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ONLINE

Sticks & Mud: Perspectives in the 90's

A question that plagued me during my formative years came from colleagues at other institutions. Its tenor approached this—"Why don't paleobotanists do anything exciting?" Nowhere did this point hit home more than during the mid-70's at a regional meeting of one of those other North American Geological societies. My coauthors and I were presenting our results on some permineralized Oligocene wood from the Great Plains. The paper was scheduled next to last in the general paleontology session, the last paper also paleobotanical in scope (only two paleobotany presentations at the meeting). The speaker immediately before was a renowned invertebrate paleontologist. His address concerned changing Antarctic freshwater ecosystems from the Devonian to Recent. Attendance at this talk was standing room only and people were seated on the floor in front of the podium. An enthusiastic round of applause followed the lecture and an equally enthusiastic exodus ensued. The chairman of the session, my colleagues and I, and two stalwarts (who may have actually been knocked unconscious by the departing masses) remained.

The despair of those years has been replaced with promise. The subdiscipline that was considered as the pariah has come of age. The breadth of information and insight that can be gained from this data set slowly has been realized by the geological community at large. This has become apparent particularly at national and international meetings where paleobotanical topics have been integrated into short courses, workshops, symposia, and general sessions of themes ranging from tectonics to global climate models. Attendance at paleobotanical presentations has increased exponentially relative to the incident described above (but then again, what wouldn't). This perception is not only apparent at meetings, but is obvious in the literature. Rather than feeling obligated to publish an illustration of *Rhynia* (although still referred to as a 'psilophyte' in some editions), a Carboniferous peat swamp restoration (more of a family portrait than of our present understanding of wetland guilds), and an angiospermous tree (which may not reflect the earliest growth strategy of the group), recently published Historical texts provide more extensive coverage of the kingdom throughout geologic time than ever before.



Robert A. Gastaldo is an Alumni Professor of Geology at Auburn University. He received his Ph.D. in Botany at Southern Illinois University where he was trained as a stereotypical systematist but influenced heavily by this geological cohorts. His research includes Carboniferous plant growth architecture and community ecology, plant taphonomy in ancient and Holocene coastal environments, and the relationships between terrestrial source vegetation and hydrocarbon precursors in tropical regimes. He has been a Fulbright Research Scholar at the Laboratory of Paleobotany and Palynology in Utrecht, The Netherlands, and recently has returned from a sabbatical in the Department of Geochemistry at the Institut Français du Pétrole in Rueil-Malmaison, France.

You may ask yourself—Why? The fact of the matter is that paleobotany has broadened its scope within the past 15 years. In addition to maintaining a useful and important niche in the botanical sciences, researchers have expanded its usefulness in applied paleontology and geology.

We all recognize that these primary producers are different from the biota higher up in the food chain. Growth habits and developmental strategies differ from animals for the most part (we can circumscribe similarities between trees, for example, and colonial animals). Reproductive systems and complexities are more varied (including introgressive hybridization), and a multiplicity of ploidy numbers can exist within clades introducing bewildering morphological heterogeneity. Biomass generation of, and loss from, an individual plant can continue unabated for centuries during which the plant and its lost parts not only can dramatically modify the earth materials in which the parent is anchored, but also record subtle, and not so subtle, changes in climate. The interaction of the plant and its environment may also result in the development of a suite of consistent ecomorphotypes, independent of systematic affinity that directly reflects the conditions under which it grew. Macroscopic evidence for all (peat accumulations), some (various terrestrial and nearshore depocenters), or none of these parts may be incorporated into the stratigraphic record depending upon the growth site of the plant relative to a depositional environment. In environments of deposition where degradation and mechanical fragmentation wreck havoc with potential museum quality specimens, those resistant organic parts may impart biogeochemical features that become hydrocarbon precursors. No longer is it acceptable to disregard this class of fossils, particularly in terrestrial clastic sequences where there is little representation by other fossil groups. As in other paleontological disciplines, these clues provide us with the means to utilize such data.

How have these data been used recently? The plant kingdom has offered the paleontological community an independent data set to test evolutionary theory in all of its subtleties—trends and rates of biodiversification and extinction, as well as micro- and macroevolutionary mechanisms. These interludes of biodiversification and stasis taken within paleogeographical context have provided evidence for centers of origination and “migration” (and I hate to use such a term for non-mobile organisms) within broad climatic provinces, as well as the basis for a more valid terrestrial-based biostratigraphy. Changes in diversity along longitudinal gradients have provided the evidence for alterations in global climate either as a direct

response to tectonic activity, Milankovitch cyclicity, atmospheric chemistry, or a number of other parameters. The realization that leaf physiognomy (size, margin features, and cuticle character including stomatal configuration) and wood characters reflect the climates under which they develop has changed radically our understanding of the Cenophytic. Extrapolation back to the Paleophytic is one of the next steps.

Our understanding of these topics is only as good as the fidelity of the fossil assemblages themselves. Insights into all aspects of plant paleobiology have been gained from autochthonous fossil Lagerstätten. Based upon such data, individual plants have been reconstructed relative to their growth architectures, their responses to nutritional and climatic stresses have been deduced, their reproductive mechanisms and strategies have been detailed, and paleoecological communities with ensuing guild structuring has been documented. This infrastructure forms the foundation for all other terrestrial biotic communities. Unfortunately, not all litter assemblages are fossil Lagerstätten, but the information that is now being extracted from these accumulations has a higher semblance of resolution than previously interpreted. What was once geofantasy has become more georeality because of an intense focus on the taphonomy of plant-bearing strata. Documentation of recurrent biofacies-lithofacies relationships within terrestrial clastic sequences, without regard to systematic affinity of the contributing vegetation, has been used to refine broadly delineated depositional settings. This is a benefit not only to the paleontologist but also to a number of researchers including sedimentologists, stratigraphers, organic and inorganic geochemists.

Paleobotany and paleobotanists (*sensu lato*, so that it is not construed as an omission of palynologists and micropaleontologists) have the ability to provide the geological community with a multi-faceted array of valuable information. The inclusion of their data or, better yet, of their assistance in an interdisciplinary research program will not only benefit the project results, but also provide a broader understanding based on a different perspective. Interdisciplinary cooperation should not only be encouraged, but also fostered in our educational institutions. Sticks and Mud are not just for “them” anymore, but for “us” all.

—ROBERT GASTALDO
