

## Relationships and Distribution

The gymnosperms embrace two great phyla, the Cycadophytes and Coniferophytes, both with a geologic history extending far back into the Paleozoic. Because both groups were highly developed and very abundant in the Carboniferous, they must have originated much earlier. These two great lines of descent have undergone a parallel evolutionary development for over three hundred million years. The fossil record does not reveal which group is the older or even whether the two groups had a common ancestry. In fact, the oldest available material, of Upper Devonian age, shows the two lines about as sharply separated as they are today. However, the many fern-like features of the Cycadophytes, especially of the Paleozoic members, strongly indicate that they were derived from an ancient fern stock, while the many structural resemblances between the two gymnosperm phyla <sup>imply</sup> ~~imply~~ that either the Coniferophytes were derived from the Cycadophytes very early, or that both arose independently from a common filicinean ancestry.

During the Paleozoic the Cycadophytes were represented by the Cycadofilicales, and the Coniferophytes by the Cordaitales. Both orders, dominant then, are extinct today. During the Mesozoic the Bennettitales and Cycadales, both probably derived independently from the Cycadofilicales, carried on the Cycadophyte line, while the Ginkgoales and Coniferales, both probably descended from the Cordaitales, continued the Coniferophyte line. Of these four Mesozoic orders, the Bennettitales became extinct before the close of the era, but the others have persisted. The Cycadales are represented today by nine genera and about <sup>one hundred</sup> ~~one hundred~~ species, the Ginkgoales by a single species (Ginkgo biloba), and the Coniferales by about forty genera and over five hundred species. Another modern

order of gymnosperms, the Gnetales, comprise three genera and about sixty-five species. Although their affinities may be with the Coniferales, they occupy a very isolated systematic position and are practically unknown as fossils.

The Cycadophytes are comparatively small plants with pinnate leaves and unbranched or slightly branched stems having a ~~small~~<sup>large</sup> pith, scanty zone of wood, and large cortex. The Coniferophytes, on the other hand, are comparatively large plants with simple leaves and profusely branched stems having a small pith, abundant wood, and scanty cortex. Fern-like characters, retained by the Cycadophytes from their filicinean ancestors, include the general habit, vascular anatomy, form and venation of the leaves, occurrence of microsporangia in sori, structure of the microsporangia, and multiciliate sperms.

In the Cycadofilicales the sporophylls are much like the vegetative leaves and are not collected into cones. In the Bennettitales cones that are mostly bisporangiate are borne in large numbers, generally laterally along the stem. The microsporophylls are somewhat leaf-like and loosely clustered below the megasporophylls, which are much reduced, not at all leaf-like, and compactly organized. In the Cycadales monosporangiate cones are borne in small numbers and in an apparently terminal position on the stem. Both the microsporophylls and megasporophylls are much reduced. All except the megasporophylls of Cycas are organized into a more or less compact cone.

In the Mesozoic the Cycadales were world wide in distribution. Now they are confined to tropical and subtropical regions, and even there <sup>most of them</sup> ~~they usually~~ occur in scanty patches <sup>in out-of-the-way</sup> ~~and inaccessible~~ places, <sup>hard to find after the general locality is reached.</sup> The order is represented by a single family, the Cycadaceae,

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Of its nine genera, four are restricted to the Western Hemisphere and five to the Eastern Hemisphere. The occidental genera are Zamia, Microcycas, Ceratozamia, and Dioon. All of these occur north of the equator except a few species of Zamia. The oriental genera are Cycas, Bowenia, Macrozamia, Stangeria, and Encephalartos. All of these are found south of the equator except some species of Cycas and Encephalartos. The principal cycad regions of the world are southern Mexico, the West Indies, Australia, and South Africa.

Zamia, the largest genus, ranges from Florida to Chile<sup>e</sup>. It has nearly one-third of all the species in the family. About thirty of the species already described appear to be valid, but the identity of the others is doubtful. Only a few have been thoroughly studied in the field. Microcycas, which is monotypic, is confined to western Cuba. Ceratozamia and Dioon are both endemic to southern Mexico. Ceratozamia appears to have six valid species and Dioon five; perhaps one or two more may later be recognized. Cycas, occurring from Japan to Australia and Madagascar, may have at least twenty species, but some are not very well marked. Bowenia and Macrozamia are confined to Australia. Bowenia has only two species. Macrozamia has about sixteen, most of them easily recognized; more may later be discovered in the vast central region of Australia. Stangeria is monotypic and confined to South Africa. Encephalartos, in its well-studied South African range, has thirteen species, while in tropical Africa there are six or seven more.