Feb. 3, 2014

Summary to date: We have progressed through the Precambrian, roughly 4 Ga, and 8/9* = 90% of geologic time, based on radioactive dating of early Archean rocks, dates of rocks on the moon, and radioactive dates obtained from asteroids. We have noted the possible development of single replicating cells with not much more than short strands of RNA and a bounding membrane of lipids. Prior to development of eukaryotic cells, these prokaryotes would probably have developed, first, longer strands of RNA and then development of DNA (loss of an oxygen ion in RNA to form Deoxy-Ribonucleic Acid and gain of a Methyl (CH_3) group to Uracil to make Thymine), the double helix, which is more stable than RNA and easier to replicate without error.

Keep in mind the importance of symbiosis and lateral exchange to the growing complication of early prokaryotes, culminating in the development of eukaryotes by incorporation of endosymbionts, formation of mitochondria by incorporation of primitive Bacteria. By the time we got to the late Proterozoic (approx. 600 Ma) we note that there are geological signs (BIF, UO_2, redbeds and absence of pyrite (FeS_2) in shallow water sediments) that oxygen is getting abundant or superabundant (snowball earth) as a result of photosynthesis in the absence of widespread respiration causing an "icehouse" period, one of the most important developments in the history of life on earth. By 2Ga approximately, we had an abundant biota in the Gunflint chert, and possible respiring by animals.

In the latest Precambrian (Ediacaran), we see near the base the occurrence of acritarchs (green algae encapsulations) and animal embryos (Phosphatized in Doushantuo) and sponges (in Namibia). Then we have the widespread faunas of Ediacaran multicellular animals in Ediacara Hills, White Sea area of Russia, Nama and numerous other important areas of the world. This fauna consists mostly of animals that were non-ancestral, but we apparently have an ancestor of the Mollusca (*Kimberella*) and an ancestor of the Arthropoda (*Yorgia*). In Namibia and at least one other area we find the first to biomineralize a shell (*Cloudina*), a taxon that may straddle (or disappeared just below) the 542 Ma boundary between the Cambrian and Precambrian. Sponges were also on the scene, apparently as early as ca. 700 Ma in Namibia. All other Ediacaran taxa disappeared prior to the beginning of the Paleozoic Era, with the Cambrian at its base. Also, don't ignore the fact that a number of Ediacaran genera and species didn't seem to be stem group members that were going anywhere. They did not survive into the Cambrian, nor did the stem groups, except for the Porifera, Cnidaria, Mollusca and Arthropoda, with further development in Cambrian and younger time.