to the method of reproduction which will ultimately be utilized in publication, since this affects both the techniques to be followed and the cost of preparation and publication.

Technique in drawing is largely a personal matter, depending on the ability and training of the individual. A scientist is fortunate if he

Delete and close up	En dash
Reverse	Insert semicolon
Close up	Insert colon
Insert space	Insert period
Paragraph	Insert interrogation point
Indent one em	Query to author
Move to left	Use ligature
Move to right	Spell out
Lower	Transpose
Elevate	Wrong font
Insert marginal addition	Set in bold face type
Even space	Set in roman type
Broken letter	Set in *italic* type
Push down space	Set in CAPITALS
Straighten line	Set in SMALL CAPITALS
Align type	Set in lower case
Insert comma	Lower-case letter
Insert apostrophe	Let it stand
Insert quotes	Run in same paragraph
Hyphen	Insert lead between lines
Em dash	Hair space between letters

FIG. 41. Proofreaders' marks.

happens to be endowed with talent as an artist. However, the scientist who lacks artistic talent need not be discouraged, because clear-cut diagrammatic drawings are perfectly satisfactory and, in some cases, superior to artistic drawings for scientific purposes. Ferris (1928) has called this type of drawing *drafting* and expresses the opinion that any conscientious scientist can learn to make satisfactory drawings of this kind. Several

books or manuals have been published on the subject, among which may be mentioned Ridgway (1938), Kuhl (1949), and Cannon (1936).

Pencil sketches should be made with a soft pencil, and bilaterally symmetrical animals should be "corrected" for symmetry by tracing one half on the other with thin semitransparent paper.

The original outline may be obtained by freehand sketching but, at least with microscopically small organisms, can be done more quickly and accurately by one or another mechanical means. Perhaps the most popular of these devices is the *camera lucida*, which, by means of prisms and a mirror, projects the microscope image on a piece of paper. With this

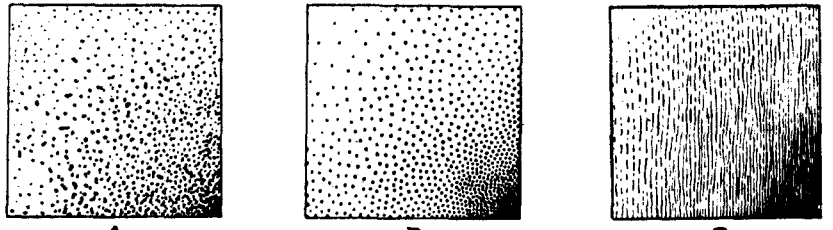


FIG. 42. Simple types of shading: *A*, pseudo stipple; *B*, stipple; *C*, lines (*reprinted from The Principles of Systematic Entomology, by Gordon Floyd Ferris, with permission of the author and the publishers, Stanford University Press*).

apparatus it is possible to look in the microscope and see the specimen superimposed on the reflection of the paper. By careful adjustment of the light, it is possible to draw an outline with the specimen and the pencil point both clearly in view. Another method of obtaining the outline is the direct projection of an image on a screen or paper by a microprojector attached to the microscope. Still another technique is to photograph the specimen and print an enlargement on a dull mat paper. The outline can be inked directly on the photograph, after which the photographic emulsion can be washed off. Some workers prefer to sketch freehand on a crosshatched paper, guided by a grid in the ocular of the microscope.

The preliminary sketches should be checked for accuracy of proportion and then transferred to the final drawing paper. A hard-surface white paper is best for black-and-white line drawings, but various surfaced papers may be used for special purposes. Chalk-surface "stipple boards" are especially useful when shading is desired, soft carbon pencils or black wax crayons being used to obtain the desired effects. High lights may be shown on chalk-surface papers by simply scraping an area.

Pens of various styles may be used, depending on the strength of line desired and on the preference of the illustrator.

Line drawings are made with black India ink. The lines should be

firm and even—not scratched—and should be heavier on the lower right side of the drawing (assuming that the light source is from the upper left) to indicate depth and contour (Fig. 43). Convexity may also be indicated by short crosslines on the side away from the light (Fig. 44).

More elaborate shading may be rendered by stipple or parallel lines, but this requires more artistic ability and should not be attempted without considerable practice. If stippling is to be done, it should be even, not irregularly speckled, the variations in tone being due to spacing rather

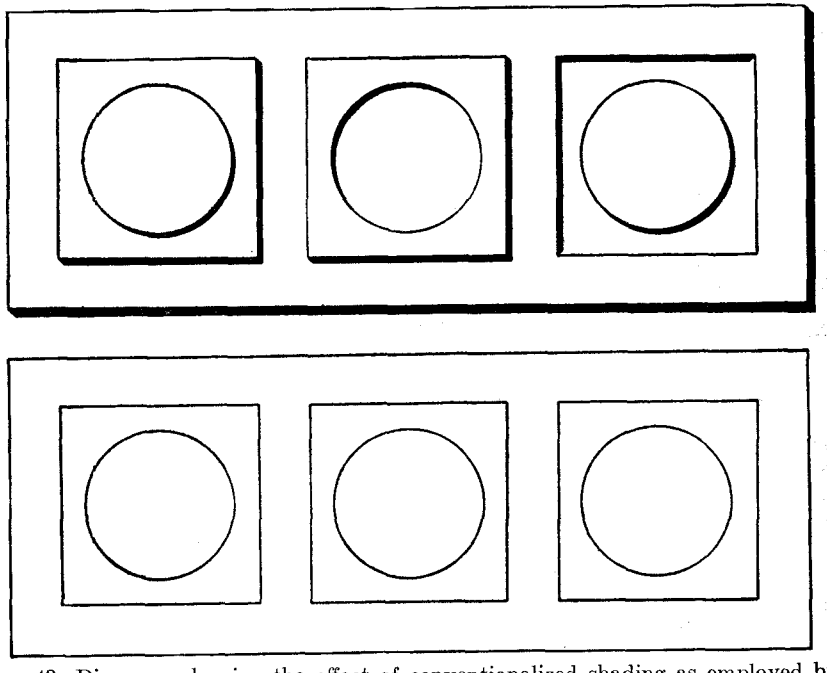


FIG. 43. Diagrams showing the effect of conventionalized shading as employed by mechanical draftsmen (*reprinted from The Principles of Systematic Entomology, by Gordon Floyd Ferris, with the permission of the author and of the publishers, Stanford University Press*).

than size of dots. Lines are also useful for shading but require great care. In every case, individual drawings should be made one and one half to two times larger than final size, because minor imperfections in line and stipple are deemphasized by reduction (Fig. 42).

Transparent stipple paper is available commercially with various sizes of dots, crosshatching, and lines. These papers may be pressed onto drawings and trimmed to fit a given space, thus automatically providing a uniform tone. This technique is especially useful for distribution maps, which, incidentally, are handled exactly like line drawings.

More delicate shading is accomplished by rubbing on tones of carbon

pencil, using a soft stub, or by brushing on various dilutions of India ink. In either case a very different type of drawing results which must be reproduced as a halftone or fulltone, like a photograph. Details of mounting and labeling halftones will be given later.

Photographs are generally less effective than drawings because of lack of contrast and dimension. However, they do serve to portray general facies or habitus, and they are indispensable for portraying the habitat of a given species and other biological features. Photographs should be specific, *i.e.*, concentrated on the portrayal of one object. They should show as much contrast as possible, and they must not be dull or blurred.

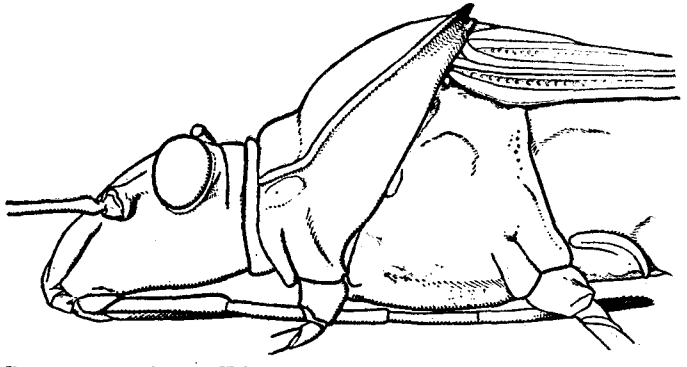


FIG. 44. *Riptortus tutuilensis* China; lateral view of head and thorax (*China*, 1930)

For best reproduction, photographs to be shown on the same plate should have similar backgrounds and should be similar in tone, both for esthetic reasons and because the engraver cannot make a satisfactory plate if the photographs are uneven in tone. If for any reason photographs are not up to standard, they may be improved somewhat by careful retouching. This is a delicate operation and should not be undertaken without considerable experience. A mat print is made, and soft pencil is employed to strengthen lines or emphasize certain points. Then the retouched photograph is rephotographed and printed on glossy paper or, in some cases, may be used directly.

Halftone drawings or retouched photographs should be protected by a tissue-paper cover to prevent rubbing.

Colored illustrations are strictly in the realm of works of art and, as such, should be left to the skilled artist or scientist-illustrator. No general rules are given here, because so much depends on the skill of the artist. A recent development along this line is the production of color prints by photography. In the future this method may be exploited more fully; it has already proved useful for illustrations of butterflies.

Drawings are most frequently reproduced either as zinc etchings or halftones or by photolithography. Zinc etchings are produced by

photographing the illustration on zinc and etching away the background with acid. It is the least expensive method of reproduction and is especially satisfactory for line drawings, graphs, charts, etc. Halftones are screened and broken up into tiny dots, so that white areas appear gray. The method is more costly than zinc etchings but shows greater detail and more delicate shading. If desired, the background may be routed out, as in zinc etching, but this still further increases the cost. In photolithography the illustration is photographed on gelatine and is

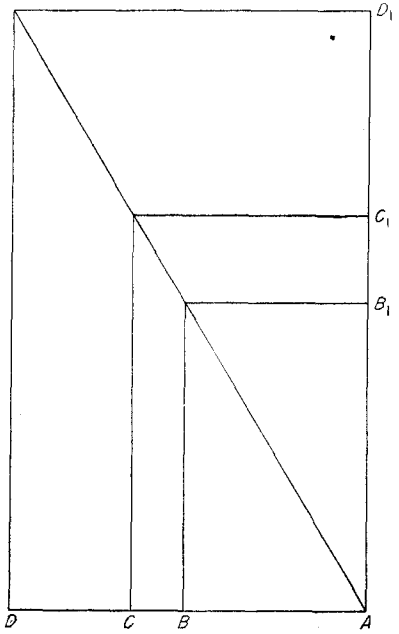


FIG. 45. Method of calculating proportions for enlargement or reduction of illustrations. If the side AC of an illustration is enlarged to AD or reduced to AB, the length of the other side (AD' or AB') can be easily determined as the point of intersection with the diagonal.

not screened, thus becoming a fulltone process. It will therefore show even greater detail than a halftone but lacks some of the contrast. Halftones and photogelatin plates are often printed on glossy paper or at a different printing establishment, and for this reason it is frequently easiest to assemble them together at the end of an article. Zinc etchings are usually printed on the same paper as the text and may therefore more readily be distributed through the article as plates or text figures. The latter are most economical when printed the same width as the printed page.

Proper proportions for the original drawing may be obtained by expanding on a diagonal line through a rectangle drawn to page size (Fig. 45).

Room must be allowed at the bottom of the page for the legend. Figure numbers, letters, abbreviations, etc., should be put on neatly. In order to be legible, letters should be $1\frac{1}{2}$ or $2 \times \frac{1}{16}$ in. or $\frac{3}{32}$ in. high, depending on the amount of reduction. Freehand lettering is rarely satisfactory. Numbers and letters may be clipped from old calenders or standard characters printed on gummed paper, or they may be made by various mechanical lettering guides. The editor, when determining the amount of reduction, is limited by the size of the page, the need for captions, and other considerations and is therefore often not in a position to follow the instructions of the author. This is particularly true in the case of large figures. Magnification or reduction should therefore not be stated on the figures themselves, but rather in the captions.

Where many illustrations are to be utilized, grouping is often required for economical reproduction. For zinc etchings, drawings may be assembled into plates by merely arranging and pasting on a cardboard sheet. Colorless paste or rubber cement should be used. The paper edges of individual drawings will not show. For halftones, however, trimmed edges will show, and when several drawings are to be fitted together for a plate, a mechanical paper cutter should be used for trimming. Slight discolorations, especially when yellowish, also become conspicuous in reproduction. It is usually more satisfactory to draw numbers and letters directly on the original, rather than pasting them on. However, characters printed on transparent gummed paper are also available for halftone. Photographs should be mounted with smooth edges touching and symmetrical, so that the engraver can rout out neat, straight lines.

Curves and graphs are reproduced by zinc etchings and largely used as text figures. In preparing them for publication, the same instructions as to size, proportions, and lettering apply as for drawings. However, they should be made either on white paper or blue-lined coordinate paper, never on green-, black-, red-, or yellow-lined paper unless the coordinates are to be reproduced.

Colored illustrations are the most complicated and most expensive to reproduce. A screen similar to halftone screens is used, and several separate colors are used in printing, each one superimposed on the previous impressions.

Some scientific journals charge the author for cuts (approximately $10 per page for zinc cuts and $15 per page for copper halftone plates). An author may be billed for the glossy paper if halftones are to be printed in a journal which normally employs a rough eggshell-surface paper. This extra cost may include not only the paper but the hand labor involved in tipping in or pasting in the extra pages.

Offset printing obviates most of these difficulties because the entire page, included printed (or typed) matter and line cuts, is photographed on

a plate and then rolled onto a second roller before it is printed on the final paper. Photographs are made separately because of differences in contrast and then are "stripped in" on the negative of the photolithographed page. By this method illustrations cost no more than printed matter.

It is a wise precaution to retain good, clear, photographic copies of all illustrations in the event that they are lost in the mail. A good photograph of a drawing is only slightly inferior to an original as a basis for reproduction.

Reprints. Reprints must be ordered at the time the proof is returned to the editor. It is advisable to order a much larger number of reprints of all papers that deal with general principles.

PART 3

ZOOLOGICAL NOMENCLATURE

CHAPTER 10

HISTORICAL AND PHILOSOPHIC BASIS OF NOMENCLATURE

The respective roles of classification and nomenclature are often misunderstood. The identification, delimitation, and ranking of taxonomic categories are zoological tasks. The role of nomenclature is merely to provide labels for these taxonomic categories in order to facilitate communication among biologists. We cannot speak of objects if they do not have names. Nomenclature (nō-men-clā-tūr) means a system of names. The term is derived from the Latin *nomen*, name, and *calare*, to call, and means literally to call by name. Nomenclature thus is the "language" of zoology, and the rules of nomenclature are its grammar. Nomenclature is a means to an end, not an end in itself. Since all zoologists work with animals and use their names, it is essential that the general principles of zoological nomenclature be familiar to all zoologists, whether they are systematists or not.

Zoological nomenclature, as stated above, is the language of the zoologist. To be a useful means of communication a language must be widespread, and the same words must have the same meaning to everyone. Universality and stability are therefore the principal objects of any nomenclature. Unfortunately, complete stability is impossible, since nomenclature involves the naming of taxonomic categories, and new discoveries are bound to change the concepts and limits of these categories. Scientific progress is therefore bound to lead to some name changing. A second group of name changes, which we shall discuss in the next chapter, is, however, independent of scientific progress.

THE ORIGIN OF THE BINOMINAL SYSTEM

Vernacular Names. There are in most languages more or less elaborate systems of nomenclature for animals and plants. A primitive tribe of Papuans in the mountains of northwestern New Guinea has 137 different names for the 138 species of local birds. Hunting peoples usually have a better knowledge of nature and consequently a richer taxonomic nomenclature than agricultural or particularly, urban peoples. The more conspicuous species of mammals, fishes, birds, and insects have names in all the languages of Europe. They are an accepted part of German, French, Spanish, and other languages. In English many of our so-called "common names" are of Anglo-Saxon origin. Those applied to major

groups of animals are usually short, frequently monosyllabic, as bear, finch, frog, bee, etc. Common names for species are often formed by modifying these group names with a descriptive noun or adjective, thus polar bear, brown bear, etc. These double names are binominal. Many of the better known species, however, were always uninominal: for example, among British birds, raven, rook, jay, (mag)pie, (jack)daw, robin, redwing, twite, linnet, nightingale, hoopoe, lapwing, quail, partridge, and many others; and among the butterflies, monarch, grayling, ringlet, peacock, comma, swallowtail, etc. Others were polynominal, such as small pearl-bordered fritillary, dark green fritillary, etc.

Such common, or vernacular, names have proved inadequate for scientific purposes, because they are different in the thousands of languages and dialects of the world. The same name is often applied to different organisms in different regions (*e.g.*, *robin*), or the same organism is known under different names in different areas. It is evident that it would be difficult to base a universal nomenclature of scientific names on the vernacular names of one of the living languages.

Scientific Names. Latin was the international language of European scholars of the Middle Ages, and the majority of scientific treatises up to the eighteenth century were written in that language. Modern scientific nomenclature is a direct descendent of the terminologies of the naturalists of the sixteenth to eighteenth centuries, who wrote in Latin. Linnaeus is to be credited with having standardized the system of scientific nomenclature. Even before Linnaeus there was a recognition of the categories *genus* and *species*, which in part goes back to the nomenclature of primitive peoples (Bartlett, 1940). Linnaeus based his generic concept on the concepts of Tournefort and Plumier, who in turn reformed the less rigid generic concepts of Brunfels and Bauhin. The generic names themselves often went back to names used by the Romans or Greeks.

Plato definitely recognized two categories, the genus (γενος) and the species (ειδος), and so did his pupil Aristotle (Chap. 1). The naturalists of the pre-Linnaean era were not consistent in the Latin names they gave to plants and animals. These names ranged all the way from uninominals (a generic name only) and binominals (a generic and a single trivial name) to polynominals (a generic name with several trivial epithets). The reason for this confusion was that they tried to combine two different functions in the name: naming (in the restricted sense of the word) and describing. A unique type of animal they might refer to with a uninominal (*Cantharis*). A species with relatives they might refer to with a qualifying adjective: *Musca carnivora*, *M. canum*, *M. equina* (Moufet, 1634). If they found that the original *M. carnivora* actually consisted of two species, a later author would refer to them as *M. carnivora major* and *M. carnivora minor*. The specific name, whose function was diagnostic, evolved into a specific phrase. Eventually these phrase names became so elaborate and changed so often that the need arose for a simple "label" for each species. To satisfy this need, Linnaeus introduced a single "catchword" for each species, the *nomen triviale*. For instance, for the honey bee, *Apis pubescens, thorace subgriseo, abdomine fusco, pedibus posticis glabris utrinque margine ciliatis*, he introduced the trivial name *mellifera*; for other bees of the genus *Apis*, the names *surinamensis*, *longicornis*, and so forth. This simple system of a unique combination of two names for every species, often called the binominal system, was quickly accepted by zoologists. Linnaeus applied this system for the first time consistently to animals in 1758 in the tenth edition of his *Systema naturae*. This work was therefore designated in the International Rules as the starting point of zoological nomenclature.

CODES OF NOMENCLATURE

The simplicity of the binominal system proved tremendously stimulating to taxonomy. It gave anyone the authority to apply Latin names to organisms, and these names automatically had permanent status, either as valid names or as synonyms. If an author in the post-Linnaean period described an apparently new animal in the vernacular or in polynominals, as was done, for instance, by Daubenton, Sonnerat, Buffon, Latham, Brisson, and many other naturalists of that period, other taxonomists would rename these species according to the Linnaean system, that is, with Latin binominals. When finally (after 1800) virtually all authors had adopted the Linnaean system, a new source of confusion appeared: many authors decided to change existing names if they had not been correctly formed according to Greek or Latin grammar, or if the old name proved to be inapplicable (*e.g.*, *brunneus* was changed to *viridis* because it was found that in life the animal was green). Geographical names were often changed when they were found to be inaccurate (*e.g.*, *capensis* was changed to *indicus* if it was found that the species came from India rather than from the Cape of Good Hope). The result was nomenclatural confusion, if not anarchy. The need for a set of definite rules of nomenclature became clear. As a matter of fact, the need for a nomenclatural procedure had already been recognized by Linnaeus (1751), who formulated a personal set of rules. Fabricius (1778) followed with another personal code for entomological nomenclature, and Rudolphi (1801) did likewise for the naming of parasites. Here the matter rested for nearly half a century, during which time a large amount of work was published with little uniformity as to procedure. It was, however, acknowledged by most authors even at that early period that a name that

was in prior use was not to be arbitrarily replaced by a subsequently published name. Otherwise there was little uniformity.

The taxonomist in the middle of the twentieth century can hardly realize the "confusion of tongues" in zoological nomenclature during the first half of the nineteenth century. Owing to the disturbances caused by the Napoleonic wars, there had been a drastic reduction—almost a standstill—in exchange of scientific publications and periodicals. This led to ignorance of the publications of other countries and to the development of many local scientific nomenclatures. As Strickland said in 1842,

> If an English zoologist, for example, visits the museums and converses with the professors of France, he finds that their *scientific* language is almost as foreign to him as their *vernacular*. Almost every specimen which he examines is labelled by a title which is unknown to him, and he feels that nothing short of continued residence in that country can make him conversant with her science. If he proceeds thence to Germany or Russia, he is again at a loss, bewildered everywhere amidst the confusion of nomenclature, he returns in despair to his own country and to the museums and books to which he is accustomed.

Eventually the situation became so critical that the British Association for the Advancement of Science appointed a committee to draw up a general set of rules for zoological nomenclature. The resulting code (Strickland, 1842), often referred to as the "Strickland Code" from the name of one of the committee members, was a brilliant piece of work for its time and formed the basis of all future codes. In 1843 the Strickland Code was republished in France, Italy, and the United States. Although scarcely international in scope, these rules fully justified Strickland's expressed hope, "that they may lead to sufficient uniformity of method in the future to rescue science from becoming a mere chaos of words."

The American Association for the Advancement of Science, thirty years later, appointed W. H. Dall as a committee of one "to obtain an expression from the working naturalists of America, in regard to the nature of a set of rules for facilitating the decision of questions relating to nomenclature." The so-called "Dall Code" (Dall, 1877) is still one of the best essays on zoological nomenclature. However, it was never formally adopted by the Association.

During the next two decades national codes were adopted by the Société Zoologique de France (1881) and by the Deutsche Zoologische Gesellschaft (1894). In 1885 an excellent code for bird nomenclature was prepared by the American Ornithologists' Union (revised, 1908), and the International Congress of Geology adopted the so-called "Douvillé Code" (Douvillé, 1881), which set the procedure for naming fossils.

By this time it had become evident that zoological nomenclature was an international matter and could be handled only by an international set of rules. Hence the First International Zoological Congress, Paris, 1889, adopted a code proposed by Raphael Blanchard. This was actually the beginning of our present International Rules. The Second International Congress, Moscow, 1892, readopted the Blanchard Code, but unfortunately it was not generally accepted outside of France and America for nationalistic and perhaps other reasons.

Thus, in the year 1895, according to Stiles (1905),

> English systematists were following the Strickland Code; French systematists were following the International Code; German systematists were following the German Code; American systematists were divided between the Stricklandian, the A.O.U., the Dall, and the International Codes; systematists in special groups were in some cases following special or even personal codes; and systematists of Italy, Russia, and some other countries were following either the International or some other code.

In an attempt to resolve this apparently hopeless confusion, an international committee of five members—R. Blanchard (Paris), J. V. Carus (Leipzig), F. A. Jentink (Leyden), P. L. Sclater (London), and C. W. Stiles (Washington)—was appointed by the Third International Zoological Congress, Leyden, 1895. This committee made a careful study of all existing codes and, after being increased to 15 members at the Fourth International Congress, Cambridge, 1898, finally brought forth the *Règles Internationales de la Nomenclature Zoologique*. These rules were adopted by the Fifth International Zoological Congress, Berlin, 1901, and were edited in French by Blanchard, in English by Stiles, and in German by Maehrenthal. The French text is the definitive text (Règles, 1905). At the Sixth Congress, Berne, 1904, the committee of 15 was made a permanent commission (later increased to 18) and served with changing membership for nearly half a century. At the Paris Congress, 1948, the limit on membership was removed, and provision was made for revision and codification of the rules.

The Rules became the universal code of nomenclature. At no time since they were formally adopted has a nationally biased system of nomenclature been established. The International Rules have thus been truly international.

THE INTERNATIONAL RULES

The International Rules of Zoological Nomenclature (also called International Code or simply the Code), as adopted by the Fifth International Zoological Congress (Berlin, 1901), consisted of 41 articles and 20 recommendations, dealing with family, generic, specific, and subspecific names, with their validity, formation, and orthography.[1] Articles 33 to 41 dealt

[1] For a detailed presentation and interpretation of the Rules as they were prior to the Paris decisions, see Richter, 1948.

with priority, others with the designation of types and the rejection of names. Various provisions of the International Rules are explained in detail in Chaps. 12 to 16.

All good law is living law. It affects the surrounding situation and, in turn, is affected by it. This is true for all codes of law, including the International Rules of Zoological Nomenclature. The adoption of the International Rules has helped not only to produce stability in nomenclature, but also to standardize certain taxonomic procedures. However, during the fifty years in which the rules have been in force, a number of contradictions and omissions have been discovered.

Major changes have involved the revision of articles or the adoption of new articles. Most of the changes in the International Rules up to 1948 were in the form of Opinions of the International Commission.

The Opinions, of which 194 have been rendered by the International Commission, are of several kinds. In most cases they attempt to rephrase obscurely worded articles of the Rules more clearly or to interpret them as applied to particularly difficult cases. A second type of Opinion deals with nomenclatural situations that were not covered by the original articles. A third type of Opinion reports special acts of the Commission, particularly suspensions of the Rules in particular cases (see also Van Cleave, 1943).

More basic changes in the articles have been adopted by vote of the International Commission and, after approval by the Section on Nomenclature, by formal vote of the International Congress in plenary session. On four occasions major changes of the rules have been adopted since 1901. The first was the refinement of the type method adopted by the Seventh International Zoological Congress at Boston. The principles involved, according to which the names of all categories up to the family are based on a type, are explained in Chap. 12.

The second major change, which was the immediate result of the nomenclatural upheaval created by the retroactive adoption of the type method, was the Plenary Powers Resolution (Monaco, 1913). It permits the suspension of the rules in any case where "the strict application of the rules will clearly result in greater confusion than uniformity."

The third major change was the modification of Art. 25 as adopted by the Budapest Congress in 1927. The original version of the Rules failed to require a mentioning of the differentiating characters of the genus, species, or subspecies in the formal description and, in the case of a generic name, the definite unambiguous designation of a type species. At Budapest it was decided that it would be mandatory after Dec. 31, 1930, to include in the formal description "a summary of characters [seu diagnosis; seu definition; seu condensed description] which differentiate or distinguish the genus or the species from other genera or species" and in

the case of a genus, the definite unambiguous designation of a type species. The Article was interpreted differently by various authors, and an attempt was therefore made at the Paris Congress (see Chap. 11) to clarify this Article.

During the 47 years prior to 1948 that the International Rules were in effect, so much poorly digested case law had accumulated that a complete revision of the Rules was authorized at the Paris Congress (1948). Specifically, all interpretations of the Rules contained in Opinions and Declarations were incorporated into the Revised Rules, after which the Opinions and Declarations were repealed and canceled for all except historical purposes; numerous amendments, additions, and clarifications were adopted; the meaning of the expression *binary nomenclature* was fixed as exactly equivalent to *binominal nomenclature;* the term *indication* as used in Art. 25 was defined; rules were adopted for the first time relating to secondary homonyms and names for forms of less than subspecific rank; the status of names on the Official List of Generic Names in Zoology was clarified; and an Official List of Specific Trivial Names in Zoology was established. In addition, the composition and bylaws of the Commission were changed, the most important changes being removal of the limit to the number of commissioners and liberalizing of the voting procedure of the Commission. Three important subjects were deferred for consideration at the next meeting of the International Commission. These questions which are *sub judice* are (1) emendations, (2) the names of families and higher categories, and (3) neotypes.

Some of the Paris procedures and decisions have been criticized, especially the temporary suspension of the bylaws and the decisions on names for categories of less than subspecific rank, the treatment of secondary homonyms and of *nomina nuda,* and the retroactive change from the right of the first reviser to strict page and line precedence in determining priority. Presumably any of these criticisms that are substantiated will be considered at future meetings of the International Commission and will result in continued improvement of the International Rules.

RANGE OF AUTHORITY OF THE RULES

The International Rules of Zoological Nomenclature apply to both neozoology and paleozoology. Since there is no separate code for paleontological nomenclature, no nomenclatural dualism can develop. If a living species was first named on the basis of fossil material, the name is also valid for the living species. If a generic name has been used for a fossil animal, it cannot be used for a different genus of living animals, and vice versa.

There is a separate code for plant names, the International Rules of Botanical Nomenclature, which applies equally to recent and to fossil

plants. Also, an International Bacteriological Code of Nomenclature was adopted in 1947 (Buchanan *et al.*, 1948). There are so many differences between these codes that it is unlikely that a uniform biological code will be adopted in the foreseeable future.

FUNCTIONS AND POWERS OF THE INTERNATIONAL COMMISSION

The International Commission on Zoological Nomenclature derives its authority from the International Congresses of Zoology, reporting at each meeting of the Congress through the Section on Nomenclature of the Congress. Although the actions of the Commission are submitted for formal ratification at the plenary session of each congress, the Commission is virtually independent and self-perpetuating, in the sense that it has full power to proceed about its business in intercongress periods. Deliberations take place in open meetings (Paris, 1948) in conjunction with meetings of the Congress or by correspondence in the intervals between congresses. Results are published in the *Bulletin of Zoological Nomenclature* and in other official publications of the Commission. The financial affairs of the Commission are handled through the International Trust for Zoological Nomenclature, which is incorporated under British law.

The functions of the International Commission are (1) to recommend to the Congress amendments or additions to the Rules; (2) to render opinions as to the interpretations of questions of zoological nomenclature in the Rules; (3) to compile the official lists of generic and trivial names in zoology; and (4) to use the plenary powers to set aside the International Rules when it would appear that greater confusion than uniformity would result from a strict application of the Rules.

Thus the International Commission is an authoritative body with power to interpret, amend, or suspend provisions of the Rules. Questions of nomenclature submitted to the Commission must be accompanied by a full statement of the history of the case, since the Commission is a board of review, not a fact-finding board. A petition for setting aside the rules must contain proof that strict application of the rules would result in greater confusion than stability. Furthermore, a well-documented petition to the International Commission should preferably bear the endorsement of one or more national or specialist committees on nomenclature.

NOMENCLATURE COMMITTEES

The fourth part of the Plenary Powers Resolution (Monaco, 1913), which was made a separate section of the Rules (Paris, 1948) states, "That the Congress fully approves the plan that has been inaugurated by the Commission of conferring with special committees from the special group involved in any given case, and that it authorizes and instructs the Commission to continue and extend this policy."

The first international committee on entomological nomenclature was formed at the First International Congress of Entomology at Brussels in 1910. Specific powers were given to this committee at the Second Congress (Oxford, 1912) as follows: to elect, in conjunction with the executive committee and the national committees, additional members as necessity arises, such election to be subject to the approval of the Congress following, but the additional members meanwhile having full voting power; to enter into communication with the entomological societies of the world, with a view of forming national committees on entomological nomenclature; to collect, in cooperation with the national committees, the opinions of entomologists on questions of nomenclature as affecting entomology; to consider what elucidations, extensions, and emendations, if any, are required in the International Rules of Zoological Nomenclature; and to present a report on these points before the next Congress of Entomology. Finally, the International Entomological Committee on Nomenclature was commissioned to communicate the above resolutions, unanimously carried, to the secretary of the International Commission on Zoological Nomenclature and to take such action as would ensure the adequate representation of entomology on the International Commission on Zoological Nomenclature (*Proc. 2d Congress:* **1914**:120–121).

National Committees. Various national committees have functioned at one time or another in various parts of the world. At present the nomenclature committee of the Society of Systematic Zoology is the most representative committee in America.

Specialist Committees in America. The better known nomenclature committees in special fields in America are those of the American Ornithological Union, the American Society of Mammalogists, the American Malacological Union, the Entomological Society of America, and the Joint Committee on Zoological Nomenclature for Paleontology in America. The first of these was the pioneer in the field of specialist committees, having prepared a code for ornithological nomenclature in 1885 and revised it on several occasions. At the present time the A.O.U. committee regularly considers proposals for name changes in birds.

Local Committees. Local nomenclature committees of societies and museums are too numerous to list, but a few of the better known American committees are the Washington, D.C., Nomenclature Discussion Group (composed of taxonomists of the U.S. National Museum, Bureau of Entomology and Plant Quarantine, U.S. Geological Survey, Fish and Wildlife Service, U.S. Public Health Service, etc.) and the nomenclature committee of the American Museum of Natural History. These committees have varied objectives, but in general they provide a focal point for questions on nomenclature and, most important, an opportunity for individuals to share ideas and discuss problems in this field.

ALTERNATE SYSTEMS OF NOMENCLATURE

In spite of the obvious advantage of the binominal system of nomenclature in fulfilling simultaneously two functions in relation to the names of animals (discreteness in the specific trivial name and expression of relationship in the generic name), the binominal system has several weaknesses. The first one is that the scientific name changes every time the generic classification of a species is changed. The second is that with the ever-increasing number of genera (by 1950 over 220,000 generic names had been proposed for animals), the generic name alone is no longer able to express position in the system.

At the time of Linnaeus, when less than a thousand generic names were sufficient for all the known animals, the Linnaean nomenclature ideally fulfilled its two functions. Now no zoologist can memorize more than a fraction of the names of the more than 100,000 valid genera. If a generic name is mentioned somewhere in a biological treatise, it is often difficult to determine to what higher category it belongs. For this reason several authors have proposed modifications of the present system in order to express the higher categories by prefixes or suffixes attached to the generic names.

Harting, who was apparently the first to suggest such a system, proposed the use of class suffixes combined with ordinal prefixes. Herrera (1899) advocated a system similar to that of Harting. He proposed to prefix generic names with a syllable to indicate class (*Ins* = Insecta), to terminate them with *us* or *s*, and to place behind the specific name initials to further help in placing the genus. In his system *Apis mellifera* is written *Insapis mellifera* (I, HY, A).

More recently Rhumbler (1910) followed by Heikertinger (1916, 1918) and Felt and Bishop (1926) suggested modifying the generic name with initial letters indicating class and order and terminations indicating subkingdom (*us* = Vertebrata, *a* = Invertebrata, *um* = Protozoa). Thus *Papilio* becomes *Ylpapilia* (*Y* = Insecta, *l* = Lepidoptera, *a* = Invertebrata). Further, specific trivial names were modified to indicate distribution with vowels indicating continents (*e* = North America), consonants indicating oceans, and combinations used for wider distribution (*ae* = Asia and America). Thus the squash bug (*Anasa tristis*) would be written *Yranasa etrista*.

Systems for locating names in their proper phylogenetic position have been proposed by Tornier (1898) and Felt (1934). Both these are based on classifying symbols combined into formulae. Tornier advocated the use of letter formulae to indicate higher categories and numerical designations for species. Thus, VROCZ, 2 = *Zamenis arenarius* Boulenger (*V* = Vertebrate, *R* = Reptiles, *O* = Ophidia, *C* = Colubriidae, *Z* = Zamenis). Felt used four-letter combinations based on the same system. Thus Ilre = Geometridae (*I* = Insecta, *l* = Lepidoptera, *re* = arbitrary designation for Geometridae).

Needham (1910, 1911) suggested a return to the Linnaean concept of all-inclusive genera designated by *fit* names, with subgenera, species, and varieties designated by simple combinations of letters and figures.

That none of these systems has been seriously considered by most workers indicates either that the present system is more satisfactory or that scientists are inherently conservative. Probably both factors are at work in maintaining the *status quo*, and it seems certain that our present system will continue for many years to come. The International Commission has considered the system of Herrera (and also that of Rhumbler) and has ruled (Opinion 72) that "designations of animals, according to the system proposed by Herrera . . . are formulae and not names. Accordingly they have no status in nomenclature, and are therefore not subject to consideration under the Law of Priority. No author is under obligation to cite these designations in any table of synonymy, index, or other list of names." A similar ruling (Opinion 132) applied to the "Gattungsbezeichnungen" of Sololew.

Viewed in the light of centuries, however, and with unforeseen millions of possible forms remaining to be described and named, a more mechanical system may eventually become necessary. Recent advances in the cataloguing of books, fingerprints, card files, etc., by means of mechanical sorting devices suggest that, should it ever become necessary, it may be possible to deal with problems of animal classification in a similar manner. Such a system, however, would presumably be supplementary to the present system of scientific names rather than replacing it. A system of symbols consisting of letters and numerals might be a more logical way of designating organisms, particularly if all were known, but it would have the serious disadvantage that long series of numerals are very difficult to remember.

CHAPTER 11

THE PRINCIPLE OF PRIORITY

Of all the rules of zoological nomenclature, the most difficult to formulate was the one determining which of two or more competing names should be chosen. Since it is obvious from the continuing argument that final acceptance of a principle has not yet been agreed upon, this problem will be discussed in detail.

During the lifetime of Linnaeus there was a fair degree of stability in nomenclature, since the authority of Linnaeus led to the general acceptance of the names proposed by him. Some of his successors, such as Fabricius among the entomologists, exerted a similar authority, but a great deal of arbitrariness in nomenclature characterized the period from 1780 to 1850. Owing to the French Revolution and the Napoleonic wars, this was also a period of disturbed communications, and taxonomists in one country were often unaware of the new species and genera described by taxonomists in other countries. Each author used his own judgment as to which names to adopt. The need for a replacement of this subjective method by one which was more objective became increasingly acute. The nomenclatural chaos prevalent at that period is not appreciated by those contemporary authors who blame the rules of nomenclature for all the evils of name changing. A clear distinction must be made between the need for rules to stabilize names and the specific rules which may be adopted for this purpose. If the current rules are deficient, this does not prove that rules, as such, are unnecessary.

The fathers of modern nomenclature, from Fabricius, Rudolphi, and Strickland on, thought that the subjectivity and arbitrariness of personal nomenclature could be abolished if an objective criterion were adopted. They believed that the continuous changing of names could be prevented if priority were adopted as a basic principle of nomenclature. Under this principle it would not be possible to change or replace an earlier name merely because it was incorrectly formed or misleading or for other personal, esthetic, or even scientific reasons. It is evident from much of the earliest writings on the subject that the "priority" these authors had in mind was a *priority of usage* rather than a *priority of publication*. However, admirable though the principle of priority of usage is, it is subjective, and so an attempt was made to restore objectivity by

replacing priority of usage with priority of publication. Unfortunately, while gaining objectivity, the nomenclaturists abandoned one of the most important objects of nomenclature, namely, stability.

It is not enough that the zoologists of all nations agree to have a single nomenclature. Essential as stability in space may be, it should be supplemented by stability in time. Ideally, if an animal is called *Turdus musicus* in 1850, it should also be *Turdus musicus* in 1900, in 1950, and forever. Furthermore, the name should not be used for any other animal. This would seem axiomatic. Actually, this particular scientific name (*Turdus musicus*) was used for one hundred and fifty years for the common European song thrush but about 1910 was shifted to the redwing (as it later turned out, quite unnecessarily). This is by no means an exceptional case; in fact, thousands of familiar species of animals have had their names changed in the past fifty years owing to a strict interpretation of the rule of priority of publication. It would be unfair, however, to blame all name changes on the law of priority. There are various reasons for name changes, discussed below.

REASONS FOR NAME CHANGES

There has been much confusion in the literature on the reasons for name changes. Some zoologists seem to be under the impression that every change of names is indicative of scientific progress. Actually there are two classes of name changes: (1) changes necessitated by scientific progress and (2) changes dictated by rules of nomenclature.

I. **Changes Necessitated by Scientific Progress.** These changes are inevitable regardless of the kind of rules of nomenclature that is in force. Such changes may be referred to as "scientific changes of names." Examples of such are the following:

A. Change of Generic Component of the Binominal Resulting from Transfer of a Species from One Genus to Another. The scientific name of a species, being compounded of the generic and specific epithet, will change if a species is transferred to a different genus. Usually there is one of three reasons for such a transfer:

1. A genus may be found to be heterogeneous and to require division into several genera, some of which may be new.
2. A species may be erroneously allocated to a genus *A* and subsequent research shows that it requires transfer to a previously named genus *B*.
3. Genus A is found to be the same as a previously named genus *B*, so that it becomes a synonym of *B*.

The change of name under (1) is caused by the dividing of a genus, under (3) by the combining of two genera, and under (2) by the transfer of a species from one genus to another. A change of the generic component of the species binominal is involved in all three cases.

B. Change of Specific Trivial Name Resulting from Transfer of a Species to a Different Genus. In cases (2) and (3) above, it is possible that the specific trivial name of the transferred species is already in use in genus *B* and that it therefore becomes homonymous. Since it is not permissible to have identical names for two different species in a single genus, obviously one of the two names will have to be replaced.

C. Synonymizing of Two Currently Accepted Species Names. It happens not infrequently that more detailed researches prove that two currently listed species are merely stages or phases (see Chap. 5) of a single species. Or in groups that have not yet been monographed, it may be found that workers in different parts of the world use different names for the same species. It is evident that one of these names will have to be synonymized. The reduction in the number of names in this case indicates scientific progress and is independent of the kind of rules accepted. Which of the two names is to be synonymized is, however, very much a matter of rules.

D. Analysis of Species Complexes. Under a single scientific name there is sometimes concealed a whole group of sibling species. For instance, the three *Anopheles* mosquito species, *messeae* Falleroni, *atroparvus* van Thiel, and *labranchiae* Falleroni, were listed until recently as *Anopheles maculipennis* Meigen. As soon as it was realized that several species were involved, it was inevitable that the undescribed sibling species had to have a name.

In all four cases (I*A*, I*B*, I*C*, I*D*), the name changes are caused by scientific progress, regardless of the particular rules of nomenclature in force.

II. **Changes Dictated by Rules of Nomenclature.** The criticism of the nontaxonomists (medical researchers, parasitologists, physiologists, geneticists, etc.) is on the whole directed against name changes that are not caused by scientific progress but result from the application of rules of nomenclature. Critics of such changes point out that there were no rules of nomenclature for the early taxonomists to follow, and that conscientious taxonomists of that period should not be penalized by retroactive application of our modern rules, especially when such action results in more confusion than uniformity in nomenclature.

A. Discovery of an Earlier Synonym. The discovery of an earlier synonym is a frequent source of trouble. If the name with priority of publication was a forgotten name at the time of its discovery, or if its original description was so poor that the identity could be determined only by examination of the type, the use of such a name appears to be open to particular criticism.

B. Discovery of an Earlier Homonym. Occasionally it is found that an earlier primary homonym exists for a well-known name in current use.

A name change is particularly difficult to defend if the senior homonym is no longer in the same genus and thus the main source of confusion has been removed.

C. Discovery of an Earlier Genotype Fixation. It may be discovered that an earlier author has priority of genotype fixation, and that he has selected a species which has been transferred in the meantime to another genus or has been selected as type of yet another genus. By adhering to priority of type fixation, a wholesale shift of generic names may result, as has indeed happened in numerous instances.

D. Discovery of Inapplicable Type Specimens. When the original description is vague, short, or otherwise lacking in essential diagnostic features, it may happen that the name is eventually applied to some species other than the original one. When subsequent authors supply the diagnostic details, such a name may become standard for a well-known species, until the original type specimen is reexamined and it is found that the name does not apply. Misidentified species are particularly critical when they have been designated as types of genera.

All four of these changes (II*A*, II*B*, II*C*, II*D*) have several features in common. First of all, they do not result in scientific progress. Secondly, all are the result of bibliographical or historical searches and not of biological analysis.

Name changing for the sake of priority started in 1842 with the adoption of the Strickland Code. Few accurate figures are available on the percentage of names that have had to be changed owing to application of the law of priority. The figure of 90 per cent that has been quoted for birds is undoubtedly too high. Since 1885, 77 species (28 per cent) of Fenno-Scandian carabids have had their names changed; since 1896, 35 species (11 per cent); and since 1939, 6 species. Many more will have to have their names changed if the recent proposals of Csiki and Jeannel are considered (Lindroth, 1949). Old names are still being continuously discovered, even in the most thoroughly studied groups of animals. These discoveries involve names of some of our most familiar species.

PRIORITY VERSUS CONTINUITY

In view of the nomenclatural upheaval caused by the strict application of the principle of priority of publication, zoologists began to rebel against "priority" soon after the proposal of the Strickland Code. As early as 1849 Darwin wrote to Strickland with regard to cirriped nomenclature, ". . . I believe if I were to follow the strict rule of priority more harm would be done than good . . . ." and this conviction has been shared by an increasing number of zoologists down to the present time.

As early as 1858, at the annual meeting of the German entomologists at Dresden, H. R. Schaum proposed that "no name should be replaced, if it

had been in general use for 30 years or longer, even if subsequently a older name was discovered." He warned that "perhaps one-third of th currently used names, including some of the best known, might have to b changed if this rule of superannuation was not accepted." However, hi warning was not heeded. We now know that Schaum actually unde estimated the eventual results.

Schaum was not a lone dissenter. Indeed, the evidence indicates th the majority of the zoologists is and always has been opposed to the rig application of the laws of priority. In 1911 the invertebrate taxonomi T. Mortensen took an opinion poll among Scandinavian zoologists; on two were in favor of a strict interpretation of the rule of priority, 120 we against it (*Ann. Mag. Nat. Hist.*, **8**:770, 1911). The Zoological Section the British Association for the Advancement of Science took a poll Great Britain. Of 112 votes cast, 26 were in favor of, 86 against, stri application of the priority rule. S. W. Williston reported at the Mona meeting, "I think I am safe in saying that the majority of Americ zoologists is opposed to the rigid application of the law of priorit *Internatl. Cong. Zool. Proc.*, p. 827, 1913).

At the Paris Congress (1948) (see *Bul. Zool. Nomencl.*, **5**:5–18, 19 the question of priority came up again. On the one hand a petition h been received from a group of American zoologists favoring a relative strict application of priority. As opposed to this the Scandinavi zoologists presented a petition in which 63 of 71 signers favored protecti of names in general use since 1850, and Viennese zoologists sent a co munication favoring restriction of priority: "*Jeder heute einheitl gebrauchte, eingelebte wissenshaftliche Tiername ist ein unschätzbarer nom klatorischer Wert, ein Verständigungsmittel, dessen Zerstörung den Zoo giebetrieb schwer schädigt. Bis zur endgültigen Regelung der Verhältni ist daher jede Aenderung eines einheitlich gebrauchten Namens zu unt lassen, wenn für die Aenderung nur formal-nomenklatorische (Priorität Gründe, aber keine systematischen Notwendigkeiten vorliegen*" (*Bul. Zoo Nomencl.*, **5**:78, 1950).

In the ensuing discussion it developed that there was a unanimou feeling that a provision should be adopted to prevent the upsetting o well-established names solely through the strict application of the law o priority. Accordingly the Commission was invited "to consider gener ally the problem of how to secure greater stability in Zoological Nomen clature and to submit a report thereon, with proposals, to the nex (Fourteenth) International Congress of Zoology."

The Continuity Principle. What alternative is there to strict priority Despairing that priority will ever lead to stability, some taxonomist have recently proposed to replace priority by "continuity" (Heike

tinger, 1943). A group of prominent German entomologists proposed the resolution, "No zoologist shall change a currently used name merely for the sake of priority. No zoologist shall use a name changed contrary to this rule." As laudable as many may consider the sentiment expressed in this proposal, such a rule would have serious practical difficulties. In popular groups like birds or butterflies it is usually easy to determine the currently used name. The scientific name of a species may well be cited more than a thousand times in a twenty-year period (hence the utter confusion resulting from changing such a universally used name!). In an obscure family of invertebrates, a rare species may not be mentioned more than once in a generation. What shall be considered the currently used names in such a group?

Even if the continuity principle were adopted, it still would have to rely heavily on priority. There are many cases in which monographers do not agree on the choice of the currently used names. Some monographers do work that is notoriously poor. Shall their conclusions then become the standard of nomenclature? Furthermore, there are some cases in which it develops that two currently used names refer to the same zoological category (species or genus). One or the other must be synonymized. Most of these cases cannot be decided without resorting to priority.

The zoologist thus seems to be caught between Scylla and Charybdis. The believers in continuity favor currently used names but have no objective method for determining which names are currently used. On the other hand, the adherents of rigid priority have an objective method but sacrifice to it one of the main objects of nomenclature, namely, stability. Furthermore, this method allows no unequivocally final nomenclature, because there is no guarantee, except for the Linnaean names of 1758, that a hitherto overlooked older name does not exist.

THE PLENARY POWERS

The International Commission attempted to solve this dilemma by means of a compromise. At the Monaco meeting in 1913, the International Congress conferred on the Commission plenary powers to suspend the law of priority in cases where "the strict application of the Rules would clearly result in greater confusion than uniformity." Thus the law of priority was retained, but a loophole was provided for special cases.

Unfortunately the Monaco Resolution did not settle the matter, because the procedure for setting aside the rules was too cumbersome. Applications for suspension of the Rules were required to give not less than one year's notice in two or more of a specified list of scientific journals, so that zoologists could present arguments for or against sus-

pension in each case. It was further required that the Commission's vote be unanimously in favor of suspension, or, if only a two-third majority of the full Commission were in favor, then, at the next International Congress, the president of the Section on Nomenclature was required to select a special board of three members, consisting of one member of the Commission who voted on each side of the question and one ex-member of the Commission who had not expressed any public opinion on the case, this special board to review the evidence and, by majority vote, decide the question without further reference to the Congress.

It is not surprising, in view of these difficulties, that the Monaco Resolution contributed little toward the stabilization of zoological nomenclature. Thousands of names were changed, while only 53 were conserved by the Commission in the 35 years from 1913 to the Paris meeting of the Commission in 1948. These names were added to the Official List as *nomina conservanda*. Most zoologists felt that there were far too few of these stabilizing decisions, and all zoologists agreed that the amount of time required to process a case (as many as 15 years and never less than 5 years) was too long, especially since the status of the name remained in doubt during this time. The *modus operandi* broke down completely during the Second World War when, for 13 years, the Commission did not meet. At the first postwar meeting (Paris, 1948) there was a strong element that favored liberalizing the restrictions on the use of the plenary powers, although there was also a petition from the proponents of strict priority advocating further restrictions on the use of the plenary powers.

The views of the former group prevailed. As a result the Monaco Resolution was modified (see below) and it was decided (*Bul. Zool. Nomencl.*, **4**:234–235, 1950) that (1) where a worker discovers that a well-known name in common use, particularly a name of importance in medicine, agriculture, veterinary science, or other applied fields of biology, is invalid under either the rule of priority or the rule of homonymy or, in the case of a generic name, has as its type a species not commonly accepted as referable to the genus in question, that worker should at once report the case to the International Commission on Zoological Nomenclature for such action as the Commission may deem to be proper; (2) *that in such cases neither the worker by whom the error is discovered nor any other worker shall substitute some other name for that in common use, until such time as the decision on the future status of the name in question is made known by the Commission.* This settled the status of names during the period when they are *sub judice* and also placed the onus on individual taxonomists to submit cases involving well-known names in common use, particularly in medicine, agriculture, etc., *at once.* The

actual procedure is outlined in the revised wording of the Plenary Powers Resolution, which is in part as follows:

Plenary Powers Resolution

Article 1. Plenary power is herewith conferred upon the International Commission on Zoological Nomenclature, acting for this Congress, to suspend the Rules as applied to any given case, where in its judgment the strict application of the Rules will clearly result in greater confusion than uniformity, *provided,* however, that not less than six months' notice from the date of publication in Bulletin of Zoological Nomenclature, shall be given that the question of a possible suspension of the Rules as applied to such a case is under consideration, thereby making it possible for zoologists, particularly specialists in the group in question, to present arguments for or against the suspension under consideration; the notice to be published in the Bulletin of Zoological Nomenclature and in two other serials, of which one is to be a serial published in Europe and the other a serial published in America, the serials in question to be selected on each occasion by the Secretary to the Commission as being, in his opinion, the serials in which publication of the notice is best calculated to bring the subject matter of the notice to the attention of interested specialists; and *provided,* also, that the vote in the Commission is either unanimous or, if by a majority, then by a majority of the whole Commission or, when after a period of six months calculated from the date of dispatch by the Secretary to the Commission of voting papers in regard to the proposed case, not less than one-fourth of the total number of members of the Commission, calculated by reference to the number of such members as at the date on which the voting papers were so dispatched, record their votes on the said proposal or, without voting, signify their willingness to support the view of other members of the Commission, provided that, where the voting is not unanimous, such proposal shall require to receive at least two affirmative votes out of every three votes cast, in order to secure its adoption by the Commission. A decision taken by the Commission under their plenary powers is final and not subject to appeal.

Article 2. The foregoing authority refers especially to cases of the names of larval stages; the transference of names from one genus or species to another; the suppression for nomenclatorial purposes of some old long-forgotten or long-ignored work containing new names, the introduction of which would sink in synonymy names that are well established in current use; the suppression of any long-ignored name, or in the case of a generic name, any long-ignored type designation or type selection where the acceptance of that name or, as the case might be, that type designation or type selection, would in the first case sink in synonymy, or in the second case, sink in synonymy or alter the meaning to be attached to, some well-known name in current use; cases where confusion exists and is likely to persist through the impossibility, in the absence of the use of such powers, of determining the species to which a given specific or subspecific trivial name should be applied.

It is doubtful if the liberalized procedures inaugurated at Paris will solve the problem. The fact is that zoological nomenclature has become

so intricate that an ever-increasing number of cases need to be referred to the Commission. Thus from 1907 to 1936, 133 cases were dealt with by the Commission (less than 5 per year). From 1936 to 1950, 218 decisions were reached (14 per year). At the present time (1951), 268 cases await decision, and new applications are being received at the rate of 8 per month (96 per year)! When one considers the fact that the Commissioners are scattered all over the world, that they serve without compensation, and that only a small proportion of the regular commissioners are able to attend the meetings which take place at five-year intervals, it becomes evident that the situation is very serious.

THE LAW OF PRIORITY

The law of priority covers the period from Jan. 1, 1758, to the present. Its basis is to be found in Art. 25 of the Rules and, as amended at Paris (1948), its essential provisions are that *the valid name of a genus or species can be only that name under which it was first designated, on the condition*

1. That (prior to Jan. 1, 1931) this name was published (see below) and accompanied by an indication (see below) or a definition or a description, and, in the case of a generic or subgeneric name, that the genus or subgenus was monotypical or a type species was designated or indicated by the original author when publishing the name, or that the name, on being first published, was accompanied by no verbal definition or description, the only indication given being that provided by the citation under the generic or subgeneric name concerned of the names of one or more previously published nominal species; and

2. That the author has applied the principles of binominal nomenclature (see below).

3. That no generic name nor specific trivial name published after Dec. 31, 1930, shall have any status of availability (hence also of validity) under the Rules, unless and until it is published either

a. With a statement in words indicating the characters of the genus, species, or subspecies concerned (see Statement of Characters, below)

b. In the case of a name proposed as a substitute for a name which is invalid by reason of being a homonym, with a reference to the name which is thereby replaced (see Replacement of Junior Homonyms, later in this chapter)

c. In the case of a generic name or subgeneric name, with a type species designated or, as the case may be, indicated in accordance with one or other of the rules prescribed for determining the type species of a genus or subgenus upon the basis of the original publication (*i.e.*, Rules (*a*) to (*d*) in Art. 30; see below)

4. That even if a name satisfies all the requirements specified above, that name is not a valid name if it is rejected under the law of homonymy.

On the following pages the more important rulings of the Commission with respect to the law of priority are summarized. Many of these were first promulgated in connection with Opinions of the International Commission, but most are interpretations or new rulings made by the Commission at its Paris meeting in 1948. In order not to complicate unduly the wording of the law of priority, numerous special cases have been omitted. A full account of these will be found in Vol. 4 of the *Bulletin of Zoological Nomenclature*, pp. 1 to 760, and also in the revised Rules, which are scheduled for publication at an early date.

Publication. A scientific name becomes available through publication. What constitutes publication was not clearly specified in the original Rules, but the Commission has elucidated the question in several Opinions (15, 87, and 191). At the Paris meeting (1948) the International Commission clarified the definition of publication further. The Commission decided that a name made public prior to Dec. 31, 1950, is regarded as published only if it complies with both the following conditions: (1) it must be included in a document reproduced either by printing or by some other mechanical method of reproduction which secures that every copy is identical with every other copy; (2) the document in which the name is included must be a document issued for purposes of record and of consultation by interested persons and must accordingly not be issued for consideration by special persons, or for particular purposes or for only a limited time.

Further, in order to be regarded as published, any name made public after Dec. 31, 1950, must comply with all the following conditions: (1) it must have been made public in conditions which satisfy the requirements above; (2) the document containing the new name must be reproduced on paper and with ink of quality and durability sufficient to offer a reasonable prospect of permanency; (3) where a document is distributed by (or on behalf of) its author to certain selected persons, at least some copies must also be placed on sale or made available for issue free of charge to any institution or person who may apply for a copy.

Furthermore, it was recommended that publications carry a clear statement of the name of the institution or individual responsible for publishing the work or journal concerned, of the address from which the work or journal may be purchased, and of the price for which a copy may be obtained.

It was further specified by the Commission that none of the following types of action constitute publication: the anonymous issue, or the issue over initials only, of a work or paper after Dec. 31, 1950; the deposit of a document, however reproduced, in a public library or in the library of a scientific institution; the distribution of printers' proof sheets; the presentation of a paper before a meeting of any kind; the distribution of

separata (preprints, offprints, etc.) in advance of the appearance of the paper in question in the journal for inclusion in which it was printed; the affixing of labels or tags on museum specimens.

The date of publication is the date on which the publication was mailed to subscribers or placed on sale or, where the whole edition is distributed free of charge, mailed to institutions and individuals to whom such free copies are normally distributed. The May issue of a journal which is actually mailed on June 22 is considered as published on June 22. In the last century journals were sometimes as much as six to ten months late. This is particularly misleading when the December issue of a journal is not mailed until the next year.

Even more confusing are many serial publications, parts of which sometimes continue to be issued over a period of twenty or thirty years. In such publications each part has a separate publication date, namely, the date on which it was actually mailed.

Sherborn and other bibliographers have devoted much time to discovering actual dates of publication. Valuable records of the dates of publication of many periodicals and series are found in the *Journal of the Society for the Bibliography of Natural History*, 1936–1949, Vols. 1 to 2.

Simultaneously Published Names. The International Rules, in the version valid for the 33 years from 1905 to 1948, decreed that if two or more names for the same taxonomic unit were published in the same article, these names were to be considered as published simultaneously. In such a case it was the privilege of the first reviser (Art. 28) to select one of these names as the valid one and to place the others in synonymy. This ruling permitted adoption of the more suitable or better known of the available names and had a beneficial effect on nomenclatural stability.

At the Paris meeting (1948) this rule was revoked and the following ruling was adopted with retroactive effect:

(1) If two or more names are published for the same taxonomic unit, or if the same name was published for more than one taxonomic unit in the same book or serial, so that the names were in consequence of identical date, the name printed on the earlier of the pages concerned is to have precedence; (2) if two or more such names are published on the same page, the name which appears on the line nearest to the top of the page is to have precedence; and (3) if two or more such names are printed in the same line, a name appearing earlier is to have precedence over any name appearing later in the same line.

Official Languages. Languages recommended for use in describing new systematic units are German, English, French, Italian, and Latin.

Indication. The International Commission on Zoological Nomenclature has also ruled on how the word *indication* in the law of priority is to be construed. With regard to specific names, an indication is a bibliographic reference, or a published figure (illustration), or a definite citation of an earlier name for which a new name is proposed. With regard to generic names, it has been decided than an indication is a bibliographical reference, or a definite citation of an earlier name for which a new name is proposed, or the citation of the names of one or more previously published species (Opinion 1 as amended at Paris, 1948). A generic name is not to be treated as having been published with an indication by virtue only of its having been published as the generic component of a species name cited in a synonymy given for a nominal species.

Further, in no case is the word *indication* to be construed as including museum labels, museum specimens, or vernacular names. However, the description of the work of an animal constitutes an indication even if unaccompanied by a description of the animal itself, provided that it satisfies the other provisions of Art. 25.

Binary vs. Binominal. It was ruled at Paris (1948) that the expression *nomenclature binaire* is completely synonymous with the expression *nomenclature binominale*, and that in order to qualify as an author who has applied the principles of binominal nomenclature, an author must have consistently applied those principles in the book or paper in question and not merely in a particular section or passage thereof.

Statement of Characters. Authors were urged (Paris, 1948), when drawing up descriptions, to give not only a diagnosis, but also a differential diagnosis, indicating (1) *in the case of a generic or subgeneric name,* the characters which separate the new genus or subgenus from the previously described genus or subgenus to which it is considered most closely related; (2) *in the case of a specific name,* the characters which separate the new species from the previously described species to which it is considered to be most closely allied, and, if that is a little-known species, the characters which separate the new species from a well-known or common species included in the genus; (3) *in the case of a subspecific name,* the characters which distinguish the new subspecies from the subspecies to which it is considered to be most closely allied, and, if that is a little-known subspecies, the characters which distinguish the new subspecies from a well-known or common subspecies of the species concerned.

Designation of a Type Species. A recommendation was passed by the Commission (Paris, 1948) urging every author, when publishing a name for a new genus or subgenus, (1) expressly to designate by name the type species; (2) when designating as the type a species the name of which has already been published, to cite that species, first under the original binominal combination, with a bibliographical reference to the place where it was published, and second under its new binominal combination, consisting of the new generic (or generic and subgeneric) name and the specific trivial name.

Designation of New Names. It is recommended that an author who publishes a name as new state definitely that it is new, and that this statement be made only in the first publication, thus: new species (or *species nova, n. sp., sp. n.*). The date of publication should not be added to the name in this first publication. Subsequent references should add the name of the author and date of publication at least once and preferably the first time the name appears. To further facilitate the work of cataloguers, most editors of scientific journals now set new names in boldface type, while the setting of all textual scientific names in italics has long been an established rule of editorial style.

Specific Names. For a further discussion of the requirements for validation of specific trivial names, see Chap. 13.

Rejection of Names. Names proposed under the Rules are available, *e.g.*, have a status in nomenclature. If they do not conform to the rules, they are *nomina nuda* and are unavailable and without standing in nomenclature. Even though available a name may not be valid, because it may have been previously used for some other group of animals (homonym), or it may stand for an animal already described under another name (synonym). Thus invalid names are of two types, homonyms and synonyms, both resulting from application of the law of priority.

Synonyms. Synonyms are different names for one and the same thing. The oldest available name is the valid name and may be referred to as the *senior synonym* (Blackwelder, 1949) in contrast to *junior synonyms* which are more recent and therefore invalid names.

In biology there are two quite distinct kinds of junior synonyms. There are some which are clearly proposed for the same thing (new names for supposedly preoccupied names, and names based on the same specimens or illustrations) and are therefore absolutely synonymous; they can never be separated by any means. These are called *absolute synonyms*, *objective synonyms*, or *nomenclatural synonyms.*

There are other synonyms that are synonyms only in the opinion of one or more students. One person may lump two genera together, making the names synonyms; another may recognize them as two separate genera, making both names valid. Synonyms that are based on opinion are called *conditional synonyms*, *subjective synonyms*, or *zoological synonyms* (Blackwelder, 1949).

Homonyms. Homonyms are one and the same name for two or more different things. In the case of genera these are always unavailable, because, as pointed out previously, all generic names of animals are on an

[1] The International Commission on Zoological Nomenclature has stated (Opinion 107, Summary, in part), " . . . a name in current use is not to be supplanted by an earlier but rarely adopted or unadopted name unless the argument is unambiguous and unless the premises are not subject to differences of opinion . . . ."

equal footing and must stand on their own. Two genera in the animal kingdom with the same name would cause continual confusion.[1] However, the same name may be used for both a genus of plants and a genus of animals. At the species level identical specific trivial names are permissible, provided that they are not referred to the same nominal genus. When two names are found to be homonymous, the more recent name is said to be preoccupied by the older name.

A primary homonym exists when two scientific names, at the time of their original publication, consisted of the same combination of generic and specific trivial names: thus *X-us albus* Smith, 1910 and *X-us albus* Jones, 1920. In this case the latter is renamed, and *X-us albus* Jones is rejected and can never be revived, even though *X-us albus* Smith be subsequently removed to another genus, thus eliminating the conflict. If the original author of the preoccupied name is deceased, a dedicatory replacement name is often proposed, such as *X-us jonesi* Brown. If he is still alive, the procedure outlined in the Code of Ethics is to be followed (Chap. 17).

Secondary homonyms result either from the combination of two genera (*e.g.*, when *X-us* with its species *albus* is combined with *Y-us*, which also has a species *albus*) or from reclassification or taxonomic transference (*X-us albus* Smith is transferred to *Y-us*, which also has a species *albus*).

Homonyms may be classified in much the same way as synonyms, the oldest name being the *senior homonym* and the more recent name the *junior homonym.* To carry the analogy still further, secondary specific homonyms are comparable to conditional synonyms, in the sense that both are the result of revised classification or transference of species and hence are matters of opinion.

A type of homonymy which is rarely encountered is specific homonymy in connection with generic homonymy. For example, *Noctua variegata* Jung, 1792, represents an insect, and *N. variegata* Quoy and Gaimard, 1830, a bird. The International Commission has ruled (Paris, 1948) that in such cases the later published of the two specific trivial names is not to be rejected on grounds of homonymy.

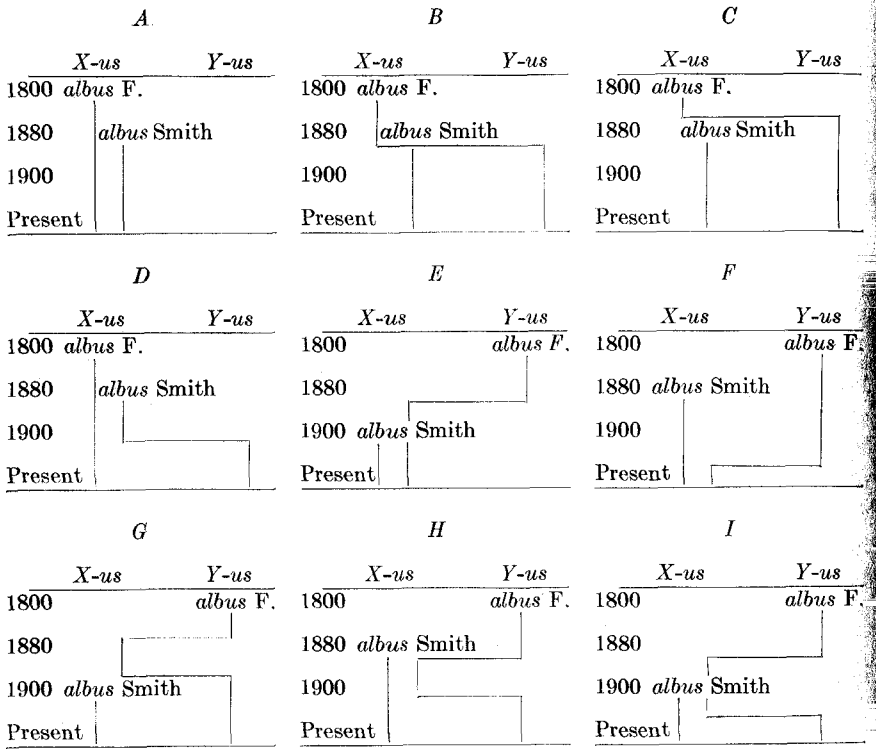
The distinction between primary and secondary homonyms is an important one but is an oversimplification. Actually nine types of homonymy may be recognized (Blackwelder, 1948) (Table 14). *A*, *B*, *C*, and *D* are primary homonyms, and *E*, *F*, *G*, *H*, and *I* are secondary homonyms. Still another classification of homonyms (Blackwelder, 1948) is based on the criterion of current use at the time of discovery, in contrast to historical homonyms, or names which are not homonyms at the

[1] The International Commission on Zoological Nomenclature has taken action to eliminate the concurrent use of certain similar but *not* identical names in allied genera where obvious confusion would result.

time of discovery. *A*, *E*, and *F* are present homonyms, in contrast to all the others, which are historical homonyms.

At Paris (1948) the International Commission decided on a method of dealing with homonyms which involves both the above criteria, *i.e.*, the permanent replacement of primary homonyms whenever discovered, combined with the permanent replacement of secondary homonyms only

TABLE 14. TYPES OF HOMONYMS



if discovered where the condition of homonymy exists. Thus in Table 14, cases *A*, *B*, *C*, *D*, *E*, and *F* would require new names at the present time, whereas *G*, *H*, and *I* would not.

According to Art. 35 of the International Rules as amended at Paris,

> Where it is evident that two generic names either (1) consist of the same Latin word or of the same Latinized word (including proper names other than modern patronymics), or (2) are based upon the same modern patronymic, or (3) are based upon the name of the same continent, country, district, town or other place or upon the name of the same geographical feature such as a mountain, island, sea, river or lake, and the said generic names are distinguished from one another only by one or more of the under-mentioned differences in spelling, the two names are to be treated as homonyms of one another.

> It was further ruled that this is an exhaustive provision, and therefore that no generic name which differs from another generic name in any other way is to be rejected as a homonym of that generic name (Table 15).

TABLE 15. DIFFERENCES IN SPELLING THAT ARE CONSIDERED HOMONYMOUS

The use of *ae*, *oe*, and *e*
The use of *ei*, *i*, and *y*
The transcription of the semivowel or consonantal "i" as "y," "ei," "ej," or "ij"
The use of "f" and "ph"
The use of "c" and "k"
The aspiration or nonaspiration of a consonant
The presence or absence of a c before a *t*
The use of a single or double consonant

The same rules apply to specific trivial names, except that differences in the termination of adjectives are to be ignored.

Replacement of Junior Homonyms. The Commission at its meeting in Paris passed a recommendation urging authors, when publishing substitute names, to give a full bibliographical reference to the name itself, its author, the date on which it was published, the title of the book or serial in which it was published, and the volume number (if any) or letter or other mark distinguishing the portion in which the name was published.

It was ruled at Paris (1948) that after Dec. 31, 1950, no replacement name for a secondary junior homonym is to be accepted unless the author of the new name clearly indicates that he believes that the species involved are congeneric. Prior to this date no such limitation is imposed.

A specific junior homonym should be renamed as follows: *X-us niger* Smith, new name (or *nomen novum*) for *X-us fuscus* Jones, 1860, *Trans. Ent. Soc.*, **6**:42, not Brown, 1800, Insects, p. 63.

Although primary homonyms are "stillborn and cannot be brought to life" (Art. 36), it has not been the practice of zoologists to rename junior homonyms if a synonym is available. This is certainly sound practice in the case of objective synonyms, *e.g.*, two species based upon the same type specimen, but this is of rare occurrence. Usually the available synonym is a subjective synonym and therefore is open to question and may be subject to removal from the synonymy. This situation has been the excuse for the unnecessary creation of hundreds of replacement names which have never been removed from synonymy. It is therefore better to wait before renaming a homonym with an available subjective synonym, until it is certain that the subjective synonym is not applicable. An exception to this procedure might be made in the case of genera that serve as types of higher categories.

Secondary subjective homonyms are created by the transfer of specific trivial names from one genus to another or by the union of two genera. Confusion may be caused by careless or loose handling of such situations.

For example, it may be stated simply that *X-us albus* Smith, 1900, is transferred to the genus *Y-us*, where it becomes a secondary homonym of *Y-us albus* Jones, 1880. But it is the actual combination of generic and specific trivial names that makes homonymy, so it has been argued that technically the homonymy does not exist until *X-us albus* Smith is cited as *Y-us albus* (Smith, 1900, not Jones, 1880). Still more subject to confusion is the situation when two genera are united. If it is simply stated that the two genera are synonymous without citing any species, it may be assumed that the types of the two genera were meant to be regarded as congeneric. The status of the remaining species of the two genera and the existence of homonymy, if any, must be inferred.

To obviate the above difficulties, it has been recommended that when a reviser creates a secondary homonym, he should expressly cite the two species concerned in the same genus; expressly list the later published of the two specific trivial names as a homonym; and give a new name to or resurrect an available name for the species the specific trivial name of which has been rejected.

Before proposing a new name as a replacement for one which is preoccupied, an author must make sure of the following four points:

1. That there is no other name available for the species (or genus). There have been a few nomenclaturists, of whom Embrik Strand was the most notorious, who have provided alternative names for all junior homonyms whenever a catalogue or nomenclator was published. Since most of these homonyms were already known to specialists, such wholesale renaming has resulted in nothing but an added burden in synonymies.

2. That the original author of the preoccupied name is no longer alive. The Code of Ethics is very specific on the renaming of preoccupied homonyms:

> When it is noticed by any zoölogist that the generic or trivial name published by any living author as new is in reality a homonym, and therefore unavailable under Articles 34 and 36 of the International Rules, the proper action, from a standpoint of professional etiquette, is for said person to notify said author of the facts of the case, and to give said author ample opportunity to propose a substitute name.

A name proposed in violation of the Code of Ethics (Chap. 17) is available under the Rules, but it does not enhance the prestige of its author.

3. That the new name is proposed in the form recommended in the Rules. A new name is invalid and unavailable unless proposed in accordance with the provisions of Arts. 25 and 34 to 36. In accordance with the Paris recommendations, it is well to provide a full bibliographical reference (not merely "Smith 1907") to the original citation of the

preoccupied name and to name the type species, in the case of preoccupied generic names.

4. That it is desirable to propose the new name. If a new name is proposed for a species, it takes automatically the same type and the type locality of the preoccupied name. However, there are occasions when it is preferable to describe a new species (or subspecies) rather than to replace a preoccupied name with a *nomen novum*. This is true particularly if the type of the preoccupied name is no longer in existence, or if there is the slightest doubt as to the identity of the species with the preoccupied name.

For example, there are two species of shrike-billed flycatchers (*Clytorhynchus*) on Taviuni in the Fiji Islands which differ mainly in size. A specimen of one of these species was described by Layard in 1875 as *Pachycephala macrorhyncha* and transferred in 1876 to the genus *Clytorhynchus*. The original description was poor, and since the type was lost, some subsequent authors referred *macrorhyncha* to the large species (*nigrogularis*) of *Clytorhynchus*, others to the small one (*vitiensis*). Although the latter disposition of the name is presumably correct, Mayr (1933) preferred to describe the Taviuni subspecies of *vitiensis* as new (with an existing type), rather than to make a *nomen novum*, when it was discovered that *P. macrorhyncha* Layard 1875 was preoccupied by *P. macrorhyncha* Strickland 1849.

Under exceptional circumstances a homonym may provide an opportunity to shift an originally ill-chosen type locality of a subspecies. For example, let us assume that there is a species with a northern and a a southern subspecies, meeting in a narrow zone of intergradation. The type locality of the southern subspecies is far in the south, but the type locality of the population the name of which had always been applied to the northern subspecies is actually located in the zone of intergradation. If it is found that this name is preoccupied, it is better not to replace it, but to redescribe the northern subspecies and select a new type locality in the middle of its range. The number of cases where such a shift of type localities is desirable is undoubtedly very small. In the majority of the cases it would only be confusing.

The Names of Combined or Divided Categories. The question of priority among names for combined categories is resolved as follows:

A genus formed by the union of two or more genera or subgenera takes the oldest valid generic or subgeneric name of its components.

The same rule obtains when two or more species or subspecies are united to form a single species or subspecies.

When two families (or higher categories) are combined, the name of the oldest family is usually considered as the valid name of the composite family, not the name of the family with the oldest type genus, or the

largest family, or the family with the best known name (this subject is *sub judice* at the present time).

The division of a taxonomic category is governed by the provisions of Art. 29, which states, "If the genus is divided into two or more restricted genera, its valid name must be retained for one of the restricted genera. If a type was originally established for said genus, the generic name is retained for the restricted genus containing said type." When a species is divided into several subspecies, the subspecies which contains the topotypical population becomes the *nominate* subspecies, *i.e.*, its subspecific trivial name is the same as the specific trivial name.

Linnaeus described the red-winged blackbird (*Agelaius phoeniceus*) on the basis of Catesby's drawings and description from South Carolina. South Carolina has therefore been fixed as the type locality. When this species was divided into several subspecies, the subspecies of eastern North America (including the region of South Carolina) became automatically the nominate subspecies, namely, *Agelaius phoeniceus phoeniceus* Linnaeus.

Occasionally authors create synonyms by ignoring this rule. For instance, Thienemann (1938) found that the well-known turbellarian worm, *Planaria alpina*, consisted of two subspecies. The northern one (northern Germany, Scandinavia) he called *septentrionalis;* the southern one (Alps) he called *meridionalis*. Since the species had been described originally from Scandinavia and the Alps, it is obvious that either *meridionalis* or *septentrionalis* is a synonym of the nominate subspecies *P. alpina alpina*, the type locality of which needs to be restricted to one of the two areas.

Emendations. Article 19 of the Rules states that the original orthography of a name is to be preserved unless an error of transcription (actually, *transliteration*), a *lapsus calami*, or a typographical error is evident. Emendations are intentional changes in the original orthography of a name made to correct a *lapsus* or error. As a result of the indiscriminate use of emendations, particularly during the nineteenth century, taxonomists are frequently confronted with a choice of several names for an animal. Articles 19 and 20 and various Opinions were intended to clarify the treatment of emendations but unfortunately have failed to do so because of ambiguous wording (Kirby, 1944).

The International Commission at Paris (1948) set this matter aside for full consideration at its next meeting but, without prejudice, agreed to recommend that in determining whether an error is evident, particular attention should be paid to evidence contained in the book or paper in which the name was first published. The following examples were cited to illustrate cases where the original spelling of a name should be emended:

1. In the case of modern patronymics, where the spelling of the scientific name is different from that of the person to whom the genus or species is dedicated, the spelling of the scientific name is to be emended. Example: the names *Ruppelia* Swainson, 1839, and *Rupellia* Swainson, 1839, are to be emended to *Rüppellia*, in view of the fact that this genus was dedicated to a zoologist named Rüppell.

2. In cases where an author founds a new name upon one or more Greek words but inadvertently makes an error in transliterating the Greek letters into the Latin alphabet, the error is to be corrected. Example: the inadvertent mistransliteration of the Greek letter *zeta* committed in the spelling of *Pentoxocera*, a name formed from the Greek words πεντα (five), οζος (branch), and κερας (horn), is to be corrected, and the spelling of this name is to be emended to *Pentozocera*.

3. When an author founds a new name upon one or more Greek words cited in the original publication, and one of the words proves to be spelled incorrectly, thus causing an error in the spelling of the scientific name, the spelling of the name is to be emended. Example: the authors of the generic name which was originally published as *Athlennes* stated that the name was based on a Greek word of similar spelling (*i.e.*, a word having the Greek letter *theta* as its second letter). In fact, however, the Greek word concerned has as its second letter the Greek letter *beta*. The spelling of this generic name is therefore to be emended to *Ablennes*.

4. When an author founds a specific trivial name upon the locality or district from which the type specimen was obtained, but as a result of misreading or miscopying the name of the locality publishes a name with erroneous spelling, the name is to be emended. When Gunther gave to a new fish the name *Leuciscus hakuensis*, he selected that specific trivial name because he had misread as Lake Hakou the locality of the type specimen of this species. In fact, however, the name of the type locality was Lake Hakone. In these circumstances, the specific trivial name *hakuensis* is to be emended to *hakonensis*.

5. When an author, in naming a new species, selects for its specific trivial name a word which, though adjectival in form, is not a recognized Latin adjective, and where that author uses for the nominative singular of that word the termination *ius* (masculine) or *ia* (feminine), these terminations are to be corrected to *eus* and *ea*, respectively. Example: the word *iridia* (published by Gibbons in 1855 as a new specific trivial name in the combination *Salmo iridia*), though adjectival in form, is not a recognized Latin adjective. The specific trivial name is, therefore, to be emended to *irideus* (masculine) and *iridea* (feminine).

Article 20 states that in forming names derived from languages in which the Latin alphabet is used, the exact original spelling, including diacritical marks, is to be retained. Examples: *Stâlia*, etc. However,

it is recommended that in proposing new names based on personal names which are written sometimes with ä, ö, or ü, at other times with ae, oe, and ue, authors should adopt ae, oe, and ue. Example: *muelleri* in preference to *mülleri*.

Blackwelder, Knight, and Sabrosky (1948) differentiate between emendations and errors. Emendations are defined as intentional changes, whereas errors are any changes that are not emendations. As interpreted in Opinion 29, errors are correctable and are to be treated as if corrected wherever they occur. They have no separate status in nomenclature, do not preoccupy, are not available as replacement names, and never acquire validity by citation in synonymy. Blackwelder, Knight, and Sabrosky (1948) cite as an example the generic name *Oxytelus* (Coleoptera), which has been written erroneously as *Cxytelus*, *Otylelus*, *Orytelus*, *Oxitelus*, *Oxyletus*, *Oxyteles*, *Oxyteius*, *Oxytellus*, *Oxeotelus*, *Oxytetus*, and *Oyxtelus*. These are all to be corrected and have no separate status.

Emendations, on the other hand, do have separate status, even if invalid at the time they are proposed. This point was clarified by the International Commission (Paris, 1948) as follows: (1) a generic name published as an invalid emendation of an earlier name (an emendation made otherwise than in accordance with Art. 19) is to be rejected as a synonym of the earlier name where that name is an available name, the type species of the later published nominal genus being automatically the same species as the type species of the earlier published nominal genus; (2) where the name of a genus is rejected as an invalid homonym, and the next oldest name is a name published as an invalid emendation of that name, and that invalid emendation is sufficiently different in spelling from the original name not to be a homonym thereof under the conditions contained in the third paragraph of Art. 35 as applied to Art. 34 by Opinion 147, the generic name originally published as an invalid emendation becomes an available name for the genus in question and has priority as from the date on which it was first published as an invalid emendation and is to be attributed to the author by whom it was so published.

Authority Citation for Scientific Names. Article 21 of the Rules states, "The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description."

The word *responsible* in the above statement is particularly significant. The author's name following a scientific name is not intended as a means of awarding credit to the worker, but rather serves to fix responsibility

for the name and to assist in locating its original description and eventually placing the species accurately.[1] In this same connection it should be remembered that, once a name is published the original author has no more right to the name than anyone else.

It is not required by the Rules that the author's name be quoted every time a scientific name is used. But "if it is desired to cite the author's name, this should follow the scientific name without interposition of any mark of punctuation" (Art. 22). This practice has now become so general that Pearse (1933) made the statement, "The scientific name of an animal consists of the genus, species, *and the name of* the author." Such a statement is misleading, because the code specifies that scientific names shall be ". . . . uninominal for subgenera and all higher groups, binominal for species, and trinominal for subspecies" (Art. 2). Hence the author's name cannot be regarded as part of the scientific name. However, a recommendation was passed at the Paris (1948) meeting of the International Commission to the effect that the authority for a name should be cited at least on the occasion of its first appearance in any publication.

Because of frequent advances in knowledge of the classification, it often becomes necessary to change species from one genus to another. Without the name of the author it is quite impossible to tell whether *X-us albus* is the original *albus* described in this genus by Smith or *X-us albus* Brown, *Z-us albus* Jones, or any one of a host of other species with the same name which may subsequently have been referred, correctly or incorrectly, to the genus *X-us*. It is customary to place in parentheses the name of an author of a species which has been transferred from one genus to another. This was apparently first sanctioned by the Strickland Code (1842) and is officially approved in the present International Rules as follows: "When a species is transferred to another than the original genus or the specific name is combined with any other generic name than that with which it was originally published, the name of the author of the specific name is retained in the notation but placed in parentheses" (Art. 23). Thus *X-us albus* Smith, when referred to the genus *Y-us*, becomes *Y-us albus* (Smith).

The Rules state that "if it is desired to cite the author of the new combination, his name follows the parenthesis." Thus when Jones transfers *X-us albus* Smith to the genus *Y-us*, it is permissible to cite the name as *Y-us albus* (Smith) Jones. Although this method of two-man authority

[1] Opinion 30 (International Commission) states that ". . . *responsibility* takes precedence over *credit* in publishing new names" and Opinion 49, that ". . . it is the sense of the Commission that the fundamental idea in citing an author's name is not in order to give him credit, but (1) to hold him responsible, and (2) as a bibliographic aid."

has been widely used by botanists for the past half-century, it has had little use in zoology. When botanists cite only a single authority, the name retained is often that of the author of the new combination rather than the original describer.

The rule dealing with parentheses has become rather onerous in recent years. Many species have been transferred repeatedly from one genus to another, and it often requires much time-consuming research to determine in what genus a species was first described. Typists and editors also tend to insert parentheses where they are not required, in order to restore "consistency." In view of these difficulties it was proposed by Osgood (1939) that this rule be made optional. Many recent authors have followed this advice. In large genera with uncertain nomenclature, and particularly those in which homonyms occur, the use of parentheses is a necessity. The rule should, of course, be rigidly followed in a strictly nomenclatural work, such as a check list, catalogue, or monograph.

With the vast increase in number of names and the inevitable transfer of specific trivial names from one nominal genus to another, it has become increasingly difficult to trace the history of the name of a species of animal. In an effort to facilitate bibliographical work in the future, it is recommended that all nomenclatural changes be made in a formal manner. This is obvious when new synonymy or new homonymy is involved (see pp. 227 to 229), but it is not so obvious, and is often handled carelessly, in the case of new combinations. In addition to the authority citation *X-us albus* (Smith) Jones, therefore, it is recommended that the words *new combination* be added at the time the combination is first proposed.

One of the problems arising from authority citation has been that of abbreviating author's names. During the first half-century of operation of our nomenclatural system, the number of authors' names was small enough so that distinctive abbreviations could be utilized without duplication or confusion. Thus *L.* stood for Linnaeus, and *F.* or *Fab.* indicated that the species was described by Fabricius. As the number of workers increased, these abbreviations were expanded to *Linn.* and *Fabr.*, but thousands of other less prominent names severely taxed the inventive minds of abbreviators and the memory of scientists called on to keep the numerous combinations of letters in mind. Toward the end of the nineteenth century an attempt was made by the Museum für Naturkunde in Berlin to standardize abbreviations, and the International Rules recommended (Art. 22) that this list be followed if abbreviations are to be used. At Paris the International Commission withdrew this recommendation on the grounds that the above-mentioned list was out of print and virtually unobtainable. In place of the above it was recommended that abbreviations not be used except in the case of deceased authors whose names, by reason of the importance of their published work, will be easily recognized even if abbreviated.

Special problems arise when an author changes his name during the period when he is actively publishing (Mitzmain to Mayne) or assumes a title (Laporte to le Comte de Castelnau). More common, of course, are the changes in name of women scientists at marriage. In the latter case it would be well to retain the maiden name as part of the full name which is cited, *e.g.*, Dorothy McKey-Fender, or to continue publishing under the maiden name.

Unfortunately the vanity of certain authors has sometimes been the cause of descriptions and the incentive for the excessive naming of species by persons who "like to see their names in print" or by those who are suffering from so-called "mihi itch." It has therefore been repeatedly suggested that the system be abolished entirely (*e.g.*, Darwin, 1849; Jacot, 1930, 1938; Ball, 1946). Although the sentiments underlying this proposal are understandable, the suggestion is not practical, for the following plainly utilitarian reasons: (1) authority citation makes it possible to distinguish between two or more different species with the same scientific name; (2) it gives an immediate clue to the original description and an indirect clue to the quality of work and to the location of the type specimen; and (3) it reveals something of the history of the name. In other words, the author's name is a link between nomenclature and classification; it is a tag by which a scientific name may be identified.

Certain well-known works of the late eighteenth century, for example, the *Vienna Catalogue* (1775), were published anonymously, and yet the names proposed therein were recognizable and came into general use. The International Commission (Paris, 1948) decided that when, prior to Jan. 1, 1951, a new name was published anonymously, over a pseudonym, or over initials only, that name was to be accepted if it satisfies the requirements of the law of priority. It was further ruled that such a name is not available if published on or after the above date unless it is republished by a named author, and the name shall rank for purposes of priority as from the date of republication.

CHAPTER 12

THE TYPE METHOD AND ITS SIGNIFICANCE

It is very difficult to characterize or to define a taxonomic entity solely by means of words. As a result, many of the Linnaean and early post-Linnaean species, particularly among the invertebrates, are unidentifiable on the basis of the description alone. It is obvious that more secure "standards" are needed to tie scientific names unequivocally to objective taxonomic entities. These standards are the *types*, and the method of using types to eliminate ambiguity is called the *type* method.

The modern type concept has developed slowly. The original draft of the International Rules (1901) did not include any directives concerning types. Provisions for generic types were adopted (Art. 30) at the Boston Congress (1907). As far as the types of species are concerned, they were first provided for in the Rules as a recommendation in Appendix A by the Monaco Congress (1913). Formal rules and recommendations regarding type specimens were adopted at the Paris Congress (1948).

The type of a species is a definite specimen, and the type of a genus or other higher category is a lower category. No matter how many new taxonomic categories and characters are discovered, the verbal definitions may be continuously modified and improved by reference to the types. In a group of sibling species, the type specimen of the earliest described species can be reexamined as soon as the minute differences of the species of the sibling complex are understood. In many groups of insects and arachnoids the emphasis in the species diagnosis has been shifted recently from exposed characters to concealed ones (genital armatures). Whenever types are available, it is an easy matter to check them for newly discovered taxonomic characters.

Early taxonomy was dominated by the typological concept (Chap. 1). All those specimens that conformed to the type were considered members of a species. Furthermore, all the specimens on which the original description was based were considered "typical" and thus regarded as types. The function of the types at that time was to form the basis of the description of the species.

The modern concept does not consider any specimen as typical in the strictest sense of the word. Subspecies and species are based on populations, and what is typical are mean values and ranges of variation. As Simpson (1945) has pointed out,

> It is a natural but mistaken assumption that types are somehow typical, that is, characteristic, of the groups in which they are placed. It is, of course, desirable that they should be typical because then they are less likely to be shifted about from group to group, carrying their names with them and upsetting nomenclature, but there is no requirement that a type be typical, and it frequently happens that it is quite aberrant. Types are almost never really average specimens within a species, or fully central species in a genus. Types were formerly, and still are by many students, supposed to be not only name-bearers but also the bases on which group concepts are erected and the standards of comparison for those concepts. They cannot possibly serve either function in modern taxonomy and the requirements of these functions are flatly incompatible with the requirement of name-bearing which types can and do serve.

In spite of this concept, taxonomists still recognize types. Only the function of the type has shifted. It has happened thousands of times in the history of taxonomy that the material on which the original description of a species was based actually included several species, as revealed by more discriminating subsequent analysis. If a single type specimen is available, it can be determined by reexamination of this type to which of the several species the name given by the original author should be applied.

The function of the type specimen has therefore been described as that of a "name bearer." Simpson (1940) has actually suggested that one might drop the misleading term *type* and call the name-bearing specimen the *onomatophore* (Greek for name bearer). The term *type*, however, is too firmly fixed in the taxonomic tradition for such a change of terms to be practical.

Since the type is the name bearer, it is obvious that it has full authority only if it is unique. Ideally for every name of a species or subspecies there should be only a single type. If there are two type specimens, there is danger that the second specimen may at some subsequent date be found to belong to a second species. It would then be questionable to which of the two the name should be applied.

However, since a single type specimen cannot reflect the total variability of the species population, the description must be supplemented by information derived from a study of all the available material of a species. To minimize the danger of a composite species description, a statement should be added as to how the type specimen differs from other specimens. To draw attention to the significance of the total *material* used for description, Simpson (1940) has introduced the term *hypodigm*. A *hypodigm* is all the available material of a species. This term is mentioned here because it is occasionally used in the paleontological literature. It is unlikely that it will replace the well-known and generally used term *material*.

The original type specimen is the last court of appeal in cases of doubt as to the applicability of a name. If a description and a type specimen seem to apply to different entities, the name should be assigned to the species to which the type specimen belongs, provided that it is certain that it is the type selected by the original describer. Unfortunately this is not always evident. It was, for example, customary in one or two European museums in the first half of the nineteenth century to substitute "new" type specimens when the old ones became faded or were damaged by insect pests. In other instances there are known cases of inadvertent transfer of labels from one specimen to another which have caused an obscuring of the identity of type specimens. However, a specimen labeled as the type should be accepted as such unless clear proof to the contrary exists.

TYPES OF SUBSPECIES

Types of subspecies are subject to the same rules as types of species. The type of a species is always simultaneously the type of its nominate subspecies.

KINDS OF TYPE SPECIMEN

In the early days, when taxonomy was still dominated by the typological concept of taxonomic categories, and when any specimen that agreed with the description was considered "typical," many authors had in their collection large series of "types," or "cotypes," or "syntypes." This system contributed to many of the ambiguities and difficulties described above. A transition period followed, during which the proper function of the type as a name bearer was realized, but authors were still anxious to have several types. They were reluctant to abandon special names for specimens that were significant because they had been identified by the original author or collected simultaneously with the holotype or for similar reasons.

Recognizing the danger of loose type designation, Waterhouse (see Thomas, 1893) proposed the restriction of the term *type* to a single specimen which was before the original describer and the use of the term *co-type* for each of the specimens when two or more were used as the basis for the description. This suggestion for defining various kinds of types more precisely was followed by Thomas (1893) in an article entitled, "Suggestions for the More Definite Use of the Word Type and its Compounds, as Denoting Specimens of a Greater or Lesser Degree of Authenticity." Thomas proposed the terms *paratype* (or *side type*) for the remaining specimens of the original series when one particular example had been selected as the type; *topotype* (or *place type*) for a specimen from the original locality; and *metatype* for a specimen from the original locality subsequently identified by the original author. Walsingham and Durrant (1896) added *homotype* for a specimen identified by another than

the original author after comparison with the type and altered the meaning of *metatype* slightly to include any specimen subsequently identified by the original author of the species.

From these humble beginnings, growing out of a need for more exact designation of specimens which had served as a basis for previous work, a large body of type nomenclature quickly grew.

Frizzell (1933) and Fernald (1939) list, define, and give the authority for more than one hundred type terms. These may be divided into three main groups as follows: (1) primary types: the original specimens of any described or figured new species (including *holotypes, allotypes, paratypes, syntypes, lectotypes,* etc.); (2) supplementary types: the described or figured specimens used by any authors to supplement or correct knowledge of a previously defined species (including *neotypes, plesiotypes,* etc.); and (3) typical specimens: specimens that have not been used in published descriptions or figures, but which consist of material which "authors" have worked on or such as have been collected at the original locality (including *homotypes, metatypes, topotypes,* etc.)

Some of these kinds of types are classified and defined below:

I. Primary types

- *A. Holotype* (or simply *type*). The single specimen designated or indicated as "the type" by the original author at the time of publication of the original description or the only specimen known at the time of the original description.
- *B. Allotype.* A paratype of the opposite sex to the holotype which is designated or indicated as such.
- *C. Paratype.* A specimen other than the holotype which is before the author at the time of original description and which is designated as such or is clearly indicated as being a specimen upon which the original description was based.
- *D. Syntype* (= *cotype*). One of several specimens on which an author bases an original description when no single specimen is designated as the holotype.
- *E. Lectotype.* One of a series of syntypes which is selected subsequent to the original description and thenceforth serves as the definitive type of the species. In order to be effective, such selection must be made known through publication.

II. Supplementary types

- *A. Neotype.* A specimen selected as type subsequent to the original description in cases where the primary types are definitely known to be destroyed. Here again selection must be made known through publication.
- *B. Plesiotype.* A specimen or specimens on which subsequent descriptions or figures are based.

III. Typical specimens

- *A. Topotype.* A specimen not of the original type series collected at the type locality.
- *B. Metatype.* A specimen compared by the author of the species with the type and determined by him as conspecific with it.
- *C. Homotype.* A specimen compared by another than the author of a species with the type and determined by him to be conspecific with it.

Where the type of a species is lost, or destroyed, the first interpretation shall obtain unless later acquired information clearly proves it should be otherwise, when a change is allowable.

In cases where specimens have been labeled as types by others than the author of the species such type labels shall be interpreted independently by each investigator since there is much variation in the credibility of such labels.

A species based wholly on a figure has the original of that figure as the type.

The type of a specific name proposed to replace a preoccupied specific name is the same as the type of the name replaced, irrespective of any attached description.

In the case of fossil material, if the type consists of many individual pieces (*e.g.*, bones) it is advisable to designate the most diagnostic of them as type, if there is any doubt as to whether the pieces actually belong to a single individual. Many "types" of formerly described fossil species have, on reexamination, turned out to be composites of several different species. Designating a single piece as the type and other pieces as paratypes prevents the confusion created by such composite types.

The selection of lectotypes should be undertaken with great care. It is unethical for a curator who obtains by exchange a single syntype from the museum that has the entire syntypical series to make this single specimen the lectotype (see *g*, above). If the series of syntypes is heterogeneous, the same considerations should govern the selection of the lectotype as govern the selection of the holotype from the original material (see below). A selection of lectotypes should be undertaken only when it leads to the clarification of a taxonomic problem, not merely in order to add a type specimen to the collection. If one of the syntypes was illustrated it should—other things being equal—be selected as lectotype. If the description of the species is clearly based on a particular specimen, that specimen should be made the lectotype.

The following additional suggestions may be offered with regard to types:

1. Type designation and fixation should always be completed before publication.
2. Type designation should be clear and unambiguous; location and museum number of types should always be recorded.
3. Types of undescribed species should not be generally distributed prior to publication.
4. Type labels should never be changed or replaced.
5. Types should be carefully preserved.
6. Type fixation for species of older authors should be attempted only by a specialist.

MARKING TYPES IN COLLECTIONS

Since type specimens have a special significance and value, they should be marked with special labels (in most museums red labels are used).

If possible the label should give reference to the original publication. If the name is a synonym, this information may also be placed on the label. With small specimens such as insects and with material in special preservatives (alcohol, formalin), it is better to have this special information in a separate card catalog. See Chap. 4 for additional remarks on type collections.

TYPE LOCALITIES

Species can be identified by single specimens, subspecies usually only by adequate samples representing populations. It is immaterial for the status of the type specimen of a species from what part of the range of the species it comes, as long as it represents the species. The type locality is relatively unimportant at the species level. The reverse is true for subspecies, for which the type locality is much more important zoologically than the type specimen.

The type locality is the locality where the type specimen was collected. It is the locality where the population lives from which the type specimen was taken. Specimens collected at the type locality are called *topotypes*, and the population that occurs at the type locality is called the *topotypical population*. The taxonomic importance of this population is obvious. In view of the fact that populations as little as 400 ft. apart are sometimes visibly distinct (Welch, 1938) and that genetic tests have shown that populations only a few miles apart (*Drosophila*) or only a few feet apart (some ecotypes in plants) may be different, it is important that the type locality be fixed with extreme accuracy. This is even more critical in paleontology, where a few inches may mark a change from one horizon to another.

The type locality can usually be fixed only as accurately as is permitted by the data given on the labels of the specimens. Hence the importance of accurate labeling (Chap. 3). If the collector is still alive, it is sometimes possible to obtain from him more precise data than are available on the locality labels. In other cases such information may be found in published or unpublished journals or field books.

The Selection of a Type Locality. Often a worker has before him material from many localities within the range of a new species or subspecies. It is his duty to make as prudent a choice of type locality as is possible. In this he should be guided by the following considerations, among others:

It is advisable to choose a type locality from which many topotypes are available which constitute a fair sample of the population and illustrate its variation.

In the case of a variable species or subspecies, the type locality should be placed in the area from which the populations come which the describer considers most typical for the new form.

If a new subspecies is composed of populations which, together with populations of another subspecies, form a cline, the type locality should be placed as near as possible to that end of this character gradient which is most distant from the other subspecies.

Type localities should not be selected from areas of intergradation or hybridization.

The Restriction of Designated Type Localities. Earlier authors, not appreciating the need for exact type localities, often described new species from "California" or "Brazil" or "Africa." When later collections indicate that the species from "Brazil" is geographically variable and consists of two or more subspecies, it becomes necessary to determine the exact locality from which the type of the nominate subspecies came.

The International Rules do not contain any provisions governing the secondary restriction of a designated type locality. However, many workers accept the principle that the "first reviser," the person who first realizes the geographical variability of such a species, has the right to designate arbitrarily a more restricted type locality, provided that evidence derived from a study of the type itself does not contradict his selection. Such a fixation is usually followed, unless it can be shown that the action of the first reviser was erroneous. Obviously, if the first reviser restricts to Rio de Janeiro the type locality of a species from "Brazil," his restriction should not be binding if the type is still in existence and belongs to a subspecies which is confined to the neighborhood of Cayenne. To avoid such mistakes, the first reviser should make a careful investigation of the probable route of the collector. Even in the absence of exact information, certain conclusions may be obvious. Thus a type collected in China in 1775 most likely came from Canton or some part of Fukien, not from Szechuan, Kansu, or some other place far in the interior.

In the case of a "voyage" it is often possible to determine the exact locality by a study of the course of the voyage. For example, a small owl, *Ninox ocellata*, collected by the Voyage au Pôle Sud was described by Hombron and Jacquinot as having come from Chile, South America. This is an obvious error, since the genus does not occur in America. Later on, Mathews, believing *ocellata* to be an earlier name of *N. roseoaxillaris* Hartert 1929 (San Cristobal, Solomon Islands), restricted the type locality of *ocellata* to San Cristobal. However, it is stated in the report of the Voyage au Pôle Sud that the expedition landed in the Solomon Islands only on Ysabel Island (and adjacent St. George), where no owl resembling *ocellata* occurs. Mathews's restriction of the type locality is therefore untenable. Subsequently it was shown by Peters that the Coburg Peninsula, Northern Territory, Australia, is the only locality touched by the Voyage au Pôle Sud where an owl occurs that agrees with the description of *N. ocellata*. Peters therefore restricted the type locality to Coburg Peninsula, and this restriction has been universally accepted. The restricting of type localities should normally be reserved for a specialist.

Correction of Wrong Type Locality. There are two sets of circumstances under which an error in the originally stated selection of the type locality can be corrected:

1. Exact type locality given in the original description. If the author or some subsequent worker can prove beyond doubt that the type(s) did not come from the locality given in the original description (owing to some error or misinformation), he can shift the type locality to the place from which the type really came. Actually this is not a shift of the type locality but only of the "stated" type locality, since the type never came from the originally designated locality.

The type locality should not be altered because an author finds that the population at a different locality is "more typical" or because he has received "better material" from a new locality. Proposals for the shift of type localities for these and similar reasons should be rejected.

2. Exact type locality not given in the original description. If no type locality is given, or only a vague one ("India"), the first reviser may designate a restricted type locality. Such a restriction may later be set aside if it conflicts with the available evidence. Such an action is justifiable, however, only if the case is unequivocal. A fixation of type locality should not be set aside because that locality, at the time of the collection, was "less accessible" than some other locality, or because the species is "rather rare" at that locality. It should be changed, however, if it is clearly outside the range of the species.

TYPES OF HIGHER CATEGORIES

The types of higher categories are not definite specimens, as are types of species, nor are they the names of other categories. The type of a genus is a species. The type of a tribe or family is a genus. The procedures that govern the selection of these types are explained in Chaps. 14 and 15.

CHAPTER 13

SPECIFIC AND INFRASPECIFIC NAMES

Scientific names in zoology are of five kinds, each kind or group of name differing in form and method of treatment. The five groups of names ar as follows:

1. Specific group: specific and subspecific trivial names
2. Infrasubspecific group: names for individual variants
3. Generic group: generic and subgeneric names
4. Family group: names for categories above the genus and below th suborder
5. Order, class, and phylum group: names for categories above the superfamily

In the following chapters it will be seen that each of these groups is distinct and is subject to a more or less independent set of rules or nomenclatural practices.

THE SPECIFIC GROUP OF NAMES

In order to understand the terminology of the specific group of names, a short historical survey may be helpful. Authors before Ray made no clear distinction between genus and species. When referring to an animal or a plant they used indiscriminately mononominals, binominals, or polynominals. Linnaeus not only accepted Ray's distinction of genus and species but also expressed it in his scientific names. The polynominal specific name was for Linnaeus a differential diagnosis, a word which does not occur in Linnaeus's writings. "The specific name was a series of descriptive words (*differentiae specificae*) selected according to rules laid down in *Philosophia botanica*, by which each species was to be differentiated at first glance from all others in the genus" (Svenson, 1945). These polynominal *differentiae* were not fixed but had to be elaborated and changed each time a new species was added to the genus. This procedure is equivalent to the modern practice of altering a diagnostic key when additional species are discovered. It is interesting to compare the changes in the *differentiae specificae* for the same species from the pre-Linnaean authors to Linnaeus and through the various editions of the works of Linnaeus.

As these names became more and more elaborate, they performed their function as diagnoses more and more efficiently. However, the foremost function of a name, to serve as an identifying label, was sacrificed to this diagnostic perfection. To satisfy the evident need for such a "label" for each species, Linnaeus introduced the *nomen triviale*. At first (1749) these trivial names were one of the words of the *differentiae specificae*, singled out by means of either italics or parentheses. In the *Species plantarum* (1753) trivial names were employed consistently but were placed in the margin of the page. For animals this method was employed for the first time in the tenth edition of the *Systema naturae* (1758).

Having a different function, the trivial name was for Linnaeus merely an accessory to the *differentiae specificae*. The Latin word *triviale* means "commonplace," and it is evident from his discussions in the *Philosophia botanica* and the *Incrementa botanices* that Linnaeus considered trivial names merely a convenient device and of no scientific significance. So useful was the new device of a unique binominal combination for every species, however, that it soon became the best known element of nomenclature. As a result, the specific name of Linnaeus, consisting of the generic name and the *differentiae specificae*, was speedily replaced by the combination of generic name and *nomen triviale*. Furthermore, it soon became customary to call the trivial name the *specific name*. In the transition period Murray (1784) stated that the binominal consisted of (1) a generic *cognomen gentilitium*, and (2) a specific *praenomen triviale*. The replacement of *trivial* by *specific* became so universal by 1800 that the original Linnaean usage of the terms was almost entirely forgotten by the taxonomists. For instance, De Candolle stated in 1813: "Linné . . . proposes . . . that the name of an organism shall be composed of two words: the first he called the generic name . . . and the second, which he called specific, should be unique [*propre*] for each species of the genus."

The obsolescence of the term *trivial name* was in part due to the change of function of the scientific name from that of a diagnosis to that of a handle. The change of terms thus signified an important evolution in the philosophy of nomenclature. The portion of the binominal which *specifies* the species is *specific*, and a precise counterpart to the *grouping* component, the *generic* name. The use of *trivial* was very unfortunate anyhow, since it means *trifling* in some languages. Furthermore, in most European languages the term *trivial name* is synonymous with *vernacular name*. It is therefore not surprising that the term *trivial* fell into virtual oblivion in zoology after 1800, being used only in a few nomenclatural and antiquarian works.

The standard usage of a "scientific name (or species binominal), consisting of a generic and specific name" was adopted by all major codes of

nomenclature from the Strickland Code (1842) and the A.O.U. Cod (1889) to the International Rules (1901).

This usage, which has been stabilized for one hundred and fifty years, was changed by the Commission in Paris (1948) where the term *trivial* was reintroduced and the term *specific name* was shifted from the specific epithet to the species binominal. There has been much criticism of this shift, particularly by those Europeans in whose language *trivial* nam means *vernacular name*. In this text the authors have endeavored t choose wordings that will prevent a confusion of the two usages o *specific name*.

Specific trivial names are the fixed portion of the binominal designatio (scientific name) of an organism and follow the species through all of th vagaries of its classification. A specific trivial name may be synony mized, may be referred to any one of a dozen or more genera, or may eve be shifted from one order or class to another without change, provide that it was properly formed and has never been used previously in an of the genera to which it is referred. Subspecific trivial names have th the same status as specific trivial names (Art. 35).

Specific trivial names are formed either from Latin words or from othe words or combinations of letters which are Latinized. Ideally they should be short, descriptive, euphonious, and easy to pronounce. Practically, however, it should be remembered that names are not definitions, nor ar they descriptions. They are merely "handles by which the objects ar known." Hence, in the last analysis, any name, once published, might as well be regarded simply as an arbitrary combination of letters because the law of priority rules that it cannot be changed except in rar instances, regardless of how ill chosen or inappropriate it may be

In order to be *available* under the Rules, the designation of the scien tific name of a species of animals has to satisfy certain conditions:

1. It must be binominal (or, in case of subspecies, trinominal).
2. It must be accompanied by a description (or indication or defini tion) (see Chap. 11).
3. It must be properly published (see Chap. 11).
4. It must be based on a taxonomic entity.
5. It must be a name.

Even if it satisfies the above conditions, the name of a species may be *invalid*.

6. If the same specific trivial name has been used previously in the same genus (homonym).
7. If an earlier name for the taxonomic entity (species or subspecies) is available (synonym). For a discussion of (6) and (7) see Chap. 11.[1]

[1] For a classification of species names in zoological nomenclature see H. M. Smith (1945).

The following comments on the above listed conditions may be helpful:

1. Binominal Nomenclature. The expression *binomial nomenclature* is commonly used to describe the system established by Linnaeus in 1758. However, the term *binominal* was used in Art. 2 of the International Rules: "The scientific designation of animals is uninominal for subgenera and all higher groups, binominal for species and trinominal for subspecies." This statement seems perfectly clear, but the issue was confused by the provision in Art. 25 that an author must apply "the principles of binary nomenclature." Thus zoologists were confronted with three more or less equivalent terms, *binomial*, *binominal*, and *binary*, none of which was precisely defined. It has been stated that a "phraseology of a deliberately ambiguous character" (Hemming, *Bul. Zool. Nomencl.*, **5**:155, 1950) was used so that zoologists could either accept or reject generic names proposed by nonbinominal authors. This confusion was cleared up at Paris when the Commission ruled that the expression *nomenclature binaire* is exactly equivalent to the expression *nomenclature binominale*. It was further ruled that an author must consistently apply the principles of binominal nomenclature throughout a given work. This rules out many of the early post-Linnaean authors who used single-word names and multiple-word names intermixed with binominal combinations.

Subgeneric names are not considered as part of the binominal combination. The combination *Passerella* (*Melospiza*) *melodia* is still considered binominal, because the parenthetical treatment of *Melospiza* takes it out of the actual combination. Nor does the addition of the author's name change the binominal status of a scientific name, because the author's name is not part of the scientific name.

2. Nomina nuda. A published name which does not meet the requirements of Art. 25 of the Rules as amended at Paris (1948) is called a *nomen nudum*.

Opinion 78 states that the citing of another author's manuscript name in the synonymy of a valid name constitutes an "indication" as demanded by Art. 25. This decision has been severely criticized, and Hemming, in his reissue of Opinion 4 (1944), states that

> . . . in some groups the number of manuscript names and *nomina nuda* made available nomenclatorially through being published as synonyms of described names is very large. In most cases such names constitute a heavy, expensive and unnecessary burden on the systematics of the group concerned.

A petition to the International Commission is now pending to reverse the decision expressed in Opinion 78.

3. Pre-Linnaean Names. Names published prior to Jan. 1, 1758, are *pre-Linnaean* names and have no status. They do not become eligible

simply by being cited or reprinted with the original diagnosis. Not even the citation in synonymy or in a bibliographical reference after Jan. 1, 1758, establishes a pre-Linnaean name (Opinion 5). The citation of pre-Linnaean names in synonymies in the tenth (and later) editions of Linnaeus's *Systema naturae* does not make such names valid substitute names. Linnaeus and post-Linnaean authors have sometimes adopted pre-Linnaean names (*e.g.*, *Turdus pilaris* Linnaeus, 1758 ex *Turdus pilaris* Gesner, 1551). Such names date from the time of adoption and are attributed to the new author.

Setting the year 1758 (arbitrarily fixed as Jan. 1, 1758) as the starting point for the law of priority deprived many excellent pre-Linnaean zoologists of the authorship of the new species found and described by them. However, the fixing of a base line for nomenclature was essential, and the tenth edition of the *Systema naturae* (1758) was the first publication in which binominal nomenclature was consistenly employed. To admit occasional pre-Linnaean names because they are binominal would lead to endless disputes and great nomenclatural uncertainty. However, at Paris (1948), an exception was made in the case of Clerck's *Aranei svecici* (1757) (*Bul. Zool. Nomencl.*, **4**:274, 315).

4. **Nomina dubia.** It was decided at Paris (1948) (*Bul. Zool. Nomencl.*, **4**:76, 1950) that where specialists are agreed that the available evidence is insufficient to permit the identification of a species, the name is to be treated as a *nomen dubium* and therefore not available for taxonomic purposes. It was further stated that where specialists disagree the question at issue is to be referred to the International Commission for decision.

5. **Hypothetical Names.** Names for hypothetical or mythical forms have no status in nomenclature. A name in the sense of the Rules refers to the designation by which the actual objects are known. The objects themselves are named, not our conception of these objects (Opinion 2).

For instance, the name *Pithecanthropus* Haeckel, 1866, was based on a hypothetical missing link between ape and man. It has therefore no status under the Rules and does not invalidate the name *Pithecanthropus* Dubois, 1894, based on actual specimens.

6. **Status of Symbols and Formulae.** The scientific names of animals must be words which are either Latin or Latinized or are considered and treated as such in case they are not of classic origin. Symbols, numbers, and formulae have no status in nomenclature (Opinions 64, 72, etc.).

The Rules of Nomenclature mention two further categories of names of species.

a. Species inquirendae. These are species the taxonomic position of which was in doubt at the time of the original publication of a generic name, either because the species concerned were unknown to the author or because of difficulties in identifying the species.

b. Nomina rejecta. The proceedings of the Ninth International Congress at Monaco (1913) contain a list of permanently rejected names. Unfortunately this list was not kept up to date during the years when the Official List was being augmented. However, in 1948 the Commission recognized the need for separate lists of names which had been rejected by the Commission under the plenary powers. Accordingly official indexes were prepared of rejected and invalid generic and specific trivial names in zoology. Eighty-six generic names and thirty-six specific trivial names were placed on the list at Paris (*Bul. Zool. Nomencl.*, **4**:694–698).

FORMATION OF SPECIFIC TRIVIAL NAMES

In order to assist in proposing new names, certain simple rules of Latin grammar are given below, together with examples of the formation of specific trivial names of each type. Words taken from a Latin dictionary will be adjectives, nouns, or verbs or their participles.

Adjectives. If an adjectival name has been selected as a specific trivial name, the International Rules state that it "must agree grammatically with the generic name" (Art. 14). Thus the descriptive adjective *albus*, meaning white, retains its *us* ending if referred to a masculine genus (*Turdus albus*) but changes to an *a* ending if the genus is feminine (*Muscicapa alba*) and to a *um* ending if the genus is neuter (*Dicaeum album*). This is the simplest case of an adjective of the first or second declension. Adjectives of the third declension end in *is*, masculine and feminine (*Cervus brevis*, *Rana brevis*), and in *e*, neuter (*Therium breve*).

It is sometimes difficult to determine the gender of the name of the genus to which the new species is to be referred. Particularly confusing to students without training in the classical languages are such names as *Venus*, a feminine name with a masculine ending (*Venus maculata* Linnaeus) and *Conosoma*, a Greek neuter with an ending which in Latin usually indicates the feminine gender. In this last case some authors have erroneously employed masculine endings, *e.g.*, *Conosoma parvulus* Horn instead of *C. parvulum*. A Latin noun ending in *es* is usually feminine, a Greek noun ending in *es* is usually masculine.

Grensted (1944) discusses the gender of generic names, especially those derived from Greek roots, and points out that we have the alternatives of determining the gender by (1) the meaning of the word, (2) its general form, or (3) the gender of the Greek in one of its parts.

In an attempt to clarify the situation, the International Commission (Paris, 1948) ruled that

1. Where a generic name is a classical Latin word, the specific trivial name, if an adjective, should agree in gender with the generic name.

2. Where a generic name consists of a word which is unknown in classical Latin but is found in the later history of the Latin language, the specific trivial name, if an adjective, should agree in gender with the ascertained gender of the word selected as the generic name.

3. Where a generic name consists of a word unknown in any stage of the history of the Latin language except as used today for scientific nomenclature, the following rules should be observed:

a. If the word ends with any of the terminations used for nouns in classical or later Latin, the gender of the generic name shall be assumed to be the gender usually applicable to a noun having that termination.

b. If the generic name has a termination not found in Latin other than Latin as used in scientific nomenclature, the gender of that noun shall be deemed to be masculine.

Simple adjectives may be altered to indicate fullness by the endings *osus, -a, -um,* thus *Muscicapa fuliginosa.* Comparatives may be indicated by the ending *ior,* masculine and feminine (*Cervus brevior, Rana brevior*), or *ius,* neuter (*Dicaeum brevius*). Superlatives may be indicated by the endings *issimus, -a, -um,* thus *Muscicapa brevissima* or, in the case of adjectives ending in *er,* by *errimus, -a, -um,* thus *M. nigerrima.*

Nouns or Substantives. If a noun is selected as a specific trivial name it may either be appositional (qualifying) nominative (as *Felis leo, Capra ibex,* or *Astrapia helios*) or in the possessive genitive (*Musca fagi,* of the or belonging to the beech). Dedicatory ("*smithi*") or geographical names ("*italiae*") are often nouns in the genitive. If several things are involved, the genitive plural is used (*X-us rosarum, X-us insularum*).

Participles. Present or past participles are often used as specific trivial names. They consist of verbs altered to an adjectival form and in general denote action. Present participles end in *ans* or *ens* (*fulminans,* light or brilliant; *virens,* green). The ending, *scens,* added to the stem denotes action (*virescens,* becoming green). These endings are the same in masculine, feminine, and neuter. Past participles are passive and have the usual adjectival endings, *us, a, um* (*productus, -a, -um,* produced).

Compound Words. Specific trivial names are often formed of two or more Latin words (*duodecimpunctata,* twelve-spotted) or modified by prefixes or suffixes (*subnitida,* slightly shining). Such compound words of classical origin should always be pure Latin (*rufipectus*) or pure Greek (*rhodothorax*), never a hybrid combination of the two (*rufithorax*). Some purists such as Horvath (1913) felt so strongly about this that they renamed hybrid generic names which came to their notice (*Macrocranella* Horvath, 1913, for *Leptocimex* Roubaud, 1913). Unfortunately for scholarly scientists, this is not permissible because of the disastrous effect such a practice would have on the stability of our nomenclature.

Compound nouns, if used as specific trivial names, cannot be changed to take the gender of the generic name. It is *Papilio rhodogaster,* not *P. rhodogastris:* and *Therium rhodogaster,* not *Th. rhodogastre* or *Th. rhodogastrum.* It is *Dicaeum albipectus* (with *pectus,* breast, a noun) not *D. albipectum.*

Prefixes frequently used to indicate degree of relationship or resemblance should be employed only with words derived from the same language, *e.g., sub* with Latin (*subalbidus*) and *pseudo* with Greek words (*pseudodelta, pseudognatha*). The same applies to prefixes denoting number (*diops,* Greek, *binoculus,* Latin, *monacantha,* Greek, *unispina,* Latin). Neither should be used with proper names (*parasmithi, pseudojonesi*). The terminations *oides* and *ides,* (similar to), should likewise never be used in combination with proper names (*smithoides*).

In addition to the above grammatical categories, most specific names will fall into one of the following classes.

Descriptive Names. The earliest (1758) trivial names of Linnaeus were often one-word condensations of the descriptive *differentiae specificae.* However, since the function of the single trivial name was that of a call word and not a description, it was not necessarily descriptive. With the tremendous increase in number of species since 1758, it has frequently happened that the very characteristic to which attention was called by a descriptive name was the least typical or the most variable in the species. Moreover, a Linnaean species named *minuta* (small) may have been followed by a smaller Fabrician species, *minutissima* (smallest), but what of the many still smaller species discovered since that time? Nevertheless a descriptive name, when selected judiciously, is a useful aid to the memory, particularly if it is a well-known Latin word with a standard spelling and pronunciation. Such names are easily memorized and are considered more desirable than mere heterogeneous combinations of letters.

The Rules suggest that it is well to avoid the introduction of the names *typicus* and *typus,* since these words are used with special nomenclatural significance in taxonomic papers, and their use as scientific names is liable to result in later confusion.

Geographical Names. These are frequently used to indicate type localities or the general distribution of a species, especially when such distribution is unusual or significant. According to the International Rules of Zoological Nomenclature (Art. 16), geographical names "are to be given as substantives in the genitive [*arizonae, sanctaehelenae*] or are to be placed in adjectival form [*arizonicus, arizonensis*]." Here, again, an originally appropriate name such as *mexicanus* may lose its significance if a dozen additional species of the same genus are subsequently discovered in Mexico. Likewise, geographic names frequently become trite through repeated use in various groups of organisms for a

single geographic region; for example, the hundreds of animals and plants bearing the specific trivial name *hawaiiensis*. Geographical names are often particularly appropriate for subspecies, especially for those with well-defined ranges, such as island or mountain races. If there is a Latin equivalent for a barbaric geographical name, its use is preferred (*e.g.*, Lutetia = Paris, Batavi = Holland, Lugdunum = Lyon, etc.).

Ecologic Names. Many specific trivial names refer to the particular habitat of the species (*subterraneus*, subterranean; *conicola*, cone-inhabiting; *xerophila*, desert-loving). If the habitat is unique within the genus or group, such names are excellent; otherwise they are subject to the same disadvantages as inappropriate geographic names.

Patronymic Names. Specific names based upon the surnames of persons, such as the original collector or a person who has made an outstanding contribution to the particular field, have some utilitarian value, because they may indicate indirectly the approximate time or place of collection. They are primarily considered as memorials to, or as recognition for, the efforts of individual scientists. Whether justifiable or not, the practice of naming species after persons is apparently here to stay. However, the scientific world frowns upon abuse of the practice. Patronymics should always be used with restraint. A publication filled with such dedicatory names is an indication of poor taste.

The rules of nomenclature that were considered by the first two international congresses of zoology (1889, 1892) stated that patronymic names should *always* be written with the first letter capitalized. Previously (1885) the American Ornithologists' Union had ruled that all specific trivial names, regardless of derivation or reference to persons or places, be written with lower-case letters. For nearly half a century the International Rules left the matter optional, but during that time the lower-case initial letter came into general use by nearly all zoologists except in a few western European countries. Accordingly the International Commission at Paris (1948) prescribed the uniform use of a small initial letter for such names.

In the formation of patronymic names, the person's surname is considered as the stem of a Latin noun, even though the name may have a true Latin form. To this stem, with the exact and complete original spelling, is added the genitive ending denoting possession. As shown for Latin nouns above, these endings are *i* (singular) or *orum* (plural) in the masculine and *ae* (singular) or *arum* (plural) in the feminine.

The following exceptions to the above rule were agreed upon (Paris, 1948): (1) The names of Linnaeus, Fabricius, and Poda should be treated as Latin nouns in the genitive—*linnaei, fabricii, podae*. (2) If a surname ends with the letter *q*, the letter *u* is to be inserted immediately after the letter *q* and before the appropriate genitive termination. (3) When the surname is preceded by a nobiliary particle (*e.g.*, *de, di, von*, etc.), that particle is to be omitted (de Lessert becoming *lesserti*) except where the particle is actually attached to the surname (Dujardin) or where, by long custom, it forms an integral part of the surname (DeGeer); thus *dujardini* and *degeeri*. The particle is also retained in names based upon such surnames as MacCook and O'Connor (*maccooki, o'connori*). (4) Names formed from a modern French surname preceded by the definite article *le, la*, or *les* should include the definite article, *e.g.*, *lesueuri*.

Nonclassical Names. Barbaric names have long been frowned upon by purists. This view has come down from the period when all scientists wrote in Latin. More recently, perhaps owing as much to ignorance or carelessness as to the multiplicity of names now in use, barbaric words have come into general use (*ziczac*). However, it is obviously undesirable to use without change words in common use for other purposes (*box*).

Barbaric names can either be treated as nouns in apposition or declined as if Latin words: *Zosterops malaitae* (from Malaita Island, Solomon Islands). Very often they are Latinized as adjectives: *mexicanus, luzonica, congensis*, etc. This is particularly true for geographical names of barbaric origin.

Names without Definite Meaning. These have been strongly urged by some zoologists in order to avoid possible undesirable or erroneous implications of meaningful names. It has been pointed out that most new species are described from relatively few individuals from a limited area, and that hence authors are not in a position to generalize on their characteristics. Some authors meet the criticism by using such names as *validus, novus, cognatus*, or names denoting similarity such as *similis, assimilis, confinis, soror, congener;* others by using meaningless combinations of letters. However, an appropriate descriptive or geographical name is always superior if relevant information is available.

Undesirable Names. The proposal of a new scientific name should not be taken lightly. Under the Rules, all names, whether good or bad, are permanently preserved and hence are handed down as a legacy to future generations. Each name will stand through the centuries as a monument to the intelligence, taste, judgment, and ethics of its author. Long, awkward names are impractical and show lack of judgment on the part of their author (*anteromediobasalimagnofasciatipennis*).[1] The same is true of facetious names such as Thomson's *Amphionycha knownothing* or irreverent names such as *Eudaemonia jehovah*.[2] Such meaningless and

[1] The International Commission (Paris, 1948) recommended that unnecessarily long names be avoided and that the words selected should be euphonious.

[2] A ruling of the International Commission (Paris, 1948) prohibits the use for a scientific name of a word which can reasonably be regarded, in any language, as calculated to cause political, religious, or personal offense.

repetitious names as those of Kearfott (1907) have become the laughing stock of the scientific world (see *Ent. Soc. London, Proc.*, 1912). In the genus *Eucosma* many names were proposed simply by altering the first letter, thus: *bandana, landana,* etc. One of the worst features of Kearfott's system is the fact that some of the resulting names are pronounced alike (*xandana* and *zandana, cocana* and *kokana*) while others are distinguishable with difficulty (*vandana, wandana*).

Since the rank of genus is arbitrary, and since many taxonomic groups are decidedly oversplit at the present time, it is safe to predict that future revisers will do a considerable amount of generic lumping. For this reason it is wise never to propose a specific trivial name that is also used in related genera. The danger is too great that such a name will eventually become a homonym. It is wise when proposing a new name in a large genus not to utilize a very common name, such as *major*, *punctatus*, *littoralis*, or *niger*.

It is particularly bad taste for an author to give a name to a taxonomic entity which an earlier author described but deliberately left unnamed. A name should be given to such an entity only after additional *new* material has become available.

INFRASPECIFIC NAMES

The species of Linnaeus and of his immediate successors was monotypical and typological. The category *variety* was used only sparingly and in many cases in the same sense as the modern *subspecies*. During the nineteenth century the polytypic species became firmly established and with it the definite recognition of the subspecies.

The International Rules originally provided for subspecific names as follows:

Article 2. The scientific designation of animals is uninominal for subgenera and all higher groups, binominal for species, and trinominal for subspecies.

Article 11. Specific and subspecific names are subject to the same rules and recommendations, and from a nomenclatural standpoint they are coordinate, that is, they are of the same value. [See also Art. 35.]

Article 12. A specific name becomes a subspecific name when the species so named becomes a subspecies, and *vice versa*.

Article 17. If it is desired to cite the subspecific name, such name is written immediately following the specific name, without the interposition of any mark of punctuation. Example: *Rana esculenta marmorata* Hallowell.

Article 35. A specific (or subspecific) name is to be rejected as a homonym when it has previously been used for some other species or subspecies of the same genus.

The subspecies is the only taxonomic category within the species that is nomenclaturally recognized. Since the days of Linnaeus, however,

names have also been given to infrasubspecific variants, to "individual variants." The various possible kinds of such individual variants have been listed in Chap. 4. They are not taxonomic categories but nonrandom samples from populations. The females, for instance, within a population are *not* a taxonomic category distinct from the males and do not deserve a different scientific name, nor do the immature stages or the individuals in winter plumage.

The fact is, however, that this distinction between categories (= populations) and individual variants (= nonrandom samples within populations), which is now generally accepted by biologists, was not fully understood by the earlier taxonomists and still is not completely understood by some dilettante collectors. Some collectors are interested merely in having in their collections specimens with as many names as possible and therefore do not hesitate to name every individual which differs from the type. The status of names given to these variants and aberrations is often in doubt, particularly since some of these authors made no distinction either in form or in principle between subspecies and individual variants. It is therefore not possible to ignore these names completely. Since the original Rules dealt with the status of subspecies names only, there was much doubt concerning the validity of the thousands or tens of thousands of names that were *not* clearly proposed as new subspecies. Realizing this deficiency, the International Commission at its Lisbon meeting directed the secretary to confer with specialists in representative branches of the animal kingdom in order to determine what status should be accorded to names given to forms of less than subspecific rank, with a view to the formulation of an Opinion on the subject.

The secretary's report was submitted to the International Commission at Paris (1948) and, after considerable discussion was adopted in much the following form:

Definitions: "*Subspecies*": A geographical or ecological population within a species which differs from any other such population within the same species. "*Infrasubspecific form*": Any form of a species other than a subspecies as defined above. This term therefore includes seasonal forms and minority elements of all kinds within a species, such as sexual forms, transition forms, aberrations, etc.

Provisions: (*a*) Any trivial name published prior to January 1, 1951 as the name of a taxonomic unit of less than specific rank shall be classified for the purposes of the Rules as follows:—(i) as the trivial name of a subspecies, when at the time of the original publication of the name the author concerned either (1) clearly indicated that he regarded the unit named as of subspecific rank or (2) did not clearly indicate the status attributed by him to the form so named, that is to say, whether he regarded it as being a subspecies or as being a form of infra-subspecific rank; (ii) as the trivial name of an infra-

subspecific form, only when at the time of the original publication of the name the author concerned expressly indicated that he regarded the form so named as being a form of infrasubspecific rank.

(*b*) Any trivial name published after the point of time specified above as the name of a taxonomic unit of less than specific rank shall be classified for the purposes of the Rules as follows:—(i) as the trivial name of a subspecies, only when, at the time of the original publication of the name, the author concerned clearly indicated that he regarded the form so named as being a subspecies; (ii) as the trivial name of a form of infrasubspecific rank, in all cases where, at the time of the original publication of the name, the author concerned either expressly indicated that he regarded the form so named as being a form of infra-subspecific rank or if he did not so indicate the status of the form, where he failed to indicate clearly that he regarded that form as being a subspecies.

(*c*) It is strongly recommended that an author when proposing a trivial name for a previously unnamed subspecies, or when re-naming a subspecies, the only published name for which is invalid under Article 35, should cite that name in a trinominal combination consisting of (1) the generic name, (2) the specific trivial name and (3) the subspecific trivial name and further that, by using the expression "ssp. n." or otherwise, he should clearly indicate both that the name is a new name and that it is intended to apply to a subspecies.

(*d*) The trivial names of subspecies shall be co-ordinate with the trivial name of species.

(*e*) A name given to any infra-subspecific form shall be co-ordinate with the name given to any other infra-subspecific form of the same species but not with names of subspecies and species.

(*f*) A name originally published as the name of an infra-subspecific form, if elevated to subspecific or specific rank by a subsequent reviser, shall rank in its new status for purposes of priority as from the date on which it was so elevated and shall be attributed to the author by whom it was so elevated.

(*g*) For the purposes of (*f*) above, an author need not expressly state that he is elevating the status of a name originally published as the name of an infra-subspecific form but he must so treat the name as to make it clear that he is in fact treating that name as the name of a subspecies.

(*h*) It is recommended that every author, when elevating to subspecific rank a name originally published as the name of an infra-subspecific form, should expressly state that he is so doing.

(*i*) Where a name, originally published as the name of an infra-subspecific form, is elevated to subspecific rank under (*f*) above but some other author does not recognize the taxonomic validity of the action taken by the previous reviser and in consequence continues to regard the organism in question as referable not to a subspecies but to an infra-subspecific form, the name for any such author shall retain its original priority and shall be attributed to its original author.

(*j*) Where a name originally published as the name of a species or subspecies is treated by a subsequent reviser as applying to an infra-subspecific form, the name shall retain its original priority and shall be attributed to its original author.

(*k*) When an author desires to cite by name an infra-subspecific form, he should cite that name immediately after the trivial name of the species, if no subspecific name is to be cited, and immediately after the subspecific trivial name, if a subspecific name is to be cited, provided: (i) that a comma be inserted immediately after the trivial name of the species or the subspecies, as the case may be; and (ii) that an expression indicating the status of the infra-subspecific form in question (*e.g.*, an expression such as "form vern.", " ♀-form," or "ab.") be inserted immediately before the name of the infra-subspecific form.

(*l*) When different names are applied to parallel infra-subspecific forms occurring in two or more allied species (*i*) the International Commission may, on application of specialists in the groups concerned, use their plenary powers to establish technical designations to be applied to such parallel forms, such designations: (1) to consist of Latin or Latinized words or words treated as such; and (2) to comply with the provisions in the *Rules* relating to the formation of specific and subspecific trivial names, and (*ii*) where a given term has been prescribed under the fore-going procedure to be the technical designation of a parallel form occurring in two or more allied species, the term so prescribed shall have absolute priority over: (1) any name which may already have been, or may thereafter be given to that form in any of the species concerned, and over (2) any other use of the same word as the name of any other infra-subspecific form of any species in the same genus or genera.

Procedure. The legal status of infraspecific names is defined in the above rules. It remains for the working taxonomists to decide in each group which, if any, of the infrasubspecific forms should appropriately be named and to which of the two "realms" a particular form pertains. This requires a clear understanding of infraspecific categories and concepts (see Chaps. 2 and 5) and in some cases unfortunately more information than is available in the usual museum collections.

The essential points of this ruling are (1) that only those trinominals proposed after Jan. 1, 1951, have status under the Rules which are clearly indicated as new subspecies by the author; (2) that the name of an infrasubspecific form that is elevated to subspecies rank dates from the date of such elevation and has as author the person who proposes the change of rank; (3) that the names of infrasubspecific forms do not affect the nomenclature of specific or subspecific names.

The long ruling of the International Commission does not clearly bring out that the infrasubspecific forms are not taxonomic categories in the sense of all the other taxonomic categories: *They are not populations.* Infrasubspecific forms are based on arbitrarily selected individuals within populations or on arbitrarily selected generations within populations.

The specialists of butterflies and other variable groups of insects, as well as of mollusks, seem to feel that the extraordinary variability of their material calls for a special nomenclatorial treatment. They therefore segregate (arbitrarily) the conspicuous variants within an investigated population into definite groups and give a special variety (=infrasubspecific) name to each of these groups. One might illustrate this procedure by applying it to human systematics. It would correspond to the procedure of an anthropologist who gave names not only to the conventionally recognized human races, such as to Mongolians, Australian aboriginals, Pygmies, Negroes, and so forth, but also to red-haired, black-haired, brown-haired, blond-haired individuals, also to those with blue eyes or brown eyes, with straight, wavy, curled hair, of small or large stature, and so forth. In addition he would give special names to aberrations, that is, to individuals which showed rarer deviations from the normal, such as harelip, clubfoot, birthmarks, and so forth. By applying this procedure to the species *Homo sapiens*, it becomes obvious how absurd it is, and this is equally true for other animals. The nomenclature of some genera of beetles, Lepidoptera, and snails has become so top-heavy with names given to "varieties" and "aberrations" (individual variants), that the picture of the significant intraspecific variation and population structure has become completely obscured (Mayr, 1942, p. 104).

In consequence, the naming of individual variants ("infrasubspecific forms") is on the whole frowned on by the biologically trained taxonomist.

Linsley (1944) has suggested a method for treating infraspecific variation which is presented in modified form below:

I. Subspecific realm (populations)

A. Namable when recognized

1. Subspecies (= populations which are more or less isolated as distinct geographical or ecological races)

II. Infrasubspecific realm (individual variants)

A. Naming optional (but not ordinarily recommended)

1. Varieties (recurrent discontinuous variations in a single interbreeding population, *e.g.*, Mendelian variations)

B. Naming not advisable (may be designated by standard terminology or symbols rather than by scientific names)

1. Sexual dimorphs (*X-us albus*, ♂; ♀)
2. Castes (*X-us albus*, soldier; ergate; ♀ dealate; ♀, etc.)
3. Alternate generations (*X-us albus*, agamic form; bisexual form; etc.)
4. Polymorphic forms (*X-us albus*, minor ♂; brachypterous ♀, fundatrix, migrant; etc.)
5. Seasonal forms (*X-us albus*, vernal form; Brood I; etc.)
6. Pathological forms (*X-us albus*, phthisogyne; mermithogyne, etc.)
7. Freaks, teratological specimens, and other aberrations.

CHAPTER 14

GENERIC NAMES

Perhaps the most important group of names in systematic nomenclature is the generic group. The generic name is not only the mainstay to which specific trivial names are attached, but it is also the foundation for the names of possible higher categories. Hence it must be unique, that is to say, different from every other generic name ever proposed for an animal.[1] That about 220,000 generic and subgeneric names have now been proposed in zoology further emphasizes the need for great caution and judgment in adding to this enormous list and in applying rules for the interpretation of the names already proposed.

In order to be available nomenclaturally, a generic or subgeneric name must satisfy two important conditions: (1) it must have been published (see p. 221); (2) publication must have been accompanied by an indication (see p. 222), or by a definition, or by a description. If originally published before 1758, it becomes valid only if expressly adopted by an author after Jan. 1, 1758; and if published after Dec. 31, 1930, it must be accompanied by (1) a statement indicating the characters of the genus concerned or, (2) in the case of a name proposed as a substitute for a name which is invalid by reason of being a homonym, with a reference to the name which is thereby replaced, and further, (3) it must include a type species designated in accordance with one or other of the Rules prescribed for determining the type species of a genus or subgenus solely on the basis of the original publication.[2] Also, it must not have been used as an intermediate term of the kind rejected by Opinion 124; it must have been published in the nominative singular (Opinion 183).

An author proposing a new generic name should make certain that his proposal does not omit any of the following five essential points:

1. A clear statement that it is a new genus: *X-us*, new genus
2. Coining of a generic name which does not violate the rules and recommendations

[1] However, "a generic name . . . is not invalidated by the earlier publication of the identical or a similar name of higher rank" (Opinion 102) or by the use of the same name in the plant kingdom (Art. 1).

[2] Paraphrased from Art. 25 of the International Rules of Zoological Nomenclature, Opinion 184 of the International Commission on Zoological Nomenclature, and minutes of the Paris meetings of the International Commission.

3. Ascertaining that the newly proposed name is not a homonym (preoccupied by earlier usage in some other group of animals) or a synonym (of a previously proposed name for the same group of species)

4. Presentation of a diagnosis which contains a clear statement of the characters in which the new genus differs from previously described genera

5. Unambiguous citation of the type species

The generic name denotes the general kind of animal. It is essentially a group designation, much like our surname, and serves as a category to which are assigned various specific trivial names (see also Chap. 3 for the concept of the genus). Because of the flexibility of generic limits as interpreted by different authors, it is necessary to settle upon a type species for each genus. This type becomes the focal point of the genus. Each subsequent student may have his own ideas concerning the limits of the genus and may add or remove one or one hundred species, but unless the generic name falls into synonymy or homonymy, it must always be used for the type species (see Chap. 12).

Formation of Generic Names. Generic names are single words in the nominative singular written with a capital initial letter. They are usually of classical origin, customarily Latinized names of Greek origin. Here, even more than in the case of species, good taste and judgment should be exercised in the formation of names, because a generic name is of concern to a larger group of people. Such absurdly long names as *Dolichocephalocyrtus* in the Coleoptera and *Electroheliocopsyche* in the Trichoptera inconvenience all who have occasion to use them.[1] Pronunciation of such beetle names as *Aaages* and *Zyzzyva* is difficult. Ridiculous names involving a play on words, such as Kirkaldy's (1904) *Peggichisme* (pronounced Peggy kiss me), *Polychisme*, *Nanichisme*, *Marichisme*, *Dolichisme*, and *Florichisme*, were condemned by the Zoological Society of London (1912).

The following types of word employed as nouns in the nominative singular may be taken as generic names:

1. Latinized Greek nouns selected from lists of Greek roots or combining forms or obtained by transliteration from a Greek lexicon. Examples: *Ancylus*, *Amphibola*, *Aolysia*, *Pompholyx*, *Physa*, *Cylichna*. The letters of the Greek alphabet are as follows:

A α a	alpha	a	Δ δ ∂	delta	d
B β ϐ	beta	b	E ε	epsilon	e
Γ γ	gamma	g	Z ζ	zeta	z

[1] The International Commission has formally rejected (Opinion 105) a series of long, awkward generic, subgeneric and specific trivial names in the Crustacea proposed by Dybowski. This Opinion quotes the following as one example of his names: *Cancelloidokytodermogammarus* (*Loveninuskytodermogammarus*) *loveni* Dybowski, 1926.

H η	eta	e	Π π	pi	p
Θ θ ϑ	theta	th	P ρ	rho	r, rh
I ι	iota	i	Σ σ s	sigma	s
K κ ϰ	kappa	k	T τ	tau	t
Λ λ	lambda	l	Υ υ	upsilon	y, u
M μ	mu	m	Φ φ ϕ	phi	ph
N ν	nu	n	X χ	chi	ch
Ξ ξ	xi	x	Ψ ψ	psi	ps
O ο	omicron	o	Ω ω	omega	o

2. Compound Greek words, in which the attributive should precede the principal word.[1] Examples: *Stenogyra*, *Pleurobranchus*, *Tylodina*, *Cyclostomum*, *Sarcocystis*, *Pelodytes*, *Hydrophilus*, *Rhizobius*. This does not, however, exclude words, formed on the model of *Hippopotamus*, in which the attributive follows the principal word. Examples: *Philydrus*, *Biorhiza*.

3. Latin substantives. Examples: *Ancilla*, *Auricula*, *Dolium*, *Harpa*, *Oliva*.

4. Compound Latin words. Examples: *Stiliger*, *Dolabrifer*, *Semifusus*.

5. Greek or Latin derivatives expressing diminution, comparison, resemblance or possession. Examples: *Dolium*, *Doliolum; Strongylus*, *Eustrongylus; Limax*, *Limacella; Limacia*, *Limacina*, *Limacites*, *Limacula; Lingula*, *Lingulella*, *Lingulepis*, *Lingulina*, *Lingulops*, *Lingulopsis; Neomenia*, *Proneomenia; Buteo*, *Archibuteo; Gordius*, *Paragordius*, *Polygordius*. Such words should always be pure, *i.e.*, both elements of Latin or both of Greek, never hybrids combining elements of both languages.

6. Mythological or heroic names. Examples: *Osiris*, *Venus*, *Brisinga*, *Velleda*, *Crimora*. If these are not Latin, they should be given a Latin termination. Examples: *Aegirus*, *Göndulia*.

7. Proper names used by the ancients. Examples: *Cleopatra*, *Belisarius*, *Melania*.

8. Modern patronymics, to which is added an ending denoting dedication. Rules for the formation of patronymic generic names are as follows: (*a*) Names terminating with a consonant take the ending *ius*, *ia*, or *ium* (*Selysius*, *Lamarckia*, *Köllikeria*, *Mülleria*, *Stâlia*, *Krøyeria*, *Ibañezia*. (*b*) Names terminating with the vowels *e*, *i*, *o*, *u*, or *y* take the ending *us*, *a*, or *um* (*Blainvillea*, *Wyvillea*, *Cavolinia*, *Fatioa*, *Bernaya*, *Quaya*, *Schulzea*). (*c*) Names terminating with *a* take the ending *ia* (*Danaia*). (*d*) Particles are omitted if not coalesced with the name (*Blainvillea*, *Benedenia*), while articles are retained (*Lacepedea*, *Dumerilia*). (*e*) With patronymics consisting of two words, only one should be used (*Selysius*,

[1] Grensted (1944) states that "when, in a compound, an attributive expresses action or activity, or even a state, it may either precede or follow the noun with which it is conjoined. When it expresses a quality it must precede it."

Targionia, Edwardsia, Duthiersia, Buenoa). (*f*) Proper names should not be combined with Greek or Latin attributive or principal words to form compound names. Names such as *Eugrimmia, Buchiceras,* or *Lichtensteinipicus* are monstrosities.

9. Names of ships. These should be treated in the same manner as mythological names or as modern patronymics. Examples: *Blakea, Hirondellea, Challengeria.*

10. Barbarous names (words of nonclassical origin). Examples: *Vanikoro, Chilosa.* Such words may be given a Latin termination. Examples: *Yetus, Fossarus.*

11. Words formed by an arbitrary combination of letters. Examples: *Neda, Clanculus, Salifa, Torix, Syndyas, Anaxo, Edeta, Amytis, Daria.*

12. Names formed by anagram. Examples: *Acledra, Claerda, Clardea, Clerada, Dacerla, Daclera, Daerlac, Dalcera, Eldarca, Erlacda, Lecadra, Racelda.*

In actual practice most zoologists decide on one or more distinctive features, either morphological or biological, of a new genus and then select several Greek words or combining forms which represent or describe these characteristics. Appropriate Greek words may be found by reference to an English-Greek lexicon or to dictionaries of Greek and Latin combining forms (Jaeger, 1944). Names are formulated by various combinations of Greek or Latin combining forms as detailed above. The names are then checked in Neave's *Nomenclator zoölogicus* and, for the period since the last volume of Neave, in the *Zoological Record.* If care is taken to avoid the commonest combining forms, *e.g., acantho* (spiny), *stoma* (mouth), it is surprisingly easy to coin a word which has never been used before. A convenient method, in the absence of other appropriate words or combining forms, is to modify the generic name of a near relative, *e.g., Paratriatoma* Barber, *Neotriatoma* Pinto, and *Eutriatoma* Pinto, all inspired by Laporte's genus *Triatoma.* Another procedure which is useful both to the coiner of the new name and to subsequent users of the name is to follow a traditional series, *e.g., Chionaspis, Diaspis,* etc., in the scale insects; *Leptocoris, Gelastocoris, Geocoris,* etc. in the true bugs; *Chirothrips, Taeniothrips,* etc., in the Thysanoptera.

The gender of generic names has been discussed in a previous chapter in connection with the agreement in endings of adjectival trivial names. It is well in forming new generic names to select words with classical endings, so that the gender of the name will not have to be established arbitrarily.

Homonymy. A generic name that has previously been used for some other genus of animals is to be rejected as a homonym. Example: *Trichina* Owen, 1835, nematode is rejected as a homonym of *Trichina* Meigen, 1830, insect (Art. 34). The extent to which names are to be considered homonyms if they differ only in minor details of spelling is stated in Art. 35 (see Chap. 11). Generic names that differ only slightly in their endings are not considered homonyms. Both names are valid in the following pairs of names: *Picus, Pica; Lorius, Loria; Chlorurus, Chlorura,* etc. (Art. 36, recommendations).

Designation of Type Species of Genera. There has been more controversy over the rules and practices of selecting generic types[1] than perhaps over any other single nomenclatural question. As seen above, stability is to a great extent dependent on a uniform system of designating the types and thus fixing generic names.

The genera of the Linnaean period were very wide, in fact, many Linnaean genera correspond to several modern families combined. The result is that in the post-Linnaean period one species after another was removed from the Linnaean genera and included in new genera. At this period there was no clear understanding of the type method, and all the species left in the genus after each elimination of species not belonging to it were considered as typical. This method was called *type fixation by elimination* and was the prevailing method of handling the delimitation of genera during the eighteenth and a good part of the nineteenth century. This is unfortunate, because the method and its application involved many uncertainties and ambiguities. Let us, for instance, consider genus *A* with the species *a, b, c, d, e, f, g,* and *h.* Subsequent author 1 proposed that species *b* and *c* ought to be eliminated by removal to the new genus *B,* and that species *f, g,* and *h* should be transferred to the previously known genus *C.* This left *a, d* and *e* in genus *A.* Author 2 disagreed with author 1; he considered *a, b,* and *c* as typical for genus *A,* made a new genus for *d* and *e,* and transferred *f, g,* and *h* to *C.* Finally, author 3 made a new genus for species *a.* By that time all the species of genus *A* had been eliminated, and the genus had become an empty shell. It was therefore realized by some authors that the only way to have certainty was to apply the type method (Chap. 12) to genera as well as to species. This method did not become universal until the latter half of the nineteenth century and was in fact not even included in the first versions of International Rules (1901). Article 30, which governs the fixation of generic types, was not included in the Rules until 1907.

The conflict between the elimination and the type-fixation principles has had an exceedingly adverse effect on the stability of generic nomenclature. There are literally thousands of cases where an original genus *A* with species *a–h* had been split by elimination into, let us say, genera *A* with species *a–c, B* with species *d–f,* and *C* with species *g* and *h,* but where the original revisers had neglected to fix a type species for genus *A*

[1] The International Commission (Paris, 1948) recommends that the term *genotype* not be used because of possible confusion with the same word as used in genetics.

(because it was not customary at that time). If now a subsequent reviser chose *d* as the type species of genus *A*, the name *A* had to be transferred to species *d–f*, the name *B* became a synonym of *A*, and the species *a–c* required a new generic name *D*. One of the main objects of the Monaco Resolution (for suspension of the Rules) was to mitigate the effects of the application of the type-fixation principle. This difficulty does not affect recently proposed genera, since the type-fixation principle has been in fairly universal use since 1850 and was made obligatory in 1930. If at the time of the drafting of the International Rules a compromise had been made between the two principles with respect to the names without originally fixed types, many upsetting changes of nomenclature could have been avoided. However, the proposal to go back at this late stage to the elimination principle, as advocated by Poche (1937) would lead to new nomenclatural turmoil and is to be rejected categorically.

The International Rules list detailed rules for the designation[1] of type species of genera proposed before Jan. 1, 1930, to be applied in the following order of precedence (Art. 30):

I. Cases in which the generic type is accepted solely upon the basis of the original publication:

(*a*) When in the original publication of a genus, one of the species is definitely designated as type, this species shall be accepted as type, regardless of any other consideration. (Type by original designation.) It was ruled (Opinion 7) that the formula "n.g., n.sp.," when used for only one of the new species under a new genus, is to be considered as type by original designation.

(*b*) If in the original publication of a genus, *typicus* or *typus* is used as a *new* specific trivial name for one of the species, such use shall be construed as "type by original designation."

(*c*) A genus proposed with a single original species takes that species as its type. (Monotypical genera.) According to Opinion 47 the foregoing statement is applicable irrespective of whether or not the author concerned regarded the genus as monotypical.

(*d*) If a genus, without originally designated (see *a*) or indicated (see *b*) type, contains among its original species one possessing the generic name as its specific or subspecific trivial name, either as valid name or synonym, that species or subspecies becomes *ipso facto* type of the genus. (Type by absolute tautonymy.)

II. Cases in which the generic type is accepted not solely upon basis of the original publication:

(*e*) The following species are excluded from consideration in determining the types of genera. (1) Species which were not included under the generic name at the time of its original publication.* (2) Species which were *species inquirendae* from the standpoint of the author of the generic name at the time of its publication. (3) Species which the author of the genus doubtfully referred to it.

(*f*) In case a generic name without originally designated type is proposed as a substitute for another generic name, with or without type, the type of either, when established, becomes *ipso facto* type of the other. It was further ruled (*Bul. Zool. Nomencl.* **4**:155,1950) that any of the species cited under the original as well as under the substitute name, where some or all of these are different, is eligible for selection as the type species of the genus.

(*g*) If an author, in publishing a genus with more than one valid species, fails to designate (see *a*) or to indicate (see *b*, *d*) its type, any subsequent author may select the type, and such designation is not subject to change. (Type by subsequent designation.) Furthermore (Opinion 64), a type may be selected irrespective of whether the nominal species is already the type of another nominal genus.

For the special case where there are only two originally included nominal species, the commission has ruled that type selection by elimination applies, *e.g.*, when one of the two originally included species is designated as the type of a new monotypical genus, that action automatically constitutes the selection of the remaining species as the type of the original genus.

Occasionally an author cites a nominal species as the type of a genus under the erroneous belief that it was correctly designated or selected by a previous author, or under the erroneous belief that the species was the type under some provision (such as the "Law of Elimination") not recognized in the Rules. It was ruled at Paris that in such cases the author is to be treated as having selected the type provided that he makes it clear that he accepts, for whatever reason, the species in question as the type species of the genus concerned.

The meaning of the expression "select the type" is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type.

III. Recommendations. In selecting types by subsequent designation authors will do well to govern themselves by the following recommendations:

(*h*) In case of Linnean genera, select as type the most common or the medicinal species. (Linnean rule, 1751.)

(*i*) If a genus, without designated type, contains among its original species one possessing as a specific or subspecific trivial name, either as valid name or synonym, a name which is virtually the same as the generic name, or of the same origin or same meaning, preference should be shown to that species in designating the type, unless such precedence is strongly contraindicated by other factors. (Type by virtual tautonymy.)

(*j*) If the genus contains both exotic and nonexotic species from the standpoint of the original author, the type should be selected from the nonexotic species.

[1] The International Commission decided (Paris, 1948) that the word *designation* should apply to Rule (*a*); *indication* to Rules (*b*), (*c*), and (*d*); and *selection* to Rule (*g*).

* According to Opinion 35, to be eligible for consideration in determining the types of genera, it is not necessary that a species should have been cited under a binominal name when cited in the original publication. Furthermore (Opinion 46), if no species was originally referred to the genus by name, then the first nominal species to be subsequently referred to it by the same or another author and agreeing with the generic description is considered as an originally included species and becomes the type species of the genus. When the first subsequent author to refer such species to such a genus referred to it two or more species and did not designate or indicate one as the type, all the species so referred become the sole originally included species from which the type may be selected by a subsequent author.

(*k*) If some of the original species have later been classified in other genera, preference should be shown to the species still remaining in the original genus. (Type by elimination.)

(*l*) Species based upon sexually mature specimens should take precedence over species based upon larval or immature forms.

(*m*) Show preference to species bearing the name *communis*, *vulgaris*, *medicinalis*, or *officinalis*.

(*n*) Show preference to the best-described, best-figured, best-known, or most easily obtainable species, or to one of which a type specimen can be obtained.

(*o*) Show preference to a species which belongs to a group containing as large a number of species as possible. (De Candolle's Rule.)

(*p*) In parasitic genera, select, if possible, a species which occurs in man or some food animal, or in some very common and widespread host species.

(*q*) All other things being equal, show preference to a species which the author of the genus actually studied at or before the time he proposed the genus.

(*r*) In case of writers who habitually placed a certain leading or typical species first as "chief de file," the others being described by comparative reference to this, this fact should be considered in the choice of the type species.

(*s*) In case of those authors who have adopted the "first species rule" in fixing generic type, the first species named by them should be taken as the types of their genera.

(*t*) All other things being equal, page precedence should obtain in selecting a type.

These rules seem simple enough, but numerous complexities arise, and indeed, it might be said that each case is a problem in itself. Special problems are raised by the cases in which no type was designated and no species included at the time when a new generic name was first proposed. Under these circumstances it is assumed that all the species in the world which agree with the description are potential candidates for inclusion in the genus and thus for selection as the type of the genus. The first subsequent reviser to include such species and the first to select one of these as the type fixes the genus. Thus the law of priority also applies to the actions of the first revisers.

The proper form for proposing a new generic name has been the subject of several rulings of the International Commission. The minimal requirements are stated in Art. 25 (see above), but at the Budapest Congress (1927) it was decided that as of Jan. 1, 1931, more rigorous requirements would be set up. According to the amended rules, a generic name had to be published either (1) with a summary of characters which differentiate or distinguish it from other genera or (2) with a definite bibliographical reference to such characters and (3) with the definite unambiguous designation of the type species.

This apparently desirable amendment created certain difficulties in actual practice, as follows: the words *definite bibliographic reference* were

interpreted rigidly by the International Commission (Lisbon, 1935) (Opinion 138), so that a new name published as a substitute name had to be accompanied by a bibliographical reference consisting of the name to be replaced, its author, the date of its publication, the work in which it was published, the number of the volume, and the number of the page on which the name appeared.

This so-called "ritualism" had the effect of invalidating many otherwise perfectly clear taxonomic works merely because of the failure of an author to comply with the particular form prescribed by the Commission. The question was considered at Paris (1948), and it was decided that such ideal procedures in regard to a bibliographic reference, while desirable, should be promulgated not as inflexible rules but rather as recommendations.

MISIDENTIFIED GENERIC TYPES

It is a *species*, not a name, that is the type of a given genus. A species is a natural object, a zoological unit. It is this object which is the type of the genus, just as a definite object, namely, a type specimen, is the type of a species. If the name of the object, namely, of the type species of the genus, changes, such a change does not affect its status as generic type. It is evident from the whole theory of taxonomy (Chap. 12) that it is not the name of the species which is the type of the genus, but the natural object which carries the name. In order to avoid confusion, it is well to select as generic types species the type specimens of which have been carefully studied and positively identified. Otherwise there is always the danger of misidentification and subsequent nomenclatural upheaval.

It is obviously impossible for subsequent authors to check in each case whether the species that was made the type of a genus was correctly identified and carried the correct name. Normally, "if an author designates a certain species as generic type, it is to be assumed that this determination of the species is correct" (Opinions 65 and 168). However, if there is evidence that the author based his genus on certain specimens which he misidentified, "it would be well to submit the case, with full details, to the Commission." Such cases are by no means rare.

For example, the genus *Gastrodes* was proposed by Westwood in 1840 with *Cimex abietis* Linnaeus as the type. A brief description was given, together with a bibliographical reference to a good figure of the species, *i.e.*, Panzer, (1805). *Gastrodes* was used in the above sense for half a century. Then Horvath, in 1898, examined the type of *C. abietis* Linnaeus in the collection of the Linnaean Society of London and found that it was an entirely different insect, known at the time as *Eremocoris erraticus* Fabricius.

If it is assumed that Westwood's determination of *C. abietis* Linnaeus was correct, then the name *Gastrodes* must be used for the large and well-known genus *Eremocoris*, and the species formerly belonging to *Gastrodes* must take the name of an old and very obscure junior synonym, *Oimoctes* Gistel. But in the above case we know that Westwood's determination was incorrect, because Panzer's colored illustration shows clearly the distinctive characters of *C. abietis* of authors, not Linnaeus. Accordingly, the case was submitted to the International Commission (China, 1943) and it was decided at Paris that the insect described by Westwood and illustrated by Panzer, and later named *Gastrodes abietum* by Bergroth, is to be taken as the type of *Gastrodes*, not the name *C. abietis* Linnaeus, which is now applicable to the species which stood formerly under the name *Eremocoris erraticus* Fabricius.

THE DIVIDING OR COMBINING OF GENERA

Special problems are raised when genera are divided or combined. In the former case, the valid name of the genus must be retained for the restricted genus which contains the type of the genus. If, on the other hand, two or more genera are combined, *e.g.*, synonymized, the oldest of the available generic names becomes the valid name, and this name retains as its type the nominal species previously designated, indicated, or selected.

Subgeneric Names. Subgeneric names "are subject to the same rules and recommendations" as generic names "and from a nomenclatural standpoint . . . are co-ordinate, that is, . . . of the same value" (Art. 6). A subgeneric name becomes a generic name if the subgenus is raised to full generic standing, and vice versa. If a genus is divided into two or more subgenera, the subgenus containing the original type of the genus is the typical or nominate subgenus and retains the name of the genus. This is not true in the botanical code but is universally accepted in zoology. The subgeneric name is cited in parentheses between the generic and specific trivial names thus: *Lygus* (*Lygus*) *pabulinus* Linnaeus, for a typical or nominate subgenus; and *L.* (*Neolygus*) *invitus* Say for a subgenus other than the nominate one.

To eliminate ambiguity in Art. 2, "The scientific designation of animals is uninominal for subgenera and all higher groups, binominal for species, . . . " the International Commission agreed (Paris, 1948) that, as the subgenus is an optional category, the name of a subgenus is not to be taken into account when determining the number of words comprised in the designation of species or subspecies.

CHAPTER 15

FAMILY NAMES

The names of the categories above the genus are always uninominal. It is their function to serve as name labels for the higher categories in which the species are classified.

The names of the higher categories are always in the plural, and many have a uniform termination that reveals their rank at a glance. Names for all categories from just above the (super)genus to and including the rank of superfamily (subtribe, tribe, subfamily, family, and superfamily) are based upon type genera. Names of still higher categories are of independent classical origin. The names of all the categories above the (super)genus are single words that are to be considered Latin plurals (whatever the actual etymological derivation). This must be kept in mind to avoid grammatical mistakes. One can say, "The family Fringillidae *is* the largest family of songbirds," but must say, "The Fringillidae *are* the largest . . . ." The same is true for orders, classes, and all other higher categories.

THE FAMILY GROUP OF NAMES

Family names, although not utilized by Linnaeus, were employed soon after his time (de Jussieu, 1789) and are now an essential part of our system of nomenclature. Actually most of the Linnaean genera were raised to families when the number of known species began to increase. At the present time family names are widely used in textbooks and in elementary courses in biology. This is particularly true for insects because of the large numbers of species. Even a professional entomologist relies on family names for insects outside his special field of investigation, and it is a rare taxonomist who knows *all* the families of insects that occur even in his immediate vicinity.

Family names are important to the economic entomologist and the general biologist, who use such names as *tachinid* and *noctuid* in the absence of any other group name for these well-known insects. Consequently, as Sabrosky (1947) has stated,

> The changing of familiar and long-recognizable [family] names and the continued use of conflicting names by different specialists contribute not only to confusion but to a low regard in some quarters for both taxonomy and nomenclature. For example, the pictured-winged flies of the family long known as the

Trypetidae are commonly called the trypetids, and they are widely known and recognized because of such common species as the cherry fruitflies, the apple maggot, or "railroad worm," the Mediterranean fruitfly, the goldenrod gall maker, and many others. Yet the appearance of such names for this family as Trupaneidae, Trypaneidae, Euribiidae and Tephritidae leaves the average reader only bewildered.

THE FORMATION OF FAMILY NAMES

The first somewhat vague and inconsistent attempts to introduce the category *family* in zoology were made in the seventies and eighties of the eighteenth century. Latreille (1796) was the first to apply the family concept to insects. He divided all insects into *families*, which he characterized but did not name. Duméril (1800) arranged the insects by orders and families (*familles naturelles*) but used family names in the French vernacular that were not based on the names of included genera (for instance, Lamellicornes and Brachelytres in the Coleoptera). Other authors in the following decade used vernacular family names that were based on included genera (*e.g.*, Latreille, 1802). Kirby (1813) first suggested the uniform ending *idae* as "a patronymic appellation . . . for instance, Coleoptera *Scarabaeidae*, Coleoptera *Staphylinidae*, Coleoptera *Sphaeridiadae*, Orthoptera *Gryllidae* . . . " This termination is a Greek plural meaning *like*.

Article 4 of the International Rules formalizes this practice as follows: "The name of a family is formed by adding the ending *-idae*, the name of a subfamily by adding *-inae*, to the stem of the name of the type genus." This has been extended by Van Duzee (1916) and others to include the endings *oidea* for superfamilies, *ini* for tribes, *i* or *ae* for subtribes, and *aria* for divisions.

Article 4 seems clear enough but has proved confusing in actual practice. The chief difficulty lies in determining just what is the stem of a generic name. The Strickland Code (1842) furnishes more help in this regard, stating that "these words are formed by changing the last syllable of the genitive case into *idae* or *inae*, as *Strix, Strigis, Strigidae, Buceros, Bucerotis, Bucerotidae*, not *Strixidae, Buceridae*." Formation of family names from generic names which differ only in Latin termination in the nominative and genitive is more obvious. Thus, *Carabus, Carabi, Carabidae*. If the stem ends in *i*, the resulting double *ii* is preserved, thus *Acridium, Acridii, Acridiidae*.

Some names are of unknown or nonclassical origin, and in such cases one cannot be sure of the stem. Thus it is not clear whether *Aphis* has as its stem *Aphi* or *Aphidid*. Furthermore certain genera like *Anthomyia* have an *ā* in their stem, which would result, according to Art. 4, in *Anthomyiaidae*. To avoid such difficulties Grensted (1947) proposed, and the International Commission (Paris, 1948) accepted, the following:

We can retain the general use of *-idae*, and *-inae* and also retain Article 4 in its present form, if we re-define the word "stem," using it not in the grammatical sense, with reference to classical Latin, but in a practical sense, applicable to scientific Latin. . . . This could be secured by a note attached to the Article in the following terms:

"For the purposes of Article 4 the term 'stem' is to be taken to mean either the grammatical and classical stem or such part of it as will make wholly clear the relation between the generic name and the name of the family or subfamily, and will at the same time give the family or sub-family name the simplest and most euphonious form compatible with that relationship. The stem, in this sense, will normally be found by putting the generic name into the genitive case and then cutting off the termination, *-ae*, *-i*, *-is*, or *-ius*, according to the ordinary rules of Latin declension."

THE SELECTION OF THE TYPE GENUS

No mention was made in the original Rules of the method of selecting the type genus of a family. The Strickland Code (1842) suggested "the earliest known, or most typically characterized genus." This suggestion grew out of Latreille's method of selecting a Linnaean genus which represented a general type of animal. Doubtful or annectent types were not utilized, because an effort was made to set aside a more or less uniform group centered around the single, presumably most typical, example upon which the name was based. This principle was not definitely formulated but was simply followed in a rather loose way, subsequent workers selecting typical, or sometimes (as it may now appear) atypical, genera.

During the early twentieth century, the "*oldest genus* type principle" found strong advocates in Kirkaldy, McAtee, Karny, and others. In actual practice these workers created such confusion that systematics was seriously impeded for a number of years. Kirkaldy at various times called the bed bug family Cimicidae, Cacodmidae, and Clinocoridae, and the chinch bug family Lygaeidae, Myodochidae, Geocoridae, and Pyrrhocoridae. Oberholser (1920) summarized the objections to the "oldest genus" method of selecting the type genera of families as follows:

(*a*). The family name would be changed when any genus with an older name is added to the group.

(*b*). The transfer of an older genus to another family would cause confusion by the corresponding transfer of the family name.

(*c*). Its universal application would produce wholesale changes in nomenclature.

(*d*). There would be no permanent concept of a family type.

The International Commission (Paris, 1948) agreed that, without prejudice to the thorough study of the problem of nomenclature of families which the secretary was invited to prepare for consideration by the Com-

mission at the Fourteenth Congress, words should be inserted in Art. 4 to make it clear (1) that the genus bearing the oldest available generic name in a family need not be taken as the type genus of a family; (2) that an author, when establishing a new family, is free to select as the type whatever genus he considers the most appropriate; (3) that the name of a family is to be based on the name of its type genus, and that the selection of a generic name to be the basis of a family name constitutes *ipso facto* a definite designation of the genus bearing that name to be the type genus of the family. Thus the principles expressed in Opinions 133 and 141 were formally incorporated in the Rules.

THE CHANGING OF FAMILY NAMES

In view of the tremendous importance of family names, particularly for nonspecialists, every effort should be made to preserve those that are well established. Article 5 of the International Rules states that "the name of a family or subfamily is to be changed when the name of its type genus is changed." Here, as at other levels in the taxonomic hierarchy, certain changes are inevitable as a result of new discoveries. Thus when two families are found to be synonymous, perhaps through the discovery of intermediate forms, one of the names must be suppressed. Most taxonomists also agree that it is undesirable to have two identical family names, at least in the same phylum or class of the animal kingdom. Hence the name of a family is changed if the type genus is found to be a homonym of the type genus of another family. The special problem of identical family names, such as Cyprinidae based upon *Cyprina* Lamarck, 1818, a mollusk, and *Cyprinus* Linnaeus, 1758, a fish, is to be dealt with by *ad hoc* decisions of the International Commission during the present period when the whole subject of the nomenclature of family names is *sub judice*.

Article 5 does not distinguish between the various types of name change to which the type genus of a family may be subjected. One of the commonest reasons for changing any name is, of course, synonymy. Such synonymy is usually subjective and therefore open to different opinions. The Committee on Generic Nomenclature of the Royal Entomological Society of London decided that there is no need to change a family name in such cases, if its type genus is an available synonym in the family (E. E. Green and W. E. China, *The Generic Names of British Insects*, Part 8, **235,** 1943). Although unofficial, this decision has been welcomed because it permits the use of many well-known names, some of which have even become the base for vernacular names (chironomid based upon *Chironomus* Meigen, 1803, a synonym of *Tendipes* Meigen, 1800).

It should be carefully considered by the Commission whether Art. 5 could not be revised in such a manner as to conform with the modern type

concept. Since it is the zoological genus which is the type of the family, not the name of the genus, there seems to be no reason for changing the name of the family when the name of the type genus is changed, even though the name of the family is originally formed from the name of the type genus.

GENERAL RECOMMENDATIONS

Although the entire subject of family names is *sub judice*, certain practices have come into general use and will undoubtedly form the basis for the formal treatment of the subject which the International Commission proposes to undertake. In lieu of a formal ruling, the following statements modified from Horvath (1912), Van Duzee (1916), Oberholser (1920), and Sabrosky (1939) may serve as a guide in the selection of family names:

1. The type of a family is a genus.
2. The first family name proposed and formed from a valid generic name shall stand, whether the genus be the oldest or youngest included in the group. The family concept will henceforth center about this type and may be enlarged or reduced by the addition or withdrawal of allied genera by subsequent revisers.
3. Such a family name is valid whether originally accompanied by a description or specific designation of a type genus or not, provided that it is clearly formed from an available generic name.
4. If the original name was written in colloquial form or with tribal, divisional, subfamily, or other ending but with the root of the type genus still indubitably recognizable, the name is valid, but the termination should be changed to *idae*, for family, etc.
5. The family always retains its original type genus.
6. The same rules apply to all categories above generic rank and below ordinal rank (superfamily, family, tribe, division, etc.), and transference of a name from one category to another simply involves a change to the appropriate termination, the type genus remaining the same.
7. If two or more families are united, the family name first proposed takes precedence, not the family name based on the older generic name.
8. The author of the family name is the one who first proposed the name, regardless of its termination. If the termination has been changed, the name may be placed in parentheses with the name of the reviser following, as in the case of authority citation for specific names.

CHAPTER 16

NAMES OF ORDERS, CLASSES, AND PHYLA

Names above the superfamily differ from all the lower group names in that they are not tied to a type. Higher group names are single words, usually of classical origin, and usually descriptive in a general way (Coleoptera = sheath-winged; Vertebrata = backboned, etc.). They are in the form of Greek or Latin plurals, so that in the case of insect orders we speak of one Coleopteron but of several Coleoptera.

Although names for higher groups are still not officially recognized in the International Rules,[1] they were used by Linnaeus in 1758. Under Regnum Animale, for example, he recognized six classes, Mammalia, Aves, Amphibia, Pisces, Insecta, and Vermes. Within each class he recognized orders, some of which remain today essentially as he proposed them. In the Insecta, for example, six of the seven orders of Linnaeus, *i.e.*, Coleoptera, Hemiptera, Lepidoptera, Neuroptera, Hymenoptera, and Diptera are recognized today in the same sense and, with certain exceptions, with the same limits as at the time of their original proposal. The seventh order, Aptera, was composite and has been broken up into several distinct groups.

Names have been changed as taxonomic knowledge increased, the Primates being the only Linnaean order of mammals which retains its original status (Simpson, 1945), whereas Glires Linnaeus, 1758, is now a "cohort," Ferae Linnaeus, 1758, is a "superorder," etc.

Despite the lack of rules governing the formation and use of higher group names, a surprising degree of stability has been achieved. Thus most general textbooks agree in the names of phyla and classes and even in the more numerous ordinal names. A notable exception, in the case of orders, is the confusion which exists in the Insecta. This situation dates back to the last half of the eighteenth century.

The system of classification employed by Linnaeus for the separation of insect orders was based on the structure of the wings. Hence Linnaeus's seven original ordinal names refer to wing characteristics and are formed by adding a descriptive prefix to the Greek *ptera* (wings): *e.g.*, Coleoptera (sheath wings), Lepidoptera (scale wings), Hemiptera (half wings), etc. Fabricius (1798) on the other hand, based his ordinal classification on the structure of the mouth-parts. Although he made a great contribution to the fundamental classification of insects by calling attention to the importance of these structures, he created several synonyms. For example, under the Fabrician system the Coleoptera were known as Eleutherata (free), referring to the free or distinctly separated mouth-parts; the Lepidoptera became Glossata (tongue); and the Hemiptera, the Rhyngota, later emended to Rhynchota (snout). The earlier ordinal names of Linnaeus are now accepted for all the Fabrician orders except one, the Odonata (a tooth), a name proposed for the dragonflies and damselflies which Linnaeus had included among the Neuroptera (nerve wings). Thus the eighth name for an insect order did not contain the ending *ptera*. This departure was followed by Latreille, who added the ordinal names Thysanura (tassel tail), Parasita (parasites), etc. Kirby (1813), foreseeing possible confusion, made a plea for the adoption of a uniform *ptera* ending for all ordinal names of insects, and a majority of the names since proposed have conformed to this rule. Some workers, including Shipley (1904), have gone so far as to emend those names without the *ptera* ending, with ludicrous results etymologically. For example, the *Embiidina* (lively), referring to the rapid running of the insects in their silken tunnels, became *Embioptera* (lively winged), a descriptive term which is highly inappropriate in a group where the females are mostly wingless and the males are slow, feeble fliers.

Even the principle of priority has not been universally applied for insect orders, with the result that modern textbooks refer to the earwigs as Dermaptera *or* Euplexoptera, the thrips as Thysanoptera *or* Physopoda, the fleas as Siphonaptera *or* Aphaniptera, etc.

Another source of confusion is the matter of uniform endings for names of a particular category. As shown in a previous section, uniform endings have been adopted for the various categories of names in the family group. This scheme is very useful, because the position of the name and the status of the group which it represents can be determined at a glance. As shown above, an attempt has been made to secure uniformity of the *ptera* ending for insect orders. This attempt has not been successful because of the absurdity of the resulting words (cf. Embioptera, above), and because such a ruling would threaten many old familiar names, such as Odonata (as against Paraneuroptera).

Some nomenclaturists want to go even further and propose a uniform ending for all ordinal names from the Protozoa up to the mammals. The ending that has been suggested most frequently is *formes*, to be attached to a type genus. Instead of Primates we might have Hominiformes, and Papilioniformes instead of Lepidoptera. The only group in which the

[1] The subject of names for higher categories is *sub judice*, the secretary having been asked (Paris, 1948) to prepare a full report on this subject for the next meeting of the Commission, scheduled for Copenhagen, 1953.

ending *formes* for orders has been used with any degree of consistency is the birds, and even there it threatens many familiar names, as, for instance, Tubinares (for shearwaters and petrels). Consequently several recent bird taxonomists (*e.g.*, Stresemann) continue with the time-honored ordinal names in the plural (*e.g.*, Alcae, Psittaci, Passeres, etc.). In the mammals, likewise, the ordinal names Primates, Rodentia, Insectivora, Edentata, Lagomorpha, Carnivora, Perissodactyla, etc., are much too well established to be upset "for the sake of uniformity."

Until the International Commission settles on detailed rules for names of higher categories, zoologists would do well to avoid drastic changes in well-known names. In cases of doubt or choice of several names, a few common-sense rules may be applied as follows:

1. The first higher group name proposed in an unambiguous manner should be accepted, regardless of the ending employed.

2. The author and date of higher group names should be cited, just as in the case of a name of a lower category.

3. When a composite group is divided, the original name should be retained for the "typical" group and a new name should be applied to the newly recognized group. Unfortunately, it is not always possible to determine the "typical" group because, unlike the situation with families, the name is not a positive indication of the type group but is only a clue. Thus if the insects with uniform wing texture (Homoptera) are removed from the Hemiptera, those insects with *half wings* and half leathery coverings logically should retain the original designation, Hemiptera. On the other hand, the loose assemblage of unrelated forms included by Linnaeus under the term Aptera pertains to several different arthropod classes, and the term gives no clue as to the "typical" group. In this and a few other cases the loosely applied term has been generally ignored and the first clear definition of the separate groups involved has been accepted. On the other hand, an equally valid argument might be advanced for the arbitrary assignment of the name to a particular group by the first reviser.

CHAPTER 17

ETHICS IN TAXONOMY

A so-called "Code of Ethics" to be observed in the renaming of homonyms was adopted by the International Commission on Zoological Nomenclature at its Monaco meeting in 1913. In the report of that meeting the Commission pointed out "that there exists in the zoological profession no recognized and generally adopted code of ethics that is comparable to the code of ethics existing in the medical profession of certain countries. Without presuming to be the arbiter of points of general ethics . . . " the Commission has from time to time issued Declarations or Opinions, which together constitute at least a start toward a code of ethics in the field of nomenclature.

The original point which prompted the Monaco Resolution was the procedure to be followed upon discovery of a preoccupied name. Three distinct problems are involved in this case: (1) procedure when the author of the preoccupied name is living; (2) procedure when the author is dead; and (3) procedure involving names outside the particular group with which the worker is concerned. The first of these problems is covered by Declaration 1 of the International Commission as follows:

> *Resolved,* That when it is noticed by any zoologist that the generic or specific name published by any living author as new is in reality a homonym, and therefore unavailable under Articles 34 and 36 of the Rules of Nomenclature, the proper action, from a standpoint of professional etiquette, is for said person to notify said author of the facts of the case, and give said author ample opportunity to propose a substitute name.

When the author of a newly discovered generic or specific homonym is dead, the discoverer is free to rename the genus or species as he likes. It is common practice in such circumstance to rename the category after the author of the homonym. However, this practice is by no means universal, nor is it always possible or desirable, and it is not a matter of ethics.

An ethical problem does arise, however, when a taxonomist discovers a homonym outside the group in which he is working. Under such circumstances it is the ethical procedure to permit the change to be made by someone who is familiar with the group and in a position to judge whether or not the change is required on zoological, as well as nomenclatural,

grounds. Neave (1939) has recently set such an example in his invaluable *Nomenclator zoologicus*. In the preface to the work he makes the following statement: " . . . many apparent homonyms have been, or require to be, sunk as synonyms on systematic grounds. I would therefore urge very strongly on my zoological colleagues that in their revisionary work they should confine themselves in [proposing new names for apparent homonyms] to the groups in which they are specialists . . . "

The question of what action should be taken in cases of breach of ethics was considered by the Commission at its Lisbon meeting (1935). At that time the Commission reaffirmed the Code of Ethics but at the same time "recorded their considered opinion that the question whether the Code of Ethics had been complied with in any given case was not a matter on which they were authorized to enter."

At Paris (1948) the Commission added a recommendation to the Rules

. . . condemning the selection as a generic name of a word which purported to be an arbitrary combination of letters but which, when pronounced, appeared to be a word or words in some language other than Latin, especially where those words had a bizarre, comic or otherwise objectionable meaning.

In contrast to the above recommendations, it was *ruled* that names "which can reasonably be regarded, in any language, as calculated to give offense on political, religious or personal grounds" are prohibited and upon submission to the International Commission, are to be suppressed.

Still another point in ethics was dealt with in Declaration 4 by the Commission at Monaco (1913). This was "the need for avoiding intemperate language in discussions on zoological nomenclature." Obviously this point is just as pertinent to general scientific writing as to the special field of nomenclature.

In the general field of systematic zoology a certain body of ethics has been built up, most of which is rather obvious to anyone who has a sense of moral responsibility, courtesy, and sensitivity to his fellow workers. However, it may be worth while to call attention to some of the points which, although obvious, are sources of offense, mistrust, and misunderstanding among taxonomists. It should be added that ethics in taxonomy is, of course, only a part of the larger subject of ethics for science as a whole (Pigman and Carmichael, 1950).

Credit. The giving of proper credit is one of the most important ethical responsibilities of the scientist. Acknowledgment should be made of all unpublished observations, determinations, and data derived from others. This not only involves ethics but should be practiced for self-protection if for no other reason. This credit should be given in a dignified manner. It is particularly bad practice to give credit by means of unauthorized quotations from letters. If an unpublished statement is to

be quoted, the author of the statement should be allowed to prepare it especially for that purpose.

Previously published data should never be utilized in such a way as to appear original.

Acknowledgment should be made of borrowed and donated specimens studied. The means by which this may best be accomplished vary with the amount of material received from any one source and the general plan of presentation of the paper. Usually ways may be found for such acknowledgment even in complex cases.

Photographs, drawings, and other illustrative material lent or donated by others should be credited. Credit should also be given to artists and photographers for their work, whether or not they received pay for their efforts. Good drawings or good photographs are scientific contributions on a par with descriptive work and are frequently far more accurate and useful.

Credit should be given to the collector, who, after all, is the real discoverer of the material and *not* the describer.

Assistance in outlining a research program (including the help of a major professor or senior colleague) should be acknowledged, as well as aid in the preparation of a manuscript by critical reading. Such acknowledgment should not be presented in such a manner, however, that the reader receives the impression that the persons involved necessarily approve of the conclusions or vouch for the results.

Finally, acknowledgment should be made of financial grants or of institutional aid, such as the use of laboratory facilities, libraries, etc. Frequently such help is a primary factor in making a particular taxonomic research project possible.

Collections. Obviously anyone who wishes may make a collection of animals. He may do so for any one of many reasons other than purely scientific ones. However, if his collection, or any part thereof, becomes the basis of a published scientific study, its status has immediately been changed and it has lost its wholly private nature. This is especially true if it contains type material. Types, in essence, belong to science as a whole, and the owner may be regarded as holding them in trust for science. This means that he is ethically bound to care for them and to make them available for any qualified scientist who wishes to come and examine them. No one who is unwilling to accept this responsibility and the obligations which it implies has any right to dabble in science, much less to pose as a scientist or patron of science. What is true at the individual level is equally true of institutions. Those responsible for institutional policy have a moral and ethical obligation to maintain and protect the collections in their care, to provide facilities for those who may wish to study them, to respond to requests for information on types,

etc. If the authorities involved are unable or unwilling to accept this responsibility, they should turn their collections over to an institution that will.

Type specimens assume such an important role in the taxonomy of lesser known groups that some workers have taken the stand that ethically, no one has the right to retain them in a private collection after their study has been completed. There is much to recommend this viewpoint, although there are some who insist on the right to retain types throughout their own lifetime, compensating for their monopoly by distributing paratypes, when available, as widely as possible.

Borrowed Material. No one is under obligation to lend material which he has collected, although most collectors, at either the amateur or the professional levels, are happy to do so. However, when a loan has been made, certain matters of custom and ethics affect both the borrower and the lender. The borrower is under ethical obligation to study the material as quickly as possible and return it in good condition within a reasonable length of time. This obligation obtains regardless of whether the loan was initiated by the borrower or the lender. In certain groups (*e.g.*, many invertebrates) where long series are usual, the borrower is entitled, by custom, to retain a certain proportion of the material in payment for his determinations. The lender should expect this, but unless arrangements to the contrary were made in advance, he also expects that all unique specimens and types will be returned. Some specialists expect the privilege of keeping the second specimen of each species if they so desire and every third specimen thereafter up to a short series. A few may expect to retain as much as half the series. Most, however, will keep but a small percentage of the material studied, and few abuse this privilege. In any event, the specialist should return a list of the material retained and the localities represented, especially for specimens borrowed from an institutional collection. It is advisable that an agreement on the division of the material be made at the time when the loan of the collection is arranged.

Exchange of Material. The exchange of specimens with other workers provides one of the simplest and least expensive methods of building up a representative collection in any group. In general, it is poor taste to insist upon exchanging specimen for specimen, except where institutional requirements or some other unusual factor demand it. Relationships with other workers can be maintained far more satisfactorily if the exchanger follows the general policy of always attempting to give more than value received. No specimen is important enough to the individual to justify quibbling or a quarrel with fellow taxonomists. Exchanges are particularly important on the species and genus level to permit the building up of complete synoptic series. The exchanging of specimens of subspecies is often undesirable, since it breaks up samples of variable local populations. This is particularly true when there is an overlap of characters between two or more variable populations.

Relations with Coworkers. A taxonomist's relations with his coworkers run the gamut of problems in human relationships. Two points only are singled out for special mention. He has an obligation to his science to maintain relationships on a level which permits the free exchange of ideas and to resist any outside influence which may be brought to bear to restrict the free exchange of ideas and scientific information. Further, for the welfare of systematics in general, he should keep his fellow workers informed as to what he is doing. This frequently forestalls needless duplication of effort or permits workers to supplement each other's efforts, or even to collaborate to the over-all benefit of the field. However, this procedure is subject to abuse, and no taxonomist should use this method to preempt a field or to restrict the research activities of others.

Suppression of Data. Obviously no scientist who is worthy of the appellation would deliberately suppress data. This is sometimes done by taxonomists inadvertently, however, or through carelessness, or through lack of understanding of the significance of their acts. This most frequently occurs through failure to mention specimens which do not "fit" the description or will not "run out" properly in the key. The author may be tempted to dismiss such specimens as atypical, or as freaks, aberrations, etc., or he may simply honestly not know just what to do with them. In any event, it is his responsibility in most cases to mention these specimens, since they may later provide a most valuable clue in the clarification of a taxonomic problem.

Undesirable Features of Taxonomic Papers. It hardly seems necessary to call attention to certain undesirable features of some taxonomic papers, especially since these involve bad taste rather than bad ethics; yet a perusal of contemporary publications reveals how frequently the reader is offended by them. The author should make a definite attempt to avoid (1) emotional phraseology, (2) controversy, (3) personal attacks, (4) too much use of the first person, and (5) evaluation of his own work. These five features probably offend the reader more than any other incidental aspects of a published article. Criticism is an important and all too infrequently exercised part of the scientific method, but it should be conducted in a dignified and constructive manner. In general, the author who indulges in personal attacks and pure controversy does more harm to his own reputation than to that of the worker with whom he disagrees.

Letter Writing. Letter writing involves certain elements of ethics, custom, and taste which are important to the taxonomist. Only a few such points are here emphasized.

The taxonomist frequently finds it necessary to write letters requesting

information, especially with regard to types. Such requests should ask for definite and specific information and should not be in general terms. The request that is too general not only offends the person who receives it but nearly always results in the receipt of an unsatisfactory reply. Letters requesting reprints should also be specific. Most authors resent a request for "a set of reprints of your papers," except under unusual circumstances. Few authors have an inexhaustible supply of their papers, and the majority prefer to distribute their limited stock to those who will obtain the greatest use from them. It is only rarely that all the reprints of any one author are of scientific interest to any other single author. For this reason the ethical thing to do is to request desired reprints by title. If the author wishes to send all his reprints, he is still free to do so. The receipt of reprints should be acknowledged, and in some cases, especially where the expense of shipment amounts to a significant item, the recipient should offer to refund the postage involved.

Requests for the loan of specimens should also be specific, in so far as possible, and should be accompanied by a statement of the reason for the request and some indication as to the length of time for which the material is needed. The qualified beginner may be unable to borrow certain material except through a loan to his institution, or a well-known colleague, or his major professor. In such cases any laxity in carrying out the conditions of the loan reflects not only on himself but also on the sponsoring individual or institution. In any case, if it should develop that the borrower is unable to complete his studies in the time designated, he should inform the party or institution which made the loan, without waiting and placing them in the embarrassing position of having to write and ask about the status of the study.

Finally, it should be remembered that most scientists save their correspondence, and that most institutional letter files are semipublic. For this reason, nothing should be included in a letter that the writer is not willing for any person to read. Personalities should not be discussed in a derogatory manner, and all letters should be carefully and tactfully prepared. Carbon copies of scientific correspondence should be retained by the writer both as a matter of scientific record and future reference and for reasons of self-protection.

Although ethics and good taste are not technically a part of the science of taxonomy, they are an important part of the relationship of the taxonomist with his fellow workers, and they may seriously influence his ability to contribute his share to the advancement of science.

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GLOSSARY

Accessory sexual characters. The structures and organs (except the gonads) of which the genital tract is composed, including accessory glands and external genitalia (cf. Primary, Secondary sexual characters).

Acquired character. A character which arises during the life of an individual, either in response to the environment or from a functional cause (cf. Lamarckism).

Adaptation. The condition of showing fitness for a particular environment, as applied to characteristics of a structure, function, or entire organism; also the process by which such fitness is acquired (cf. Preadaptation, Environment).

Adaptive. Fitted for a particular environment (cf. Environment).

Adaptive convergence. The evolution, or presence within a series of comparable ecological niches, of only distantly related forms which superficially resemble one another in morphological and other characters, correlated with very similar or identical environmental conditions (cf. Adaptation, Adaptive radiation).

Adaptive radiation. Evolution and spread of a single phyletic line of organisms into several distinctive ecological niches resulting in a series of sometimes strikingly different forms, each adapted to a particular niche.

"Age and Area." The hypothesis (by Willis) that the older a species is, the wider will be its geographical distribution.

Albinism. In zoology, the absence of pigmentation, and particularly of melanins, in an animal (cf. Melanism).

Allele. An alternative expression of a gene having the same locus in homologous chromosomes (cf. Gene).

Allochronic species. Species which do not occur at the same time level (cf. Synchronic species).

Allometric development. Differential growth rate of one part of an individual in relation to another part or to the individual as a whole.

Allopatric. A term applied to two or more populations which occupy mutually exclusive (but usually adjacent) geographical areas (cf. Sympatric).

Allopatric hybridization. Hybridization between two allopatric populations (species or subspecies) along a well-defined contact zone (cf. Sympatric hybridization).

Allopatric speciation. Species formation during geographical isolation (cf. Sympatric speciation).

Allotype. A paratype of the opposite sex to the holotype (cf. Paratype).

Alpha taxonomy. The level of taxonomy concerned with the characterization and naming of species (cf. Beta taxonomy, Gamma taxonomy).

Alternation of generations. The alternation of a bisexual with a unisexual generation.

Amphiploid. A polyploid produced by the chromosome doubling of a species hybrid, that is, of an individual with two rather different chromosome sets.

Analogous. Similar in external features or function but not in essential structural pattern or origin (cf. homologous).

Anatomy. The science of internal morphology, as revealed by dissection.

Antibody. A serum globulin which is produced in the blood of an immunized animal in response to the introduction of a foreign antigen (cf. Antigen, Antiserum, Serum globulin, Serology).

Antigen. A substance capable of inducing the formation of antibodies when introduced into the blood stream of animals (cf. Antibody, Precipitin reaction, Serology).

Antiserum. Blood serum containing specific antibodies (cf. Antibody, Precipitin reaction).

A.O.U. Code. A code of nomenclature published in 1885 (revised 1908) by the American Ornithologists' Union for the standardization of bird nomenclature.

Archetype. A hypothetical ancestral type arrived at by the elimination of specialized characters (cf. Phylogeny).

Artenkreis (Rensch). Superspecies (q.v.).

Artificial classification. Classification based upon characters of convenience without relation to phylogenetic significance; classification based upon characters erroneously presumed to indicate phylogenetic relationship; also classification based on a single arbitrarily chosen criterion, instead of an evaluation of the totality of characters (cf. Classification, Phylogeny, Natural classification).

Asexual reproduction. Not involving the fusion of the nuclei of different gametes.

Atlas. In taxonomy, a method of presenting taxonomic materials primarily by means of comparative illustrations rather than by comparative descriptions (cf. Monograph).

Authority citation. The custom of citing the name of the author of a scientific name or name combination [*e.g.*, *X-us* Jones, *X-us albus* Jones, *Y-us albus* (Jones)]; **Double authority citation** includes the name of the author of the specific trivial name and the author of the currently accepted combination if different from the original combination [*e.g.*, *Y-us albus* (Jones) Smith].

Autosome. One of the chromosomes other than a sex chromosome; autosomes usually occur in identical numbers in the two chromosome sets of the same species (cf. Chromosome, Sex chromosome).

Available name. A name proposed in compliance with Art. 25 of the International Rules of Zoological Nomenclature (cf. Valid name).

Backcross. A cross between a hybrid and one of its parents; a cross between a heterozygote and a homozygote (cf. Hybridization, Heterozygous, Homozygous).

Beta taxonomy. The level of taxonomy concerned with the arranging of species into a natural system of lesser and higher categories (cf. Alpha taxonomy, Gamma taxonomy).

Bibliographical reference. For nomenclatural purposes, the citation of the name of the author and date of publication for a scientific name; a **Full bibliographical reference** includes, in addition, the citation of the exact place of publication of a scientific name (*i.e.*, title of book or journal, volume, page, etc.).

Binary nomenclature. Synonymous with, and to be replaced by, the term *binominal nomenclature*, by decision of the International Commission on Zoological Nomenclature (cf. Binominal nomenclature, Binomial nomenclature).

Binomial nomenclature. The system of nomenclature first standardized by Linnaeus and now generally referred to as binominal nomenclature (cf. Binominal nomenclature, Binary nomenclature).

Binominal nomenclature. The system of nomenclature adopted by the International Congress of Zoology, by which the scientific name of an animal is designated by both a generic and specific trivial name (cf. Binary nomenclature, Binomial nomenclature).

Biological character. A taxonomic attribute of a living organism (in contrast to the museum specimen), hence usually a character which is not strictly morphological (cf. Taxonomic character).

Biological race. Noninterbreeding sympatric populations, which differ in biology but not, or scarcely, in morphology; supposedly prevented from interbreeding by preference for different food plants or other hosts (cf. Sibling species).

Biota. The flora and fauna of a region (cf. Fauna, Flora).

Biotype. A population or group of individuals composed of a single genotype (cf. Population, Genotype).

Bisexual. A population composed of functional males and females; applied also to an individual possessing functional male and female reproductive organs (= hermaphrodite).

Blending characters. Characters which merge and do not show clear-cut Mendelian segregation (cf. Blending inheritance).

Blending inheritance. Inheritance (generally due to multiple factors) in which clear segregation is not evident in the F_2 generation (cf. Multiple factors).

Catalogue. An index to taxonomic literature arranged by taxonomic categories so as to provide ready reference to at least the most important taxonomic and nomenclatural references to the category involved (cf. Check list).

Category. *See* Taxonomic category.

Character. *See* Taxonomic character.

Character gradient. *See* Cline.

Check list. Usually a skeleton classification of a group listed by taxonomic categories for quick reference and as an aid in the arrangement of collections (cf. Catalogue).

Cheironym. A manuscript name (q. v.).

Chorology. The study of the geographical distribution of organisms.

Chromosome. One of the deeply staining chromatin bodies, formed in the nucleus of a cell during mitosis, which carries the genetic factors (cf. Gene).

Classification. The definition, ranking, and arrangement of taxonomic categories and taxonomic entities (cf. Taxonomy, Systematics, Horizontal classification, Vertical classification, Artificial classification, Natural classification).

Cline. A gradual and nearly continuous change of a character in a series of continuous populations; a character gradient (cf. Subspecies).

Clone. All the offspring derived by asexual reproduction from a single sexually produced individual.

Coefficient of difference. Difference of means divided by sum of standard deviations

$$\text{C.D.} = \frac{M_B - M_A}{\text{S.D.}_A + \text{S.D.}_B}$$

Coefficient of variability. The standard deviation as percentage of the mean:

$$\frac{\text{S.D.} \times 100}{M}$$

Coenospecies. All the ecospecies so related that they may exchange genes among themselves to a limited extent through hybridization (cf. Ecospecies, Introgressive hybridization).

Colloquial name. Common name = vernacular name (q.v.).

Common name. Colloquial name = vernacular name (q.v.).

Complex. A neutral term for a number of related taxonomic units, most commonly involving units in which the taxonomy is difficult or confusing (cf. Group. Neutral term).

Congeneric. A term applied to species of the same genus (cf. Genus).

Conspecific. A term applied to individuals or populations of the same species (cf. Species).

Contemporary species. Synchronic species (q.v.).

Continuity. In nomenclature, the principle that continuity of usage should supersede priority of publication in determining which of two or more competing scientific names should be adopted for a particular taxonomic category (cf. Law of priority).

Continuous variation. Variation in which individuals differ from each other by infinitely small steps, as variation in quality of expression of a character or group of characters (cf. Discontinuous variation).

Convergence. Morphological similarity in distantly related forms (cf. Adaptive convergence).

Cotype. Syntype (q.v.).

Cryptic species. Sibling species (q.v.).

Cyclomorphosis. A seasonal (and thus cyclic) nongenetic change of phenotype in species of planktonic fresh-water organisms, particularly cladocerans and rotifers.

Cytogenetics. The study of cell structures in relation to the phenomena of heredity.

Cytology. The study of the structure and physiology of the cell and its parts.

Dall Code. A code of nomenclature prepared by W. H. Dall at the direction of the American Association for the Advancement of Science (1877).

Definition. In taxonomy, a formal statement of characters which sets limits to a taxonomic category (cf. Description, Diagnosis, Differential diagnosis, Taxonomic category).

Deme. A population within a species [*see Nature*, **144**:333(1939)].

Dendrogram. A diagrammatic drawing in the form of a tree designed to indicate degrees of relationship as suggested by degrees of similarity (cf. Phylogenetic tree).

Description. In taxonomy, a more or less complete formal statement of the characters of a taxonomic category without special emphasis on those which set limits to the category or distinguish it from coordinate taxonomic units (cf. Definition, Diagnosis, Differential diagnosis Taxonomic category).

Diagnosis. In taxonomy, a formal statement of the characters (or most important characters) which distinguish a taxonomic category from other similar or closely related coordinate categories (cf. Differential diagnosis, Definition, Description, Taxonomic category).

Differentiae specificae. The descriptive method developed by Linnaeus whereby a series of descriptive words was used to distinguish each species from all others.

Differential diagnosis. A formal statement of the characters which distinguish a given taxonomic unit from other specifically mentioned equivalent units (cf. Diagnosis, Definition, Description, Taxonomic category).

Dimorphism. Occurrence of two distinct morphological types (forms) in a single population (cf. Sexually dimorphic, Polymorphism).

Diploid. Having a double set of chromosomes ($2n$), the normal chromosome number of the cells (except for mature germ cells) of a particular organism derived from a fertilized egg (cf. Haploid, Polyploidy, Chromosome).

Discontinuous variation. Variation in which the individuals of a sample fall into definite classes which do not grade into each other, as variation in qualitative characters (cf. Continuous variation).

Division. *See* Section.

Dollo's rule. That structures or functions once gained may be lost, but once lost they can never be regained.

Dominant. In ecology, genetics, and psychology, superior in frequency or rank; a gene that is expressed in the phenotype in like manner regardless of whether the individual is homozygous or heterozygous for this gene (cf. Recessive, Homozygous, Heterozygous).

Double authority citation. *See* Authority citation.

Douvillé Code. A code of nomenclature prepared by H. Douvillé (1881) for the International Congress of Geology and designed to set the procedures for the naming of fossils.

Drift. *See* Genetic drift.

Ecological isolation. A condition in which interbreeding between two or more otherwise sympatric populations is prevented by mating in different ecologic niches (cf. Reproductive isolation, Geographic isolation, Genetic isolation).

Ecological race. Subspecies (q.v.).

Ecology. The study of the relationship between organisms and their environment.

Ecophenotypic variation (habitat variation). A nongenetic modification of the phenotype by specific ecological conditions, particularly those of a habitat.

Ecospecies. "A group of populations so related that they are able to exchange genes freely without loss of fertility or vigor in the offspring" (Turesson).

Ecotype. A descriptive term applied to plant races of varying degrees of distinctness which owe their most conspicuous characters to the selective effects of local environments (cf. Subspecies).

Edaphic factor. The influence of soil properties on organisms (especially plants).

Emendation. In nomenclature, an intentional modification of the spelling of a previously published scientific name (Cf. Error, *Lapsus calami*).

Environment. The total of physical, chemical, and biotic conditions surrounding an organism.

Error. In nomenclature, an unintentional misspelling of a scientific name, as a typographical error or an error of transcription (cf. Emendation, *Lapsus calami*).

Eyepiece micrometer. A linear scale in the field of vision of the eyepiece (or one of a pair of eyepieces) of a microscope for use as a measuring device.

F_1 generation. The first-generation offspring of a particular mating.

F_2 generation. Progeny derived from a mating within the F_1 generation.

Facies. In taxonomy, the general aspect, appearance, or habitus of a species or group.

Family. A taxonomic category including one genus or a group of genera or tribes of common phylogenetic origin, which is separated from related similar units (families) by a decided gap, the size of the gap being in inverse ratio to the size of the unit (family).

Family name. The scientific designation of a family, recognized by the termination *idae*, which termination, by action of the International Commission on Zoological Nomenclature, may not be used in names of other taxonomic categories [for minor exceptions in specific trivial names, *see Bul. Zool. Nomencl.*, **4**:262 (1950)] (cf. Subfamily name).

Fauna. The animal life of a region (cf. Flora, Biota).

Faunal work. A method of presenting taxonomic materials defined primarily by geographic area rather than by phylogenetic units (cf. Local list, Monograph).

First Reviser. The first author to publish a definite choice of one among two or more conflicting nomenclatural or zoological interpretations which are equally available under the Rules; in order to qualify as first reviser an author must give evidence of a choice between available alternatives.

Flora. The plant life of a region (cf. Fauna, Biota).

Form. A neutral term for a single individual or taxonomic unit (cf. Group, Neutral term).

Formenkreis. A collective category of allopatric subspecies or species (Kleinschmidt); in paleontology, a group of related species or variants.

Full bibliographical reference. *See* Bibliographical reference.

Full bibliographical synonymy. A reasonably complete list of references to a given taxonomic category arranged so as simultaneously to serve the needs of nomenclature (chronology of names) and zoology (pertinent taxonomic and biological sources) (cf. Synonymy).

Gamma taxonomy. The level of taxonomy dealing with various biological aspects of taxa, ranging from the study of intraspecific populations to studies of speciation and of evolutionary rates and trends (cf. Alpha taxonomy, Beta taxonomy).

Gause's rule. The theory that no two species with identical ecological requirements can coexist in the same place.

Gene. A hereditary determiner; the unit of inheritance, carried in a chromosome, transmitted from generation to generation by the gametes, and controlling the development of the individual (cf. Chromosome).

Gene flow. The exchange of genetic factors between populations owing to dispersal of zygotes or gametes, *e.g.*, pollen.

Gene frequency. The percentage of a given gene in a population (cf. Gene, Population).

Generitype. Genotype in the nomenclatural sense (cf. Genotype).

Generotype. Genotype in the nomenclatural sense (cf. Genotype).

Genetic drift. Genetic changes in populations due to random fixation rather than to selection; the so-called "Sewall Wright effect" (cf. Local population).

Genetic isolation. A condition in which interbreeding between two or more populations is prevented by sterility barriers (cf. Reproductive isolation, Geographic isolation, Ecological isolation).

Genotype. In nomenclature (not recommended, International Commission, 1948), the type species of a genus (cf. Type species); in genetics, the class in which an individual falls on the basis of its genetic constitution, without regard to visible characters (cf. Phenotype).

Genus. A taxonomic category including one species or a group of species, presumably of common phylogenetic origin, which is separated from related similar units (genera) by a decided gap, the size of the gap being in inverse ratio to the size of the unit (genus).

Geographic isolation. A condition in which interbreeding between two or more allopatric populations is prevented by extrinsic barriers or geographic discontinuity (cf. Reproductive isolation, Ecological isolation, Genetic isolation).

Geographical race. Subspecies (q.v.).

Group. A neutral term for a number of related taxonomic units, especially an assemblage of closely related species within a genus (cf. Complex, Neutral term, Section).

Gynandromorph. An individual in which one part of the body is masculine, the other feminine; most frequent are bilateral gynandromorphs, in which the left and right halves are of different sex.

Handbook. In taxonomy, a publication designed primarily as an aid to field and laboratory identification rather than for the presentation of new taxonomic conclusions (cf. Manual, Monograph).

Haploid. The single or basic number (n) of chromosomes for the species as found in mature germ cells (cf. Diploid, Polyploidy, Chromosome).

Hermaphrodite. An individual having both male and female reproductive organs (cf. Intersex).

Heterozygous. Having different alleles at one locus (cf. Allele, Locus, Homozygous).

Hierarchy. In classification, the system of ranks which indicates the taxonomic level of various taxonomic categories (*i.e.*, kingdom to species) (cf. Taxonomic category).

Higher category. A taxonomic category of rank higher than the species (*i.e.*, from subgenus to kingdom) (cf. Supraspecific).

Holotype. "The single specimen designated or indicated as 'the type' by the original author at the time of the publication of the original description" [*see Bull. Zool. Nomencl.*, **4**:186 (1950)].

Homologous. Similarity of organs, parts, or functions with comparable features in another species or group as a result of a structural pattern derived from a common ancestor (cf. Analogous).

Homonym. In nomenclature, one of two or more identical but independently proposed names for the same or different taxa (cf. Senior homonym, Junior homonym, Primary homonym, Secondary homonym).

Homozygous. Having identical alleles at one locus (cf. Allele, Locus, Heterozygous).

Horizontal classification. Classification based upon organisms which coexist in time; classification which, according to Simpson, separates ancestral from descendent groups and unites contemporaneous groups, or those in a similar stage of evolution, if they are derived from a common ancestry (cf. Classification, Vertical classification).

Hybridization. The production of individuals from genetically unlike parents (cf. Heterozygous); in taxonomy, crossing between individuals from different populations, especially different species (cf. Sympatric hybridization, Allopatric hybridization).

Hypodigm. The entire known material of a species which is available to the taxonomist.

Industrial melanism. The evolutionary development of a darker population favored by selection in the darkened surroundings of an industrial area (cf. Melanism).

Infraspecific. Within the species; usually applied to categories (subspecies) and individual forms (varieties) (cf. Subspecies, Variety, Infrasubspecific form).

Infrasubspecific form. Individual and seasonal variants in a single interbreeding population (cf. Variety, Infrasubspecific name).

Infrasubspecific name. The trivial name of an infrasubspecific form (cf. Subspecific name, Infrasubspecific form) [for nomenclatural status *see Bul. Zool. Nomencl.* **4**:89–96 (1950)].

Intergradation. Merging gradually through a continuous series of intermediate forms or populations.

International Code. A term sometimes applied to the *Régles Internationales de la Nomenclature Zoologique* (International Rules of Zoological Nomenclature).

International Rules of Zoological Nomenclature. Règles Internationales de la Nomenclature Zoologique (q.v.).

Intersex. An individual more or less intermediate in phenotype between male and female (cf. Hermaphrodite).

Introgressive hybridization. The spread of one or more genes of one species into the germ plasm of another species as a result of hybridization (cf. Hybridization, Coenospecies).

Irreversibility. *See* Dollo's rule.

Isolating mechanism. Any intrinsic agent which hinders the interbreeding of groups of individuals.

Isophenes. Lines connecting points of equal expression of a character; lines at right angles to a cline on a map (cf. Cline).

Junior homonym. The more recently published of two or more identical names for the same or different taxonomic categories (cf. Homonym, Senior homonym).

Junior synonym. The more recently published of two or more available synonyms for the same taxonomic category (cf. Synonym, Senior synonym).

Karyological character. A character involving chromosome structure or number (cf. Taxonomic character).

Key. A tabulation of diagnostic characters of species (or genera, etc.) in dichotomous couplets facilitating rapid identification.

Lamarckism. The theory advocated by Lamarck, that evolution is brought about by the inheritance of acquired characters.

Lapsus calami. In nomenclature, a slip of the pen, especially an error in spelling (cf. Error, Emendation).

Law of priority. The provision in the International Rules of Zoological Nomenclature that the correct name for a genus or species can be only that name under which it was *first* designated in conformance with the requirements laid down in those rules.

Lectotype. One of a series of syntypes which, subsequent to the publication of the original description, is selected and designated through publication to serve as "the type" [*see Bul. Zool. Nomencl.* **4**:186(1950)] (cf. Syntype).

Line. As a unit of measure, $\frac{1}{12}$ in. or 2.12 mm. (cf. Millimeter).

Local list. A publication giving a listing of the animals or plants recorded from a locality or district.

Local population. The individuals of a given locality which potentially form a single interbreeding community (cf. Natio, Subspecies).

Locus. The hypothetical position of a gene in a chromosome (cf. Gene, Chromosome).

Lumper. In taxonomy, one who tends to unite related units into a single taxon; one whose criteria for determining the level to be assigned to a given taxonomic category are such that the effect of his work is to lower the rank of existing categories (as families to subfamilies, species to subspecies) (cf. Splitter).

Manual. Handbook (q.v.).

Manuscript name. In nomenclature, an unpublished scientific name (cf. *Nomen nudum*).

Material. In taxonomy, the sample available for taxonomic study (cf. Series, Hypodigm).

Melanism. An unusual darkening of color owing to increased amounts of black pigment; sometimes a racial character, sometimes, as in cases of polymorphism, restricted to a certain percentage of individuals within a population (cf. Industrial melanism, Albinism).

Metatype. A specimen compared by the author of the species with the holotype and determined by him as conspecific with it.

Metric system. A decimal system of measures (with the meter as base) and weights (with the gram as base); the universal system for reporting measures and weights in the scientific field.

Microbiology. The science which deals with the study of microorganisms; the biological relationship of microorganisms.

Microgeographic race. A local race, restricted to a very small area.

Millimeter (mm.). 1/1,000 m., or 0.03937 in., approximately $\frac{1}{25}$ in. (cf. Metric system).

Mimetic polymorphism. The occurrence within a population of several (often strikingly different) forms, each of which resembles closely a different sympatric species, in butterflies often restricted to females.

Monograph. In taxonomy, an exhaustive treatment of a phylogenetic group in terms of all available information pertinent to taxonomic interpretation; usually involving full systematic treatment of all included taxonomic units in terms of comparative anatomy, biology, ecology, and detailed distributional analyses (cf. Revision, Synopsis).

Monophyletic. A term applied to a taxonomic category in which the contained units are all part of a single immediate line of descent (cf. Polyphyletic).

Monotypic. A category containing but one immediately subordinate zoological unit, as a genus containing but one species, or a species containing but one (the nominate or nominotypical) subspecies [for nomenclatural meaning, *see Bul. Zool. Nomencl.*, **4**:153 (1950)] (cf. Polytypic).

Multiple factors. Two or more pairs of genes with a complementary or cumulative effect (cf. Blending inheritance).

Mutation. In genetics, a discontinuous change of a genetic factor; in paleontology, a sudden change in a phyletic series of fossils.

Mythical name. A name proposed for hypothetical or mythical forms; without status in nomenclature.

Natio. Local populations within a subspecies (cf. Population, Local population, Subspecies).

Natural classification. As currently used, classification based on characters or groups of characters which indicate phylogenetic relationship (cf. Classification, Phylogeny, Artificial classification).

Natural selection. The process by which the environment eliminates the less well-adapted members of a population or causes a differential reproductive success of different genotypes; the "survival of the fittest."

Natural system. The arrangement of taxonomic categories in a hierarchy based on an evaluation of all their known characters.

Neontology. The systematics of recent organisms (cf. Paleontology).

Neoteny. Attainment of sexual maturity in an immature or larval stage.

Neotype. A specimen selected as type subsequent to the original description in cases where the primary types are definitely known to be destroyed.

Neutral term. A taxonomic term of convenience, such as form or group, which may be employed without reference to the formal taxonomic hierarchy of categories, and which has no nomenclatural significance.

New name. A new name for a preoccupied name (cf. Substitute name).

Niche (ecological). The precise constellation of environmental factors into which a species fits or which is required by a species.

Nomenclator. A book containing lists of scientific names assembled for nomenclatural, rather than taxonomic, purposes (cf. Catalogue).

Nomenclature. A system of names (cf. International Rules of Zoological Nomenclature).

Nomenclature binaire. *See* Binary nomenclature.

Nomen dubium. The name of a nominal species for which available evidence is insufficient to permit recognition of the taxonomic species to which it was applied [for nomenclatural status *see Bul. Zool. Nomencl.*, **4**:76 (1950)].

Nomen novum. New name (cf. Substitute name).

Nomen nudum. A published scientific name which does not meet the requirements for availability defined in Art. 25 of the International Rules of Zoological Nomenclature (cf. Valid name).

Nomen rejectum. Rejected name (q.v.).

Nomen specificum. Specific name (q.v.).

Nomen triviale. Trivial name (q.v.).

Nomen vanum. An indeterminate name (cf. *Nomen dubium*).

Nomina conservanda. Names whose usage has been preserved by agreement or decision in spite of actual or potential conflict with established rules of nomenclature; often applied to the Official Lists established by the International Commission on Zoological Nomenclature (cf. Official List of Generic Names in Zoology).

Nominal genus. "The concept denoted by a given generic name," as contrasted with the concept represented by a taxonomically accepted genus (International Commission).

Nominal species. "The concept denoted by a given specific name," as contrasted with the concept represented by a taxonomically accepted species (International Commission).

Nominate subspecies. Nominotypical subspecies (q.v.).

Nominotypical subgenus. That subgenus of a polytypic genus which shares with its genus the same type species and the same name [*e.g., X-us* (*X-us*) *albus* in contrast to *X-us* (*Y-us*) *rufus*] (cf. Subgeneric name).

Nominotypical (or nominate) subspecies. That subspecies of a polytypic species which shares with its species the same type specimen and the same name; the subspecies of a species with the earliest valid name (*e.g., X-us albus albus* in contrast to *X-us albus niger*).

Objective synonym. An absolute or nomenclatural synonym resulting from the proposal either of a replacement name for a supposedly preoccupied name or of names based on the same specimen, illustration, or taxonomic entity (cf. Synonym, Subjective synonym).

Official Index of Rejected and Invalid Generic Names in Zoology. A record of generic names suppressed by the International Commission on Zoological Nomenclature under the plenary powers or declared by the Commission to be invalid or nonexistent [*see Bul. Zool. Nomencl.*, **4**:334 (1950)].

Official Index of Rejected and Invalid Specific Trivial Names in Zoology. A record of specific trivial names suppressed by the International Commission on Zoological Nomenclature under the plenary powers or declared by the Commission to be invalid or non existent [*see Bull. Zool. Nomencl.* **4**:334 (1950)].

Official List of Generic Names in Zoology. A record of generic names (and the type species of each) which have been validated, conserved, or stabilized by the International Commission on Zoological Nomenclature through use of the plenary powers or the rendering of an Opinion [*see Bul. Zool. Nomencl.*, **4**:267–268 (1950)].

Official List of Specific Trivial Names in Zoology. A record of trivial names of species or subspecies which have been validated, conserved, or stabilized by the International Commission on Zoological Nomenclature through the use of the plenary powers or the rendering of an Opinion [*see Bul. Zool. Nomencl.*, **4**:269–27 (1950)].

Onomatophore. "Name bearer" = type (Simpson) (cf. Type).

Ontogeny. The developmental history of an individual organism from egg to adult.

Original description. The summary of characters accompanying the proposal of a name for a new taxonomic entity in conformance with Art. 25 of the International Rules of Zoological Nomenclature.

Orthogenesis. A term usually applied either to a tendency to evolve consistently in the same direction or to the concept of "predetermined" evolution toward a definite goal.

Page precedence. The principle that when two or more conflicting homonyms or synonyms are published in the same work (or portion of a work) and, as a consequence, are of the same date, the names shall have priority according to the sequence in which they first appear in the work (or portion) concerned.

Paleontology. The science that deals with the life of past geological periods (cf. Neontology).

Paratype. A specimen other than the holotype which was before the author at the time of preparation of the original description and was so designated or indicated by the original author (cf. Allotype).

Parthenogenetic. The production of offspring from unfertilized eggs.

Patronymic. In nomenclature, a dedicatory name, a name based on that of a person or persons.

Phenotype. The class in which an individual falls on the basis of visible characters, as the result of an interaction between genotype and environment (cf. Genotype).

Phyletic. Pertaining to a line of descent (cf. Phylogeny).

Phylogenetic tree. A diagrammatic presentation of assumed lines of descent, based on paleontological, morphological, or other evidence.

Phylogeny. The study of the historical development of the line or lines of evolution in a group of organisms; the origin and evolution of higher categories (cf. Classification).

Physiological race. *See* Biological race.

Physiological species. *See* Sibling species.

Plenary powers. Special powers granted by the International Congress of Zoology (Monaco, 1913; Paris, 1948) to the International Commission on Zoological Nomenclature permitting the suspension of the International Rules of Zoological Nomenclature or decisions as to how they shall apply in specific cases [*see Bul. Zool. Nomencl.*, **4**:51–56 *et seq.* (1950)].

Plesiotype. A specimen or specimens upon which subsequent descriptions or figures are based.

Polymorphism. A form of individual variability; the occurrence together in the same habitat of two or more distinct forms of a species in such proportions that the rarest of them cannot be maintained by recurrent mutation (cf. Dimorphism).

Polynomial nomenclature. A system of nomenclature consisting of a scientific designation of a species on the basis of more than three descriptive words; the antecedent of the Linnaean "binomial" system.

Polyphyletic. A term applied to a taxonomic category derived from two or more ancestral sources; not of a single immediate line of descent (cf. Monophyletic).

Polyploidy. A condition in which the nuclear complement of chromosomes is an integral multiple (greater than 2) of the haploid number.

Polytopic. Occurring in different places as, for instance, a subspecies composed of widely separated populations.

Polytypic. A category containing two or more immediately subordinate categories, as a genus with several species or a species with several subspecies (cf. Monotypic).

Population. *See* Local population.

Preadaptation. Fitness for an environment which the organism does not occupy, or an environmental relationship which it does not maintain, at the time when the adaptation appears; usually applied to a new characteristic, arising by mutation, which permits invasion of a new habitat or the development of a new environmental relationship (cf. Adaptation, Environment).

Precipitin reaction. The formation of a visible precipitate at the interface when an antigen and the corresponding antiserum are brought together (cf. Antigen, Antiserum, Antibody, Quantitative specificity).

Pre-Linnaean name. A name published prior to Jan. 1, 1758, the starting point of zoological nomenclature and the assumed date of publication for the tenth edition of Linnaeus's *Systema naturae;* such names are unavailable and may not be made available by republication in their original form after Jan. 1, 1758, nor through citation in synonymy (cf. Available name).

Primary homonym. One of two or more identical trivial names which, at the time of original publication, were proposed in combination with the same (or an identical) generic name (*e.g.*, *X-us albus* Smith, 1910, and *X-us albus* Jones, 1920); the later of such primary homonyms are to be permanently rejected; also one of two or more identical names for genera or higher categories (cf. Homonym, Secondary homonym).

Primary sexual characters. The gonads; the ovaries in females, the testes in males (cf. Accessory sex characters, Secondary sexual characters).

Protozoology. The science which deals with the study of protozoa (cf. Microbiology).

Quantitative specificity. In serology, the principle that a given kind of antibody will react more strongly, under comparable conditions, with the particular kind of antigen used in its formation than with any other substance (cf. Antibody, Antigen, Precipitin reaction).

Race. Subspecies (q.v.).

Radiation. *See* Adaptive radiation.

Rassenkreis (Rensch). A polytypic species composed of several subspecies (cf. Subspecies, Polytypic).

Recapitulation. The theory that ontogeny recapitulates phylogeny (cf. Ontogeny, Phylogeny).

Recessive. A character that is expressed in the phenotype only when the individual is homozygous for the gene producing it (cf. Dominant, Homozygous).

Règles Internationales de la Nomenclature Zoologique. The International Rules of Zoological Nomenclature adopted by the Fifth International Congress of Zoology at Berlin (1901) and subsequently amended at succeeding congresses. The French text is the official version.

Rejected name. An otherwise available name which has been permanently rejected by the International Commission on Zoological Nomenclature under the plenary powers (cf. Official Index of Rejected and Invalid Specific Trivial Names in Zoology, Official Index of Rejected and Invalid Generic Names in Zoology).

Replacement name. Substitute name (q.v.).

Reproductive isolation. A condition in which interbreeding between two or more populations is prevented by intrinsic factors (cf. Geographic isolation, Ecologic isolation, Isolating mechanism).

Reticulate evolution. Evolution "dependent on repeated intercrossing between a number of lines, and thus both convergent and divergent at once" (Huxley).

Reversion. The reappearance of an ancestral character which was not exhibited in the parental or immediately ancestral generations.

Review. Synopsis (q.v.).

Revision. In taxonomy, the presentation of new material or new interpretation integrated with previous knowledge through summary and reevaluation (cf. Synopsis, Monograph).

Saltation. Discontinuous variation produced at a single step by mutation (cf. Mutation).

Sample. That portion of a true population which is actually available to the taxonomist.

Scientific name. The binominal or trinominal designation of an animal; the formal nomenclatural designation of a taxonomic category (cf. Vernacular name).

Secondary homonym. One of two or more identical trivial names which, at the time of original publication, were proposed in combination with different generic names but which, through subsequent transference, reclassification, or combination of genera have come to bear the same (or an identical) combination of a generic and trivial name [for nomenclatural status *see Bul. Zool. Nomencl.*, **4**:97–105(1950)] (cf. Homonym, Primary homonym).

Secondary sexual characters. The characters which distinguish the two sexes of the same species but which do not function directly in reproduction (cf. Primary sexual characters, Sexually dimorphic).

Section. A neutral term usually employed with reference to a subdivision of a taxonomic unit or a series of related elements in one portion of a higher taxonomic category (cf. Higher category, Neutral term, Group).

Selection. *See* Natural selection.

Semispecies. The species of which a superspecies is composed (cf. Superspecies); semispecies are a special kind of species, not a category different from the species.

Senior homonym. The earliest published of two or more identical names for the same or different taxonomic categories (cf. Homonym, Junior homonym).

Senior synonym. The earliest published of two or more available synonyms for the same taxonomic unit (cf. Synonym, Junior synonym).

Series. In taxonomy, the sample which the collector takes in the field or the sample available for taxonomic study (cf. Material, Hypodigm); also a neutral term employed especially with reference to a sequence of taxonomic categories or forms (cf. Neutral term, Taxonomic categories, Form).

Serology. The study of the nature and interactions of antigens and antibodies (cf. Antigen, Antibody).

Serum globulin. The blood fraction in which antibodies, if present, are to be found (cf. Antibody).

Seventy-five per cent rule. The rule that population *A* can be considered subspecifically distinct from population *B* if 75 per cent of the individuals of *A* are different from "all" the individuals of population *B* (cf. Coefficient of difference).

"Sewall Wright effect." *See* Genetic drift.

Sex chromosome. A special chromosome, not occurring in identical number or structure in the two sexes and usually concerned with sex determination; the X chromosome or Y chromosome (cf. Chromosome, Autosome).

Sex-limited character. A character belonging to one sex only (cf. Secondary sexual character, Sex-linked character).

Sex-linked character. A character for which the determiner is located in the sex chromosome (cf. Sex chromosome, Sex-limited character).

Sexually dimorphic. With pronounced difference in the morphological expression (form) of the two sexes of a single species (cf. Dimorphism).

Sibling species. Pairs or groups of closely related species which are reproductively isolated but morphologically identical or nearly so (cf. Species).

Speciation. The splitting of a phyletic line; the process of the multiplication of species; the origin of discontinuities between populations due to the development of reproductive isolating mechanisms (cf. Allopatric speciation, Sympatric speciation).

Species. Groups of actually (or potentially) interbreeding natural populations which are reproductively isolated from other such groups (cf. Subspecies, Population, Reproductive isolation).

Species complex. *See* Complex.

Species group. *See* Group.

Specific name. "The binominal combination of a generic name and a specific trivial name which constitutes the scientific designation of a species" (International Commission, 1948) (cf. Species, Scientific name, Binominal nomenclature); also used by many workers and in the original Rules in place of *trivial* name.

Specific trivial name. The second term of the binominal designation of a species (cf. Species, Binominal nomenclature).

Splitter. In taxonomy, one who divides his material more finely than the average; one whose criteria for determining the level to be assigned to a given taxonomic category are such that the effect of his work is to push existing classification upward (as subfamilies to families, subspecies to species); also one who attempts to express even small differences nomenclaturally (cf. Lumper).

Standard deviation, S.D. The square root of the sum (Σ) of the squared deviations (d) from the mean, divided by N:

$$\text{S.D.} = \sqrt{\frac{\Sigma d^2}{N}}$$

Standard error (of the mean). Standard deviation divided by the square root of the sample size (N):

$$\text{S.E.}_M = \frac{\text{S.D.}}{\sqrt{N}}$$

Strickland Code. A code of nomenclature prepared by a committee of the British Association for the Advancement of Science under the secretaryship of H. E. Strickland and first published in 1842.

Subfamily. A taxonomic category intermediate between a family and a tribe (cf. Family).

Subfamily name. The scientific designation of a subfamily, recognized by the termination *inae*, which termination, by action of the International Commission on Zoological Nomenclature, may not be used for names of other categories [for minor exceptions in trivial names, *see Bul. Zool. Nomencl.*, **4**:262(1950)] (cf. Family name).

Subgeneric name. The name of an optional category between the genus and the species, enclosed in parentheses when cited in connection with a binominal or trinominal combination and therefore excluded from consideration when determining the number of words of which a specific, subspecific, or infrasubspecific name is composed [*e.g.*, *X-us* (*Y-us*) *albus rufus* is a trinominal—*see Bul. Zool. Nomencl.*, **4**:96–97(1950)] (cf. Nominotypical subgenus).

Subjective synonym. A conditional or taxonomic synonym dependent upon an author's opinion (subject to subsequent revision) that two or more available names proposed for nominally different categories actually represent a single taxonomic category (cf. Synonym, Objective synonym).

Subspecies. A geographically defined aggregate of local populations which differs taxonomically from other such subdivisions of the species (cf. Polytypic, Cline).

Subspecific name. "The trinominal combination of a generic name, a specific trivial name and a subspecific trivial name which constitutes the scientific designation of a subspecies" (International Commission) (cf. Subspecies, Nominotypical subspecies).

Subspecific trivial name. The third term of the trinominal designation of a subspecies [for nomenclatural status *see Bul. Zool. Nomencl.*, **4**:89–96(1950)] (cf. Infrasubspecific name, Subspecific name, Subspecies).

Substitute name. A name proposed to replace a preoccupied name and automatically taking the same type and type locality (cf. New name).

Superfamily. The taxonomic category immediately above the family and below the order (cf. Family).

Superspecies. A monophyletic group of entirely or largely allopatric species (cf. *Artenkreis*, Allopatric, Semispecies).

Supraspecific. A term applied to a taxonomic category or to taxonomic and evolutionary phenomena at a level higher than the species (cf. Higher category).

Sympatric. A term applied to two or more populations which occupy identical or broadly overlapping geographical areas (cf. Allopatric).

Sympatric hybridization. The occasional production of hybrid individuals between two otherwise well-defined sympatric species.

Sympatric speciation. Species formation in the absence of geographic isolation (cf. Allopatric speciation).

Synchronic species. Species which occur at the same time level (cf. Allochronic species).

Synonym. In nomenclature, one of two or more different names for the same taxonomic unit (cf. Senior synonym, Junior synonym, Objective synonym, Subjective synonym).

Synonymy. A chronological list of the scientific names which have been applied correctly or incorrectly to a given taxonomic unit, including the dates of publication and the authors applying the names; in its most abbreviated form designed for nomenclatural purposes only (cf. Full bibliographical synonymy).

Synopsis. In taxonomy, a brief summary of current knowledge of a group; the inclusion of new material or new interpretations is not necessarily implied (cf. Review, Revision, Monograph).

Syntype. "One of a number of specimens of equal nomenclatural rank which formed all or part of the material before the original author, in those cases where the author did not designate or indicate a holotype" (I.C.Z.N.) [*see Bul. Zool. Nomencl.*, **4**:186(1950)] (cf. Cotype, Lectotype).

Systematics. Taxonomy (q.v.).

Systematic serology The application of serology to taxonomic problems; comparative serology (cf. Serology).

Taxon. A taxonomic unit or category (pl., taxa).

Taxonomic category. One of a hierarchy of levels into which natural populations are classified, such as subspecies, species, genus, and family.

Taxonomic character. Any attribute of an organism or of a group of organisms by which it differs from an organism belonging to a different taxonomic category or resembles an organism belonging to the same category (cf. Biological character).

Taxonomy. The science of classification of organisms (cf. Classification, Systematics).

Teratology. The study of structural abnormalities, especially monstrosities and malformations.

Topotype. A specimen collected at the type locality.

Tribe. A taxonomic category intermediate between the genus and the subfamily.

Trinominal nomenclature. An extension of the binominal system of nomenclature to permit the designation of subspecies by a three-word name (cf. Binominal nomenclature, Subspecies, Subspecific name, Nominotypical subspecies).

Trivial name. The second or third word in a binominal or trinominal name of an animal; the specific and subspecific components in the scientific designation of an animal (cf. Specific trivial name, Subspecific trivial name, Infrasubspecific trivial name).

Type. A zoological object which serves as the base for the name of a taxonomic category (*e.g.*, a specimen which is the name bearer for a species, a species which is the name bearer for a genus, etc.)

Type designation. Determination of the type of a genus under Art. 30, Rule (*a*) of the International Rules of Zoological Nomenclature (cf. Type indication, Type selection).

Type indication. Determination of the type of a genus under Art. 30, Rules (*b*), (*c*), and (*d*) of the International Rules of Zoological Nomenclature (cf. Type designation, Type selection).

Type locality. The locality at which a holotype, lectotype, or neotype was collected (cf. Topotype).

Type method. The method of preserving the identity of a taxonomic category by fixing an included zoological object as "type."

Type selection. Determination of the type of a genus under Art. 30, Rule (*g*) of the International Rules of Zoological Nomenclature (cf. Type indication, Type designation).

Type species. The expression recommended by the International Commission on Zoological Nomenclature to refer to the concept of "a type species of a genus" [*see Bul. Zool. Nomencl.*, **4**:300(1950)] (cf. Genotype).

Typology. In taxonomy, the method of approach to classification which involves the postulate that all members of a taxonomic unit conform to a given morphological "type."

Uninominal nomenclature. The designation of a taxonomic category by a scientific name consisting of a single word; required for the categories above the species, but occasionally also advocated for the species.

Valid name. The name of a taxonomic category which is available nomenclaturally and also is recognized as valid on zoological grounds (cf. Available name).

Variance. The square of the standard deviation.

Variety. A term originally applied indiscriminately to various kinds of infraspecific forms, individuals as well as populations (*i.e.*, subspecies); in modern usage, usually limited to discontinuous variants within a single interbreeding population (cf. Subspecies, Infrasubspecific form).

Vernacular name. The colloquial designation of a taxonomic category (cf. Scientific name).

Vertical classification. Classification based upon the historical development of groups of organisms as indicated by the fossil record; classification which, according to Simpson, unites ancestral and descendent groups and separates contemporaneous groups that are diverging from a common ancestry (cf. Classification, Horizontal classification).

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