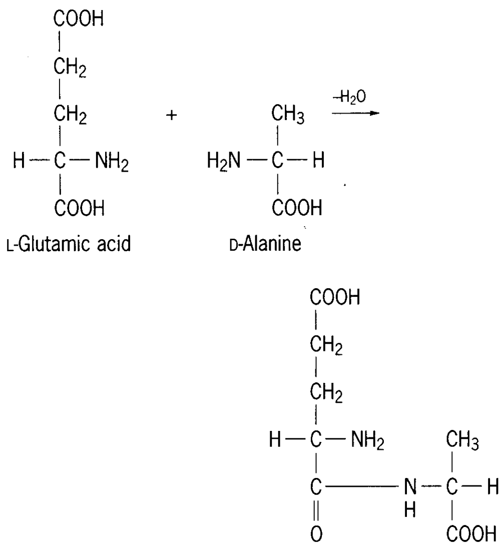
Peptide

A compound that is made up of two or more amino acids joined by covalent bonds which are formed by the elimination of a molecule of H_2O from the amino group of one amino acid and the carboxyl group of the next amino acid. Peptides larger than about 50 amino acid residues are usually classified as proteins.

In the reaction shown, the α linkage between the α-amino group of alanine and the α-carboxyl group



L-Glutamic acid D-Alanine

L-Glutamyl-D-alanine

of glutamic acid is by far the most common type of linkage found in peptides. However, there are a few cases of γ linkage in which the side-chain carboxyl group of one amino acid is linked to an α-amino group of the next amino acid, as in glutathione and in part of the structure of the bacterial cell wall. Linear peptides are named by starting with the amino acid residue that bears the free α-amino group and proceeding toward the other end of the molecule. Sometimes the configuration of the asymmetric carbon atom of each residue is included in the name, as shown in the reaction. A three-letter notation is convenient to use, for example, L-Glu-D-Ala.

Occurrence. Peptides of varying composition and length are abundant in nature. Glutathione, whose structure is γ-L-glutamyl-L-cysteinyl-glycine, is the most abundant peptide in mammalian tissue. Hormones such as oxytocin (8), vasopressin (8), glucagon (29), and adrenocorticotropic hormone (39) are peptides whose structures have been deduced; in parentheses are the numbers of amino acid residues for each peptide. Some of the hormone regulatory factors which are secreted by the hypothalamus are peptides that govern the release of hormones by other endocrine glands. In the peptides indigenous to mammalian tissues all of the amino acid residues are of the L-configuration.

Many of the antimicrobial agents produced by microorganisms are peptides that can contain both D- and L-amino acid residues. Penicillin contains a cyclic peptide as part of its structure. Other peptide antibiotics include the gramicidins, the tyrocidines, the polymyxins, the subtilins, and the bacitracins. *See* ANTIBIOTIC.

Synthesis. For each step in the biological synthesis of a peptide or protein there is a specific enzyme or enzyme complex that catalyzes each reaction in an ordered fashion along the biosynthetic route. However, although the biological synthesis of proteins is directed by messenger RNA on cellular structures called ribosomes, the biological synthesis of peptides does not require either messenger RNA or ribosomes. *See* RIBONUCLEIC ACID (RNA); RIBOSOMES.

In the methods most commonly used in the laboratory for the chemical synthesis of peptides, the α-carboxyl group of the amino acid that is to be added to the free α-amino group of another amino acid or peptide is usually activated as an anhydride, an azide, an acyl halide, or an ester, or with a carbodiimide. To prevent addition of the activated amino acids to one another, it is essential that the α-amino group of the carboxyl-activated amino acid be blocked by some chemical group (benzyl oxycarbonyl-, *t*-butyloxycarbonyl-, trifluoroacetyl-) that is stable to the conditions of the coupling reaction; such blocking groups can be removed easily under other conditions to regenerate the free α-amino group of the newly added residues for the next coupling step. In order to ensure that all the new peptide bonds possess the α linkage, the reactive side chains of amino acid residues are usually blocked during the entire synthesis by fairly stable chemical groups that can be removed after the synthesis. For a successful synthesis of a peptide or protein, all of the coupling steps should be complete, and none of the treatments during the progress of the synthesis should lead either to racemization or to alteration of any of the side chains of the amino acids. In the earlier techniques for the chemical synthesis of peptides the reactions were carried out in the appropriate solvents, and the products at each step were purified if necessary by crystallization ("solution method"). An innovation devised by R. B. Merrifield uses a "solid phase" of polystyrene beads for the synthesis. The peptide, which is attached to the resin beads, grows by the sequential addition of each amino acid. The product can be washed by simple filtration at each step of the synthesis. *See* AMINO ACIDS; PROTEIN.

James M. Manning

Peracarida

A large crustacean superorder generally classified within the phylum Arthropoda, subphylum Crustacea, class Malacostraca, subclass Eumalacostraca. The Peracarida are defined as having the following characteristics: a telson (posteriormost body segment) without appendages; one pair (rarely two or three pairs) of maxillipeds (thoracic appendages modified as mouthparts); mandibles (primary jaws) with articulated accessory processes in adults, between the molar and incisor teeth, called the lacinia mobilis; a carapace, when present, that is not fused with posterior thoracic segments and that is usually reduced in size; basalmost leg segments of the thorax with unique, thin, flattened ventral plates (oöstegites) that enclose a ventral brood pouch (marsupium) in all orders except the Thermosbaenacea (which use the carapace to brood embryos); and having the young hatch as a prejuvenile stage called a manca, lacking the last pair of legs (that is, no free-living larvae occur in Peracarida). The roughly 21,500 species of peracarids are divided among nine orders. The orders Mysida and Lophogastrida were formerly combined (as the Mysidacea), but most authorities now treat them separately. *See* CRUSTACEA; MALACOSTRACA.

Natural history. The peracarids are an extremely successful group of crustaceans and are known from many habitats. Although most are marine, many also occur on land and in freshwater, and several species live in hot springs at temperatures of 30–50°C (86–122°F). Aquatic forms include planktonic as well as bottom-dwelling species at all depths. The group includes the most successful terrestrial crustaceans—the pillbugs and sowbugs of the order Isopoda (suborder Oniscidea)—and a few amphipods that have invaded land and live in damp leaf litter and gardens. Peracarids range in size from tiny interstitial (living among sand grains) forms only a few millimeters long to planktonic amphipods over 12 cm (4.7 in.) long (*Cystisoma*) and deep-water bottom-dwelling isopods that grow to 50 cm (20 in.) in length (*Bathynomus giganteus*). Peracarids exhibit all sorts of feeding strategies, including carnivory, herbivory, and detritivory, and a number of them, especially isopods and amphipods, are symbionts (parasites or commensals). *See* DEEP-SEA FAUNA.

Classification. The Peracarida include nine orders: Mysida, Lophogastrida, Cumacea, Tanaidacea, Mictacea, Spelaeogriphacea, Thermosbaenacea, Isopoda, and Amphipoda (see **illustration**).

The order Mysida comprises nearly 1000 known species of marine shrimplike forms ranging in length from about 2 to 80 mm (0.08 to 3.2 in.) *See* MYSIDA.

The order Lophogastrida (~40 pelagic marine species) is similar to the Mysida; most are 1–8 cm (0.4–3.2 in.) long, although the giant *Gnathophausia ingens* reaches 35 cm (13.8 in.).

The order Cumacea comprises about 1000 species of small, odd-looking, bottom-dwelling marine and freshwater crustaceans with a large, bulbous anterior and a long slender posterior (0.5–2 cm or 0.2–0.8 in. in length). *See* CUMACEA.

The order Tanaidacea comprises about 1500 benthic marine and brackish-water species (0.5–2 cm or 0.2–0.8 in. in length). Tanaids often live in burrows or tubes and are known from all ocean depths. *See* TANAIDACEA.

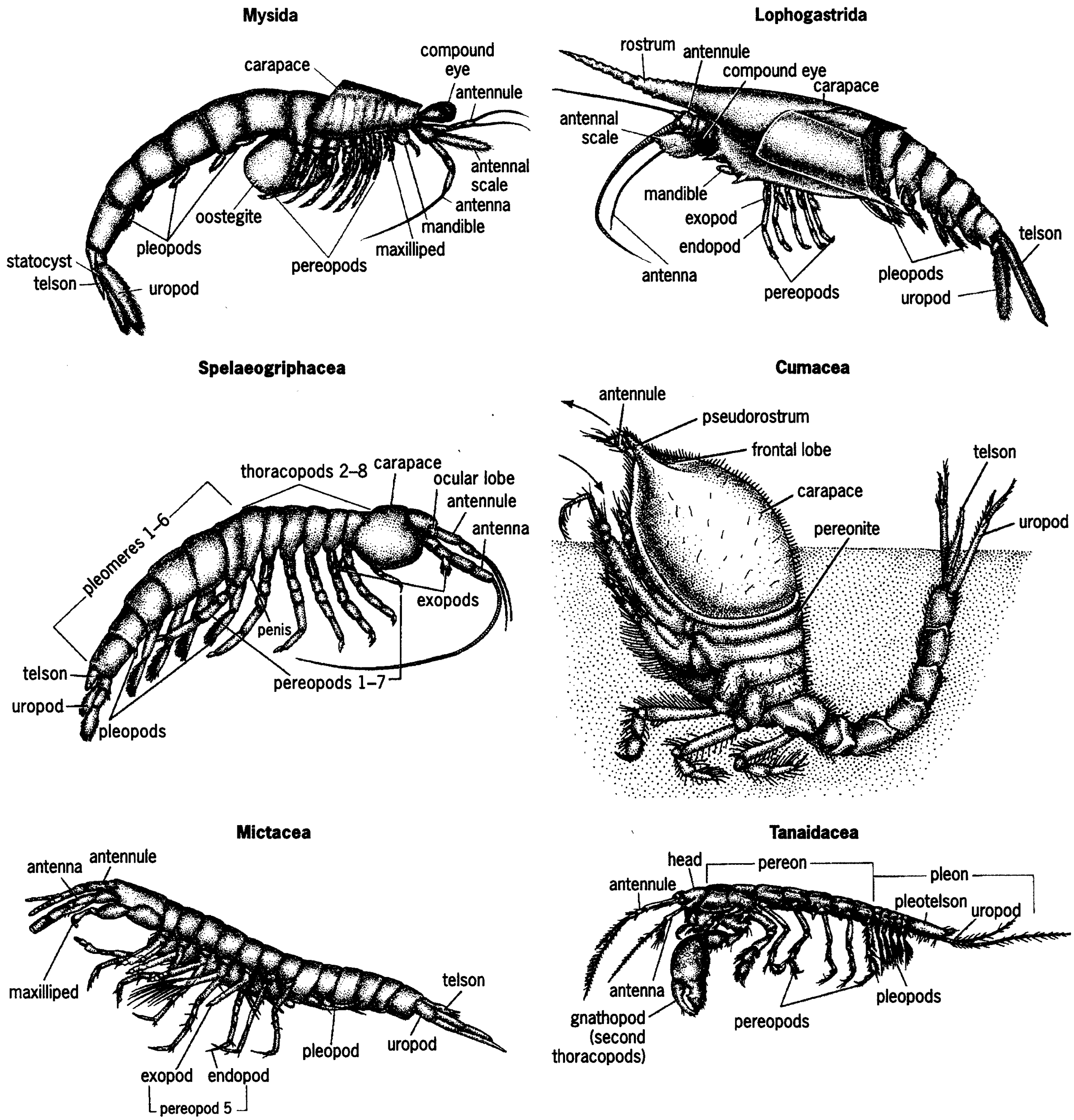
The four known species that compose the order Mictacea are small (2–3.5 mm or 0.08–0.14 in. in length) creatures living in refugial habitats (that is, areas that have escaped the great changes that occurred in the regions as a whole, providing conditions in which relic colonies can survive). *See* MICTACEA.

The order Spelaeogriphacea is known from only three species. These rare, small (<1 cm or 0.4 in.) peracarids were long known only from a single species living in a freshwater stream in Bat Cave on Table Mountain in Cape Town, South Africa. A second species was recently reported from a freshwater cave in Brazil, and a third from an aquifer in Australia. Little is known about the biology of these animals. *See* SPELAEOGRIPHACEA.

The order Thermosbaenacea contains 11 known species. *Thermosbaena mirabilis* is known from freshwater hot springs in North Africa, where it lives at temperatures in excess of 40°C (104°F). Other thermosbaenacean species occur in much cooler freshwaters, typically in ground water or in caves, and still others are marine or inhabit underground marine pools. *See* THERMOSBAENACEA.

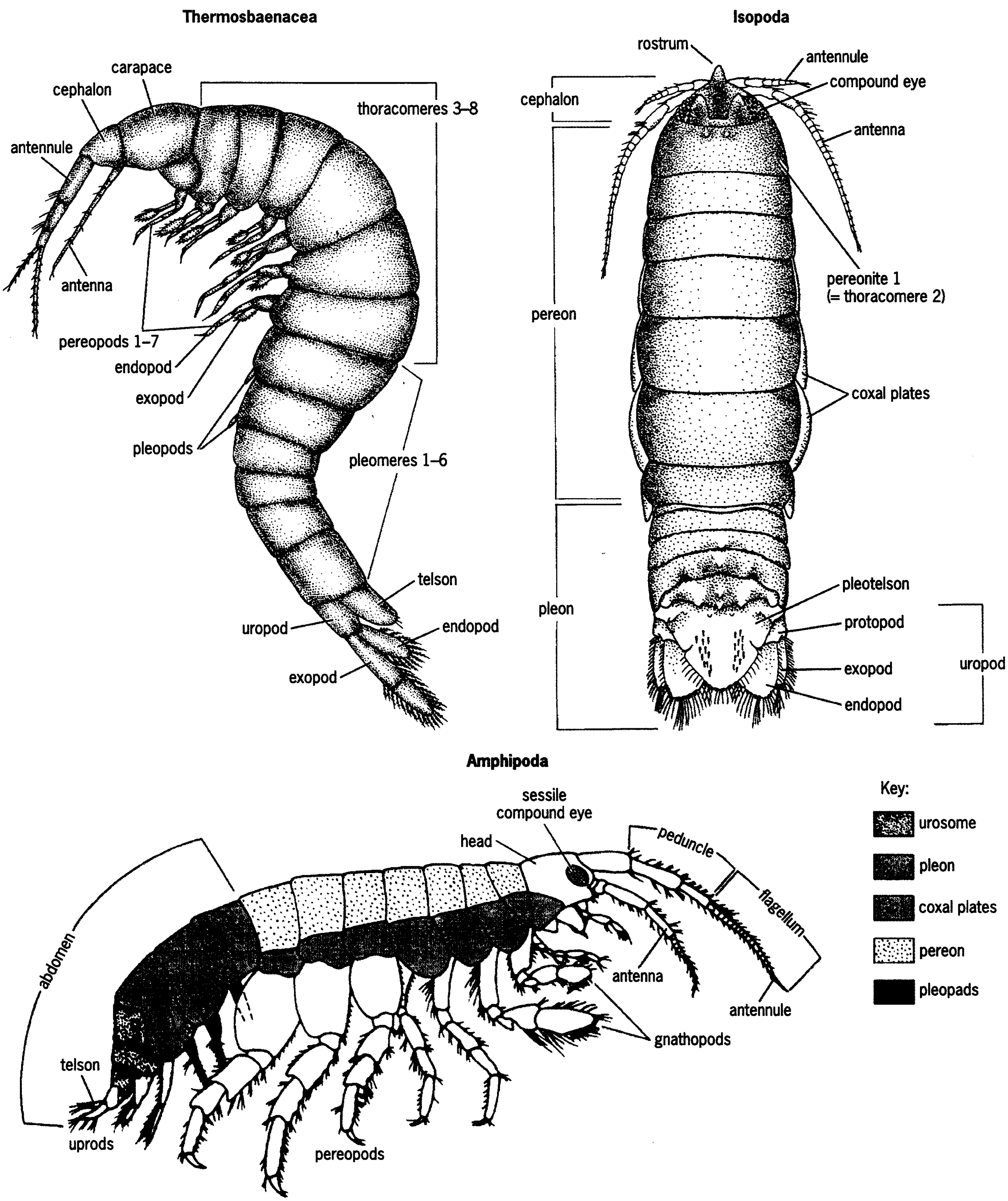
The largest order of Peracarida is the Isopoda, characterized by a complete lack of a carapace, a heart located primarily in the abdomen, and biphasic molting (posterior region molts before anterior region). The isopods comprise about 10,000 described marine, freshwater, and terrestrial species ranging in length from 0.5 to 500 mm (0.02 to 20 in.), the largest being species of the benthic genus *Bathynomus* (family Cirolanidae). Isopods are common inhabitants of nearly all environments, and some groups are exclusively (suborder Epicaridea) or partly (suborder Flabellifera) parasitic. The suborder Oniscidea includes about 5000 species that have invaded land (pillbugs and sowbugs); they are the most successful terrestrial crustaceans. Their larvaless development, flattened shape, good osmoregulatory capabilities, thickened exoskeleton, and aerial gas exchange organs (pseudotracheae) allow most oniscideans to live divorced from aquatic environments. Most isopods are herbivorous or omnivorous scavengers, but direct plant feeders, detritivores, and predators are also common. Some are parasites (for example, on fishes or on other crustaceans). One isopod fish parasite, *Cymothoa exigua* (family Cymothoidae), consumes the tongue of its host fish (snappers) but remains attached to the tongue stub such that the fish continues to thrive using the isopod as a "replacement tongue"—this is the only known case of a parasite functionally replacing a host's organ that it has destroyed. *See* ISOPODA.

Like the isopods, the order Amphipoda is characterized by a lack of a carapace, but the heart is thoracic and molting is not biphasic. The roughly 8000 species of amphipods range in length from 1-mm (0.04-in.) forms to deep-sea bottom-dwelling species reaching 25 cm (10 in.) and some planktonic forms exceeding 10 cm (4 in.). They have invaded most marine and many freshwater habitats and constitute a large portion of the biomass in many marine regions. The principal amphipod suborder is Gammaridea. A few gammarideans are semiterrestrial in moist forest leaf litter or on sandy beaches (for



Representatives of the nine orders of Peracarida. ***(From R. Brusca and G. Brusca, Invertebrates, 2d ed., Sinauer Associates, 2003)***

example, beach hoppers); a few others live in moist gardens and greenhouses (for example, *Talitrus sylvaticus* and *T. pacificus*). They are common in subterranean ground-water ecosystems of caves, the majority being obligatory ground-water species characterized by reduction or loss of eyes, pigmentation, and occasionally appendages. Most gammarideans, however, are marine species. The three other amphipod suborders are the open-ocean Hyperiidae (most, if not all, associate with gelatinous zooplankton such as jellyfishes and salps), the Ingolfiellidea (about 30 species of primarily subterranean fresh- and brackish-water species, and some marine species), and the Caprellidea. Caprellids include about 300 species of marine "skeleton shrimp," highly modified for clinging to other organisms, including filamentous algae and hydroids. In one family of caprellids, the Cyamidae (28 species), individuals are



obligate symbionts on cetaceans (whales, dolphins, and porpoises) and have flattened bodies and prehensile (adapted for seizing or grasping) legs. *See* AMPHIPODA; CAPRELLIDA. Richard C. Brusca

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Percent

A ratio comparison of two quantities expressed by using 100 equal parts, or hundredths; symbolized %. There are three major uses of percent: part of a whole, rate, and comparison of any two quantities.

Part of a whole. The basic idea of percent is as a ratio that shows a part of a whole. The technical name for the whole is base.

Ratios as percents. If 89 out of 100 problems are correct, the part/whole comparison shows 89/100 or 89% correct. If the whole is not already divided into equal parts, an equivalent ratio to 100 is found.

Certain ratios are easy to express as hundredths. When 3 baskets are made in basketball out of 10 attempts, an equivalent ratio using 100 is found from which the percent is obvious: $3/10 = 30/100 = 30\%$.

For 35 hits out of 126 times at bat, the ratio 35/126 is not easily expressed as a ratio using 100. Hundredths will be more obvious by dividing 35 by 126, and then reading the number of hundredths to find the percent: $35 \div 126 \approx 0.278$ or 27.8%. The percent is obtained by moving the decimal point two places to the right.

Another method is to set up a part-to-whole proportion with n representing the part out of 100, as in Eqs. (1). The ratio is 27.8%.

$$\frac{\text{part}}{\text{whole}} \quad \frac{35}{126} = \frac{n}{100} \quad \frac{\text{part}}{\text{whole}}$$

$$126n = 3500 \text{ (multiplying each side by } 126 \times 100) \qquad (1)$$

$$n = 27.8$$

The usage for the word percentage has changed over time from its original meaning of the "part." In sports statistics, pct. for percentage really means average, not percent. If a batting average of .278 were a percent, it would be reported as 27.8%.

Discounts and savings from bargain sales are examples of a part of a whole. A discount of \$35 (the part of the whole) on a coat with an original price of \$105 (the whole or base is 105) is a savings of 35/105 or 33.3% off the original price, as in Eq. (2).

$$\frac{35}{105} = \frac{1}{3} = \frac{33^1/_3}{100} = 33^1/_3\% \text{ or } 33.3\% \qquad (2)$$

Percent decrease shows a relative amount of decrease. The amount of decrease, the part, is compared to the original amount, the whole or base. If the value of a house drops \$9000 from an original price of \$80,000, the percent decrease is 9000/80,000, 0.1125, or 11.25%.

Percent of a number. To find a part when the percent and the whole (base) are known, a percent of a number is found.

There are three ways to find the part saved in buying a chair marked at \$300 (the whole or base) with a 25% discount: using a fraction and division, as in notation (3); using multiplication by a fraction or decimal, as in notation (4); or using a proportion, as in Eqs. (5).

$$\begin{aligned} 25\% \text{ of } \$300 &= {}^1/_4 \text{ of } \$ \\ {}^1/_4 \text{ of } \$300 &= \$300 \div 4 \text{ or } \$75 \end{aligned} \qquad (3)$$

$$25\% \text{ of } \$300 \text{ is } 0.25 \times \$300 \text{ or } {}^1/_4 \times 300 = \$75 \qquad (4)$$

$$\begin{aligned} \frac{25}{100} &= \frac{n}{300} \\ 25 \times 300 &= 100n \\ n &= 75 \end{aligned} \qquad (5)$$

The advantage of the first method is that it can be done by easy computation, often mentally. The second method is easier on a calculator. The third method illustrates the proportional connection for percent. In this example, the sale price is \$300 − \$75 or \$225. The sale price can also be found by taking 75%, that is, 100% − 25%, of \$300.

Income tax is a part (the tax) of the whole or base (income). For example, a tax of \$12,500 on income of \$65,000 is 12,500/65,000 or 19.2%.

Calculator use. On calculators, percents can be expressed as decimals and calculations can be done with the decimals. The amount saved in a 35% sale on a \$467 desk can be keystroked as .35 × 467 =. If a percent key, %, is used, conversions are not made to decimals and the % key is pressed last: 467 × 35%. (On some calculators, = is pressed after the %.) After seeing \$163.45 as the amount saved, pressing the minus sign (−) and = keys shows the balance after the discount, \$467 − \$163.45 = \$303.55.

If \$83 is saved on a printer originally priced at \$425, keystroking 83 ÷ 425% shows 19.5, a 19.5% saving.

Rate. While percent always means a comparison to 100, percent can show a rate of so many per 100, not so many out of 100. A sales tax of 6% means a rate of 6% for each dollar, and this 6% is in addition to the dollar. The tax amount can often be calculated mentally by multiplying the 6% rate by the number