl	Ethanoyl
CH_3CH_2CO—	Propionyl	Propanoyl
$CH_3(CH_2)_2CO$—	Butyryl	Butanoyl
$CH_3(CH_2)_3CO$—	Valeroyl	Pentanoyl
$CH_3(CH_2)_4CO$—	Hexanoyl	
$CH_3(CH_2)_5CO$—	Heptanoyl	
$CH_3(CH_2)_6CO$—	Octanoyl	
$CH_3(CH_2)_7CO$—	Nonanoyl	
$CH_3(CH_2)_8CO$—	Decanoyl	
$CH_3(CH_2)_9CO$—	Undecanoyl	
$CH_3(CH_2)_{10}CO$—	Dodecanoyl	Lauroyl
$CH_3(CH_2)_{11}CO$—	Tridecanoyl	
$CH_3(CH_2)_{12}CO$—	Tetradecanoyl	Myristoyl
$CH_3(CH_2)_{13}CO$—	Pentadecanoyl	
$CH_3(CH_2)_{14}CO$—	Hexadecanoyl	Palmitoyl
$CH_3(CH_2)_{15}CO$—	Heptadecanoyl	
$CH_3(CH_2)_{16}CO$—	Octadecanoyl	Stearoyl
$CH_3(CH_2)_{17}CO$—	Nonadecanoyl	
$CH_2{:}CHCO$—	Acryloyl	Propenoyl
$CH_3CH{:}CHCO$—	Crotonoyl	*trans*-2-Butenoyl
$CH_3(CH_2)_7CH{:}$ $CH(CH_2)_7CO$—	Oleoyl	*cis*-9-Octadecenoyl

[a] The recommended acyl radical follows the recommended carboxylic acid nomenclature. Systematic (IUPAC) names are used for substituted acyl radicals.

TABLE IX

Diacyl Radical Nomenclature

Formula	Recommended name[a]	Other acceptable name
—$COCO$—	Oxalyl	Ethanedioyl
—$COCH_2CO$—	Malonyl	Propanedioyl
—$CO(CH_2)_2CO$—	Succinyl	Butanedioyl
—$COCH{:}CHCO$—	Maleoyl	*cis*-Butenedioyl
—$COCH{:}CHCO$—	Fumaroyl	*trans*-Butenedioyl
—$CO(CH_2)_3CO$—	Glutaryl	Pentanedioyl
—$CO(CH_2)_4CO$—	Adipoyl	Hexanedioyl
—$CO(CH_2)_5CO$—	Pimeloyl	Heptanedioyl
—$CO(CH_2)_6CO$—	Suberoyl	Octanedioyl
—$CO(CH_2)_7CO$—	Azelaoyl	Nonanedioyl
—$CO(CH_2)_8CO$—	Sebacoyl	Decanedioyl
—$CO(CH_2)_9CO$—	Undecanedioyl	…………
—$CO(CH_2)_{10}CO$—	Dodecanedioyl	…………
—$CO(CH_2)_{11}CO$—	Tridecanedioyl	…………
—$CO(CH_2)_{12}CO$—	Tetradecanedioyl	…………
—$CO(CH_2)_{13}CO$—	Pentadecanedioyl	…………
—$CO(CH_2)_{14}CO$—	Hexadecanedioyl	…………
—$CO(CH_2)_{15}CO$—	Heptadecanedioyl	…………
—$CO(CH_2)_{16}CO$—	Octadecanedioyl	…………
—$CO(CH_2)_{17}CO$—	Nonadecanedioyl	…………
—$CO(CH_2)_{18}CO$—	Eicosanedioyl	…………

[a] The recommended diacyl radical follows the recommended dicarboxylic acid nomenclature. Systematic (IUPAC) names are used for substituted diacyl radicals.

TABLE X

Acylamido Radical Nomenclature

Formula	Recommended name[a]	Other acceptable name
$CHCONH$—	Formamido	Formylamino
CH_3CONH—	Acetamido	Acetylamino
CH_3CH_2CONH—	Propionamido	Propionylamino
$CH_3(CH_2)_2CONH$—	Butyramido	Butyrylamino
$CH_3(CH_2)_3CONH$—	Valeramido	Valeroylamino
$CH_3(CH_2)_4CONH$—	Hexanamido	Hexanoylamino
$CH_3(CH_2)_5CONH$—	Heptanamido	Heptanoylamino
$CH_3(CH_2)_6CONH$—	Octanamido	Octanoylamino
$CH_3(CH_2)_7CONH$—	Nonanamido	Nonanoylamino
$CH_3(CH_2)_8CONH$—	Decanamido	Decanoylamino
$CH_3(CH_2)_{10}CONH$—	Dodecanamido	Dodecanoylamino
$CH_3(CH_2)_{12}CONH$—	Tetradecanamido	Tetradecanoylamino
$CH_3(CH_2)_{14}CONH$—	Hexadecanamido	Hexadecanoylamino
$CH_3(CH_2)_{16}CONH$—	Octadecanamido	Octadecanoylamino

[a] The recommended acylamido radical follows the recommended acyl radical nomenclature. Systematic (IUPAC) names are used for substituted acylamido radicals.

IV. Poor Practice

The practice of adding the suffix "ic" acid to the name of a hydrocarbon radical such as heptylic acid and undecylenic acid should be avoided. The practice of eliding the "ane" of alkanoic acid such as nonoic acid should be avoided. The practice of using Greek letters over numbers for locants in common names should be avoided; however, the recent trend to use numbers for locants of both Geneva and common names will prevent such confusion.

V. Organic Radicals

Some of the commonly occurring organic radicals are listed in Tables VII-X; but for a more complete list, see the Introduction to the Subject Index of *Chemical Abstracts*. Volume 56.