

d15 Cenozoic epochs < nuts-and-bolts use of fossils >

... species of petrified aquatic animals, rougher and more imperfect in the lowermost strata of the mountains that I have distinguished as secondary ... and gradually more perfect in the upper strata, according to the order of their subsequent formation, so that in the last strata, those which form the tertiary mountains or hills, there are perfect species, and all are similar to those recognized in the modern seas. —Arduino, 1760.¹

The geognostic equivalents of Giovanni Arduino’s Tertiary and (older) Secondary formations in northern Italy, which he had described and named in the 1760s, were recognized in 1811 by Cuvier and Brongniart in the environs of the Paris basin, France. Here, the Tertiary are loose, often shelly, clays, sands and gravels that occur as horizontal strata in swales of an angular unconformity cut across moderately tilted or folded Chalk. The Chalk is the top stratum of the Secondary that is otherwise here a succession of sharply-differentiated strata of often fossiliferous sandstone, shale, gypsum and limestone.² Outcrops of these Tertiary strata cannot be correlated physically from place to place by walking out formations and contacts. However, Charles Lyell, who came to study the fossils in them, found an “increase of existing species, and gradual disappearance of the [locally] extinct [i.e. extirpated], as we trace the series of formations from the older to the newer, [and this] is strictly analogous ... to the fluctuations of a population such as might be recorded at successive periods, from the time when the oldest of the individuals now living was born to the present moment.” His working hypothesis was to count extant and extirpated species to know the “gradual [local] extinction of certain animals and plants and the successive introduction of new species.” The fidelity of his statistical results allowed Lyell in 1833 to propose a threefold subdivision of the Tertiary into time-stratigraphic periods by the percentage of locally living species amongst the period’s fossil faunas.³

Lyell did not see any evidence of evolution in the fossil record. He explained what he saw in terms of migrations to replace extirpated species in response to “a cooling climate brought on by increasing continentality.” It is only of passing interest to mention the divisions that Lyell proposed. From youngest to oldest, these were: the Pliocene Period in its type deposits, the “Subapennine formations” of northern Italy, have 49 percent of living (extant) species; the Miocene Period, its type deposits, the “Faluns (shelly marls) of the Loire” of southwestern France have slightly less than 18 percent of living species; and the Eocene Period, its type deposits in the Paris Basin have 3.5 percent of living species. His “periods” have since been lessened to epochs as they were found to be of short duration compared to the duration of other named periods of the geologic column. He correctly presumed that additional marine strata would be found and intercalated into the Tertiary according to his scheme.

Lyell’s “nuts-and-bolts” statistical use of fossil illustrates their utility if nothing else for dating strata. As a procedural detail: whereas living clams are classified by their gill structures, fossil clam genera can only be compared, or differentiated, by shell features of such as their hinge-line teeth and sockets. This system for conchology was introduced by C. N. Lang (Languis) in 1722.⁴ Historically, epochs of the Quaternary and Tertiary periods of the Cenozoic Era have been:⁵ □

Period	Epoch
QUATERNARY	RECENT (for modern divisions <i>see</i> Table d19.2) PLEISTOCENE (most recent) Lyell, 1839 (Gk. <i>pleisto</i> , most) 90-100 percent modern species
TERTIARY	PLIOCENE (very recent) Lyell, 1833, type area in northern Italy (Gk. <i>pleion</i> , more) 50-90 percent modern species MIOCENE (moderately recent) Lyell, 1833, type area is in southwestern France (Gk. <i>meion</i> , few) 20-40 percent modern species OLIGOCENE (slightly or little recent) Hiernich von Beyrich, 1854, type area is in Germany (Gk. <i>oligos</i> , little) EOCENE (dawn of the recent) Lyell, 1833, type area is in the Paris Basin, France (Gk. <i>eos</i> , dawn) 1-5 percent modern species PALEOCENE (early dawn of the recent) Wilhelm Philipp Schimper, 1874, type area is in France (Gk. <i>palaios</i> , ancient) no modern species