Judy Chen, Florida Museum of Natural History, Gainesville

Reevaluating fossil seeds of Vitaceae from the Eocene of Peru.

E.W. Berry in the 1920s described an assemblage of angiosperm fruits and seeds from the Tertiary of western Peru. Berry considered the source horizon to be Oligocene at first, then Eocene. More recently Romero considered the Pariñas Sandstone in which the fruits were found, to be of Early Eocene age. Included among the seeds were examples of Vitaceae. We have re-examined seeds of modern and fossil seeds of Vitaceae as a basis for reevaluating the identification of the Peruvian fossils. At least three different seed morphotypes with features diagnostic of Vitaceae (paired ventral infolds, perichalaza) are present. *Ampelocissus bravoi* Berry, conforms closely to modern *Ampelocissus* in having broad, cup-like ventral infolds. *Cissus willardi* Berry is distinguished by seeds with relatively short ventral infolds and lacks a swollen chalazal knot. *Carpolithus olssoni* Berry has two elongate ventral infolds that are very closely spaced, and an elongate furrow on the dorsal side. Although we have not found a precisely corresponding form in our survey of extant seeds, its morphology is consistent with Vitaceae. *Carpolithus cissiformis* Berry specimens are distinct in many characters from *Cissus*, but resemble Vitaceae in the presence of a pair of small shallow ventral infolds. These specimens show no indication of a groove or chalazal knot on the dorsal surface, indicating that they might be fruits rather than seeds. The Vitaceae were also diverse in the Eocene of Europe and North America as indicated by fossil seeds. The confirmation of Vitaceae in the Eocene of South America is significant as an indication that this family was diverse in South America in the Early Eocene just as in the Northern Hemisphere.

David A. Frankel, Ohio University, Athens

Sporangia and Spores of the Mississippian plant *Chlidanophyton dublinensis* Gensel

Abundant material of *Chlidanophyton dublinensis* Gensel has been found at a new Lower Mississippian locality at Alta, (Greenbrier Co.) West Virginia. As originally described, *C. dublinensis* has three orders of terete branches, each with a pair of vegetative appendages at its base. The ultimate branching systems are composed of equally dichotomizing axes that can be either vegetative or fertile. Numerous new specimens have been collected that consist of coalified axes with recurved terminal sporangia. Sporangia are oval, with a distinct epidermal pattern, and measure ca. 2 x 1 mm. The pattern of dehiscence is longitudinal, splitting the sporangium in half, and with no evidence of an annulus. Sporangia have been macerated for spores using hydrofluoric acid and Schulze's solution. Spores are subspheroidal and trilete, and compare favorably with those from trimerophytes, *Calamophyton*, *Rhacophyton*, and other ancient fern-like plants.

Shusheng Hu, David Dilcher, Harald Schneider, & David Jarzen, University of Florida, Gainesville, Florida Museum of Natural History, Gainesville, Albrecht-von-Haller-Institut für Pflanzenwissenschaften Abt. Systematische Botanik Georg-August-Universität

Mid-Cretaceous Eusporangiate Sporangia Materials from Courtland Clay Pit, Minnesota

Fossil records of the eusporangiate fern family Marattiaceae are common from Paleozoic and early Mesozoic. However the occurrence of this family during the Cretaceous and Tertiary is unknown. In the family Marattiaceae extant species of the genus *Marattia* are distributed worldwide while the genus *Danaea* occurs only in the New World. Other extant genera of the Marattiaceae show disjunct distributions throughout the Old World. Eusporangiate sporangia recovered from the Dakota Formation of the Coutland clay pit in south central Minnesota provide evidence for existence of marattioid ferns during the mid-Cretaceous in North America. Two types of sporangia were discovered. One type is elongate elliptical slightly asymmetrical shape, 1.2 X3.5 mm, ca 4500 spores in it. The other type has an irregular shape having one or more lobes, 0.6 X 0.6 mm to 1.2 X 2 mm, ca 9000 spores in the largest ones and ca 1000 spores in smallest ones. The characteristics from spore ultrastructure, spore morphology and number of spores per sporangia/syangia indicates that these sporangia/syangia and spores have a Marattiaceae affinity. This is the only record of the Marattiaceae in post Jurassic times.

Alex Kittle, Melanie L. DeVore, Kathleen B. Pigg and Bill Wall,
Georgia College & State University, Milledgeville, and Arizona State University, Tempe

Acer fruits from the Paleocene of North Dakota

Winged fruits are a conspicuous component of Cenozoic floras (e.g. Florissant and Green River). One of the most recognizable types of winged fruits is the samara. Two samara types are represented in the Almont and Beicegel Creek, ND floras from the Sentinel Butte Formation. The first samara type represents the genus *Securidaca* (Polygalaceae). The second samara clearly can be placed in the genus *Acer* (maple, Spindaceae)and represents the oldest record of fruts belonging to the maples. The *Acer*-like samaras are 2.75-5.50 cm long and 1.5-2.5 cm wide. The fruits belong to the genus based on shape, wing venation and basal attachment scars. The fossil *Acer*-like samaras differ from most modern members of *Acer* based on the presence of a pronounced, elongated stipe. To date, no fossil foliage assignable to this genus has been documented from the Paleocene of North Dakota. However, *Acer* leaves have been described from the uppermost Paleocene of southeastern Alaska. Like the dogwoods (Cornaceae), the maples have a disjunct distribution between eastern North America and eastern Asia. *Acer* also has an eastern North America and eastern Mexican pattern of distribution. In the case of *Acer*, the genus first appeared in the Paleocene and underwent a major radiation in the Eocene. Means of dispersal are clearly significant when examing the radiation of a taxon and the utility of applying aerodynamics to assessing dispersal capability will be addressed.

Mandela A. Lyon, University of Pennsylvania

A quantitative morphospace for dicot leaves

Dicot angiosperm leaves exhibit a wide range of morphologies, with shape variation occurring in many dimensions. The different forms are likely adaptive, as aspects of leaf morphology have been demonstrated to differ with changes in climate, habitat, and ecology. Traditional systems for describing leaf morphology have been primarily qualititative or semiquantitative, although some studies have examined the relationship between climate and a limited set of quantitative measurements of leaf form. Here I propose a fully quantitative morphospace that provides a reasonably complete description of dicot leaves, allowing local floras to be characterized without the morphospace being distorted by the particularities of scoring procedures and the imprecision introduced by different observers.

The primary dimensions of dicot leaf morphospace are blade area, blade perimeter, apex angle, base angle, whole-blade symmetry, base symmetry, apex symmetry, length:width ratio, distance along midrib to maximum blade width, tooth importance, and blade lobation. These dimensions reflect aspects of leaf form typically characterized in qualitative analyses, and results of leaf outline analyses indicate that these dimensions are fundamental features of leaf shape variation. The morphospace has been tested against leaves from two modern New World floras (Barro Colorado Island, Panama, and York County, Pennsylvania; 196 species in 69 families). Tropical and temperate floras appear to occupy semi-distinct areas of the morphospace, although there is considerable overlap. Overall, the dicot leaf morphospace is large but only sparsely occupied at the edges. Most species in both tropical and temperate floras appear to occupy a limited volume of the available morphospace, despite being moderately distinct from each other.

Although this quantitative morphospace currently requires complete (or artificially healed) leaf specimens, it is an efficient and effective way of collectively analyzing the key sources of variation in leaf form. As a broader global range of dicot leaf floras are examined, a more comprehensive view of the volume and filling of dicot leaf morphospace will emerge.

Steven Manchester, Florida Museum of Natural History, Gainesville, and Lena Golovneva, Komarov Botanical Institute, St. Petersburg

New data on the floral and fruiting structure of *Ranunculaecarpus* from the Lower Cretaceous of Northeastern Siberia.

In 1960, V.A. Samylina described a new genus of angiosperm, Ranunchulaecarpus, from the sediments of the Ziryanki River, a tributary of the Kolyma River in Northeastern Siberia. The fruits were among other leaf and fruit remains in a mudstone, considered to be of Early Cretaceous (Albian) age. Based on several permineralized specimens fractured in different orientations, Samylina described the fruits of R. quinquecarpellatus as about 1 cm long, consisting of five free carpels, each about 2 mm wide, containing two rows of small reticulate-surfaced seeds. Details of placentation, receptatcle and other floral parts were not indicated. The original specimens have been reinvestigated by scanning electron microscopy and by serial sectioning. These techniques confirm of the accuracy of Samylina's morphological description, and provide additional characters of fruit and floral morphology. The fruits are apocarpous. Each carpel has a dorsal keel and a ventral suture, with parietal placentation.. Transverse sections at the base of the fruit reveal a hypogynous perianth of free tepals and stamens with anthers having longitudinal dehiscence. The number and arrangement of perianth parts , and the number of stamens and pollen morphology are not yet determined. The full suite of characters now available provides a basis for reevaluating the systematic position of this extinct genus.

Paula Mejia* and David Dilcher, Florida Museum of Natural History, Gainesville

Diversification of Angiosperms in the tropics

Tropical rainforests are one of the most diverse ecosystems of the world, with flowering plants (angiosperms) dominating both in biomass and diversity. Angiosperms originated during the Lower Cretaceous (140-130 My), and subsequently radiated and expanded to become the dominant group of plants in almost every terrestrial ecosystem by the Paleocene (60My). The geographic origin of angiosperms is still a mystery. The most common hypothesis points out a tropical origin, however there is very little quantitative data from the tropics that can test this hypothesis. For example, in Colombia there is only one published article describing fossil pollen grains of the Lower Cretaceous (Prossl 1992). More quantitative biostratigraphic and taxonomic work are necessary to understand early angiosperm composition and diversification of Lower Cretaceous tropical ecosystems.

The Aptian-Albian Caballos Formation (114My) presents well preserved, abundant, and diverse pollen and spores, making it ideal for a plant diversity study. The Caballos Formation is located in the Upper Magdalena Valley (UMV), in SW central Colombia. Three cores from the Caballos Formation will be studied for its palynological content. The pollen and spore data will be correlated among the three cores using Graphic Correlation. The results of the correlation will provide a quantitative pattern of the rates of angiosperm increase in diversity and abundance in the tropics during the early stages of angiosperm evolution.

Initial study of one core has been done and yields excellent results. Preliminary results suggest an environment dominated by ferns (64% of palynomorphs), with gymnosperms present (35% of palynomorphs) and angiosperms comprising 1% of palynomorphs. This suggests angiosperms may have occupied a minor role in the tropical ecosystems in the Lower Cretaceous. The number of samples analyzed (5) presently is not enough for statistically significant conclusions about the composition of tropical ecosystems. Analyses of additional cores are necessary to reduce sampling bias. These data can be used to determine the nature, details and relationships of early tropical biotas and their evolution.

James E. Mickle and Vince Schneider, North Carolina State University and North Carolina Museum of Natural Sciences

A Fossil Flora of Probable Pleistocene Age from Southeastern North Carolina

A rich deposit of plant megafossils is exposed is an aggregate quarry operated by Martin Marietta Corp. in New Hanover County, North Carolina (N 34° 22. 368’ N, W 77 ° 50.356’). Plant fossils were recovered from channel fill or oxbow lake deposits that occur in older (Eocene) marine sediments of the Castle Hayne Formation and occur as compressions and thin lenses of peat in clay sediments. The presumed Pleistocene age is based on previous geological reports on similar settings in other mines, and on the elements of the flora. Floral elements include abundant fossil leaves, wood, fruits and seeds. Tentatively identified fagaceous fruits and leaves are dominant members of the fossil flora, with conifer remains represented principally as wood samples. This suggests that the ecosystem was a mixed hardwood - conifer forest.

Elizabeth O'Leary* and Steven Manchester, Botany Department, University of Florida, Gainesville.

Diversity of Winged Fruits in the Middle Eocene of Oregon and Utah

A preliminary survey was made of winged fruits and seeds from two Eocene lacustrine deposits, one in the Clarno Formation of Oregon and the other in the Parachute Creek member of the Green River Formation of Utah and Colorado. These lacustrine sites contain a variety of winged disseminules that have been assigned to either modern genera, extinct genera in modern families, or have not been identified in respect to modern taxa. The current distance between these localities is 1,000 km. The Clarno Formation has at least 30 distinct types of winged disseminules. These include *Ailanthus*, *Calycites*, *Cedrelospermum*, *Cruciptera*, *Deviacer*, *Eucommia*, *Florissantia*, *Fraxinus*, *Hooleya*, *Palaeocarya*, *Paliuris*, *Pinus*, *Potanospira*, and 17 unknowns. Similarly, the Parachute Creek assemblage has approximately 24 types of winged fruits and seeds. Genera from this horizon include *Ailanthus*, *Cedrelospermum*, *Cheynia*, *Eucommia*, *Hooleya*, *Palaeocarya*, *Pinus*, *Koelreuteria*, as well as 16 unknowns. There are at least eight distinct types of disseminules shared between the Clarno Fm and Parachute Creek. This is approximately one quarter of the winged taxa found in Clarno Fm and one third of the taxa from Parachute Creek. These high percentages of shared taxa may indicate that dispersal occurred between these localities.

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Can we use the fossil record to test hypotheses of the evolution of developmental pathways?

The fossil record illuminates morphological alterations critical to organ evolution, that may have occurred in parallel in leptosporangiate ferns and seed plants. Both clades have stems, leaves and roots that appear to be derived from forking axes of the most ancient vascular plants. Studies of mutants in model organisms such as *Arabidopsis* show that large scale changes in morphology can be effected by modifications in a relatively small number of developmental genes. Mutant analyses could provide clues to the morphological modifications resulting in evolution of stems and leaves from axes. Current evidence suggests that the same developmental mechanisms were recruited and modified independently ferns and seed plants. Can we find morphological signatures of developmental genetic patterns in the most ancestral leaves?

Nymphaeceous seeds from the Late Paleocene of North Dakota, USA

Witt Taylor, Melanie L. DeVore and Kathleen B. Pigg

Seeds referable to the water lily family Nymphaeaceae are described from the Late Paleocene Almont Flora of central North Dakota, USA. Seeds are oval, 5 mm long x 3 mm wide, and have an apical operculum and a prominent raphe. The outer surface of the seeds is comprised of rectangular shingle-like cells 150 µm wide x 40 µm high with only slightly sinuous cell margins. The raphe and micropyle are separated by several cells. Several specimens have well-developed perisperm centrally and a small embryo cavity apically. The Almont seeds share some features with several different extant genera including *Nymphaea*, *Nuphar*, *Euryale*, and *Victoria* and appear distinct from the permineralized fossil seeds of the early Eocene of Wutu, China and the middle Eocene *Allenbya* from the Princeton chert. The presence of these fossils illustrates the occurrence of Nymphaeaceae in higher latitudes of North America by the Paleocene.

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W. P. Wall, K. H. Tracy, V. L. Santucci and A. J. Mead, Georgia College & State University, Milledgeville; Texas A&M University, and College Station, National Park Service

Paleontological survey of Grand Teton National Park.

A comprehensive paleontological survey of Grand Teton National Park (GTNP) was completed during the 2002 and 2003 field seasons. A number of formations from within the park yielded a variety of invertebrate, vertebrate, and plant fossils. The following formations (listed in stratigraphic sequence from oldest to youngest) were surveyed in this study: the Gros Ventre, Gallatin Limestone, Bighorn Dolomite, Darby, Madison Limestone, Amsden, Tensleep Sandstone, Phosphoria, Dinwoody, Chugwater, Gypsum Springs, Sundance, Morrison, Cloverly, Thermopolis, Mowry Shale, Frontier, Cody Shale, Bacon Ridge Sandstone, Sohare, Mesaverde, Meeteetse, Harebell, Pinyon Creek, Hominy Peak, Colter, Teewinot, and Huckleberry Ridge Tuff. Comments on the depositional environments of the various formations are based on field observations and analysis of voucher specimens. This study provides a greater understanding of the extensive paleontological resources present in the park.