TREATISE ON INVERTEBRATE PALEONTOLOGY

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Part G

BRYOZOA

Revised

Volume 1: Introduction,
Order Cystoporata, Order Cryptostomata

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THIS VOLUME

Part G. BRYOZOA (Revised, Volume 1). Introduction, Order Cystoporata, Order Cryptostomata, xxvi + 626 p., 1,595 fig., 1983.

VOLUMES IN PREPARATION

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Part J. MOLLUSCA 2 (Gastropoda, Streptoneura exclusive of Archaeogastropoda, Euthyneura).
Part M. MOLLUSCA 5 (Coleoidea).
Part R. ARTHROPODA 4, Volume 3 (Hexapoda).
Part E Revised. Volume 2. PORIFERA.
Part G Revised. BRYOZOA (additional volumes).
Part L Revised. MOLLUSCA 4 (Ammonoidea).
Part O. ARTHROPODA 1 (supplement 1, Trilobita).
Part Q. ARTHROPODA 3 (supplement 1, Ostracoda).
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EDITORIAL PREFACE

THE AIM of the *Treatise on Invertebrate Paleontology,* as originally conceived and consistently pursued, is to present the most comprehensive and authoritative, yet compact statement of knowledge concerning invertebrate fossil groups that can be formulated by collaboration of competent specialists.

The major goal of this revision of Part G is to provide a workable reference to identify Bryozoa above the species level. Introductory papers review some of the current biological concepts of the phylum. The taxonomy is based on the reexamination of critical specimens, a reevaluation and increase in the number of taxonomic characters, and reclassification where necessary. Taxonomic characters range from microscopic to colony-wide, requiring new illustration at different magnifications. Systematic descriptions pertaining to two orders, the Cystoporata and Cryptostomata, are included here. The remainder of the bryozoan orders will be covered in subsequent volumes. Most manuscript for this volume was completed in April 1978.

ZOOLOGICAL NAMES

Many questions arise in connection with zoological names, especially including those related to acceptability and to alterations of some that may be allowed or demanded. Pro-

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cedure in obtaining answers to these questions is guided and to a large extent governed by regulations published (1961) in the *International Code of Zoological Nomenclature*[1] (hereinafter cited simply as the *Code*). The prime object of the *Code* is to promote stability and universality in the use of the scientific names of animals, ensuring also that each name is distinct and unique while avoiding restrictions on freedom of taxonomic thought or action. Priority is a basic principle, but under specified conditions its application can be modified. This is all well and good, yet nomenclatural tasks confronting the zoological taxonomist are formidable. They warrant the complaint of some that zoology, including paleozoology, should be the study of animals rather than of names applied to them.

Several ensuing pages are devoted to aspects of zoological nomenclature that are judged to have chief importance in relation to procedures adopted in the *Treatise.* Terminology is explained, and examples of style employed in the nomenclatural parts of systematic descriptions are given.

A draft of a revised edition of the *Code* was submitted to the meeting of the International Union of Biological Sciences at Helsinki, Finland, in August 1979. This revised edition has not come into force as of this writing, and the existing *Code* of 1961 is, therefore, strictly followed herein.

TAXA GROUPS

Each taxonomic unit (taxon, pl., taxa) belongs to a rank in the adopted hierarchy of classificatory divisions. In part, this hierarchy is defined by the *Code* to include a species-group of taxa, a genus-group, and a family-group. Units of lower rank than subspecies are excluded from zoological nomenclature and those higher than superfamily of the family-group are not regulated by the *Code.* It is natural and convenient to discuss nomenclatural matters in general terms first and then to consider each of the taxa groups separately. Especially important is the provision that within each taxa group, classificatory units are coordinate (equal in rank), whereas units of different taxa groups are not coordinate.

FORMS OF NAMES

All zoological names are divisible into groups based on their form (spelling). The first-published form (or forms) of a name is defined as original spelling (*Code,* Art. 32) and any later-published form (or forms) of the same name is designated as subsequent spelling (Art. 33). Obviously, original and subsequent spellings of a given name may or may not be identical and this affects consideration of their correctness. Further, examination of original spellings of names shows that by no means all can be distinguished as correct. Some are incorrect, and the same is true of subsequent spellings.

Original Spellings

If the first-published form of a name is consistent and unambiguous, the original spelling is defined as correct unless it contravenes some stipulation of the *Code* (Arts. 26–31), or the original publication contains clear evidence of an inadvertent error, in the sense of the *Code,* or, among names belonging to the family-group, unless correction of the termination or the stem of the type genus is required. An original spelling that fails to meet these requirements is defined as incorrect.

If a name is spelled in more than one way in the original publication, the form adopted by the first reviser is accepted as the correct original spelling, provided that it complies with mandatory stipulations of the *Code* (Arts. 26–31).

Incorrect original spellings are any that fail to satisfy requirements of the *Code,* represent an inadvertent error, or are one of multiple original spellings not adopted by a first reviser.

[1] N. R. Stoll and others (ed. comm.), *International Code of Zoological Nomenclature, adopted by the XV International Congress of Zoology,* xvii + 176 p. (International Trust for Zoological Nomenclature, London, 1961; 2nd edit., xx + 176 p., 1964.)

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These have no separate status in zoological nomenclature and therefore cannot enter into homonymy or be used as replacement names, and they call for correction. For example, a name originally published with a diacritic mark, apostrophe, diaeresis, or hyphen requires correction by deleting such features and uniting parts of the name originally separated by them, except that deletion of an umlaut from a vowel in a name derived from a German word or personal name requires the insertion of "e" after the vowel.

Subsequent Spellings

If a name classed as a subsequent spelling is identical with an original spelling, it is distinguishable as correct or incorrect on the same criteria that apply to the original spelling. This means that a subsequent spelling identical with a correct original spelling is also correct, and one identical with an incorrect original spelling is also incorrect. In the latter case, both original and subsequent spellings require correction (authorship and date of the original incorrect spelling being retained).

If a subsequent spelling differs from an original spelling in any way, even by the omission, addition, or alteration of a single letter, the subsequent spelling must be defined as a different name (except that such changes as altered terminations of adjectival specific names to obtain agreement in gender with associated generic names, of family-group names to denote assigned taxonomic rank, and corrections for originally used diacritic marks, hyphens, and the like are excluded from spelling changes conceived to produce a different name). In certain cases species-group names having variable spellings are regarded as homonyms as specified in Art. 58 of the *Code*.

Altered subsequent spellings other than the exceptions noted may be either intentional or unintentional. If demonstrably intentional, the change is designated as an emendation. Emendations may be either justifiable or unjustifiable. Justifiable enemdations are corrections of incorrect original spellings, and these take the authorship and date of the original spellings. Unjustifiable emendations are names having their own status in nomenclature, with author and date of their publication; they are junior objective synonyms of the name in its original form.

Subsequent spellings that differ in any way from the original spellings, other than previously noted exceptions, and that are not classifiable as emendations are defined as incorrect subsequent spellings. They have no status in nomenclature, do not enter into homonymy, and cannot be used as replacement names. It is the purpose of the following chapters to explain in some detail the implications of various kinds of subsequent spellings and how these are dealt with in the *Treatise*.

AVAILABLE AND UNAVAILABLE NAMES

Available Names

An available zoological name is any that conforms to all mandatory provisions of the *Code*. Such names are classifiable in groups which are recognized in the *Treatise*, though not explicitly differentiated in the *Code*. They are as follows:

1. So-called "inviolate names" include all available names that are not subject to alteration from their originally published form. They comprise correct original spellings and commonly include correct subsequent spellings, but include no names classed as emendations. Here belong most genus-group names (including those for collective groups), some of which differ in spelling from others by only a single letter or by the sequential order of their letters.

2. Names may be termed "perfect names" if, as originally published, they meet all mandatory requirements, needing no correction of any kind, but nevertheless are legally alterable in such ways as changing the termination (e.g., many species-group names, family-group names). This group does not include emended incorrect original spellings (e.g., *Boucekites*, replacement of *Boučekites*).

3. "Imperfect names" are available names

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that as originally published contain mandatorily emendable defects. Incorrect original spellings are imperfect names. Examples of emended imperfect names are: among species-group names, *guerini* (not *Guérini*), *obrienae* (not *O'Brienae*), *terranovae* (not *terra-novae*), *nunezi* (not *Nuñezi*), *Spironema rectum* (not *Spironema recta,* because generic name is neuter, not feminine); among genus-group names, *Broeggeria* (not *Bröggeria*), *Obrienia* (not *O'Brienia*), *Maccookites* (not *McCookites*); among family-group names Guembellotriinae (not Gümbellotriinae), Spironematidae (not Spironemidae, incorrect stem), Athyrididae (not Athyridae, incorrect stem). The use of "variety" for named divisions of fossil species, according to common practice of some paleontologists, gives rise to imperfect names, which generally are emendable (*Code,* Art. 45e) by omitting this term so as to indicate the status of this taxon as a subspecies. The name of a variety is always of feminine gender. If the variety is converted into a species or subspecies, the name takes on the gender of the associated genus.

4. "Vain names" are available names consisting of unjustified intentional emendations of previously published names. The emendations are unjustified because they are not demonstrable as corrections of incorrect original spellings as defined by the *Code* (Art. 32c). Vain names have status in nomenclature under their own authorship and date. They constitute junior objective synonyms of names in their original form. Examples are: among species-group names, *geneae* (published as replacement of original unexplained masculine, *geni,* which now is not alterable), *ohioae* (invalid change from original *ohioensis*); among genus-group names, *Graphiodactylus* (invalid change from original *Graphiadactyllis*); among family-group names, Graphiodactylidae (based on junior objective synonym having invalid vain name).

5. An important group of available zoological names can be distinguished as "transferred names." These comprise authorized sorts of altered names in which the change depends on transfer from one taxonomic rank to another, or possibly on transfers in taxonomic assignment of subgenera, species, or subspecies. Most commonly the transfer calls for a change in termination of the name so as to comply with stipulations of the *Code* on endings of family-group taxa and agreement in gender of specific names with associated generic names. Transferred names may be derived from any of the preceding groups except the first. Examples are: among species-group names, *Spirifer ambiguus* (masc.) to *Composita ambigua* (fem.), *Neochonetes transversalis* to *N. granulifer transversalis* or vice versa; among genus-group names, *Schizoculina* to *Oculina* (*Schizoculina*) or vice versa; among family-group names, Orthidae to Orthinae or vice versa, or superfamily Orthacea derived from Orthidae or Orthinae; among suprafamilial taxa (not governed by the *Code*), order Orthida to suborder Orthina or vice versa. The authorship and date of transferred names are not affected by the transfer, but the author responsible for the transfer and the date of his action are recorded in the *Treatise.*

6. Improved or "corrected names" include both mandatory and allowable emendations of imperfect names and of suprafamilial names, which are not subject to regulation as to name form. Examples of corrected imperfect names are given with the discussion of group 3. Change from the originally published ordinal name Endoceroidea (Teichert, 1933) to the presently recognized Endocerida illustrates a "corrected" suprafamilial name. Group 6 names differ from those in group 5 in not being dependent on transfers in taxonomic rank or assignment, but some names are classifiable in both groups.

7. "Substitute names" are available names expressly proposed as replacements for invalid zoological names, such as junior homonyms. These may be classifiable also as belonging in groups 1, 2, or 3. The glossary appended to the *Code* refers to these as "new names" (*nomina nova*) but they are better designated as substitute names, since their newness is temporary and relative. The first-published substitute name that complies with the def-

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inition here given takes precedence over any other. An example is *Marieita* LOEBLICH & TAPPAN, 1964, as substitute for *Reichelina* MARIE, 1955, *non* ERK, 1942.

8. "Conserved names" include relatively small numbers of species-group, genus-group, and family-group names that have come to be classed as available and valid by action of the International Commission on Zoological Nomenclature exercising its plenary powers to this end or ruling to conserve a junior synonym in place of a rejected "forgotten" name (*nomen oblitum*) (Art. 23b). Currently, such names are entered on appropriate "Official Lists," which are published from time to time.

It is useful for convenience and brevity of distinction in recording these groups of available zoological names to employ Latin designations in the pattern of *nomen nudum* (abbr., *nom. nud.*) and others. Thus we recognize the preceding numbered groups as follows: (1) *nomina inviolata*; sing., *nomen inviolatum,* abbr., *nom. inviol.*; (2) *nomina perfecta*; *nomen perfectum, nom. perf.*; (3) *nomina imperfecta*; *nomen imperfectum, nom. imperf.*; (4) *nomina vana*; *nomen vanum, nom. van.*; (5) *nomina translata*; *nomen translatum, nom. transl.*; (6) *nomina correcta*; *nomen correctum, nom. correct.*; (7) *nomina substituta*; *nomen substitum, nom. subst.*; (8) *nomina conservata*; *nomen conservatum, nom. conserv.* It should be noted that the *Code* does not differentiate between different kinds of subsequent intentional changes of spelling, all of which are grouped as "emendations" (see below).

Additional to the groups differentiated above, the *Code* (Art. 17) specifies that a zoological name is not prevented from availability (a) by becoming a junior synonym, for under various conditions this may be reemployed, (b) for a species-group name by finding that original description of the taxon relates to more than a single taxonomic entity or to parts of animals belonging to two or more such entities, (c) for species-group names by determining that it first was combined with an invalid or unavailable genus-group name, (d) by being based only on part of an animal, one sex of a species, an ontogenetic stage, or one form of a polymorphic species, (e) by being originally proposed for an organism not considered to be an animal but now so regarded, (f) by incorrect original spelling which is correctable under the *Code,* (g) by anonymous publication before 1951, (h) by conditional proposal before 1961, (i) by designation as a variety or form before 1961, (j) by concluding that a name is inappropriate (Art. 18), or (k) for a specific name by observing that it is tautonymous (Art. 18).

Unavailable Names

All zoological names which fail to comply with mandatory provisions of the *Code* are unavailable names and have no status in zoological nomenclature. None can be used under authorship and date of original publication as a replacement name (*nom. subst.*) and none preoccupies for purposes of the Law of Homonymy. Names identical in spelling with some, but not all, unavailable names can be classed as available if and when they are published in conformance to stipulations of the *Code,* and they are then assigned authorship and take date of the accepted publication. Different groups of unavailable names can be discriminated as follows.

9. "Naked names" include all those that fail to satisfy provisions stipulated in Article 11 of the *Code,* which states general requirements of availability. In addition they include names that, if published before 1931, were unaccompanied by a description, definition, or indication (Arts. 12, 16), as well as names published after 1930 that lacked accompanying statement of characters purporting to serve for differentiation of the taxon, or definite bibliographic reference to such a statement, or that were not proposed expressly as replacement (*nom. subst.*) of a preexisting available name (Art. 13a), or that were unaccompanied by definite fixation of a type species by original designation or indication (Art. 13b). Examples of "naked names" are: among species-group taxa, *Valvulina mixta* PARKER & JONES, 1865 (=*Cribrobulimina*

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mixta CUSHMAN, 1927, available and valid); among genus-group taxa, *Orbitolinopsis* SILVESTRI, 1932 (=*Orbitolinopsis* HENSON, 1948, available but classed as invalid junior synonym of *Orbitolina* D'ORBIGNY, 1850); among family-group taxa, Aequilateralidae D'ORBIGNY, 1846 (lacking type-genus), Héilcostègues D'ORBIGNY, 1826 (vernacular not latinized by later authors, Art. 11e(iii)), Poteriocrinidae AUSTIN & AUSTIN, 1843, = family Poteriocrinoidea AUSTIN & AUSTIN, 1842 (neither 1843 nor 1842 names complying with Art. 11e, which states that "a family-group name must, when first published, be based on the name then valid for a contained genus," such valid name in the case of this family being *Poteriocrinites* MILLER, 1821).

10. "Denied names" include all those that are defined by the *Code* (Art. 32c) as incorrect original spellings. Examples are: specific names, *nova-zelandica, mülleri, 10-brachiatus*; generic names, *M'Coyia, Størmerella, Römerina, Westergårdia*; family name, Růžičkinidae. Uncorrected "imperfect names" are "denied names" and unavailable, whereas corrected "imperfect names" are available.

11. "Impermissible names" include all those employed for alleged genus-group taxa other than genus and subgenus (Art. 42a) (e.g., supraspecific divisions of subgenera), and all those published after 1930 that are unaccompanied by definite fixation of a type species (Art. 13b). Examples of impermissible names are: *Martellispirifer* GATINAUD, 1949, and *Mirtellispirifer* GAUTINAUD, 1949, indicated respectively as a section and subsection of the subgenus *Cyrtospirifer*; *Fusarchaias* REICHEL, 1949, without definitely fixed type species (=*Fusarchaias* REICHEL, 1952, with *F. bermudezi* designated as type species).

12. "Null names" include all those that are defined by the *Code* (Art. 33b) as incorrect subsequent spellings, which are any changes of original spelling not demonstrably intentional. Such names are found in all ranks of taxa. It is not always evident from the original publication whether an incorrect subsequent spelling is intentional, resulting in a "vain name" which is invalid but available (category 4 above), or unintentional, resulting in a "null name" which is invalid and unavailable. In such cases, the decision of a subsequent author will sometimes have to be arbitrary according to his best judgment.

13. "Forgotten names" are defined (Art. 23b) as senior synonyms that have remained unused in primary zoological literature for more than 50 years. Such names are not to be used unless so directed by ICZN.

Latin designations for the discussed groups of unavailable zoological names are as follows: (9) *nomina nuda*; sing., *nomen nudum*, abbr., *nom. nud.*; (10) *nomina negata*; *nomen negatum, nom. neg.*; (11) *nomina vetita*; *nomen vetitum, nom. vet.*, (12) *nomina nulla*; *nomen nullam, nom. null.*; (13) *nomina oblita*; *nomen oblitum, nom. oblit.*

VALID AND INVALID NAMES

Important distinctions relate to valid and available names, on one hand, and to invalid and unavailable names, on the other. Whereas determination of availability is based entirely on objective considerations guided by Articles of the *Code*, conclusions as to validity of zoological names may be partly subjective. A valid name is the correct one for a given taxon, which may have two or more available names but only a single correct name, generally the oldest. Obviously, no valid name can also be an unavailable name, but invalid names may include both available and unavailable names. Any name for a given taxon other than the valid name is an invalid name.

A sort of nomenclatorial no-man's-land is encountered in considering the status of some zoological names, such as "doubtful names," "names under inquiry," and "forgotten names." Latin designations of these are *nomina dubia, nomina inquirenda,* and *nomina oblita,* respectively. Each of these groups may include both available and unavailable names, but the latter can well be ignored. Names considered to possess availability conduce to

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uncertainty and instability, which ordinarily can be removed only by appealed action of ICZN. Because few zoologists care to bother in seeking such remedy, the "wastebasket" names persist.

SUMMARY OF NAME GROUPS

Partly because only in such publications as the *Treatise* is special attention to groups of zoological names called for and partly because new designations are here introduced as means of recording distinctions explicitly as well as compactly, a summary may be useful.

Definitions of Name Groups

nomen conservatum (nom. conserv.). Name unacceptable under regulations of the *Code* which is made valid, either with original or altered spelling, through procedures specified by the *Code* or by action of ICZN exercising its plenary powers.

nomen correctum (nom. correct.). Name with intentionally altered spelling of sort required or allowable by the *Code* but not dependent on transfer from one taxonomic rank to another ("improved name"). (See *Code,* Arts. 26b, 27, 29, 30a(i) (3), 31, 32c(i), 33a; in addition, change of endings for suprafamilial taxa not regulated by the *Code.*)

nomen imperfectum (nom. imperf.). Name that as originally published meets all mandatory requirements of the *Code* but contains defect needing correction ("imperfect name"). (See *Code,* Arts. 26b, 27, 29, 32c, 33a).

nomen inviolatum (nom. inviol.). Name that as originally published meets all mandatory requirements of the *Code* and also is not correctable or alterable in any way ("inviolate name").

nomen negatum (nom. neg.). Name that as originally published constitutes invalid original spelling, and although possibly meeting all other mandatory requirements of the *Code,* cannot be used and has no separate status in nomenclature ("denied name"). It is to be corrected wherever found.

nomen nudum (nom. nud.). Name that as originally published fails to meet mandatory requirements of the *Code* and, having no status in nomenclature, is not correctable to establish original authorship and date ("naked name").

nomen nullum (nom. null.). Name consisting of an unintentional alteration in form (spelling) of a previously published name (either available name, as *nom. inviol., nom. perf., nom. imperf., nom. transl.*; or unavailable name, as *nom. neg., nom. nud., nom. van.,* or another *nom. null.*) ("null name").

nomen oblitum (nom. oblit.). Name of senior synonym unused in primary zoological literature in more than 50 years, not to be used unless so directed by ICZN ("forgotten name").

nomen perfectum (nom. perf.). Name that as originally published meets all mandatory requirements of the *Code* and needs no correction of any kind but which nevertheless is validly alterable by change of ending ("perfect name").

nomen substitutum (nom. subst.). Replacement name published as substitute for an invalid name, such as junior homonym (equivalent to "new name").

nomen translatum (nom. transl.). Name that is derived by valid emendation of a previously published name as result of transfer from one taxonomic rank to another within the group to which it belongs ("transferred name").

nomen vanum (nom. van.). Name consisting of an invalid intentional change in form (spelling) from a previously published name, such invalid emendation having status in nomenclature as a junior objective synonym ("vain name").

nomen vetitum (nom. vet.). Name of genus-group taxon not authorized by the *Code* or, if first published after 1930, without definitely fixed type species ("impermissible name").

Except as specified otherwise, zoological names accepted in the *Treatise* may be understood to be classifiable either as *nomina inviolata* or *nomina perfecta* (omitting from notice *nomina correcta* among specific names) and these are not discriminated. Names which are not accepted for one reason or another include junior homonyms, senior synonyms classifiable as *nomina negata* or *nomina nuda,* and numerous junior synonyms which include both objective (*nomina vana*) and subjective types; rejected names are classified as completely as possible.

NAME CHANGES IN RELATION TO TAXA GROUPS

Species-group Names

Detailed consideration of valid emendation of specific and subspecific names is unnecessary here because it is well understood and relatively inconsequential. When the form of adjectival specific names is changed to obtain agreement with the gender of a generic name in transferring a species

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from one genus to another, it is never needful to label the changed name as a *nom. correct.* Likewise, transliteration of a letter accompanied by a diacritical mark in manner now called for by the *Code* (as in changing originally published *bröggeri* to *broeggeri*) or elimination of a hyphen (as in changing originally published *cornu-oryx* to *cornuoryx*) does not require "*nom. correct.*" with it.

Genus-group Names

So rare are conditions warranting change of the originally published valid form of generic and subgeneric names that lengthy discussion may be omitted. Only elimination of diacritical marks of some names in this category seems to furnish basis for valid emendation. Is true that many changes of generic and subgeneric names have been published, but virtually all of these are either *nomina vana* or *nomina nulla.* Various names which formerly were classed as homonyms now are not, for two names that differ only by a single letter (or in original publication by presence or absence of a diacritical mark) are construed to be entirely distinct.

Examples in use of classificatory designations for genus-group names as previously given are the following, which also illustrate designation of type species as explained later.

Paleomeandron PERUZZI, 1881, p. 8 [**P. elegans*; SD HÄNTZSCHEL, 1975, p. W91] [=*Palaeomeandron* FUCHS, 1885, p. 395, *nom. van.*].

Vacuocyathus OKULITCH, 1950, p. 392 [**Coelocyathus kidrjassovensis* VOLOGDIN, 1937, p. 478, *nom. nud.*; 1939, p. 237; OD] [=*Coelocyathus* VOLOGDIN, 1934, p. 502, *nom. nud.*; 1937, p. 472, *nom. nud.*].

Cyrtograptus CARRUTHERS, 1867, p. 540, *nom. correct.* LAPWORTH, 1873, *pro Crytograpsus* CARRUTHERS, 1867, ICZN Op. 650, 1963 [**Cyrtograpsus murchisoni*; OD].

As has been pointed out above, it is in many cases difficult to decide whether a change in spelling of a name by a subsequent author was intentional or unintentional, that is, whether it should be classified as *nomen vanum* or *nomen nullum,* and the decision will often have to be arbitrary.

Family-group Names: Use of "nom. transl."

The *Code* specifies the endings only for subfamily (-inae) and family (-idae) but all family-group taxa are defined as coordinate, signifying that for purposes of priority a name published for a taxon in any category and based on a particular type genus shall date from its original publication for a taxon in any category, retaining this priority (and authorship) when the taxon is treated as belonging to a lower or higher category. By exclusion of -inae and -idae, respectively reserved for subfamily and family, the endings of names used for tribes and superfamilies must be unspecified different letter combinations. These, if introduced subsequent to designation of a subfamily or family based on the same nominate genus, are *nomina translata,* as is also a subfamily that is elevated to family rank or a family reduced to subfamily rank. In the *Treatise* it is desirable to distinguish the valid alteration comprised in the changed ending of each transferred family-group name by the abbreviation "*nom. trans.*" and record of the author and date belonging to this alteration. This is particularly important in the case of superfamilies, for it is the author who introduced this taxon that one wishes to know about rather than the author of the superfamily as defined by the *Code,* for the latter is merely the individual who first defined some lower-rank family-group taxon that contains the nominate genus of the superfamily. The publication containing introduction of the superfamily *nomen translatum* is likely to furnish the information on taxonomic considerations that support definition of the unit.

Examples of the use of "nom. transl." are the following.

Subfamily STYLININAE d'Orbigny, 1851
[*nom. transl.* VERRILL, 1864, *ex* Stylinidae D'ORBIGNY, 1851]

Superfamily ANCYLOCERATACEAE Meek, 1876
[*nom. transl.* WRIGHT, 1957, *ex* Ancyloceratidae MEEK, 1876]

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Family-group Names: Use of "nom. correct."

Valid name changes classed as *nomina correcta* do not depend on transfer from one category of family-group units to another but most commonly involve correction of the stem of the nominate genus; in addition, they include somewhat arbitrarily chosen modifications of endings for names of tribes or superfamilies. Examples of the use of "*nom. correct.*" are the following.

Family STREPTELASMATIDAE Nicholson, 1889

[*nom. correct.* WEDEKIND, 1927, p. 7, *pro* Streptelasmidae NICHOLSON in NICHOLSON & LYDEKKER, 1889, p. 297]

Family PALAEOSCORPIIDAE Lehmann, 1944

[*nom. correct.* PETRUNKEVITCH, 1955, p. P73, *pro* Palaeoscorpionidae LEHMANN, 1944, p. 177]

Family AGLASPIDIDAE Miller, 1877

[*nom. correct.* STÖRMER, 1959, p. P12, *pro* Aglaspidae MILLER, 1877]

Family-group Names: Replacements

Family-group names are formed by adding letter combinations (prescribed for family and subfamily) to the stem of the name belonging to the genus (nominate genus) first chosen as type of the assemblage. The type genus need not be the oldest in terms of receiving its name and definition, but it must be the first-published as name-giver to a family-group taxon among all those included. Once fixed, the family-group name remains tied to the nominate genus even if its name is changed by reason of status as a junior homonym or junior synonym, either objective or subjective. Seemingly, the *Code* requires replacement of a family-group name only in the event that the nominate genus is found to have been invalid when it was proposed (Arts. 11e, 39), and then a substitute family-group name is accepted if it is formed from the oldest available substitute name for the nominate genus. Authorship and date attributed to the replacement family-group name are determined by first publication of the changed family-group name, but for purposes of the Law of Priority, they take the date of the replaced name. Numerous long-used family-group names are incorrect in being *nomina nuda,* since they fail to satisfy criteria of availability (Art. 11e). These also demand replacement by valid names.

The aim of family-group nomenclature is greatest possible stability and uniformity, just as in other zoological names. Experience indicates the wisdom of sustaining family-group names based on junior subjective synonyms if they have priority of publication, for opinions of different workers as to the synonymy of generic names founded on different type species may not agree and opinions of the same worker may alter from time to time. The retention similarly of first-published family-group names which are found to be based on junior objective synonyms is less clearly desirable, especially if a replacement name derived from the senior objective synonym has been recognized very long and widely. To displace a much-used family-group name based on the senior objective synonym by disinterring a forgotten and virtually unused family-group name based on a junior objective synonym because the latter happens to have priority of publication is unsettling.

Replacement of a family-group name may be needed if the former nominate genus is transferred to another family group. Then the first-published name-giver of the family-group assemblage in the remnant taxon is to be recognized in forming a replacement name.

Family-group Names: Authorship and Date

All family-group taxa having names based on the same type genus are attributed to the author who first published the name for any of these assemblages, whether tribe, subfamily, or family (superfamily being almost inevitably a later-conceived taxon). Accordingly, if a family is divided into subfamilies or a subfamily into tribes, the name of no such subfamily or tribe can antedate the family

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name. Also, every family containing differentiated subfamilies must have a nominate (*sensu stricto*) subfamily, which is based on the same type genus as that for the family, and the author and date set down for the nominate subfamily invariably are identical with those of the family, without reference to whether the author of the family or some subsequent author introduced subdivisions.

Changes in the form of family-group names of the sort constituting *nomina correcta,* as previously discussed, do not affect authorship and date of the taxon concerned, but in the *Treatise* it is desirable to record the authorship and date of the correction.

Suprafamilial Taxa

International rules of zoological nomenclature as given in the *Code* are limited to stipulations affecting lower-rank categories (subspecies to superfamily). Suprafamilial categories (suborder to phylum) are either unmentioned or explicitly placed outside of the application of zoological rules. The *Copenhagen Decisions on Zoological Nomenclature*[1] (1953, Arts. 59–69) proposed to adopt rules for naming suborders and higher taxonomic divisions up to and including phylum, with provision for designating a type genus for each, hopefully in such manner as not to interfere with the taxonomic freedom of workers. Procedures for applying the Law of Priority and Law of Homonymy to suprafamilial taxa were outlined and for dealing with the names for such units and their authorship, with assigned dates, when they should be transferred on taxonomic grounds from one rank to another. The adoption of terminations of names, different for each category but uniform within each, was recommended.

The Colloquium on Zoological Nomenclature which met in London during the week just before the XVth International Congress of Zoology convened in 1958 thoroughly discussed the proposals for regulating suprafamilial nomenclature, as well as many others advocated for inclusion in the new *Code* or recommended for exclusion from it. A decision which was supported by a wide majority of the participants in the Colloquium was against the establishment of rules for naming taxa above family-group rank, mainly because it was judged that such regulation would unwisely tie the hands of taxonomists. For example, a class or order defined by an author at a given date, using chosen morphologic characters (e.g., gills of bivalves), should not be allowed to freeze nomenclature, taking precedence over another, later-proposed class or order distinguished by different characters (e.g., hinge-teeth of bivalves). Even the fixing of type genera for suprafamiliar taxa might have small value, if any, hindering taxonomic work rather than aiding it. At all events, no legal basis for establishing such types and for naming these taxa has yet been provided.

The considerations just stated do not prevent the editors of the *Treatise* from making "rules" for dealing with suprafamiliar groups of animals described and illustrated in this publication. At least a degree of uniform policy is thought to be needed, especially for the guidance of *Treatise* authors. This policy should accord with recognized general practice among zoologists; but where general practice is indeterminate or nonexistent, our own procedure in suprafamilial nomenclature needs to be specified as clearly as possible. This pertains especially to decisions about names themselves, about citation of authors and dates, and about treatment of suprafamilial taxa which on taxonomic grounds are changed from their originally assigned rank. Accordingly, a few "rules" expressing *Treatise* policy are given here, some with examples of their application.

1. The name of any suprafamilial taxon must be a Latin or latinized uninominal noun of plural form,or treated as such, with a capital initial letter and without diacritical mark, apostrophe, diaeresis, or hyphen. If a com-

[1] Francis Hemming, ed., *Copenhagen Decisions on Zoological Nomenclature. Additions to, and modifications of, the Règles Internationales de la Nomenclature Zoologique,* xxix + 135 p. (International Trust for Zoological Nomenclature, London, 1953).

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ponent consists of a numeral, numerical adjective, or adverb, this must be written in full.

2. Names of suprafamilial taxa may be constructed in almost any way. A name may indicate morphological attributes (e.g., Lamellibranchiata, Cyclostomata, Taxoglossa) or be based on the stem of an included genus (e.g., Bellerophontina, Nautilida, Fungiina) or on arbitrary combinations of letters (e.g., Yuania); none of these, however, can be allowed to end in -idae or -inae, reserved for family-group taxa. No suprafamilial name identical in form to that of a genus or to another published suprafamilial name should be employed (e.g., order Decapoda LATREILLE, 1803, crustaceans, and order Decapoda LEACH, 1818, cephalopods; suborder Chonetoidea MUIR-WOOD, 1955, and genus *Chonetoidea* JONES, 1928). Worthy of notice is the classificatory and nomenclatural distinction between suprafamilial and family-group taxa which respectively are named from the same type genus, since one is not considered to be transferable to the other (e.g., suborder Bellerophontina ULRICH & SCOFIELD, 1897; superfamily Bellerophontacea MCCOY, 1851; family Bellerophontidae MCCOY, 1851). Family-group names and suprafamilial names are not coordinate.

3. The Laws of Priority and Homonymy lack any force of international agreement as applied to suprafamilial names, yet in the interest of nomenclatural stability and the avoidance of confusion these laws are widely applied by zoologists to taxa above the family-group level wherever they do not infringe on taxonomic freedom and long-established usage.

4. Authors who accept priority as a determinant in nomenclature of a suprafamilial taxon may change its assigned rank at will, with or without modifying the terminal letters of the name, but such change(s) cannot rationally be judged to alter the authorship and date of the taxon as published originally. A name revised from its previously published rank is a "transferred name" (*nom. transl.*), as illustrated in the following.

Order CORYNEXOCHIDA Kobayashi, 1935

[*nom. transl.* MOORE, 1959, *ex* suborder Corynexochida KOBAYASHI, 1935]

A name revised from its previously published form merely by adoption of a different termination, without changing taxonomic rank is an "altered name" (*nom. correct.*).

Order DISPARIDA Moore & Laudon, 1943

[*nom. correct.* MOORE in MOORE, LALICKER, & FISCHER, 1952, p. 613, *pro* order Disparata MOORE & LAUDON, 1943]

A suprafamilial name revised from its previously published rank with accompanying change of termination (which may or may not be intended to signalize the change of rank) is recorded as *nom. transl. et correct.*

Order HYBOCRINIDA Jackel, 1918

[*nom. transl. et correct.* MOORE in MOORE, LALICKER, & FISCHER, 1952, p. 613, *ex* suborder Hybocrinites JAEKEL, 1918, p. 90]

5. The authorship and date of nominate subordinate and superordinate taxa among suprafamilial taxa are considered in the *Treatise* to be identical since each actually or potentially has the same type. Examples are given below.

Subclass ENDOCERATOIDEA Teichert, 1933

[*nom. transl.* TEICHERT in TEICHERT *et al.*, 1964, p. K128 (*ex* superorder Endoceratoidea SHIMANSKIY & ZHURAVLEVA, 1961, *nom. transl.* TEICHERT in TEICHERT *et al.*, 1964, p. K128, *ex* order Endoceroidea TEICHERT, 1933)]

Order ENDOCERIDA Teichert, 1933

[*nom. correct.* TEICHERT in TEICHERT *et al.*, 1964, p. K165, *pro* order Endoceroidea TEICHERT, 1933]

Suborder ENDOCERINA Teichert, 1933

[*nom. correct.*, herein, *ex* Endoceratina SWEET, 1958, suborder]

TAXONOMIC EMENDATION

Emendation has two distinct meanings as regards zoological nomenclature. These are: (1) alteration of a name itself in various ways for various reasons, as has been reviewed, and (2) alteration of taxonomic scope or concept in application of a given zoological name.

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The *Code* (Art. 33a and Glossary p. 148) concerns itself only with the first type of emendation, applying the term to either justified or unjustified changes, both intentional, of the original spelling of a name. These categories are identified in the *Treatise* as *nomina correcta* and *nomina vana,* respectively. The second type of emendation primarily concerns classification and inherently is not associated with change of name. Little attention generally has been paid to this distinction in spite of its significance.

Most zoologists, including paleozoologists, who have signified emendation of zoological names refer to what they consider a material change in application of the name such as may be expressed by an importantly altered diagnosis of the assemblage covered by the name. The abbreviation "*emend.*" then may accompany the name with statement of the author and date of the emendation. On the other hand, many workers concerned with systematic zoology think that publication of "*emend.*" with a zoological name is valueless, because more or less alteration of taxonomic sort is introduced whenever a subspecies, species, genus, or other assemblage of animals is incorporated under or removed from the coverage of a given zoological name. Inevitably associated with such classificatory expansions and restrictions is some degree of emendation affecting diagnosis. Granting this, still it is true that now and then somewhat radical revisions are put forward, generally with published statement of reasons for changing the application of a name. To erect a signpost at such points of most significanct change is worthwhile, both as aid to subsequent workers in taking account of the altered nomenclatural usage and as indication that not-to-be-overlooked discussion may be found at a particular place in the literature. Authors of contributions to the *Treatise* are encouraged to include records of all specially noteworthy emendations of this nature, using the abbreviation "*emend.*" with the name to which it refers and citing the author and date of the emendation.

Examples from *Treatise* volumes follow.

Order ORTHIDA Schuchert & Cooper, 1932

[*nom. transl. et correct.* MOORE in MOORE, LALICKER, & FISCHER, 1952, p. 220, *ex* suborder Orthoidea SCHUCHERT & COOPER, 1932, p. 43] [*emend.* WILLIAMS & WRIGHT, 1965]

Subfamily ROVEACRININAE Peck, 1943

[Roveacrininae PECK, 1943, p. 465; *emend.* PECK in MOORE & TEICHERT, eds., 1978, p. T921]

STYLE IN GENERIC DESCRIPTIONS

Citation of Type Species

The name of the type species of each genus and subgenus is given next following the generic name with its accompanying author, date, and page reference or after entries needed for definition of the name if it is involved in homonymy. The originally published combination of generic and trivial names for this species is cited, accompanied by an asterisk (*), with notation of the author and date of original publication. An exception in this procedure is made, however, if the species was first published in the same paper and by the same author as that containing definition of the genus that it serves as type; in such case, the initial letter of the generic name followed by the trivial name is given without repeating the name of the author and date. Examples of these two sorts of citations are as follows:

Orionastraea SMITH, 1917, p. 294 [**Sarcinula phillipsi* MCCOY, 1849, p. 125; OD].

Schoenophyllum SIMPSON, 1900, p. 214 [**S. aggregatum*; OD].

If the cited type species is a junior synonym of some other species, the name of this latter also is given, as follows:

Actinocyathus D'ORBIGNY, 1849, p. 12 [**Cyathophyllum crenulate* PHILLIPS, 1836, p. 202; M; =*Lonsdaleia floriformis* (MARTIN), 1809, pl. 43, validated by ICZN Op. 419].

In the *Treatise,* the name of the type species is always given in the exact form it had in the original publication; in cases where mandatory changes are required, these are introduced later in the text, mostly in a figure caption.

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It is desirable to record the manner of establishing the type species, whether by original designation or by subsequent designation.

Fixation of type species originally. The type species of a genus or subgenus, according to provisions of the *Code,* may be fixed in various ways in the original publication or it may be fixed in specified ways subsequent to the original publication as stipulated by the *Code* (Art. 68) in order of precedence as (1) *original designation* (in the *Treatise* indicated as "OD") when the type species is explicitly stated or (before 1931) indicated by "n. gen., n. sp." (or its equivalent) applied to a single species included in a new genus, (2) defined by use of *typus* or *typicus* for one of the species included in a new genus (adequately indicated in the *Treatise* by the specific name), (3) established by *monotypy* if a new genus or subgenus has only one originally included species (in the *Treatise* indicated as "M"), and (4) fixed by *tautonymy* if the genus-group name is identical to an included species name not indicated as type belonging to one of the three preceding categories.

Fixation of type species subsequently. The type species of many genera are not determinable from the publication in which the generic name was introduced and therefore such genera can acquire a type species only by some manner of subsequent designation. Most commonly this is established by publishing a statement naming as type species one of the species originally included in the genus, and in the *Treatise* fixation of the type species in this manner is indicated by the letters "SD" accompanied by the name of the subsequent author (who may be the same person as the original author) and the date of publishing the subsequent designation. Some genera, as first described and named, included no mentioned species and these necessarily lack a type species until a date subsequent to that of the original publication when one or more species are assigned to such a genus. If only a single species is thus assigned, it automatically becomes the type species and in the *Treatise* this subsequent monotypy is indicated by the letters "SM." Of course, the first publication containing assignment of species to the genus which originally lacked any included species is the one concerned in fixation of the type species, and if this named two or more species as belonging to the genus but did not designate a type species, then a later "SD" designation is necessary. Examples of the use of "SD" and "SM" as employed in the *Treatise* follow.

Hexagonaria GÜRICH, 1896, p. 171 [**Cyathophyllum hexagonum* GOLDFUSS, 1826, p. 61; SD LANG, SMITH, & THOMAS, 1940, p. 69].

Muriceides STUDER, 1887, p. 61 [**M. fragilis* WRIGHT & STUDER, 1889; SM WRIGHT & STUDER, 1889].

Another mode of fixing the type species of a genus is action of the International Commission on Zoological Nomenclature using its plenary powers. Definition in this way may set aside application of the *Code* so as to arrive at a decision considered to be in the best interest of continuity and stability of zoological nomenclature. When made, it is binding and commonly is cited in the *Treatise* by the letters "ICZN," accompanied by the date of announced decision and reference to the appropriate numbered Opinion.

It should be noted that *subsequent designation* of a type species is admissible only for genera established prior to 1931. A new genus-group name established after 1930, and not accompanied by fixation of a type species through original designation or original indication, is invalid (*Code,* Art. 13b). Effort of a subsequent author to "validate" such a name by subsequent designation of a type species constitutes an original publication making the name available under authorship and date of the subsequent author.

Homonyms

Most generic names are distinct from all others and are indicated without ambiguity by citing their originally published spelling accompanied by name of the author and date of first publication. If the same generic name

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has been applied to two or more distinct taxonomic units, however, it is necessary to differentiate such homonyms, and this calls for distinction between junior homonyms and senior homonyms. Because a junior homonym is invalid, it must be replaced by some other name. For example, *Callopora* HALL, 1852, introduced for Paleozoic trepostomate bryozoans, is invalid because GRAY in 1848 published the same name for Cretaceous-to-Holocene cheilostomate bryozoans, and BASSLER in 1911 introduced the new name *Hallopora* to replace Hall's homonym. The *Treatise* style of entry is:

Hallopora BASSLER, 1911, p. 325, *nom. subst. pro Callopora* HALL, 1852, p. 144, *non* GRAY, 1848.

In like manner, a needed replacement generic name may be introduced in the *Treatise* (even though first publication of generic names otherwise in this work is generally avoided). The requirement that an exact bibliographic reference must be given for the replaced name commonly can be met in the *Treatise* by citing a publication recorded in the list of references as shown in the following example.

Mysterium DE LAUBENFELS, herein, *nom. subst. pro Mystrium* SCHRAMMEN, 1936, p. 183, *non* ROGER, 1862 [**Mystrium porosum* SCHRAMMEN, 1936, p. 183].

Otherwise, no mention of the existence of a junior homonym generally is made.

Synonymous homonyms. An author sometimes publishes a generic name in two or more papers of different date, each of which indicates that the name is new. This is a bothersome source of errors for later workers who are unaware that a supposed first publication that they have in hand is not actually the original one. Although the names were separately published, they are identical and therefore definable as homonyms; at the same time they are absolute synonyms. For the guidance of all concerned, it seems desirable to record such names as synonymous homonyms, and in the *Treatise* the junior one of these is indicated by the abbreviation "jr. syn. hom."

Identical family-group names not infrequently are published as new names by different authors, the author of the later-introduced name being ignorant of previous publication(s) by one or more other workers. In spite of differences in taxonomic concepts as indicated by diagnoses and grouping of genera and possibly in assigned rank, these family-group taxa are nomenclatural homonyms, based on the same type genus, and they are also synonyms. Wherever encountered, such synonymous homonyms are distinguished in the *Treatise* as in dealing with generic names.

A special, though rare, case of synonymy exists when identical family names are formed from generic names having the same stem but differing in their endings. An example is the family name Scutellidae R. & E. RICHTER, 1925, based on *Scutellum* PUSCH, 1833, a trilobite. This name is a junior synonym of Scutellidae GRAY, 1825, based on *Scutella* LAMARCK, 1816, an echinoid. The name of the trilobite family was later changed to Scutelluidae (ICZN, Op. 1004, 1974).

Synonyms

Citation of synonyms is given next following record of the type species and if two or more synonyms of differing date are recognized, these are arranged in chronological order. Objective synonyms are indicated by accompanying designation "obj.," others being understood to constitute subjective synonyms, of which the types are also indicated. Examples showing *Treatise* style in listing synonyms follow.

Mackenziephyllum PEDDER, 1971, p. 48 [**M. insolitum*; OD] [=*Zonastraea* TSYGANKO in SPASSKIY, KRAVTSOV, & TSYGANKO, 1971, p. 85, *nom. nud.*; *Zonastraea* TSYGANKO, 1972, p. 21 (type, *Z. graciosa,* OD)].

Kodonophyllum WEDEKIND, 1927, p. 34 [**Streptelasma Milne-Edwardsi* DYBOWSKI, 1873, p. 409; OD; =*Madrepora truncata* LINNÉ, 1758, p. 795, see SMITH & TREMBERTH, 1929, p. 368] [=*Patrophontes* LANG & SMITH, 1927, p. 456 (type, *Madrepora truncata* LINNÉ, OD); *Codonophyllum* LANG, SMITH, & THOMAS, 1940, p. 39, *nom. van.*].

Some junior synonyms of either objective or subjective sort may take precedence desir-

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ably over senior synonyms wherever uniformity and continuity of nomenclature are served by retaining a widely used but technically rejectable name for a generic assemblage. This requires action of ICZN using its plenary powers to set aside the unwanted name and validate the wanted one, with placement of the concerned names on appropriate official lists.

ABBREVIATIONS

Abbreviations used in this part of the *Treatise* are explained in the following alphabetically arranged list. Standard abbreviations and those found only in the references are not included here.

Afr., Africa
Alb., Albian
Alg., Algeria
AMNH, American Museum of Natural History, New York
Apt., Aptian
Arenig., Arenigian
Ariz., Arizona
Artinsk., Artinskian
Atl., Atlantic

Bathon., Bathonian
Belg., Belgium
Blackriv., Blackriveran
BMNH, British Museum (Natural History), London
Bol., Bolivia
Brit., Britain
Brit. Is., British Isles

C., Central
Cal., California
Can., Canada
Caradoc., Caradocian
Carb., Carboniferous
Carib., Caribbean
Cayug., Cayugan
Cenoman., Cenomanian
Champlain., Champlainian
Chazy., Chazyan
Chester., Chesterian
Cincinnat., Cincinnatian
Co., County
Coll., Collection, -s
Comm., Commission
Coniac., Coniacian
CPC, Commonwealth Palaeontological Collection, Bureau of Mineral Resources, Commonwealth of Australia, Canberra
Cr., Creek
Cret., Cretaceous
Czech., Czechoslovakia

Del., Delaware
Delft, Mineralogisch-Geologisch Museum, Technische Hoogeschool, Delft
Denm., Denmark
Dev., Devonian
Distr., District
Dolbor., Dolborian
Dzhulf., Dzhulfian

E., East
Eden., Edenian
Eifel., Eifelian
Eng., England
Est., Estonia
Eu., Europe

F., Formation
Fla., Florida
FMNH, Field Museum of Natural History, Chicago
Frasn., Frasnian

G. Brit., Great Britain
Ger., Germany
Givet., Givetian
Gotl., Gotland
Gr., Group
Greenl., Greenland
Guadalup., Guadalupian

Helderberg., Helderbergian
HM, Hunterian Museum, University of Glasgow, Glasgow

Ill., Illinois
Ind., Indiana
Indon., Indonesia
Is., Island(s)
Ire., Ireland
ISGS, Illinois State Geological Survey, Urbana
ISGS(ISM), specimen from Illinois State Museum (Springfield), now housed at ISGS, Urbana

Jur., Jurassic

Kans., Kansas
Kazakh., Kazakhstan
Kazan., Kazanian
Kinderhook., Kinderhookian
KUMIP, Kansas University Museum of Invertebrate Paleontology, Lawrence
Ky., Kentucky

L., Lower
lat., latitude, lateral
Leonard., Leonardian
Llandeil., Llandeilian
Llandov., Llandoverian
Llanvirn., Llanvirnian
loc., locality
long., longitude, longitudinal
Ls., Limestone
LSU, Louisiana State University, Baton Rouge
Ludlov., Ludlovian

M, monotypy
M., Middle
Maastricht., Maastrichtian
Mangaze., Mangazeian
Manit., Manitoba
Mass., Massachusetts
Maysvill., Maysvillian.
Mbr., Member
Medit., Mediterranean
Meramec., Meramecian
MGU, Muzej Ministerstva geologii Uzbek. SSU, Tashkent
mi., mile
Mich., Michigan
mid., middle
Mio., Miocene
Minn., Minnesota
Miss., Mississippian, Mississippi
Missour., Missourian
Mo., Missouri

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Mohawk., Mohawkian
Mt(s)., Mountain(s)
Münster, Geologisch-Paläontologisches Institut der Westfälischen Wilhelms-Universität Münster, Münster-Westfalen

N., North
N.Am., North America
Namur., Namurian
N.Car., North Carolina
Neb., Nebraska
Neth., Netherlands
Niag., Niagaran
nom. conserv., *nomen conservatum* (conserved name)
nom. dub., *nomen dubium* (doubtful name)
nom. nud., *nomen nudum* (naked name)
nom. oblit., *nomen oblitum* (fogotten name)
nom. subst., *nomen substitutum* (substitute name)
nom. transl., *nomen translatum* (transferred name)
Nor., Norway
N.Y., New York
NYSM, New York State Museum, Albany
N.Z., New Zealand
N.Zemlya, Novaya Zemlya

O., Ocean
obj., objective
OD, original designation
Okla., Oklahoma
Ont., Ontario
Ord., Ordovician
Osag., Osagian
OT, original tautonomy
OUM, Oxford University Museum, Oxford

Pac., Pacific
Pak., Pakistan
Paleoc., Paleocene
Penin., Peninsula
Penn., Pennsylvanian
Perm., Permian
PGU, Geological Museum of the Geological Board of the Maritime Territory, Vladivostok
Philip., Philippines
PIN, Paleontoligicheskij institut, Akademiya nauk SSSR., Moscow
Plio., Pliocene
Port., Portugal
prov., province
PSU, Pennsylvania State University (Paleobryozoological Research Collection), University Park
Pt., Point

Ra., Range
rec., recent
Richmond., Richmondian
RSM, Royal Scottish Museum, Edinburgh
Russ. platf., Russian platform

S., South
Santon., Santonian
Scot., Scotland
SD, subsequent designation
Sh., Shale
Sib., Siberia
Sib. plat., Siberian platform
Sil., Silurian
SIUC, Southern Illinois University, Carbondale
SM, Sedgwick Museum, Cambridge University, Cambridge; subsequent monotypy
SNIIGGIMS, Muzej Sibirskogo nauchno-issledovatelskogo instituta geologii, geofiziki i mineralnogo syrya, Novosibirsk
Spits., Spitsbergen
sp., species
Ss., sandstone
Sta., Station
Stephan., Stephanian
Str., Strait(s)
SU, Department of Geology, University of Sydney, Sydney
Swed., Sweden
Switz., Switzerland

tang., tangential
Tenn., Tennessee
Terr., Territory
Tournais., Tournaisian
Transcauc., Transcaucasia
transv., transverse
Trenton., Trentonian
TsGM, Central Geological Museum, Central Geological and Prospecting Institute, Leningrad

U., Upper
UI, University of Illinois Paleontology Museum, Urbana
Ulster., Ulsterian
UMMP, University of Michigan Museum of Paleontology, Ann Arbor
up., upper
USA, United States (America)
USNM, United States National Museum, Washington, D.C.
USSR, Union of Soviet Socialist Republics

Va., Virginia
Valangin., Valanginian
Vict., Victoria
VNIGRI, Musej, Vsesoyuznyj neftyanoj nauchno-issledovatskij geologorazvedochnoj institut, Leningrad
Vt., Vermont

W., West
Wash., Washington
Wenlock., Wenlockian
WM, Walker Museum of Paleontology, University of Chicago, housed at the Field Museum, Chicago
Wolfcamp., Wolfcampian

YPM, Peabody Museum, Yale University, New Haven

REFERENCES TO LITERATURE

The titles of serials cited in the references are abbreviated as recommended in the *Bibliographical Guide for Editors and Authors* (1974, The American Chemical Society, Washington, D.C.); titles of serials not covered in the *Guide* have been abbreviated according to the standard established in International Standards Organization (ISO) recommendation

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833-1974. The names of authors and titles of works in Cyrillic have been transliterated for the most part according to the same standard. A translation of each Cyrillic title is given in brackets at the end of the reference. Full citations of references containing senior homonyms are not included, but may be found in contracted form in S. A. NEAVE, *Nomenclator Zoologicus* (1939–1975, 7 v., Zoological Society, London).

SOURCES OF ILLUSTRATIONS

Most illustrations in this volume are new. Where previously published illustrations are used, the author and date of publication are given in parentheses in the figure caption. Full citation of the publication is provided in the references.

STRATIGRAPHIC DIVISIONS

As commonly cited in the *Treatise,* classification of rocks forming the geologic column is reasonably uniform and firm throughout most of the world as regards major divisions (e.g., series, systems, and rocks representing eras), but it may be variable and unfirm as regards minor divisions (e.g., substages, stages, and subseries), which tend to be provincial in application. A tabulation of commonly cited European and North American divisions is given for systems from the Ordovician to the Permian, which corresponds to the stratigraphic range of bryozoan genera that are diagnosed here.

Generally Recognized Division of Geologic Column

EUROPE	NORTH AMERICA
CENOZOIC ERATHEM	**CENOZOIC ERATHEM**
QUATERNARY SYSTEM	**QUATERNARY SYSTEM**
TERTIARY SYSTEM	**TERTIARY SYSTEM**
MESOZOIC ERATHEM	**MESOZOIC ERATHEM**
CRETACEOUS SYSTEM	**CRETACEOUS SYSTEM**
JURASSIC SYSTEM	**JURASSIC SYSTEM**
TRIASSIC SYSTEM	**TRIASSIC SYSTEM**
PALEOZOIC ERATHEM	**PALEOZOIC ERATHEM**
PERMIAN SYSTEM	**PERMIAN SYSTEM**
Upper Permian Series	**Upper Permian Series**
Tartarian Stage	Ochoan Stage
Kazanian Stage	Guadalupian Stage
Lower Permian Series	**Lower Permian Series**
Artinskian Stage	Leonardian Stage
Sakmarian Stage	Wolfcampian Stage
Asselian Stage	
CARBONIFEROUS SYSTEM	
Silesian Subsystem	**PENNSYLVANIAN SYSTEM**
Stephanian Series	Virgilian Series
	Missourian Series
Westphalian Series	Desmoinesian Series
	Atokan Series
Namurian Series	Morrowan Series
Dinantian Subsystem	**MISSISSIPPIAN SYSTEM**
Visean Series	Chesterian Series
	Meramecian Series
Tournaisian Series	Osagian Series
	Kinderhookian Series

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DEVONIAN SYSTEM
Upper Devonian Series
Famennian Stage
Frasnian Stage
Middle Devonian Series
Givetian Stage
Eifelian Stage
Lower Devonian Series
Emsian Stage
Siegenian Stage
Gedinnian Stage

SILURIAN SYSTEM
Pridolian Series
Ludlovian Series
Wenlockian Series
Llandoverian Series

ORDOVICIAN SYSTEM
Ashgillian Series

Caradocian Series

Llandeilian Series
Llanvirnian Series
Arenigian Series

Tremadocian Series[1]

CAMBRIAN SYSTEM

ROCKS OF PRECAMBRIAN ERAS

DEVONIAN SYSTEM
Upper Devonian Series
Famennian Stage
Frasnian Stage
Middle Devonian Series
Givetian Stage
Eifelian Stage
Lower Devonian Series
Emsian Stage
Siegenian Stage
Gedinnian Stage

SILURIAN SYSTEM
Pridolian Series
Ludlovian Series
Wenlockian Series
Llandoverian Series

ORDOVICIAN SYSTEM
Cincinnatian Series (Upper Ordovician)
Richmondian Stage
Maysvillian Stage
Edenian Stage

Champlainian Series
(Middle Ordovician)
Mohawkian Stage
Chazyan Stage
Whiterockian Stage
Canadian Series (Lower Ordovician)

CAMBRIAN SYSTEM

ROCKS OF PRECAMBRIAN ERAS

[1] Tremadocian is placed in Cambrian by some authors.

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