Chapter 7
Biostratigraphic Units

A. NATURE OF BIOSTRATIGRAPHIC UNITS

Biostratigraphic units (biozones) are bodies of rock strata that are defined or characterized on the basis of their contained fossils.

Biostratigraphic units exist only where the particular diagnostic biostratigraphic feature or attribute on which they are based has been identified. Biostratigraphic units are, therefore, descriptive units based on the identification of fossil taxa. Their recognition depends on the identification of either their defining or characterizing attributes. Biostratigraphic units may be enlarged to include more of the stratigraphic record, both vertically and geographically, when additional data are obtained. In addition, since they depend on taxonomic practice, changes in their taxonomic base may enlarge or reduce the body of rocks included in a particular biostratigraphic unit. Biostratigraphic units are geographically as extensive as their particular diagnostic taxa.

A biostratigraphic unit may be based on a single taxon, on combinations of taxa, on relative abundances, on specified morphological features, or on variations in any of the many other features related to the content and distribution of fossils in strata. The same interval of strata may be zoned differently depending on the diagnostic criteria or fossil group chosen. There are thus several kinds of biostratigraphic units.

Because of this diversity of possible biostratigraphic units, gaps or overlaps frequently occur both vertically and laterally between the different kinds of biozones, between biozones based on different fossil groups, or even between biozones of the same kind or based on the same fossil group.

Biostratigraphic units are distinct from other kinds of stratigraphic units in that the organisms whose fossil remains define them show evolutionary changes through geologic time that are not repeated in the stratigraphic record. Fossil assemblages representing organisms whose occurrence and distribution were closely controlled by the environment in which they lived may recur with little overall change in stratigraphic sequences representing short intervals of time.
with the recurrence of the controlling environment. However, over any considerable interval of geologic time, evolutionary changes have made the assemblages of any one age distinctive from any other.

The relation of biostratigraphic units to other kinds of stratigraphic units is discussed in Chapter 10.

**B. THE FOSSILS**

1. **Value of Fossils.** Because of their morphological uniqueness and local abundance, fossils are often important simply as distinctive lithologic features of rock strata. As the remains of once living forms, they are, moreover, sensitive indicators of past environments of deposition and essential in the interpretation of paleoecology, paleobathymetry, paleobiogeography, and paleoceanography. Finally, because of the irreversibility of organic evolution, fossils are particularly valuable in time-correlation of strata and in placing strata in their proper relative chronologic position.

2. **Fossil Assemblages.** Fossils usually constitute only a minor, disseminated, fractional part of a rock stratum. Even within fossiliferous sequences, fossils are rarely found in every bed or formation, nor are they found everywhere along a bed or formation. There are barren spaces or intervals in all stratigraphic sequences. The fossils found in sedimentary strata are either remains of organisms that lived in an area and were covered by its deposits (*biocoenosis*); or remains of organisms that were brought to an area by different means only after death (*thanatocoenosis*); or remains of organisms transported alive away from their normal environment. They are commonly a mixture of the three categories. All three categories of fossils may be the basis for biostratigraphic zonation.

3. **Reworked Fossils.** Fossils from rocks of one age may have been eroded, transported, and redeposited in sediments of younger age. The reworked fossils may thus be mingled with indigenous fossils, or they may constitute the only fossils present in the younger sediment. In some cases, the reworked fossils can be distinguished readily from the indigenous ones, but in other cases they cannot. This last is particularly true in the case of micro- or nannofossils, where a fossil specimen may behave like a single grain of sediment and pass through one or more cycles of sedimentation with little evidence of wear. All fossil remains, whether indigenous or reworked, may constitute distinctive features of a sediment and may serve as the basis for biostratigraphic zonation; however, because of the difference in their significance with respect to age and environment, fossils that can be identified as reworked should be treated apart from those believed to be indigenous.
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4. Introduced or Infiltrated Fossils. Under some circumstances, rocks may contain fossils younger than the enclosing material. Sometimes this is due to infiltration of fluids carrying micro- or nannofossils from one formation into the pore spaces or fractures of an underlying formation, or it may be that younger sediments fill caves or cavities in older rocks. It also happens that animal burrows or root cavities extending down into one formation may be filled with fossiliferous material from an overlying formation. Likewise, sedimentary dikes or diapirs may contaminate a formation with either younger or older fossil material. Such introduced fossils should be distinguished from indigenous fossils in biostratigraphic zonation.

5. Effects of Stratigraphic Condensation. Extremely low rates of sedimentation may result in fossil representatives of different ages and different environments being mingled or very intimately associated in a very thin stratigraphic interval, even in a single bed.

C. DEFINITIONS

1. Biostratigraphy. The element of stratigraphy that deals with the distribution of fossils in the stratigraphic record and the organization of strata into units on the basis of their contained fossils.

2. Biostratigraphic Classification. The systematic subdivision and organization of the stratigraphic section into named units based on their fossil content. Those parts of the rock record without fossils have no biostratigraphic character and are not amenable, therefore, to biostratigraphic classification.

3. Biostratigraphic Zone (Biozone). A general term for any kind of biostratigraphic unit. Biozone is a short alternative term for biostratigraphic zone. “Bio” should be used in front of the term “zone” to distinguish biostratigraphic zones from other kinds of zones whenever there is any danger of confusion (see section 3.A.7). However, the term “zone” may be freely used instead of “biozone” after an explicit statement to that effect has been made, or when the meaning of the term is clear from the context of the topic under discussion. A similar convention may be followed in the use of the terms indicating the kind of biozone being discussed: after the kind of biozone is made clear (taxon-range biozone, assemblage biozone, etc.) the complete name need not be repeated every time that the biozone is mentioned. The Globigerina brevis Taxon-range Biozone, for example, can be referred to simply as the Globigerina brevis Zone.

Biozones vary greatly in thickness and geographic extent. They may range from a local single thin bed to a unit thousands of meters thick and extending over a widespread geographic area. The time they represent may likewise vary widely.
4. Biostratigraphic Horizon (Biohorizon). A stratigraphic boundary, surface, or interface across which there is a significant and distinctive change in biostratigraphic character. It may correspond to a boundary surface between biozones or be recognized within a biozone. The features on which biohorizons are commonly based in a given stratigraphic section include lowest occurrences, highest occurrences, distinctive occurrences, changes in frequency and abundance, or changes in the character of individual taxa (e.g., changes in the direction of coiling in foraminifers or in number of septa in corals).

The term “biohorizon” has also been applied to a thin bed or interval characterized by a particularly distinctive fossil assemblage. However, the term should be applied to surfaces or interfaces, not to beds or stratigraphic intervals, no matter how thin or distinctive.

Biohorizons have been called surfaces, horizons, levels, limits, boundaries, bands, markers, indexes, datums, datum planes, datum levels, and key horizons. “First appearance datums,” or FADs, and “last appearance datums,” or LADs, are kinds of biohorizons in common use.

5. Subbiozone (Subzone). A subdivision of any kind of biozone established when necessary or useful to express finer biostratigraphic detail.

6. Superbiozone (Superzone). A grouping of several biozones with common biostratigraphic features.

7. Zonule. Even though the term “zonule” has been used with different meanings (see Glossary of Stratigraphic Terms), it is now generally used as a subdivision of a biozone or of a subbiozone. The use of the term is discouraged.

8. Barren Intervals. Stratigraphic intervals with no fossils are common in the stratigraphic section, both between successive biozones and within a biozone. These intervals are not, therefore, subject to biostratigraphic classification but may be referred to informally as barren intervals and identified with reference to adjacent or enclosing biozones; for example, the Exus parvus to Exus magnus barren interval or the barren interval near the top of the Exus albus Assemblage Zone. In normal practice these designations may indicate that the intervals are barren of the specific fossil group that the particular biostratigrapher is studying, such as vertebrates, foraminifers, conodonts, ammonites, etc., and not that it does not contain any kind of fossils (see Figure 1).

D. KINDS OF BIOSTRATIGRAPHIC UNITS

1. General. Strata may be zoned biostratigraphically in many different ways. For this reason, there are different kinds of biozones, each having a different sig-
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nificance and each being useful under appropriate circumstances. It is important, therefore, to have separate, specific, and well-defined terms for each kind of biozone in order to indicate clearly which kind of biozones is being used.

The following five general kinds of biozones are in common use: range zones, interval zones, assemblage zones, abundance zones, and lineage zones. "Range," "interval," "assemblage," "abundance," and "lineage" have no hierarchical significance and are not mutually exclusive criteria. A single stratigraphic interval can be subdivided independently into range zones, interval zones, assemblage zones, abundance zones, and lineage zones depending on the features chosen.

2. Range Zone. A range zone is the body of strata representing the known range of occurrences of any selected element or elements of the assemblage of fossils present in a stratigraphic sequence. The word "range" means extent in both stratigraphic and geographic sense.

A biostratigraphic range zone may represent the stratigraphic range of one taxonomic unit (species, genus, family, order, etc.) or of a grouping of taxa or of any particular paleontological feature whatsoever. Whenever a range zone is established, the basis for defining its limits should be explicitly given.

The term "range zone" is difficult to translate into some languages. Acrozone, from the Greek akros, meaning "topmost" or "extreme," has been suggested (R. C. Moore, 1957a) as a substitute for range zone in order to have a term derived directly from a classical language. However, the term is not very informative as to the nature of the zone and might even be misleading. For this reason this Guide recommends the use of the English language term in all languages.

There are two principal kinds of range zones: taxon-range zones and concurrent-range zones.

a. Taxon-range Zone. See Figure 5.

i. Definition. A taxon-range zone is the body of strata representing the known range of occurrence (stratigraphic and geographic) of specimens of a particular taxon (species, genus, family, etc.). It is the sum of the documented occurrences in all individual sections in which the particular taxon has been identified.

ii. Boundaries. The boundaries of a taxon-range zone are surfaces (biohorizons) marking the outermost limits of known occurrence in each and every local section of specimens of the taxon whose range is to be represented by the zone. The boundaries of a taxon-range zone in any one section are the horizons of lowest stratigraphic occurrence and highest stratigraphic occurrence of the specified taxon in that section. Thus, the Linopoductus cora Taxon-range Zone is the total body of strata enclosed within the outer limits of the established occurrence of specimens of Linopoductus cora, and the Globotruncanata Taxon-range Zone is the total body of strata enclosed within the outer limits of the established occurrence of specimens of any species whatsoever of Globotruncanata.

iii. Name. The taxon-range zone is named from the taxon whose range it
expresses, for example, *Didymograptus* Taxon-range Zone or *Globigerina brevis* Taxon-range Zone.

*iv. Local Range of a Taxon.* The terms *teilzone*, *local-range zone*, and *topozone* have been used to indicate the range of a taxon in *some particular area or locality* as contrasted with its total range. However, the range in a local area is not meaningful unless the name of that area is given. The *Guide*, therefore, suggests that instead of using these terms, reference to the local range of a taxon be made as “the range zone of taxon A at section X,” or “at well Y,” or “in the Mediterranean region,” without any additional modifying zonal term.

*b. Concurrent-range Zone.* See Figure 6.

*i. Definition.* A concurrent-range zone is the body of strata including the concurrent, coincident, or overlapping parts of the range zones of two specified taxa selected from among the total forms contained in a sequence of strata. Other taxa may be included as characterizing members of the zone, or beginning or terminating in the zone, but only two can be used for defining the boundaries. By their nature, biostratigraphic classifications employing successive concurrent-range zones have gaps that are not biostratigraphically zoned or overlaps where the same strata are included in more than one zone.

*ii. Boundaries.* The boundaries of a concurrent-range zone are defined in any particular stratigraphic section by the lowest stratigraphic occurrence of the higher-ranging of the two defining taxa and the highest stratigraphic occurrence of the lower-ranging of the two defining taxa.

*iii. Name.* A concurrent-range zone is named from both of the taxa which characterize the biozone by their concurrence, for example, *Globigerina sellii-Pseudohastigerina barbadoensis* Concurrent-range Zone.

The term “concurrent-range zone” is expressive of the meaning of the zone, although difficult to translate from English into some other languages. Concurrent-range zones have been referred to as overlap zones or range-overlap zones.
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Figure 6. Concurrent-range Zone. The lower, upper, and lateral limits of this zone are determined by the range of concurrent occurrence of taxa a and b.

3. Interval Zone. See Figures 7 and 8.

a. Definition. An interval zone is a body of fossiliferous strata between two specified biostratigraphic horizons (biohorizons). Such a zone is not itself necessarily the range zone of a taxon or concurrence of taxa; it is defined and identified only on the basis of its bounding biohorizons. Barren intervals between two distinctive biohorizons are not interval zones.

The base or the top of an interval zone might be marked by

- the horizon of the lowermost documented occurrence of a specified taxon in any particular section.
- the horizon of the uppermost documented occurrence of a specified taxon in any particular section.
- any other distinctive biostratigraphic feature (biohorizon).

In subsurface stratigraphic work, where the section is penetrated from top to bottom and paleontological identification is generally made from drill cuttings, often contaminated by recirculation of previously drilled sediments and material sloughed from the walls of the drill hole, interval zones defined as the stratigraphic section comprised between the highest known occurrence (first occurrence downward) of two specified taxa are particularly useful (Figure 8). This type of interval zone has been called last-occurrence zone but should preferably be called highest-occurrence zone.

Interval zones defined as the stratigraphic section comprised between the lowest known occurrence of two specified taxa (lowest-occurrence zone) are also a useful type of biozones.

Interval zones established to partition the range of a taxon on the basis of the occurrence of two other taxa whose ranges do not overlap, in other words, the part of the range of the taxon above the uppermost documented occurrence of
one taxon and below the lowermost documented occurrence of the other taxon, have been called partial-range zones (Report of the Stratigraphical Code Subcommittee, Geological Society of London, 1967, p. 85). An example is the *Globigerina ciperoensis* Partial-range Zone which, by definition, is the interval zone between the uppermost occurrence of *Paragloborotalia opima opima* and the lowermost occurrence of *Globorotalia kugleri* and occupies only a part of the range of *Globigerina ciperoensis*.

**b. Boundaries.** The boundaries of an interval zone are defined by the occurrence of the biohorizons selected for its definition.

**c. Name.** The names given to interval zones may be derived from the names of the boundary horizons, the name of the basal boundary preceding that of the upper boundary; for example, *Globigerinoides sicanus–Orbulina suturalis* Interval Zone. A name of this type, however, does not tell whether the named
taxa appear or disappear at the zone boundaries, or if some other criterion is involved (e.g., abundance, dwarfing or gigantism, coiling direction).

Alternatively, the name of a single taxon well represented in an interval zone, though not necessarily confined to it, may be used to name the zone, even though the boundaries of the zone may have been selected on the basis of the occurrence of other taxa.

4. Lineage Zone. See Figure 9. Lineage zones were treated in the first edition of the *International Stratigraphic Guide* (1976) as a special type of range zones. It has also been argued that they should better be considered as a type of interval zone or even that lineage zones are chronostratigraphic rather than biostratigraphic in character and should, therefore, be considered as a type of chronozone. Lineage zones are different from other kinds of biostratigraphic units because they require for their definition the reasonable assurance that the taxa chosen for their definition represent successive segments of an evolutionary lineage. This, in many cases, may involve paleontological inference.

For this reason, lineage zones are discussed as a separate category of biostratigraphic units in this second edition of the *Guide*.

a. **Definition.** A lineage zone is a body of strata containing specimens representing a specific segment of an evolutionary lineage. It may represent the entire range of a taxon within a lineage (Figure 9A) or only that part of the range of the taxon below the appearance of a descendant taxon (Figure 9B).

Whenever the lowest appearance of successive segments in an evolutionary lineage over the area of their distribution can be considered as essentially synchronous, lineage zones have strong time significance and approach chronostratigraphic units. A lineage zone, however, differs from a chronozone in being restricted to the

![Figure 9. Examples of lineage zones.](image)

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Figure 9. Examples of lineage zones. In A (left) the lineage zone represents the entire range of taxon b, from the highest occurrence of its ancestor, taxon a, to the lowermost occurrence of its descendant, taxon c. In B (right) the lineage zone represents that part of the range of taxon y between its lowest occurrence and the lowest occurrence of its descendant, taxon z.
actual presence of the segment of the evolutionary lineage upon which it is based and not to all rock bodies anywhere formed during the time span of the segment.

A system of overlapping lineages offers good assurance of reliable time correlation on a biostratigraphic basis. In practice, the assurance may be lessened by the uncertainty about the actual evolutionary courses and the possibility of differences in the rate of evolution.

b. Boundaries. The boundaries of a lineage zone are determined by the biohorizons representing the lowest occurrence of successive elements in the evolutionary lineage under consideration.

c. Name. A lineage zone is named for the taxon in the lineage whose range or partial range it represents; for example, the Miogypsinia intermedia Lineage Zone or the Globorotalia fohsi fohsi Lineage Zone. This type of biozone has also been called an evolutionary zone, a morphogenetic zone, or a phylogenetic zone.

The term phylozone, though having etymological affinity, has been applied to a kind of stratigraphic unit different from a lineage zone. As originally defined by van Hinte (1969, p. 271), a phylozone is the "belt of rock formed during a biochron." Since a biochron is a unit of geologic time, the total span of time of existence of a taxon, the phylozone, as defined by van Hinte, represents all the rocks formed anywhere during such a time span, whether or not the taxon is actually present. It is, therefore, a chronostratigraphic unit, not a biostratigraphic unit.

5. Assemblage Zone. See Figure 10.

a. Definition. An assemblage zone is a stratum or body of strata characterized by a distinctive assemblage or association of three or more fossil

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**Figure 10. Assemblage zone.** In this example, the assemblage diagnostic of the zone includes nine taxa with diverse stratigraphic ranges. For this assemblage zone to be useful, it may be necessary to provide some explicit description of its boundaries; for example, the lower boundary can be said to be placed at the lowermost occurrence of taxa a and g and the upper boundary at the highest occurrence of taxon e. Most of the taxa of the assemblage characteristic of the zone should, however, be present.
taxa that, taken together, distinguishes it in biostratigraphic character from adjacent strata.

An assemblage zone may be based on all kinds of fossils present, or it may be restricted to only certain specified kinds. Thus we may have an assemblage zone based only on fossil fauna or one based only on fossil flora; an assemblage zone of corals, or of foraminifers, or of mollusks; an assemblage zone of planktonic forms or an assemblage zone of benthonic forms; and so on.

Assemblage zones are usually linked to local areas or regions, as they are closely associated with life environments that vary greatly geographically. However, marine planktonic assemblages may approach worldwide extent within restricted latitude ranges and under conditions where variation in temperature is low. Assemblage zones, therefore, may be particularly significant as indicators of environment. They also may be indicators of geologic age.

(The Oppel zone, named after the German biostratigrapher Albert Oppel, has previously been considered as a type of assemblage zone or as a multi-taxon concurrent-range zone. However, neither Oppel nor subsequent biostratigraphers have precisely defined the biozones used by Oppel, which, in any case, do not appear to correspond consistently to any one kind of biozone. For this reason, the Oppel zone has not been included as a distinct kind of biozone in this second edition of the International Stratigraphic Guide.)

b. Boundaries. The boundaries of an assemblage zone are drawn at surfaces (biohorizons) marking the limits of occurrence of the assemblage characteristic of the unit. Not all members of the assemblage selected for its characterization need occur in order for a section of strata to be assigned to an assemblage zone, and the total range of any of its constituents may extend beyond the boundaries of the assemblage zone. Identification of the zone and its limits depends on identification of the characteristic assemblage. Whenever an assemblage zone is established, the fossil assemblage that characterizes it should be explicitly given. However, in cases when an assemblage zone is proposed on the basis of many fossil taxa with diverse stratigraphic ranges, the recognition of its limits is difficult.

c. Name. The name of an assemblage zone should be derived from the name of one, or preferably no more than two, of the prominent and diagnostic constituents of the fossil assemblage; for example, Eponides Assemblage Zone.

The term cenozoic, from the Greek koinos, meaning "common," has been suggested as a substitute for "assemblage zone" (R. C. Moore, 1957a). Although this term has the advantage of being derived from a classical language and lends itself better to translation to other languages, it does not satisfactorily express the significance of an assemblage zone, and for this reason the English language term seems preferable.

6. Abundance Zone. See Figure 11.

a. Definition. An abundance zone is a stratum or body of strata in which
the abundance of a particular taxon or specified group of taxa is significantly greater than is usual in the adjacent parts of the section, regardless of either association or range.

Unusual abundance of a taxon or group of taxa in the stratigraphic record may be the result of a number of processes, many of them influenced by local environmental, ecological, or postdepositional conditions, and may, therefore, vary in stratigraphic position between geographically separated sections or occur at several levels anywhere within the stratigraphic range of the taxon or group of taxa under consideration (Fig. 11). The only sure way to identify a particular abundance zone is to trace it laterally. More than content of taxa alone must be used, or an unwarranted assumption of continuity may mistakenly be made. Abundance zones, therefore, are generally of local utility only.

b. Boundaries. The boundaries of an abundance zone are defined by the biohorizons of notable change in abundance of the taxon or group of taxa chosen to characterize the zone.

c. Name. The abundance zone takes its name from the taxon or taxa whose significantly greater abundance it represents.

The abundance zone has been called *acme zone* (first edition of the *International Stratigraphic Guide*), *peak zone*, and *flood zone*.

E. HIERARCHY OF BIOSTRATIGRAPHIC UNITS

The different kinds of biostratigraphic units described above do not represent different ranks of a biostratigraphic hierarchy. Range zones, for example, are not subdivided into assemblage zones or *vice versa*. Some kinds of biozones, however, may be usefully subdivided into subbiozones (subzones) and/or grouped into superbiozones (superzones) (see sections 7.C.5 and 7.C.6).

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Figure 11. Abundance zones.
With respect to taxon-range zones, there is no need for a hierarchy of bio-
zone terms because the hierarchical system of biological taxonomy extends also
to these biostratigraphic units in the sense that the range zone of a species is sub-
sidiary to the range zone of the genus to which it belongs, and so on.

**F. PROCEDURES FOR ESTABLISHING BIOSTRATIGRAPHIC UNITS**

General procedure for establishing stratigraphic units is discussed in section
3.B, and the procedure for biostratigraphic units accords closely with that for
other stratigraphic units in most respects. Special mention is made again, how-
ever, of the need to specify the kind of biostratigraphic unit being proposed and
the basis used for defining its limits. Figures and descriptions of the taxa diag-
nostic of a unit should also be provided, or references to the literature in which
they can be found should be given.

In setting up new biozones or in selecting for use biozones that already
have been proposed, practicability in identification and correlation should be
considered. Other things being equal, units based on abundant, widespread,
stratigraphically restricted and readily recognized taxa should be preferred.
Esoteric zonal criteria lose value because of difficulty of application.

Biostratigraphic units are often based on concepts which cannot readily be
laced in advance to a specific interval of the stratigraphic section because the
stratigraphic scope of the unit may vary widely with increasing information. The
scope and character of a biostratigraphic unit should, therefore, be defined by
carefully specifying the kind of zone under discussion and the diagnostic taxon
or taxa on which it is based. It is desirable, however, that the definition and de-
scription of a biostratigraphic unit and of its boundaries include the designation
of one or more specific reference sections that demonstrate the occurrence of the
taxon or taxa diagnostic of the unit and that permit its recognition elsewhere.
The designation of one or more such reference sections serves as protection
against the inadequacies of language, fossil recovery, and the uncertainties of
taxonomic identification.

**G. PROCEDURES FOR EXTENDING BIOSTRATIGRAPHIC
UNITS—BIOSTRATIGRAPHIC CORRELATION**

Biostratigraphic units are extended away from the areas where they were
defined or from their reference sections by biostratigraphic correlation (biocorre-
lation), which is the establishment of correspondence in biostratigraphic charac-
ter and position between geographically separated sections or outcrops based on
their fossil content. Biostratigraphic correlation is not necessarily time-correla-
tion. It may approximate time-correlation, or it may be the identification of the
same biofacies and potentially diachronous because homotaxy does not always imply synchronicity.

H. NAMING OF BIOSTRATIGRAPHIC UNITS

The formal name of a biostratigraphic unit should be formed from the names of one, or preferably no more than two, appropriate fossils combined with the appropriate term for the kind of unit in question.

A disadvantage of names formed from more than two taxa is their often cumbersome length. This difficulty has commonly been circumvented by naming the biozone for a single taxon that occurs in the interval although not otherwise specially diagnostic of the biozone. The function of the taxon thus selected is name-giving. It may or may not be common and may or may not be a particularly good guide-fossil among the members of the assemblage. Single-taxon names of this type may be considered formal provided their introduction is duly proposed and is accompanied by an unequivocal designation of the zonal limits.

The same name should not be used for different biostratigraphic units of the same kind, even if of different rank.

The writing and printing of fossil names for stratigraphic units should be guided by the rules laid down in the International Code of Zoological Nomenclature and in the International Code of Botanical Nomenclature. The initial letter of generic names should be capitalized; the initial letter of the specific epithets should be in lowercase; taxonomic names of genera and species should be in italics. The initial letter of the unit-term (Biozone, Zone, Assemblage Zone) should be capitalized; for example, Exus albus Assemblage Zone.

The name of the fossil or fossils chosen to designate a biozone should include the genus name plus the specific epithet and also the subspecies name, if there is one. Thus Exus albus Assemblage Zone is correct. After the first mention, the genus name may be abbreviated to its initial letter if there is no danger of confusion with some other genus beginning with the same letter; for example, Exus albus may be shortened to E. albus. On the other hand, the use of the specific epithet alone, in lowercase or capitalized, in italics or not (albus Assemblage zone, Albus Assemblage zone, albus Assemblage zone, or Albus Assemblage zone), is inadvisable because it can lead to confusion in the case of frequently used species names. However, once the complete name has been cited, and if the use of the specific epithet alone does not cause ambiguous communication, it may be used, in italics and lowercase, in the designation of a biozone; for example, uniformis Zone.

Codification of biostratigraphic zones by letters or numbers or a combination of both is becoming a common practice. If used consistently and judiciously such code designations can be extremely useful. They are brief and they avoid repetition of the lengthy formal names of zones (an advantage in both written and oral presentations); also, letter and/or number sequences automatically indi-
cate the sequence and relative positions of the zones (not true of their formal names); and they facilitate liaison between biostratigraphers, geologists and other professionals such as engineers. On the other hand, code designations do not lend themselves readily to insertions, combinations, eliminations, or revisions within a zonal sequence once it has been published. Letter/number designations have no intrinsic meaning, and confusion can arise if two or more stratigraphers have applied them in different senses within the same general area. Code designations of biostratigraphic units, if used for reasons of brevity, should be considered informal nomenclature. They should be explained in each published work in which they are used or references to the literature in which they are set forth should be given.

I. REVISION OF BIOSTRATIGRAPHIC UNITS

Revision of stratigraphic units in general is discussed in section 3.B.5, and the basic rules of priority are discussed in section 3.B.4.b. Priority should be preserved for the sake of stability and ease of communication, but in the case of biostratigraphic units, it must be kept in mind that out of the almost limitless number and variety of overlapping biozones that could be proposed, the first to be described and named is not necessarily the most useful. This means that workers must continually be free to propose new zones or improve previous proposals in both scope and nomenclature. Among critical considerations affecting the adoption of any newly proposed biozone or revision of an already existing biozone should be adequacy of description, freedom from ambiguity, extent of applicability, and, of course, that the new biozone is not a synonym.

Names of biostratigraphic units should be changed to conform with changes in names of taxa required by the International Code of Zoological Nomenclature and by the International Code of Botanical Nomenclature. Also, named biostratigraphic units will automatically change to accord with changes in the scope of taxa that may have been recognized subsequent to the naming of the unit. A fossil name once used for a biozone should not be available for use in a different zonal sense by a later author. If it is desirable to continue use of a taxonomic term which is no longer valid, the term should be in quotation marks, for example, “Rotalia” beccarii Zone.
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