

TREATISE ON INVERTEBRATE PALEONTOLOGY

*Prepared under the Guidance of the
Joint Committee on Invertebrate Paleontology*

*Paleontological
Society*

*Society of Economic
Paleontologists and
Mineralogists*

*Palaeontographical
Society*

Directed and Edited by

RAYMOND C. MOORE

Assisted by CHARLES W. PITRAT, DORIS E. N. ZELLER, and LAVON McCORMICK

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CONODONTS

CONOIDAL SHELLS OF UNCERTAIN AFFINITIES

WORMS

TRACE FOSSILS AND PROBLEMATICA

By W. H. HASS, WALTER HÄNTZSCHEL, D. W. FISHER, B. F. HOWELL,
F. H. T. RHODES, K. J. MÜLLER, and R. C. MOORE

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CONTRIBUTING AUTHORS

- AGER, D. V., Imperial College of Science and Technology, London, England.
AMSDEN, T. W., Oklahoma Geological Survey, Norman, Okla.
†ARKELL, W. J.
BAIRSTOW, LESLIE, British Museum (Natural History), London, Eng.
BARKER, R. WRIGHT, Shell Development Co., Houston, Tex.
†BASSLER, R. S.
BATTEN, ROGER, L., University of Wisconsin, Madison, Wisconsin.
BAYER, FREDERICK M., U.S. National Museum, Washington, D.C.
BEAVER, HAROLD H., Humble Oil & Refining Co., Houston, Texas.
BENSON, R. H., University of Kansas, Lawrence, Kans.

- BERDAN, JEAN M., U.S. Geological Survey, Washington, D.C.
- BIERNAT, GERTRUDA, Państwowe Wydawnictwo Naukowe, Warszawa, Polska.
- BOARDMAN, R. S., U.S. Geological Survey, Washington, D.C.
- BOLD, W. A. VAN DEN, Louisiana State University, Baton Rouge, La.
- BOSCHMA, H., Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.
- BOUCOT, A. J., Massachusetts Institute of Technology, Cambridge, Mass.
- BOWSHER, ARTHUR L., Sinclair Oil & Gas Co., Tulsa, Okla.
- BRAMLETTE, M. N., Scripps Institution of Oceanography, La Jolla, California.
- BRANSON, CARL C., University of Oklahoma, Norman, Okla.
- BROWN, D. A., Australian National University, Canberra, Austral.
- BULMAN, O. M. B., Sedgwick Museum, Cambridge University, Cambridge, Eng.
- CAMPBELL, ARTHUR S., St. Mary's College, St. Mary's College, Calif.
- CARPENTER, FRANK M., Biological Laboratories, Harvard University, Cambridge, Mass.
- CASEY, RAYMOND, Geological Survey of Great Britain, London, Eng.
- CASTER, K. E., University of Cincinnati, Cincinnati, Ohio.
- CHAVAN, ANDRÉ, L'École d'Anthropologie, Seyssel (Ain), France.
- COLE, W. STORRS, Cornell University, Ithaca, N.Y.
- COOPER, G. ARTHUR, U.S. National Museum, Washington, D.C.
- COX, L. R., British Museum (Natural History), London, Eng.
- CURRY, DENNIS, Northwood, Middlesex, Eng.
- †DAVIES, L. M.
- DECHASEAUX, C., Laboratoire de Paléontologie à la Sorbonne, Paris, France.
- DELL, R. K., Dominion Museum, Wellington, N. Z.
- DOUGLASS, R. C., U.S. National Museum, Washington, D.C.
- DURHAM, J. WYATT, Museum of Paleontology, University of California, Berkeley, Calif.
- EAMES, F. E., British Petroleum Company, Middlesex, Eng.
- ELLIOTT, GRAHAM F., Iraq Petroleum Company, London, Eng.
- EMERSON, W. K., American Museum of Natural History, New York, N.Y.
- ERBÈN, H. K., Universität Bonn, Bonn, West Ger.
- EXLINE, HARRIET, Rolla, Mo.
- FAY, ROBERT O., Oklahoma Geological Survey, Norman, Okla.
- FELL, H. BARRACLOUGH, Victoria University of Wellington, Wellington, N.Z.
- FISCHER, ALFRED G., Princeton University, Princeton, N.J.
- FISHER, D. W., New York State Museum, Albany, N.Y.
- FLEMING, CHARLES A., New Zealand Geological Survey, Lower Hutt, N. Z.
- FRIZZELL, DONALD L., Missouri School of Mines, Rolla, Mo.
- FURNISH, WILLIAM M., State University of Iowa, Iowa City, Iowa.
- †GARDNER, JULIA
- GEORGE, T. NEVILLE, University of Glasgow, Glasgow, Scot.
- GLAESSNER, M. F., University of Adelaide, Adelaide, S. Austral.
- GLENISTER, B. F., State University of Iowa, Iowa City, Iowa.
- GORDON, MACKENZIE, JR., U.S. Geological Survey, Washington, D.C.
- GRANT, RICHARD E., U.S. National Museum, Washington, D.C.
- HAAS, FRITZ, Chicago Natural History Museum, Chicago, Ill.
- HANAI, TETSURO, University of Tokyo, Tokyo, Japan.
- HANNA, G. DALLAS, California Academy of Sciences, San Francisco, Calif.
- HÄNTZSCHEL, WALTER, Geologisches Staatsinstitut, Hamburg, Ger.
- HARRINGTON, H. J., Tennessee Gas Transmission Company, Houston, Tex.
- †HASS, WILBERT H.
- HATAI, KOTORA, Tohoku University, Sendai, Japan.
- HAWKINS, H. L., Reading University, Reading, Eng.
- HEDGPETH, JOEL, College of the Pacific, Dillon Beach, Calif.
- HENNINGSMOEN, GUNNAR, Paleontologisk Museum, University of Oslo, Oslo, Norway.
- HERTLEIN, L. G., California Academy of Sciences, San Francisco, Calif.
- HESSLAND, IVAR, Geologiska Institutet, University of Stockholm, Stockholm, Swed.

- HESSLER, ROBERT R., Woods Hole Oceanographic Institution, Woods Hole, Mass.
- HILL, DOROTHY, University of Queensland, Brisbane, Austral.
- HOLTHUIS, L. B., Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.
- HOWE, HENRY V., Louisiana State University, Baton Rouge, La.
- HOWELL, B. F., Princeton University, Princeton, N.J.
- HYMAN, LIBBIE H., American Museum of Natural History, New York, N.Y.
- JAANUSSON, VALDAR, Paleontological Inst., Uppsala, Sweden.
- JELETZKY, J. A., Geological Survey of Canada, Ottawa, Can.
- KAMPTNER, ERWIN, Naturhistorisches Museum, Wien, Aus.
- KEEN, MYRA, Stanford University, Stanford, Calif.
- KESLING, ROBERT V., Paleontological Museum, University of Michigan, Ann Arbor, Mich.
- KIER, PORTER, U.S. National Museum, Washington, D.C.
- †KNIGHT, J. BROOKES
- KUMMEL, BERNHARD, Museum of Comparative Zoölogy, Harvard College, Cambridge, Mass.
- LA ROCQUE, AURÈLE, Ohio State University, Columbus, Ohio.
- †LAUBENFELS, M. W. DE
- LECOMPTE, MARIUS, Université de Louvain, Louvain, Belg.
- LEONARD, A. BYRON, University of Kansas, Lawrence, Kans.
- LEVINSON, S. A., Humble Oil & Refining Company, Houston, Tex.
- LOCHMAN-BALK, CHRISTINA, New Mexico Institute of Mining and Geology, Socorro, N.Mex.
- LOEBLICH, A. R., JR., California Research Corporation, La Habra, Calif.
- LOHMAN, KENNETH E., U.S. Geological Survey, Washington, D.C.
- LOWENSTAM, HEINZ A., California Institute of Technology, Pasadena, Calif.
- LUDBROOK, N. H., Department of Mines, Adelaide, S.Austral.
- MARWICK, J., New Zealand Geological Survey, Wellington, N.Z.
- MELVILLE, R. V., British Embassy, Paris, France.
- MILLER, ARTHUR K., State University of Iowa, Iowa City, Iowa.
- MONTANARO GALLITELLI, EUGENIA, Istituto di Geologia e Paleontologia, Università, Modena, Italia.
- MOORE, RAYMOND C., University of Kansas, Lawrence, Kans.
- MORRISON, J. P. E., U.S. National Museum, Washington, D.C.
- MUIR-WOOD, HELEN M., British Museum (Natural History), London, Eng.
- MÜLLER, KLAUS J., Technische Universität Berlin, West-Berlin (Charlottenburg), Ger.
- NEWELL, NORMAN D., American Museum of Natural History (and Columbia University), New York, N.Y.
- OKULITCH, VLADIMIR J., University of British Columbia, Vancouver, Can.
- OLSSON, AXEL A., Coral Gables, Florida.
- PALMER, ALLISON R., U.S. Geological Survey, Washington, D.C.
- PALMER, KATHERINE VAN WINKLE, Paleontological Research Institution, Ithaca, N.Y.
- PECK, RAYMOND E., University of Missouri, Columbia, Mo.
- PETRUNKEVITCH, ALEXANDER, Osborn Zoological Laboratory, Yale University, New Haven, Conn.
- POPENOE, W. P., University of California, Los Angeles, Calif.
- POULSEN, CHRISTIAN, Universitetets Mineralogisk-Geologiske Institut, København, Denm.
- POWELL, A. W. B., Auckland Institute and Museum, Auckland, N.Z.
- PURI, HARBANS, Florida State Geological Survey, Tallahassee, Fla.
- RASETTI, FRANCO, Johns Hopkins University, Baltimore, Md.
- RASMUSSEN, H. W., Universitetets Mineralogisk-Geologiske Institut, København, Denm.
- REGNÉLL, GERHARD, Paleontologisk-Geologiska Institutionen, Lunds Universitet, Lund, Swed.
- REHDER, HARALD A., U.S. National Museum, Washington, D.C.
- REICHEL, M., Bernouillanum, Basel University, Basel, Switz.
- REYMENT, RICHARD A., University of Stockholm, Stockholm, Swed.
- RHODES, F. H. T., University of Wales, Swansea, Wales.
- †RICHTER, EMMA
- †RICHTER, RUDOLF

- ROBERTSON, ROBERT, Academy of Natural Sciences, Philadelphia, Pa.
- ROLFE, W. D. I., Museum of Comparative Zoölogy, Harvard College, Cambridge, Mass.
- ROSEWATER, JOSEPH, U.S. National Museum, Washington, D.C.
- ROWELL, A. J., Nottingham University, Nottingham, Eng.
- SCHINDEWOLF, O. H. Geologisch-paläontologisches Institut, Universität Tübingen, Tübingen, Ger.
- SCHMIDT, HERTA, Senckenbergische Naturforschende Gesellschaft, Frankfurt-a.-M., Ger.
- SCOTT, HAROLD W., University of Illinois, Urbana, Ill.
- SDZUY, KLAUS, Senckenbergische Naturforschende Gesellschaft, Frankfurt-a.-M., Ger.
- SHAVER, ROBERT, Indiana University and Indiana Geological Survey, Bloomington, Ind.
- SIEVERTS-DORECK, HERTHA, Stuttgart-Möhringen, Ger.
- SINCLAIR, G. W., Geological Survey of Canada, Ottawa, Can.
- SMITH, ALLYN G., California Academy of Sciences, San Francisco, Calif.
- SOHN, I. G., U.S. Geological Survey, Washington, D.C.
- SOOT-RYEN, T., Zoologisk Museum, Oslo, Nor.
- †SPENCER, W. K.
- †STAINBROOK, MERRILL A.
- STEHLI, F. G., Western Reserve University, Cleveland, Ohio.
- STENZEL, H. B., Shell Development Co., Houston, Tex.
- STEPHENSON, LLOYD W., Dover, Ohio.
- STØRMER, LEIF, Paleontologisk Institutt, Universitetet Oslo, Oslo, Nor.
- STOUGH, JOAN, Humble Oil & Refining Company, Houston, Tex.
- STRUVE, WOLFGANG, Senckenbergische Naturforschende Gesellschaft, Frankfurt-a.-M., Ger.
- STUBBLEFIELD, C. J., Geological Survey and Museum, London, Eng.
- STUMM, ERWIN C., Museum of Paleontology, University of Michigan, Ann Arbor, Mich.
- SWEET, WALTER C., Ohio State University, Columbus, Ohio.
- SWAIN, FREDERICK M., University of Minnesota, Minneapolis, Minn.
- SYLVESTER-BRADLEY, P. C., University of Leicester, Leicester, Eng.
- TAPPAN, HELEN, University of California, Los Angeles, Calif.
- TASCH, PAUL, University of Wichita, Wichita, Kans.
- TEICHERT, CURT, U.S. Geological Survey, Federal Center, Denver, Colo.
- THOMPSON, M. L., Illinois State Geological Survey, Urbana, Ill.
- THOMPSON, R. H., University of Kansas, Lawrence, Kans.
- †TIEGS, O. W.
- TRIPP, RONALD P., Seven Oaks, Kent, Eng.
- TURNER, RUTH, Museum of Comparative Zoölogy, Harvard College, Cambridge, Mass.
- UBAGHS, G., Université de Liège, Liège, Belg.
- VOKES, H. E., Tulane University, New Orleans, La.
- WAINWRIGHT, JOHN, Shell Development Co., Houston, Texas.
- †WANNER, J.
- WEIR, JOHN, University of Glasgow, Glasgow, Scot.
- WELLER, J. MARVIN, University of Chicago, Chicago, Ill.
- WELLS, JOHN W., Cornell University, Ithaca, N.Y.
- WHITTINGTON, H. B., Museum of Comparative Zoölogy, Harvard College, Cambridge, Mass.
- WILLIAMS, ALWYN, Queens University of Belfast, Belfast, N.Ire.
- WILLS, L. J., Romsley, Eng.
- †WITHERS, T. H.
- WRIGHT, A. D., Queens University of Belfast, Belfast, N. Ire.
- WRIGHT, C. W., London, Eng.
- †WRIGLEY, ARTHUR
- YOCHELSON, ELLIS L., U.S. Geological Survey, Washington, D.C.
- YONGE, C. M., University of Glasgow, Glasgow, Scot.

†—Deceased.

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 in seeking to organize what has been learned of this subject up to the mid-point of the present century. Such work has value in providing a most useful summary of the collective results of multitudinous investigations and thus should constitute an indispensable text and reference book for all persons who wish to know about remains of invertebrate organisms preserved in rocks of the earth's crust. This applies to neozoologists as well as paleozoologists and to beginners in study of fossils as well as to thoroughly trained, long-experienced professional workers, including teachers, stratigraphical geologists, and individuals engaged in research on fossil invertebrates. The making of a reasonably complete inventory of present knowledge of invertebrate paleontology may be expected to yield needed foundation for future research and it is hoped that the *Treatise* will serve this end.

The *Treatise* is divided into parts which bear index letters, each except the initial and concluding ones being defined to include designated groups of invertebrates. The chief purpose of this arrangement is to provide for independence of the several parts as regards date of publication, because it is judged desirable to print and distribute each segment as soon as possible after it is ready for press. Pages in each part will bear the assigned index letter joined with numbers beginning with 1 and running consecutively to the end of the part. When the parts ultimately are assembled into volumes, no renumbering of pages and figures is required.

The outline of subjects to be treated in connection with each large group of invertebrates includes (1) description of morphological features, with special reference to hard parts, (2) ontogeny, (3) classification, (4) geological distribution, (5) evolutionary trends and phylogeny, and (6) sys-

tematic description of genera, subgenera, and higher taxonomic units. In general, paleoecological aspects of study are omitted or little emphasized because comprehensive treatment of this subject is given in the *Treatise on Marine Ecology and Paleocology* (H. S. LADD, Editor, Geological Society of America, Memoir 67, 1957), prepared under auspices of a committee of the United States National Research Council. A selected list of references is furnished in each part of the *Treatise*.

Features of style in the taxonomic portions of this work have been fixed by the Editor with aid furnished by advice from the Joint Committee on Invertebrate Paleontology representing the societies which have undertaken to sponsor the *Treatise*. It is the Editor's responsibility to consult with authors and co-ordinate their work, seeing that manuscript properly incorporates features of adopted style. Especially he has been called on to formulate policies in respect to many questions of nomenclature and procedure. The subject of family and subfamily names is reviewed briefly in a following section of this preface, and features of *Treatise* style in generic descriptions are explained.

In December, 1959, the National Science Foundation of the United States, through its Division of Biological and Medical Sciences and the Program Director for Systematic Biology, made a grant in the amount of \$210,000 for the purpose of aiding the completion of yet-unpublished volumes of the *Treatise*. Payment of this sum was provided to be made in installments distributed over a five-year period, with administration of disbursements handled by the University of Kansas. Expenditures planned are primarily for needed assistance to authors and may be arranged through approved institutions located anywhere. Important help for the Director-Editor of the *Treatise* has been made available from the grant, but no part of his stipend comes from it. Grateful acknowledgment to the Foundation is expressed on behalf of the societies sponsoring the *Treatise*, the University of Kansas, and innumerable individuals benefited by the *Treatise* project.

FORM OF ZOOLOGICAL NAMES

Many questions arise in connection with the form of zoological names. These include such matters as adherence to stipulations concerning Latin or Latinized nature of words accepted as zoological names, gender of generic and subgeneric names, nominative or adjectival form of specific names, required endings for some family-group names, and numerous others. Regulation extends to capitalization, treatment of particles belonging to modern patronymics, use of neo-Latin letters, and approved methods for converting diacritical marks. The magnitude and complexities of nomenclature problems surely are enough to warrant the complaint of those who hold that zoology is the study of animals rather than of names applied to them.

CLASSIFICATION OF ZOOLOGICAL NAMES

In accordance with the "Copenhagen Decisions on Zoological Nomenclature" (London, 135 p., 1953), zoological names may be classified usefully in various ways. The subject is summarized here with introduction of designations for some categories which the *Treatise* proposes to distinguish in systematic parts of the text for the purpose of giving readers comprehension of the nature of various names together with authorship and dates attributed to them.

CO-ORDINATE NAMES OF TAXA GROUPS

Five groups of different-rank taxonomic units (termed *taxa*, sing., *taxon*) are discriminated, within each of which names are treated as co-ordinate, being transferrable from one category to another without change of authorship or date. These are: (1) Species Group (subspecies, species); (2) Genus Group (subgenus, genus); (3) Family Group (tribe, subfamily, family, superfamily); (4) Order/Class Group (suborder, order, subclass, class); and (5) Phylum Group (subphylum, phylum). In the first 3 of these groups, but not others, the author of the first-published valid name for any taxon is held to be the author of all other taxa in the group which are based on the same nominate type and the date of publication for purposes of priority is that of the first-published name. Thus, if author

A in 1800 introduces the family name X-idae to include 3 genera, one of which is X-us; and if author B in 1850 divides the 20 genera then included in X-idae into subfamilies called X-inae and Y-inae; and if author C in 1950 combines X-idae with other later-formed families to make a superfamily X-acea (or X-oidea, X-icae, etc.); the author of X-inae, X-idae and X-acea is A, 1800, under the Rules. Because taxonomic concepts introduced by authors B and C along with appropriate names surely are not attributable to author A, some means of recording responsibility of B and C are needed. This is discussed later in explaining proposed use of "*nom. transl.*"

The co-ordinate status of zoological names belonging to the species group is stipulated in Art. 11 of the present Rules; genus group in Art. 6 of the present Rules; family group in paragraph 46 of the Copenhagen Decisions; order/class group and phylum group in paragraphs 65 and 66 of the Copenhagen Decisions.

ORIGINAL AND SUBSEQUENT FORMS OF NAMES

Zoological names may be classified according to form (spelling) given in original publication and employed by subsequent authors. In one group are names which are entirely identical in original and subsequent usage. Another group comprises names which include with the original subsequently published variants of one sort or another. In this second group, it is important to distinguish names which are inadvertent changes from those constituting intentional emendations, for they have quite different status in nomenclature. Also, among intentional emendations, some are acceptable and some quite unacceptable under the Rules.

VALID AND INVALID NAMES

Valid names. A valid zoological name is one that conforms to all mandatory provisions of the Rules (Copenhagen Decisions, p. 43-57) but names of this group are divisible into subgroups as follows: (1) "*inviolable names*," which as originally published not only meet all mandatory requirements of the Rules but are not subject to any sort of alteration (most generic and subgeneric names); (2) "*perfect names*," which as they

appear in original publication (with or without precise duplication by subsequent authors) meet all mandatory requirements and need no correction of any kind but which nevertheless are legally alterable under present Rules (as in changing the form of ending of a published class/order-group name); (3) "imperfect names," which as originally published and with or without subsequent duplication meet mandatory requirements but contain defects such as incorrect gender of an adjectival specific name (for example, *Spironema recta* instead of *Spironema rectum*) or incorrect stem or form of ending of a family-group name (for example, Spironemidae instead of Spironematidae); (4) "transferred names," which are derived by valid emendation from either of the 2nd or 3rd subgroups or from a pre-existing transferred name (as illustrated by change of a family-group name from -inae to -idae or making of a superfamily name); (5) "improved names," which include necessary as well as somewhat arbitrarily made emendations allowable under the Rules for taxonomic categories not now covered by regulations as to name form and alterations that are distinct from changes that distinguish the 4th subgroup (including names derived from the 2nd and 3rd subgroups and possibly some alterations of 4th subgroup names). In addition, some zoological names included among those recognized as valid are classifiable in special categories, while at the same time belonging to one or more of the above-listed subgroups. These chiefly include (7) "substitute names," introduced to replace invalid names such as junior homonyms; and (8) "conserved names," which are names that would have to be rejected by application of the Rules except for saving them in their original or an altered spelling by action of the International Commission on Zoological Nomenclature in exercising its plenary powers to this end. Whenever a name requires replacement, any individual may publish a "new name" for it and the first one so introduced has priority over any others; since newness is temporary and relative, the replacement designation is better called substitute name rather than new name. Whenever it is considered desirable to save for usage an otherwise

necessarily rejectable name, an individual cannot by himself accomplish the preservation, except by unchallenged action taken in accordance with certain provisions of the Copenhagen Decisions; otherwise he must seek validation through ICZN.

It is useful for convenience and brevity of distinction in recording these subgroups of valid zoological names to introduce Latin designations, following the pattern of *nomen nudum*, *nomen novum*, etc. Accordingly, the subgroups are (1) *nomina inviolata* (sing., *nomen inviolatum*, abbr., *nom. inviol.*); (2) *nomina perfecta* (sing., *nomen perfectum*, abbr., *nom. perf.*); (3) *nomina imperfecta* (sing., *nomen imperfectum*, abbr., *nom. imperf.*); (4) *nomina translata* (sing., *nomen translatum*, abbr., *nom. transl.*); (5) *nomina correctata* (sing., *nomen correctum*, abbr., *nom. correct.*); (6) *nomina substituta* (sing., *nomen substitutum*, abbr., *nom. subst.*); (7) *nomina conservata* (sing., *nomen conservatum*, abbr., *nom. conserv.*).

Invalid names. Invalid zoological names consisting of originally published names that fail to comply with mandatory provisions of the Rules and consisting of inadvertent changes in spelling of names have no status in nomenclature. They are not available as replacement names and they do not preoccupy for purposes of the Law of Homonymy. In addition to *nomen nudum*, invalid names may be distinguished as follows: (1) "denied names," which consist of originally published names (with or without subsequent duplication) that do not meet mandatory requirements of the Rules; (2) "null names," which comprise unintentional alterations of names; and (3) "vain or void names," which consist of invalid emendations of previously published valid or invalid names. Void names do have status in nomenclature, being classified as junior synonyms of valid names.

Proposed Latin designations for the indicated kinds of invalid names are as follows: (1) *nomina negata* (sing., *nomen negatum*, abbr., *nom. neg.*); (2) *nomina nulla* (sing., *nomen nullum*, abbr., *nom. null.*); (3) *nomina vana* (sing., *nomen vanum*, abbr., *nom. van.*). It is desirable in the *Treatise* to identify invalid names, particularly in view of the fact that many of these names

(*nom. neg.*, *nom null.*) have been considered incorrectly to be junior objective synonyms (like *nom. van.*), which have status in nomenclature.

SUMMARY OF NAME CLASSES

Partly because only in such publications as the *Treatise* is special attention to classes of zoological names called for and partly because new designations are now introduced as means of recording distinctions explicitly as well as compactly, a summary may be useful. In the following tabulation valid classes of names are indicated in bold-face type, whereas invalid ones are printed in italics.

Definitions of Name Classes

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

nomen correctum (nom. correct.). Name with intentionally altered spelling of sort required or allowable under the Rules but not dependent on transfer from one taxonomic category to another ("improved name"). (See Copenhagen Decisions, paragraphs 50, 71-2-a-i, 74, 75, 79, 80, 87, 101; in addition, change of endings for categories not now fixed by Rules.)

nomen imperfectum (nom. imperf.). Name that as originally published (with or without subsequent identical spelling) meets all mandatory requirements of the Rules but contains defect needing correction ("imperfect name"). (See Copenhagen Decisions, paragraphs 50-1-b, 71-1-b-i, 71-1-b-ii, 79, 80, 87, 101.)

nomen inviolatum (nom. inviol.). Name that as originally published meets all mandatory requirements of the Rules and also is uncorrectable or alterable in any way ("inviolate name"). (See Copenhagen Decisions, paragraphs 152, 153, 155-157).

nomen negatum (nom. neg.). Name that as originally published (with or without subsequent identical spelling) constitutes invalid original spelling and although possibly meeting all other mandatory requirements of the Rules, is not correctable to establish original authorship and date ("denied name"). (See Copenhagen Decisions, paragraph 71-1-b-iii.)

nomen nudum (nom. nud.). Name that as originally published (with or without subsequent identical spelling) fails to meet mandatory requirements of the Rules and having no status in nomenclature, is not correctable to establish orig-

inal authorship and date ("naked name"). (See Copenhagen Decisions, paragraph 122.)

nomen nullum (nom. null.). Name consisting of an unintentional alteration in form (spelling) of a previously published name (either valid name, as *nom. inviol.*, *nom. perf.*, *nom. imperf.*, *nom. transl.*; or invalid name, as *nom. neg.*, *nom. nud.*, *nom. van.*, or another *nom. null.*) ("null name"). (See Copenhagen Decisions, paragraphs 71-2-b, 73-4.)

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

nomen substitutum (nom. subst.). Replacement name published as substitute for an invalid name, such as a 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 category 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 emendations having status in nomenclature as junior objective synonyms ("vain or void name"). (See Copenhagen Decisions, paragraphs 71-2-a-ii, 73-3.)

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 correctata* among specific names) and these are not discriminated. Names which are not accepted for one reason or another include junior homonyms, a few senior synonyms classifiable as *nomina negata* or *nomina nuda*, and numerous junior synonyms which include both objective (*nomina vana*) and subjective (all classes of valid names) types; effort to classify the invalid names as completely as possible is intended.

NAME CHANGES IN RELATION TO GROUP CATEGORIES

SPECIFIC AND SUBSPECIFIC 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 from one genus to another, it is never needful to label the changed name as a *nom. transl.* Likewise, transliteration of a letter accompanied by a diacritical mark in manner now called for by the Rules (as in changing originally published *bröggeri* to *broeggeri*) or elimination of a hyphen (as in changing originally published *cornuoryx* to *cornuoryx* does not require “*nom. correct.*” with it. Revised provisions for emending specific and subspecific names are stated in the report on Copenhagen Decisions (p. 43-46, 51-57).

GENERIC AND SUBGENERIC 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. It 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 are not now, 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. Revised provisions for emendation of generic and subgeneric names also are given in the report on Copenhagen Decisions (p. 43-47).

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

Kurnatiophyllum THOMSON, 1875 [**K. concentricum*; SD GREGORY, 1917] [=*Kumatiophyllum* THOMSON, 1876 (*nom. null.*); *Cymatiophyllum* THOMSON, 1901 (*nom. van.*); *Cymatiophyllum* LANG, SMITH & THOMAS, 1940 (*nom. van.*)].

Stichophyma POMEL, 1872 [**Manon turbinatum* RÖMER, 1841; SD RAUFF, 1893] [=*Stichophyma* VOSMAER, 1885 (*nom. null.*); *Stichophyma* MORET, 1924 (*nom. null.*)].

Stratophyllum SMYTH, 1933 [**S. tenue*] [=*Ethmoplax* SMYTH, 1939 (*nom. van. pro Stratophyllum*); *Stratophyllum* LANG, SMITH & THOMAS, 1940 (*nom. van. pro Stratophyllum* SMYTH) (*non Stratophyllum* SCHEFFEN, 1933)].

Placotelia OPPLIGER, 1907 [**Porostoma marconi* FROMENTEL, 1859; SD DE LAUBENFELS, herein] [=*Plakotelia* OPPLIGER, 1907 (*nom. neg.*)].

Walcottella DE LAUB., *nom. subst.*, 1955 [*pro Rhopalicus* SCHRAMM., 1936 (*non FÖRSTER*, 1856)].

Cyrtograptus CARRUTHERS, 1867 [*nom. correct.* LAPWORTH, 1873 (*pro Cyrtograptus* CARRUTHERS, 1867), *nom. conserv.* proposed BULMAN, 1955 (ICZN pend.)]

FAMILY-GROUP NAMES; USE OF “NOM. TRANSL.”

The Rules now specify the form of endings only for subfamily (-inae) and family (-idae) but decisions of the Copenhagen Congress direct classification of all family-group assemblages (taxa) as co-ordinate, signifying that for purposes of priority a name published for a unit in any category and based on a particular type genus shall date from its original publication for a unit in any category, retaining this priority (and authorship) when the unit 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 emendation comprised in the changed ending of each transferred family group name by the abbreviation “*nom. transl.*” and record of the author and date belonging to this emendation. 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 Rules, 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 of the author 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.* EDWARDS & HAIME, 1857 (ex Stylinidae d'ORBIGNY, 1851)]

**Superfamily ARCHAEOCTONOIDEA
Petrunkevitch, 1949**

[*nom. transl.* PETRUNKEVITCH, herein (ex Archaeoctonidae PETRUNKEVITCH, 1949)]

Superfamily CRIOCERATITACEAE Hyatt, 1900

[*nom. transl.* WRIGHT, 1952 (ex Crioceratitidae HYATT, 1900)]

**FAMILY-GROUP NAMES; USE OF “NOM.
CORRECT.”**

Valid emendations classed as *nomina correctae* 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 modification of ending for names of tribe or superfamily. Examples of the use of “*nom. correct.*” are the following.

Family STREPTELASMATIDAE Nicholson, 1889

[*nom. correct.* WEDEKIND, 1927 (ex Streptelasmidae NICHOLSON, 1889, *nom. imperf.*)]

Family PALAEOSCORPIIDAE Lehmann, 1944

[*nom. correct.* PETRUNKEVITCH, herein (ex Palaeoscorpionidae LEHMANN, 1944, *nom. imperf.*)]

Family AGLASPIDIDAE Miller, 1877

[*nom. correct.* STØRMER, herein (ex Aglaspidae MILLER, 1877, *nom. imperf.*)]

Superfamily AGARICIIDAE Gray, 1847

[*nom. correct.* WELLS, herein (ex Agaricioidae VAUGHAN & WELLS, 1943, *nom. transl.* ex Agariciidae GRAY, 1847)]

**FAMILY-GROUP NAMES; USE OF “NOM.
CONSERV.”**

It may happen that long-used family-group names are invalid under strict application of the Rules. In order to retain the otherwise invalid name, appeal to ICZN is needful. Examples of use of *nom. conserv.* in this connection, as cited in the *Treatise*, are the following.

Family ARIETTIDAE Hyatt, 1874

[*nom. correct.* HAUG, 1885 (pro Arietidae HYATT, 1875), *nom. conserv.* proposed ARKELL, 1955 (ICZN pend.)]

**Family STEPHANOCERATIDAE
Neumayr, 1875**

[*nom. correct.* FISCHER, 1882 (pro Stephanoceratinen NEUMAYR, 1875, invalid vernacular name), *nom. conserv.* proposed ARKELL, 1955 (ICZN pend.)]

FAMILY-GROUP NAMES; REPLACEMENTS

Family-group names are formed by adding letter combinations (prescribed for family and subfamily but not now for others) to the stem of the name belonging to 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. According to the Copenhagen Decisions, the family-group name requires replacement only in the event that the nominate genus is found to be a junior homonym, 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.

The aim of family-group nomenclature is greatest possible stability and uniformity, just as in case of 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. Conversely, a long-used family-group name founded on a junior objective synonym and having priority of publication is better continued in nomenclature than a replacement name based on the senior objective syno-

nym. The Copenhagen Decisions (paragraph 45) take account of these considerations by providing a relatively simple procedure for fixing the desired choice in stabilizing family-group names. In conformance with this, the *Treatise* assigns to contributing authors responsibility for adopting provisions of the Copenhagen Decisions.

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 a 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 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 as 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 correctae*, as previously discussed, do not affect authorship and date of the taxon concerned, but in publications such as the *Treatise* it is desirable to record the authorship and date of the correction.

ORDER/CLASS-GROUP NAMES; USE OF "NOM. CORRECT."

Because no stipulation concerning the form of order/class-group names is given yet by the Rules, emendation of all such names actually consists of arbitrarily devised changes in the form of endings. Nothing precludes substitution of a new name for an old one, but a change of this sort is not

considered to be an emendation. Examples of the use of "*nom. correct.*" as applied to order/class-group names are the following.

Order DISPARIDA Moore & Laudon, 1943

[*nom. correct.* MOORE, 1952 (*ex* Disparata MOORE & LAUDON, 1943)]

Suborder FAVIINA Vaughan & Wells, 1943

[*nom. correct.* WELLS, herein (*ex* Faviida VAUGHAN & WELLS, 1943)]

Suborder FUNGIINA Verrill, 1865

[*nom. correct.* WELLS, herein (*ex* Fungiida DUNCAN, 1884, *ex* Fungacea VERRILL, 1865)]

TAXONOMIC EMENDATION

Emendation has two measurably distinct aspects as regards zoological nomenclature. These embrace (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, whatever its hierarchical rank. The latter type of emendation primarily concerns classification and inherently is not associated with change of name, whereas the other type introduces change of name without necessary expansion, restriction, or other modification in applying the 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, a multitude of 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 significant change is worth while, 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.

In Part G (Bryozoa) and Part D (Protista 3) of the *Treatise*, the abbreviation “*emend.*” is employed to record various sorts of name emendations, thus conflicting with usage of “*emend.*” for change in taxonomic application of a name without alteration of the name itself. This is objectionable. In Part E (Archaeocyatha, Porifera) and later-issued divisions of the *Treatise*, use of “*emend.*” is restricted to its customary sense, that is, significant alteration in taxonomic scope of a name such as calls for noteworthy modifications of a diagnosis. Other means of designating emendations that relate to form of a name are introduced.

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 and date, 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 which 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, for this saves needed space. Examples of these 2 sorts of citations are as follows:

Diplotrypa NICHOLSON, 1879 [**Favosites petropoli-tanus* PANDER, 1830].

Chainodictyon FOERSTE, 1887 [**C. laxum*].

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

Acervularia SCHWEIGGER, 1819 [**A. baltica* (= **Madrepora ananas* LINNÉ, 1758)].

It is judged desirable to record the manner of establishing the type species, whether by original designation or by subsequent designation, but various modes of original designation are not distinguished.

Fixation of type-species originally. The type-species of a genus or subgenus, according to provisions of the Rules, may be fixed in various ways originally (that is, in the publication containing first proposal of the generic name) or it may be fixed in specified ways subsequent to the original publication. Fixation of a type-species originally may be classified as automatic if the new genus was introduced for a single species (monotypy), or if the names of species referred to the genus are objectively synonymous. In addition, fixation of a type-species originally may be established in several ways by original designation, as by explicit statement given by an author, by use of *typus* or *typicus* as a new specific name, and by absolute tautonymy (e.g., *Mesolobus mesolobus*). According to convention adopted in the *Treatise*, the absence of indication as to the manner of fixing the type-species is to be understood as signifying fixation of the type-species in one way or another originally. Where an author wishes to specify the mode of original fixation, however, this may be done by such abbreviations as “M” (monotypy), “OS” (objective synonymy), and “OD” (original designation), the first- and last-mentioned being most common and the other very rare.

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 2 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 [**Cyathophyllum hexagonum* GOLDFUSS, 1826; SD LANG, SMITH & THOMAS, 1940].

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

Another mode of fixing the type-species of a genus that may be construed as a special sort of subsequent designation is action of the International Commission on Zoological Nomenclature using its plenary powers. Definition in this way may set aside application of the Rules 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 (generally) reference to the appropriate numbered Opinion.

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 has been applied to 2 or more distinct taxonomic units, however, it is necessary to differentiate such homonyms, and this calls for dis-

inction between junior homonyms and senior homonyms. Because a junior homonym is invalid, it must be replaced by some other name. For example, *Callopora* HALL, 1851, introduced for Paleozoic trepostome bryozoans, is invalid because GRAY in 1848 published the same name for Cretaceous-to-Recent cheilostome bryozoans, and BASSLER in 1911 introduced the new name *Hallopora* to replace HALL's homonym. The *Treatise* style of entry is:

Hallopora BASSLER, 1911 [pro *Callopora* HALL, 1851 (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 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, using its assigned index number, as shown in the following example.

Mysterium DELAUBENFELS, nom. subst. [pro *Mysterium* SCHRAMMEN, 1936 (ref. 40, p. 60) (non ROGER, 1862)] [**Mystrium porosum* SCHRAMMEN, 1936].

For some replaced homonyms, a footnote reference to the literature is necessary. A senior homonym is valid, and in so far as the *Treatise* is concerned, such names are handled according to whether the junior homonym belongs to the same major taxonomic division (class or phylum) as the senior homonym or to some other; in the former instance, the author and date of the junior homonym are cited as:

Diplophyllum HALL, 1851 [non SOSHKINA, 1939] [**D. caespitosum*].

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

Homonyms by misidentification. When an author uses a generic name for species not congeneric with the type-species, it is needful to record the misuse of the generic name, even though this is only determinable subjectively. In the *Treatise* homonyms by misidentification are cited in synonymies as illustrated in the following example.

Asmussia PACHT, 1849 [**A. membranacea*] [= *Posidonomya* PACHT, 1852 (non BRONN, 1834); *Estertheria* JONES, 1856 (non ROBINEAU-DESVOIDY, 1830; nec RUEPPELL, 1837)]. . . .

Synonymic 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 which 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 synonymic 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 synonymic homonyms are distinguished in the *Treatise* as in dealing with generic names.

SYNONYMS

Citation of synonyms is given next following record of the type species and if 2 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. Examples showing *Treatise* style in listing synonyms follow.

Calapoecia BILLINGS, 1865 [**C. anticostiensis*; SD LINDSTRÖM, 1883] [= *Columnopora* NICHOLSON, 1874; *Houghtonia* ROMINGER, 1876].

Staurocyclia HAECKEL, 1882 [**S. cruciata* HAECKEL, 1887] [= *Coccostaurus* HAECKEL, 1882 (obj.); *Phacostaurus* HAECKEL, 1887 (obj.)].

A synonym which also constitutes a homonym is recorded as follows:

Lyopora NICHOLSON & ETHERIDGE, 1878 [**Palaeopora? javosa* M'COY, 1850] [= *Liopora* LANG, SMITH & THOMAS, 1940 (non GIRTY, 1915)].

Some junior synonyms of either objective or subjective sort may take precedence desirably 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. In the *Treatise* citation of such a conserved generic name is given in the manner shown by the following example.

Tetragraptus SALTER, 1863 [*nom. correct.* HALL, 1865 (pro *Tetragraptus* SALTER, 1863), *nom. conserv.* proposed BULMAN, 1955, ICZN pend.] [**Fucoides serra* BRONGNIART, 1828 (= *Graptolithus bryonoides* HALL, 1858)].

ABBREVIATIONS

Abbreviations used in this division of the *Treatise* are explained in the following alphabetically arranged list.

Abbreviations

abs., abstract
 aff., affinis
 Afr., Africa, -an
 Ala., Alabama
 Alb., Albanian
 Algonk., Algonkian
 alter., alternate
 Alta., Alberta
 Am., America, -n
 ant., anterior
 Antarct., Antarctica
 append., appendix

approx., approximately
 Apt., Aptian
 Arenig., Arenigian
 Arg., Argentina
 Ariz., Arizona
 AsiaM., Asia Minor
 auctt., auctorum
 Aus., Austria
 Austral., Australia
 Balt., Baltic
 Barton., Bartonian
 B.C., British Columbia

Belg., Belgium, Belgique
 Boh., Bohemia
 Bol., Bolivia
 Br.I., British Isles
 Brit., Britain, British
 C., Central
 ca., circa
 Calif., California
 Cam., Cambrian
 Campan., Campanian
 Can., Canada
 Caradoc., Caradocian

Carb., Carboniferous
Carib., Caribbean
Cenoz., Cenozoic
cf., confer (compare)
Chester., Chesteran
Cinc., Cincinnati
cm., centimeter
Co., Company
Colo., Colorado
Colomb., Colombia
Conn., Connecticut
cosmop., cosmopolitan
Cret., Cretaceous
Czech., Czechoslovakia
D.C., District of Columbia
Dec., December
Denm., Denmark
Dev., Devonian
dia., diameter
diagram., diagrammatic
Dol., Dolomite
Downton., Downtonian
E., East
Ecuad., Ecuador
ed., edition, editor
e.g., exempli gratia (for example)
Eifel., Eifelian
emend., emendatus (-a)
Eng., England
Eoc., Eocene
Est., Estonia
et al., et alii
ety., etymology
Eu., Europe
F., Formation
fam., family
Famenn., Famennian
fig., figure, -s
Fin., Finland
Fr., France, French, Français, -e
Frasn., Frasnian
Ft., Fort
G.Brit., Great Britain
Geol., Geology, Geological, Geologische
Ger., Germany, German
Givet., Givetian
Gotl., Gotland, Gotlandian
Gr., Group
Greenl., Greenland
horiz., horizontal
hom., homonym
Hung., Hungary, Hungarica
I. (Is.), Island, -s
ICZN, International Commission on Zoological Nomenclature
i.e., id est (that is)
Ill., Illinois
illus., illustration, -s
Ind., Indiana
Ind.O., Indian Ocean
Internatl., International
Ire., Ireland
Ital., Italian
Jap., Japan
jr., junior
Jur., Jurassic
Kans., Kansas
Kinderhook., Kinderhookian
Ky., Kentucky
L., Lower
lat., lateral
Lias., Liassic
Llandeil., Llandeilian
Llandov., Llandoverian
Llanvirn., Llanvirnian
long., longitudinal
Ls., Limestone
Ludlov., Ludlovian
M., Middle
Maastricht., Maastrichtian
mag., magnification
Man., Manitoba
Mass., Massachusetts
Md., Maryland
Meramec., Meramecian
Mich., Michigan
Minn., Minnesota
Mio., Miocene
Miss., Mississippi, Mississippian
mm., millimeter
Mo., Missouri
mod., modified
Mont., Montana
n., new
N., North
N.Am., North America
Namur., Namurian
N.B., New Brunswick
NC., North Central
N.Car., North Carolina
NE., Northeast
Neb., Nebraska
Neog., Neogene
Neth., Netherlands
Nev., Nevada
Newf., Newfoundland
N.J., New Jersey
no., number
nom. correct., nomen correctum
nom. imperf., nomen imperfectum
nom. nov., nomen novum
nom. nud., nomen nudum
nom. null., nomen nullum
nom. subst., nomen substitutum
nom. transl., nomen translatum
nom. van., nomen vanum
Nor., Norway
NW., Northwest
N.Y., New York
N.Z., New Zealand
O., Ocean
obj., objective
Okla., Oklahoma
Oligo., Oligocene
Ont., Ontario
Ord., Ordovician
orient., orientation
Osag., Osagian
p., page, -s
Pa., Pennsylvania
Pac., Pacific
Pak., Pakistan
Paleoc., Paleocene
Paleog., Paleogene
Palest., Palestine
pend., pending
Penn., Pennsylvanian
Perm., Permian
Philip., Philippines
pl., plate, -s, plural
Pleist., Pleistocene
Plio., Pliocene
Pol., Poland
Port., Portugal
Portland., Portlandian
post., posterior
Precam., Precambrian
Prot., Proterozoic
pt., part, -s
Quat., Quaternary
Que., Quebec
Rec., Recent
reconstr., reconstructed, -ion
Rhaet., Rhaetian
Rotl., Rotliegende
Rupel., Rupelian
S., South, Sea
S.Am., South America
SC., South Central
schem., schematic
Scot., Scotland
SD, subsequent designation
S.Dak., South Dakota
SE., Southeast
sec., section, -s
Senon., Senonian
ser., series, serial
Sh., Shale
Shrops., Shropshire
Sib., Siberia
Sil., Silurian
simpl., simplified
sp., species
Sp., Spain
Spitz., Spitzbergen
s.s., sensu stricto
Ss., Sandstone
Staatsinst., Staatsinstitut
subsp., subspecies
suppl., supplement
SW., Southwest
Swed., Sweden, Swedish
Switz., Switzerland
Syst., System
tang., tangential
Tasm., Tasmania
tech., technical, technische
Tenn., Tennessee
Tert., Tertiary
Tex., Texas
Torton., Tortonian
transl., translated, translation
transv., transverse
Tremadoc., Tremadocian
Trias., Triassic

Turk., Turkey
Turon., Turonian
U., Upper
U.S., United States
USA, United States (America)
USSR, Union of Soviet Socialist
Republics

v., volume, -s
Va., Virginia
var., variety
vert., vertical
Vict., Victoria
Vt., Vermont
W., West

Wenlock., Wenlockian
Wis., Wisconsin
W.Va., West Virginia
Wyo., Wyoming
Z., Zone
Zool., Zoology

REFERENCES TO LITERATURE

Each part of the *Treatise* is accompanied by a selected list of references to paleontological literature consisting primarily of recent and comprehensive monographs available but also including some older works recognized as outstanding in importance. The purpose of giving these references is to aid users of the *Treatise* in finding detailed descriptions and illustrations of morphological features of fossil groups, discussions of classifications and distribution, and especially citations of more or less voluminous literature. Generally speaking, publications listed in the *Treatise* are not original sources of information concerning taxonomic units of various rank but they tell the student where he may find them; otherwise it is necessary to turn to such aids as the *Zoological Record* or NEAVE's *Nomenclator Zoologicus*. References given in the *Treatise* are arranged alphabetically by authors and accompanied by index numbers which serve the purpose of permitting citation most concisely in various parts of the text; these citations of listed papers are enclosed invariably in parentheses and are distinguishable from dates because the index numbers comprise no more than 3 digits. Ordinarily, index numbers for literature references are given at the end of generic or family diagnoses.

The following is a statement of the full names of serial publications which are cited in abbreviated form in the *Treatise* lists of references. The information thus provided should be useful in library research work. The list is alphabetized according to the serial titles which were employed at the time of original publication. Those following it in brackets are those under which the publication may be found currently in the *Union List of Serials*, the United States Library of Congress listing, and most library card catalogues. The names of serials published in Cyrillic are transliterated; in

the reference lists these titles, which may be abbreviated, are accompanied by transliterated authors' names and titles, with English translation of the title. The place of publication is added (if not included in the serial title).

List of Serial Publications

- Académie des Sciences URSS, Comptes Rendus [Akademiya Nauk SSSR, Leningrad].
Académie Impériale des Sciences, St. Pétersbourg, Mémoires [Akademiya Nauk SSSR, Leningrad].
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[K.] Akademie der Wissenschaften, St. Petersburg [Akademiya Nauk SSSR, Leningrad].
Akademie der Wissenschaften und der Literatur, Mainz, mathematisch-naturwissenschaftliche Klasse, Abhandlungen.
Akademie der Wissenschaftlichen zu München, mathematische-physikalische Klasse, Sitzungsberichten.
Akademie der Wissenschaftlichen zu Wien, mathematisch-naturwissenschaftliche Klasse, Denkschriften.
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American Journal of Science. New Haven, Conn.
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¹ K. preceding a serial title stands for all forms meaning royal, imperial, e.g., Königliche, Kaiserliche, Kongelig, etc.

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- Maryland Geological Survey. Baltimore.
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SOURCES OF ILLUSTRATIONS

At the end of figure captions an index number is given to supply record of the author of illustrations used in the *Treatise*, reference being made either (1) to publications cited in reference lists or (2) to the names of authors without indication of individual publications concerned. Previously unpublished illustrations are marked by the letter "n" (signifying "new") with the name of the author.

STRATIGRAPHIC DIVISIONS

Classification of rocks forming the geologic column as commonly cited in the *Treatise* in terms of units defined by concepts of time is reasonably uniform and firm throughout most of the world as regards major divisions (e.g., series, systems, and rocks representing eras) but it is variable and unfirm as regards smaller divisions (e.g., substages, stages, and subseries),

which are provincial in application. Users of the *Treatise* have suggested the desirability of publishing reference lists showing the stratigraphic arrangement of at least the most commonly cited divisions. Accordingly, a tabulation of European and North American units, which broadly is applicable also to other continents, is given here.

Generally Recognized Divisions of Geologic Column

EUROPE ROCKS OF CENOZOIC ERA

NEOGENE SYSTEM¹

- Pleistocene Series (including Recent)
- Pliocene Series
- Miocene Series

PALEOGENE SYSTEM

- Oligocene Series
- Eocene Series
- Paleocene Series

ROCKS OF MESOZOIC ERA

CRETACEOUS SYSTEM

Upper Cretaceous Series

- Maastrichtian Stage²
- Campanian Stage³
- Santonian Stage²
- Coniacian Stage²
- Turonian Stage
- Cenomanian Stage

Lower Cretaceous Series

- Albian Stage
- Aptian Stage
- Barremian Stage³
- Hauterivian Stage³
- Valanginian Stage³
- Berriasian Stage³

JURASSIC SYSTEM

Upper Jurassic Series

- Portlandian Stage⁴
- Kimmeridgian Stage
- Oxfordian Stage

Middle Jurassic Series

- Callovian Stage
- Bathonian Stage
- Bajocian Stage

NORTH AMERICA

ROCKS OF CENOZOIC ERA NEOGENE SYSTEM¹

- Pleistocene Series (including Recent)
- Pliocene Series
- Miocene Series

PALEOGENE SYSTEM

- Oligocene Series
- Eocene Series
- Paleocene Series

ROCKS OF MESOZOIC ERA

CRETACEOUS SYSTEM

Gulfian Series (Upper Cretaceous)

- Navarroan Stage
- Tayloran Stage
- Austinian Stage

Woodbinian (Tuscaloosan) Stage

Comanchean Series (Lower Cretaceous)

- Washitan Stage

- Fredericksburgian Stage
- Trinitian Stage

Coahuilan Series (Lower Cretaceous)

- Nuevoleonian Stage

- Durangoan Stage

JURASSIC SYSTEM

Upper Jurassic Series

- Portlandian Stage
- Kimmeridgian Stage
- Oxfordian Stage

Middle Jurassic Series

- Callovian Stage
- Bathonian Stage
- Bajocian Stage

Lower Jurassic Series (Liassic)

Toarcian Stage
Pliensbachian Stage
Sinemurian Stage
Hettangian Stage

TRIASSIC SYSTEM

Upper Triassic Series

Rhaetian Stage⁵
Norian Stage
Carnian Stage

Middle Triassic Series

Ladinian Stage
Anisian Stage (Virgloian)

Lower Triassic Series

Scythian Series (Werfenian)

ROCKS OF PALEOZOIC ERA

PERMIAN SYSTEM

Upper Permian Series

Tartarian Stage⁹
Kazanian Stage⁷
Kungurian Stage

Lower Permian Series

Artinskian Stage⁸
Sakmarian Stage

CARBONIFEROUS SYSTEM

Upper Carboniferous Series

Stephanian Stage

Westphalian Stage

Namurian Stage

Lower Carboniferous Series

Viséan Stage

Tournaisian Stage

Strunian Stage

DEVONIAN SYSTEM

Upper Devonian Series

Famennian Stage

Frasnian Stage

Lower Jurassic Series (Liassic)

Toarcian Stage
Pliensbachian Stage
Sinemurian Stage
Hettangian Stage

TRIASSIC SYSTEM

Upper Triassic Series

(Not recognized)
Norian Stage
Carnian Stage

Middle Triassic Series

Ladinian Stage
Anisian Stage

Lower Triassic Series

Scythian Stage

ROCKS OF PALEOZOIC ERA

PERMIAN SYSTEM

Upper Permian Series

Ochoan Stage
Guadalupian Stage

Lower Permian Series

Leonardian Stage
Wolfcampian Stage

PENNSYLVANIAN SYSTEM

Kawvian Series (Upper Pennsylvanian)

Virgilian Stage
Missourian Stage

Oklan Series (Middle Pennsylvanian)

Desmoinesian Stage
Bendian Stage

Aradian Series (Lower Pennsylvanian)

Morrowan Stage

MISSISSIPPIAN SYSTEM

Tennessean Series (Upper Mississippian)

Chesteran Stage

Meramecian Stage

Waverlyan Series (Lower Mississippian)

Osagian Stage
Kinderhookian Stage

DEVONIAN SYSTEM

Chautauquan Series (Upper Devonian)

Conewangoan Stage
Cassadagan Stage

Senecan Series (Upper Devonian)

Chemungian Stage
Fingerlakesian Stage

Middle Devonian Series

Givetian Stage

Couvian Stage

Lower Devonian Series

Coblentzian Stage

Gedinnian Stage

SILURIAN SYSTEM

Upper Silurian Series

Ludlovian Stage

Middle Silurian Series

Wenlockian Stage

Llandoveryian Stage (upper part)

Lower Silurian Series

Llandoveryian Stage (lower part)

ORDOVICIAN SYSTEM

Upper Ordovician Series

Ashgillian Stage

Caradocian Stage (upper part)

Middle Ordovician

Caradocian Stage (lower part)

Llandeilian Stage

Llanvirnian Stage

Lower Ordovician Series

Arenigian Stage

Tremadocian Stage⁹

CAMBRIAN SYSTEM

Upper Cambrian Series

Middle Cambrian Series

Lower Cambrian Series

EOCAMBRIAN SYSTEM

ROCKS OF PRECAMBRIAN AGE

Erian Series (Middle Devonian)

Taghanican Stage

Tioughniogan Stage

Cazenovian Stage

Ulsterian Series (Lower Devonian)

Onesquethawan Stage

Deerparkian Stage

Helderbergian Stage

SILURIAN SYSTEM

Cayugan Series (Upper Silurian)

Keyseran Stage

Tonolowayan Stage

Salinan Stage

Niagaran Series (Middle Silurian)

Lockportian Stage

Cliftonian Stage

Clintonian Stage

Medinan Series (Lower Silurian)

Alexandrian Stage

ORDOVICIAN SYSTEM

Cincinnatian Series (Upper Ordovician)

Richmondian Stage

Maysvillian Stage

Edenian Stage

Champlainian Series (Middle Ordovician)

Mohawkian Stage

Trentonian Substage

Blackriveran Substage

Chazyan Stage

Canadian Series (Lower Ordovician)

CAMBRIAN SYSTEM

Croixian Series (Upper Cambrian)

Trempealeuan Stage

Franconian Stage

Dresbachian Stage

Albertan Series (Middle Cambrian)

Waucoban Series (Lower Cambrian)

EOCAMBRIAN SYSTEM

ROCKS OF PRECAMBRIAN AGE

RAYMOND C. MOORE

¹ Considered by some to exclude post-Pliocene deposits.

² Classed as division of Senonian Subseries.

³ Classed as division of Neocomian Subseries.

⁴ Includes Purbeckian deposits.

⁵ Interpreted as lowermost Jurassic in some areas.

⁶ Includes some Lower Triassic and equivalent to upper Thuringian (Zechstein) deposits.

⁷ Equivalent to lower Thuringian (Zechstein) deposits.

⁸ Equivalent to upper Autunian and part of Rotliegend deposits.

⁹ Classed as uppermost Cambrian by some geologists.

PART W

MISCELLANEA

By W. H. HASS, WALTER HÄNTZSCHEL, D. W. FISHER, B. F. HOWELL,
F. H. T. RHODES, K. J. MÜLLER, and R. C. MOORE

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INTRODUCTION

By RAYMOND C. MOORE

[University of Kansas]

The letter "W," assigned to this volume of the *Treatise*, indicates a position next to last in the planned sequence of units. This is explained readily by its intended content of "left-overs"—mostly groups of fossils set apart as unknown or very doubtful as to taxonomic affinities. Such a residuum might be expected to follow the publication of all other units, possibly with a miscellany of minor groups that for some reason had been

omitted from already-issued volumes in which they would logically have found place. Obviously, the presumption expressed does not accord with fact, since several important divisions of the *Treatise* are yet unfinished. Readers may be reminded that an initial feature of this collaborative project was to publish each planned volume whenever it could be made ready for the press. No good end would be served by withhold-