j27 Ordovician life does not move onto the land

< co-revolutions >

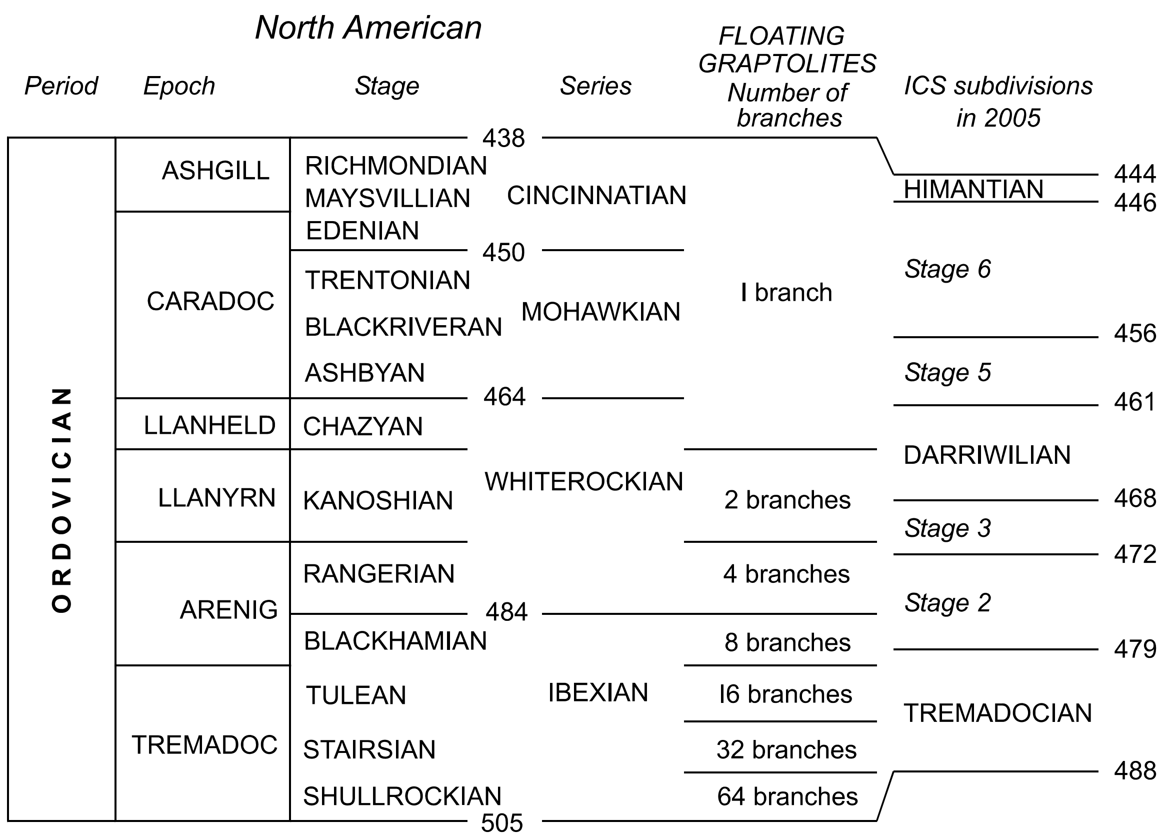
The history of life, on the whole, has been a soggy affair.
—Carl Zimmer.[1]

The Ordovician Period (***Figure j27.1***) was a time when invertebrate marine life diversified greatly worldwide: 530 families included 1,580 genera at its end (444 Ma) were up from the 160 families that included 470 genera at its beginning (488 Ma). During the Ordovician, orogenies (the Taconic orogeny in Laurentia, for example) raised fold mountains in several marginal mobile belts in what had been stable carbonate shelf environments formerly. Marine species' habitats were thereby altered and increased in number (shoalings break up a species' range) and in kind (sand and mud and nutrients enters a nutrient-poor carbonate shelf environment).

Physically the setting in which life made transitions to the land in the Devonian, as in ORS, was present in the Ordovician. But starkly different were freezing conditions that came to prevailed toward the end of the Ordovician. This coincides with the second greatest mass extinction of all time, when at least half of all marine animal species became extinct.

Before the appearance of vascular land plants of the simplest sort for which is fragmentary evidence in the Middle Silurian, there is claimed evidence in latest Ordovician redbeds, Junaita fm, Pennsylvania, 20 million years earlier, of soils in which root traces are present. In these "soils" other trace fossils are burrows up to 15 millimeters in diameter. Simpler-tissued plants that can be anticipated to have been present even earlier are mosses and liverworts. However, mosses (division

Figure j27.1 [2] Ordovician graptolite stages



Bryophyta) and liverworts (division Hepatophyta), so far as these are known from their present organization, cannot have been the ancestors of vascular ("higher") plants. The presumption is that vascular plants, mosses and liverworts evolved separately from different green algae (division Chlorophyta) ancestors.[3]

The oldest unequivocal moss (*Musites polytrichaceus*, Upper Carboniferous, France) and liverwort (a compression of a thalloid liverwort, *Pallavicinites devonicus*. Devonian, New York) fossils are rare and fragmentary. The existence of these tissued, *nonvascular,* plants before then is probable but, as the only distinctive fossils to hand are spores, the problem is to distinguish their spores from the spores of algae that, certainly, were present.[4]

In this quest there has been no success with mosses. Modern liverworts, however, have spores arranged uniquely in fours. Beginning in the early Late Ordovician, spores as these are present in freshwater sediments, and sometimes in association with cuticle (sun screen and desiccation retardant tissue) plant fossil material.

Liverworts and mosses cannot tolerate desiccation and are killed by sustained strong sunlight. Their covering of *wet* ground is most extensive at high latitudes. They are tolerant of shade, acid bog water and, being rootless, do not require aerated soil for their growth.

Abiotic weathering produces loose particles by chemical weathering, salt growth, freezing, stress-release fracturing, and chemical dissolution.[5] In the absence of rooted plants, soils such as pedalfers, pedocals, and laterites cannot develop. During the Ordovician and before, the terrain of the world between water courses, bogs, and lakes, would have been rain-washed rock, dunes of wind blown sand, and wind-deflated lag gravels. Fines and salts could only have come to rest as water-laid sediments in porous ground, bog, lake, and sea.

Geological and biological co-revolutions have often been noted. Looking for a causal link: 1) Arnold I. Miller and Shuguang Mao categorized the geographic distribution of 6,576 Ordovician marine fossils of trilobites, brachiopods, and mollusks. For these, they found, the diversity of animal genera does increase markedly in areas closest to growing mountain ranges.[6] 2) Birger Schmitz's egalitarian view (counter the usual dire extinction-image focus) is that the "Great [Middle] Ordovician Biodiversification Event" was due to Earth peppered by L-chondrite meteorites (with 450-500 My shock ages that record the largest asteroid-breakup event in the past few billion years).[7]

Ancestral to land vertebrates were Devonian bony fish that had come to occupy freshwater (which is indicated by the association of their fossils with invertebrate eurypterids and the absence, in the same sediments, of marine invertebrates as brachiopods and trilobites). The greatest variety and mass of animal life has always been invertebrate. These are closer to the base of the food chain. Fragmentary nonmarine animal remains occur in Silurian sediments.[8]

During the Ordovician, fish were present but they were small jawless forms (Agnatha).The internal skeleton of these is assumed and was cartilaginous (not bony), if present, as it does not show in any of their fossils that have been found). Some had an armor of bony plates. Agnatha fossils occur in association with trilobite fossils, which declares that they were marine. No land vertebrates evolved then. Why? Lack at the time of fodder and prey that these could support on the land? The sterile land and freshwater conditions, which evidently existed during the Ordovician, is so of all older times. Acid rain can produce sparkling clear (dead) lake and stream waters today. Were the environmental factors that held off the conquest of the land by life, high carbon dioxide levels and low oxygen levels? Low oxygen levels would mean less ozone in the ionosphere and higher levels of UV light at ground level. The abundance of carbonate secretions (the shelly facies) by marine life would be matched by massive pumping out of carbon dioxide from seawater into the atmosphere.[9] Or was life, having no agenda, just taking its time? ❑