Geoscience Canada

Third North American Palaeontological Convention

Robert M. Schoch

Volume 10, Number 4, December 1983

URI: https://id.erudit.org/iderudit/geocan10_4con01

See table of contents

Publisher(s)

The Geological Association of Canada

ISSN

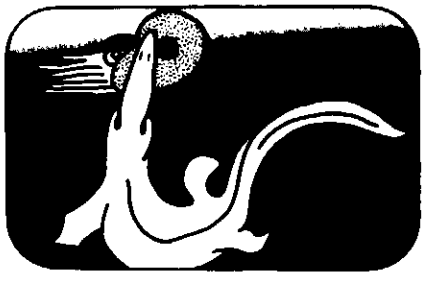
0315-0941 (print)
1911-4850 (digital)

Explore this journal

Cite this article

Schoch, R. M. (1983). Third North American Palaeontological Convention. *Geoscience Canada*, *10*(4), 204–207.

Conference Reports


Jean-Pierre Bourque

Third North American Palaeontological Convention

Robert M. Schoch
Department of Geology & Geophysics
and Peabody Museum of Natural History
Yale University
New Haven CT06511

The Third North American Palaeontological Convention was held at McGill University, Montreal, Quebec from August 5 to 7, 1982. During these three days, fourteen symposia and four general sessions (including one poster session) were held and approximately two hundred papers were delivered. Unfortunately, except for the Thursday morning opening symposium, many of the sessions ran simultaneously and it was impossible for a single person to attend every one. Here I will attempt to summarize and highlight the proceedings based on both my own attendance of symposia, and discussions with numerous colleagues.

The opening session, on the mechanics of evolution, focused on pattern, process and macroevolution as interpreted from the fossil record. This symposium was of interest to almost all attending the convention and in many ways it set the stage for the remainder of the talks delivered over the next two and a half days.

S. M. Stanley opened the meeting with a discussion in which he analysed changes in the species composition (in terms of percentages of species with various distinct morphologies, or percentage of species in an ancient fauna that survive to the present day) of higher-level taxa (groups of closely related organisms) through time. He demonstrated that rates of extinction differ among classes of animals within some phyla, and suggested that macroevolutionary trends, such as those observed in the fossil record, may be due to differences in rates of speciation and/or extinction among groups of organisms (termed "species selection"). Species with certain distinctive characters may be more prone to extinction than are other species with alternative character-states; this form of species selection may be roughly analogous to Darwinian natural selection between the two forms of individuals in a dimorphic population. As an example, Stanley noted that among the marine Bivalvia (Mollusca) of the last 100 million years non-siphonate burrowers have experienced higher extinction rates than have siphonate burrowing species. This may be because the non-siphonates are more vulnerable to modern predators and they also tend to have smaller population sizes.

K. Derstler discussed morphological change in some early Palaeozoic echinoderms. Instead of relying primarily on morphometric data (i.e., measurements), Derstler suggested that morphological change through time in a fossil lineage can be better estimated by tabulating the progressive appearance and accumulation of derived (more advanced or more highly evolved) characters relative to a primitive ancestor. This latter technique is less time consuming and can incorporate more complete information about the organisms involved. Applied to the echinoderm class Stylophora, a particularly high rate of morphologic change was found by Derstler to have occurred in this lineage during the earliest Ordovician.

D. C. Fisher suggested that phylogenetic inferences (hypotheses concerning the evolutionary relationships between organisms) are generally dependent on assumptions about process (for example, that evolution occurred, and/or that evolutionary convergence in morphology is minimal between different lineages of organisms), but that with care circular arguments can be avoided. He advocated the use of "stratocladistics", the integration of both morphologic and stratigraphic data, for phylogeny reconstruction of fossil organisms. Taking the Xiphosurida (horseshoe crabs) as an example, Fisher used a reconstructed phylogeny to test a hypothesis concerning the influence of adaptation on macroevolution. Fisher attempted to demonstrate that certain previously evolved adaptations in ancestral horseshoe crabs may have limited the morphological diversity of their descendants and may also explain, at least in part, differences in the longevity of various lineages of horseshoe crabs.

K. Padian made a clear distinction between the origin of major adaptations and the origin of major groups (these two problems are often treated together as a single topic) and concentrated on the origin of major adaptations. Phylogenetic, functional, experimental and theoretical patterns and approaches all need to be studied and utilized when working on such problems. Questions to be asked include, what characteristics did an ancestor possess which may have fostered a certain major adaptation? What is the functional significance of certain morphologies? What do differences between groups with similar adaptations signify? What problems need to be solved in order to achieve a major adaptation? How does experimental data fit hypothesized models? Padian then explored the example of the origin of vertebrate flight, with special reference to *Archaeopteryx* (the earliest known bird, of Jurassic age) and the origin of flight in birds as a cursorial, predatory adaptation, as suggested previously by J. H. Ostrom. He also presented a cladogram (phylogenetic hypothesis) of selected theropod dinosaurs and *Archaeopteryx*. According to this hypothesis, the birds are the living descendants of the dinosaurs.

R. Cowen and J. H. Lipps argued that adaptive scenarios alone are scientifically testable due to their complexity and far reaching implications and predictions, which can be compared with the known data. Furthermore, a scenario may suggest

further lines of investigation and thus may help to solve complex evolutionary problems. As a case study, they hypothesized and then explored the possibility that display and intraspecific fighting played an important role in the evolution of avian characters, including feathers, wings and flight. They noted that for living birds feathers serve as an important thermoregulatory device. Feathers are also often used in living birds as display structures that are particularly useful in competition for mates. The same may have been true for *Archaeopteryx*. Flight in birds may have evolved later, after the evolution of well-developed wings and feathers.

J. J. Sepkoski, Jr. and D. M. Raup presented a paper on macroextinction. During the Phanerozoic at least eleven mass extinctions of marine invertebrates can be recognized. The greatest extinction of all time was the late Permian event which depressed familial diversity by 52% and species diversity by 90% or more. Smaller, but still major, extinction events occurred during the late Ordovician, late Devonian, late Triassic and late Cretaceous (perhaps due to an asteroid impact?). Many lesser extinctions, of limited geographic or taxonomic scope, also can be documented. Most of the mass extinctions appear to have affected both marine and continental ecosystems, but with differing magnitudes. Although exact causes for the extinctions were not suggested, Sepkoski and Raup did demonstrate that diversity rebounded immediately after each extinction event, suggesting that the extinctions represent perturbations in an equilibrium system.

In the final paper of the opening session (read by N. Eldredge), S. J. Gould again espoused a theory of macroevolution (evolution above the species level) independent of Darwinian microevolutionary theory, which relies solely on small-scale, observable processes. An independent theory of macroevolution might be based on the notions of hierarchy in evolutionary processes, non-extrapolation of evolutionary processes from below the species level to above the species level, constraints of organismal development and architecture (such as had been discussed by D. C. Fisher), punctuated equilibria (organisms evolving not slowly and gradually, but rather by leaps and bounds interspersed with periods of stasis when no evolution occurs) and species selection (as had been discussed by S. M. Stanley). Gould suggested that certain, as yet unspecified, emergent properties of evolution on levels and time scales above that of individual organisms and species may not be reducible to evolutionary processes and mechanisms such as are observed in living organisms on a human time scale.

On Thursday afternoon three symposia and a general session on palaeobotany took place. The first symposium was devoted to exploring the tempo and mode of evolution based on micropalaeontological data. Highlights and major themes of this symposium include the suggestion by A. J. Arnold that supraspecific survivorship analysis of fossil taxa may better reflect taxonomy and its artifacts than biology; there was an increasing emphasis on the sophisticated measuring, recording and analysis of the morphology of the Foraminifera, Radiolaria and Ostracoda; likewise, the importance of good temporal, geographical and ecological control was acknowledged; the question of whether punctuated equilibria (cladogenetic evolution) or phyletic gradualism (anagenetic evolution) better describes the tempo of evolutionary pathways of various lineages of micro-organisms was a prime concern of many of the participants, although no consensus was reached; and the problem of possible hybridization between "lineages" and "species" arose several times, as did the relative prevalence of allopatric, sympatric and other possible forms of speciation.

A symposium was devoted to the contributions to palaeontology of Sir John William Dawson (1820-1899). Papers were presented on the contributions of Dawson to the study of Precambrian paleontology, Devonian and Carboniferous palaeobotany, Carboniferous land invertebrates, invertebrate palaeontology in general, and the Pennsylvanian terrestrial vertebrates (early amphibians and reptiles) of Nova Scotia. M. Dunbar presented an extremely interesting paper on Dawson's reaction to the evolutionary theory of his time. Apparently, it was not solely due to religious convictions that Dawson was unconvinced by Darwin's and Wallace's theory of evolution. Dawson expressed a dissatisfaction with the gradualism implicit in the theory of natural selection and in this respect Dawson's views approach those of some students of evolution today who argue that many species evolve according to a punctuated pattern. It was appropriate that this symposium was held in the Redpath Museum at McGill University, which Dawson helped to create and which now houses his collections of fossils.

There was a symposium on the evolution of large (usually over 75 kg. in weight) terrestrial mammals. Participants addressed the methodological problems and advantages of studying large, terrestrial fossil organisms and the theoretical, evolutionary aspects peculiar to the biology of large mammals. Large fossil mammals are usually known from smaller sample sizes of teeth (the basis of most species-level taxonomy) than are small mammals, but complete skeletons are more common for large mammals. Many large terrestrial mammals have broader geographic ranges than do small terrestrial mammals. Case studies presented included recent work on taeniodonts (Taeniodonta, including the Ectoganini = Psittacotheriini), pantodonts (Pantodonta), amynodontid rhinocerotoids (Perissodactyla), chalicotheres (Perissodactyla), bovids (Artiodactyla), uintatheres (Dinocerata), horses (Perissodactyla), and island mammals. Y. Tong and S. Lucas presented further evidence supporting the suggestion, made previously by W. Wheeler, C. de Paula Couto and M. McKenna, among others, that the Dinocerata of the Palaeocene and Eocene of North America and Asia are closely related to the South American Palaeocene Xenungulata (*Carodnia*). Together these two orders constitute the mirorder Uintatheriamorpha. B. Van Valkenburgh discussed the evolutionary dynamics of selected terrestrial, large-predator guilds and J. S. Mellett presented an interesting paper on body size, diet and scaling factors in large carnivores and herbivores. In mammals metabolic rates are inversely scaled to body size; thus large size may allow animals to consume foods that are high in cellulose, or swallow food in larger chunks. Mellett suggested that mammalian herbivores may use fermentive heat in thermoregulation and that the absence of giant marine herbivores may be due to an inability of these animals to control the gas production of microbes in the gut; uncontrolled gas production could cause excessive buoyancy.

At the Thursday afternoon general palaeobotany session a wide variety of papers was presented covering such topics as the effects of palaeotopography on the late Devonian flora and the origin of coal swamps; early Pennsylvanian megaflora palaeoecology; development of late Palaeozoic terrestrial ecosystems; lower Cretaceous floristics and palaeoecology; fossil soils and the development of Tertiary grasslands; and the effects of volcanism on Miocene vegetation distribution. Papers were also presented on specific taxonomic groups, such as early Silurian acritarchs, a new species of *Gosslingia*, early seed ferns, Palaeozoic gymnosperms, pecopterids, cycadophytes and lycopsids. A. C. Scott suggested that the evolution of the seed and of trees in the late Devonian allowed the spread of vegetation into diverse terrestrial environments and also gave rise to vertically structured forests. According to Scott, the main herbivores of the coal measures were arthropods and most of the vertebrates were carnivores. G. Retallack suggested that the development of mid-Tertiary savannas and grasslands was caused principally by climatic drying.

On Friday three all-day symposia were held. One, on geological factors and the evolution of plants, explored the interaction

between the evolution of plants and the physical evolution of the earth. Most of the papers presented concerned the evolution of Precambrian and Palaeozoic floras. Of particular note, was A. J. Boucot and J. Gray's suggestion that whereas transgressions-regressions, volcanism and orogenies show no correlation with early land plant evolution (Ordovician to Devonian), global climatic gradients may have been a significant factor in land plant evolution. Another symposium, on the evolution and palaeobiology of the Gastropoda, included papers on functional anatomy, evolutionary rates and modes, palaeoecology, and predator-prey coevolution in snails. The third symposium focused on North American Jurassic-Cretaceous palaeobiogeography, biostratigraphy and chronology. Most of these talks were either of a general nature or concentrated primarily on the detailed correlation of Jurassic-Cretaceous marine sediments. R. W. Scott discussed the five tectonic controls on sediment accumulation during the Mesozoic in the Gulf of Mexico: a convergent island-arc system along the Pacific coast of Mexico and Central America, a backarc basin in the Gulf of Mexico, the Bahaman and Yucatan platforms, the Caribbean oceanic volcanic arc system, and the oceanic basin.

On Friday afternoon a symposium was held on Problematica: fossils which cannot be attributed to any well-known systematic group. A number of late Precambrian and Cambrian Problematica were described and discussed, as well as enigmatic plants from the Devonian, Problematica of Mazon Creek (Pennsylvanian), acritarchs, stromatoporoids, receptaculitids and what may be fossil chondrichthyan (shark) egg cases. As S. Rietschel and many other speakers pointed out, even if it is not known just what many Problematica represent in the way of living organisms, many of these groups are extremely important in stratigraphic correlation and may also be useful for facies interpretation. Rietschel proposed that when investigating Problematica workers should concentrate on formulating detailed functional models of the possible life habits of these enigmatic forms.

Also on Friday afternoon two general sessions were held, one on general palaeoecology and one on general palaeontology. The majority of talks on palaeoecology concentrated on Palaeozoic and Mesozoic marine communities. C. R. Clark II observed that some pectins (Bivalvia) extract cadmium from sea water and suggested that under certain conditions cadmium accumulations could jeopardize the individual's and species' existence. The general palaeontology session included talks on crustaceans, crinoids, bryozoans, trilobites, stromatolites, conodontophorids, nautiloids, Carboniferous plants, Foraminifera and Oligocene mammalian biostratigraphy. Of particular note were two papers on phacopid trilobites: P. Lespérance and J. Letendre described a new species of *Denckmannites* and five new species of *Acernaspis;* L. Babcock described what may represent original colouration schemes, consisting of ordered black spots on the dorsal exoskeletal surfaces, in *Phacops* and *Greenops.*

Two morning symposia were held on Saturday. In the session on Silurian-Devonian palaeontology of Arctic North America papers were presented on corals, brachiopods, radiolarians, trilobites and trace fossils. On the basis of trilobite faunas, B. Chatterton and the late D. Perry suggested that during the Silurian there were no major boundaries to dispersal between the Arctic Islands and the MacKenzie Mountains region; however, dispersal between eastern Canada and Arctic and northwestern Canada was sporadic. Participants in the symposium on Cainozoic insects discussed and compared selected fossil insect assemblages with an emphasis on taphonomy, palaeoecology and palaeoenvironmental reconstruction. To circumvent the taphonomic (preservational) biases inherent in, and low taxonomic diversity of, many fossil insect assemblages, J. Matthews presented a methodology for sorting insect fossils into "ecological groups". This technique allows various fossil and living assemblages to be more meaningfully compared.

An all-day symposium on palynology also took place on Saturday. The morning talks concentrated on particular groups with an emphasis on their utility in solving geological and biological problems. G. D. Wood explained why fossil plant spores are particularly useful: spores are easily dispersed by wind and water and thus have a relatively facies-free distribution over wide areas; they possess a resistant outer wall (exine) which enhances their preservability; and they exhibit relatively distinct and rapid morphological changes through time. The groups discussed were fossil plant spores, acritarchs, dinoflagellates, angiosperm pollen, fungal palynomorphs and calcareous nannofossils. The afternoon talks emphasized the use of palynology in palaeocommunity and palaeoenvironmental reconstruction. Several speakers agreed that our knowledge of the biology and ecology of many groups of living microorganisms has not kept pace with studies of fossil forms. Consequently, it can be extremely difficult to interpret the fossil forms without adequate knowledge of living analogues.

Three symposia were held on Saturday afternoon. In the symposium on time resolution in evolutionary palaeobiology, participants approached the question of estimating and refining temporal and stratigraphic resolution from a number of points of view. This is a subject which may find many applications besides the strictly palaeontological, and should be of interest to sedimentologists, stratigraphers and other geologists in general. The two leading speakers, D. Schindel and P. Sadler, independently proposed the concept of "completeness" of a particular stratigraphic section. To calculate completeness, the net rate of accumulation of a sedimentary section (thickness of section divided by length of time over which it was deposited) is divided by a short-term rate of sedimentation (based on modern analogues and compilations of sedimentation rates from various sedimentary environments). The completeness of a stratigraphic section is calculated for various levels of resolution, such as for the 10-year, 100-year, or 1,000-year levels. For example, to calculate completeness at the 1,000-year level of resolution, the net rate of sediment accumulation for the section is divided by an average sedimentation rate observed over a period of 1,000 years in an appropriate depositional environment. In this case, the resulting completeness value can be thought of as the percentage of 1,000 year intervals that are represented by some net accumulation of sediment, no matter how small, in the stratigraphic section. A major unresolved difficulty in calculating such completeness estimates is how to account for compaction: until now, it has been ignored that various rocks, such as limestones, sandstones, siltstones and clays, surely have very different compaction values and the amount of compaction may change with the amount of rock deposited and how long ago it was deposited.

D. Schindel introduced the concept of "microstratigraphic acuity" to refer to the amount of time represented by each individual fossiliferous sediment sample in studies based on sequences of such samples collected up a stratigraphic section. To calculate the maximum stratigraphic acuity it must be assumed that, by careful sampling, all gaps (which are longer than a specified level of resolution) in a stratigraphic section can be avoided. Thus the total, gap-ridden stratigraphic section is broken down into a number of short, "complete", gap-free stratigraphic sections. But, as P. Sadler and L. Dingus pointed out, hiatuses in a sedimentary sequence may be both very subtle and very significant; many gaps may remain unmarked and it is unrealistic to suppose that all hiatuses can be avoided when collecting samples in the field. The concept of microstratigraphic acuity requires assumptions that cannot be justified by the *ad hoc,* probabilistic nature of completeness esti-

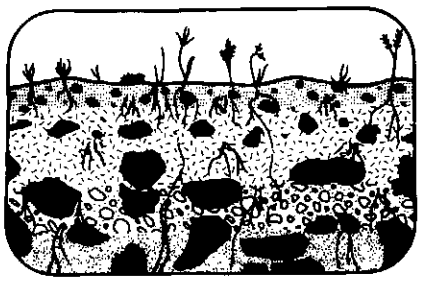
mations of sedimentary sections. The strength of completeness estimates lies in the fact that no such assumptions need to be made. Completeness estimates make no predictions as to the distribution of gaps versus temporal intervals represented by sediment in a particular stratigraphic section.

D. Schindel also presented his "habitat-shift" model in which gaps in the stratigraphic record are considered to correspond to interruptions in within-populational processes of the organisms (later preserved as fossils) living in the particular depositional environment. As a palaeontologist, I question this model. I see no *a priori* reason why periods of sediment accumulation necessarily have any correlation with hospitable or inhospitable conditions for organisms which later die and are preserved in the sediments. For example, in the Eocene Bighorn Basin fluvial system (discussed by P. Gingerich in the same session) the mobile mammals would have been relatively independent of the exact coordinates of the river system, while for many marine organisms relatively high rates of sedimentation (perhaps burying the organisms in sediment), rather than profound breaks in sedimentation, might represent the most inhospitable conditions. The following methodologies and taxonomic groups were also considered by various speakers in the symposium on time resolution: time resolution using magnetostratigraphy; analysis of biometric characters in foraminiferans; and time resolution using Holocene pollen, megaflora assemblages, marine benthic invertebrates and terrestrial mammal fossil assemblages.

A short symposium on the palaeobiology of Foraminifera was also held on Saturaday afternoon, as was a symposium on palaeontological innovations in the eighties. In the former symposium J. Kennett, B. Malmgren and M. Srinivasan presented their evidence for gradual, steady and continuous change in the *Globorotalia* lineage during eight million years. In the latter, a number of new techniques and technologies were described and discussed, such as applications of scanning electron microscopy, accelerator mass spectrometry and fluorescence of palynomorphs to palaeontology and stratigraphy; quantitative biostratigraphy; computer retrieval of biostratigraphic data; and voice access to computers for palaeontological data.

Finally, a general poster session was held on Saturday. This session included a broad range of specialized topics, such as stromatoporoid ecostratigraphy and the upper Ordovician glacial episode; ichthyolith (microscopic fish skeletal fragments) biostratigraphy across the Cretaceous-Tertiary boundary; and case studies of the evolution of various Foraminifera and Radiolaria.

Overall, this was a most exciting and well-attended convention. Abstracts of the papers were published before the meeting as a supplement to volume 56, number 2 of the *Journal of Paleontology* (March, 1982). A two volume set entitled *Third North American Paleontological Convention Proceedings* (B. Mamet and M. J. Copeland, eds., 1982, Business and Economic Service Limited, Toronto, 599 pages) was also published and distributed at the convention.



Correlation of Quaternary Chronologies Symposium

W. C. Mehaney
Geography Department
York University
Downsview, Ontario M3J 2R7

Quaternary scientists from Canada, U. S. A., U. K., Sweden, Denmark, West Germany, Estonia (USSR), Poland, France, South Africa and New Zealand convened at York University in Toronto from May 26-30, 1983, to discuss Quaternary records. Chronologies were examined from various points of view, including the radiocarbon time scale, vertebrate, paleomagnetic and paleosol records, and glacial/interglacial sequences. This conference proved to be a logical extension of the 1981 York Symposium on *Dating Methods*, the proceedings of which are to be published shortly by A. M. Dowden, Box 188, Stroudsburg, PA18360.

The first session on long range time scales, chaired by C. S. Churcher (U. of Toronto) and D. Easterbrook (Western Washington State U.), opened with a discussion by H. B. S. Cooke (White Rock, B. C.) on the reconciliation of different chronologies. He reviewed the multidisciplinary approach required to achieve a precise subdivision of key horizons in the Quaternary as well as the problems involved in correlation between the continental and marine records. He stressed the need for further studies of loess sequences in North America. The extension of the radiocarbon time scale by accelerator mass spectrometry was discussed by R. E. Taylor *et al.* (U. of California, Riverside), and P. Fritz (U. of Waterloo) assessed problems associated with ^{14}C dating of marl deposits.

The session continued with an important summary of the chronology of late Cenozoic climates in Africa by E. M. van Zinderen Bakker (U. of The Orange Free State, Bloemfontein, South Africa), and a description by J. Terasmae (Brock U.) of using palynostratigraphy for correlation of deposits. Next, W. Vortisch (U. of Marburg, W. Germany) discussed clay minerals and their use in correlating tills in northwestern Europe.

The afternoon session on Thursday, chaired by B. D. Fahey, (Guelph U.), and I. J. Smalley (U. of Waterloo), began with a paper on long time scales derived from cave deposits in North America by D. Ford (McMaster U.). This concluded the first set of papers. The second group of papers, on the paleomagnetic record, began with R. Barendregt (U. of Lethbridge) and A. MacS. Stalker (Geological Survey of Canada, Ottawa), who discussed the paleomagnetic correlation of older Quaternary deposits in the Canadian prairies. The use of paleomagnetic data from tills and other glacial drifts was assessed by D. J. Easterbrook and J. S. Mothersill (Lakehead U.), followed by a discussion on the correlation of lacustrine deposits using paleomagnetism.

The third session was on the vertebrate record. C. A. Repenning (U. S. G. S., Menlo Park, Calif.) opened with a summary of Quaternary rodent biochronologies and their correlation with paleoclimatic and paleomagnetic events leading to a synthesis of Quaternary stratigraphy for North America. The paleoecology of an early Pleistocene cenote in Hannover Quarry, PA, was discussed by E. B. Evenson *et al.* (Lehigh U., Bethlehem, PA) and K. E. Luchterhand (Field Museum of Natural History, Chicago, Ill) considered the evolution of tropical terrestrial communities in the late Cenozoic. This third session continued on Friday, May 27, chaired by C. Burrows (U. of Canterbury, Christchurch, N. Z.) and A. MacS. Stalker. The first paper, by C. S. Churcher, dealt with faunal correlations of Pleistocene deposits in Western Canada. He provided corroborative evidence for the antiquity of older Pleistocene glacial deposits in Saskatchewan previously discussed by R. Barendregt. Early postglacial mammalian faunas in the Bighill Creek Formation of Alberta and their importance in understanding Pleistocene extinctions formed the main topic of discussion by M. C. Wilson (U. of Calgary).