PALEONTOLOGIC TERMINOLOGY

FOR TAXONOMIC PAPERS, rules of the zoologic and botanic sciences with regard to priorities and other legalities require that fossils be described with scrupulous attention to detail. Clarity and brevity are the goals of descriptive paleontology, as well as of all good scientific writing, but clarity should never be sacrificed for the sake of brevity.

Every species description should contain (1) a brief diagnosis, (2) a full morphologic description, (3) an indication of the types and other specimens used for the description, plus their repositories, (4) accurate information about the locality from which the fossils came, including stratigraphic and geographic detail, (5) comparison with other similar species, and (6) remarks on variability of features. Discussions should include significant results regarding phylogeny, ontogeny, functional morphology, paleoecology, and biostratigraphy.

If a species has been described before, give a synonymy to show the history of usage of names applied to the taxon. If the species is new, give the etymology of the name, plus the type locality.

Species are illustrated, as completely as feasible, with photographs, line drawings, and charts showing morphologic variations.

Descriptive morphologic terms vary from phylum to phylum, and some words have different meanings in different fossil groups. For example, the term "septum" refers to entirely different structures in the foraminifers, corals, brachiopods, cephalopods, ostracodes, and mammals. Proper terminology can be learned from recent pertinent monographs, the "Treatise on Invertebrate Paleontology" (Moore, various dates), and other similar sources.

A sample format for species description:

Generic assignment, describer's name, date
Species name
Plates and figures of illustrations
Synonymy
Diagnosis
Description
Material, including types, with museum numbers and indication of repository
Measurements, with charts and graphs showing variability, where practicable
Occurrence
Discussion and comparison

Generic descriptions are similar to specific ones. Special emphasis is placed on an accurate diagnosis and an unambiguous designation of the type species. Suprageneric assignments should be given where they are not obvious or redundant.

SYNONYMY

In paleontologic writing, the history of usage of a name is given in a synonymy. Several styles may be used, depending on what the writer wishes to emphasize. Generic synonymies usually first list former usages of the genus in the sense of the writer and then list synonyms, incorrect usages, questionable assignments, and errors. All are in chronologic order. A similar style may be used for species synonymies, although a strictly chronologic listing, with correct and incorrect references in their proper order, is becoming more generally accepted.

In the past, bibliographic references customarily were given for each item in a synonymy, generally because they were not given at the end of the paper. It is now more common for synonymies to be condensed and for full references to be given in the bibliography.

The basic requirement for a synonymy is that it clearly express the history of usage of the name given to a taxon and present the writer's conclusions about the validity of the name. Because this aspect of paleontologic writing often is troublesome to writer and editor alike, examples of several generic synonymy styles are given:

1 The complete form, including reasons for some of the assignments (although it is not essential to give the reasons):

Genus *PARAPARCHITES* Ulrich and Bassler, 1906, emend. Scott, 1959

Paraparchites Ulrich and Bassler, 1906, Proceedings of the National Museum, v. 30, p. 149. Scott, 1959, Journal of Paleontology, v. 33, no. 4, p. 673.

Antiparaparchites Coryell and Rogatz, 1932, American Midland Naturalist, v. 13, no. 6, p. 387. Based on reversal of overlap.

Ardmorea Bradfield, 1935, Bulletins of American Paleontology, v. 22, no. 73, p. 138. Based on steinkern.

Microcoelonella Coryell and Sohn, 1938, Journal of Paleontology, v. 12, no. 6, p. 597. Based on juvenile.

?*Cyathus* Roth and Skinner, 1930, Cooper, 1941, Illinois State Geological Survey Report of Investigations 77, p. 61.

2. Condensed format; full reference to each paper given in the bibliography:

Genus *DERBYIA* Waagen, 1884

Derbyia Waagen, 1884, p. 576, 591; Hall and Clarke, 1892, p. 261; Schellwien, 1900, p. 10; Girty, 1909, p. 181; Dunbar and Condra, 1932, p. 75; Sokolskaya, 1960, p. 209.
Derbyina Grabau, 1931a, p. 259, 262 (*Graubauellina* Licharew, 1934).
Grabauellina Licharew, 1934a, p. 507.
Derbyaeconcha Licharew, 1934a, p. 507.
Plicatoderbya H. D. Thomas, 1937, p. 13–18.

3. A strictly chronologic format:

Genus *SYRINGAXON* Lindström, 1882

1882. *Syringaxon* Lindström, p. 20.
1900. *Laccophyllum* Simpson, p. 201.
1902. *Nichelsonia* Pocta, p. 184. Cited in plate explanations *Alleynia* (*Nichelsonia*).
1928. *Laccophyllum* Simpson. Grabau, p. 82.
1928. *Alleynia* Pocta (*Nichelsonian* Pocta). Grabau, p. 82.
1935. *Syringaxon* Lindström. Butler, p. 117.
1938. *Syringaxon* Lindström (in part). Prantl, p. 21.
1940. *Syringaxon* Lindström. Lang, Smith, and Thomas, p. 129.
1949. *Syringaxon* Lindström. Stumm, p. 10.
1956. *Syringaxon* Lindström. Hill, p. F258.
1962. *Syringaxon* Lindström (in part), Flugel and Free, p. 224.

Similarly, species synonymies can use several styles. Two of these follow, the first according to usage of names and the second according to chronology of references:

***Pentagonia unisulcata* (Conrad)**

Atrypa unisulcata Conrad, 1841, p. 56.
Atrypa uniangulata Hall, 1861, p. 101.
Meristella? unisulcata (Conrad). Hall, 1862, p. 158, pl. 2, figs. 17, 20–23 (not figs. 19, 24, 25).
Meristella (*Pentagonia*) *unisulcata* (Conrad), Hall, 1867, p. 309, pl. 50, figs. 18–29 (not figs. 30–35).
Not *Meristella unisulcata* (Conrad). Nettleroth, 1889, p. 99, pl. 15, figs. 9–16.
Pentagonia unisulcata (Conrad). Stauffer, 1915, p. 104, 245 (not p. 160, 171, 175, 234); Dunbar, 1919, p. 87, 89; Goldring, 1935, p. 148, figs. 53*B–D*; Butts, 1940, p. 300, 301, 304, 305; Butts, 1941, pl. 115, figs. 17–21, 35; Cooper and others, 1942, chart; Cooper, 1944, p. 333, pl. 127, fig. 27; Oliver, 1954, p. 633, 634, 638–640; Oliver, 1956, p. 1452, 1456, 1462, 1469; Rickard, 1964, chart; Boucot and others, in Moore, 1965, p. M656, pl. 633, figs. 2*a–d* (not figs. 2*e–f*); Oliver and others, 1969, chart.
Not *Pentagonia unisulcata* (Conrad). Savage, 1930, p. 47, 50, 53, 62; Savage, 1931, p. 242, pl. 30, figs. 17, 18.

***Goniatites crenistria* Phillips**

1836. *Goniatites crenistria* Phillips, Illustrations of the geology of Yorkshire, pt. 2, p. 234, pl. 19, figs. 7–9.
1836. *Goniatites vesica* Phillips, Illustrations of the geology of Yorkshire, pt. 2, p. 236, pl. 20, figs. 19–21.
1897. *Glyphioceras incisum* Hyatt (part). Smith, Proceedings of the California Academy of Science, 3d. ser., Geology, v. 1, no. 3, p. 111–121, pl. 13, figs. 1, 2, 6–12, pl. 14, figs. 1–9, pl. 15, figs 1–11 (not pl. 13, figs. 3–5).
1903. *Goniatites crenistria* Phillips (part). Smith, U.S. Geological Survey Monograph 42, p. 68–76, pl. 14, figs. 1, 2, 7–12, pl. 15, figs. 1–9, pl. 16, figs. 1*a–j*, pl. 26, figs. 1–4 (not pl. 10, figs. 12–16, pl. 14, figs. 4–6, pl. 26, fig. 5).
1910. *Goniatites crenistria* Phillips. Grabau and Shimer, North American index fossils, v. 2, p. 141, figs. 1393*f–h*.
1911. *Goniatites choctawensis* Shumard (part). Girty, U.S. Geological Survey Bulletin 439, p. 97–99, pl. 15, figs. 7, 7*a* (not figs. 1–6).
1911. *Goniatites crenistria* Phillips. Girty, U.S. Geological Survey Bulletin 439, p. 99–101, pl. 15, figs. 8, 9.
1924. *Goniatites crenistria* Phillips. Bisat, Proceedings of the Yorkshire Geological Society, v. 20, pt. 1, p. 78–82, pl. 3, figs. 4, 5, pl. 9, fig. 1.
1925. *Glyphioceras crenistria* (Phillips) (part). Schmidt, Preussischen Geologischen Landesanstalt Jahrbuch, v. 45, p. 565, 566, p. 21, figs. 1, 3, pl. 23, fig. 14 (not pl. 2, fig. 2, pl. 23, fig. 13).
1952. *Goniatites crenistria* Phillips. Bisat, Transactions of the Leeds Geological Association, v. 6, pt. 4, p. 173, 174, text fig. 3(*b*).

A Few Guidelines

Formal generic and specific fossil names are in Latin and are italicized. Informal names and adjectives based on fossil names are not italicized: Pectens, spirifers, bryozoans, productids, Ostreas, foraminifers, and others. All generic and suprageneric names are capitalized. (See also p. 141 for further information on the use of italic in regard to fossil names).

The two parts of species names agree in gender according to rules of classical grammar. Gender does not necessarily indicate the sex of the object in question. Most Latin nouns ending in *-us* are masculine, in *-a* are feminine, and in *-um* are neuter, but there are exceptions. Consult classical grammars when in doubt. Brown's "Composition of Scientific Words" (1954) is indispensible for anyone composing scientific names for use in systematics.

The name of the first describer of a taxon should be included in all references to that taxon, although the name can be omitted from tables and elsewhere, at the discretion of the paleontologist, if earlier reference to the describer is clear.

When a species is assigned to a genus other than the original one, the name of the first describer is

placed in parentheses and the reviser's name is added. For example, the proper citation for the olenellid trilobite that was first described as *Olenus thompsoni* by Hall in 1859, but that later was used as the type species of *Olenellus* by Billings, is *Olenellus thompsoni* (Hall) Billings.

Taxonomic rules differ for animals and plants. Anyone writing about fossils should study the two standard nomenclatural guides carefully (Stafleu, 1983; Ride and others, 1985).

Various degrees of certainty in identification of taxa are expressed by modification in citations of fossil names. For example:

Taxon	Degree of certainty
Spirifer grimesi Hall	Taxon definitely identified.
Spirifer cf. *S. grimesi* Hall	Taxon compared with named species.
Spirifer aff. *S. grimesi* Hall	Taxon has affinities with named species.
Spirifer? *grimesi* Hall	Species questionably assigned to genus.
Spirifer grimesi Hall?	Species doubtful, but assigned to correct genus.
?*Spirifer grimesi* Hall	Entire assignment doubtful.

A species name consists of two parts; the first is the generic part and the second is the trivial part. Despite a clear statement by Schenk and McMasters (1956, p. 13), among others, confusion concerning this basic fact continues.

The name of the original describer of a taxon should not be abbreviated. However, the rules of botanical nomenclature provide for use of standard abbreviations of the names of certain classical botanists.

The English forms of "n. gen.," "n. sp.," "not," "part," "of authors," "undet.," "indet.," and so on, are to be used rather than the Latin forms.

An unpublished name, or "nude" name, is invalid and should not be used in a manuscript unless the description of that species will be published before the manuscript is published.

Generic names may be abbreviated where they are a part of a species name if the full name has been used earlier in the paper and there is no confusion with other generic names having the same initial letter.

Authors who cite systematic identifications and opinions of others should quote accurately and should include original qualifying statements and clear reference to source and date of communication, whether published or unpublished.

In describing species authors must state the nature of the material on which the description is based. Include (1) number and condition of specimens, (2) sex and growth stage where known, (3) measurements of all important morphologic features and indication of variability, and (4) an unambiguous indication of the types, their catalog numbers, and their repository.

Descriptions of taxa may be in complete sentence form or they may be in telegraphic style. As with synonymies, however, a consistent format is used throughout any particular paper.

Authors who are not paleontologists, but who are describing fossils or are quoting or paraphrasing paleontologists on referred fossils, should submit relevant parts of their reports to the Branch of Paleontology and Stratigraphy for inspection early in the review process.

Formats for different journals vary; the suggestions for authors of papers submitted to any specific journal should be followed closely when designing a contribution to that journal. This procedure ultimately avoids grief for writer, critic, and editor alike.

NUMBERING SYSTEMS FOR SAMPLES AND SPECIMENS

Different institutions use various numbering systems to identify repositories for their fossils, minerals, ores, and rocks. A serial number with the description of a new fossil species can tell the reader where the type specimen is preserved, whether in the paleontologic collections of the U.S. National Museum, the American Museum of Natural History, the Harvard Museum of Comparative Anatomy, or another permanent repository. Similar numbering systems applied by groups within the Survey, and by other groups, are indispensable to future researchers and should be used in published reports wherever applicable. Informal and temporary systems applied in the field on a particular project, or in the laboratory, seldom have a place in a final report. In general, any material of permanent value that will need to be physically retrieved by some future worker should be identified with a meaningful permanent collection number.

By law, all type specimens and significant collections made on projects supported by Federal money must be deposited in the National Collections of the U.S. National Museum, Smithsonian Institution; a logical time to transfer specimens is soon after completion of the project for which the specimens were collected.

Significant specimens such as type fossils or minerals are far more valuable if the exact spots from which they were collected are also recorded permanently. Some scientists understandably hesitate to pinpoint these locations for fear that the remaining material will be removed by others or vandalized. Each researcher must balance the potential damage of disclosing the collecting locality against possible benefits to science. On geologic maps the collecting locality can be shown by symbol. Whether or not a map accompanies a report, the locality should be referred to permanent topographic features, to a land-survey (section, township, and range) system, to latitude and longitude, or to the Universal Transverse Mercator projection grid. Road intersections and the like may prove to be ephemeral.