An Imperfect Window

Our view of the past is built from countless stony fragments and impressions left in sedimentary rocks by fortunate, yet improbable accidents of preservation of once living tissue. The history of the family of plants that we know as cycads is a long one, but they have left us only a few scattered clues to the richness of that reign. These fossils are named for leaves and leaf fragments, for cones, and for stems. Only rarely, as in fossil animals, does a generic name refer to the intact plant. This is because the vegetative fossils we find in ancient sediments are mostly the storm debris of prehistoric forests, a stump, or sodden log, or a pile of leafy debris gathered in an eddy and buried under silt and sand. If discovered, they become clues in the great puzzle of what the times that came before us were like.

When fossil cycads first began to be discovered in significant numbers decades ago, they attracted much interest. Researchers like Seward, Wieland, Williamson, and Chamberlain were foremost in the 30's and 40's. Wieland's "American Fossil Cycads," in two volumes, remains one of the landmark reference works in this area. Chamberlain, whose "The Living Cycads" is another classic, also wrote in depth on cycad evolution in his "Gymnosperms, Structure and Evolution." It is through the dogged physical labor of field paleontologists, the technician in the lab who frees the fossil for study, and the determination and insight of researchers who try to understand and describe these fragments out of time that we have any knowledge at all of vanished worlds. It has just been in the last century that an explosion of knowledge has occurred as the science of Paleontology has matured. Like a grimy window being wiped clean, our view of the past grows better and better with each passing day. This article is a brief review of the current knowledge of the fossil cycads. Photos and drawings of representative fossils are included. The clues remain scant. But with each new dig, the Cycadale fossil record is filled out with additional pieces of evidence.

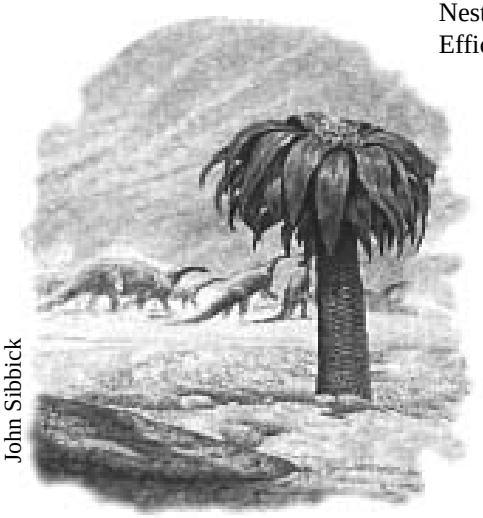
Hylonomus, one of the earliest reptiles in a forest of lycopods, tree ferns and seed ferns. Carboniferous Period

Variations in leaves

The chart at right is based on a diagram in Chamberlain's paper "The Gymnosperms," published in 1935. It has been updated to reflect new information and the names of representative fossil discoveries have been noted very roughly in the time scale. The majority of fossils listed are based on leaf fragments, but some are of cones and these are listed within the "trunk" of the Cycadale family tree.

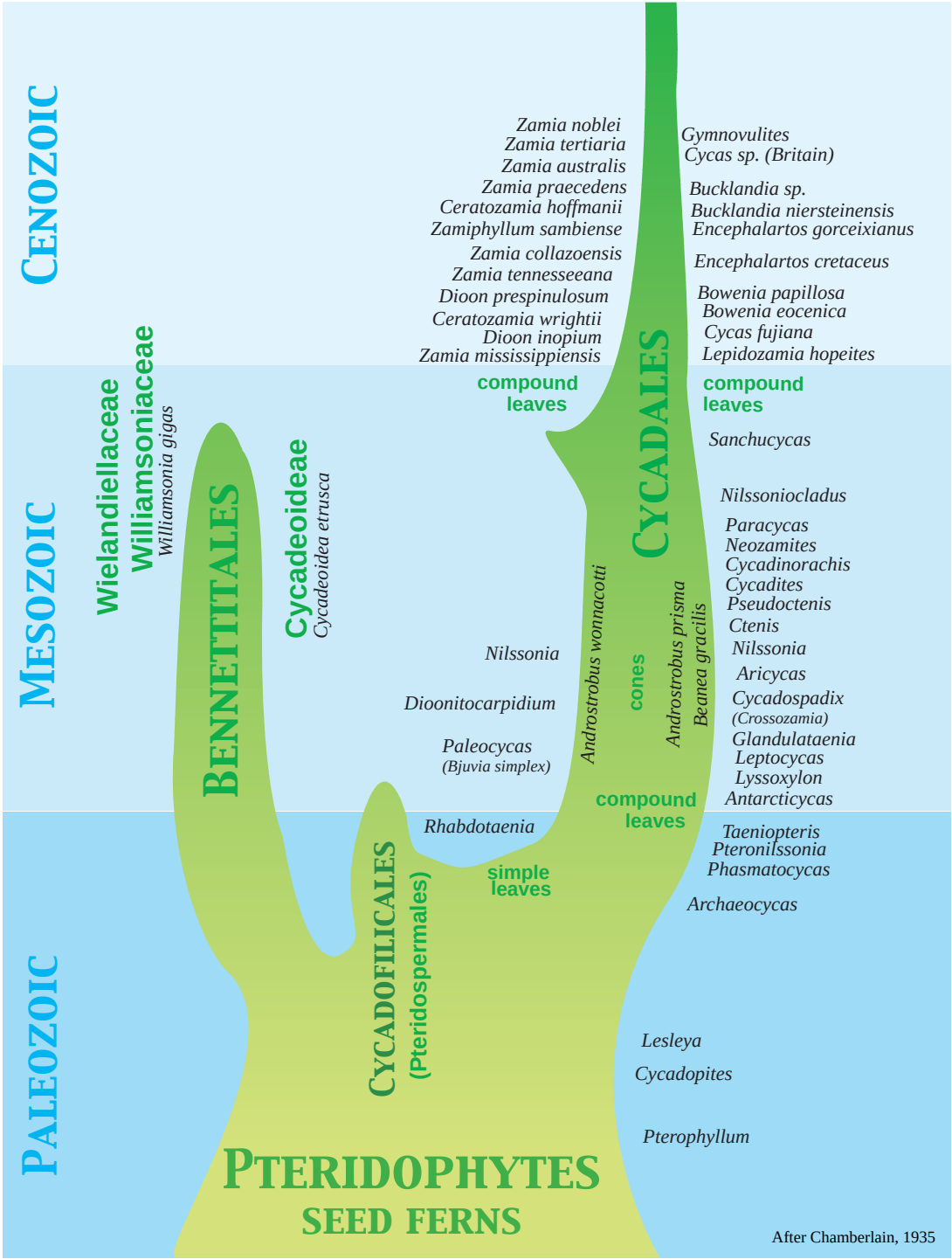
Early seed ferns (Cycadofilicales), from which the Bennettitales and the Cycadales sprang, were derived from asexual ferns that had begun to produce both large spores with female gametes and smaller spores with male gametes. With time, the female spore and a supply of starch became encased in a hard shell while the male spore remained small for mobility. Both were produced on the edges of leaf structures. Eventually, all seeds became restricted to the tip or base of the leaf. A remnant of this reproductive leaf design can still be recognized in *Cycas* today. It has reached it's pinnacle in the hard, protective female cone, and male pollen cones of all modern cycad genera.

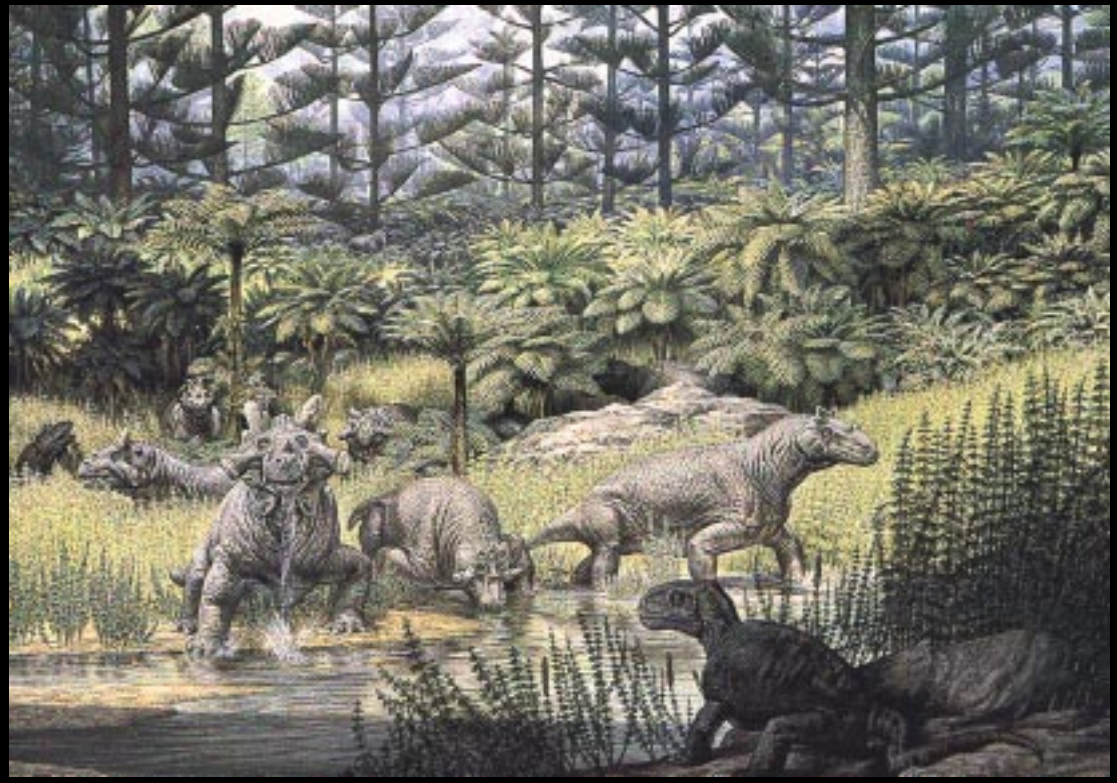
As leaf structure further diversified, some held seeds or pollen, others became purely photosynthetic structures. In the beginning these vegetative leaves were simple, a single sheet of veined tissue stiffened by a stout rachis (as in the modern Bird Nest fern, *Asplenium nidus)*. Efficiency and mechanical considerations apparently gave an edge to a compound leaf design (which would be less prone to wind damage), because simple leaf designs were relatively short-lived in both the Cycadales and the Bennettitales.



John Sibbick

Bjuvia simplex, a Triassic Cycadale wih a simple leaf pattern





Douglas Henderson

In the Beginning . . .

In the painting above a Carboniferous period meadow is dominated by a forest of araucarians and *Neuropteris*, a seed fern and a distant precursor to the modern cycad. Horsetails and other fern allies form the undergrowth. The large horned animals approaching the water hole are *Estemmosuchus*. Members of the therapsids, these herbivores were probably warm-blooded. Dinosaurs would not arise until after the therapsids had vanished in a series of worldwide extinctions, which brought forth a whole new set of plant and animal players of the Mesozoic Era.

The Carboniferous, known variously as the “Age of Ferns”, and the “Coal Age”, was a time of low lands and immense, swampy forests of simple vascular plants like horsetails and tree ferns. For plants, it was a time of experimentation in reproductive structures. Seed bearing plants had just appeared.

Ferns are homosporous, they produce one asexual spore. After it lands on a suitable moist medium, it produces both male and female gametes of similar genetic makeup. After they combine, the new fern that is produced from the prothallus is for the most part a clone of the parent plant. Sexual reproduction is a huge advantage because it allows considerable genetic variation in characteristics. In times of severe environmental change, this can mean the difference between survival and extinction. The Cycadofilicales (=Pteridospermales) were the first to transition from asexual reproduction to producing true seeds. The seeds of *Lyginopteris* were small and formed at the tips of short stalks at the ends of the leaves. *Neuropteris* was closer to the cycad pattern of reproduction. Its seeds were large and carried in a terminal crown of leaves. In appearance, this species resembled a tree fern and, judging from its numbers in fossil deposits, very successful in its time.

Ptilophyllum
A compund leaf fossil