BOTANY

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ABSTRACTS

Origin and Development of Non-Articulated Laticifers in Leaves of *Catharanthus roseus*. Larry R. Yoder, Botany Department, The Ohio State University, Marion, Ohio 43302.——Sectioned leaves and whole mounts treated with Jeffrey reagent show a laticifer system that arises from initials that first appear when primordia are about 500 μm long. Additional initials differentiate behind the marginal meristem where they form a system of subdermal and vasculature-related laticifers oriented parallel with or at right angles to the longitudinal axis. Longitudinally-oriented laticifers were present just beneath the lower epidermis across the entire abaxial surface and in association with the phloem on the adaxial and abaxial sides of the bicollateral bundles in the petiole and midrib. Subdermal laticifers were present around the outer circumference of the petiole. Laticifers oriented at right angles to the midrib were associated with the xylem in minor veins. Earlier investigations failed to recognize laticifers associated with the minor veins and those along the margin and lower epidermis. Laticifers present beneath the epidermis of the blade and petiole are derived from ground tissue; those associated with the vasculature are presumably derived from the procambium. Occurrence of laticifers next to xylary elements in the minor veins is unique among laticifer systems that have been studied.

Stipulate Leaves from the Middle Eocene Claiborne Formation of Tennessee. John L. Roth and David L. Dilcher, Department of Plant Sciences, Indiana University, Bloomington, Indiana 47401.——Fossil leaves previously identified as *Leitneria eocenica*, *Diospyros wilcoxiana*, *Anacardites marshallensis*, *Schefflera? elliptica* and *Carapa eolignitica* were examined and found to have persistent adnate stipules. The stipules are unique to a single leaf type in the Eocene flora of Tennessee and exclude these leaves from the previously identified taxa. Cleared leaves from several modern genera and cuticular preparations for light microscopy and S.E.M. of both the fossil and modern material were used in comparing the fossil leaves with extant taxa. The gross morphology, venation and cuticular features of the fossil leaves appear to circumscribe a new leaf form. No extant taxon has been found with the same combination of features observed in the fossils.

Occurrence of Lycopod Fossils in The Path Fork Coal Zone of Harlan County, Kentucky. Larry R. Yoder, Botany Department, The Ohio State University, Marion, Ohio 43302.——Plant fossils were collected at a site adjacent to the Harlan Airport runway south of U.S. Rt. 119 in Harlan

County, Kentucky. Fossils exposed during runway construction occurred in soft shale, sandstone and clay of The Path Fork coal zone, Hance formation in the middle Pennsylvanian. Clay above the coal seam contained abundant *Pecopteris* and *Calamites*. Two negative stump casts of *Lepidodendron* 30 cm in diameter and a 3 m section of *Lepidodendron* trunk 35 cm in diameter were observed in the sandstone. One small cast of *Sigillaria* was also observed. Frequent examples of *Stigmaria ficoides* occur in the soft shale above the sandstone. Many roots lie parallel with the plane of the sandstone and are easily followed for several meters. A 7 m section with a uniform diameter of 8 cm was the longest root collected. Erosion had scattered the remaining parts of this specimen and no bifurcations were recovered. Rootlets ½-1 cm in diameter were intact where the specimen was still buried. Numerous fragments have been washed down at this location, and erosion in the soft shale will eventually destroy the continuity of remaining specimens.

The Accuracy of Paleoclimatic Estimates Based on Foliar Physiognomy. GARY E. DOLPH and DAVID L. DILCHER, Division of Natural and Physical Sciences, Indiana University at Kokomo, Kokomo 46901 and Department of Plant Sciences, Indiana University, Bloomington 47401.——Data collected from modern regional floras have been interpreted to indicate that leaf form and climate are correlated. Leaf margin type, as measured by the percentage of woody dicotyledons in a flora having leaves with entire margins, has been correlated with mean annual temperature; leaf size distribution, one estimate of which is the percentage of woody dicotyledons in a flora having large leaves (greater than 20.25 sq. cm. in area), with mean annual rainfall. Angiosperm paleobotanists have used these two correlations to estimate paleoclimate. To test the accuracy of paleoclimatic estimates, the mean annual temperature and mean annual rainfall patterns for North and South Carolina were estimated using leaf form. The estimates were compared with the patterns actually observed. Because the majority of data on modern leaf size distribution comes from the tropical life zones of the western hemisphere, insufficient data were available to estimate the mean annual rainfall of the Carolinas. Using the percentage of woody dicotyledons having entire-margined leaves in each county of North and South Carolina, the variation in mean annual temperature was estimated. The mean annual temperature on the coastal plain was estimated to be greater than 22° C with the mean temperature of the coldest month being between 15 to 18° C. For the remainder of the Carolinas, the mean annual temperature was estimated to range between 15 to 19° C with the mean temperature of the coldest month being between 6 to 10° C. These predictions overestimate the temperatures actually observed in the Carolinas. Therefore, paleoclimatic predictions based on broad regional correlations between leaf form in modern floras and climate can be inaccurate.

Botanical Data Banking. THEODORE J. CROVELLO, Biology Department, University of Notre Dame, Notre Dame, Indiana 46556.——Computerized data banking in botany today is experiencing rapid but uneven growth. Its history and current growth rate depend on the type of data

being banked, the area of botany in question, and whether the data bank is to serve basic or applied research needs. Botanical information input to a data bank may consist of: a) literature citations or more complete descriptions of printed work; b) information from botanical specimens (living or dead); c) information about the environment in which the specimens are found; or d) information based on experiments performed in the laboratory or in more natural environments. Banking of botanical literature has had the longest history, and covers all areas of botanical study. However, data banking of information in botany other than literature has been most intensively undertaken in the areas of ecology and systematics. Sometimes this has occurred under the aegis of a large project (e.g., The International Biological Program), but data banks of single workers or of single institutions also are very common. Botanical data banking has progressed far enough, and uncontrolled enough such that compatibility of data banks and of networking are most timely topics.

Development of Non-Articulated Laticifers in Embryos of *Carissa grandiflora*. LARRY R. YODER, Botany Department, The Ohio State University, Marion, Ohio 43302.——Non-articulated laticifers arise at the outer margin of the procambium in the cotyledonary node and form an extensive system consisting of an estimated 18-30 branched cells in the mature embryo. These acuminately-tipped cells appear to grow intrusively and they contain one or more spindle-shaped nuclei with prominent nucleoli. Most branching and ramification occurs in the cotyledonary node where laticifers penetrate to the periphery of the cortex but not inwardly through the procambium. Laticifer growth away from the cotyledonary node generally follows the margin of the procambium. Those in the hypocotyl extend ⅔ of the distance to the root meristem and exhibit few branches in their distal portions. They do not penetrate the root meristem. Laticifers also extend into the cotyledons where they are associated with the procambial strands. *C. grandiflora* is considered a primitive member of the Apocynaceae, subfamily Plumerioideae, and the occurrence of branching laticifers associated with the procambium supports the hypothesis that branching represents a primitive condition in laticifer evolution within this family.

Macroscopic Variation in Fossil and Modern Oak Leaves. MARILYN K. GILBREATH and GARY E. DOLPH, Division of Natural and Physical Sciences, Indiana University at Kokomo, Kokomo 46901.——Thirty-nine lobed red oak leaves were collected from the Upper Miocene Sardine Formation in western Oregon. These fossil leaves were compared with leaves from 22 modern species of lobed red and white oaks. The fossil and modern oak leaves studied were very similar in gross morphology, except for differences in the shape of the lobes and the presence or absence of bristle tips. The oak leaves studied had the following gross morphological features in common. Lobules were present on the majority of leaves. The secondary venation was craspedodromous. The tertiary veins joined together in a series of prominent arches in each lobe except for an occasional tertiary vein which would terminate at

the tip of a lobule. Below each sinus, a tertiary vein arising from the midrib branched and joined the arching tertiary veins in the lobes above and below the sinus. A fimbrial vein was present just inside the margin of each leaf. The higher order venation was random reticulate. The areolae were triangular to pentagonal in shape. Finally, the veinlets terminating in the areolae were branched. The similarity noted in the gross morphology of the fossil and modern oak leaves studied raises the question of the validity of the more than 150 species of fossil oaks that have been identified. Many species are undoubtedly synonomous with others. Identification of fossil oaks are particularly tenuous when more than one species occurs at the same locality.

Microscopic Variation in Fossil and Modern Oak Leaves. BEECHER A. WATERS and GARY E. DOLPH, Division of Natural and Physical Sciences, Indiana University at Kokomo, Kokomo 46901.——Many investigators consider cuticular morphology as superior to gross morphology for identifying species. The species of fossil and modern oaks having lobed leaves are difficult to identify using venation characters. Therefore, an attempt was made to distinguish between 39 fossil lobed red oak leaves collected from the Upper Miocene Sardine Formation in western Oregon and 22 modern species of lobed red and white oaks using cuticular morphology. The leaves were compared using 206 cuticular characters. The leaves of *Quercus alba* could be distinguished from those of the other species by the presence of two-celled glandular hairs on the lower epidermis. No diagnostic differences were found between the remaining modern and fossil oak leaves, although environmentally induced differences in characters such as cuticular thickness (*Q. albocincta*), lower epidermal cell shape (*Q. Kelloggii* and *Q. nitescens*), and lower epidermal trichome density (*Q. oleoides*) were present. The modern and fossil oak leaves had the following cuticular characteristics in common. The leaf cuticle was thin and unornamented. The cells of the upper and lower epidermis were isodiametric with straight to undulate anticlinal walls. Unicellular, pointed trichomes appearing either singly or in tuffs were present on both leaf surfaces. The trichomes were more numerous on the lower epidermis. Anomocytic stomates with T-pieces of thickened cutin at the poles of the guard cells were confined to the lower epidermis. The cuticular morphology of the oak leaves studied was sufficiently constant to allow the genus to be identified with assurance. However, cuticular morphology does not offer a mechanism by which the majority of lobed oak species, either fossil or modern, can be identified.

Occurrence of Jeffrey Reagent, Neutral Red, IKI, Dragendorff's Reagent, and PAS Reactions in Stems and Leaves of *Carissa grandiflora*. STEVEN R. SHAFER and LARRY R. YODER, Botany Department, The Ohio State University, Marion, Ohio 43302.——Freehand stem and leaf sections of *Carissa grandiflora* were treated with Jeffrey reagent, neutral red, IKI, Dragendorff's reagent and periodic acid-Schiff reagent. *Carissa*, unlike several other members of the Apocynaceae, is reported to contain no alkaloids. However, Jeffrey reagent, which has been used as an

alkaloid indicator, reacted with certain cells in *Carissa grandiflora*. In stems, Jeffrey-reactive cells occurred beneath the epidermis, as linear series in the cortex, and as cortical isolates. Jeffrey-positive cells occurred in the palisade mesophyll, along the foliar midrib, and adjacent to the lower epidermis. Neutral red and the alkaloid indicators IKI and Dragendorff's reagent stained neither Jeffrey-positive cells nor the branched, non-articulated laticifers located near the vasculature of stems and leaves. The PAS test in the Jeffrey-positive cells revealed dense, granular material which is interpreted to be an insoluble polysaccharide other than starch. Jeffrey reagent can be used as an alkaloid indicator, but this study indicates that Jeffrey reactions must be interpreted cautiously because of possible false-positive reactions.

A Study as to Whether the Variability Illustrated by *Melilotus alba* and *Melilotus officinalis* Specimens is Due to Polymorphism or Speciation. WILLIAM J. DAYTON and BETTY D. ALLAMONG, Department of Biology, Ball State University, Muncie, Indiana 47306.——The major purposes of this study were to see whether or not *Melilotus alba* and *Melilotus officinalis* specimens in the area were, in fact, species specific and to illustrate the methods by which they have, or might have, been separated as competitor species. *Melilotus* plants were studied at area sites and in the laboratory. This study used a variety of techniques to illustrate characteristics of the two species. A comparison of the percentage of seeds that are viable with the percentage of seeds that germinate was completed. The rate of plant growth was illustrated, as were the roles of light and temperature stimuli. Chromatography and electrophoresis were used for comparative analyses of plant biochemistry. In this study, the chronology of maturation and the sites where the *Melilotus* species were located were postulated to be major factors in the processes of speciation. These time and space properties were associated with the rare reports of spontaneous hybrids.

Some Effects of Cadmium on Water Relations of Silver Maple Seedlings. ROBERT J. LAMOREAUX and WILLIAM R. CHANEY, Department Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907.——Effect of $CdCl_2$ on water movement in stems of eight-week-old silver maple (*Acer saccharinum* L.) seedlings grown in sand amended with 0, 5, 10, and 20 ppm $CdCl_2 \cdot 2\frac{1}{2} H_2O$ was determined. Cadmium treatment significantly reduced relative conductivity of excised stem sections. The reduction was shown to be caused by a progressive decrease in differentiation of water conducting xylem tissue, a reduction in diameter of vessel and tracheid elements, and partial occlusion of xylem elements by cellular debris or gums. The results of this study suggest that cadmium affects silver maple seedlings, and perhaps many other plant species, by increasing resistance to water movement in stems, and thereby imposing a water deficit in the shoot system. This study represents the first application of the parameter of relative conductivity in research on environmental pollutants.

An Interesting Pattern of Chlorosis in a Pin Oak, *Quercus palustris*. BELINDA A. SHENK and WILLIAM J. BRETT, Indiana State University,

Terre Haute, Indiana 47809.——A pin oak tree 40 feet tall and 15 inches d.b.h. located on the campus of I.S.U. was found to exhibit a specific pattern of chlorosis for the past two years. The branches bearing chlorotic leaves extend out from an 80° section of the main trunk. Analysis of the chlorophyll content of the "normal" and chlorotic leaves over a two year period shows a consistent difference between the two types of leaves ($\bar{x} = 3.34$ mg/gr wet we normal leaves versus $\bar{x} = 1.33$ mg/gr wet we for chlorotic leaves). The relationship of the tree to surface features, cement covered soil as opposed to grass covered soil, suggests several possible explanations for the chlorosis.

Analyses of sap content and of soil borings will be run to determine possible deficiencies.

Vascular Patterns in Euphorbia Pteroneura. STEVEN SENGER and S. N. POSTLETHWAIT, Department of Biological Sciences, Purdue University, West Lafayette, Indiana 47907.——The pattern in which vascular tissue branches from the vascular cylinder to a leaf and the accompanying axillary bud was investigated by serial sectioning. The cylinder is a 6-8 sided polygon with the vascular tissue at the vertices organized into a pointed bundle, corresponding to the ribs on the stem. Three of these point bundles emerge from the cylinder and extend into the leaf. The tissues which formed the two sides of this polygon connecting the three points then come together to form a new cylinder which enters the axillary bud just above the leaf. Before this cylinder penetrates the bud, however, it has already taken on the form of a polygon with distinct point bundles. The same pattern is again found in the flower in the vascular branching to the stamens.