BOTANY

Chairman: JAMES R. REES, Anderson College, Anderson, Indiana 46011

WILLARD F. YATES, JR., Department of Botany, Butler University Indianapolis, Indiana 46208, was elected Chairman for 1972

ABSTRACTS

Inorganic Arsenate as a Tool for Genetic and Biochemical Analysis of Photosynthetic Metabolism in Algae. ROBERT K. TOGASAKI and MARGARET O. HUDOCK, Department of Botany, Indiana University, Bloomington 47401.——Wild type cells of *Chlamydomonas reinhardi* were grown on acetate supplemented agar plates, containing varied concentrations of inorganic arsenate, and the number of surviving colonies were scored. The concentration of arsenate required to inhibit growth was lower in the light than in the dark. Addition of 3-(3,4-dichlorophenyl) 1-1,1-dimethylurea, or DCMU, to the solid medium decreased the cell's sensitivity towards arsenate in the light, but did not affect sensitivity in the dark. Several mutant strains, each carrying a specific defect in its photosynthetic apparatus, were tested for their response towards arsenate, and all were found to be more resistant in the light than wild type cells. The potential application of this system to genetic analysis of photosynthesis, and also some possible explanations for the observed phenomena was discussed.

The "Liquid" Endosperm of Grasses. PAUL WEATHERWAX, Department of Botany, Indiana University, Bloomington 47401.——A few species of Gramineae have an endosperm which remains soft and plastic even after the seeds have been stored dry for many years. The cell walls are thin and fragile, and the stored food consists of what seems to be a fatty matrix surrounding the nucleus and numerous minute starch grains. This type of endosperm is distributed in such an erratic way in the grass family that thus far it seems to have very little taxonomic significance.

The Dichotomous Dilemma. ARTHUR T. GUARD, Department of Biological Sciences, Purdue University, Lafayette, Indiana 47907.——Very early in the history of plant morphology, the growing apex of multicellular plants became recognized as a focal point of interest. The final form of the plant is very largely determined by the development of this apex and the appendages which it produces. The biochemical compounds which so profoundly affect the plant's development often originate in this area.

In view of these facts, it is indeed surprising that one finds such confusing and conflicting usage of the term, "dichotomous branching", in the descriptions of apical growth and development. This paper presented some of the observable forms of apical branching and how the term has been used in reference to these forms.

A Comparison of Modern and Cretaceous *Sassafras* Leaves. RONALD A. RIEPE and DAVID L. DILCHER, Department of Botany, Indiana University, Bloomington 47401.——A study was undertaken to reevaluate the fossil record of *Sassafras* using a comparison of leaf form and fine

venation of modern and fossil material. *Sassafras*, a monotypic genus which has been identified early in the fossil record of angiosperms, has leaves that are entire, asymmetrically bilobed, or trilobed, but may possess up to six lobes (Berry, 1902). The form of the lobes and sinuses may be extremely variable. Berry stated that the venation of the basal portion of the blade was a constant character which could be used to differentiate *Sassafras* from *Aralia*, *Cissites*, and *Platanus*. The distinctive marginal vein pattern of *Sassafras* may also be used in classification, however this character could be obliterated easily or overlooked in fossil forms. Ward (1887) pointed out the remarkable character of the marginal veins of the sinuses in modern leaves. Lesquereaux (1892) wrote of many of his identifications of leaf remains from the Dakota Group with some uncertainty. By 1902, twenty-eight American forms of *Sassafras* had been published. Berry retained only six forms in the genus *Sassafras*, referring others to *Aralia*, *Cissites* and *Platanus*. The leaf form and venation characters of *Sassafras* have been reevaluated and applied to the fossil record.

Structure of Glandular Hairs of Marihuana. CHARLES T. HAMMOND and PAUL G. MAHLBERG, Department of Botany, Indiana University, Bloomington 47401.——Glandular hairs on the bracts of pistillate flowers of marihuana (*Cannabis sativa* L.) were viewed with the aid of light, electron tramission, and electron scanning microscopy. Three morphologically distinct types of glandular hairs occur on bracts: bulbous, capitate-stalked, and capitate-sessile. Bulbous glandular hairs, which are small and composed of only a few cells, consist of a globular head of one to several cells positioned on a basal cell or cells. Capitate glandular hairs, whether stalked or sessile, have a flattened multicellular cap composed of 8 to 13 cells which are covered by an abundant secretory product. The secretory product accumulates beneath a membranous sheath which is derived from the outer surface of the cap cells. Maturing cap cells have a large central vacuole with a very dense peripheral cytoplasm. The cytoplasm contains dictyosomes, endoplasmic reticulum, and plastids with crystaline inclusions. Large pores in the walls between neighboring cells contribute to the formation of a continuous protoplast in the cap. The possible association of capitate glandular hairs with production and/or localization of the hallucinogen tetrahydrocannabinol (THC) was discussed.

Chromic Acid as a Selective Stain for Laticifers in *Vinca rosea*. LARRY R. YODER and PAUL G. MAHLBERG, Department of Botany, Indiana University, Bloomington 47401.——A mixture of equal parts of 10% chromic acid and 10% nitric acid added to living tissues of *Vinca rosea* causes some cells to turn bright red within a few minutes. Acidified chromate and dichromate salts produce the same effect indicating the dichromate anion as the reactant. Reacting cells included occasional parenchyma cells in the pith, stem cortex and root cortex along with laticifers in all parts of the plant. Use of this staining procedure permitted delineation of *Vinca's* entire non-articulated, unbranched laticifer system with a minimum of preparation. Some coloration appears if latex exudes directly into the reagent, but no reaction occurs if latex stands 30 to 60 seconds. Staining only occurs when living cells are treated and the coloration fades after 10 to 15 minutes and cannot be restored. Tissues which have been

frozen, fried, heated above 55 degrees Centrigrade, or treated with an fixative are unreactive. The same cells vitally stain with neutral red and toluidine blue indicating a low pH and possible lysosomal activity. Although the reaction is not common to all latex-bearing plants, coloration does appear in laticifers of *Vinco minor*, *Plumeria*, *Asclepias* and some euphorbias. The reaction is postulated to be dependent upon a lower pH in these specialized cells, and any treatment which interferes with maintenance of this acid condition also blocks the reaction with chromic acid. The precise nature of this reaction is yet to be determined.

The Terminal Inflorescence of the Maize Mutant *Tassel seed-2*. C. L. GEHRING, Department of Life Sciences, Indiana State University, Terre Haute, Indiana 47809, and S. N. POSTLETHWAIT, Department of Biological Sciences, Purdue University, Lafayette, Indiana 47907.——A morphological and histological examination of developmental changes in the terminal inflorescence of the maize mutant, *Tassel seed-2* was conducted. Plants were grown in environmental control chambers under the conditions: 80 degrees Fahrenheit during 16 hours of artificial light (flourescent and incandescent) and 65 degrees during an 8-hour dark period.

Two plants a day were removed from the growth chamber starting 19 days after planting and terminating 67 days after planting. Examination of these plants revealed that the sequence of development and arrangement of floral structures are similar to comparable structures in normal maize. Primordia for both pistillate and staminate flowers are initiated in all flowers. However, in tassels which develop functional pistaillate flowers, the staminate primordia abort. Pistillate primordia abort in the tassels which develop functional staminate flowers.

One hundred and nine days after planting, 28 plants were harvested; 16 plants had 100% pistillate tassels and they averaged 560.6 silks per tassel and 12 plants had completely staminate tassels which averaged 281.3 stamens per tassel.

A Review of the Fossil Apocynaceae from the Eocene of Western Tennessee and Kentucky. GARY E. DOLPH, Department of Botany, Bloomington 47401.——Fossil leaves similar to those described by Berry in the form genus *Apocynophyllum* were collected from the Claiborne Formation (Middle Eocene) of western Tennessee and Kentucky. Fossil material representing three of Berry's original eleven species of *Apocynophyllum* —*A mississippiense*, *A. crassum*, and *A. wilcoxense*—was found. Fossil leaves of *A. mississippiense*, a species characterized megascopically by closely spaced major lateral veins and a broadly alate petiole, were divided into two groups based on the presence or absence of cuticular flanges on the abaxial cuticle. In addition, two previously undescribed leaf types which also possessed alate petioles were distinguished from *A. mississippiense*. The first showed a much greater spacing between the major lateral veins than *A. mississippiense* but yielded no cuticle. The second, whose gross morphological features (except for the alate petiole) were totally distorted, yielded a cuticle which lacked the trichome bases characteristic of *A. mississippiense*. *Apocynophyllum crassum* has a broad petiole that

is woody throughout and not alate as in *A. mississippiense*. In the preceding four leaf types where cuticle has been isolated, the paracytic accessory cell arrangement common to some extant members of the Apocynaceae was found. Although a superficial resemblence exists with regard to accessory cell arrangement, differences between the morphological characteristics of the fossil leaf types and that of the extant members of the Apocynaceae precludes the assignment of the fossil material to any extant genus of the Apocynaceae. Fossil leaves, whose closely spaced, subparallel major lateral veins terminate in a distinct marginal vein, were divided by Berry among *A. wilcoxense* and select fossil species of *Ficus* and *Myrcia*. Upon examination, only one leaf type characterized by internal mucilaginous cavities was discerned. Internal mucilaginous cavities are not characteristic of the Apocynaceae or Moraceae but are found in the Myrtaceae.

Revaluation of *Engelhardia* of the Eocene of Southeastern United States. FRANK W. POTTER, JR., and DAVID L. DILCHER, Department of Botany, Indiana University, Bloomington 47401.——Several species of fossil fruits, leaves and pollen from the Eocene of southeastern United States have been assigned to the genus *Engelhardia*. Recent examination of modern representatives of Old and New World sections indicates sufficient diversity to warrant segregating the New World members into the genus *Oreomunnea*. Two fruits of *E. puryearensis* Berry were obtained from the Puryear clay pit, Puryear, Tennessee; both specimens are impressions of the three anterior lobes. No fourth posterior lobe is present. The anterior wings of the fossil show venation patterns similar to the New World group, particularly *O. mexicana*. Based on the fruits, *E. puryearensis* is more closely aligned to Central American populations than Asiatic taxa. Other *Engelhardia* fruits reported by Berry suggest the presence of both genera in the southeastern United States during the Eocene. Modern pollen is not sufficiently distinctive to conclusively separate New and Old world sections. To date, no fossil leaves have been obtained that can be assigned to either the genus *Engelhardia* or *Oreomunnea*, although the two extant genera show distinct morphological and cuticular differences. The presence of leaves could be important for determining the relationship of the fruits to *Engelhardia* and/or *Oreomunnea*.

Middle Eocene Sabaloid Palms. C. P. DAGHLIAN and D. L. DILCHER, Department of Botany, Indiana University, Bloomington 47401.——E. W. Berry reported three palm types from the middle Eocene clay deposits of western Kentucky and Tennessee. Two of these were pinnately compound types. The third being palmately compound. The palmate palm fossils in the Indiana Paleobotanical collection from the same sediments suggest that there are more than one genus and species of palmately compound palm leaf fossils. Berry's specimens of *Sabalites grayanus*, were identified primarily on the basis of gross features, leaflet distribution and venation. A detailed study of the palm material from the Indiana University collection is in progress and a thorough examination of fine features, particularly cuticular characteristics, as well as gross features has indicated that there are clearly two and perhaps three kinds of palmately compound palm leaf fossils rather than the one that Berry

reported. The first group has been identified as a member of the genus *Sabal* indicating that it was a clearly defined group as early as the middle Eocene. These palms are large, costa-palmate leaf fragments similar to modern sabals such as *S. texana*. The second group is comprised of palmate leaf fragments of *Sabalites grayanus* but contains two subgroups. Those show differences in venation and the pattern of their stomatal apparatus. These findings are important because they show a greater diversity of palms in the flora of these middle Eocene sediments.

Cell Wall Regeneration Around Protoplasts Isolated from *Convolvulus arvensis* Tissue Culture. RANDALL K. HORINE, Department of Biology, Earlham College, Richmond, Indiana 47374, and ALBERT W. RUESINK, Department of Botany, Indiana, University, Bloomington 47401.—— Protoplasts of *Convolvulus arvensis* L. tissue culture regenerated a wall-like structure within 3 days in culture. Although unusually electron dense and atypically amorphous in the electron microscope, this structure could be digested with cellulase but was resistant to protease, pectinase, and β-1,3-glucanase just like the original wall. A cytochemical test for callose was negative. Wall regeneration required a readily metabolized external carbon source and was not inhibited by a high concentration of cycloheximide, puromycin, or actinomycin D, suggesting that stable, long-lived protein or messenger RNA is involved in its synthesis. Protoplast budding was correlated with the wall regeneration and the latter was related quantitatively to the sucrose concentration in the medium. Auxin (2,4-D) neither promoted nor inhibited wall regeneration at any concentration. Culturing protoplasts in the presence of proteolytic enzymes decreased their ability to undergo cell wall regeneration, although the concentration required was so high as to suggest that the proteins involved must be at least partially buried in the plasma membrane.