

d19 Subdivision of the Cenozoic into Neogene and Paleogene < Pleistogene proposed, Tertiary discontinued >

Even when a new century begins it is only we mortals who ring bells and fire off pistols.— Thomas Mann.¹

In the lowland scenery of Europe, locally not covered by riverine alluvial and glacial sediments of Quaternary age, are outcrops of *unconsolidated* horizontally stratified marine sediments with shells that look little different, to the casual observer, from those of living shellfish that wash up on the beach. For these strata, Moritz Hörnes (1815-1868) in 1853 formally proposed the name Neogene (new born) System. “Apparently older” are noticeably more consolidated horizontally-stratified marine sediments with shells, many of which look unfamiliar even to the casual observer. For the time that these strata record, Hörnes in 1864 hinted at, and C. F. Naumann in 1866 formally proposed, the name Paleogene (ancient born) Period (**Table d19.1**).

Cenozoic index fossils in use today in Europe and elsewhere are mostly marine microfossils (**Figure d19.1**) and terrestrial pollens and spores.

A Pleistocene index microfossil is the foraminifera *Hyalinea balthica* that continues to live today in the cool water areas of the northeast Atlantic, the Mediterranean Sea, the west coast of Africa, and the Arabian sea.⁴ Its first occurrence has been used to differentiate in Italy, Pleistocene from Pliocene. Bridging between is the edifice of the active stratovolcano Mt. Etna that sits atop Pliocene strata.

A type fossil for marine strata of the Eocene Epoch is the large foraminifera *Nummulites* (The Sphinx and the pyramids of Egypt were built of Eocene limestone composed mostly of nummulitid foraminifera of the genus *Nummulites*. Herodotus, the Greek historian of the 5th century BC, thought the disc-shaped nummulitids were lentils that, by evidence of their abundance, were to be fed to the slaves who built the pyramids but which had been spilled accidentally and in time had turned to stone.) The largest nummulitids lived about 50 million years ago. Then *Nummulites millecaput* (described from fragments by Louise Purton and Martin Brasier) attained the astonishing (being a single cell) size of about 6 inches in diameter, lived for a hundred years (extrapolating from growth rates of more numerous complete penny-sized shells of related *N. laevigatus* that lived to six years) and tolerated sharp seasonal temperature changes (as recorded by shell oxygen isotopes).²

The subdivisions of the Cenozoic Era are still provisional. The Pleistogene Period inclusive of the Holocene and Pleistocene epochs (**Table d19.2**)³ is too recently proposed to be much used. Neogene and Paleogene, long used in Europe, are now with formal application outside of Europe. In America, the Quaternary (0-2.588 Ma) includes the Holocene Epoch, the Pleistocene Epoch, and the Gelasian Age. The Geological Survey of America and the Canadian Geological Surveys in geological reports and maps continue recognize the Tertiary Period. However, in 2003 the International Commission on Stratigraphy (ICS) proposed that the Tertiary be discontinued as a formal name and that divisions of the Cenozoic (CN) Erathem/Era should (omitting the mnemonic) be named as follows:⁵

System / Period	Series / Epoch (Stage / Age)	
Neogene (N)	Holocene — beginning 0.0115 Ma	Ho!
	Pleistocene (Upper, Middle, Lower)	Please
	Pliocene (Gelasian, Piacenzian, Zanclean)	Place
	Miocene (Messinian, Tortanian, Serravallian, Langhian, Burdigalian, Aquitanian)	My
<hr/>		23.03 Ma
Paleogene (E)	Oligocene (Chattian, Rupelian)	Order
	Eocene (Priabonian, Bartonian, Lutetian, Ypresian)	Early,
	Paleocene (Thanetian, Selandian, Danian)	Pal.
<hr/>		65.5±0.3 Ma



Table d19.1 Original subdivisions of the Cenozoic

For “period” subdivisions names of the Tertiary of increasing age as inferred from living (“recent”) species percentages (as determined by his collaborator Deshayes) in them of 95 (or at least 65), 30, 1, and 0, Lyell originally offered combining forms *pleio-*, *meio-*, *eo-* and *a-* with *synchronous*. Whewell deemed the resulting names “long, harsh and inappropriate” and recommended as “shortest and best” *plio-*, *mio-*, *eo-* and *a-* with *cene*.⁶

Cenozoic Era <i>Phillips 1841</i>	Quaternary <i>Desnoyers 1829</i>	Recent “Period” Pleistocene “Period”	<i>Lyell 1833</i> , <i>Lyell 1839</i>	Holocene Epoch <i>Paul Gervais c. 1867–9</i>
	Tertiary <i>Arduino 1760</i>	Neogene “System” <i>Hörnes 1853</i>	Pliocene “Period” Miocene “Period”	<i>Lyell 1833</i> <i>Lyell 1833</i>
		Paleogene Period <i>Naumann 1866</i>	Oligocene “Period” Eocene “Period” Paleocene Epoch	<i>Heinrich von Beyrich 1854</i> <i>Lyell 1833</i> <i>Wilhelm Schimper 1874</i>

Table d19.2 Modern subdivisions of the Cenozoic (After Harland, W. B., Armstrong, R. L., Craig, L. E., Smith, A. G., and Smith, D. G. (1989) *A Geologic Time Scale*, Cambridge Univ. Press, Cambridge.)

<i>Era</i>	<i>Sub-era</i>	<i>Periods</i>	<i>Epochs</i>	
Cenozoic	Quaternary	Pleistogene	historical time (Recent)	‘cene’ from <i>Kainos</i> = recent
			Holocene	Holos = complete
			Pleistocene	Pleiston = most
	Tertiary	Neogene	Pliocene	Pleion = more
			Miocene	Meion = less
		Paleogene	Oligocene	Oligos = few
Eocene	Eos = dawn			
Paleocene	Paleos = ancient			

Figure d19.1⁷ Globigerinacean foraminifera that are useful index fossils for the upper Cenozoic

