LYELL'S PROPOSAL OF THE TERM "PLEISTOCENE"

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In order to simplify his terminology of Tertiary subdivisions, and probably at the urging of his friend, Charles Darwin, Charles Lyell introduced the Pleistocene "period" (Wilson, 1972, p. 484-485). The term was substituted for "Newer Pliocene" as the name of the most recent of the Tertiary divisions, based on the ratio of extant to extinct species of fossil mollusks. According to Lyell's original criteria, the presence of ninety percent or more extant species from any formation anywhere in the world indicated deposition during the Newer Pliocene (Lyell, 1833, p. 58-59). (Lyell's concept of percentages recently has undergone a very interesting revival at the hands of evolutionary paleobiologists; see Stanley, 1979, p. 113-118.). Because attributes of assemblages of fossil mollusks were the first keys to the identification of latest Tertiary formations, we reproduce in Figure 1 Lyell's illustration of the species regarded as typical Pliocene forms.

The initial division of the Pliocene period into Newer and Older seems to have resulted from Lyell's working relationship with Gerard Deshayes, who he referred to as "the first fossil conchologist in Europe" (from letter to Gideon Mantell, 10 October 1830 *in* Lyell, 1881, p. 306-307). Deshayes believed that the Tertiary was divisible on paleoconchologic grounds into only three major subunits — the Pliocene, Miocene, and Eocene periods, as subsequently designated by Lyell (1833; see also Berry, 1968, p. 106).

Lyell became fully aware of the need for a fourth subdivision during his exploration of southern Italy and Sicily in 1828. His growing awareness of the richness of the stratigraphic record of the latest Tertiary is recorded in his personal correspondence:

> I found Ischia just what I had hoped, a most admirable illustration of Mont Dore, with the difference which we sometimes wished for, as the substitution of marine for freshwater, and the consequent abundance of organic remains . . . I have now the satisfaction of having an example of marine remains at a greater height than any of Brocchi's sub-Apennines, and belonging to a formation decidedly more recent. (from letter to Roderick Murchison, 6 November 1828 *in* Lyell, 1881, p. 210-212)

His growing conviction that the Pliocene should be separated into Older and Newer divisions was reinforced during the tour of Sicily:

> . . . What will you say if I tell you that even the blue marl with its capping of yellow sand cannot be Brocchi's sub-Appenine beds? I am come most unwillingly to this conclusion. But the numerous extinct species which characterised the sub-Appenines are wanting here, and living shells are present too plentifully to admit a doubt that it is more related to our own epoch that that remote one when the Parmegiano and Placentino beds were deposited. (from letter to R. I. Murchison, 12 January 1829 *in* Lyell, 1881, p. 232-234).

Thus, it was in southern Italy that Lyell found the compelling reasons to subdivide the Pliocene; here he found evidence for a Tertiary period younger than the period in which the Subapennine beds of the Italian peninsula were deposited. But because of his reliance on Deshayes' compilation of paleoconchologic data (Lyell, 1833, Appendix I), Lyell did not employ a fourth distinct "period" for these very young, fossiliferous deposits when he wrote

the third volume of the *Principles*. Lyell regarded the deposits of the Val di Noto in Sicily, and on the island of Ischia, just offshore from Naples, as typical Newer Pliocene formations (Lyell, 1833, pp. xii-xiii, 54, 63-66, 126-127; see also Wilson, 1972, map 9).

Later, Lyell found that the Pliocene could be subdivided even further as work proceeded on the Crag and other later Tertiary deposits, and on their contained fossils (Wilson, personal communication, 1981). Wilson (1972, p. 485) has written:

> As the number of subdivisions of the Pleiocene period had increased, he (Lyell) had found himself in the uncomfortable position of referring to the upper and lower 'older Pleiocene' and the arkwardness of this suggested the need for new terms.

The term "Pleistocene," then, was finally substituted for Newer Pliocene as a kind of utilitarian afterthought in an Appendix to the first edition of the French translation of the *Elements of Geology* (Lyell, 1839). This curious supplement to the main text reads like the "notes added in proof" of modern publications, and served to update the Tertiary divisions then in use. Because of the obscure location of the original proposal of the term, few students of the Pleistocene have actually read the passages containing the designation of the new division. Surprisingly, the geologists of our acquaintance whom we questioned about its origin were only vaguely aware that Lyell had actually proposed the term and the majority had no idea when or where the term first appeared. For these reasons, and to provide additional available documentation of the evolution of Lyell's Tertiary subdivisions, we present a translation of the Appendix to the French *Elements* , followed by the original text (Lyell, 1839, p. 616-621). We have added footnotes to the translation to identify colleagues and publications to which Lyell refers.

In the third chapter of this work,[1] I said that important additions were made to collections of living and tertiary fossil shells, during the past ten years, making necessary the revision of that part of the classification of tertiary formations which rests principally upon the relative proportion of recent to fossil species in each group.

Since the publication of the previously mentioned chapter in the English edition,[2] I have been earnestly researching this subject; and already these researches have led me to the modification and amplification of some of my initial ideas, — changes which I am going to give in this appendix, in a manner as abbreviated as possible.

After recent investigations, it appears that the English Crag, which I reported as entirely Older Pliocene (See p. 349), belongs to several periods, namely: the Red Crag and the Coralline Crag of Suffolk, the fossils of which are shown on pages 353-356, are characteristic of the Miocene epoch; and only the Norwich Crag is entirely Older Pliocene. The following considerations caused the change of opinion.

1. The beds of shelly sand and clay which are known as Crag, and which, in the county of Norfolk, overlie a chalk, representing fluvio-marine deposition, contain 90 species of marine shells, and about 20 species of freshwater and terrestrial shells. Among these shells, the number of recent species is, as for the present, around 50 to 60 percent. This formation can be placed in the oldest Pliocene period, in which at one time I placed all of the English Crag.

2. The number of fossil shells from the Red Crag of Suffolk excluding the annelids and cirripeds, is 214 in the collection of Mr. Searles Wood.[3] of this number, 64 are recent species, which establishes, with regard to extinct species, a proportion of about 30 percent.

3. In the same collection, of 329 shells collected from the Corallline Crag, there are 62 recent species, that is 19 percent.

I was assisted in this comparison of fossil and recent shells by two very distinguished naturalists Mr. Searles Wood, who possesses a profound knowledge of British tertiary shells; and Mr. G. -B. Sowerby,[4] whose knowldege of recent shells is justly appreciated by all conchologists.

The predominance of the above mentioned extinct species in the Red Crag and in the Coralline Crag indicates a great differ-

Figure 1. Reproduction of Plate 1 from *Principles of Geology* (1833), Volume III, showing fossil shells regarded by Lyell as typical Pliocene forms. Numbers 1, 7, 9, 11, 13, and 14 were listed by Lyell as being found in Newer Pliocene, or Pleistocene, deposits; no attempt has been made to update the fossil names.

1.2 Turbo rugosus Lm. – 3.4 Trochus magus, Lm. – 5 Solarium variegatum, Lam.k 6 Ternatella fasciata Lam.k – 7 Pleurotoma vulpecula Brocc. – 8 Fusus crispus, Born 9 Buccinum prismaticum Born. – 10 Pleurotoma rotata Brocc. – 11 Buccinum serrulatum Brocc. – 12 Mitra plicatula Brocc. – 13 Cassidaria echinophora Lam.k – 14 Cytherea exoleta Lam.k var

ence between the fauna of the neighboring sea and that of the two formations, which I was inclined to attribute to different epochs of the Miocene period. This difference, in regard to the living fauna of the German Ocean,[5] is not confined to species; it also extends to many genera which, actually, are foreign to the adjacent seas: such as, among others, a large Cassis, and a Voluta in the Red Crag; a Pyrula, a Voluta, a Lingula, a Pholadomya, and a Glyximeris [*sic*] in the Coralline Crag. Many corals (stone-corals) are found in the latter deposits, the species of which belong to the intertropical genus Anthophyllum.

After carefully examining, in 1825, the Suffolk Crag and the faluns of Touraine, M. Desnoyers[6] decided, in his opinion, that the two formations were contemporaneous.[7] This conclusion, which I consider today to be very probable, was, in principle, contested by me with regard to the supposedly large proportion of recent shells in the Suffolk Crag, and the distinction that exists between the species of fossil shells from Touraine and those from Norfolk and from Suffolk.[8] The first of these arguments was based on an error, that resulted pirincipally from the more recent shells of the Norfolk Crag being confused with those of the Suffolk, and attributed to the same period, — a circumstance which gave a greater proportion of recent shells than that which is fitting for the Red Crag or for the Coralline Crag of Suffolk, if each were taken separately. The other argument, namely, the distinction between fossil species from Suffolk and those from Touraine, presents a great difficutly, since out of one hundred species, there are not ten which are common to the two formations.

After examining, jointly with Mr. G. -B. Sowerby, a collection of 236 species of shells from Touraine, assembled by M. Dujardin,[9] and described by him in the Mémoires de la Société géologique de France (See this work, vol. II, page 211),[10] we have found, among these shells, a proportion of 26 percent of recent species. As for fossil species, those from the Suffolk Crag are for the most part identical to those from British regions and arctic climates, likewise, here, they resemble Mediterranean or North African species. One could say that during the time of deposition of the two formations in question, a geographic barrier extended across the English Channel, separating it into two gulfs, one opening to the north and the other to the south.

Mr. Sowerby also examined with me 400 species of shells from Eocene marine and freshwater formations of England. In their number, we found only four which could be identified as recent species. This proportion of 1 percent could perhaps be raised slightly; but we believe that in each case this augmentation would not be considerable, because the collections of living shells which, in the course of our research, we have examined, are part of the richest which exist in Europe.

On the other hand, some of the most recent shelly deposits in England, as much lacustrine as marine, contain more than 90 or 95 percent living species; and I doubt that everything that is to be discovered has been discovered including, in the different tertiary deposits of Europe, almost all proportions intermediate between those which characterize the English Eocene mentioned above, in which scarcely one percent of recent species is found; and the opposite case, in which the same proportion of extinct species is found. Already, finding that it will become necessary to establish an arbitrary line of demarcation between those deposits to which I have given the names of Older and Newer Pliocene,[11] I designated the former, that is to say the most ancient of these groups, the strata which contain 40 to 70 percent recent species of shells; and the most modern, those in which this proportion exceeds 70 percent.

However, at the same time that it became necessary to subdivide the two periods mentioned here, I found that the terms destined to designate those subdivisions were inconveniently long, and I propose to employ in the future the word Pliocene for the Older Pliocene, and to substitute for the designation Newer Pliocene the abbreviation of *Pleistocene*, taken from the Greek pleiston, *most*, and kainos, *recent*.

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1. 1839, *Elements of Geology* (first French edition)
2. 1838, *Elements of Geology* (first English edition)
3. Searles Valentine Wood (1798-1880). English paleontologist and Tertiary mollusk authority; specialized in Crag fossils of Suffolk and Norfolk, and Eocene fossils of the Hampshire Basin (*see* Lambrecht *et al.*, 1978, p. 466).
4. George Brettingham Sowerby (1788-1854). English Conchologist and paleontologist; member of famous family of naturalists that included James Sowerby (father) and James De Carle Sowerby (older brother) (*see* Lambrecht *et al.*,1978, p. 406).

5. North Sea.
6. Jules Pierre Francois Stanislas Desnoyers (1800-1887). French geologist and archaeologist; one of the founders of the Société Géologique de France, Librarian of the Muséum d'Histoire Naturelle, and author of memoirs on the Mesozoic and Cenozoic deposits of the Paris Basin and Northern France (*see* Lambrecht *et al.*, 1978, p. 114),
7. *see* Desnoyers, 1825, Mémoire sur la craie, et sur les terrains tertiaires de Contentin:Mém. Soc. d'Hist.Nat. de Paris, v. 2, p. 176-248.
8. *see* Lyell, 1838-39, Lettre à M. Desnoyers sur le crag du Norfolk et du Suffolk: Soc. Géol. Bull., v. 10, p. 321-322.
   see also Lyell, 1839, On the relative ages of the tertiary deposits commonly called Crag, in Norfolk and Suffolk: London and Edinburgh Philosophical Magazine and Journal of Science, series 3, v. 15, p. 407-411.
9. Félix Dujardin (1801-1862). French zoologist and geologist; professor of mineralogy and geology in the Faculté des sciences de Toulouse, and later professor of zoology in the Faculté des sciences de Rennes (*see* Lambrecht *et al.*, 1978, p. 121).
10. Dujardin, 1835, Mémoire sur les couches du sol en Touraine, et description des coquilles de la craie et des faluns: Mém. Soc. géol. France, v. 2, p. 211-312.
11. *see* Lyell, 1833, Principles of Geology, v. 3, chapt. 5.

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