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"Paleoclimatic analysis of three Eocene lacustrine floras (Laguna del Hunco, Chubut, Argentina; Republic, Washington, USA; and Green River, Utah, USA) using digital leaf physiognomy."

Bárbara Cariglino[1]; Peter Wilf[1], Dana L. Royer[2]; and Kirk R. Johnson[3]

Fossil leaf size and shape have been widely used in proxies for past continental climates since Bailey and Sinnott [1,2] first noted the climatic distribution of toothed leaves. Among the most-used methods for estimating past mean annual temperatures (MAT) are leaf margin analysis (LMA), the climate-leaf analysis multivariate program (CLAMP [3]), and nearest living relative analysis (NLR). Here, we test a new method called digital leaf physiognomy (DiLP [4,5]) using three mid-latitude fossil floras from South and North America. This technique has the potential to provide more accurate paleoclimate estimates because subjective and irreproducible discrete characters are replaced by continuous variables, generated mostly by image analysis using fixed algorithms. Thus, instead of only quantifying margin percentage or more problematic discrete characters such as base or apex types, DiLP was developed to accurately measure preserved areas (e.g., blade area, tooth area), perimeters, and other variables, as well as their ratios. Importantly, the common underestimation of MAT produced by riparian vegetation effects (very common in fossil floras, since these tend to be lake or river deposits [7]) is reduced when using DiLP versus LMA or CLAMP [5]. We used a total of 20 extant floras from the eastern USA and Central and South America to calibrate this method [5,6].

DiLP was tested using recent collections from the Laguna del Hunco (51.9 Ma; Tufolitas Laguna del Hunco Fm; LH), Republic (49.4 Ma; Klondike Mountain Fm; RP), and Green River (47.3 Ma; Bonanza Fm, BZ) floras. These are ideal test floras because they are well-preserved and well-understood paleoclimatically; thus, they can be used to test and refine new paleoclimate proxies for use in less-understood floras.

DiLP mean annual temperature (MAT) estimates were in line with and near the warm end of those obtained by previous methods (LH_{MAT}= 16.0 $\pm$ 2.3 °C; RP_{MAT}= 14.2 $\pm$ 2.3 °C; BZ_{MAT}= 21.2 $\pm$ 2.3 °C), including NLR, LMA, and CLAMP. The 'warm' results suggest that riparian bias was mitigated in all three cases and that DiLP is the more consistently accurate proxy. Importantly, DiLP estimates were not significantly affected by the use of partly preserved and even fragmentary leaves. This allows maximization of species diversity and total sample size for analysis, increasing the accuracy of DiLP as in all other methods. Although the DiLP approach is labor intensive, this is justified by the decreased riparian bias and the ability to use characters other than margin state reproducibly.

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"Hungry Insect Herbivores during the Paleocene-Eocene Thermal Maximum in the Bighorn Basin, Wyoming, USA."

Ellen D. Currano[4]; Peter Wilf, Scott L. Wing[5]; and Conrad C. Labandeira[5]

The Paleocene-Eocene Thermal Maximum (PETM, 55.8 Ma) is a well-known major perturbation to the global carbon cycle and climate. The start of the PETM is marked by a sharp negative excursion in carbon isotope values, consistent with the release of a large amount of ^{13}C-depleted carbon to the atmosphere and ocean, and warming of 5-10^{o}C over ~10 ky[3]. After ~100 ky, isotope values and temperatures returned to background levels. Floral and faunal turnover during the PETM has been documented, but the responses of insect herbivores to the climatic and floral changes of the PETM have not been examined. Here, we report an unusually high level of insect damage in Wyoming's Bighorn Basin during the PETM when compared with pre- and post-PETM values.

We conducted insect damage censuses at five sites in the Bighorn Basin ranging in age from 59.5 Ma to 55 Ma, including one that is well constrained to the middle of the PETM. At each locality, over 800 identifiable dicot leaves were scored for insect damage using the damage morphotypes (DTs) of Labandeira *et al*[4]. These DTs can be divided into six functional feeding groups: hole feeding, margin feeding, external surface feeding, galling, mining, and piercing and sucking. They can also be classified as damage typical of generalist insects or damage strongly associated with oligophagous or monophagous specialist herbivores. Damage metrics were compared using randomized re-sampling routines to standardize for sample size, and cluster analyses were used to detect changes in the abundance distributions of damage types.

Both total and specialized damage diversity significantly increase during the latest Paleocene, reach a maximum in the PETM, and decline slightly in the early Eocene. This pattern is visible on the bulk floral assemblages and on individual plant species. The relative abundances of the six feeding groups also changes across the studied interval. Insect damage on PETM plant hosts is significantly different from the other samples because of the high abundance of specialized damage, particularly mines and external surface feeding traces. Additionally, the frequency of damaged leaves is 1.5 times higher in the PETM than at any other time.

In the absence of any other likely explanation, we consider the rise and fall of insect herbivory to be directly linked to the correlated temperature and pCO_2 changes. Experimental results show that plants grown in elevated CO_2 have a lower nitrogen : carbon ratio and are therefore nutritionally poorer, leading to an average increase in insect consumption rates[5]. Increases in damage diversity, particularly of specialized feeding groups, may represent an influx of thermophilic herbivores to the mid-latitude regions. We expect modern insect herbivore damage to similarly increase in response to anthropogenic carbon release and accompanying global warming.

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"New Paleobotanical Remains from the Upper Permian of Niger."

Dan Chaney[6] and Cindy Looy[6]

In Late 2007 an expedition went to the region west of the Air Massif in the north African country of Niger. In addition to vertebrate paleontology there were researchers collecting paleosol data and paleobotanical specimens. Fossil leaf remains were discovered at two localities and fossil wood was recovered from several others. Palynological samples were collected but have not been processed yet. Two forms of strap-like leaves dominate the new floras; one wide, one narrow. The narrow form measures at least 10 cm, and is 2-3 mm wide, and has an obtuse to acute tip. The broader form is more than 8.5 cm long, between 6-11cm wide, a square base, an obtuse tip, and is slightly curved. This form has veins running parallel to the leaf margin. One type of ovuliferous dwarf shoots belonging to the voltzian Voltziales has been found in the same flora. The observed specimens are up to 20 mm long and 10 mm wide. The dwarf shoots are flattened and bilaterally symmetrical with approximately 10 partially fused acute scales. The basal parts of dwarf shoots are stalk-like. A large trunk was excavated at another locality which is 58 cm in diameter at the preserved lower end tapering to 20 cm at the point at which excavation ceased. Fully 25 meters of trunk was exposed. Borings in another wood specimen is lined and may be teredo borings or an unusual insect.

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"Diversity changes across the Cretaceous-Paleocene boundary in the Tropics."

De La Parra, Felipe[7]; Dilcher, David [7]; and Jaramillo, Carlos[8]

The Cretaceous-Paleocene (KP) boundary is recognized as one of the major environmental crisis of earth history and it is associated with a significant extinction of many groups. The palynological record from mid latitudes shows a dramatic and abrupt disappearance of most dominant taxa and nearly all of the Late Cretaceous angiosperms following the KP boundary. An estimated loss of ~30-50% of palynomorph species has been seen throughout the western Interior of North America. However, we have very little information from tropical latitudes. Not a single section has been palynologically studied in detail from the tropics. The effect of the K/P boundary in tropical vegetation is unknown. Did the palynological diversity change as a consequence of this crisis ? To address this question we have studied 76 palynological samples across the KP boundary of a stratigraphic section in Cesar-Rancheria basin (Northern South America). *).* This section (Diablito) is a 2200 feet rock core composed by shale, coal and fine sandstones that accumulated in coastal plain and transitional environments during the middle Maastrichtian to the early late Paleocene Techniques including range through method,

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rarefaction, per-capita extinction and origination rates and measures of taxonomic diversity, were used to estimate the changes in diversity trough the boundary.

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"The Pennsylvanian-Permian Transition in North-Central Texas: Paleobotanical Patterns and Paleoclimatic Implications."

William DiMichele[9]; Neil Tabor[10]; Dan Chaney[9]; and Isabel Montañez[11]

The geological section of North-Central Texas preserves an excellent record of the Pennsylvanian-Permian transition. This was a time when climates in the western parts of the Pangean equatorial belt changed dramatically from oscillating wet and dry (and possibly cool and warm) to predominantly dry and much warmer. These climatic changes were tracked closely by vegetation and are reflected in the rock record. For example, in the Late Pennsylvanian-age Markley Formation, outcrops consist of several different lithologies with distinct floras representative of swamp, wetland floodplain, and seasonally-dry habitats, the former two sharing few species in common with the latter. Paleosols in these exposures indicate wet, but well drained conditions. In the Early Permian-age Archer City and Nocona formations, outcrops are monolithic, with floras overwhelmingly dominated by plants of seasonally-dry habitats. Associated paleosols indicate formation under warm, seasonal moisture regimes. The shift between predominantly wet-flora dominance to seasonally-dry flora dominance at the outcrop scale occurs over a short stratigraphic interval and appears to have been a temporally rapid shift. We will visit some of these outcrops on the field trip.

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"Taphonomic Bias from Two Modern Forest Leaf Litter Studies and Their Implications to Analysis for Fossil Assemblages in the Denver Basin, Colorado."

Beth Ellis[12] and Kirk Johnson[12]

To better understand the taphonomic biases inherent in fossil leaf assemblages from the Denver Basin, we re-examined two extensive studies of modern leaf litter that were collected by Kirk Johnson between 1986 and 1991. In the first study, we evaluated data from a low diversity, temperate forest in Wharton Brook, Connecticut (41.43°N, 72.84°W). In the second study, we investigated a high diversity, tropical forest along Noah Creek, in the Cape York Peninsula rainforest in Queensland, Australia (16.15°S, 145.45°E). In both modern studies, we mapped and identified all the trees > 5 cm dbh (diameter at breast height) in a ~ 0.5 hectare forest plot of the forest. We collected leaf litter samples from the forest floor and from adjacent streams and recorded the species,

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leaf margin and leaf area. This data allowed us to perform the typical suite of calculations made for fossil leaf assemblages including diversity, mean annual temperature (MAT), and mean annual precipitation (MAP). To interpret how well a fossil assemblage could record the trees living in the surrounding forest, we compared the species and growth habit of the leaf specimens from different assemblages with the mapped forest species.

In the Wharton Brook study, we mapped a total of 227 trees representing 15 species with a dbh of 19.9 ± 13.9 cm. We collected leaf litter from 13 forest floor localities and 12 stream localities, leading to the analysis of 18,682 leaves. In the Noah Creek study, we mapped a total of 526 trees representing 87 species with a dbh of 18.0 ± 14.2 cm. We collected leaf litter from 15 localities within the mapped plot using three different collection methods. We collected an additional 18 localities from the adjacent river in various locations outside of the mapped plot. In all at Noah Creek, we evaluated 20,417 leaves, representing 354 identified species. In both studies, we observed that allochthonous assemblages are more diverse than autochthonous assemblages, and that a single allochthonous site represents the mapped forest better than a single autochthonous site. However, grouping a few well-spaced autochthonous assemblages in either forest yielded a recovery rate of mapped forest species that was similar to the allochthonous samples. In both forests, a single tree species with large basal area was better represented in the leaf litter than a tree species that had a small basal area but many stems.

The Wharton Brook study is a reasonable proxy for the depauperate, early Paleocene floras found in the distal part of the Denver Basin. The Noah Creek study serves as our proxy for the proximal Paleocene Denver Basin floras, which are highly diverse and often have rainforest characteristics. In the Noah Creek study, we observed that collections of the same autochthonous site in subsequent years contained different species. This observation may partially explain the hyper-diversity of the parautochthonous Castle Rock Rainforest site from the Denver Basin, where multiple flooding events were recorded at each of the individual quarries in the lower horizon.

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“A multidisciplinary approach to the paleoenvironmental reconstruction of a major Late Oligocene ash bed, Chilga, Ethiopia.”

García Massini J. L.[13], Jacobs B. F[14].

Chilga is located on the northwestern Ethiopian Plateau, where Late Oligocene rifting created opportunities for sedimentary deposition and fossilization. Tropical plant assemblages preserved from the Paleogene of inland Africa are rare; and the diversity, quality of preservation, and abundance of localities found at Chilga are remarkable. Here, I describe megafloras and sedimentology in three contiguous geological sections, up to 7 m high and about 10 meters apart, from the Magargaria River, and their response to abiotic change. Sedimentology, lithology, and paleosols indicate the landscape and associated plants were subject to episodic ingression of large loads of fluvially

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redeposited or airfall ashes. The dynamic fluvial geomorphology influenced by this ash contributed to the creation of short-lived environments where plant assemblages characterized by pioneer taxa rapidly alternated both temporally and spatially. Systematic sampling among 25 - 29 stratigraphic units within each of the geological sections yielded a variety of taxa, including five fern types and six angiosperm taxa. Angiosperms [e.g., cf. Cynometra (Caesalpinioideae)] are the only group of plants that occur at the bottom of all sections, which together with sedimentology indicate rather calm deposition by a meandering river in a moist, at least seasonally, inundated landscape. Ferns and certain angiosperm taxa [Pandanites (Pandanaceae), cf. Alstonia (Asclepidiaceae), Hyphaene (Arecaceae) and cf. Macaranga (Euphorbiaceae)] occur towards the upper part of all sections and reflect either drier periods or greater adaptation to living in recurrently disturbed habitats.

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"Systematic and Morphometric Analysis of Miocene Leaf Remains in Venezuela."

Erika B. González[15]; Juan C. Gaviria[13]; and Fresia Ricardi-Branco[16].

The main objective of this work is the systematic description and foliar morphometric analysis of a Miocene paleoflora in the Venezuelan Andes. The Palmar Formation has been described as an early to middle Miocene and the depositional environment has been interpreted as an alluvial to coastal plain settings based on pollen content. Currently, this section is exposed at 800 m above sea level in a sub-montane forest and represents, among others formations, the beginning of the uplift of the northeastern Andes. Well-preserved fossil leaves (compressions and impressions) from this formation were given preliminary systematic descriptions by following the methods of classical palebotanical studies. Using leaf architectural analysis, thirty one morphotypes were defined. These morphotypes are assignable to elements from the families *Lauraceae, Annonaceae, Clusiaceae, Rubiaceae, Anacardiaceae, Polygonaceae, Convolvulaceae, Myrtacea*e, and to the Order Fabales. A few seeds, representing examples of Fabales, were also described as well as a few specimens that most likely belong to the Pteridophyta group. Many of these morpho-species are represented by a single specimen. The predominance of an entire margined leaves, elliptic shape, and the prevalence areas among mesophyll and microphyll size class (2.25 cm^2 y 182.25 cm^2) suggest that this formation represents the occurrence of a lowland tropical forest (i. e. riparian forest) with relatively warm temperatures and wet conditions. In addition, the percentage of specimens with acuminate tips (16%) suggests very wet conditions in the local environment during this period. This paleobotanical study emphasizes the importance of further research on macrofossil plants in Venezuela due to the lack of data, scarcity of knowledge, and potential for novel findings in this geographic region.

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"Araceous fossil leaves from the Paleocene of Colombia, Northern South America."

Herrera, F[17,16]; Dilcher, D.L[15]; Jaramillo, C[18]; and Wing, S.L[19]

Araceae is a monocotyledon family with high diversity and endemism in tropical America. The araceous fossil record and molecular data support a long history of evolution. However, this fossil record has been limited to the mid and high latitudes while no data has been available from low latitudes. Here, we reported the first oldest fossil record of Araceae leaves from the Paleocene (Cerrejón flora) in Northern South America. These fossils constitute the first evidence for the subfamilies *Pothoideae* and *Aroideae* and are related to two extant Neotropical genera *Anthurium* and *Montrichardia*. The new aroid fossil species inhabited a coastal rainforest ~60 million years ago and provided new clues about the patterns of diversification in the Neotropic.

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"Evolution of Osmundaceous Ferns; First Fossil Evidence for the Genus Todea."

Nathan A. Jud[20], Gar Rothwell[18] and Ruth Stockey[21]

An anatomically preserved osmundaceous rhizome with the diagnostic anatomical characters of the genus *Todea* has been recovered from the Lower Cretaceous (Hauterivian - Valanginian) sediments of Vancouver Island, British Columbia, Canada. The specimen was preserved by calcareous cellular permineralization in a greywacky sandstone matrix. The stem stele is dictyoxylic, showing up to eight bundles around an entirely sclerechymatous pith. Leaf bases diverge from the bundles in a typically osmundaceous pattern. Each leaf base displays a ring of sclerenchyma, or sheath, around a C-shaped xylem trace with 2-6 protoxylem strands. Within the adxial concavity of each trace is a single sclerenchyma bundle that becomes C-shaped as the leaf diverges from the stem. Sclerotic cortex is heterogeneous with indistinct outer margin. Adventitious root diverges with some leaf bases. The roots wind through the cortex in oblique cross section. The root xylem is diarch. The rhizome is described as a new species of *Todea* consisting of a branching stem, adventitious roots, and leaf bases. This specimen represents the first extinct species of the genus *Todea*, and provides evidence that *Todea*-like plants evolved as far back as the Cretaceous period.

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"Early Oligocene Flora from Huntsville, Texas."

Steven R. Manchester[22] and David L Dilcher[20]

A recreational lake near Huntsville, Texas, now called "Blue Lagoon" and popular as a haven for scuba divers, was excavated during quarry operations in the 1970 and 80s. These excavations exposed a nice section of the Catahoula Formation, from which well-preserved fossil leaves, fruits, wood, and pollen were collected. This plant debris was buried in sediment that included volcanic ash from eruptions to the south and west. Sanidine crystals picked from a hand-sample of the tuff which also contained fossil leaf material, were dated by William McIntosh by the $^{40}Ar/^{39}Ar$ laser-fusion method, indicating an Early Oligocene age of about 33.4 Ma. Components of the flora, studied previously by Delevoryas, Dahlian,Crepet, Dilcher, Herendeen, Manchester, Wheeler, Pigg, and Devore, include several taxa of Fagaceae (*Quercus*, *Trigonobalanus*), Leguminosae (*Eomimosoidea*), Theaceae (*Gordonia*), Ulmaceae (*Cedrelospermum*), Juglandaceae (cf. Oreomunnea) and a palm. Of particular interest in this flora is that it is a post- Eocene flora with taxonomic similarities to older floras both in the Mississippi embayment and Rocky Mountain regions. It differs from both of those, however, in the abundance of lobed-leaved oaks and lesser proportion of lauraceous leaf remains. Based on collections now housed at the Florida Museum of Natural History, we will present an overview of the Huntsville assemblage, illustrating the taxonomic diversity in megafossils known from the locality and considering its phytogeographic significance.

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"A Complete Cycad Plant from the Castle Rock Rainforest: Implications for the Evolution and Paleo-distribution of American Zamiaceae."

Ian M. Miller[23]; Kirk. R. Johnson[21]; and Beth Ellis[21]

Whole fossil-plant reconstructions provide information about the habit, paleoecology, and botanical affinity of extinct taxa, and inform our understanding of the evolutionary history of plant clades. However, whole plant preservation is extremely rare, so reconstructions typically rely on the structural agreement between isolated plant organs. In 1995, a complete cycad, which shows preservation of the root, stem and leaf-crown with abundant cuticle, was found at the site of the 63.8 Ma Castle Rock Rainforest in the Denver Basin, Colorado.

The leaf crown of the Castle Rock cycad consists of approximately 25 nearly complete, mature leaves (length 80 cm, width 20). The leaves lack spines, are paripinnate and bear 25 to 35, opposite to alternate, non-articulate pinnae. The pinnae have decurrent bases and are broadly attached to the thinnest part of the hour glass-shaped, woody rachis,

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which in compression obscures the pinna bases. The pinnae on mature leaves are entire-margined, lack midviens, and show one order of open, dichotomously branched veins, which anastomose, particularly near the leaf base. The laminae are hypostomatic and the stomata are randomly oriented and haplocheilic. The guard cells are sunken in stomatal pits and, with the subsidiary cells, are overarched by a cuticular coronal rim. The adaxial laminar surface shows undifferentiated, non-sculptured, randomly oriented epidermal cells with scattered trichome-base scars that are circular in shape. The trichomes are unbranched. The abaxial surface lacks trichome-base scars and shows epidermal cells that are randomly oriented or concentrically-arranged around stomata. These cells show striations. Associated with the leaf crown was a rectangular-shaped, woody stem (width ~10 cm) that was found rooted in the forest floor. The stem was connected to a shallow, apparently woody tap-root that gave rise to numerous rootlets. Seeds with cycadean morphology were found in the same beds as the leaf crown, stem and root. These seeds are large (3 by 3 cm), radiospermic, possibly stalked and show a thick, coalified sarcotesta.

Based on leaf and cuticle morphology, we assign the Castle Rock cycad to *Dioonopsis*, a genus previously known only from Japan. All described members of *Dioonopsis* have mature leaves with toothed-margins; thus, the specimen from Castle Rock represents a distinct species. In North America, the leaves of the Castle Rock *Dioonopsis* closely resemble those of *Zamia coloradensis* (Knowlton) Brown, which occurs in the Paleocene Fort Union and Middle Park formations of Wyoming and Colorado, respectively. The leaves, seeds and growth habit suggest that the Castle Rock *Dioonopsis* is attributable to Zamiaceae. Within the family, just the Central American genus, *Dioon* has hourglass-shaped rachii, lanceolate leaves, occasional vein anastomoses, and stalked seeds. Compared to Mesozoic cycads, only species of *Ctenis* show similar leaf morphology and cuticular ultrastructure. Thus, *Dioonopsis* arguably represents a stem lineage between ancestral *Ctenis* forms and extant *Dioon*. The occurrence of *Dioonopsis* in both North America and Asia suggests that the presently disjunct distribution of the Zamiaceae was contiguous between the Old and New World in the Paleocene.

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"The Earliest Record of the Genus Cola (Malvaceae sensu lato: sterculioideae) from the Late Oligocene (28 – 27 Ma) of Ethiopia and Leaf Characteristics within the Genus and Close Relatives."

Aaron D. Pan[24] and Bonnie F. Jacobs[22]

A fossil leaf compression from the Late Oligocene (28-27 Myr) of northwestern Ethiopia is the earliest record of the African endemic moist tropical forest genus Cola (Malvaceae sensu lato: Sterculioideae). Based on leaf and epidermal morphology, the fossil is most similar to some extant Guineo-Congolian species but differences warrant designation of a new species. Based on this fossil as well as others from the Paleogene of northern and northeastern Afro-Arabia, elements from these paleofloras need to be taken

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into account when trying to understand close affinities between Guineo-Congolian and eastern tropical moist forests. Examination of epidermal micro-morphology indicates that multi-cellular glandular hairs were found to be almost universally present within Cola, Octolobus, and Pterygota. Other characteristics of the leaf and epidermis may provide evidence for close relationships between Cola species.

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"An Evolutionary Reversion: Isoetes becomes Paurodendron."

Heather Sanders[25]; Gar Rothwell[22]; and Sarah Wyatt[22]

The sister group of all other living vascular plants, lycopods, have an independent evolution of stem-leaf-root organography from the euphyllophytes, and show novel morphologies of vegetative organs. The Isoetalean lycopsids formed the dominant canopy vegetation in Carboniferous coal swamps until the Upper Pennsylvanian in Euramerica and the Permian in China. Morphological studies of arborescent lycopsids show that isoetalean trees had bipolar growth analagous to seed plants, but that the aerial shoot and underground rooting systems shared homologous organography. That is to say that the stigmarian rooting system (i.e., the rhizomorph) is essentially a shoot that grows downward and is modified for rooting. The Carboniferous isoetalean lycopsids encompassed numerous growth forms with varying degrees of elongation and branching of the stems and rhizomorph. *Isoetes*, is the most extreme example of morphological modification within the clade. The two oppositely growing primary meristems of *Isoetes* produce the corm, in which an almost total absence of apical elongation leads to sunken apices and nearly no increase in corm length over the lifetime of the plant. The leaf producing meristem of *Isoetes* is radial with leaves that are produced in a helix. The rootlet producing meristem is bilateral with radiating rows of rootlets that emerge from a basal furrow during growth. This is in contrast to the radial rhizomorph apices of many extinct isoetalean lycophytes. Auxin, in lanolin paste at a concentration of 5000ppm, was applied to the leaf- and root-producing meristems of *Isoetes* plants for a period of four months to test whether the highly unusual morphology of the corm is associated with a failure of polar auxin regulaton during growth. Among the morphological alterations that resulted from these treatments were twisted leaves, highly-branched "rootlets", elongation of leaf producing meristems, and a basal meristem that was modified from bilateral to radial. The latter root producing meristem is virtually identical to the radial rhizomorph meristems that characterize most extinct isoetalean lycophytes. These data support homology between the basal meristem of *Isoetes* and the rhizomorph meristem of *Stigmaria*, P*aurodendron* and many other extinct lycophytes. We may also infer that morphological variations among rhizomorphic lycophytes of the Lepidodendrales, Pleuromeiales, and Isoetales are strongly influenced by changes in polar auxin regulaton during development the various vegetative organs of the sporophyte.

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"Mesofossil Analysis of the Brandywine Flora, Mid-Atlantic Coastal Plain."

Debra Stults[26]

Previous analyses of the Brandywine flora have concentrated on its mega- and microfossil components. A renewed and ongoing study is now emphasizing its mesofossils. Consequently, preliminary additions to the fossil record of the Brandywine flora include the probability of three species of *Carya*, the presence of *Glyptostrobus*, *Liquidambar* fruits, *Sagittaria*, and *Ranunculus*. Further expected results are the recovery of additional vegetative/floral organs belonging to taxa initially documented substantiating these original identifications. It is also likely that a significant number of taxa new to the Brandywine flora collection will be added as many of the mesofossils being worked on are as yet unidentified. The Brandywine flora accumulated in an upland, fluvial environment within the Mid-Atlantic Coastal Plain. Recognition of a small number of exotic genera and ternary plots of its pollen data strongly suggest a Late Miocene age for the flora. Future projects for the Brandywine fossils include several floral descriptions. Its components will also be used in physiognomic and taxonomic coexistence exercises in an effort to generate quantitative climate data.

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"The Blind Leading the Severely Myopic: Studying Devonian Megaspores with Undergraduates."

W.A. Taylor[27]; B.A. Deml, K.A. Gullickson; A.J. Lee; L.L. Loos; S.M. Pechauer; L.L. Scardino; and K.J. Walter

The Marcellus Formation of New York contains an extremely rich assemblage of Middle Devonian spores. A near total lack of experience with Devonian assemblages hampered efforts to assign the recovered spores to recognized form taxa. Rather than despair (or scour the literature), a decision was made to embrace ignorance as a pathway to freedom from prior taxonomic prejudice. The only purer approach would be to locate a population who knew even less about Devonian spore taxonomy than I. My undergraduate biology students in Biology 491, Electron Microscopy, possess such a trait, and were more than happy to oblige. The focus was on spores larger than 100µm since these are an ideal size for novice electron microscopists. Students collectively photographed approximately 150 spores using the SEM. TEM analysis will provide the means of testing the distinctness of several categories identified using the SEM. Two spore taxa of particular interest in this deposit are *Dibolisporites gibberosus* (Naumova) and *D. echinaceus* (Eisenack) Richardson; both have highly variable ornamentation. Spores comparable to the former were reported by Bonamo and Banks *in situ* from *Calamophyton* from the Ashokan Formation. The bulk of the dispersed spores more

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closely resemble the latter. TEM analysis could well provide information on the distinctness of these taxa, as well as their relationship, if any, to the spores of *Calamophyton*.

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"Variations in Dicot Wood Anatomy: A Global Analysis"

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Information from the InsideWood database (5,663 descriptions of extant woods) was used to determine the relative abundance of selected IAWA Hardwood List Features, for the whole world and for the broad geographic regions used in the IAWA List. This survey of extant wood anatomy provides a context for work on wood anatomical variation in Cretaceous – Tertiary woods. The default pattern for extant dicot woods is: growth ring boundaries indistinct or absent, diffuse porosity, exclusively simple perforation plates, alternate intervessel pitting, and non-septate fibers with simple to minutely bordered pits. Much recent work has been devoted to investigating the trade-offs between hydraulic efficiency, safety, and mechanical strength. As shown by numerous other studies, and shown here on a wide geographic scale, incidences of quantitative vessel characteristics differ significantly between temperate and tropical regions, and between trees and shrubs. Few wide vessels is a syndrome that is virtually absent from shrubs and small trees, suggesting that at times the habit of an isolated wood fragment can be inferred from its anatomy. Axial parenchyma features show geographic variation, but for ray features, geographic patterns are less apparent. This paper is but a general overview, information from the InsideWood database when combined with detailed information on ecological and geographical distributions of present-day species, and subjected to robust statistical analyses can be used to address a variety of questions on the evolution of wood structure and the ecological and phylogenetic significance of suites of features.

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