k23 Proterozoic microfossils <1 micron = 1 thousandth of a millimeter >

> I had been dead for billions and billions of years before I was born, and had not suffered the slightest inconvenience from it. —Mark Twain. An *aperçu* to console the dying.[1]

Animals and plants have cells [2] with a karyote (a membrane enclosed nucleus). These are called *eukaryotic* (Gk. *eu*: full, true; *karyon*, nucleus) cells to distinguish them, even when microbes, from microbe cells with no nucleus, which is the condition of archaea and bacteria (***Figure k23.1***).

Common ancestors of existing multi-celled animals (metazoa) and plants (higher plants) must date to before the certain presence of Eocambrian metazoa. Genetic distance indicates too that divergence from a common, presumably uni-celled ancestor, would have been during the early Proterozoic.[3]

"Who knew" writes D. Graham Burnet in his review of *Building of the Scientific Revolution* by Lisa Jardine, 2000, "that commerce in spices stimulated one of the most striking discoveries of the 1600's: microscopic organisms? It turns out that, with pepper prices sky high, an enterprising investigator wanted to see what gave the spice its delightful kick; the 'little eels' he saw galvanized Europe." [4] As remarkable to the scientific world, beginning in the 1940s, examples of predicted Precambrian unicelled life were finally seen: fossils sealed in black chert (hardened silica-gel). Thenceforward, once researchers knew what shapes to look for, microfossils were identified in the cements of many types of sedimentary rock.

Famous examples of Proterozoic cherts with some unicellular eukaryotes in addition to no-nucleus microbes are:

0.9 Gy, Bitter Springs Formation, Australia,[5]
1.2-1.4 Gy, Beck Spring Dolomite, southeastern California,[6]

and with only no-nucleus microbes identified are:

1.8-2.1 Gy, Gunflint Iron Formation, northern Minnesota and southern Ontario (near Thunder Bay), Ontario, Canada—a stromatolitic chert biofacies in BIF (Banded Iron Formation). Its fossils are filamentous structures resembling cyanobacteria (*Gunflintia, Entosphaeroides, Animikiea*), spheroids (*Eosphaera, Huroniospora*), star-shaped forms (*Eoastrion*), and umbrella-shaped forms (*Kakabekia*).[7]

Figure k23.1 [8] Some features of bacterial and eukaryotic cells

Bacterial cells have no nucleus.

Usually much larger than bacterial cells are eukaryotic cells of which:

A plant cell has a cellulose cell wall.

A fungal cell, has a cell wall, when it does, mostly of chitin and rarely with cellulose.

An animal cell has no cell wall and is bounded by a single lipid bilayer membrane.

A flagellum (plural: flagella) (not shown in these diagrams) is present only in some microbes and unicelled eukaryotes.

The flagellum tail of sperm is mostly microtubules (made from a protein called *tubulin*) together with special components as dyneins that regulate the microtubules' activity and allow paired microtubules to slide against each other. When this sliding is convert to a bending motion by a timed cross-latching protein, the sperm's tail beats.