

of retrieval on the other is especially evident. This has led to various theoretical insights, which are also valid in other fields, where they could render much experimentation superfluous. In particular, it is the analytic-synthetic principle of classification to which chemical information owes its great success. This principle also promises to bring about major progress in other fields, although its applicability is not as apparent in these fields as in chemistry. Chemical information could profit still more from this fruitful principle if its strength were more clearly realized and if it were more consciously employed. In particular, the documentation of chemical reactions and of fields closely related to chemistry, such as pest control, plant protection, and pharmacy, could be made more effective and durable.

If, as theory requires, a distinction is drawn between the mode of expression and the concept to be conveyed, then the example of chemistry very clearly shows the necessity of expert and reliable manual indexing, if accurate searches are to be expected of an information system.^{12,13} It shows us, too, how far distant we are from the replacement of good manual indexing by any type of automatic, algorithmic indexing. The crucial obstacle here is the inherent unpredictability of an author's and inquirer's natural language expressions for *general concepts* and statements. This was hitherto prevented their reliable algorithmic detection in a text and also their reliable algorithmic translation into an indexing-language mode of expression.

Theory also teaches us that concept detection and translation seem programmable in principle in the case of *individual concepts*, because they are nearly always encountered only in the (fairly predictable) lexical mode of expression in the original texts. Any claims of success for automatic indexing should be viewed with scepticism whenever no distinction has been made between individual and general concepts.

All these interrelationships are revealed especially clearly

in chemical information science. Hence, it has been and can also in the future be a pioneer for other fields. However, some fields of pure and applied chemistry, too, could profit from a more consistent and conscious application of the theoretical principles that have been used successfully in chemistry for the last 2 decades.

*The meaning in which the terms with an asterisk are used in this paper can be looked up in the table on page 119 of reference 2.

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Principles for the Continuing Development of Organic Nomenclature

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Complexity of organic nomenclature increases not only because more and more complicated structures are to be named but also because, for lack of a generally accepted policy, several linguistic procedures are used for describing the same structural feature. A prerequisite for any progress in systematic nomenclature is a precise definition of nomenclature operations through which structural features are represented by linguistic procedures. Progress is to be sought mainly in the elimination of alternative procedures, new methods being introduced only when no existing method seems satisfactory. Nodal nomenclature, which inserts, as far as possible, existing methods in a general logical frame, shows that it is really possible to simplify systematic nomenclature even if for practical—mainly financial—reasons such a change may be long and difficult to introduce.

Nomenclature of organic chemistry, because of the considerable number of organic compounds, constitutes a particularly interesting subject of study. The very magnitude of the number of organic compounds has created a situation whose complexity has probably no equal in the field of scientific language. The quantity of available information being very large in organic chemistry, a significant part of most research projects should generally consist of a careful investigation of previous results.

Although other methods for representing chemical structures, such as line notations or connection tables, have been

developed, organic nomenclature remains an indispensable tool for current communication and for access to alphabetical indexes. It is therefore timely to evaluate existing nomenclature methods and, as far as possible, to improve them so that they are able to cope with the future needs of the chemical community.

As happens for any language, future development of chemical nomenclature is largely unpredictable because nomenclature will have to deal with various problems, some of which are not yet known. Nevertheless, what can certainly be improved is the methodology to be used for solving no-



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menclature problems, old or new.

Evolution of chemical nomenclature will most probably take the same course as that of living languages, which develop according to the changing needs of the users while retaining many features inherited from the past. For instance, a traditional method, such as radicofunctional nomenclature, may have been good for simple cases but is not sufficient for complicated structures. It should then be supplemented or replaced by a more powerful technique, such as substitutive nomenclature.

At present, formulation of nomenclature rules must take into consideration existing practice, if only to have some chance of success. With users being generally reluctant to change appreciably their nomenclature habits, it would be unwise to recommend useless changes of vocabulary while the most useful ones are already difficult to enforce. It is clear, therefore, that new nomenclature systems should always contain some amount of preexisting methods or terminology, provided that great caution is used in order to avoid confusion between old and new methods. What can be discussed, however, is the relative importance that should be given to traditional methods when defining a nomenclature system.

The attitude of authors of nomenclature rules relative to existing practice should be rather similar to the attitude of a grammarian toward a language. In both cases, one has to see what general rules can be deduced from observation of current practice, and cases escaping classification are termed "exceptions" or "irregular forms". Therefore, rational principles underlying grammar or nomenclature rules may be, in some way, considered as the result of a statistical observation. However, while grammarians have to accept exceptions as they are, the situation for chemical nomenclature is somewhat different because the general trend is rather to discourage exceptions.

For both living languages and chemical nomenclature, it is interesting to note that the popular trend is rather to

"regularize" irregular forms, the latter being more favored by confirmed scholars than by the man in the street. The tendency to "rationalize" existing languages, including chemical nomenclature, has simple and good reasons. The main one seems that as the number of compounds to name is increasing continuously the natural reaction of an individual, and more particularly of a nonspecialist, is to store the maximum amount of information at the cost of a minimum strain for the mind. In the case of chemical nomenclature, this means that the number of arbitrary trivial names, i.e., nonsystematic, should be kept as small as possible and that the rules for coining systematic names should be as short and simple as possible.

Benefits expected from good nomenclature rules or from physical theories are rather similar. Progress brought by a physical theory resides in the correlation of previously independent experimental laws in a consistent system based upon common principles. In a similar way, progress in nomenclature depends upon the development of general rules treating in a consistent way different classes of compounds previously named according to different and sometimes contradictory methods.

However, while the quest for unification is not restrained for physical theories, nomenclature rules, for practical reasons, must find a balance between existing practice and a general need for simplicity and consistency. Whenever such a balance has to be struck between contradictory objectives, there is room for long arguments about the best place to strike the balance. This type of problem has sometimes been described as a conflict between logic and practicability. It would probably be more accurate to say that it is a choice between short-term advantages by avoiding immediate work and long-term advantages resulting from the capacity of a logical system to resolve new and more complicated problems without resorting to special provisions filling the gaps left by insufficiently consistent methods.

Changes in nomenclature are a source of immediate expense for documentation systems, for both the makers and the users of documentation tools. Such expenditure is economically justified only if, afterward, sizable savings in documentation expenses can be expected from the contemplated changes. It is a question of investment, and the importance of foreseeable returns for a given investment is generally debatable. One can always find excellent reasons for avoiding expenditures: a peremptory reason, for instance, would be that the necessary funds are not available.

On the other hand, any industrial activity needs some amount of investment to keep abreast of the evolution of the market. The only practical conclusion that can be drawn is that as changes are always costly, their long-term advantages, in terms of clarity, generality, and consistency, must be carefully evaluated before making a decision. For instance, small repetitive adjustments may be much more costly, in the long run, than an important, but lasting, modification.

One of the main problems of organic nomenclature is that potential complications were not recognized in time, leading to solutions that were perhaps satisfactory for simple cases but did not constitute a sound basis for treating very complex structures. This situation follows mainly from the fact that, in its early days, organic nomenclature lacked a general acceptance of some directives ensuring the mutual consistency of the different rules.

Some effort was made in this direction with the Geneva rules. For instance, rule 17¹ states "Le numérotage des hydrocarbures est conservé pour tous leurs produits de substitution" ("The numbering of hydrocarbons is maintained for all their substitution products"). This is the basic principle of what is now called the "parent hydride approach" of organic nomenclature. In fact, in the present IUPAC rules, this

principle is rather generally applied to cyclic compounds but does not constitute the basis for the nomenclature of acyclic compounds. This discrepancy is regrettable because such a principle facilitates name formation by dividing it into two successive steps: the naming of the parent hydride and the indication of substitution.

If we consider now chemical names, there are two extreme cases and one intermediate: the trivial names, the systematic names, and the semisystematic (or semitrivial) names.

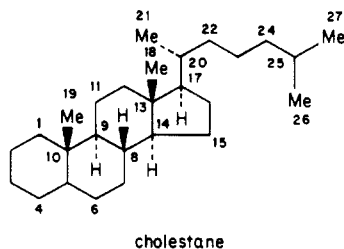
Trivial names do not imply any knowledge of the structure of molecules, and their choice is arbitrary, just as is the choice of names for the elements, if we exclude the recommendations for naming elements of atomic numbers greater than 100.² Some elements such as sulfur, iron, copper, and tin, as well as some compounds such as water, were named many centuries ago, showing the ancient origins of the use of trivial names.

In fact, at the beginning of chemical nomenclature, trivial names were used exclusively, either alone or associated in pairs for naming "binary compounds" according to a method which developed afterward into what is known now as "radicofunctional nomenclature".

At present, in organic nomenclature, the "state of the art" is defined by what is generally called the "Blue Book",³ whose introduction^{3a} defines its objectives as follows: "Owing to the very extensive nomenclature which has come into being since the last revision, the Commission has, in the main, confined its efforts to codifying sound practices which already existed, rather than to originating new nomenclature—the latter may form a later stage of the Commission's activities."

This codification has been facilitated by the fact that, from the origin, development of nomenclature has been often directed by relatively clear principles such as addition or substitution. This favorable situation is unfortunately marred by two things. (a) The same compound can be named according to different methods: for instance, "methylamine" and "methanamine" are synonymous, which means that the same term (amine) is used with two completely different senses. (b) Even if only one principle, such as substitution, is applied, it is not always clear how a name must be constructed. It happens, for instance, with the associations of chains and rings. If one uses only IUPAC rule A-61,^{3b} one cannot choose between the two following names: (2-chrysenyl)diphenylmethane; 2-(diphenylmethyl)chrysene. The first name complies with rule A-61.3 (compounds containing several cyclic radicals attached to one chain are named as derivatives of the acyclic compound). The second name is in accordance with rule A-61.4 (a hydrocarbon containing a small group attached to a large cyclic nucleus is generally named as a derivative of the cyclic hydrocarbon).

Present nomenclature continues to make great use of trivial names, even when simple systematic ones are available, for instance, for the simpler carboxylic acids. Effectively, trivial names are very helpful for designating relatively complex structures occurring frequently: a good example is given by the rules for steroids in which trivial names, such as cholestane, are recommended for some parent hydrides. Such names imply stereochemistry as shown:



An important feature of trivial names is that they designate a compound, including bond delocalization or stereochemistry.

For instance, the word "benzene" represents the compound with its double bond delocalization while the systematic name "1,3,5-cyclohexatriene" alone does not point to any form of delocalization.

Nevertheless, whatever may be the advantages of some trivial names, it is clear that excessive proliferation of trivial names would constitute an unbearable burden for the mind of chemists. Although it is not easy to legislate in this domain, two objectives can be defined: (a) limitation of the number of accepted trivial names; (b) definition of a general method for numbering the structures that receive a trivial name.

The last point should be particularly stressed. While the use of a trivial name may be well justified, nothing at all legitimizes the association of completely arbitrary numberings with the corresponding structures. This constitutes an absolutely useless complication for users who have to remember not only the structure but also its arbitrary numbering. This would be avoided if, as a rule, a systematic numbering were attributed to the structures. Some efforts in this direction have been accomplished, for instance, with terpenes, but a lot remains to be done.

In contrast to trivial names, systematic names describe the structure of the molecule. A name such as "cyclohexasilane" is entirely defined by chemical features: here, the geometry of the skeleton and the nature of the elements. Modification of a trivial name in order to indicate a structural modification, such as substitution, leads to what is called a "semisystematic" or "semitrivial" name.

Chemical nomenclature has to find a balance between lists of arbitrary trivial names and rules indicating how a name is deduced completely, if systematic, or partially, if semisystematic, from the structure of the molecule. For this purpose, the structure is virtually cut into smaller parts whose nature, position, and bonding are specified in the name through the channel of nomenclature operations. Nomenclature operations are the description by words, affixes, and numerals of structural and chemical features. For instance, in "cyclohexasilane", "cyclo" indicates the presence of a cycle; "hexa" says it is a six-membered cycle; "sil(a)" indicates that the element constituting the skeletal atoms is silicon; the ending "ane" says that this compound is saturated. A nomenclature operation that is frequently used is substitution: for instance, the prefix "chloro" indicates the replacement of a hydrogen atom by a chlorine atom. The operation includes, if necessary, multiplying numerical prefixes (di, tri, etc.) if more than one hydrogen atom is replaced, and appropriate numerals (locants) specify, if necessary, the skeletal atoms where the substitution occurs.

As systematic or semisystematic names result from a series of nomenclature operations, a prerequisite for any progress is a careful definition of these operations. In many cases, those described in existing rules, such as substitution, are straightforward. However, in some cases, such as the fusion method for polycycles and indicated hydrogen, the corresponding nomenclature operations are rather intricate and may eventually lead to diverse interpretations. In such cases, more detailed rules appear to be necessary, but on the other hand, future development of systematic nomenclature should endeavor to limit the number of the methods used and to extend the scope of those that will be retained.

It is obvious that a systematic name can reflect only the information available on the structure of the compound under consideration. As this amount of information can vary considerably, a common practice in coining systematic names consists of adding supplementary information to a generic name, as far as available knowledge permits. The following example shows how successive addition of numerical locants, of stereochemical indicators, and of isotopic indicators increases

progressively the accuracy with which a molecule is described:

pentene
2-pentene
cis-2-pentene
cis-2-[1-¹⁴C]pentene

Omission of some information is common practice, sometimes because it is wished to name a class of compounds (e.g., pentenes) but most often because this information does not exist. For instance, most systematic names give no indication whatever about the mass number of the nuclides constituting a molecule: it is then assumed that, for any atom, the isotopic distribution of the nuclides is the "natural" one. Appropriate indications are added to a chemical name only when there are proofs of a noticeable deviation from the "natural distribution".

As the various structural features of a molecule are more or less easily defined, those having the greatest influence on physicochemical properties, being easier to define, are generally considered first in the construction of the name: this is for instance the case for the nature of the elements constituting a molecule and for the bonding of the atoms in the molecule. Stereochemical properties, generally less accessible, are considered afterward, and last, isotopic modification, which is relatively rare, is eventually indicated. This situation outlines the concept of *rule modularity*. Rules are said to be modular when, in the construction of the name, the various types of structural properties are successively considered always in the same prescribed order.

An essential quality of nomenclature rules is to lead to unambiguous names. For this purpose, rules must be exhaustive, any structural feature concerning nature and position of atoms or bonds having a precise and unambiguous effect on the construction of the name.

The simplest and surest way to ensure exhaustivity is to adopt a modular organization of the rules according to which nomenclature operations must be performed in a well-established order. For the principal classes of operations, this order may be suggested by the relative importance of the chemical features considered. However, in many cases, this order is rather arbitrary: there is, for instance, no evident reason for deciding that a double bond is more or less important than an ionic center or that substitution by bromine is more or less important than substitution by chlorine.

In any case, it is essential that a clear seniority order be stated in the rules, even if this order has no chemical significance such as the alphabetical order that is used in many instances. Such rules which are necessary for selecting preferred names must be organized in such a way that they are easily understood and applied.

When developing new nomenclature methods, the choice of terminology cannot be overlooked but does not constitute a major problem. Many existing terms may be used without drawbacks provided that the format of the new names prevents any confusion between previous practice and new methods.

The order in which the various operations are performed being defined, any operation must affect the formation of the name only in so far as the preceding operations leave a choice. Sizable progress in this direction has already been accomplished in the Blue Book.³ It is now standard to find a list of criteria considered in turn until a decision is reached. This is a great improvement upon texts such as "A is done, taking also care that B is done". Such a sentence does not say clearly what to consider first, A or B, and this is especially troublesome if criteria A and B lead to different results.

The preceding remarks suggest that the following conditions are particularly valuable for ensuring clarity and exhaustivity of nomenclature rules: (a) operations of the same kind are

treated together, and operations of different kinds are treated separately; (b) operations of different kinds are successively performed in a prescribed order; (c) any operation affects the naming and numbering only in so far as the preceding operations leave a choice. We shall say that rules fulfilling these conditions are *strictly modular*.

NODAL NOMENCLATURE

The objective of nodal nomenclature has been to show that it is possible to develop a strictly modular system by modifying, to a moderate extent, procedures and terminologies already in use. These modifications are of two kinds: (1) Introduction of a unitary method for the description of molecular skeletons by (a) extending to acyclic compounds a method similar to the von Baeyer nomenclature for bridged systems, (b) applying to every type of ring system a method derived from the von Baeyer nomenclature by removal of unnecessary complications, a procedure that is a development of initial proposals made in this Journal,⁴ and (c) creating a consistent method for the assemblies of chains and rings. (2) Diminution of the number of acceptable nomenclature operations by (a) limiting the use of additive and subtractive operations to formal addition of subtraction of hydrogen, either charged or neutral (i.e., H⁺, H[•], H⁻) and (b) limiting the use of substitution to simple substitution, use of substituted substituents being avoided.

Nodal nomenclature is strictly modular, and the order in which the various structural features are successively considered during the construction of the nodal name is the following:

(1) The *parent graph* of the molecule is first defined. For this purpose, hydrogen atoms and substituents are removed. In the *skeleton* obtained in this way, the nodes of the parent graph are defined: they may be isolated atoms (mononuclear nodes) or groups of atoms (polynuclear nodes) such as those resulting from the presence of benzene rings when cyclophane nomenclature is used. In the parent graph, only the position of the nodes and of the lines (bonds) are indicated, without consideration of the chemical nature of the atoms and of the bonds. The way in which the parent graph is numbered and named is described in the first paper on nodal nomenclature,⁵ and complementary indications for assemblies of chains and rings are given in a note following the second paper.⁶

(2) The nature of atoms and bonds is defined. Nodal nomenclature based on the use of mononuclear nodes only is described in reference 6 and may be summarized as follows:

(a) The nature of the atoms forming the skeleton is indicated, any node of the graph corresponding to an atom of the skeleton. The most common element in the skeleton is indicated by a suffix derived from the name of the element (e.g., "-silane"). For carbon, the suffix "-carbane" may be used, but the syllable "-carb-" is generally omitted. For other elements present in the skeleton, usual "a" replacement prefixes are used.

(b) The state of hydrogenation of the *neutral parent hydride* is defined according to one of the two following methods:

(b1) The name is based on the fully hydrogenated structure, unsaturation being indicated, if needed, by appropriate suffixes, "-ene", "-yne", "-axene" (or "-arene"), the latter being used to denote that a *part of the parent hydride* contains the maximum number of noncumulative double bonds. In such names, the ending "-ane" of the suffix indicating the nature of the most common element of the skeleton is *not elided*.

(b2) The name is based on the structure containing the maximum number of noncumulative double bonds. In this case, the "-ane" ending of the suffix denoting the most common element in the skeleton is *replaced* by "-axene" or "-arene". Indicated hydrogen, "hydro-" and "dehydro-", prefixes are used as needed.

(c) Ionic charges and free valences on skeletal atoms are indicated by the usual suffixes.

(d) Substituents, including ionic substituents, are indicated by the usual prefixes or suffixes.

(3) Stereochemistry and isotopic modifications are indicated according to pertinent IUPAC rules, these indications being facilitated by the sequential numbering of the skeleton.

Most of the terminology used in nodal nomenclature is common with current organic nomenclature. Only few neologisms have been introduced, such as the endings "-axene" or "-arene" denoting the presence of the maximum number of noncumulative double bonds, thereby reserving the ending "-ene" for indicating the presence of a double bond(s) at a precise place(s).

However, just as any new type of chemical name, a nodal one must be easily recognizable so that the reader may know what are the rules that give its meanings. The vocables used in nodal nomenclature, being generally the same as in current organic nomenclature, may not suffice to identify a nodal name, but there is an unmistakable clue permitting this identification: the presence of a *numerical descriptor* enclosed in square brackets. Some descriptors of this type are already in use for bridged systems (von Baeyer names) and for spiro systems, but even in these cases, no confusion with them is possible: the corresponding nodal descriptors, apart from differences in the distribution of numerals, contain a conspicuous clue, the fact that the numerals are preceded by a zero in the nodal descriptors of cyclic systems.

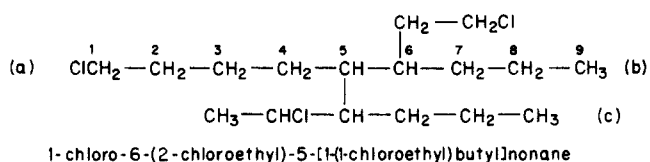
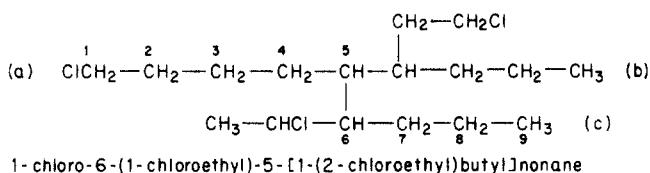
While nodal nomenclature is particularly useful in complicated cases, it is also apparent that some advantages can be drawn from its use even with simple structures. For instance, isomers are designated by the same word and are differentiated only by their *numerical descriptors*. Furthermore, nodal names may compete in simplicity with current IUPAC names, as shown in the following examples:

IUPAC names	nodal names
hexane	[6]hexane
2-methylpentane	[5.1 ²]hexane
2,3-dimethylbutane	[4.1 ² 1 ³]hexane

Apart from the first compound, the nodal names are shorter than the IUPAC ones. Another simplification brought by nodal nomenclature is that the general sequential numbering facilitates naming substitution derivatives without disturbing the numbering of the parent hydride.

Advantages of a modular approach are particularly tangible when complicated structures are considered. This can be seen with the two following examples for which current systematic names are compared with nodal names.

Example 1. Strict application of IUPAC rules leaves the possibility of naming the following structure in two ways:



IUPAC rule C-13.1, which should normally permit one to choose the preferred name between the first and the second one, is not sufficient: this appears if we consider the successive criteria used for choosing the principal chain.

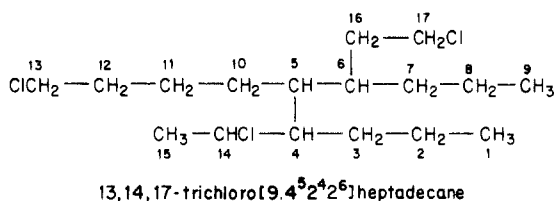
As there is no principal group, the first criterion to apply here is criterion c: maximum length. This leaves six possibilities for choosing and numbering the principal chain: ab,

ba, ac, ca, bc, and cb. Criterion h, "maximum number of substituents cited as prefixes", does not apply: there are in all cases three substituents. Criterion i, "lowest locants for all substituents in the principal chain cited as prefixes", restricts the choice to ab and ac for which the locant set 1,5,6 is lowest. Subsequent criteria j and k, based on alphabetical order, do not apply, as the alphabetical order of the substituents is the same in both cases.

In order to make a choice, another criterion is therefore necessary. The user of the rules has then to try to find a clue somewhere else in the rules. He can, more or less easily, find what he needs 89 pages earlier in the Blue Book:³ rule A-2.3(iii), which concerns, in principle, only hydrocarbons. This rule states: "in cases where names of complex radicals are composed of identical words, priority for citation is given to the radical which contains the lowest locant at the first cited point of difference in the radical." Applying this rule, "(1-chloroethyl)" is preferred to "(2-chloroethyl)".

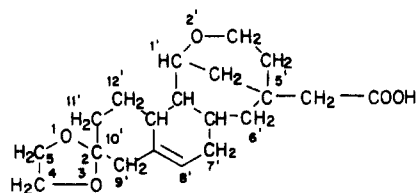
It appears that rule C-13.1 should be completed as indicated above, but even if this is done, the application of the rule will remain difficult because two different types of substitution are treated simultaneously: substitution by alkyls, which is directly related to the choice of the principal chain, some parts of the structure being possibly either a substituent or a part of the principal chain; substitution by chlorine atoms that cannot be part of the principal chain.

The modular approach of nodal nomenclature facilitates the numbering and naming of this compound. In the nodal method, atom and bond identities are ignored initially while the remaining graph is numbered. The longest chain of the graph contains nine nodes, the longest branch contains four nodes and is attached to node 5, the remaining branches have two nodes each and are attached to nodes 4 and 6. This information is contained in the descriptor [9.4⁵2⁴2⁶]. Consideration of the atom and bond identities leads to addition of "heptadecane" to the descriptor to yield the name of the parent hydride: [9.4⁵2⁴2⁶]heptadecane. Only after the parent hydride is named is substitution by chlorine considered. The chlorine atoms introduce an element of asymmetry, requiring a choice between two possible numberings, the locant set "13,14,17" being preferred to "13,15,16". This leads to the following name:



With nodal nomenclature, the numbering of the carbon skeleton is the same for the parent hydride and for the trichloro derivative. In contrast, the IUPAC name for this example shows that the numbering of the carbon skeleton is not the same for the parent hydride and for its trichloro derivative: the name of the parent hydride is 5-butyl-4,6-diethylnonane and not 6-ethyl-5-(1-ethylbutyl)nonane, the latter name corresponding to the numbering of the trichloro derivative.

Example 2

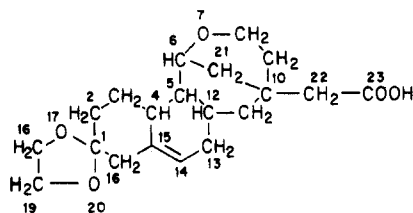


3',4',6',6'a,7',9',11',12',12a,12'b-decahydro-spiro[1,3-dioxolane-2,10'(1'H)-1,5]methano-[5H]naphth[1,2-c]oxocine-5'-acetic acid

For naming this structure, IUPAC rules have been applied but, as they only give general guidance, the precise construction of the name, including indicated hydrogen, asks for supplementary rules. For this purpose, we have used the *Chemical Abstracts* conventions.

It appears that, in this name, the description of the structure uses four methods based on different principles: (a) naming a fused polycyclic system containing heteroatoms; (b) naming a bridge fixed on a fused polycyclic system; (c) indication of a spiro junction; (d) introduction of a side chain by conjunctive nomenclature. Any of the successive operations b, c, and d affects not only the skeleton but also the state of hydrogenation and must be considered, one after the other, for defining indicated hydrogen and added hydrogen.

In contrast, nodal nomenclature defines first the whole skeleton, including the spiro junction and the side chain. The longest path in the graph contains 16 nodes. A chain of four nodes is attached to node 1 to form a spiro junction. A one-node bridge connects nodes 6 and 10, and nodes 4 and 15 and nodes 5 and 12 are directly connected. The descriptor for the graph of the ring system is therefore (016.4^{1,1}1^{6,10}0^{4,15}0^{5,12}). A side chain of two nodes is attached to the ring system through node 10. This is reflected in the complete descriptor for the graph as follows: [(016.4^{1,1}1^{6,10}0^{4,15}0^{5,12})10:22(2)]. The parent hydride is named pentacyclo[(016.4^{1,1}1^{6,10}0^{4,15}0^{5,12})10:22(2)]tricosane. Description of the three oxygen atoms in the skeleton, unsaturation, and the carboxylic acid function leads to the following name:



7,17,20-trioxapentacyclo[(016.4^{1,1}1^{6,10}0^{4,15}0^{5,12})-10:22(2)]tricosan-14-en-23-oic acid

Apart from being clearly shorter, the nodal name asks for the knowledge of fewer rules and is therefore simpler to construct for a nonspecialist. In the same way, the retrieval of the structure from the name is simpler.

CONCLUSIONS

Future development of systematic nomenclature will not prevent a continued use of trivial names. Entirely systematic names are cumbersome whenever structures are complex, and if only for this reason, trivial names have a bright future. Use of trivial names will also probably develop in the description of simple subunits in complicated structures such as cyclophanes.

Evolution of the use of trivial names is an interesting topic, but unfortunately, very little can be said about it. This field is for a large part outside the control of nomenclature specialists and of nomenclature commissions who come into action almost always too late.

Adoption of new trivial names results from some consensus between specialists in the field and nomenclature commissions, the latter only trying to define how and when old or new trivial names should be used. Nomenclature commissions could at least suggest that a general numbering method be applied in connection with new trivial names. Trivial names have an unquestionable advantage: brevity, while arbitrary and exceptional numberings, far from being useful, are just a nuisance. Nodal nomenclature provides a systematic method for the sequential numbering of assemblies of chains and rings such as those that frequently occur in natural products.

While evolution of trivial names is difficult to predict and to control, the way to improve and develop systematic nomenclature is clear: it is by better use of carefully selected existing principles and by the elimination of unnecessary alternative procedures. This should be done while limiting, as far as possible, changes in methods already established. For this reason, any reform must be preceded by a detailed analysis of elementary nomenclature operations, which should be afterward ordered according to a logical and modular scheme.

Nodal nomenclature shows that such improvements are not beyond reach and therefore deserves at least a careful study. Its fundamental procedures, apart from strict modularity, are developments of some existing methods of current nomenclature: these have been selected for their simplicity and potential of logical extension.

For these reasons, nodal nomenclature can easily complement, and eventually replace, current nomenclature procedures, particularly for the description of complicated structures for which existing methods can be considered as excessively intricate.

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