

HIGHER CLASSIFICATION OF COCCOLITHOPHORES

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INTRODUCTION: Since constructing this chart, for my PhD, I have found that it provides a useful reference to the confusing array of groups in the phycological literature. On this basis I felt it might be of interest to others.

The main source I used in compiling it was Taylor (1980), with additional information from Blackmore & Toothill (1984).

NOTES

1. The chart is based on Kingdom Protista (unicellular organisms), rather than Plantae, in order to include all the microplankton groups. This is however a somewhat artificial group, since a number of divisions include both unicellular and multicellular algae.

2. Taxonomic levels: Cyanophyta, Haptophyta, Euglenophyta etc. - Divisions / Phyla. Dinophyceae, Prymnesiophyceae, etc. - Classes. Calyptosphaeraceae, Coccolithaceae etc. - Families.

3. All algae with golden-brown pigments are sometimes included in one division, the Chrysophyta, including coccolithophores and diatoms. Of these the diatoms have always been regarded as a distinctive group, class Bacillariophyceae. The other golden-browns were, however, for a long while considered to be a single class, the Chrysophyceae. Parke (1961) showed that they could be subdivided into two series, on the basis of their appendages and scale structure. This led to the establishment of the class Haptophyceae by Christensen (1962), for coccolithophorids and related non-calcifying genera. Subsequent research (see eg Hibberd 1976), has strongly supported this separation so that many authors now consider the haptophytes a separate division.

Unfortunately there is a further, nomenclatural, complication - Haptophyceae is a descriptive name and so invalid, under the ICBN, as a class level name. Hence Hibberd (1976) proposed the alternative typified names Prymnesiophyceae and Prymnesiophyta, from the genus *Prymnesium*. The former is widely used, the latter not so frequently.

4. Typical haptophytes and chrysophytes are planktonic and flagellated, with two (golden-brown) chloroplasts, a prominent nucleus and well developed golgi-body. They differ in the following ways: (A) The motile phases of haptophytes have smooth flagella, as opposed to the flimmer (hairy) flagella of chrysophytes. Also they have a unique third flagella-like appendage, the haptonema. This has a distinctive ultrastructure, is frequently coiled, and seems to be used for attachment rather than locomotion - it is best known from non-calcifying genera.

(B) Haptophytes nearly always possess unmineralised organic scales, and often calcareous coccoliths. The scales of chrysophytes, when present are usually silicified, to varying degrees. [N.B. Prasinophyceae also have organic scales produced within the golgi body, and so are sometimes compared with chrysophytes and haptophytes].

(C) Haptophytes have uniquely developed golgi bodies (in which the scales and coccoliths are formed), distinctive pyrenoids, slightly different pigments, and various ultrastructural and biochemical differences.

(D) Haptophytes are predominantly marine, whereas most chrysophytes are freshwater.

6. The family level classification is not meant to be profound or original, I have only included extant families. The Hymenomonadaceae have delicate rarely (?never) fossilised coccoliths. *Hymenomonas carterae*, much studied by biologists, is in this family. I included families in the "non-coccoliths" group for the following, debatable, reasons: Ceratolithaceae - ceratoliths are not coccoliths, although coccoliths of a sort are produced (Norris 1965, 1971). Calciosolenaceae - scapholiths are markedly different in form to coccoliths and have an independent fossil record, also an uncalcified genus *Navisolonia* is known (see Leadbeater & Manton 1973). Braarudosphaeraceae - the pentoliths show very different ultrastructure, morphology, and distribution to other nannoliths. Lefort (1972), however, has presented reasonable evidence that *Braarudosphaera* is an haptophyte.

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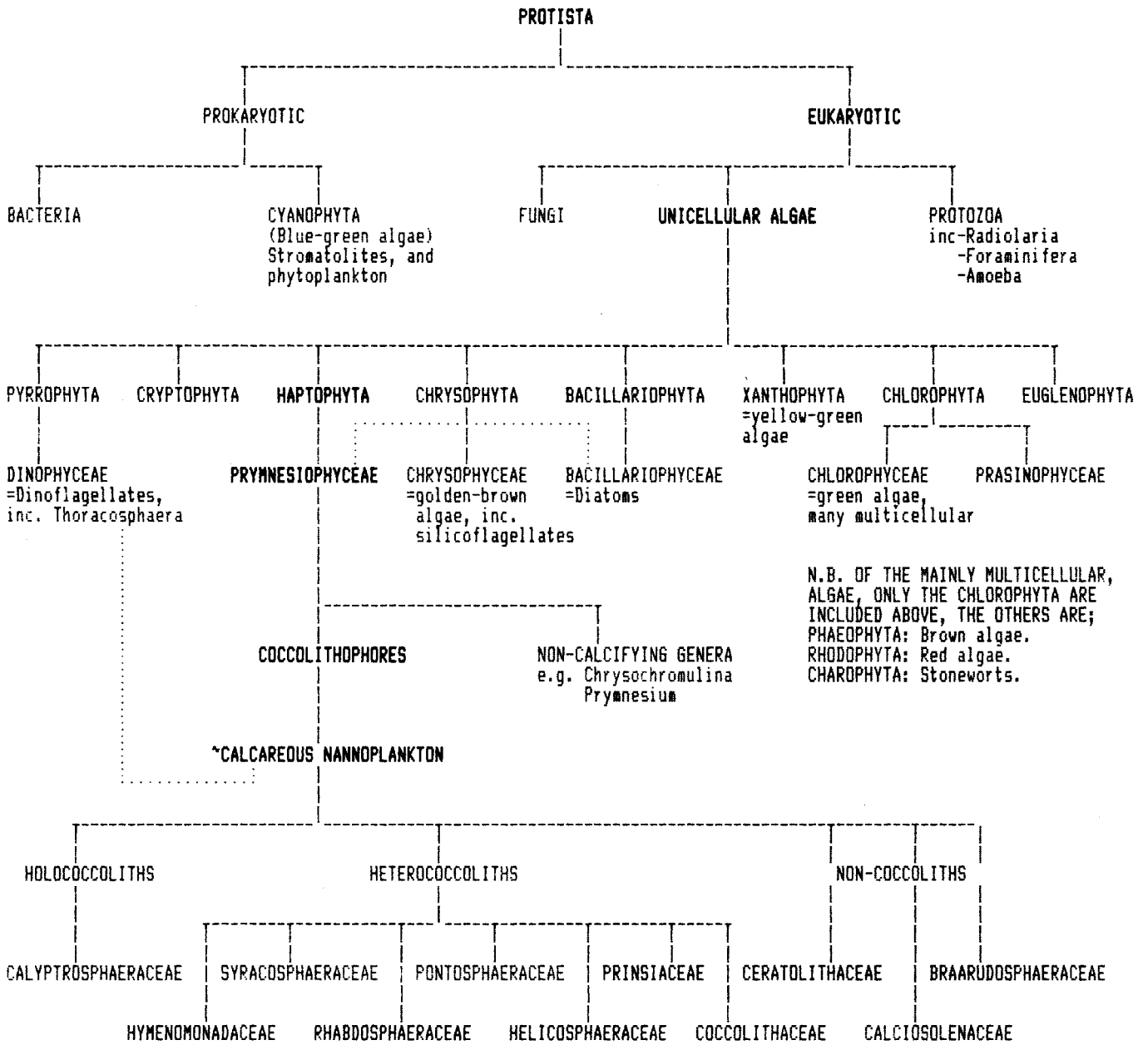


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