

*Thomas P. Penchak*

# October, 1995 Volume 28, Number 4

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## AASP MEMBERSHIP APPLICATION AND DUES NOTICE

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Telephone: \_\_\_\_\_

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Nature of work (graduate student, exploration stratigrapher, etc.)

**Send along with your remittance to Dr David T. Pocknall at the above address.**





# A.A.S.P. NEWSLETTER

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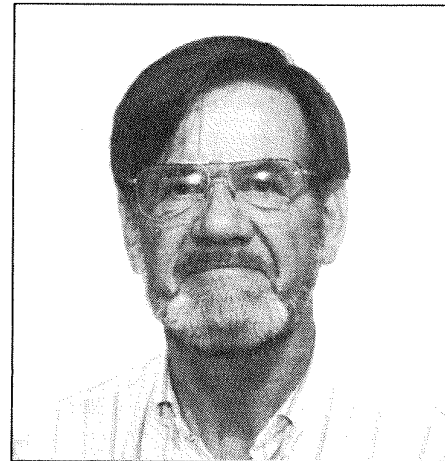
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The AASP NEWSLETTER is published four times annually. Members are ENCOURAGED to submit articles, "letters to the Editor," technical notes, meeting reports, information about "members in the news," and information about job openings in the industry. Every effort will be made to publish all information received from our membership.

The deadline for the next NEWSLETTER, the first of 1996, is **December 15**. All information should be sent on computer disk (MS Word for the Mac is best, but anything will do) or by e-mail, if possible, or if not—send hard copy. Always include a duplicate typescript of all electronic copy sent so I can check formatting, diacritics, etc. If possible, please illustrate your contribution with art, line drawings, eye-catching logos, black & white photos, color photos, etc. We look forward to contributions from our membership.



*Jan Jansonius, President of AASP*

## PRESIDENTIAL ADDRESS

**T**HIS address is a bit of a departure from previous custom: it was written well in advance of this year's business meeting, in order to provide the Editor with a copy for the October Newsletter—where it customarily would appear, but now we mail that issue in early October.

When the Nominating Committee asked to put my name on the slate of candidates, I had reservations about my relevance. It is many years since I was a full-time palynologist, though I stayed interested in palynology and tried to help our science along through the "Genera File of Fossil Spores," and as co-editor of the book "Palynology: principles and applications." However, I agreed to give people a chance to vote for me. Enough of you did, and I appreciate your confidence.

What do I see as mandate for this year's Executive? We can do little to combat the forces that are changing the way geology and palynology are now done. It does not help to tilt at windmills, particularly if we believe in using renewable resources. As we observe the world around us and the way it is changing, we must adapt to new circumstances, trying to profit from new opportunity, even as we see old venues of opportunity disappear. What can we do?

I entered the world of palynology by good fortune, at a time when we had to invent the science as we went along. We made mistakes, but also had successes. Eventually, palynology was accepted as a basic component in sound geological practice. For a majority of AASP members, that practice then included petroleum exploration and exploitation. That accounts for the "S" in the name of our Association. For historic reasons, most headquarters of international oil companies are in the USA; this explains the first "A" in AASP—a group of young oil

company and university palynologists decided to band together to further palynology. The freedom of action possible in the "new world," and the support of the companies for which these people worked, helped to shape AASP. In retrospect it is astounding to see what was accomplished: an organization with world-wide membership, a yearly technical meeting where peers are treated to excellent presentations. For a low membership cost there is the annual volume of *Palynology*, with a variety of topics, and the quarterly *Newsletter*. Furthermore, AASP Foundation sponsors publications in the Contributions Series, and carries a fund of text books and incidental publications. The volunteerism, energy and enthusiasm of many to make dreams a reality, has truly benefited the full membership of the Association. This is something over which we can have influence.

Companies now show more awareness of their bottom line, and must be less generous in providing time and supplies for non-essential activities. In the past, AASP has greatly benefited from mailing and reproduction privileges. Of course, by allowing AASP to grow strong and successful, the companies benefited from better palynology. Now, as the tide is changing, the association must show it is capable of looking after itself.

What are the priorities of AASP in these times. Is it to demonstrate the worth of our science to managers, geologists and co-workers who have not grown up with it? Or, is it more important to ensure that the technical prowess of our members remains competitive? What new ideas are worth promoting, and which old notions should remain part of a palynologist's basic knowledge?

It is unusual in any branch of science to see such a large proportion of its membership retire within a brief span of time. Many retiring palynologists are not replaced for reasons of economy (expressed in general hiring freezes), not because palynology has fallen in disrepute. This policy, deriving from managerial administrators rather than technical staff, pertains as well to universities, where departments of palynology, staffed in the 1950s, are now discontinued. Although this is a particular North American phenomenon—as palynology is much more valued in other parts of the world—the American ASP keenly feels its impact. In these circumstances it is difficult to persuade executives of the necessity to hire permanent palynological staff; mere utility is not enough justification, possibly because non-technical personnel have little understanding how such little fossils can save such big amounts of money.

In the last five years Colin McGregor and I have focused our energy on editing the book *Palynology*, which has more than one hundred contributing authors. We had to overcome various hurdles, but all chapters originally planned are in, as well as many more that seemed to fit the idea of the book. In its three volumes the next generation will find high quality data that are immediately applicable, as well as pointers and references to new techniques, methods and applications. This will help to ensure continuity in our discipline; even if many of the mentors are retired, they have found a voice that will reach their successors. Happily, there are also contributions from young specialists. Through the efforts of many volunteers (Bob Clarke, take a bow on behalf of all of them), the price of the book will be so low (ca \$100 plus postage) that any interested or aspiring palynologist can afford it. And, referring to what I just said: we added to the book a final chapter with documentation of instances of large sums of money saved or gained by companies, or conclusions of great importance to society, based on the application of palynology. We hope that these may help to convince managers and administrators that palynology is indispensable.

In the coming year other things need attention as well. The Center of Excellence must be supported by somehow, somewhere, finding the required financing—even if that will have to come from many more, and smaller, sources than at first anticipated. This is a major ongoing concern for the Executive, and any ideas from our membership are welcome. CENEX will never threaten the existence of other schools,

but must be allowed to grow big enough in North America to show, with authority and successful programs, that it can provide the standards of excellence by which palynological training, and palynological practice, will be measured.

Earlier I said that in the 1950s we had to invent palynology as we were practicing it. We have grown past that, and palynology has developed its own discipline and principles, in which modern students are well versed. Where, earlier, the details of palynology were foremost in the minds of the practitioners, now the nuts and bolts are easier to apply—it is the peripherals, such as sequence stratigraphy, graphic correlation, environment of deposition, sedimentary structures, ancient climates etc., on which palynologists must focus. My predecessors have stressed, but it bears repeating: palynology no longer stands on its own, and separate. Rather, it has become an integral part of the exploration, or other, team that together solves specific problems. For that reason, AASP is on the verge of affiliating with the Geological Society of America, and other similar alliances may follow.

As is evident from the subjects at our recent meetings, and from our upcoming "book," stratigraphic palynology is no longer the only game in town. Palynology is applied in many fields, such as Quaternary pollen analysis. The results of such applications are not without significance for "paleopalynology;" and, vice-versa, understanding the analyses of older sediments can have direct implications for those on modern material. Thus I am pleased to see that several branches of our discipline are growing vigorously on the same tree. However, this is no reason for changing the name AASP, by which our Association is recognized.

The next AASP annual meeting will coincide with the IX IPC in Houston, which is sponsored by AASP. I want all of you to realize how important it is to give our support to Vaughn Bryant, John Wrenn, and their volunteers, who organize this event. We all will benefit from their efforts. This will be an opportunity to meet colleagues and exchange views and experiences, and, I hope, for the AASP to reinforce its ties with the visitors from abroad, and convince them that joining our Association will benefit both them and us. We also hope to increase membership among North American colleagues and students. By maintaining a large membership, we can reap advantages of scale, and continue to provide low cost, high quality publications and services to our members.

The officers of the Association and I will do our best to look after the interests of its membership. We hope that you will assist us by showing your interest, letting us know your concerns and your solutions for any of our collective problems, and by your cooperation if we need assistance.

Jan Jansonius, President



## 1995 AASP STUDENT SCHOLARSHIP RECIPIENTS

The AASP Awards Committee congratulates Caroline Davies and Florin Neumann, winners of the 1995 AASP Student Scholarships. These awards are based on the qualifications of the student, originality and imagination evident in the proposed project, and the likelihood of significant contribution in the field of palynology. Both awardees received \$1000 (US). Fourteen students applied for the scholarship in 1995. They were from universities in six countries with thesis topics

including biostratigraphy, palynofacies, paleoenvironmental analysis, and climatology. This scholarship is not restricted to AASP members.



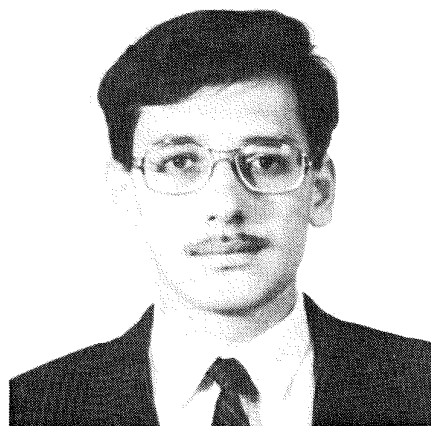
CAROLINE P. DAVIES is pursuing a Doctoral degree in Physical Geography at Arizona State University, Tempe, under the direction of Dr. Patricia Fall. Caroline completed her bachelor's degree in Archaeology and a minor in Religious Studies at Hobart William Smith Colleges in 1983. Her master's was from the Institute for Quaternary Studies, University of Maine in 1992. She has been a member of the Wadi el Hasa Paleolithic Project under the direction of Dr. Geoffrey Clark in Central Jordan since 1984. Caroline has also spent a total of fifteen months working for the British Archaeological Expedition in northern Iraq in 1985 and 1986, six months at the Assyrian site of Tell Mohammed 'Arab and nine months surveying in the North Jasyra plain and directing excavations at Tell Shelkiya.

Her thesis topic, and winning proposal, is entitled "The Biogeography of Levantine Palaeoclimatic Transition Zones." The object of this study is to identify the fundamental differences in Levantine precipitation arising from two distinct atmospheric circulation patterns using palynological data to reconstruct the paleoclimate, the polar jet stream, and southwest Asian monsoon. At the leading edge of atmospheric fluctuation, the climatic transition zone should be the first area to register long-term climate change. Another object of this study is to address the paucity of palynological data in the Levant. The Jafr basin and Wadi el Hasa, due to their size, depositional histories, and location, are particularly well suited to regional vegetation reconstructions and testing hypotheses of paleoclimatic atmospheric circulation. Caroline has also recently received a Fellowship from the American Center for Oriental Research, Amman, Jordan. She plans to take sediment cores in the El Jafr Basin, Central Jordan for palynological and sedimentological analyses in the summer of 1996. Her American Association of Stratigraphic Palynologists Award will go toward funding the coring expedition.

FLORIN-ALEXANDRU NEUMANN is working on his Ph.D. at the University of Toronto under the guidance of Professor Geoffrey Norris and Dr. Martin J. Head. Florin completed an M.Sc. from the University of Bucharest, Romania, and a *Maîtrise en Palynologie* under the direction of Professor M. Streeel from the University of Liège, Belgium, and Drs. Jan de Coninck and Stephen Louwye, University of Gent. He also has had experience in the Romanian oil industry both as an explorationist in the Geological Bureau, Gaesti Production Division, Pitesti Oil Trust, and as a palynologist in the Oil and Gas Research and Development Institute.

His winning proposal is entitled "Stratigraphy and Palaeobiogeography of Organic-Walled Dinoflagellate Cysts in Upper Neogene Deposits of the Columbia and Panama Basins." Florin's

project addresses the lack of temporal distribution data of Neogene dinocysts in the low-latitude eastern Pacific and western Caribbean. Most late Cenozoic dinocyst stratigraphic have been described for the Mediterranean, and for high- to mid-latitude areas in the North Atlantic and the North Pacific. The proposed research will fill a gap in the knowledge of Neogene dinocyst distribution, and will represent an important step towards a global dinocyst biostratigraphy. The objectives of the investigation are: 1) to develop a dinocyst biostratigraphy for Upper Neogene deposits of the study area (based on DSDP/ODP cores) by calibration to existing biozonations and magnetostratigraphic and isotope time scales, for comparison with high-latitude dinocyst zonations if possible; 2) to determine the possible biostratigraphic response of cyst-producing dinoflagellates to the emergence of the Panama Isthmus; and 3) to determine the possible effect of the onset of continental glaciation in the Northern Hemisphere on low-latitude cyst producing dinoflagellates.



Florin expresses his gratitude to Dr. Nicolae Baltes of Bucharest, who supervised his first steps in palynology, and to Professor Maurice Streeel and Drs. Jan de Coninck and Stephen Louwye who enthusiastically supported his studies in applied palynology at the University of Liège.

Submitted by Merrell A. Miller, Chair, AASP Awards Committee.



## NEW DEVELOPMENTS ON AASP WEB SITE

Abstracts and Technical Program of the AASP Annual Meeting (Ottawa, October 10–14) have been available on the AASP web site since late September. (Sue Jarzen, Rob Fensome, and Bill MacMillan are thanked for supplying electronic versions of the text.) If you were unable to attend the meeting, why not visit the AASP web site instead!

Abstracts of *Palynology* vol. 18 are also now online (electronic version of text courtesy of David Goodman). Other features, including the e-mail membership directory and 9th IPC pages, are updated regularly—indeed the e-mail directory often gets changed daily! The AASP Web site can be accessed via the AASP Home Page (address is case sensitive) at:

<http://www.geology.utoronto.ca/AASP>

Martin J. Head, AASP WebMaster



## 9TH IPC MEETING: UPDATE

If you have not already done so, please mark your 1996 calendar with the dates of the 9th International Palynological Congress (June 22–29, 1996). As mentioned in both the First and Second IPC Circular, and, as mentioned on the AASP World Wide Web site (<http://www.geology.utoronto.ca/AASP>), the meeting will be held in the air-conditioned Houston Marriott Hotel. If you do not already have confirmed room reservations, you might think about sending in your reservation form early.

When you come to the 9th IPC, you and those accompanying you will have access to Galleria Mall, located just across the street from the hotel. It is one of the largest shopping mall complexes in the United States, contains 6 miles of enclosed, air-conditioned corridors, has more than 300 shops and also has cinemas, restaurants, and an Olympic-size ice skating rink.

Many of the symposia topics and all of the field trips for the 9th IPC are already scheduled and details are available in the Second IPC Circular. Almost 600 people have returned the Response Form from the First Circular indicating that they intend to participate in the IXth IPC. Thirty-six symposia or theme sessions have been established thus far and there will probably be a few more set up as abstracts begin to arrive. Approximately 400 oral and 120 poster presentation titles, covering a wide variety of topics, have been submitted for the meeting program. There is room for 700 oral presentations in seven concurrent sessions over the 5 days of the meeting. We encourage you to please send in your titles and abstracts now!

For those who need more information, registration material, or want to offer suggestions, the Co-chairs of this meeting (John Wrenn & Vaughn Bryant) encourage you to write, email, FAX, or call us at the addresses below.

We are looking forward to a large group of participants at the 9th IPC and urge all of you to take advantage of this opportunity to meet and visit with your colleagues from all over the world.

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## NEW 9IPC SYMPOSIUM

### Long Continental and Marine Records of Paleoclimate

The program of the 9th International Palynological Congress in Houston (USA), 23–28 June 1996 does not have a symposium on long palynological records. Therefore Herman Mommersteeg and Eva Ran (Hugo de Vries-Laboratory, University of Amsterdam) have taken the initiative to organize such a symposium, entitled "Long Continental and Marine Records of Paleoclimate."

We would like to consider Quaternary records of climatic change

from both continental and marine environments. The records should preferably cover at least one full glacial–interglacial cycle. We ask contributors to put special emphasis on such topics as orbital forcing of climatic change, cyclic and abrupt climatic changes, aspects of land–sea correlation of paleoclimatic proxy records, and leads and lags in the climate system, but also other relevant topics are welcome. Henry Hooghiemstra has agreed to provide an introductory presentation giving a framework for studies of long continental records, a field in palynology which is hopefully stimulated in the years to come by the International Continental Drilling Project (ICDP) of PAGES. We have agreed with Elsevier Science Publishers to prepare a special volume of the international peer-reviewed journal *Palaeogeography Palaeoclimatology Palaeoecology*, based on a selection of papers presented on the symposium. Please let us know by November 1st if you are interested in participating in this symposium. We need a tentative title, a preliminary summary of your talk, and the desired length of your talk (20 or 30 minutes, including 5 minutes discussion). For a fast communication we would like to urge you to make use of e-mail as much as possible. We look forward to your reply.

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## EXTINCTION EVENT AT USGS

Because of budgetary problems, the United States Geological Survey (USGS) instituted a Reduction-in-Force (RIF) in its Geologic Division. Before the RIF, the Geologic Division employed about 2200 scientists and support staff. The RIF announcement this past August 14 included a total of 541 separation notices that become effective October 14.

In conjunction with the RIF, the USGS will reorganize the Geologic Division and all existing branches will be abolished, including the Branch of Paleontology and Stratigraphy (P&S). The reorganization establishes a regional structure for the Geologic Division, consisting of the Eastern, Central, and Western Regions. Within the regions, the reorganization follows programmatic lines.

In general, most microfossil workers survived, but only one invertebrate megafossil paleontologist from P&S survived. Before the RIF, eight palynologists worked in P&S and one worked in the Branch of Coal Geology—seven of these palynologists survived the RIF. As a consequence of the reorganization and RIF, all of the palynology technicians were separated. Palynologists who survived the RIF have been dispersed to one of three programs in the different regions as follows:

Eastern Region  
Energy Resource Surveys Program  
Norrie Robbins  
Global Change and Climate History

Ron Litwin  
National Cooperative Geologic Mapping Program  
Lucy Edwards  
Norm Frederiksen

Central Region  
Energy Resource Surveys Program  
Doug Nichols  
Global Change and Climate History  
Tom Ager  
Farley Fleming  
Bob Thompson

Submitted by Farley Fleming



## PALYNOLOGICAL ACTIVITIES AT THE GEOLOGICAL SURVEY OF CANADA

Palynology is still alive at the Geological Survey of Canada (GSC) in spite of staff and budget reductions. There are now palynologists at four GSC centers and the following is a brief overview of current activities, east to west.

Rob Fensome, Peta Mudie and Graham Williams are based at GSC Atlantic (formerly Atlantic Geoscience Centre), located at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia. Interest in oil and gas exploration in offshore eastern Canada waxes and wanes and currently seems to be going through a waxing spell. Hence, Graham and Rob continue to examine Mesozoic–Cenozoic material from the Grand Banks of Newfoundland and the Scotian Shelf as part of a collaborative resource modelling program. Graham and Rob also remain active in database development, palynomorph diversity studies, and their “hobbies” such as the Eisenack Catalog of Fossil Dinoflagellates, New Series and the “Lentin and Williams” Index of Fossil Dinoflagellates. Currently working with Rob and Graham is a visiting scientist, Raquel Guerstein, from Universidad Nacional del Sur, Bahia Blanca, Argentina, who is investigating Cenozoic material from both the Grand Banks and Argentina. Peta is working on climate change studies, using annual varves from Saanich Inlet, British Columbia, to correlate toxic dinoflagellate cyst blooms with El Niño years. Her current interests also include the palynology of Miocene to Pleistocene sediments of ODP sites on the Iberia Abyssal Plain, off northwest Spain, and of Quaternary sapropels of the Aegean and Marmora Seas. GSC Quebec (formerly Quebec Geoscience Centre) at Saint-Foy, Michelle Garneau is working on microfossil and pollen analysis of Holocene sediments from the Canadian Arctic, St. Lawrence Valley and Ontario. Much older are the fossils analyzed by Aicha Achab and Esther Asselin, who are examining the Lower Paleozoic chitinozoan assemblages of eastern Canada. Current foci are Ordovician assemblages of the St. Lawrence Lowlands and Silurian–Lower Devonian assemblages of Quebec and Nova Scotia. Aicha and Esther work in close collaboration with local colleagues Azzeddine Soufiane and Bo Liang, both of the Institut National de la Recherche Scientifique (INRS). The activities of this team also include development of an integrated image and data acquisition system.

In the Nation’s Capital, Ottawa, apart from the research of Colin McGregor (whose current pursuits will be discussed below in conjunc-

tion with palynologists at GSC Calgary), only Quaternary palynologists are represented, affiliated with GSC’s Terrain Sciences Division. Individuals here are Thane Anderson, Bob Mott (Emeritus Scientist) and Helene Jette. Thane is collaborating with others in a project on the Quaternary stratigraphy and hydrogeology of the Oak Ridges Moraine, a major agricultural/recreational resource area in southern Ontario. He is also using pollen successions, in conjunction with other disciplines, to investigate possible tsunami-laid deposits in Newfoundland and Cape Breton Island. Bob is pursuing his studies on a part-time basis on the late glacial–early Holocene transition in Nova Scotia.

Helene has been modelling the forests and climate of Canada, 6,000 years B.P., using transfer functions. This time was one of warmer climates than now and provides a glimpse of conditions that might be expected with global warming. Unfortunately, this project is affected by budget cuts. Also in the Terrain Sciences Division is the Environmental Services Laboratory, staffed by Sheridan Hipwell and Alice Telka, whose multifarious activities include pollen analysis in support of other projects.

The west is represented by Ram Kalgutkar, David McIntyre, Art Sweet, John Utting and James White, all at GSC Calgary (formerly Institute of Petroleum and Sedimentary Geology). Technically, Colin McGregor is also with GSC Calgary, but works in Ottawa. Colin (November) and Dave (September) are retiring after 38 years and 35 years respectively in palynology. We wish them both well in future endeavors, although Colin may not be completely lost to the Survey. He will decide later this year whether or not to return as an Emeritus Scientist working on Silurian and Devonian palynology—i.e. after finishing his duties as co-editor, with Jan Jansonius (who is a Visiting Scientist at GSC Calgary), of the AASP compendium “Palynology: Principles and Applications.”

Ram is studying fungal palynomorph taxonomy and stratigraphy, and is currently preparing an atlas of fungal palynomorphs. Art is continuing his work on Late Cretaceous and Paleogene pollen and spores, primarily in the Western Canada Sedimentary Basin. John specializes in Carboniferous to Triassic spores and is currently involved in several Canadian and international projects. James has been working with Neogene pollen and spores in the Yukon and Alaska in a GSC-USGS collaborative investigation of Neogene, high latitude paleoclimates. With several co-authors, he is currently preparing a synthesis of the Neogene and Quaternary paleoclimatology and palynostratigraphy in the study area. His studies are expanding to include the Jurassic and Lower Cretaceous in the Western Canadian Sedimentary Basin, especially the Jurassic/Cretaceous boundary.

Also in Calgary, but attached to the Terrain Sciences Division (it gets confusing, I know!), is Bob Vance. Bob’s main interest is late Quaternary paleoclimatic reconstruction, and to this end he employs both palynology and plant macrofossil remains. Bob’s palynological work has focussed on records of vegetational change in western Canada and he plans to examine rare cores from the Canadian western interior that extend back to the late Pleistocene/early Holocene; in this work, he hopes to gain a picture of the structure and movement of the Boreal Forest there.

Hence, despite troubled times, the Geological Survey of Canada has maintained a broad variety of palynological projects. In general, the emphasis has shifted towards more team-oriented, goal-focussed projects, especially those related to resources modelling and environmental aspects, though there is still a role for basic science.

Submitted by Rob Fensome, with assistance from Thane Anderson, Esther Asselin, and James White.

## OCEAN DRILLING UPDATE

The JOIDES Resolution micropaleontology lab has an acid hood suitable for HF and HCL maceration, plus centrifuges, slides, stains, and various mounting mediums and oxidizing agents. Heavy liquids such as  $ZnBr_2$  are not permitted on ship. The microscope facilities include two Zeiss Photomicroscope III, with transmitted light, x-pol, and phase contrast capabilities; two Axioskops and one Axioplan with transmitted light and x-pol capability; and one Axiophot with transmitted light, x-pol, phase contrast, DIC, darkfield, and UV/blue/green incident light fluorescence. Below is a list of recent and upcoming ODP cruises, followed by information on how to apply for participation as a shipboard palynologists and how to apply for ODP samples.

LEG 159 (Jan. 5–March 2, 1995) drilled the Eastern Equatorial Atlantic Transform Margin in the Gulf of Guinea, to study the structural development of a transform margin from its inception in early Cretaceous time to the present, and to study the equatorial Atlantic gateway opening from the mid to late Cretaceous. Sediments from the Lower Cretaceous to Quaternary were recovered.

LEG 160 (March 12–May 3, 1995) drilled the eastern Mediterranean collisional margin to the west, south, and east of Crete, and studied sapropel development in this region.

LEG 161 (May 8–July 4, 1995) drilled the Alboran Basin to study the structural development of an extensional basin within a collisional margin area, and studied sapropel history in the western Mediterranean. Sapropels were recovered for the first time in the western Mediterranean. Continental metamorphic crust was recovered in the Alboran Sea.

LEG 162 (July 9–Sept. 3, 1995) is the second leg of the North Atlantic–Arctic Gateways program (the first being Leg 151), and will study the gateway development between the Arctic, Norwegian Greenland Sea, and Atlantic oceans from Paleogene to Quaternary, as well as paleoceanographic and paleoclimatic history of this region.

LEG 163 (7 Sept.–28 Oct., 1995) will drill the southeast Greenland margin at 66°N to study the seaward dipping basalt reflectors that formed massive flows along this margin during the early rifting of the Norwegian–Greenland Sea.

LEG 164 (1 Nov.–19 Dec., 1995) will drill the Blake Ridge and Carolina Rise to study gas hydrate formation.

LEG 165 (24 Dec., 1995–18 Feb., 1996) will drill in the Caribbean Sea and the Cariaco Basin to study Cretaceous, Paleogene, and Neogene ocean history, the Cretaceous/Tertiary boundary event, and high resolution Quaternary sedimentation in an anoxic basin.

LEG 166 (23 Feb.–11 April, 1996) will study the sea-level and fluid-flow changes in the Bahamas carbonate platform, and the history of changes in oceanic circulation and climate from the mid Cretaceous to Recent. Staffing is

now underway for this leg.

LEG 167 (21 April–16 June, 1996) will study the variability in strength and heat/salt transport capacity of the California Current due to climatic and tectonic changes in the Pacific Basin, and its relationship to fluctuations in upwelling and primary productivity, and CCD changes in the NE Pacific. Staffing is now underway for this leg.

LEG 168 (21 June–16 Aug., 1996) will investigate the nature and consequences of hydrothermal circulation in oceanic crust; specifically to obtain information on lateral gradients in fluid composition, formation pressures and temperatures, formation-scale permeability, and circulation vigor. Staffing is now underway for this leg.

LEG 169 (23 Aug.–18 Oct., 1996) will drill the Juan de Fuca–Gorda spreading system to study the inter-relationships of tectonic, igneous, and sedimentary processes in controlling fluid flow, energy and mass flux, and formation of hydrothermal deposits at sediment-dominated rift environments. Staffing is now underway for this leg.

LEG 170 (23 Oct.–18 Dec., 1996) will drill the Costa Rica accretionary prism to study the mass- and fluid-flow patterns through the prism to establish the mechanical and chemical behavior of accretion and underplating, tectonic erosion, and to determine how deformation and dewatering are distributed throughout an accretionary prism. Staffing is now underway for this leg.

Scientific Prospectuses for upcoming ODP Legs, beginning with Leg 164, and Preliminary Reports of past legs, beginning with Leg 159, are now available on the World Wide Web at:

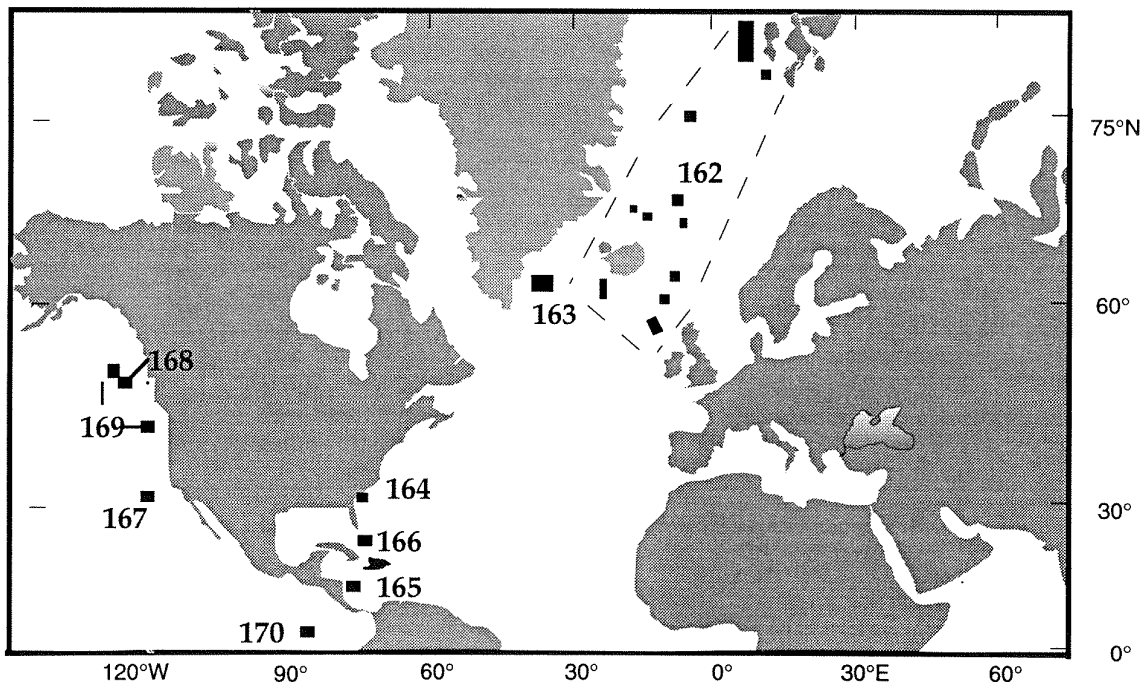
<http://www-odp.tamu.edu>

For more information on Ocean Drilling and other JOIDES activities, write to Joint Oceanographic Institutions, Inc., 1755 Massachusetts Ave., NW, Suite 800, Washington, D.C., 20036-2102, U.S.A.; Phone: 202-232-3900; Internet: [joi@iris.edu](mailto:joi@iris.edu); to request copies of the JOIDES Journal.

To apply for participation as a shipboard scientist on an ODP cruise, send a letter of request and a resume to the Manager of Science Operations, Ocean Drilling Program, Texas A&M University Research Park, College Station, TX, 77845. You will receive an application form to fill out and return to ODP.

To request samples from ODP/DSDP cores, send a letter of request to Chris Mato, Assistant Curator, Ocean Drilling Program, Texas A&M University Research Park, College Station, TX, 77845. You will receive an application form to fill out and return to ODP.

John Firth, Ocean Drilling Program.





## DINO 6, ALIVE AND KICKING

It seems like a long time since that evening in Utrecht when Henk Brinkhuis invited me, as the representative of the Institute of Earth Studies, University of Wales, Aberystwyth, to organize the 6th International Conference on Modern and Fossil Dinoflagellates. As some of you will be aware, there have been a number of changes since that time, including the fact that I am no longer at Aberystwyth! In January of this year I accepted an invitation to join IKU Petroleum Research as manager of the biostratigraphy section. This change in circumstances left me with three choices as regards the conference. Firstly, it could still go ahead in Aberystwyth as originally planned, secondly, I could organize it in Norway, and thirdly, I could ask for another institution to take it on. After discussion with a number of colleagues, including David Batten (Aberystwyth) and Henk Brinkhuis (Utrecht) and have decided for a number of reasons to offer Trondheim, Norway as the site for DINO 6.

The first consideration was whether my former colleagues in Aberystwyth were prepared to take on the conference organization following my departure. David Batten was very supportive, but concurred with me that Aberystwyth's decision not to appoint a dinoflagellate worker to my position, and the fact that there are likely to be few new dinoflagellate researchers in the Institute meant that the conference might best be organized elsewhere.

The second consideration was whether Trondheim was a suitable venue for DINO 6. At IKU there are three pre-Quaternary dinoflagellate cyst researchers, myself, Morten Smelror and Eric Monteil. In addition, there is a strong interest in living dinoflagellates associated with the Marine Biology Unit which is part of the Natural History Museum in Trondheim. We also have a large and active University (NTH) through which we intend to coordinate the conference, as well as the support of the substantial Norwegian Geological Survey office here. Admittedly, Norway is more expensive than Aberystwyth, but we intend to minimize the costs as much as possible by utilizing the academic facilities here.

The third consideration is timing. DINO 6 was planned to be held in 1997. However, a number of researchers have asked me to consider the following year, 1998, in order that the meeting does not clash with other major conferences in marine biology and also takes it two years away from the International Palynological Congress. I would concur with this alteration and intend to plan for this option.

The fourth consideration is approval by the dinoflagellate research community for the proposed changes in venue and timing. I and my colleagues are willing to organize and run DINO 6 in Trondheim, Norway. We believe we have the necessary facilities and organizational support to do this, and I hope that the research community will accept the changes outlined above in the spirit in which they are made.

A First Circular is currently being prepared with more details and will be sent out before the end of this year.

With best wishes from Trondheim,  
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## PALYNOLOGIST IN THE GOBI DESERT

Doug Nichols has returned after almost two months in northeastern Asia, including five weeks in the Gobi Desert of southern Mongolia. He seems to be in good health, despite having endured temperatures of over 40 degrees C, sandstorms, scarce water, and even ayrak (fermented mare's milk) and shemein arkhi (the local home-brew vodka). He reports that he is somewhat drier and grittier than before, and that he has a new perspective on life. "It's amazing how little things that used to be major annoyances become inconsequential after an experience like that," he said. "In the Gobi, just staying alive is half the fun."

The journey came about when Doug agreed to take part in a joint Japanese-Mongolian expedition to the Gobi Desert, the purpose of which was to collect dinosaurs that are destined for a new museum in Japan. Actually, he jumped at the chance. The Gobi has been famous as one of the best dinosaur-hunting grounds in the world since the 1920s, when skeletons of dinosaurs and nests containing their fossilized eggs were discovered by Doug's boyhood hero Roy Chapman Andrews and a team from the American Museum of Natural History, but little has been published on the palynology of the region. Doug's role in the Japanese-Mongolian expedition was to collect palynomorphs to help resolve the geologic age of the dinosaurs and provide data about depositional environments.

For part of the time Doug was joined by another American, Dr. David Fastovsky of the University of Rhode Island. He is an expert on dinosaurs (and senior author of a forthcoming book on them) and also a sedimentologist. On this expedition, his role was sedimentologic studies of the deposits from which collections were being made. The paleoenvironmental working group also included a Mongolian palynologist, Mrs. Ichinnorov, and a Mongolian sedimentologist, Dr. Badamgarov. Other scientists taking part in the expedition were Japanese and Mongolian dinosaur specialists.

Language was somewhat of a problem for everyone. The Japanese did not speak Mongolian, and the Mongolians did not speak Japanese. Communication was possible because some people in each group spoke at least some English, so all conversations were by way of English. Thus, Nichols and Fastovsky (who managed to pick up only a few words of the Asian languages) were able to keep track of what was going on. Food was not a problem; there was an adequate supply of an interesting combination of Japanese and Mongolian cuisines prepared by the expedition cooks, two young Mongolian women. Fresh meat was available by purchase from the local nomads, who keep herds of sheep



*Doug Nichols atop a camel: the original color photo shows very red rocks in the background.*

and goats. Water was another matter. The expedition towed a tanker behind one of its large four-wheel-drive trucks, but that was empty after about two weeks. There are wells here and there in the Gobi Desert, but the water is of questionable to unacceptable quality. The best wells are frequented by the herders, so even those tend to suffer from contamination by animals. Water for drinking took priority, of course (it was boiled to make tea); there was seldom enough water for bathing or washing clothes.

In addition to sheep and goats, the nomads of the Gobi keep horses (for which they are famous—this is the land of Genghis Khan) and camels. Doug ended up riding a camel when a nomad rode into camp one evening to visit. Most of the time he was on foot, however, searching the badlands for palyniferous samples. This was truly a challenge because most of the Upper Cretaceous section is oxidized and displays brilliant shades of red. Doug said he hopes to have some results in time to present at the Ninth International Palynological Conference next year.

The expedition resulted in the collection of many dinosaur specimens, including *Tarbosaurus baatar* (an Asian relative of *Tyrannosaurus rex* of North America), *Sauroplophus* sp. (a large duckbill dinosaur), a large number of armored dinosaurs, and a small velociraptor. Dinosaur eggs of several species were found, as well. Last year the Japanese-Mongolian team collected an entire nest filled with baby *Protoceratops*. These hapless creatures, about the size of kittens, evidently had been buried alive during a sandstorm. Evidently life in the Gobi was hard even during the Cretaceous.

Submitted by the "Desert Dog."

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## NEW AIRPORT HIDES 65 MILLION YEARS OF HISTORY

by Kirk R. Johnson  
Curator of Paleontology  
Denver Museum of Natural History

All the squawking about the baggage system and the budget overruns misses the point. Denver International Airport just isn't quite deep enough.

When the big earthmovers began leveling the newly annexed land in 1990, they chopped off hills and filled in valleys. In some spots, thicknesses of almost 100 feet were scraped away. As the dozers cut down through the thin soil and into the underlying sand and clay, they began to turn up huge rocks containing imprints of long dead palm leaves and extinct sycamores. The excavation was a paleontologist's dream, a huge hole in fossil-bearing rock.

The excavation had cut into the Denver Formation, a layer of sandstone, mudstone and coal that was deposited about 65 million years ago as the Rocky Mountains were just beginning to rise. The lower part of the Denver Formation contains fossils of the last dinosaurs, behemoths such as triceratops and *Tyrannosaurus rex*.

The extinction that felled the dinosaurs is known as the K-T boundary because it marked the end of the Cretaceous (K) Period and the beginning of the Tertiary Period. Through 1990 and into 1993, paleontologists from the Denver Museum of Natural History and the U.S. Geological Survey scoured the airport excavation in search of the thin layer that marks the K-T boundary. Although the layer is well-known at the roadcuts near Trinidad, it has never been located in the Denver Basin. A discovery of the layer at the airport site would have been a fantastic scientific opportunity. Moreover, dinosaur fossils lie just below the layer in the Cretaceous portion of the Denver Formation.

As construction progressed, it became clear that the excavation wouldn't go deep enough to expose the K-T boundary layer. In what would become the basement of Concourse B, the excavators encountered a thick coal seam with 47 white layers of volcanic ash. Radiometric dating of one of those ash layers confirmed that the coal seam had been a swamp more than 65 million years ago, but analysis of the fossil plant pollen grains preserved in the coal indicated the swamp had existed after the last dinosaur died.

It's not clear how many more feet the graders would have had to remove to dig up dinosaur fossils. In a last-ditch effort, USGS palynologist Doug Nichols and I monitored the giant augers that drilled holes for the concourse supports in hopes of sampling the K-T boundary layer. We never found it, and the whole airport lies on rocks deposited after the last dinosaur died.

Still, the fossil leaves and sedimentary rocks from the site paint an amazing picture of the Denver Basin after the dinosaurs and before the Front Range had grown to its present stature.

Using the plant fossils, we worked with artist Donna Braganitz, who painted a beautiful picture of Denver as it was 65 million years ago. The painting, along with fossils recovered from the excavation, is on display in the north end of the new airport's main terminal.

[Reprinted from *Rocky Mountain News* March 8, 1995. Thanks to Vaughn Bryant for sending this along.—Ed.]

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## FROM AROUND THE WORLD



## MEETING REPORTS

by Koldo Núñez-Betelu, correspondent for southern Europe

### Organic geochemistry: developments and applications to energy, climate, environment and human history

European Association of Organic Geochemists  
17th International Meeting on Organic Geochemistry  
Donostia, Basque Country, September 4-8, 1995

As C. Dorronsoro and J. O. Grimalt, chief editors of the conference volume, state at the beginning of the 1184 page long Selected Papers Volume of this meeting, organic geochemistry is a discipline devoted to the study of the composition, sources, and transformation of the organic matter in the geosphere. Most organic matter preserved in sedimentary rocks is related to ancient plants, algae, phytoplankton,

protists, ..., and thus directly related to palynology. Although biochemical aspects of organic matter were the focus of many papers presented at this meeting, there were also research topics of much interest to palynologists, such as those related to new applications of organic geochemistry to paleoceanography and paleontology.

Out of a total of 525 papers initially submitted to this conference, 436 were accepted for presentation and publication. Of these, 81 were concerned with paleoenvironment and source rock studies, 28 with paleoclimate and paleoceanography, 11 with archeology and paleontology, and 43 with applications to environmental studies. Works on paleoproductivity and preservation of organic matter in marine sediments that reviewed past knowledge and presented new ideas and findings were of great interest to palynologists. Interdisciplinary studies, including those that combine palynology and organic geochemistry, demonstrated their applicability to the reconstruction of paleoenvironments of deposition, paleoproductivity, and variations on sea level, among other topics.

The meeting was magnificently and highly professionally organized as well as wonderfully conducted by the local organizers, Carmen Dorronsoro and Joan Grimalt. They offered an excellent model of how to organize a major event such as the bi-annual celebration of the European Association of Organic Geochemists. Carmen and Joan, together with a group of co-editors and the superb technical assistance of Itxaso Estornes, produced an impressive and beautiful selected papers volume, both in terms of content and of presentation, that will become a landmark and a reference on present day organic geochemistry. In summary, the perfect organization of the meeting represented a firm and lovely frame for the high level of science presented in Donostia. With much pleasure, ESKERRIK ASKO CARMEN eta JOAN.

#### Reference:

Grimalt, J. O. and Dorronsoro, C. (eds.), 1995. *Organic geochemistry: developments and applications to energy, climate, environment and human history. Selected papers from the 17th International Meeting on Organic Geochemistry, Donostia-San Sebastian, The Basque Country, 4th-8th September 1995*. A.I.G.O.A., 1184 pp. ISBN: 84-605-3297-6.

Those interested in purchasing this book may write to:

Dr. C. Dorronsoro	or:	Dr. J. O. Grimalt
17th International Meeting on Organic Geochemistry		17th International Meeting on Organic Geochemistry
P.O.Box 309		Dept. of Environmental Chemistry
20080 Donostia		(C.I.D.-C.S.I.C.)
The Basque Country		Jordi Girona, 18
Europe 08034		Barcelona
		Catalonia, Europe

## Cretaceous Stage Boundaries

Subcommission on Cretaceous stratigraphy (SCS)

Second International Symposium

Brussels, Belgium, September 8-14, 1995

This meeting was the second of its kind, the first being held in Copenhagen in October, 1983. That first symposium put forward preliminary recommendations on the choice of boundaries for the Cretaceous Stages (*Bulletin of the Geological Society of Denmark*, vol. 3, parts 1-2). After twelve years of intensive research, the objective

of the second symposium was to make firm recommendations for stage and substage boundaries based on evidence compiled by the 12 Stage Working Groups. Although some stage and many substage boundaries still need further research, firm recommendations were made at the final session of this year's meeting. These recommendations will be presented next year in Beijing, China, to the International Commission of Stratigraphy at the 30th International Geological Congress, for the official designation of Cretaceous Stage Boundaries.

Even though agreement at Brussels was reached on most boundaries, some of them are still slightly controversial as is the case with the Campanian/Maastrichtian boundary. The base of the Campanian is not problematical but the positioning of the top remains undecided. In fact, there is room for an extra stage between the Campanian and the Maastrichtian, as has been previously suggested in several publications on the stratigraphy of the Upper Cretaceous. However, since much research on this topic is still needed, at this meeting no recommendations were made regarding the official recognition of this stage, the sometimes called Dordonian Stage.

In this meeting, stratotypes and biostratigraphic indices were proposed for Cretaceous Stage Boundaries and for some substage boundaries, although the definition and stratigraphic delineation of many substages remains unclear. All recommendations will soon be published as an addendum to the *Bulletin de l'Institut royal des sciences naturelles de Belgique—Sciences de la Terre*.

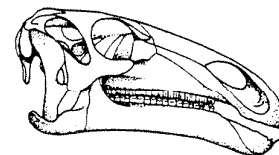
Inoceramids and ammonites, among macrofossils, and foraminifers and nannoplankton, among microfossils, appear to be most used for Cretaceous biostratigraphy. However, at some intervals such as the Cenomanian/Turonian boundary and through the entire Maastrichtian, dinocysts are remarkably useful for stratigraphic purposes. Yet, despite this great potential, relatively few palynological works were presented at this meeting and, thus, scarce palynological data has been integrated, so far, with information from other paleontological groups to define the Cretaceous Stage Boundaries.

A commentary made by several delegates attending this meeting was that many palynologists presently seem more concerned with the applicability of palynology to petroleum exploration than with taxonomy or even stratigraphy. Hopefully more palynological work integrated with other micropaleontological and magnetostratigraphical studies will remedy this situation.

In summary, this very important meeting made final recommendations on the establishment of Cretaceous Stage Boundaries based on available biostratigraphic and magnetostratigraphic data. This opens the way for palynologists to study the proposed stratotypes and to integrate palynological zonation schemes with those based on other groups. This meeting was masterfully conducted by Annie V. Dhondt within the beautiful Institut Royal des Sciences Naturelles where the participants had the opportunity to admire the important collection of macrofossils, including the famous *Iguanodon* group, as well as meteorites, minerals, etc.

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## REPORT FROM THE NORDIC COUNTRIES

by our correspondent, Niels Poulsen

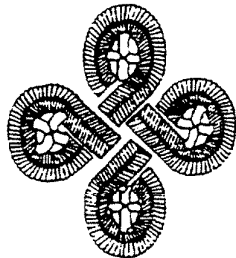
### The Geological Survey of Denmark and Greenland

The Geological Survey of Denmark and the Geological Survey of Greenland are now formally merged under the name Danmark og Grønland Geologiske Undersøgelse (Geological Survey of Denmark and Greenland) (GEUS). The two surveys, which both were based in Copenhagen (Denmark) under the Ministry of Environment and Energy, will soon start moving to a joint address.

STEFAN HULTBERG, who was head of the Stratigraphy Division at the Geological Survey of Denmark since October 1990, and director of oil & gas research programmes within the Ministry of the Environment and Energy, responsible for coordination of marketing, strategic development, and evaluations for the board, has now moved to a new position at the Energy Agency (Ministry of Environment and Energy), as head of the No. 15 Division (Research and Development Division) and director of research and development, with responsibility for coordination of the Danish energy research and organization in relation to the European Union research funds.

Stefan started his career after being awarded a Ph.D. at the University of Stockholm (Thesis entitled: Dinoflagellate studies of the Upper Maastrichtian and Lower Danian of southern Scandinavia) in 1985 with BP, and was based in London, Aberdeen and Glasgow. In the beginning of 1990 he moved to ECL Stratigraphic Services, and again in autumn 1990 to the Geological Survey of Denmark.

### INA Conference



The Sixth International Nannoplankton Association Conference was held in Copenhagen in September 1995. The congress was arranged by David Jutson at the Geological Survey of Denmark and Greenland. The congress started with a field trip guided by Dr. Hans Jørgen Hansen (University of Copenhagen) to Stevn Klint south of Copenhagen, where the K/T boundary deposits were studied and discussed. The following three congress days contained nearly 30 talks, more than 40 posters, and workshops on Recent/Paleoceanography, Cretaceous, Jurassic and Databases. Some of the talks and posters were on dinoflagellates (mainly on calcareous dinoflagellate cysts). The titles are given below:

- Tania Hildebrand-Habel and Helmut Willems: Calcdinocysts from the middle Coniacian to upper Santonian chalks at Laegerdorf (N Germany)
- Ramses P. Hoek and Karin A.F. Zonneveld: Upwelling related dinoflagellate cyst associations of the Benguela current system.
- Christine Hoell: Correlation of calcareous and organic-walled dinoflagellate cyst associations in glacial/interglacial cycles, an example of the Equatorial Atlantic
- Dorothea Janofske, Helmut Keupp and Helmut Willems: Calcareous dinoflagellate cysts: ultrastructure types and systematic application
- Beate Kemtpf: Calcareous dinoflagellates of the equatorial Atlantic Ocean

Helmut Keupp: Calcareous dinoflagellate cysts of the Late Albian and their environmental deductions (borehole Kirchrade 1/91, Germany)

Ulrike Kienel: Development of calcareous dinoflagellate cysts (Calciodinellaceae Deflandre, 1947) at the Cretaceous-Tertiary boundary (NE Germany, Denmark)

U. Kienel, U. Rehfeld, S. Bellas and R. Kohring: The Miocene Blue Clay Formation of the Maltese Islands: Sequence-stratigraphic and paleoceanographic implications based on calcareous nannofossil stratigraphy and calcareous dinoflagellate cysts.

H. Willems: Calcareous Dinoflagellate Cysts at the K/T Boundary of the Geulhemmerberg (Limburg, The Netherlands)

Submitted by Niels Erik Poulsen  
Geological Survey of Denmark  
Thoravej 8, Dk-2400 Copenhagen NV, Denmark

### UK SCENE

by our correspondent, Jim Riding

The U.K. palynological scene has been rather quiet during this long and very hot summer, with no major meetings, personnel changes etc. The U.K. body responsible for, amongst other things, the distribution of research/postgraduate training from the public purse, the Natural Environment Research Council, established a committee to assess our M.Sc. courses in Micropaleontology. This group has inspected all our major micropaleontology training centres (Aberystwyth, Sheffield, Southampton, and University College London); its findings are not known at this time. Published contributions from U.K. authors so far this year include a paper on silicious dinoflagellates from the Paleogene of Barbados and Eocene palm pollen from Java. The former work is by Ian Harding and Jane Lewis (*Palaeontology*, 37: 825-840) and the latter by Madeline Harley and Robert Morley (*Review of Palaeobotany and Palynology*, 85: 153-182). Apologies if I have overlooked anyone's *magnum opus*! Your correspondent visited the Institute of Geology and Geophysics in Novosibirsk, Siberia during July in order to study some Jurassic material from northern Siberia and the Russian Platform. I had the pleasure of using the microscope which used to belong to Tamara F. Vozzhennikova. Novosibirsk remains one of the major centres of palynology in Russia; the staff there include Vera I. Ilyina and Natasha K. Lebedeva.

Plans are being laid in Houston for next year's Ninth International Palynological Congress. If you plan to give a talk, contact the convenor(s) of the appropriate session. Abstracts need to be received by the end of March next year.

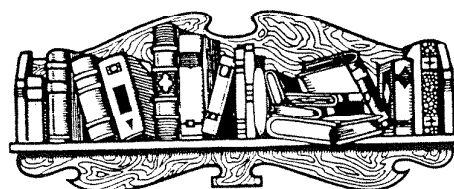
The Silver Jubilee Meeting of the British Micropalaeontological Society will be held at University College London on Saturday November 18th 1995. All AASP members are invited. This meeting celebrates 25 years of the Society and keynote speakers include Alexander Altenbach (foraminifers), Paul Brown/Jeremy Young (calcareous nannofossils), Tom Cronin (ostracodes), Anita Harris (conodonts) and Bill Riedel (radiolarians). John Richardson and Jim Riding will give talks on palynomorphs and Bernard Owens is to be the after-dinner speaker. Only a few complete sets of the BMS journal remain (see advertisement in the AASP Newsletter, 27(3), p. 26). Get your order off as soon as possible to ensure a full set.

Finally, could I remind all U.K. members to send me any relevant hot palynological news for this feature.

J. B. Riding, British Geological Survey  
Keyworth, Nottingham

## POSITION WANTED

Palynologist with over 20 years experience in biostratigraphic and paleoenvironmental studies; has worked in oil industry and taught at universities; previously worked on Jurassic to Neogene dinoflagellate assemblages, pollen and spores from India, Southeast Asia, Japan, Trinidad, and U.S.A. Looking for suitable position in industry or university. He is a landed immigrant in Canada. Please contact editor of AASP Newsletter.



## THESIS ABSTRACTS/SYNOPSES

### The dinoflagellate flora of the late Oligocene–early Miocene Old Church Formation, mid-Atlantic Coastal Plain

M.Sc. thesis by Alan. P. Hoffmeister\*

The Old Church Formation contains the only presently known exposed Oligocene sediments in the North American mid-Atlantic Coastal Plain. Some ambiguity concerning the exact age of the Old Church Formation exists because it may include both Oligocene and Miocene sediments. Two outcrops and four cores containing the Old Church Formation were examined for dinoflagellates to determine the composition of the dinoflagellate flora in the Old Church Formation, the age of the Old Church Formation as indicated by this flora, general depositional environment of the Old Church Formation and correlative relationships of the Old Church Formation with other Coastal Plain units.

The dinoflagellate flora of the Old Church Formation consists of 40 species from 29 genera and one complex that contains species from at least two genera that were in place and six species from five genera that were reworked.

Examination of this flora indicates that two distinct assemblages of dinocysts, possibly representing two pulses of sea level rise, are contained within the Old Church Formation. These assemblages are distinguishable in locations where the amount of preserved material is greater than ten feet. The age of the Old Church Formation falls within the range of late Oligocene to early Miocene, but exact age placement is not possible.

The dinocyst flora recovered from the Old Church Formation indicates that the sediment was deposited in a subtropical, neritic setting.

Correlation of the Old Church Formation with other units in the Atlantic Coastal Plain is still somewhat uncertain due to the ambiguity in the age of the dinocyst assemblages observed. The Old Church Formation has been correlated with the Haywood Landing Member of the Belgrade Formation in North Carolina, part of the Edisto Formation and possibly part of the Ashley Formation in South Carolina.

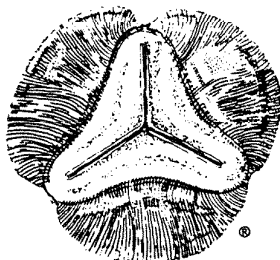
\* M.Sc. thesis, Old Dominion University, Norfolk, Virginia; 1994. Advisory committee: Drs. Carl F. Koch (Chair), Lucy E. Edwards, Stephen J. Culver, and L.W. Ward.

### Palynostratigraphy of the Upper Cretaceous Mancos Shale in western Colorado

Ph.D. thesis by Robert A. Cushman Jr.\*

During the Late Cretaceous, the Western Interior foreland basin of North America was flooded by an epicontinental sea. This north-south-trending corridor, which bisected North America, became known as the Western Interior Cretaceous Seaway. For nearly 36 million years the seaway connected the cool temperate Circumboreal Ocean to the north with the subtropical to warm temperate Caribbean Sea and Gulf of Mexico to the south. During its maximum highstand, the seaway

## SALE—CATALOG OF FOSSIL SPORES AND POLLEN



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[This announcement also appeared in the July issue of the *AASP Newsletter*.—Ed.]

extended 4800 kilometers from north to south and 1600 kilometers east to west, from Iowa and Minnesota to Utah (Fig. 1). The seaway was bordered on the west by the tectonically active Cordilleran fold-and-thrust belt and was subject to episodic tectonism and volcanism that interacted with periodic changes in eustatic sea level.

The Western Interior Cretaceous Seaway underwent five major cycles of marine transgression and regression during the Late Cretaceous. From oldest to youngest, these transgressive/regressive cycles are known as the Kiowa-Skull Creek, Greenhorn, Niobrara, Claggett, and Bearpaw Cycles. Each of these cycles left characteristic deposits in the Western Interior foreland basin. The Kiowa-Skull Creek Cycle is represented by the Thermopolis Shale and the lower part of the Mowry Shale. The Greenhorn Cycle is represented by the upper part of the Mowry Shale, Graneros Shale, Greenhorn Limestone, and the lower part of the Carlile Shale. The Niobrara Cycle is represented by the upper part of the Carlile Shale and the lower and middle parts of the Niobrara Formation. The Claggett Cycle is represented by the upper part of the Niobrara Formation and the lower part of the Pierre Shale. The Bearpaw Cycle is represented by the upper part of the Pierre Shale. In the study area, the Mancos Shale includes most of the Greenhorn Cycle, all of the Niobrara and Claggett Cycles, and the lower part of the Bearpaw Cycle. This complex system provides the geological context for this study.

The primary objectives of this study are: (1) to document the assemblages of terrestrial and marine plant microfossils that occur in the Mancos Shale near Delta, Colorado (Fig. 2); and (2) to utilize these plant

microfossil assemblages to propose a palynostratigraphic zonation for Upper Cretaceous strata in western Colorado. The secondary objectives are: (1) to describe and classify the acritarchs, dinoflagellate cysts, pollen, and spores that occur in the Mancos Shale; (2) to correlate the proposed palynostratigraphic zonation with the Western Interior reference molluscan zonation of Cobban (in Obradovich, 1993); (3) to compare the Mancos Shale palynostratigraphic zonation with other similar zonations from the Western Interior Cretaceous of Canada and the United States; (4) to clarify the use of Upper Cretaceous stage terminology used in previous palynological studies; and (5) to utilize the ratios of terrestrial to marine palynomorphs to interpret the relative influences of eustatic sea level change and regional tectonics on local palynomorph distribution in the Western Interior Cretaceous Seaway.

To accomplish these objectives, 264 taxa of acritarchs, dinoflagellate cysts, pollen, and spores are described and illustrated from outcrop samples of the Naturita Formation, Mancos Shale, and Mesaverde Formation (middle Cenomanian to upper Campanian) in western Colorado. The equivalent formations in the Western Interior reference section are the Dakota Formation, Graneros Shale, Greenhorn Limestone, Carlile Shale, Niobrara Formation, and Pierre Shale. The palynomorph assemblages are composed of 14 acritarch, 132 dinoflagellate cyst, 71 pollen, and 47 spore taxa. These taxa are used to define and characterize palynomorph biozones in the study interval.

The Mancos Shale is subdivided into both marine and terrestrial biozones in this study. Comparisons of the Mancos Shale biozones are made with several previously published palynostratigraphic zonations of the Western Interior foreland basin. The biozones used in this study are defined as interval zones in accordance with the North American Code of Stratigraphic Nomenclature. The interval zones are defined by the lowest stratigraphic occurrence or range base of selected palynomorph guide species.

The regional palynomorph biozones can be correlated throughout the Western Interior foreland basin. The three regional marine biozones are the *Isabelidium magnum* (upper middle Cenomanian–basal middle Turonian), *Chatangiella* spp. (upper middle Turonian–basal Coniacian), and *Dinogymnium acuminatum* (basal Coniacian–upper Campanian) Interval Zones. The two regional terrestrial biozones are the *Proteacidites retusus* (lower middle Coniacian–upper lower Campanian) and the Triprojectate pollen (upper lower Campanian–upper Campanian) Interval Zones.

The local palynological biozones are useful for correlation of Upper Cretaceous rocks in western Colorado. The two local marine palynological biozones are the *Ovoidinium verrucosum* (lower middle Cenomanian–upper middle Cenomanian) and *Heterosphaeridium difficile* (basal middle Turonian–upper middle Turonian) Interval Zones. The three local terrestrial palynological biozones are the *Cicatricosisporites crassiterminatus* (basal middle Cenomanian–middle middle Cenomanian), Tricolpate pollen (middle middle Cenomanian–basal upper Turonian), and *Tricolpites vulgaris* (basal upper Turonian–basal middle Coniacian) Interval Zones.

The palynomorph biozones are correlated with the recent ammonite zonation of Cobban (in Obradovich, 1993) and the recent Late Cretaceous time scale of Obradovich (1993). The *Isabelidium magnum* Interval Zone ranges from uppermost middle Cenomanian to uppermost middle Turonian. In the study area, the base of the *Isabelidium magnum* Interval Zone is approximately nine meters above an occurrence of the index ammonite *Acanthoceras amphibolum* and extends to within the *Prionocyclus hyatti* ammonite zone. The top of the *Isabelidium magnum* biozone is between two occurrences of the uppermost middle Turonian index ammonite *Prionocyclus hyatti*. The *Heterosphaeridium difficile* Interval Zone ranges from basal middle Turonian to uppermost middle Turonian. This zone extends from the *Collignonoceras woollgari* ammonite zone into the *Prionocyclus hyatti* ammonite zone. It is possible that this zone could extend down into the

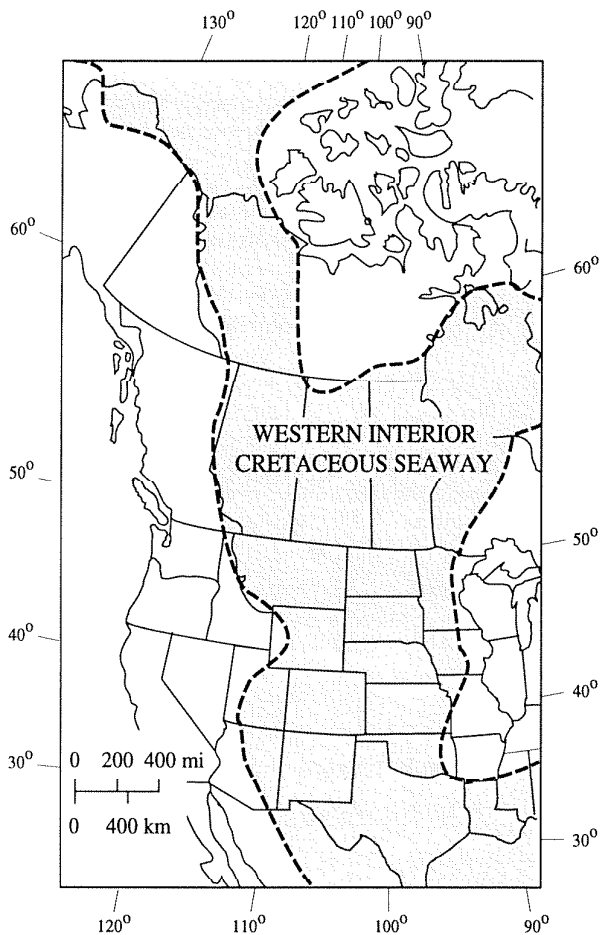


Figure 1. Maximum extent of the Western Interior Cretaceous Seaway during the early Turonian. Modified from Kauffman and Caldwell (1993) and Sageman and Arthur (1994).



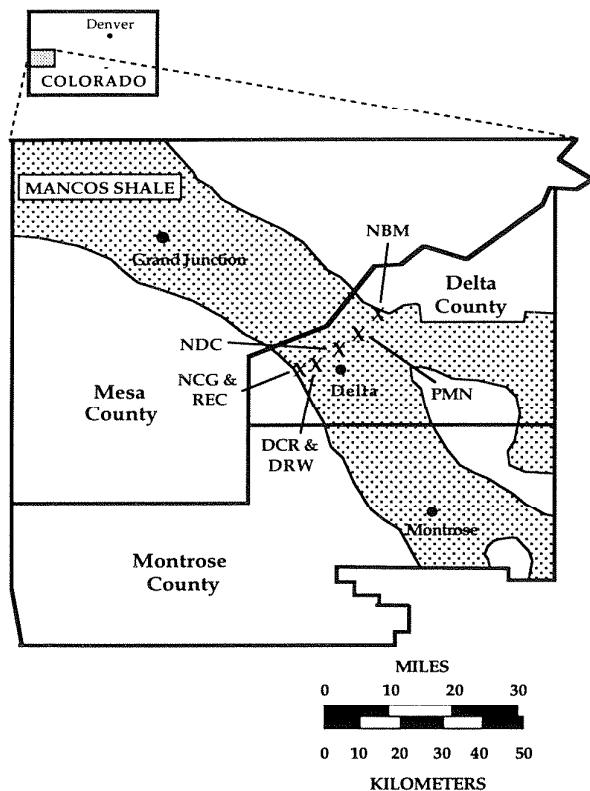


Figure 2. Map of the study area near Delta, Colorado. Locations of measured sections are marked by "X's" and are described in Appendix A of the thesis.

wer Turonian because there is a hiatus in the Mancos Shale in the lower Turonian section. The upper part of the Greenhorn Limestone equivalent is missing from the Delta, Colorado area where this study was done. The *Chatangiella* spp. Interval Zone ranges from uppermost middle Turonian to the Turonian–Coniacian boundary. The base of this biozone is within the *Prionocyclus hyatti* index ammonite zone and includes the *Scaphites warreni* index ammonite zone. The *Dinogymnium acuminatum* Interval Zone begins at the Turonian–Coniacian boundary and extends up into the middle Campanian. The base of this biozone falls between occurrences of the index mollusks *Scaphites warreni* and *Inoceramus stantoni*. According to W. A. Cobban of the U.S.G.S. (oral communication, 1993), *Inoceramus stantoni* is confined to the *Scaphites depressus* index ammonite zone. The top of the *Dinogymnium acuminatum* Interval Zone falls between an occurrence of the middle Campanian mollusk *Inoceramus subcompressus* and the upper Campanian index ammonite *Didymoceras stevensoni*.

The *Cicatricosisporites crassiterminatus* Interval Zone occurs in the basal middle Cenomanian. In the study area, the top of this biozone occurs 13 meters below an occurrence of *Conlinoceras gilberti* reported by Sharp (1963). The Tricolpate Pollen biozone ranges from middle Cenomanian to the boundary between the lower and middle Coniacian. In the study area, the base of the Tricolpate Pollen biozone is 13 meters below the occurrence of *Conlinoceras gilberti* reported by Sharp (1963). The top of the Tricolpate Pollen biozone is approximately 10 meters above an occurrence of the index ammonite *Prionocyclus hyatti*. The *Tricolpites vulgaris* Interval Zone ranges from basal upper Turonian to the boundary between the lower and middle Coniacian. In the study area, the base of this zone is approximately 10 meters above an occurrence of the index ammonite *Prionocyclus hyatti*. The top of the *Tricolpites vulgaris* biozone falls between occurrences of the upper Turonian index ammonite *Scaphites warreni* and the upper Coniacian

mollusk *Inoceramus stantoni*. The *Proteacidites retusus* Interval Zone ranges from basal middle Coniacian to upper lower Campanian. In the study area, the base of this biozone falls between occurrences of the upper Turonian index ammonite *Scaphites warreni* and the upper Coniacian mollusk *Inoceramus stantoni*. According to W. A. Cobban of the U.S.G.S. (oral communication, 1993), *Inoceramus stantoni* occurs only in the *Scaphites depressus* index ammonite zone in the Western Interior foreland basin. The top of the *Proteacidites retusus* biozone occurs approximately 21 meters below an occurrence of the ammonite *Baculites aquilaensis*, which is restricted to the lower Campanian, and 97 meters above the index ammonite *Scaphites hippocrepis* III, which is also a lower Campanian ammonite. The Triprojectate Pollen Interval Zone ranges from upper lower Campanian to upper Campanian in the study area. The base of this biozone occurs approximately 21 meters below an occurrence of the ammonite *Baculites aquilaensis*, which is restricted to the lower Campanian, and 97 meters above the index ammonite *Scaphites hippocrepis* III, which is also a lower Campanian ammonite. The stratigraphically highest ammonite in the Mancos Shale study is *Didymoceras stevensoni*, which is a lower upper Campanian index ammonite.

In this study, the bases of the biozones are also recognized as palynological datums. Within the Mancos Shale, three regional and two local marine palynological datums and two regional and three local terrestrial palynological datums are recognized. These regional palynological datums can be correlated throughout the Cretaceous Western Interior Basin of the United States and Canada. The three regional marine palynological datums are the range bases of *Isabelidinium magnum* (upper middle Cenomanian), *Chatangiella* spp. (upper middle Turonian), and *Dinogymnium acuminatum* (basal Coniacian). The two regional terrestrial palynological datums are the *Proteacidites retusus* (lower middle Coniacian) datum and the Triprojectate pollen (upper lower Campanian) datum.

The local palynological datums are useful for correlation of Upper Cretaceous rocks in western Colorado. The two local marine palynological datums are the range bases of *Ovoidinium verrucosum* (middle Cenomanian) and *Heterosphaeridium difficile* (lower middle Turonian). The three local terrestrial palynological datums are the first occurrences of *Cicatricosisporites crassiterminatus* (basal middle Cenomanian), Tricolpate pollen (middle Cenomanian), and *Tricolpites vulgaris* (basal upper Turonian). Additional palynological study of Campanian rocks is needed to provide better resolution of the palynomorph biozones during this stage in western Colorado.

The stratigraphic ranges of several palynomorph taxa are extended in this study. Range extensions of marine and terrestrial taxa are to be expected because of the paucity of stratigraphically long-ranging palynological studies on Cenomanian through Campanian rocks. Most of the previous palynological studies focus on one or two stages of the Upper Cretaceous. Palynological studies of Coniacian and Santonian strata of the Western Interior Basin are particularly rare.

The stratigraphic range bases of 18 dinoflagellate taxa, *Dinogymnium euclaense*, *Alterbidinium acutulum*, *Cerodinium pannuceum*, *Cerodinium speciosum*, *Cerodinium speciosum* subsp. *elongatum*, *Chatangiella coronata*, *Chatangiella ditissima*, *Chatangiella niiga*, *Chatangiella williamsii*, *Isabelidinium microarmum*, *Manumiella lata*, *Senegalinium microgranulatum*, *Spinidinium densispinatum*, *Trithyrodinium fragile*, *Spiniferites membranaceus*, *Spiniferites ramosus* subsp. *granosus*, and *Cordosphaeridium fibrospinosum* are extended. The stratigraphic range bases of nine pollen and spore taxa, *Cicatricosisporites ornatus*, *Ghoshispora longirimosus*, *Ghoshispora scollardiana*, *Triporetetes novomexicanus*, *Nyssapollenites coromandelinum*, *Casuarinidites microgranulatus*, *Trudopollis meekeri*, and *Aquilapollenites aucellatus* are extended. The stratigraphic range tops of 13 dinoflagellate taxa, *Chatangiella niiga*, *Chatangiella williamsii*, *Chichauadinium vestitum*, *Eurydinium glomeratum*,

*Ovoidinium scabrosum*, *Subtilisphaera cheit*, *Subtilisphaera deformans*, *Subtilisphaera hyalina*, *Subtilisphaera senegalensis*, *Subtilisphaera zawia*, *Canninginopsis colliveri*, *Cribroperidinium cooksoniae*, and *Spiniferites ancoriferus* are extended. The stratigraphic range tops of 10 pollen and spore taxa, *Appendicisporites erdtmanii*, *Appendicisporites problematicus*, *Camarozonosporites dakotaensis*, *Cicatricosisporites ludbrookii*, *Cirratiradites teter*, *Lycopodiumsporites crassimacerius*, *Triporoletes laevigatus*, *Pristinuspollenites microreticulatus*, *Rugubivesiculites reductus*, and *Cupuliferoipollenites* sp. cf. *Psilatricolporites subtilis* are extended.

The range-base extensions of the dinoflagellate taxa have particular significance. In this study, some of these species extend down into the lower Coniacian and others down as far as the middle Turonian. Many of these taxa are reported from younger rocks in the central and northern parts of the Western Interior foreland basin. This suggests that by middle Turonian time, the northern and southern water masses of the seaway had merged. Because the range bases of these taxa are younger in Colorado than in Wyoming, Montana, and Canada, it is likely that they migrated into the seaway from the south. The range base extension of *Spiniferites membranaceus* into the middle Cenomanian is the lone exception. In this case, *Spiniferites membranaceus* may not have been recognized in older rocks to the north because it is morphologically gradational with several subspecies of *Spiniferites ramosus* and may have been lumped into that species.

An important secondary objective is to interpret the effects of eustatic sea level change and regional tectonics on local palynomorph distribution patterns. The relative proportions of terrestrial to marine palynomorphs in the marine environment and ten regional paleogeographic maps for the area were used to interpret the local palynomorph distributions through time in their geological context. The trends in relative proportions of terrestrial to marine components in the palynoflora correlate well with those expected during transgressive and regressive cycles. At times during the Santonian and Campanian, ratios in this study deviate from the expected in that terrestrial palynomorphs dominate assemblages during times of relative sea level rise (when dominance by marine palynomorph assemblages is predicted by previous studies). Regional uplift and tectonism results in increased erosion, which in turn, would result in an increase in the terrestrial component of the palynoflora. Data presented here demonstrate how tectonic influence can mask the eustatic control of the palynomorph distributions.

Although much of this study focuses on taxonomy, this study goes beyond the normal systematic treatment. First, four tables summarize the key morphological characteristics of dinoflagellate cyst morphotypes and bisaccate, tricolpate, and tricolporate pollen genera. Second, a generic description is rarely given in a typical synonymy in other palynostratigraphic studies. In this study, descriptions are given for 73 genera, 102 species, and 2 variations of pollen and spores; and 63 genera, 135 species, and 6 subspecies of acritarchs and dinoflagellates. One new genus of pollen, 15 new species of pollen and spores, and 6 new species of dinoflagellates are also recognized and described.

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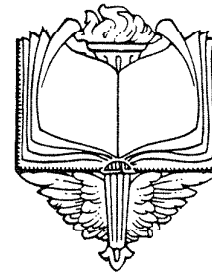
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## BOOK REVIEWS



**The Enigma of Angiosperm Origins** by Norman F. Hughes, 1994. Cambridge University Press (Cambridge Palaeobiology Series 1), Cambridge; xii + 303 pages; \$59.95.

As a sequel to his 1976 book *Paleobiology of Angiosperm Origins*, Norman Hughes again addresses the issues surrounding the “mystery” of angiosperm origins. Hughes advocates that the most fruitful approach to solution of the problem is to integrate evidence from the available fossil record using a data handling system that is not fettered by an inbuilt systematic bias. Evidence from fossils when framed within a time sequence is considered to provide a better basis for determining angiosperm origins than comparative methodologies involving character states and molecular signatures of extant plants.

Throughout the book Hughes challenges the validity of applying comparative morphology and cladistics to the fossil plant record and highlights problems associated with interpreting advancement levels and a scoring protocol of character states based on extant plants. He recognizes “older” and “newer” characters within the Mesozoic plant record but considers knowledge is insufficient to interpret evolutionary sequences and to subject these to statistical analyses. The neutral data handling system recommended comprises paleotaxa equivalent to the level of species, but in other respects distinct in that they “cannot be emended” (p. 23). When first proposed the Hughes Paleontologic Data Handling Code (PDHC) sparked considerable controversy (e.g. Traverse 1975, Doyle 1976), but, in a modified form, has found a following among some sections of the paleobotanical community for leaf fossils of unknown affinity (e.g. Hill 1982, Pole 1992).

Divided into three parts (“The Setting of the Problem,” “The Evidence for Cretaceous Origin,” and “Consequences and Conclusions”), the book is thought provoking and will undoubtedly stimulate considerable debate. It surveys current knowledge of angiosperm origins as revealed by the fossil record, and includes a detailed account of pre-Aptian pollen referred to as monosulcate columellate-tectate pollen (MCT). The first section focuses on accumulation of knowledge during the past 15 years (since the benchmark work of Hamshaw Thomas) and the range of methodologies and interpretations that have stemmed from the evidence thus far known. Hughes maintains that data



should be freed of "the untidy and unmanaged classificatory problem" and instead be expressed in neutral terms. Further, he questions current assumptions of defining characters of angiospermy and takes the stance that angiosperms are polyphyletic unless proved otherwise. His ten "Working Principles" (Ch. 4) summarize his approach to solution of the problem of angiosperm origins by accepting the primacy of all fossil records set within a stratigraphic framework.

Part II, "The Evidence for Cretaceous Origin" includes a review of Mesozoic seed plant megafossils considered as likely candidates for clues to angiosperm ancestry, and a profusely illustrated discussion of Early Cretaceous monolete MCT, which he cautiously concedes are "apparently angiospermoid." Five successive phases of MCT are recognized within Hauterivian–Aptian sequences of England, and this succession is compared with MCT successions represented in the Lower Cretaceous of eastern North America and northern Gondwana. In Hughes' view there are few convincing angiosperm fossils that predate the Albian. Late Albian–Cenomanian reproductive structures thus far reported are considered by him to represent three groups representing magnoliids, hamamelids, and rosiids. Late Cretaceous angiosperm consolidation is linked to changing environmental circumstances which Hughes suggests occurred in Campanian or Maastrichtian.

In "Consequences and Conclusions" (Part III) Hughes emphasizes the potential of intermediate-size fossils ("mesofossils") represented by small seeds, cuticles and reproductive structures in contributing to knowledge of early angiosperms. Another recommended field of study is the search for MCT pollen in earliest Cretaceous and Late Jurassic palynofloras. But the main theme of the concluding sections is on data recording procedures—using paleotaxa freed of priority and botanical classification, but set within a stratigraphic framework. Alas, he provides no guidelines on technical management or processing the large neutral data bases, nor the morphological characters he considers to be indisputable evidence of angiospermy!

*The Enigma of Angiosperm Origins* contains much of value and should be read by all those interested in angiosperm evolution. It is a thought provoking and controversial book in that it challenges conventional ideas and methods.

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**Pollen of the Southeastern United States: With emphasis on melissopalynology and entomopalynology** by Gretchen D. Jones, Vaughn M. Bryant, Jr., Meredith Hoag Lieux, Stanley D. Jones, and Pete D. Lingren, 1994. American Association of Stratigraphic Palynologists Contributions Series, Number 30. 76 pages, 104 plates \$27.00.

An insect's-eye view of vegetation in the southeastern part of the United States can be seen in the latest publication in the AASP Contribution Series—this is the first atlas of modern pollen published by the AASP. The atlas provides illustrations of pollen types selected

for their importance in melissopalynology and entomopalynology.

The introduction to the book contains pertinent information regarding methods and procedures used in collecting, processing, examining, and photographing the specimens used for the atlas. The authors also briefly review a selection of previously published pollen atlases. Following the introduction, a section is provided on voucher specimens, collection of voucher plants, and collection of pollen from voucher specimens and herbarium specimens. This information will be useful for those who are inspired by this publication and attempt to construct similar atlases for other research purposes. The book itself is well-designed for use as a reference in the laboratory. The binder format allows the book to open flat, and repeated turning back and forth between sections will not destroy the binding.

The pollen atlas contains illustrations for 398 taxa (species, subspecies, and varieties) that are distributed among four families of gymnosperms and 108 families of angiosperms. There are four genera (six species) of gymnosperms, and 262 genera (392 species) of angiosperms. About one-third of the 398 taxa are from five families—Asteraceae (31), Fabaceae (50), Fagaceae (15), Rosaceae (26), and Rutaceae (10). This breakdown suggests that the world of insects revolves around the pea, sunflower, and rose families. The geographic area covered by the atlas includes North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, Texas, and Oklahoma.

The authors chose not to develop a dichotomous morphological key for the illustrated pollen, but instead present five lists. The lists are arranged by family, by genus, by aperture, by ornamentation, and by micrograph number. Each list is cross-referenced with the other four lists. The micrographs in the plates are generally arranged by ornamentation, which reflects the exclusive use of scanning electron microscope (SEM) micrographs in the atlas.

The heart of this atlas lies in the 616 SEM micrographs. For many species, more than one micrograph is provided showing the pollen grain in different orientations. Most of the micrographs are of high quality and will serve well, however some micrographs have a little too much contrast. In contrast to some other atlases, this atlas does not provide light microscope photomicrographs.

This is a superb atlas that will undoubtedly fill a need for researchers in melissopalynology and entomopalynology. It will also serve as a useful reference for anyone interested in SEM illustrations of selected pollen types from the southeastern United States. As we contemplate the future of palynology, publications such as this illustrate some of the new directions that may be open to palynologists. At the sweet price of \$27, this is a honey of a book.

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## BOOK ANNOUNCEMENTS

**The Genus *Alexandrium* Halim (Dinoflagellata)** by Enrique Balech. Published by The Sherkin Island Marine Station, Sherkin Island, Co. Cork, Ireland. ISBN: 1 870492 61 7 (151 pages)—Hardback only. Price: £55.00 stg (or equivalent in \$U.S.) (plus surface postage £4.50 stg). Send orders to: Matt Murphy, Sherkin Island Station, Sherkin Island, Co. Cork, Ireland. Tel. +353+28+20187 Fax. +353+28+20407.

The dinoflagellate genus *Alexandrium* was originally described on only one species from Alexandria Harbor, Egypt. Since then, because of the interest in the *tamarensis* group of *Gonyaulax*, more species are being described or transferred to *Alexandrium*. The *tamarensis* group

has contained many of the PSP-causing plankton species. The genus has about 30 recognized species.

In this monograph, Professor Balech presents a historical discussion, details conservative characters for taxonomy of the group, details each species, and discusses the relationship with some other genera. Professor Balech based his study on specimens from the type location of the type species, whenever possible, and many other geographic areas.

[The genus *Alexandrium* contains many toxic dinoflagellates, a number of which are cyst producers. Hence, although this book deals more or less exclusively with the thecate stage, it may be of interest to palynologists who work with modern marine sediments.—Ed.]

Two books on Chinese pollen and spores:

**1) Pollen Flora of China, 2nd edition**, by Wang Fuhsung et al., 1995. Beijing: Science Press. 461 pp, 205 plates (Chinese version). Price: 89US\$.

The main contents of this book include descriptions of pollen morphology, their distribution in China, and ecological habitat. A total of 121 families, 912 genera and over 1400 species of pollen are described and illustrated (with both Chinese and Latin names).

**2) Spore Morphology of Chinese Pteridophytes**, by Zhang Yulong et al., 1990. Beijing: Science Press. (English version: 592pp, 101 plates, price: US\$100. Chinese version: 451 pp, 101 plates, US\$40)

In this book, the authors systematically describe the morphology of spores of over 1000 species representing 175 genera and 52 families. The illustrations include 119 text-figures (line-drawings) of spore types, 89 plates of photomicrographs of extant spores, and 12 plates of fossil spores. The main contents are: geographic distribution of extant pteridophytes in China; distribution of fossil fern spores in geological periods; general spore morphology of pteridophytes; spore types of pteridophytes; description of spore morphology in all families of pteridophytes. High quality pictures: a must for atlas collectors!

Postage: surface mail: \$15 (each book); air mail: \$25 (each book). If you are interested in either of these books, please contact:

Dr Changqing Song	or	Dr Qinhuia Jiang
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## MINUTES OF INDUSTRY BIOSTRATIGRAPHY COORDINATORS' GROUP MEETING

September 19, 1995  
Chevron, Houston, Texas

A meeting of the Industry Biostratigraphy Coordinators' Group (IBCG) was held at Chevron Tower, Houston, Texas on September 19, 1995; in attendance were: Bob Fleisher, Larry Zarra (Chevron), Denise Butler (Pennzoil), Lori Glassgold, Brian O'Neill, Mike Styzen (Shell), Rome Lytton, Sally Zellers (Texaco), Pete McLaughlin, Richard Denne (Exxon), Steve Root, Ron Morin (Mobil), Steve Truax, Mike Dumont (Vastar Resources), Dick White, Rich Lane (Amoco), Garry Jones (Unocal).

The meeting was purposely kept brief to accommodate a meeting of

the Gulf Coast Section SEPM Committee on Gulf of Mexico Taxonomic Equivalency chaired by Ed Picou (consultant, retired Shell Oil). The meeting was called to order by Bob Fleisher, host biostratigrapher.

Brian O'Neill reported that on the evening of November 7th at the upcoming GSA meeting in New Orleans, a room has been reserved at the Holiday Inn Crowne Plaza Hotel for a meeting of the Gulf Coast Section of the SEPM. Brian suggested the meeting be dedicated to further discussion on the Gulf of Mexico Taxonomic Equivalency Project.

Pete McLaughlin opened a general discussion on the need for oil companies to support promising micropaleontology students, and cited the **Louisiana State University Center for Palynological Excellence** as a shining example of how corporate funds can significantly impact the health of an entire paleontological discipline. A lively interchange of comments and ideas ensued, all positive on the need for more strategic alliances between biostratigraphy departments in oil companies and academia. Sally Zellers commented on the importance of oil companies offering student internships ("summer hires") to provide a real-world training ground for students. Several further comments reminded, unfortunately, that as of now the chance for hiring many of these students is low (with Sally Zellers being a recent exception!). Some attendees feared the paucity of jobs may scare off promising students from accepting an internship. Garry Jones mentioned that Unocal has been working on a proposal for an oil company-university strategic alliance in biostratigraphy and hoped to have more to say about it at the next IBCG meeting.

Rich Lane implored the oil companies to release and standardize their in-house biostratigraphic data (similar to the large volumes of publicly available seismic and E-log data) and to compete at the level of how to best analyze and interpret the data. The Group agreed to revisit this topic at the next IBCG meeting.

Rich Lane c/o Jere Lipps (University of California, Berkeley) asked if the oil companies would be interested in attending a proposed workshop on state-of-the-art micropaleontological taxonomy and systematics, cladistics, fossil DNA, and computer methods. And c/o Norm MacLeod and Steve Culver (Natural History Museum, London), Rich Lane distributed a recent proposal for building a taxonomic and illustrated relational data base for deep-sea benthic foraminifers. Rich also announced the distribution of the Final Circular on the 1996 North American Paleo Convention in Washington D.C. and that the IBCG group will be hosting two symposia: Biologic Signature of Sequence Stratigraphic Architecture and Quantitative Biostratigraphic Techniques.

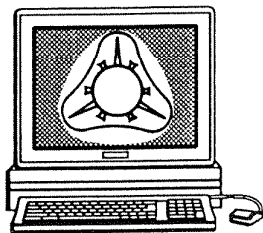
Bob Fleisher noted that four contributions for the biostratigraphy chapter in the upcoming AAPG Handbook of Petroleum Methods still need to be handed in to the editor.

The next meeting of the IBCG was scheduled for Tuesday, October 31st at Exxon in Houston (costumes required). Preliminary agenda items include:

1. Follow up on Jere Lipps' proposal for taxonomy workshop (Rich Lane).
2. Follow up on Norm MacLeod and Steve Culver proposal for a relational taxonomic data base (Rich Lane).
3. Update on future of Palco Conference (1997?) (Rich Lane, Brian O'Neill).
4. Follow up on idea of releasing in-house biostratigraphic data (Rich Lane)
5. Unocal proposal for oil company-university strategic alliance (Garry Jones, Anthony Gary).

Respectfully submitted  
Garry Jones, Unocal  
Lafayette, Louisiana.

## COMPUTERS IN PALYNOLOGY



### Counter and Strat/Range Charter

1) Good news. Here is a tip to make COUNTER and STRAT/RANGE CHARTER work on the newer Macintosh computers, or for launching most older (non-32-bit-compatible) applications that crash a Mac with lots of RAM. This trick usually works. It worked with S/RC and COUNTER on my PPC 8100/80 Macintosh.

(a) Open one or more OTHER applications first, so that all but 1–2.5 MB of available RAM is used.\*

(b) Now open the non-32-bit-compatible application (i.e. STRAT/RANGE CHARTER and/or COUNTER)

(c) That's all. They should run just fine.

\* For example: if "About This Macintosh..." (under the Apple menu in the Finder) shows 12 MB free RAM, you could set Excel or any other program to use 10 MB; then after opening Excel, you open the non-32-bit-compatible application (STRAT/RANGE CHARTER or COUNTER).

2) BETTER news. The NEW versions of COUNTER and STRAT/RANGE CHARTER will soon be available. I am nearly finished with both applications. Both work flawlessly on any Mac system and hardware. Both applications are dramatically improved! STRAT/RANGE CHARTER, especially. It now reads data directly from spreadsheets. Plot types include: x-y line plots (log style), bar charts (log style), interval histogram range charts, and cumulative growth plots with 1st derivative. The Y-axis (depth) can be scaled to depth or sequential samples. The X-axis for any display can be real or LOG scale and absolute or normalized. The charts can be scaled to any horizontal and vertical dimensions. Windows re-size and scroll. Plus many more big improvements. It is so different that I'm thinking of changing the name to WellPlot 1.0 in order to attract a larger market share.

COUNTER 3.0 now allows any record to be edited, at anytime. New smaller fonts and buttons easily allow 250 categories (species) on the screen. Features include basic spreadsheet-like functions: Add a sample, insert/delete samples; Add a new category, insert/delete categories; edit counts for any category in any sample at any time; edit any category name or sample name at any time. Other functions: Add or subtract counts by 1 or by 10 counts per click; distinct audible sounds for add and subtract; interval alert (audible tone at user defined count interval, e.g. 100 counts); multiply counts: multiplier factor and cut-off; custom screen configuration; plus many more features.

The new software should be ready in about a month. It is functional right now and I use it in my own work.

Other new software:

DIPMETER 1.0 (tadpole plots, cumulative graphs with 1st derivative, scat style plots, etc).

DIVERSITY CALCULATOR: calculates: number of species, Simpson and Shannon-Weaver indices from spreadsheet data.

Pierre A. Zippi

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## New taxonomic database and diversity analysis program

I wish to announce the first beta release (and my first attempt at authoring) of a freeware Macintosh program to the paleo community. TAXDADDY is a taxonomic database and diversity analysis program for Macintosh computers. TAXDADDY can be used to keep track of all of your taxonomic data and can be tailored to personal needs with many user defined fields for taxonomic names, ranges, distributions, synonymies, descriptions, etc... You can also incorporate scanned images or other pictures into your data records. TAXDADDY can do complex and/or not searches. The program can calculate (and plot) taxonomic diversity, originations, and extinctions as well as their proportions and standard errors and survivorship curves. TAXDADDY can import and export data and graphics to/from spreadsheet or other database programs.

TAXDADDY database programs are now available in the PaleoNet FTP Site. The programs may be accessed at either of the following IP addresses:

[ftp://nhm.ac.uk/paleonet/Application\\_Exchange/Macintosh/TaxDaddy/TaxDaddy\\_folder.sea.hqx](ftp://nhm.ac.uk/paleonet/Application_Exchange/Macintosh/TaxDaddy/TaxDaddy_folder.sea.hqx)

[ftp://nhm.ac.uk/paleonet/Application\\_Exchange/Macintosh/TaxDaddy/TaxDaddyHC\\_folder.sea.hqx](ftp://nhm.ac.uk/paleonet/Application_Exchange/Macintosh/TaxDaddy/TaxDaddyHC_folder.sea.hqx)

Both addresses accept a standard anonymous login (userid: anonymous; password: your e-mail address). You can also access these programs, using a web browser with download capability (e.g. Netscape, Mosaic), from the PaleoNet Pages at:

<http://www.nhm.ac.uk/paleonet/Index.Html>

Christopher A. McRoberts [palo008@rzbox.uni-wuerzburg.de](mailto:palo008@rzbox.uni-wuerzburg.de)  
Institute for Paleontology, University of Wuerzburg  
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## SOME WEB SITES OF INTEREST TO PALYNOLOGISTS

by Martin J. Head, AASP WebMaster

The AASP web site contains the Technical Program and Abstracts of the AASP Annual Meeting (Ottawa, October 10–14), 2nd Circular of the 9th IPC (Houston, June 23–28, 1996) with printable forms and all updates, an e-mail membership directory (updated daily), abstracts of *Palytology* vol. 18, a member's bulletin board, official notices, AASP's palydisks, and many other features of interest to palytologists. AASP's home page is at:

<http://www.geology.utoronto.ca/AASP>

Koeltz Scientific Books (new and second-hand) have a web site allowing download/access to their geology, paleontology, botany algae, and other natural history catalogs. Online ordering is available. The address is:

<http://www.shout.net/~koeltz/>

The Palaeontological Association web site now contains the programme and abstracts for its forthcoming Annual Conference, to take place in December 1995 in Galway, Ireland. There are 44 accepted abstracts, plus reserves and posters. This information is available at:

<http://www.nhm.ac.uk/paleonet/PalAss/PalAss.html>

The Museum of Paleontology at Berkeley, University of California, has Larry Bowlds's comprehensive calendar of coming events in paleontology. It can be found at:

<http://ucmp1.berkeley.edu/events/comeingevents.html>

The **PaleoNet Pages** are intended as a general purpose on-line clearing house for paleontological information. The PaleoNet Pages home page can be found at:

<http://www.nhm.ac.uk/palconct/Index.Html>

The **NOAA/Paleoclimatology Program** distributes the product of various collaborative efforts to collect and organize pollen records from around the globe. These data include pollen counts and related information and are available at:

<http://www.ngdc.noaa.gov/paleo/pollen.html>



## BRITISH MICROPALAEONTOLOGICAL SOCIETY

### SILVER JUBILEE MEETING

Saturday, 18 November 1995: 10.00–20.00 hours

Darwin Lecture Theatre

Darwin Building, University College London

### Program

#### ANNUAL GENERAL MEETING

#### GUEST LECTURES

Alexander Altenbach (Munich): *Investigations on the Ecology of Deep-Sea Foraminifera: how to keep in budget.*

Paul R. Bown (University College, London) and Jeremy R. Young (The Natural History Museum, London): *From Crystalldrusen to Coccolithophores: the slow progress of nannofossil palaeobiology.*

Thomas M. Cronin (U.S. Geological Survey, Reston): *Ostracods: modern bioindicators of Environmental Change.*

Anita G. Harris (U.S. Geological Survey, Reston): *Conodonts can: prologue and epilogue.*

James B. Riding (British Geological Survey): *Dinoflagellate Cysts, Acritarchs and Prasinophytes: a review of their evolution, affinities and economic utility.*

John B. Richardson (The Natural History Museum, London): *A palynological perspective on early land plant evolution.*

William R. Riedel (Scripps Institution of Oceanography, La Jolla): *Computer-based aids to Micropalaeontology and Stratigraphy, with examples using Cenozoic Radiolaria.*

#### SILVER JUBILEE DINNER

Speaker: Bernard Owens (British Geological Survey)

Meeting Fee (not including dinner): BMS members £5, Non-members £10, Students free. For details and tickets, contact: Local Secretary, Dr Elspeth Urquhart, Postgraduate Unit of Micropalaeontology, University College London, Gower Street, LONDON WC1E 6BT. Tel: 0171.380.7929. Fax: 0171.380.7822. E-mail: [e.urquhart@ucl.ac.uk](mailto:e.urquhart@ucl.ac.uk)



## COMMISSION INTERNATIONALE DE MICROFLORE DU PALEOZOIQUE (C.I.M.P.)

ACRITARCH SUBCOMMISSION MEETING & WORKSHOP  
PRAGUE, CZECH REPUBLIC

April 10–12, 1996

The third in the series of International Meetings and Workshops on Acritarchs, which originated in Keyworth, Nottingham in September 1991, will be held April 10th to 12th, 1996, at the Charles University at Prague (Univerzita Karlova Praha), Czech Republic.

As decided at the meeting of the C.I.M.P. Subcommittee at Sheffield in September 1994, a major aim of our meeting is the presentation and discussion of the results of the two working groups created in Sheffield.

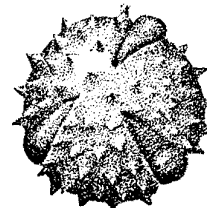
A general technical session on all topics of Acritarch Research will be organized. We encourage all acritarch workers to consider presenting either an oral contribution or a poster.

There will be time to have a look at material during the microscope session. With the hope of stimulating discussion and interchange, we invite everybody to bring along some palynological preparations, slides, or photographs.

A major objective of the Subcommittee is to keep down the costs of our meeting to allow the participation of a great number of acritarch workers. We are happy to announce that the estimated fees for our meeting are very low. For additional information, contact:

Thomas SERVAIS  
Acritarch Subcommittee Secretary  
Services associés de Paléontologie  
Université de Liège  
7, place du XX Août  
B-4000 Liège  
Belgium

Fax: 00 32 41 665 700  
Phone: 00 32 41 665 440



## ADVANCED AEROBIOLOGY 1996 (AA'96)

SAGAMORE LODGE, ADIRONDACKS PARK, NEW YORK  
from JULY 1st to JULY 5th, 1996

Organizing committee: P. Comtois (U. de Montreal); E. Dominguez (U. de Cordoba); P. Mandrioli (FISBAT-CNR, Bologna); L. Syzdeck (NY State Museum).

The Advanced Aerobiology Courses were established for students and researchers having already a technical knowledge of Aerobiology, i.e. sampling and identification of the bioaerosol. This series of courses are therefore aimed at understanding the scientific principles behind aerobiological sampling and analyses, and at giving a solid background in interpreting aerobiological results. Since we have planned this series to be held in different biogeographical zones every two years, the course program also included lectures and field activities related to the specific location of the course. We encourage the students to notify the organization committee of their personal interest or work activities so that the course can be pin-pointed to their particular needs.

The course schedule will consist of morning seminar, afternoon field work or outdoor activities in the Adirondacks, and evening lectures. Sagamore Lodge (built in 1897) is situated on a private lake in the center of a 1,526 acre estate. The estate is a historic site, located in a remote location, with rustic rooms, fireplaces and old style furniture.

Second announcement and registration are planned for fall 1995. Because of the limited number of places available, and the obligation to reserve early, we encourage all interested to notify as soon as possible one of the organizers.

For more information, please contact:

Paul Comtois, Laboratoire d'aerobiologie, Dep. de geographie, Universite de Montreal, tel. 1-514-343 8029; fax 1-514-343 8004; e-mail: comtoisp@ere.umontreal.ca

Paolo Mandrioli, Aerobiology, FISBAT-CNR, Bologna, Italy  
tel. 39 51 6399576; fax 39 51 6399649;  
e-mail: aerobio@atmosphere.fisbat.bo.cnr.it



## SMITHSONIAN RESEARCH FELLOWSHIPS IN SCIENCE

The Smithsonian Institution announces its research fellowships for 1996 in the fields of Social and Cultural History, Anthropology, Biological Sciences, and Earth Sciences.

Smithsonian Fellowships are awarded to support independent research in residence at the Smithsonian in association with the research staff and using the Institution's resources. Under this program, senior, predoctoral and postdoctoral fellowships of three to twelve months, and graduate student fellowships of ten weeks are awarded. Proposals may be made for research in a number of areas including **Anthropology** (e.g. Archaeology; cultural anthropology), Biological Sciences (e.g. ecology; environmental studies; evolutionary biology; marine biology; natural history; paleobiology; systematics; and tropical biology), and Earth Sciences (e.g. paleobiology; sedimentology). The deadline is **January 15, 1996**.

Postdoctoral Fellowships are offered to scholars who have held the degree or equivalent for less than seven years. Senior Fellowships are offered to scholars who have held the degree or equivalent for seven years or more. The term is 3 to 12 months. Both fellowships offer a stipend of \$25,000 per year plus allowances.

Predocctoral Fellowships are offered to doctoral candidates who have completed preliminary course work and examinations. The term

is 3 to 12 months. The stipend is \$14,000 per year plus allowances.

\*Predocctoral, postdoctoral, and senior stipends are prorated for periods of less than twelve months.

Graduate Student Fellowships are offered to students formally enrolled in a graduate program of study, who have completed at least one semester, and not yet have been advanced to candidacy if in a Ph.D. Program. The term is 10 weeks; the stipend is \$3,000.

Awards are based on merit. Smithsonian fellowships are open to all qualified individuals without reference to race, color, religion, sex, national origin, age or condition of handicap.

For more information and application forms, please write: Smithsonian Institution, Office of Fellowships and Grants, 955 L'Enfant Plaza, Suite 7000, Washington, D.C. 20560, or e-mail: siofg@si.edu. Please indicate the particular area in which you propose to conduct research and give the dates of degrees received or expected.

## SMITHSONIAN MINORITY INTERNSHIP PROGRAM

Internships, offered through the Office of Fellowships and Grants, are available for students to participate in research and museum-related activities for periods of ten weeks during the summer, fall, and spring. U.S. minority undergraduate and beginning graduate students are invited to apply. The appointment carries a stipend of \$250 per week for undergraduate and \$300 per week for graduate students, and may provide a travel allowance. Deadline: **February 15**.

For Summer (to begin after June 1, 1996), Fall (to begin after October 1, 1996), or Spring (to begin after January 1, 1997).

For applications and/or information, please write: Smithsonian Institution, Office of Fellowships and Grants, 955 L'Enfant Plaza, Suite 7000, Washington, D.C. 20560, or e-mail: siofg@si.edu.

## INTER-UNIVERSITY MASTER'S DEGREE IN PLANT MICROPALAEONTOLOGY AND PALYNOLOGY UNIVERSITY OF LIÈGE

This degree is for life sciences and earth sciences students who want to receive advanced training in pure and applied research in plant micropaleontology and palynology. Students will integrate their new knowledge into the broader context of the oil industry and of geological and archaeological prospecting. The writing and presentation of reports as well as team work will be emphasized. Courses will be taught in French or in English according to demand.

The period of study is at least one year. Requirements include 360 hours of courses, of which students can choose elective topics up to 100 hours, laboratory work and field work, as well as the writing of a thesis which should be a research project conducted with a team of experts.

Courses are given by experts from various Belgian research institutions and universities. The degree offers a balanced programme in each of the major palynomorph groups and plant microfossils.

Courses to be taken by all students

- Introduction to plant micropaleontology and palynology*  
M. Vanguetaine, Université de Liège
- Distribution of particular organic matter in the sedimentary basins*  
M. Roche, Université de Liège
- Basic notions of organic matter petrography*  
Y. Somers, Institut scientifique des services publics

- 4 *Analysis of sedimentary basins*  
J. Thorez, Université de Liège
- 5 *Late Cretaceous to Neogene pollen and spores*  
E. Roche, Musée royal d'Afrique centrale
- 6 *Permian to Neogene Dinoflagellates (and acritarchs)*  
J. DE CONINCK, Gent Universiteit
- 7 *Stratigraphy*  
M. VANGUESTAINE, (ULg) with the collaboration of the teachers and of MM. M. COEN (UCL), C. DUPUIS (Mons), M. DUSAR (Serv. géol.), P.J. FELDER (ULg), E. GOEMAERE (ULg), E. POTY (ULg), Y. QUINIF (Mons), F. ROBASZYNSKI (Mons)
- 8 *Data processing and quantitative biostratigraphy techniques*  
G. VAN GROOTEL, Gent Universiteit

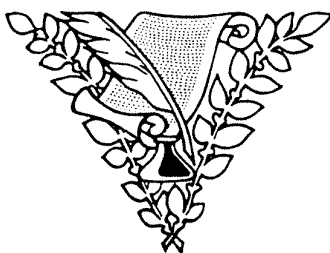
#### ELECTIVE COURSES

- 9 *Precambrian to Carboniferous Acritarchs*  
M. VANGUESTAINE, Université de Liège
- 10 *Ordovician to Devonian Chitinozoa*  
J. VERNIERS, Gent Universiteit
- 11 *Ordovician to early Cretaceous cryptospores and miospores*  
Ph. STEEMANS, Université de Liège
- 12 *Pollen and spores in situ, wood debris and cuticles*  
M. FAIRON-DEMARET, Université de Liège
- 13 *Quaternary palynology in temperate regions*  
A.V. MUNAUT, Université catholique de Louvain
- 14 *Quaternary palynology in Mediterranean regions*  
F. DAMBLON, Institut royal des sciences naturelles de Belgique
- 15 *Quaternary palynology in intertropical regions*  
E. ROCHE, Musée royal d'Afrique centrale
- 16 *Coccoliths*  
E. STEURBAUT, Koninklijk Belgisch Instituut voor Natuurwetenschappen
- 17 *Diatoms*  
C. CORNET, Faculté Univ. Notre Dame, Namur
- 18 *Quaternary geology and geomorphology*  
E. JUVIGNÉ, Université de Liège

For further information and registration forms, please contact Prof. M. Vanguestaine: Paléontologie (Bât. A1), Université de Liège, 7, place du XX Août, B-4000 Liège

Tél. (0)41/66.54.22

Final date for registration: 31 August for citizens of European Union countries; 30 June for other countries.



#### LETTER TO THE EDITOR

Dear Sir:

This December, the Latin-American Association of Paleobotany and Palynology (A.L.P.P.) will reach its 23rd anniversary. It was founded in 1972 at the First Latin-American Congress of Botany held in Mexico and has headquarters in various countries of Latin America. The A.L.P.P. has produced an important number of bulletins and other

publications which have helped to keep the palynological community in Latin America informed and in touch.

During management in the Argentine headquarters, the A.L.P.P. has published a newsletter called "NOTICIAS" which recently included, in a special edition, Research Projects in the development of Palynology and Paleobotany in Latin American. Palynological studies in Latin America have made important progress in the fields of both paleopalynology and actuopalynology, and an updated bibliography is published in "NOTICIAS" periodically.

The A.L.P.P. is interested in improving communication with other Associations and researchers of the USA and others countries. Those interested in receiving more information, please contact us by e-mail at [alpp@aspapa.org.ar](mailto:alpp@aspapa.org.ar)

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Vice President of A.L.P.P.  
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Argentina

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#### EDITORIAL

This issue was completed during the closing days of September in order to arrive in your mail boxes this month. As I write, there is a good chance (thanks to Bob Clarke) that copies will be available for distribution at the AASP Annual Meeting in Ottawa (October 10-14). Timely production of the Newsletter is important not just to satisfy readers' expectations but because the smooth running of official Association business (nominations, elections, announcements, etc.), as well as mailing of *Palynos* and other enclosed materials, all hinge on the AASP Newsletter being on time. Accordingly, Jan Jansonius has prepared a Presidential Address (p. 1) well in advance of his inauguration in Ottawa, and thereby sparing outgoing President Reed Wicander the task of writing for this Newsletter a fifth address! The January issue of the Newsletter will have full and illustrated coverage of the Annual Meeting.

For those of you unable to attend the annual meeting, the next best thing is a visit to the AASP web site (p. 3, 17) where the Technical Program and Abstracts of the Ottawa meeting can be browsed with a few mouse clicks. These items were placed on the web several weeks before the meeting to give attendees a taste of what was to come. I invite you to visit the AASP web site and check out all the good stuff on it, including a right-up-to-date e-mail directory of AASP members, as well as lots of other features. And because actual numbers of visits to the AASP site are tallied, and can be used for (or against) further support of this facility, you are helping AASP by visiting the site regularly.

Within this issue are articles on recent developments at the USGS and Geological Survey of Canada (p. 4 and 5)—two surveys with an important stake in palynology. And again, palynologists are in the news—this time in the Gobi Desert and also closer to home, in Denver (p. 7 and 8). Overseas news has once again been received from our Newsletter correspondents, Koldo Núñez-Betelu, Niels Poulsen, and Jim Riding. There are two book reviews, one by Farley Fleming and the other by Mary Dettmann, and these were arranged by our indefatigable Book Review Editor (and past President), Reed Wicander. Announcements and reports of meetings, thesis abstracts/synopses, palynology in computing and the world wide web, and many other items fill the remaining pages. Thanks to you all for your submissions, and do keep them coming!



## APPENDIX TO AASP NEWSLETTER, OCTOBER 1995 UPDATED AASP MEMBERS E-MAIL DIRECTORY



This directory is taken from the AASP Web site and is updated from the appendix to the July issue of the Newsletter. Personal WWW home pages of members will be added to the Web version of this list as they become available. You may have your e-mail and/or WWW address added, changed, or removed from the list by notifying Martin Head ([head@quartz.geology.utoronto.ca](mailto:head@quartz.geology.utoronto.ca)). The Web version of this directory is usually updated daily.

ADAM, DAVID P. [dadam@mojave.wr.usgs.gov](mailto:dadam@mojave.wr.usgs.gov)  
ASKIN, ROSEMARY A. [askin.1@osu.edu](mailto:askin.1@osu.edu)  
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CADMAN, ANN [106caa@cosmos.wits.ac.za](mailto:106caa@cosmos.wits.ac.za)  
CANRIGHT, JAMES E. [JECbot@IMAP1.asu.edu](mailto:JECbot@IMAP1.asu.edu)  
CHMURA, GAIL L. [chmura@felix.geog.mcgill.ca](mailto:chmura@felix.geog.mcgill.ca)  
CLARKE, ROBERT T. [rtclarke@dal.mobil.com](mailto:rtclarke@dal.mobil.com)  
CLARY, KAREN H. [karen.clary@mail.utexas.edu](mailto:karen.clary@mail.utexas.edu)  
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