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the wide diversity of deposits and appreciated the problem of attempting to make precise environmental interpretations of individual successions. Much discussion centred on the nature of the environment under which the materials referred to as glaciomarine might have been deposited.

On the last day of the excursion, Dr. Armstrong led the group to exposures of pre-Fraser Glaciation age deposits in the vicinity of the Coquitlam River. Most of the time was spent at the Mary Hill gravel pit examining a sequence of sediments reported to represent two glacial and two nonglacial periods. Most of the discussion revolved around the environmental interpretation of a sequence of organic sediments and their position(s) in the stratigraphic succession. A thick succession of Quaternary sediments was viewed in the Coquitlam Valley. The position of these deposits in the Quaternary framework is not certain and this highlighted the problem of correlating Quaternary successions which are beyond radiocarbon date range and do not contain tephra or other marker beds.

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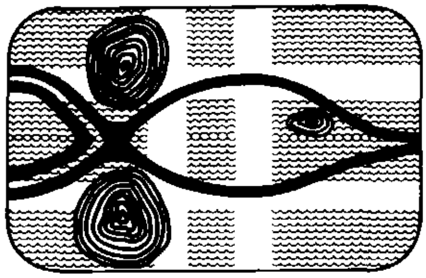

Paleontology and Biostratigraphy Seminar

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The Royal Ontario Museum in Toronto was the site for this years's Paleontology and Biostratigraphy Seminar held on November 21st and 22nd. Similar meetings have been held at various institutions in eastern and Atlantic Canada for a number of years. There is no "parent" society. This year, the Seminar was sponsored jointly by the Department of Invertebrate Paleontology of the Royal Ontario Museum and the Department of Geology, University of Toronto; Peter von Bitter, Geoffrey Norris, and Desmond Collins acting as joint convenors. Approximately 100 paleontologists attended.

Papers presented fell into three major divisions representing palaeoecology and evolution, Cenozoic and recent studies, and Paleozoic stratigraphy.

Bruce Haugh (University of Toronto) described morphologic analysis of some Mississippian camerate crinoids based on superbly preserved material containing fossilized internal "soft" parts. Not only is the internal anatomy radically different from modern crinoids, but he has discovered an apparently unique sensory system by study of pore structure of the wall and internal nerve grooves. Fixed pinnules acted as linear antennae to sense water currents and thereby change the position of the arms. Several crinoids growing close together would thus be able to form a communal baffling system to optimize suspension feeding by a mucus-net system.

Hans Hofmann (University of Montreal) has also been working on superbly preserved material. His material, however, represents the lower end of the available evolutionary and stratigraphic spectrum. Aphebian sediments, approximately two billion years old, from the Belcher Islands contain abundant stromatolites and oncolites in silicified dolomitic and evaporitic mudstone. The stromatolites and oncolites have yielded very abundant permineralized cells of blue-green algae, bacteria and possibly fungi. Hofmann pointed out that the macro-morphology of stromatolites is not useful for precise biostratigraphy, contrary to the conclusions of Soviet workers. Furthermore, the morphology of algal cells within the stromatolites suggests that little if any evolution of blue-green algae has taken place in the time interval between the Proterozoic and Recent, at least at the familial level. He documented many close similarities between recent stromatolitic microfloras and early Proterozoic ones. Of great interest was the demonstration that the so-called nuclei reported from some Proterozoic algal species are in fact degradation products of the cell contents. Hofmann was able to demonstrate this phenomenon in both decaying modern algal cells and in Proterozoic assemblages.

A neontologist's approach to phylogeny was presented by Ian Ball (Royal Ontario Museum) in a paper on derivation of phylogenetic trees using recent faunas. He indicated the problems faced by biologists in elucidating evolutionary lineages amongst organisms that leave no fossil record (his own work is concerned with flatworms), but suggested that fossils aided little in contributing a solution. He traced the impact that the early pre-evolutionary school of transcendental anatomists had had on modern phylogenetic systematics. Of particular importance in this regard is the definition and recognition of monophyly. Simpson's definition of mere common ancestry was judged to be too loose; rather, emphasis should be placed on derivation from one phyletic line, if and only if they have a common ancestor that is not also an ancestor to another group. With this stricture in mind, Ball developed the thesis that species must be defined on the basis of unique evolutionarily-derived characters and that these derived character states are the only important features for defining monophyly. He conceded that fossils do give a time-frame for phylogenetic trees but considered them of limited value in contributing information to phylogeny since very often the latest occurring fossils may be the most primitive and vice versa, at least in his opinion.

A systematic problem of a different type was outlined by Chris McGowan (Royal Ontario Museum) from his studies of the Lower Jurassic ichthyosaurs from Holzmaden in Germany. Although the skeletons are remarkably preserved, often in a fully articulated state, sometimes with unborn young within the female skeletons, there is considerable difficulty in discriminating species because of the very large size range of the specimens (these range from a few inches to several tens of feet in length). He demonstrated that due to allometry, embryonic and neonatal ichthyosaurs do not resemble their mothers and that no amount of plotting of data on log scales to produce linear relationships will resolve this. The only solution to this problem is to exclude immature individuals. Cluster and principal component analysis was used to define species and these methods agreed fairly closely with the traditional visual method.

Several papers dealt with Paleozoic biostratigraphy, including biofacies and community studies. Rolf Ludvigsen (University of Toronto) demonstrated a method for discriminating temporal and environmental influences on silicified trilobite assemblages from the Middle Ordovician platform carbonates of the southern Mackenzie Mountains. Five biofacies were recognized by examination of approximately 13,000 individuals from dozens of localities using Q- and R-mode cluster analysis of data reduced to presence-absence. Results were used to construct an ecologic range chart suggesting the presence of shallow, moderate, deep, and deep-slope trilobite biofacies, each with distinctive morphologic types of presumed adaptive significance. The distribution of these biofacies could be used to recognize five trangressive-regressive couplets in the Black River-Trenton sequences and was therefore useful in delimiting paleogeographic changes. A similar approach was outlined by Peter von Bitter (Royal Ontario Museum) in his studies of the paleoecology of Viséan (Lower Carboniferous) conodonts from the Windsor Group at Port Hood Island, Nova Scotia. A shallow water, often high energy conodont biofacies defined by the presence, in abundance, of *Cavusgnathus windsorensis* Globensky was recognized. The existence of more basinal conodont biofacies was suggested mainly by the irregular and spotty occurrence of a number of conodont genera. It was possible to relate the conodont occurrences on Port Hood Island to the distributional model proposed previously for Viséan conodonts as well as to environmental reconstructions of the Port Hood Island section. It was also demonstrated that despite the environmental controls the Lower and Upper Windsor Group possessed distinctive conodont faunas. Peter Sheehan (University of Montreal) working with silicified macro-invertebrates from the Silurian of Utah and Nevada drew parallels between Ziegler's classic benthic communities from the borders of the Caledonian geosyncline. In general, similar communities can be recognized in the Great Basin but these may be generically distinct. He demonstrated that the spatial and temporal distribution of these benthic faunas can be used to interpret the paleogeography of shelf and shelf-edge seas on the western edge of the craton during the Silurian.

Another application of biofacies to paleoenvironments and paleogeography was provided by Alf Lenz (University of Western Ontario) using Lower Devonian brachiopods from the Yukon, Northwest Territories, and British Columbia. Three brachiopod biofacies indicating shallow, intermediate, and deep water conditions were recognized; direct correlation with the Appalachian and Rhenish areas is not possible but close correspondence exists with the Bohemian-Uralian region. Biostratigraphic subdivisions are possible but complicated by paleoecologic interactions leading to high-diversity deep water faunas and low diversity, shallow water faunas, the latter containing a few dominants and the former containing none in particular. A somewhat different aspect of the application of paleontology to paleogeography was provided by Loris Russell (Royal Ontario Museum) in a paper concerning Mesozoic non-marine faunas. He argued that non-marine faunas - particularly freshwater clams - tend to be prisoners of their watersheds and seldom cross them. In spite of this, some non-marine Cretaceous faunas are widespread in the western interior, ranging from Nevada and Wyoming to north-east British Columbia and suggesting a major river draining north during the early Cretaceous in this area. Distribution of Tertiary horses was also cited as a means of assessing geotectonic elements in the circum-North Atlantic.

Another aspect of terrestrial paleontology was discussed by John McAndrews (Royal Ontario Museum) in a paper on Quaternary vegetational changes and stratigraphy. He demonstrated how terrestrial pollen floras fall into five distinct provinces during inter-glacial periods but revert to a fairly uniform spruce-sedge-alder-birch assemblage which was continent-wide in North America during glacial periods. Principal component analysis of modern surface samples was used to demonstrate his contention that spore-pollen assemblages in sediments provide, in general, an accurate estimate of the vegetation. Analysis of varved lacustrine sediments coupled with radiocarbon dating has led to a detailed zonation of the post-glacial floral history of eastern and central Canada. This history has been linked to factors associated with climatic change and also to Indian and European settlers' disturbance of the natural vegetation.

The effects of boring by modern endolithic algae and fungi of the Caribbean region on carbonates was discussed by David Kobluk (McMaster University). He illustrated results from a number of experiments utilizing clear calcite and aragonite crystals and showed that infestation starts within a few days in both natural and artificial environments. Initially, the microflora bores into the calcium carbonate and its growth is closely linked to crystallographic parameters. Later, however, as growth becomes denser, the tubules pervade the crystal in many directions. Boring is possibly a passive process due to secretion of metabolic acids. The algae eventually re-emerge at the crystal surface and later die.

Calcium carbonate deposition in the form of micrite forms around the re-emergent filaments to form a cohesive package around the infested carbonate material; eventually, the tubules also become calcified internally. This process may be a significant source of micrite in both modern and ancient sedimentary environments. Evidence of endolithic algae and fungi date back to the Paleozoic. Michael Risk (McMaster University) also presented a paper on the biologic destruction of carbonates in which he enumerated both external agents (fish, echinoderms, molluscs) and internal borers (sponges, polychaetes, and molluscs in addition to the algae and fungi discussed in the previous paper). Penetration can be by chemical or physical means. In the case of boring sponges, chips of calcite in the silt-size range are produced from coral heads. A major problem involves the precise understanding of how possible parasites settle on coral heads, and how these organisms kill the coral tissue. Symbiotic algae within the coral tissue secrete substances that retard metamorphosis of invading larvae; consequently some sort of chemical warfare between the coral and the invader is envisioned. Ultimately, however, the boring organisms achieve a dynamic balance between boring, solution, and cementation of the coral head until the coral dies.

A number of contributions to the Seminar concentrated on biostratigraphy of eastern Canada, particularly Ontario. Des Collins (Royal Ontario Museum) outlined the contributions to paleontology of J. J. Bigsby, thought to be Ontario's first biostratigrapher. Bigsby first visited Upper Canada in 1819 travelling as far as the Falls of the Sault; subsequently he travelled extensively in the Great Lakes and vicinity while assigned to the Boundary Commission. During these travels he reported on the geology and paleontology of the region because he believed it proper to "register every observation respecting these countries, as from their remoteness, total want of attractions and moreover from the difficulty of subsistence, visits to them will be very rare and brief". Major publications on the Paleozoic geology of areas now included in Ontario, New York and Michigan appeared by him during the second quarter of the 19th century. The Bigsby Medal, endowed by him, is still offered by the Geological Society of London for significant work on the geology of North America. Gordon Winder (University of Western Ontario) outlined subsequent work by numerous geologists on the Paleozoic of Ontario and the conflicting classifications that have arisen, due to the varying and sometimes inconsistent use of either lithostratigraphic or chronostratigraphic (homotaxial) interpretations. He made a plea for the use of careful taxonomy as the basis for chronostratigraphy, and the recognition of different but time-concordant biofacies. Thus, he argued, it is only possible to erect meaningful correlations by selecting marine fossils from the same environments. Several examples of possible diachronous lithostratigraphic units in the local Ordovician were given. Peter Telford (Ontario Division of Mines) argued that many of the problems of stratigraphic correlation in the Silurian of southern Ontario could be solved by micropaleontology. Preliminary conodont work has demonstrated correlations between the Niagara region and the area north of the Algonquin Arch. Other microfossil groups, such as acritarchs and chitinozoa, also have largely untested potential for stratigraphic applications in this area. Bud Cumming (Geological Survey of Canada) outlined a number of practical applications of paleontology and biostratigraphy to the solution of problems in the Lower Paleozoic of western Newfoundland in resource development. Archaeocyathids and trace fossils have been used to accurately predict the depth of the Precambrian basement and crustal stability in the Strait of Belle Isle for the planned construction of a tunnel for hydro-electric power transmission between Labrador and Newfoundland. Host rocks for the newly discovered zinc-cadmium deposits in the Lower-Middle Ordovician at Zinc Lake have been mapped using distinctive faunas and paleokarst development has been delimited at the Lower-Middle Ordovician disconformity. Many fossil localities in the Gros Morne National Park have been used in developing a geological interpretive programme.

In the evening of the first day of the two-day Symposium, the participants met again - first to quench their great thirst in the ROM Members' Lounge and then to hear Desmond Collins describe the Royal Ontario Museum expedition to the Burgess Shale during the summer of 1975. The expedition was organized to make a collection for the first comprehensive exhibit in Canada of these famous Canadian fossils. Permission to collect from the talus dumps associated with the Burgess quarries was granted after lengthy and sometimes delicate negotiation. A further stipulation was that duplicate collections be made available on a cost sharing basis to interested geological institutions across Canada that had been contacted by Parks Canada. Although no excavation was permitted, during the summer a good representative collection of the Burgess Shale fauna was made from the talus. This included many individuals of the common *Marrella splendens* as well as some specimens of the rarer species. The party of six to eight people stayed at the site for nine weeks collecting from the talus associated with the two quarries. Walcott's 1917 camp was also visited. Interestingly, Walcott had used Burgess Shale talus to level his campsite and the ROM party was able to collect some specimens at the camp.

I am grateful to Dr. P. von Bitter for assistance in providing details of some aspects of the seminar, and for critically reading the manuscript.

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