Commission Internationale de Microflore du Paléozoique

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Content Newsletter 49 (December 1, 1995)

Note of the Secretary-general

This Newsletter brings you 34 abstracts related to Palaeozoic palynology presented at the International Congress on the Carboniferous-Permian in Poland last summer and an additional 6 presented at the AASP meeting in Ottawa, Canada last october.

We announce the publication in the november 1995 issue of the Review of Palaeobotany and Palynology on **Palaeozoic Palynostratigraphy of the Kingdom of Saudi Arabia**, showing the results of a joint study between Saudi Aramco and C.I.M.P. It contains a lithostratigraphic overview of the Palaeozoic of the Arabian Peninsula with many figures in colour. There are nine other articles on biozonation and palaeobiogeography for different groups and ages. This project involving many palynologists and several workshops was presented at the 8th IPC in Aix-en-Provence and shows again as in the Lybia-CIMP project, that palynology can be a powerful tool in regional exploration.

Together with this Newsletter we distribute the Chitinozoa and the Acritarch Newsletters and Palynos to those who asked to receive the IFPS journal through the CIMP.

The Chitinozoa Newsletter N° 15 brings news from current research in 19 countries and from the working groups on a complete Chitinozoa bibliography and on a complete list of Chitinozoa species and subspecies (original description, location of holotypes, discussion), 54 recently published articles, and reports on the International Symposium On The Ordovician System, Las Vegas 1995,

The Acritarch Newsletter N° 8 contains an updated index of all acritarch workers, announcements of the Acritarch Subcommission Meeting and Workshop in Prague in april 1996, and the C.I.M.P. Symposium on Palaeozoic Palynology at the 9th IPC in Houston, U.S.A. in June 1996; there is news from the working groups on Glossary, and the titles from the Tappan/Loeblich Festschrift (see announcements in this newsletter). It contains also the complete list of Acritarch publications of Alfred Loeblich Jr.

We appreciated a lot that U. Jux and F. Schaarschmidt, retired or no longer working on palynology, gave their the outstanding CIMP membership dues for the last 5-10 years (thanks to Chr. Hartkopf-Fröder).

Finally we give you a few changes in address and the names of our 10 new CIMP members.

The most recent news from Jan JANSONIUS concerning the A.A.S.P. publication of "*Palynology: principles and applications*" indicate that there will be 3 volumes (each ca. 450 pp.) They will cost $100 US, plus shipping costs - or very close to that amount. So, the price is not quite firm, and no order forms are yet available.

Abstracts concerning the Palaeozoic and Triassic Palynology at the XIII International Congress on the Carboniferous-Permian, Aug. 28 - Sept. 2, 1995, Krakow, Poland.

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1. BIOSTRATIGRAPHY AND PALEOENVIRONMENT OF THE CENTRAL MOROCCO PERMIAN BASINS. PALEOGEOGRAPHICAL IMPLICATIONS

This paper deals with the paleobotanical and geological works performed, during the last years, on the "Tiddas", "Bou Achouch" & "khénifra" Permian basins (Central Morocco). Their biostratigraphic attribution to the Early Late Permian is based on the classification of more than sixty taxa of megaplant remains. The characterized assemblages are dominated by Conifers and Pteridospermaphytes. The occurrence of a highly diversified Ginkgophytes complex is to be pointed out. If the floral global composition is basically of Euramerican affinity, we have found some "exotic" cathaysian and gondwanan elements. The available paleobotanical data on the Westernmost peritehyan area implicate land floristic exchanges between Africa (Gondwana) and the Southwestern part of the Iberian peninsula (Laurasia) through Morocco, during the Early Permian.

The paleocological study of the fossil material from the Tiddas basin (impressions-compressions, permineralized woods, vertebrate foot pronts, roots-related pedological nodules ..., led to suggest a warm humid climate with somewhat irregularly distributed dryier periods. The last field investigations (1994), undertaken within the framework of the Peri Tethys Program, evidenced the strong similarities between the Moroccan "Khénifra", "Bou Achouch" & "Tiddas" basins themselves, and with the corresponding Southwestern Spanish "Rio Viar" & "Guadalcanal-Urbana-San Nicolas del Puerto" ones. Sedimentary facies, occurrence of bimodal magmatic coeval events, macro- and microfloral contents, suggest that all these basins were built up under very close tectonic conditions. Geographical (latitude, altitude) and climatical contex was also quite similar.

It is clear that the Moroccan basins, on the one hand, and the spanish ones, on the other hand, represent only residual parts of originally nuch more widespread intramontane basins (may be even parts of a single one). But the distance between Moroccan and Spanish areas and, above all, the different basements on which the Moroccan and Spanish Permian strata lie no permit to consider that they pertained to a same basin.

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2. MOSCOVIAN MICROFLORA FROM THE BORDJ NILI AREA (NORTHERN ALGERIAN SAHARA). COMPARISONS WITH THE EURAMERICAN MICROFLORAS AND PALEOGEOGRAPHICAL IMPLICATIONS

The palynological study concerns boreholes (NL1, NL2, NL3) from the Bordj Nili area, located in the Northern Algerian Sahara, near the South Atlas fault. The Carboniferous succession is well dated by microfauna (Lys 1979, 1986): it belongs to the Moscovian (=Westphalian - ? Lowermost Stephanian).

The microflora is composed of spores and pollen grains. Reworked acritarchs from the Lower Paleozoic are present.

Triletes spores are the most abundant (more than 45%); the main taxa are: *Lycospora pusilla, Endosporites ornatus, Granulatisporites piroformis* and *Densosporites* spp. Monolete spores are relatively rare (less than 5%); we have observed *Laevigatosporites vulgaris, Torispora securis* and *Punctatosporites* spp. This spore assemblage shows strong similarities with those of the Upper Westphalian of Northwestern Europe.

The pollen grains are abundant (15-35%) and diversified. The main taxa are: - Monosaccate pollen grains: *Florinites* sp., *Wilsonites vesicatus, Potonieisporites bhardwaji, Potonieisporites* spp., *Cannanoropolis janakii, Mosulipollenites circularis, Parasaccites* spp., *Barakarites* sp.; - Bisaccate pollen grains: *Gardenasporites* cf. *leonardii, Protohaploxypinus limpidus* spp., *Protohaploxypinus* spp., *Lunatisporites* cf. *noviaulensis, Lunatisporites* spp. It is interesting to point out that such forms, especially bisaccate ones, are considered as characteristic of the Permian period within the Euramerican realm.

Compared to Western Europe assemblages of the same age, this Moscovian microflora presents therefore, several peculiarities, such as the abundance and great diversity of pollen grains and scarcity of monolete spores.

During the Lower Carboniferous, the microflora of the Saharan platform shows specific characters: both Gondwanan and Euramerican influences were present. These influences decreased during the Moscovian, possibly as a result of the establishment of an Euramerican flora in the Western Sahara.

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3. SPORES FROM CARBONIFEROUS SAHARAN PLATFORM, ALGERIA: COMPARISON WITH OTHER BASINS ASSESSMENT OF THE GONDWANIAN AND EURAMERICAN INFLUENCES

New palynological data on the carboniferous on the Illizi - Rhadames basin have been used to specify the previously established palynological zonation (MASSA et AL. 1979) and ATTAR and AL. 1980.

In Illizi - Rhadames basin we studied 5 wells. In saharan Atlas we studied 2 wells.

A comparison between the various saharan basins is proposed and also with biozonation of western Europe (CLAYTON and AL. 1977) to acess the Gondwanian and Euremerican influences.

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13. PERMIAN FERNS FROM PATAGONIAN BASINS OF ARGENTINA: A REVIEW

In Patagonia two Upper Paleozoic Basins, Tepuel-Genoa (Chubut province) and La Golondrina (Santa Cruz p are recognized. In both, sequences with a rich associations of fern fronds showing a high diversity are found. Tl first studied by Frenguelli (1953), Archangelsky (1958) and Archangelsky & de la Sota (1960). Genera of northern as *Pecopteris, Sphenopteris, Asterotheca* and *Corynepteris* are associated with gondwanic forms as *Dizeu Neomariopteris* and *Dichotomopteris*. Stem remains referred to *Caulopteris* and *Artisophyton* were also found su a humid and temperate paleoclimate.

In recent years new collections from both basins provided abundant material and a study of these specimens : extend the characterization of several taxa.

Remains of *Asterotheca golondrinensis* Herbst show toothed pinnules, and fertile structures that suggest a c generic assignation. Fronds bearing *Sphenopteris*-like pinnules were found to possess dichotomous stems havin below their bifurcation. Some pinnules are fertile showing fertile bodies on the abaxial surface of the lamin: aphlebiae confirm the humid environment in which floras developed.

These floras are unique in Gondwana because of the high number and variety of fern taxa, also shared by othe especially the Sphenopsida (mainly Sphenophyllales). The admixture of northern and gondwanic taxa seems to that Permian assemblages from Patagonia developed under better climatic conditions than in most areas of the S tinent. With this evidence it is difficult to accept with the near-pole location of the area that is presented in paleoge reconstructions. This is especially evident when these floras are compared with much poorer assemblages founc that are eventually placed at lower paleolatitudes.

Finally, the stratigraphic distribution of ferns is notable along both sequences that measure together more thai Ferns are found from bottom to the top.

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19. SPORES OF SOME LYCOPHYTE PLANTS FROM THE CENTRAL AND WESTERN BOHEMIAN CARBONIFEROUS BASINS

Fructifications of species *Lepidostrobus cermnus, L. crassus, L. kidstoni, L. lycopoditis, L. meunieri, L. ornatus, L. stembergii* and *Sporangiostrobus feistmanteli* were palynologically studied.

No differences have been observed in morphological variability as well as in size among miospores isolated from various sporangia of one cone. One species of miospores of the genus *Lycospora* (mostly *L. pusilla* or its synonymous species) is isolated from various (lower, middle and upper) parts of cones of the genus *Lepidostrobus*.

It seems that cones of the genus *Lepidostrobus* ripened in all parts at the same time and produced the same miospore species of the genus *Lycospora*.

Rarely the stratigraphical ranges of plants of the genus *Lepidostrobus* and their miospores are identical. The stratigraphical ranges of miospores of the genus *Lycospora* are mostly longer than that of their parent plants. This fact is supported by producing of the same miospores by several parent plants with various stratigraphical ranges. In any case the stratigraphic range of parent plant is not longer than that of their miospores.

Miospores of the genus *Lycospora* are typically long-ranging forms and their parent plants coming from large plant groups as Lycopodiales, Selaginellales or Lepidodendrales have various stratigraphical ranges and wide geographic distribution.

An exception among lycophyte plants is the species *Sporangiostrobus feistmanteli*. Changes in size and morphological variability of densospore miospores (several species of genera Densosporites and Cristatisporites) have been observed in various parts of fertile apex as well as in one sporangium of *Sporangiostrobus feistmanteli*.. Miospores from the apical parts are smaller (about twice times) and more uniform (only one or two species) than miospores from the lower parts.

It seems that fertile apexes of *Sporangiostrobus feistmanteli* ripened gradually from the basal to the apical parts.

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20. SPORES OF SOME SPHENOPHYTE AND PTEROPHYTE PLANTS FROM THE CENTRAL AND WESTERN BOHEMIAN CARBONIFEROUS BASINS

Six cones of the class Sphenopsida and two fertile parts of class Polypodiopsida were palynologically studied. From plants of the order Equisetales following parent plant and their miospores were studied: *Calamostachys grandis - Calamospora breviradiata, Calamostachys tuberculata - Calamospora microrugosa, C. straminea, C. pedata* and probably alete aborted miospores, *Macrostachya carinata - Calamospora mutabilis* and *Palaeostachya ettinghausenii - Calamospora microrugosa* and unknown sculptures miospores. Changes in size of miospores have been observed in various parts of cones of *Palaeostachya ettingshausenii*. Miospores from the lower parts are bigger than miospores from the apical ones.

It seems that some of these calamite cones ripened gradually from the basal to the apical parts.

From plants of the order Sphenophyllales following parent plants and their miospores were studied: *Bowmanites cuneifolius - Vestispora magna, Bowmanites myriophyllus - Laevigatosporites desmoinesensis, L. medius, Latosporites latus* and *L. saarensis , Sphenophyllostachys aquensis - Punctatisporites obesus*.

Miospores of four species of two miospore genera isolated from fructification of *Bowmanites myriophyllus* give the evidence about larger morphological variability in one sporangium than we expected.

From plants of the class Polypodiopsida miospores *Cyclogranisporites aureus* are isolated from *Acitheca ambigua* and *Laevigatosporites perminutus* and *Latosporites minutus* from *Scolecopteris aff. arborescens*.

Often various species as well as genera of miospores are isolated from one sporangium using the system of dispersed miospores for the classification of miospores *in situ*. In fact these miospores often should be united in one type with defined morphological variability. The degree of variability usually depends on the fossilization, degree of preservation and on the type and intensity of maceration.

These miospores are identical only in their main morphological features but they are often classified (in the system of dispersed miospores) on the basis of less important morphological ones. This fact is supported by identical stratigraphical ranges as well as geographic distribution of all species of miospores isolated from one sporangium in assemblages of dispersed miospores.

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29. FIRST PALEOBOTANICAL AND PALYNOLOGICAL DATA ON THE "LES SALETTES FORMATION" UPPERMOST MEMBER (PERMIAN TOULON BASIN, SOUTHEASTERN FRANCE)

This paper deals with a first attempt of palaeobotanical dating within the Permian red-beds in the Toulon Basin (Southeastern France). Plant remains and palynomorphs came from the recently defined "Calcaires du Bau Rouge" (uppermost member of the "Les Salettes Formation"). This mainly lacustrine unit (ca.20 m thick) originated within a narrow half-graben, along the eastern side of a submeridian normal fault.

About the upper part of the coastal cliffs, lacustrine facies begin with grey sapropelic shales grading upwards into laminated limestones; the medial part of this section is rich in plant remains. Higher massive carbonate rocks are cropping out: firstly with giant domal stromatolites then with nodular and banded black cherts yielding a fossil wood fragment: *Dadoxylon* "type II", i.e. Coniferophyte wood, to be related with the discovered *Ullmannia* foliage. The best preserved palynomorphs were yielded by black mudstones, interlayered with carbonaceous arkoses, located 2 km NE of the cliff outcrop, beneath the scree mantle.

Have already been classified: - **macroflora:** *Ullmannia frumentaria, U. bronnii, Pseudovoltzia libeana, Lesleya (al. Taeniopteris) eckardtii, "Sphenopteris" dichotoma*, associated, strikingly, with *Odontopteris osmundaeformis* - like pinnules. - **microflora:** the palynological assemblage is strongly dominated by pollen grains (more than 90%). Among scarce microspores, such as *Calamospora* spp.& *Converrucosisporites eggeri*, the main taxa of pollen are *Potonieisporites "novicus-bhardwaji", Nuskoisporites dulhuntyi, Plicatipollenites spp.; Vesicaspora-Scheuringipollenites* - complex, *Illinites* sp., *Falcisporites* cf. *zapfei, Limitisporites* spp., *Gardenasporites leonardii, Vitreisporites pallidus; Protohaploxypinus microcorpus, Protohaploxypinus* spp., *Striatoabieites richteri, Lunatisporites* sp., *Lueckisporites virkkiae, Lueckisporites* spp.; *Vittatina costabilis, Vittatina* spp., *Costapollenites ellipticus*.

These macro-and microfloral assemblages are closely similar with those described from the "Tregovio Formation" (Southalpine Permian, Italy). Contingent on the quantitative palynological analysis final results, we can suggest, a post Kungurian - ante Tatarian age, to be compared with the former correlations proposed for the "Les Salettes" Formation.

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36. SPORES FROM THE EARLY CARBONIFEROUS OF THE RUSSIAN PLATFORM

In the Early Carboniferous of the Russian Platform twenty two zones were recognized by plant spores collected in the interval between the base of the Gumerovsky Horizon of the Tournaisian and the top of the Voznesensky Horizon of the Serpukhovian stage. A number od zones are divided into subzones.

The character of transitional Devonian-Carboniferous deposits is defined by Retispora lepidophyta with varieties and *Vallatisporites pusillites*. The appearance of *V. pusillites*, and disappearance of *Diducites*, and preservation of the *R. lepidophyta* varieties in the lower and middle portions of the V.pusillites zone (PLE and PM subzones) of the Gumerovsky Horizon allow to consider it as a transitional one. At the same time *Tumulispora, Dictyotriletes, Convolutispora* become more abundant and form the bulk of spores in the overlying zones of the Tournaisian. The Upper Pmi subzone (Kupavninskaya form) of *V. pusillites* zone contains no R.lepidophyta and its assignment to the Gumerovsky Horizont is not conclusive. The PLE and PM subzones can be corralated with the LN zone (Strunian) and the PMi subzone, while the M zone of the Malevsky Horizon-with the VI zone (Upper Tn fb) of Western Europe.

Apiculiretusispora septalia, Vallatisporites genuinus, Potoniespores monotuberculatus, Pustulatisporites uncatus serve as index specoes for the Upper Tournaisian. The appearance of *Spelaeotriletes balteatus* in the Cherepetsky Horizon starting from its lower boundary allows to compare it with BP zone (Tn2) od Western Europe.

In contrast to the index groups of fauna the Visean features of plants appear somewhat earlier in the record namely in the Kizelovsky age: *Trilobozonotrilites, Simozonotriletes, Euryzonotriletes*. The *Cyclogranisporites exiguus (=A.baccatus)* and *Prolycospora claytonii* specoes are encountered starting from the base of the Kosvinsky Horizon, which corresponds to the middle portion of PC zone (Tn 3) in Western Europe. The appearance of *Lycospora pusilla* in the middle portion of the Radaevsky Horizon is a characteristic feature of the Visean zones. This species mark the lower limit of the Visean (Pu zone) in Western Europe.

The change in specific character and quantative proportions of spores starting from the base of the Tulsky Horizon forms a basis to combine it with overlying zones of the Upper Visean Oksky Superhorizon, featured by *Granulatisporites, Leiotriletes, Lophotriletes, Convolutispora, Waltzispora, Camarozonotriletes* as well as *Lycospora pusilla, Tripartites vetustus, Schulzospora, Raistrckia nigra*. This part of the section correlates with the TC-VF zone (V3) in Western Europe.

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37. THE DINANTIAN (LOWER CARBONIFEROUS) PALYNOSTRATIGRAPHY OF R=FCgen, NORTHERN GERMANY

Well preserved miospore assemblages have been obtained from too deep cored boreholes on the Baltic island R=FCgen. The composite succession in the two boreholes investigated (R=FCgen 2 and Wiek 3) comprrises some 1.8 km of marine Dinantion mudstones, calcareous mudstones and limestones. Eight miospore biozones were recognised: four in the Tournisian and four in the Vis=E9an. In ascending order these are: the *Spelaeotriletes balteatus - Rugospora polyptycha* (BP) Biosone, the *Spelaeotrilites pretiosus - Raistrickia clavata* (PC) Biozone, the *Schopfites claviger - Auroraspora macra* (CM) Biozone, the *Gorgonispora multiplicabillis - Convolutispora circumvallata* (MC) Biozone, the *Lycospora pusilla* (Pu) Biozone, the *Knoxisporites triradiatus - Knoxisporites stephanephorus* (TS) Biozone, the *Perotriletes tessellatus - Schulzospora campylopiera* (TC) Biozone and the *Tripartites vetustus - Dictyotriletes peltatus* (VP) Biozone. The BP, PC, CM, Pu, and TS Biozones correlate with existing zones of the same name in Western Europe and are essentially defined on the same criteria. The MC and VP Biozones are erected on the basis of the R=FCgen miospore succession. Their bases are defined by the first appearances of *Gorgonispora multiplicabilis* and *Dictyotriletes peltatus* respectively. The R=FCgen miospore succession compares closely with those in the British Isles and Western Pomerania; correlations with the zonal schemes of both areas are proposed.

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47. MISSISSIPIAN PALYNOFLORAS FROM THE CUYAHOGA AND LOGAN FORMATIONS OF NORTHEASTERN OHIO. U.S.A.

Miospore assemblages recoverded from surface section of the Cuyahoga and Logan Formations in northeastern Ohio, U.S.A. contain a rich diversity of taxa including forms previously reported as being diagnostic of the uppermost Devonian and the mid Tournaisian.

Despite the absence of any abvious differences in preservation, it is concluded of that the assemblages are of mid Tournaisian (PC Zone) age and contain significant amounts of reworked late Devonian material. The result has significance in providing additional evidence to resolve the problem of the age formations which has been the subject of debate based on the conflicting ammonoid evidence.

In addition to miospore populations recovered, a number of characteristic late Devonian - early Mississippian megaspores are recorded.

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63. THE OCCURRENCE OF SOME VINGED POLLENS IN THE CARBONIFEROUS AND PERMIAN SEDIMENTS OF POLAND

Results of palynological research which has been carried out in the Polish Geological Institute for the last 40 years (A. Jachowicz 1957-1989; S. Dybova-Jachowicz 1957-1995) shows the importance of first appearance and existance of winged sporomorfs which belong to Anterturma POLLENITES (R. Potonie 1981) according to artificial taxonomy.

This importance indicates that beside of the occurence of hydrophylic flora and coalfoarming flora, typical terrestrial flora which were accumulated outside the primary peatbog appeared. The new flora is indicative of adaptability to new conditions of arid ground. It required a long-lasting evolutional process which led to a total change of plants' constitution and creation of new anatomic features which were necessary to their vegetation and development in terrestrial conditions.

One of the most important changes of the terrestrial flora which occured at the very beginning of its existance is the change of way and conditions of its reproduction. It may be quite accurately reconstructed basing on morphological evolution of pollen grain spores of such floral groups as **Pteridophytina, Pteridospermopsida** and **Gymnospermae**.

The whole philogenetic development of vascular plants led to make fertilization process independent from water environment which was earlier necessary to this process. It resulted in changes of the constitution and morphology of reproductive cells of the terrestrial flora groups mentioned above.

From the evolutional point of view, which assumes adaptation of first vascular plants to pollination, genera called winged sporomorfs (sporomorphae saccatae) show the best organised morphology. So far, they have been recorded in the Dinant and Late Permian sediments of Poland.

Morphologically, the winged sporomorfs represent both monosaccate and transitional sporomorfs (transition from monosaccate to disaccate forms).

If one treats all the known Carboniferous and Permian genera of winged sporomorfs as a whole (POLLENITES in the artificial taxonimy), several main assemblages of such flora different in terms of morphology and stratigraphy may be distinguished.

First of them, represented by monosaccate genus *Archaeoperisaccus*, occured in Poland from the Devonian to Namurian. In the beginning of the Carboniferous (Tournesian) monosaccate genus *Schulzospora* appeared and reached its optimum in the Upper Visean and Lower Namurian. The genera gradually became extinct in the Upper Namurian and only separate species passed to the Westphalian B. It is one of the longest occuring genera of older winged sporomorfs known so far. Occurence of first sporomorfs which were morphologically connected with disaccate forms started in the Upper Visean with the appearance of genus *Protodisaccites*.

The second assemblage appeared as an precursory event in the Upper Namurian (genera *Endosporites, Florinites, Potonieisporites*) together with numerous and typical for the Westphalian and Stephanian genera *Alatisporites, Wilsonia* and disaccate *Illinites*.

The third assemblage of microflora illustrates the changes in environmental conditions during the transition between the Carboniferoua and Permian periods. The microflora confirms the hydrophilous and coal-forming characters of the uppermost Stephanian plants (Stephanian C-D) with only a small proportion of xerophilous plants.

Disaccate sporomorfs of genera *Nuskoisporites, Cordaitina* and *Guthoerlisporites* appear and the participation of *Potonieisporites* increases. Among disaccate, genera *Vesicospora* occures.

Assemblages of plants characteristic of semi-arid climate dominate in the Lower Permian (Asselian). The change is rapid; *Sporites*, still dominating in the Stephanian, are replaced by pollen grains (*Pollenites*), which constitute up to 90% of the assamblage. Of the Permian association of continental red-beds, distinguished in Europe as the Rotliegendes, the oldest horizones correlated with the Early Autunian, are palynologically documented. In this horizone, the genera of the following disaccate winged pollen grains : *Limitisporites, Vestigisporites* and *Lunatisporites* occure for the first time. These dominate in the Autunian with the occurence of numerous pollen grains of genera *Hamiapollenites, Striatoabieites, Protohaploxypinus* and *Jugasporites*. They are the evidence of the appearance and beginning of development of mezophitic microflora which dominate in the Upper Permian.

The Upper Permian microflora of the Polish sedimentary basin can be generally described as the assemblage of the *Lueckisporites virkkiae* zone. The appearance of this characteristic species of pollen grains has been recorded already in the highest part of the continental strata of the upper Rotliegendes. The continuing climatic change resulted in extremaly arid climate during the Late Permian period.

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65. UPPER DEVONIAN–LOWER CARBONIFEROUS PALYNOLOGY AND PALYNOFACIES OF THE EASTERN AND MID-CONTINENT UNITED STATES: NEW DATA FROM OHIO AND NEW YORK STATES

Spores, organic-walled microphytoplankton and chitinozoans have been analyzed from approximately 450 samples from 57 localities in northern Ohio and western New York. Stratigraphic units examined from Ohio include the Lower Carboniferous-Tournaisian (Kinderhookian) Cuyahoga Group (Meadville Shale, Sharpsville Shale, Orangeville Shale, Sunbury Shale) and Upper Devonian (Lower Tournaisian-Famennian) Berea Sandstone, Bedford Shale and Ohio Shale (Cleveland Shale, Chagrin Shale). Formations examined from New York Upper Devonian include the Fammenian (Chautauquan) Knapp, Oswago, Cattaraugus, Chadokoin (Ellicott and Dexterville members) Canadaway (Northeast, Shumla, Westfield, Laona, Gowanda, South Wales, Dunkirk members) and Frasnian (Senecan) Java (Hanover and Pipe Creek members), Sonyea (Cashaqua and Middlesex) and Genessee (West River, Genundewa and Geneseso members). Preservation ranged from excellent for the Fammenian-Kinderhookian sediments to poorly preserved for the Frasnian section.

The Kinderhookian assemblage includes *Auroraspora macra, Cyrtospora claviger, Dibolisporites distinctus, Dictyotriletes submarginatus, Lophozonotriletes malevkensis, L. verivertucatus, Pustulatisporites gibberosus, Raistrickia corynoges, Retusotriletes incohatus, Vallatisporites splendeus* and *Verrucosisporites nitidus/congestus*. This interval is equivalent to the NV-CM spore zones of Europe. The uppermost Devonian is marked by the tops of *Hymenozonotriletes fammenensis, Retispora lepidophyta* and *Vallatisporites pusillites* var. major. This assemblage has been recovered from the Knapp and Oswago Formation of New York and the uppermost Ohio Shale, Bedford Shale and Berea Sandstone of Ohio. The top of *Retusotriletes phillipsii* and an unnamed representative of *Samarisporites* the next benchmark who encompasses the Ellicott through uppermost Shumla interval. Within the uppermost Shumla are the extinct tops of taxa assignable to *Samarisporites, Estiastria* and *Multiplicisphaeridium*.

The New York Frasnian (Senecan) is not very well preserved, but, some palynomorphs may be useful in zonation. The basal part of the Hanover is marked by the first upsection occurrence of *Auraspora torquata*. The extinction of *Duvernaysphaera angelae* and a species of *Villasacapsula* in the basal Angola marks the next identifiable palynological break. The extinction of *Quisquillites buckhornensis* and an unnamed *Emphanisporites* in the lower portion of the Cashaqua.

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71. THE DEVONIAN–CARBONIFEROUS BOUNDARY IN THE KOWALA TRENCH (HOLY CROSS MTS, POLAND), BASED ON MIOSPORES

The results of an investigation of the stratigraphic distribution of miospores in the Southern limb of the Bolechowice syncline in the south-western part of the Holy Cross Mountains are presented. 45 samples were taken from a 80 m. trench dug across the Devonian/Carboniferous boundary, of witch 15 yielded useful palynological material, mainly miospores. The semples were prepared, using standard techniques, at the Polish Geological Institute in Sosnowiec and at the University of Liege in Belgium. The change in miospore assemblages allows the approximate establishment of the Devonian/Carboniferous boundary within the section. The exact boundary horizon cannot be determined because barren sediments are found at the critical part of the trench. The miospores assemblages of samples 50, 51and 119 indicate that they are Uppermost Devonian in age. The assemblages are characterised mainly by the occurrence of *Retispora lepidophyta, R. cassicula, Diducites versabilis, D. mucrornatus, Cyrtospora cristifer, Tumulispora rarituberculata, T.malevkensis, Umbonatisporites abstrusus* and *Grandispora lupata*.

The next positive samples (181c to 255) demonstrate a marked change in the composition of assemblages, not only because of the lack of such taxa as *Retispora lepidophyta* and *Diducites versabilis*, but principally through the presence of typical, restricted in composition Lowermost Carboniferous assamblages, including *Retusotriletes incochatus, Vallatisporites verrucosus, Verrucosisporites nitidus, Knoxisporites triangularis* and *Convolutispora major*. Some species are common to both groups of assemblages, among them *Cyrtospora cristifer, Tumulispora rarituberculata, T. malevkensis, Retusotriletes icochatus, Auroraspora macra* and *Umbonatisporites abstrusus*.

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79. PERMIAN PALYNOSTRATIGRAPHY IN SHANXI, CHINA

Well preserved pollen and spores have been found in samples from the Permian Shansi Formation, Lower Shihotse and Upper Shihotse Formation pollen and spores occur in all Formation.

In addition, more 130 species and varisties of 81 genera of pollen and spores are recognized, new species described are *Cadiospora shanxiensis, Raistrickia shanxiensis*, and *Gulisporites verrucosus*.

As a result of the extensive research on the pollen and spores assemblages from the Permian in Shanxi, China. It may be subdivided into six spore assemblage Zones, with four Zones for the Early Permian and two Zones for the Late Permian.

The assemblages are unlike those of Gondwana and Angara microflora, they appear to be more similar to those described from Western Europe than those of Northwest Europe part of Russian.

Based on palynological data, the boundary of the Early and Late Permian of the Shanxi region, the reconstruction of Paleogeography and Paleoecology are discissed.

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88. STRATIGRAPHY OF THE WESTPHALIAN COAL-BEARING DEPOSITS OF THE INTRA-SUDETIC BASIN IN THE LIGHT OF PALYNOLOGICAL STUDIES

Two lithostratigraphical units represent Upper Carboniferous coal-bearing deposits in the Intra-Sudetic Basin - the Walbrzych formation of the Namurian age and the Zacler Formation. The Biały Kamień Formation, not containing coal seams, occurs between them and represents the Namurian and Early Westphalian ages. Lithological features of deposits of the Zacler Formation justify its division into lower and upper parts. Palynostratigraphical studies of deposits of the Zacler formation from six deep boreholes located in the north-western part of the Intra-Sudetic Basin were made. They delivered rich miospore assamblage consisting of 205 species belonging to 86 genera. The vertical variability of the composition of the assemblage is a basis for distinguishing three miospore cenozones, analogous to biozones of Clayton et al. (1977) distinguished in the Upper Carboniferous deposits from Western Europe. They correspond to the Westphalian A-C. The miospore assemblage typical of zone *Radiizonates aligerens* was obtained from deposits of the lower part of the Zacler formation. In the deposits of the upper part of the Zacler Formation the miospores characteristic of *Microreticulatisporites nobilis-Florinites junior* and *Torispora securis-Torispora laevigata* zones were found. The boundary between biozones corresponding to the Westphalian A and B does not coincide exactely with the boundary between the lower and upper parts of the Zacler Formation, so probably it should be accepted that this lithostratigraphical boundary is slightly diachronious .

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103. IN SITU AND DISPERSED SPORES OF *CALAMITES GIGAS/METACALAMOSTACHYS DUMASII* FORM THE ROTLIEGEND OF THE SAAR-NAHE BASIN, SW GERMANY

Calamites gigas Brongniart is a rather outstanding member of the group of the calamitaleans. Although this taxon which can locally be very abundant in the Rotliegend is still imperfectly known, recent studies have considerably contributed towards a better understanding. In several features this taxon differs fundamentally from the other representatives of this group, as well with regard to its morphology as to its life strategy and ecology. The strobili which are known as *Metacalamostachys* (al. *Calamostachys*) *dumasii* (Zeiller) Barthel have rarely been reported in the literature, although they can sometimes be so abundant that they completely cover bedding planes. Small spores of the *Calamospora* type have been extracted from the strobili. Palynological studies have been carried out to test the palaeoecological interpretations based on the megafossil material. Several profiles have been studied. The spores can be very abundant, but remarkably enough the horizons which have the highest abundance of dispersed strobili have yielded only relatively few spores attributable to this taxon. These horizons are mostly dominated by saccate forms like *Potonieisporites*.

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104. PALYNOSTRATIGRAPHY, PALYNOFACIES, AND CONODONT BIOSTRATIGRAPHY OF LATEST DEVONIAN SEDIMENTS IN THE PAFFRATH SYNCLINE, RHENISH SLATE MOUNTAINS, GERMANY

Latest Devonian and Lower Carboniferous basinal sequences have been extensively studied in the Rhenish Slate Mountains where macro- and microfaunal index fossils offer independant biostratigraphic control. However, in most cases sediments rich in well preserved miospores do not yield conodonts and vice versa.

The Paffrath Syncline is located near the northern rim of the Rhenish Slate Mountains, approximately 20 km northeast of Cologne. Due to the very rich fauna, with outstanding preservation, the biostratigraphy and the regional geology of the Devonian in the syncline are very well known. Until recently it was believed that sediments of Lower Nehdenian age terminate the Upper Devonian succession in the syncline. Surprisingly enough, late Famennian strata have been recognized in some boreholes. The sediments consist of dark grey mudstones and marls and are highly fossiliferous (e.g. conodonts, ostracods, cephalopods, brachiopods, bivalves, plant remains and palynomorphs). Heterocorals and the problematical fossil *Jinonicella* (?Monoplacophora) are very abundant and indicate a biofacies hitherto unknown in the Devonian and Lower Carboniferous of the Rhenish Slate Mountains. Compared to other Upper Devonian sediments in the Ardenne-Rhenish area, the exceptionally low thermal alteration of the sediments is remarkable (TAI approx. 2+; CAI approx. 1).

The miospore assemblages are rich and diverse in composition. The preservation is excellent. Based on the occurrence of stratigraphically significant species such as *Retispora lepidophyta, Grandispora cornuta, G. famenensis, Cyrtospora cristifera*, and the *Diducites* complex, the assemblage has been assigned to the Oppel Zone LV, which marks the base of the Fa2d. The occurrence of conodonts, e.g. *Polygnathus praehassi, Pol. znepolensis, Pol. extralobatus, Palmatolepis rugosa rugosa*, and *Bispathodus costatus* indicates a position in the Middle to Late(?) *expansa* Zone.

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116. UPPER PERMIAN ACRITARCH ASSEMBLAGES FROM POLAND

Presented are results of investigations on the acritarcha occurring in the Polish Zechstein Basin. Samples of rocks derived from twenty four boreholes, from north and west of Poland were studied. In the microfloral assemblages, spores and pollen occur and in addition about 30 acritarch taxa are fairly abundant. These latter include the genera: *Leiosphaeridia, Baltisphaeridium, Micrhystridium, Veryhachium, Wilsonastrum* and *Tasmanites*. The quantitative variability and geographic distribution of the acritarch assemblages are discussed.

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150. PALYNOSTRATIGRAPHY OF THE UPPER SILESIAN COAL BASIN

The first classification of the Polish Carboniferous, based on spores, was made in the Upper Silesian Coal Basin (A. Jachowicz 1957-1958). Further detailed miospore investigations, performed for many completely cored boreholes drilled in recent years, coupled with data derived from coal mines, enabled a new spore zonation of the Carboniferous profile in the USCB. The specific development of microflora in the basin formed the basis for establishing of a local classification which enables to correlate profiles between various areas of the basin and to idetify coal seams in the whole region.

The palynologically documented profile comprises formations deposited in the time span Lower(?) Visean - Stephanian. 16 spore zones were distinguished in the whole sequence, i.e. 2 for the Lower Carboniferous - Vn and Ma zones, and 14 for the Upper Carboniferous - the Namurian Bn, Pp, Ti, Rk, Ao, Ck, Dv, Gv zones, and the Westphalian Rf, Ra, Eg, Vm, Tsl and To zones.

In the most part of the USCB there occurs at the boundary between Lower and Upper Namurian a stratigraphic gap that comprises almost the whole standard spore zone SO, and, perhaps even, the lower portion of the KV zone. The only exception is the area of occurrence of the Jejkowice Beds which costitute a not precisely determined portion of the above mentioned zones, here classified as local spore zones Ao and Ck.

A stratigraphic gap exists in the Carboniferous sequence of the USCB at the boundary between the Westphalian C and the Westphalian D. This is inferred from the scarce presence of uppermost Westphalian C forms in the zone Tsl and a rapid change in quality of spore assotiations at the lower boundary of the zone To representing the Libiąż Beds, associated with a sudden appearance of uppermost Westphalian and Stephanian taxons. This may indicate the lack of at least certain parts of the upper Westphalian C and the lack of lower Westphalian D. In addition, it is also possible, that the To spore zone may also include, at least partly, the lowermost Stephanian.

The Libąż Beds are overlain with an erosional (?) gap by the Kwaczała Arcose ascribed to the Stephanian. The Kwaczała Arcose has no palynological documentation and its age is not precisely determined yet.

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151. PALYNOSTRATIGRAPHY OF THE CARBONIFEROUS IN POLAND AND SOME COSMOPOLITAN PALYNOLOGICAL EVENTS

Carboniferous deposits in Poland have been studied palynologically on almost the entire area of their current extent. Local units have been introduced into the spore zonation in Western Pomerania, Central Poland, the Lublin Coal Basin, the Góry Świętokrzyskie Mts., and the Upper Silesian Coal Basin. These zonations have been correlated with the standard Carboniferous spore division of western Europe and other divisions of this rank within and beyond Europe. In the region of the Carpathians and their foreland, in the Miechów Trough, on the NE margin of the Upper Silesian Coal Basin, in the Sudetes, and on the Fore-Sudetic Monocline, dating of spore assemblages has been done with respect to chronostratigraphic units or adapted standard zones.

In the Polish Carboniferous there are indications of palynological events associated with the occurrence of certain cosmopolitan taxa significant for interregional and even intercontinental correlation. They include:

- extinction of *Retispora lepidophyta* (Kedo) Playford at the Devonian-Carboniferous boundary (Góry Świętokrzyskie Mts., Western Pomerania).

- appearance in the Tournaisian of *Umbonatisporites distinctus* Clayton at the base of the HD zone equivalent, *Spelaeotriletes pretiosus* (Playford) Neves et Belt at the base of zone PC, and both *Schopfites claviger* Sullivan and *Tripartites incisotrilobus* (Naumova) Potonié et Kremp at the lower boundary of the CM spore zone equivalent (Western Pomerania, partly Góry Świętokrzyskie).

- appearance at the Tournaisian-Visean boundary of the index species *Lycospora pusilla* (Ibrahim) Somers (Western Pomerania, Carpathian Foreland, Miechów Trough, NE margin of the USCB).

- appearance in the Upper Visean of *Schulzospora campyloptera* and *Petrotriletes tesselatus* (starting zone TC, Góry Świętokrzyskie, Western Pomerania, Carpathians) and the genera *Tripartites* and *Rotaspora*, which indicate the lower boundary of zone VF. In the top part of V3, however, *Bellispores nitidus* (Horst) Sullivan and *Reticulatisporites carnosus* documented spore zone NC (in most of the studied regions).

- in Westphalian deposits the range of *Radiizonates aligerens*, indicating zone RA, appearance of index taxa for zone NJ indicating Westphalian B deposits. Zone SL (Westphalian C) is indicating by the appearance of *Punctatosporites granifer* Ibrahim, *Vestispora fenestrata*, and *Torispora* whereas the appearance of *Thymospora* indicates the equivalent of zone OT (Westphalian D-lowermost Stephanian) (USCB, LCB, Central Poland, Western Pomerania, the Sudetes and Fore-Sudetic Monocline).

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152. ORIGIN OF COAL SEAMS IN THE UPPER SILESIAN AND LUBLIN COAL BASIN (POLAND)

The microfloral (mega- and miospores) and petrographic investigations were carried aut on the distinguished lithological coal varieties from Anticlinal beds (Namurian B), (9 coal seams with the total thickness of 27 m) and Upper Marginal beds (Namurian A), (2 coal seams) in the Upper Silesian Coal Basin and on 140 selected seams from the whole profile of the coal-bearing formation of the Lublin Coal Basin (Namurian-Westphalian C).

The studies made it possible to characterize coal-forming floristic assemblages of individual coal layers, to reconstruct sedimentary environment of phytogenic deposits as well as to comprise the scheme of genesis of the coal seams.

The coal of the seams in question was formed by Pteridophyta, supplemented by Gymnospermatophyta (Pteridospermopsida of the Lepidospermales and Cycadofilicales type). In the lithological varieties of the coal from the seams in question the microfloristic associations were differentiated considering their taxa. Correlation of the determined sporomorphs with their parental plants formed the basis of distinguishing three fundamental types of the plant assemblage in paleomires:

- the assemblage with the domination of large plants (perrenial ones) with a tree-like habit (*Lepidodendron, Sigillaria, Lepidocarpon, Filicinae, Calamites*)
- the assemblage with the domination of small herbaceous plants, such as *Selaginella, Lycopodites, Sphenophyllum*
- the mixed (transitional) assemblage, composed of the two distinguished above plant varieties

These assemblages frequented various types of paleomires, so they determine the biofacial character of the peat (anthracofacies): terrestrial (FTr), telmatic (FT) and limnetic (FL).

Coal seams of the USCB and LCB are mostly formed of deposits of telmatic facies (FT), represented by three fundamental types: immersed (FTI), emersed (FTE) and mixed (transitional) (FTM) telmatic facies. Occasionaly occuring the sapropelic coals are an example of limnetic (FL) or limnetic-telmatic facies.

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174. *IN SITU* SPORES IN MID-NAMURIAN FRUCTIFICATIONS FROM AN UPLAND FLORA, WESTERN ILLINOIS, USA

Several sites in western Illinois have produced abundant and well-preserved plant fossils from the basal Upper Carboniferous. Two of these sites have produced fossils of plants which grew outside normal depositional regimes, representing plants from well-drained environments. Many of these plants are not present or are rare in facies representing swamp or lowland settings. Among these previously unknown fossils are a variety of spore-bearing fructifications. The author has published on three (*Lacoea seriata, Aulacotheca collicola*, and *Porostrobus nathorstii*). Additional taxa with *in situ* spores include *Telangiopsis* sp., fructifications associated with *Mariopteris* sp. and a variety of isolated sporangia. From the same locality are several hygrophyllous taxa with spores. These include *Calamostachys* sp. and *Lepidostrobus haslensis*. Determinations of associations of macrofossil taxa with spores aid with tracing geographic spread of plants, understanding plant evolution, interpreting the palynological record, and mapping paleoenvironments. Presence of numerous isolated spores suggests the parent plants were nearby even in strata where their macrofossils are unknown. Knowledge of the parent plants *of sporae disperse* (check term) aids interpretation of ancient plant communities.

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195. THE OCCURRENCE OF DISACCITES STRIATITI POLLEN GRAINS IN THE AMAZONAS BASIN NAMURIAN - PALAEOCLIMATIC AND PALEOGEOGRAPHIC IMPLICATIONS

The presence of Disaccites Striatiti (Pant 1954) pollen grains has been frequently used to define Upper Carboniferous/Permian ages in gondwanic neopalaeozoic basins.

Recently, Altiner and Savini (1991) attributed to the Monte Alegre, Itaituba and Nova Olinda Formations, at Amazonas Basin (Northern Brazil), ages ranging from Namurian to Neowestfalian, based on fusilinid microfaunas. They were correlated, by these authors with microfaunas recovered from Namurian/Westfalian sections of the American Mid-Continent.

Prior that paper, the Monte Alegre, Itaituba and Nova Olinda Formations were dated by Daemon and Contreiras (1974), based on palynology, ranging from Stephanian to Eopermian, due to the presence of Disaccites Striatiti pollen grains, and its correlation with gondwanic basins.

The new chronocalibration provided by the fusilinids microfaunas from the Amazonas Basin, had brought profound consequences on the Paraná Basin (Southern Brazil) biochronostratigraphical framework, were the fusilinid microfaunas do not occur.

At the Paraná Basin, as well as in all gondwanic basins, the Disaccites Striatiti microfloras have been used to assign Neocarboniferous/Eopermian ages, having not been recorded in strata older than Stephanian.

This apparent diachronism, among the Amazonas Basin and the southern gondwanic basins, characterized by an earlier appearence of the Disaccites Striatiti pollen grains in the former, could be explained by palaeoclimatic influences. The glacial age in the high latitude gondwanic basins, during Namurian/Early Westfalian times, could have played as a palaeoclimatic barrier to the development of the striatiti-pollen-bearing floras in these basins. On the other hand, at lower latitude basins, such as the Amazonas Basin, and the American Midcontinent basins, located at the Tethian, subtropical/tropical realm, and the warmer palaeoclimate allowed the development of these microfloras, since Namurian times. With the Gondwana continental migration/rotation northward during the Stephanian/Early Permian, the southern basins, such as the Paraná Basin, had achieved lower latitudes and, consequently, warmer palaeoclimates, which allowed the southward palaeofloristic migration.

This diachronic appearence of the group Disaccites Striatiti, due to palaeoclimatic factors, as suggested here, enhances the necessity of a deep reassessment of the reliability, as chronostratigraphic markers, in generic or even specific level.

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210. TAENIATE POLLEN IN THE BRITISH WESTPHALIAN AND THEIR STRATIGRAPHICAL SIGNIFICANCE

Silesian disaccate pollen grains of the Infraturma STRIATITI Pant 1954 are described from three horizons in the Westphalian of England and Scotland. Westphalian D miospore assemblages from mainly clastic sediments of the Newcastle Group in North Staffordshire are associated with common striatitid pollen attributed to the genera Complexisporites Jizba, Lunatisporites Leschik, Protohaploxypinus Samoilovich and Striatoabeites Zoricheva and Sedova.

Complexisporites and Protohaploxypinus species are also well represented in early Bolsovian grey coal measures of the Canonbie Coalfield, Dumfriesshire, Scotland.

The third horizon containing striate disaccate pollen is cored mudstones of the Vanderbeckei Marine Band (basal Duckmantian) from the U.K. sector of the Southern North Sea Carboniferous Basin.

Occurring at all three horizons is a complex of monosaccate Potonieisporites pollen grains in which the corpus is thickened proximally by verrucose elements. Alignment of the verrucae frequently results in a distinctive linear pattern of "pseudo-taeniae".

The stratigraphical, evolutionary and climatic significance of these occurrences will be discussed in the framework of sediment sequences and palaeogeography.

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216. THE OCCURENCE OF REWORKED MIOSPORES IN DEPOSITS OF THE UPPER SILESIAN SANDSTONE SERIES AND MUDSTONE SERIES IN THE AREA OF JAWORZNO (UPPER SILESIAN COAL BASIN)

Palynological assemblages from two boreholes Jaworzno 2729 and Jaworzno 5109, representing miospore zones *Stenozonotriletes triangulus - Rotaspora knoxi* (TK), *Triquitrites sinani - Cirratriradites saturni* (SS) and *Microreticulatisporites nobilis - Florinites junior* (NJ) contain older miospore species of early Namurian age belonging to the genera *Rotaspora, Tripartites* and *Schulzospora*, and single specimens of *Diatomozonotriletes cervicornutus, D. rarus, D. uberus, Triquitrites trivalvis, Grandispora spinosa, Krauselisporites echinatus, Spinozonotriletes uncatus* and acritarch *Tetrapanna horologia*.

These redeposited assemblages have been found in coarse clastic sediments in Jaworzno 2729 borehole and in deposits of Upper Silesian Sandstone Series and Mudstone Series from both boreholes.

The occurence of redeposited material implies that in this part of Upper Silesian Coal Basin the outcrops of Lower Namurian deposits have existed since Arnsbergian.

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263. ESSAY ON REAL NUMBER OF PREHISTORIC PLANT SPECIES ON THE BASE OF PALINOLOGICAL DATA

The new approach reconstructing the staff of Carboniferous and Permian vegetation by palynology data is proposed. This approach may be applied for the analysis of flora from different geologic periods. This approach includes mathematic model simulating the dependence of probability of the conservation of selection of miospores on geologic age.

It must be noted that in modern deposits of lakes the taxonomic staff of palynospectra reflects less than 10% of specific staff of plants.

The reconstruction of Paleozoic vegetation on palynologic data has a large defect, because the formal morphologic classification of miospores is used. This classification does not take in account 2 facts:

- the inconstancy of miospores within species;
- the phenomenon of convergence.

The new approach is based on ideas of Krenke (1935), Vavilov (1967), Meyen(1977). From the aforesaid authours it must be noted that taxon is characterized not only by some definite attributes, but also by the law of distribution of these attributes. The variation of quantitative characteristics has the appointed bound for any species (Cherepanov, 1985; Sapunov, 1985).

The knowledge about the scope inconstancy of the modern pollen and spores makes us to suppose the scope inconstancy of the related taxons in the Paleozoic.

Here are some features of our approach:

1. The starting volume of miospores selection is counted up.
2. The taxon is defined by the spectrum of attributes and by the law of distribution of quantitative characteristics.

The elaboration of Morphologic Conception of Species and the analysis of morphologic variety of miospores of Carboniferous-Permian makes it possible:

- to formalise the procedure of systematic description of miospores;
- to appreciate the amount of fossil taxons of plants;
- to present the general plan of the development stages of specia;
- to discern the periods of genetic instability in the history of the Earth.

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220. PALYNOSTRATIGRAPHY OF THE PENDLEIAN-ARNSBERGIAN BOUNDARY IN MIRK FELL GILL, NORTH YORKSHIRE, ENGLAND

The proposed boundary stratotype section for the Pendleian-Arnsbergian boundary, located at Slieve Anierin in Ireland contains the diagnostic ammonoid but the sediments are thermally too mature to permit the recovery of palynomorphs. A prospective parastratotype for the stage boundary has been investigated in Mirk Fell Gill, North Yorkshire, England. Hudson(1941) has previously reported the presence of the diagnostic ammonoid *Cravenoceras cowlingense* from the Mirk Fell Ironstones together with other ammonoids, brachiopodos and corals. Varker(1971) has reported on conodont faunas from the section.

A detailed palynological investigation involving a suite of 24 samples collected at regular intervals through the 175 m sequence of the Mirk Fell Ironstone, Mirk Fell Shales, Kettlepot Gannister and Tan Hill Coal is reported. The stage boundary has been equated by Owens *et al.* 1977 and Clayton *et al.* 1977 with the boundary between the *Bellispores nitidus-Reticulatisporites latisporites carnosus* (NC) and *Stenozonotriletes triangulus-Rotaspora knoxi* (TK) palynological zones. The results of the study confirm the general trends in miospore distribution but for the first time precise records relative to the position of the key ammonoid horizon facilitate minor emendations to the previously reperted stratigraphical ranges.

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227. PALYNOSTRATIGRAPHY OF THE DEVONIAN-CARBONIFEROUS SUCCESSION OF SW PORTUGAL: PRELIMINERY RESULTS

Preliminary results of a palynological investigation in SW Portugal suggest that the Upper Devonian - Carboniferous miospore succession is very similar to that further north in Western Europe.The Devonian - Carboniferous stratigraphic succession in the SW sector of the South Portuguese Zone, Portugal comprises, in ascending order; the Tercenas Formation, the Carrapateira Group and the Baixo Alentejo Flysch Group. The Tercenas Formation comprises dark marine shales with interbedded thin tempestites which are overlain by a 10m thick intertidal sandstone body. Rare clymenids, brachiopods and corals suggest a late Famennian to early Tournaisian age for this units. The base of the sandstone member corresponds to the boundary between the *Retispora lepidophyta - Verrucosisporites nitidus* (LN) Miospore Biozone and the *Vallatisporites verrucosus -Retusotriletes incohatus* (VI) Miospore Biozone and is approximately coincident with the Devonian -Carboniferous boundary. The Carrapateira Group comprises, in ascending order, the Bordalete Formation, the Murracao Formation and the Quebradas Formation. The Bordalete Formation is dominated by dark pyritic marine shales with charakteristic interbedded calcisiltitic nodules and lenticules. Rare goniatites and trilobites in the nodules indicate a Middle to Upper Tournaisian age. Miospore assemblages recovered from the Bordalete Formation are assigned to the *Vallatisporites verrucosus - Retusotriletes incohatus* (VI), *Spelaeotriletes pretiosus - Raistrickia clavata* (PC) and *Schopfites claviger - Auroraspora macra* (CM) biozones. The Murracao Formation consists of marly shales and dolomitic limestones which pass transitionally upwards into interbedded limestones and dark pyritic shales with abundant corals, crinoids, goniatites and trilobites of lower Visean - lower Namurian age. Miospore assemblages from this formation are assigned to the *Lycospora pusilla* (Pu), *Raistrickia nigra - Triquitrites marginatus* (NM) and *Tripartites vetustus - Rotaspora fracta* (VF) biozones. The Quebradas Formation consists of pyritic black shales with intercalations of detrital limestones; goniatites indicate a Namurian age. Miospore assemblages from this unit have so far been assigned to only one of the Western European zones, the *Raistrickia fulva - Reticulatisporites reticulatus* (FR) Biozone. The highest unit in the Baixo Alentejo Flysch Group is the Brejeira Formation, a southwestward prograding turbidite succession which has provided rare goniatites of middle Namurian to lower Westphalian age. In the northeastern area miospore assemblages are similar to those from the Quebradas Formation (FR Biozone). Further southwest, miospore assemblages are progressively assigned to the *Triquitrites sinani - Cirratriradites saturni* (SS) and *Radiizonates aligerens* (Ra) Biozones around the Bordeira and Aljezur Anticlines, and to the *Microreticulatisporites nobilis - Florinites junior* (NJ), *Torispora securis - T. laevigata* (ST) and *Thymospora obscura - T. thiessenii* (OT) Biozones indicating also that in the south the succession extends upwards into the uppermost part of Westphalian C or Westphalian D.

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247. THE CORRELATION OF MID-WESTPHALIAN MARINE BANDS BETWEEN THE CENTRAL APPALACHIAN BASIN (USA) AND THE UNITED KINGDOM

By comparison of ammonoid, conodont and palynological data from the mid-Westphalian successions of the Central Appalachian Basin (USA) and the United Kingdom it is possible to correlate marine bands (maximum flooding events). Thus, the Betsie Shale and Magoffin Member of Kentucky correlates with the Vanderbeckei and Aegiranum marine bands of the UK, marking the bases of the Duckmantian (Westphalian B) and Bolsovian (Westphalian C) stages respectively. Between these horizons there are six marine incursions into the Appalachian and UK sequences, although in the UK, two of these are represented only by black shales with estheriids. Precise correlation of the overlying Bolsovian marine bands is less clear, however it is likely that the Kilgore Flint Member of Kentucky is the Cambriense Marine Band, which is the youngest recognised Westphalian marine incursion in the U.K.

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289. PALYNOSTRATIGRAPHY OF THE UPPER CARBONIFEROUS SEDIMENTS IN SOME BOREHOLES FROM THE SOUTH-EASTERN PART OF THE INTRA-SUDETIC DEPRESSION

Results of miospore investigations of the Upper Carboniferous in 5 boreholes from the south-eastern part of the Intra-Sudetic Depression are presented.

The display will show the stratigraphic succesion of miospore assemblages achieved in the strata the best palynologically documented and microscopic slides with the index and characteristic miospores.

Microflora was separated from the barren core sections of the Podlesie IG 1, Kolno IG 1, Miłków IG 1, Koszyn IG 1, Ścinawka Dln. IG 1 boreholes.

The distinguished miospore assemblages made three stratigraphic complexes of the Upper Carboniferous possible to be identified.

(1) Lower Namurian A

(2) Lower Westphalian (WA)

(3) Stephanian

The upper boundary of the Lower Namurian A stratigraphic complex is well palynologically documented.

The Lower Namurian miospore assemblages mainly composed of species of short (Upper Visean - Lower Namurian) stratigraphic range: *Rotaspora knoxi, R.fracta, Acanthotriletes castanea, Pustulatisporites papillosus, Tripartites astricus T.annosus, T.pseudoianthina, T.incudis, T.scissus, T.rugosus, Triquitrites marginatus, Waltzispora planiangulata, Spinozonotriletes uncatus* that most of them decline in the upper part of Namurian A.

The Lower Westphalian (WA) stratigraphic complex is palynologically characterized by the co-existance level of a large group of namurian-westphalian miospores and index species of Westphalian A: *Savitrisporites asperatus. S.concavus, Dictyotriletes bireticulatus, Raistrickia aculeata, R.protensa, R.superba, R.fulva, Alatisporites pustulatus, Endosporites zonalis, Florinites junior, F.antiquus, F.visendus, Lophotriletes granoornatus.*

Biostratigraphic correlation of the assigned complexes confirms the identity of palynostratigraphic events on the border line between the Lowermost Namurian and the Lower Westphalian (WA) assemblages.

Palynostratigraphic succesion of miospore species observed in the adjoining stratigraphic complexes shows a tendency to rejuvenation.

Lack of characteristic visean-namurian miospore species simultaneously with the appearance of species with optimum in Lower Westphalian (WA) suggests the existance of stratigraphic gap covering Upper Namurian (NB-NC).

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290. NEW LOCALITY OF THE UPPER PERMIAN MICROFLORA IN THE MARGIN OF THE UPPER SILESIA COAL BASIN

Recent palynological data achieved in three boreholes from Tarnowskie Góry and Bolesław basins suggest the Upper Permian age of the investigated deposits (S.Dybova-Jachowicz, H.Kiersnowski, A.Trzepierczyńska, 1991).

The distinguished miospore assemblages with the predominated index and characteristic species of Disaccate pollen grains: *Lueckisporites virkkiae, Gardenasporites oberrauchii, G.leonardii, Strotersporites wilsoni, S.richteri, Vestigisporites methoris, V.balmei, Limitisporites moersensis, Jugasporites delasaucei, Lebachia pinniformis et all.*, determine and confirm the Upper Permian age of the sediments in question.

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292. THE FIRST APPEARANCE IN EUROPE OF *LYCOSPORA PUSILLA* (IBRAHIM) SOMERS AND ITS RELATIONSHIP TO THE TOURNAISIAN/VISEAN BOUNDARY

Lycospora pusilla (Ibrahim) Somers is either an index species or a characteristic taxon of miospore biozones throughout Europe. Its first appearance is clearly close to the Tornaisian/Visean boundary but a precise correlation has not yet been established. In the British Isles, the first appearance of *Lycospora pusilla* in assemblages already containing *Anaplanisporites baccatus, Colatisporites multisetus, Prolycospora claytonii, Schopfites claviger* and *S. delicatus* defines the base of the *Lycospora pusilla* (Pu) Biozone. The situation is similar in Rügen (North Germany), Western Pomerania (nortwest Poland) and the Pripyat Depression (Belorus) where the first appearance of *L. pusilla* in assemblages containing *C. multisetus, P. claytonii, S. claviger* and *S. delicatus* has also been used to define the *Lycospora pusilla* (Pu) biozones. In all these regions the *L. pusilla* Biozones are, in effect, interval zones. In the Volga - Urals regions (Russia), the zonal concept employed is markedly different and the bases of the Dinantian miospore biozones are based primarily on relative abundance of "characteristic taxa". *L. pusilla* is one of the index species of the *Lycospora pusilla - Monilospora culta* (PC) Biozone within which it occurs in large numbers in association with *A. baccatus, C. multisetus, P. claytonii* and *S. delicatus*, but also with diverse cingulate spore genera including *Simozonotriletes, Densosporites, Monilospora* and *Vallatisporites*. However, it is not clear whether the first appearance of *L. pusilla* coincides with the base of this zone. Independent faunal control is sparse but is consistent with the first appearance of *L. pusilla* being synchronous throughout Europe (with the possible exception of the Volga - Urals regions) and close to the Tournaisian / Visean boundary.

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295. PALYNOSTRATIGRAPHIC CORRELATION OF UPPER PERMIAN ROCKS OF THE CANADIAN ARCTIC, SOUTHERN BARENTS SEA AND VOLGA/URALS, RUSSIA

Correlation of Permian rocks throughout the world is based partly on comparisons with stratotype sections located in and near the Urals, Russia. Lower Permian stages are well defined by their abundant marine faunas (Asselian, Sakmarian and Artinskian), but more problematical are the partially marine younger stages with their sparse marine faunas (Kungurian, Ufimian and Kazanian) and the essentially non-marine Tatarian Stage.

Of considerable importance to the Permian of North America is the correlation of the stratotypes of the Wordian and Capitanian stages of Texas (Guadalupian) with the Kazanian stratotype of Russia. This correlation, which has been proposed by a number of workers, is tentative because, although the dominantly carbonate Guadalupian stratotypes contain a rich, diverse fauna of conodonts, brachiopods, fusulinaceans and ammonoids, the Kazanian stratotype has only a sparse marine fauna of brachiopods and bivalves and a non-marine fauna of bivalves, ostracods, and conchostracans.

Palynostratigraphic correlation between the Wordian, Capitanian and Kazanian stratotypes is not possible because palynomorphs have yet to be found in the Texan localities, although abundant well preserved pollen and spores occur in the Kazanian. Detailed palynological information is available, however, from rocks dated as Wordian (Trold Fiord Formation) by ammonoids, brachiopods and conodonts in the Sverdrup basin of the Canadian Arctic. The Trold Fiord assemblages are very different from those of the Kazanian stratotype. The reasons for these differences, if the rocks are time equivalent, could be related to numerous factors including differences in floral province, paleoclimate, paleolatitude, and facies. More similar to the Canadian material are assemblages from rocks of Kazanian/Tatarian age (based on bivalves and brachiopods) from the subsurface of Kolguyev Island, southern Barents Sea.

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311. PHYTOGEOGRAPHIC AND BIOSTRATIGRAPHIC IMPLICATIONS OF MIDDLE MISSISSIPPIAN (OSAGEAN-MERAMECIAN) PALYNOMORPHS FROM THE MID-CONTINENT UNITED STATES

The geographic and stratigraphic distribution of palynomorphs in the Middle Mississippian of the United States is not well documented. Well preserved assemblages have been recovered from a surface exposure from Illinois and two coreholes from Indiana. Sample analyzed are from the following three locations: 1, Type Section of the Warsaw Shale, Hancock Co., Illinois; 2, Borden Group (undifferentiated) - New Providence Shale, Indiana Survey Drill Hole 328, Fountain Co., Indiana; and 3, Borden Group (undifferentiated) - New Providence Shale, Indiana Survey Drill Hole 331, Warren Co., Indiana.

The assemblage is dominated by new taxa. Most can be assigned to the following genera: *Apiculatisporis, Auroraspora, Cirratriradites, Crassispora, Cyclogranisporites, Densosporites, Discernisporites, Duvernaysphaera, Grandispora, Granulatisporites, Grumosisporites, Lophozonotriletes, Neoraistrickia, Punctatisporites, Radiizonates, Raistrickia, Retusotriletes, Spelaeotriletes, Unellium, Vallatisporites* and *Verrucosisporites*. The assemblage cannot be directly compared to the spore zones (PC, CM, and PU) of western Europe suggesting phytogeographic diversification between the two regions. The assemblage is pre-*Lycospora* and contains *Vallatisporites/Radiizonates* types not assignable to the older (e.g., Kinderhookian) part of the geological column. The assemblage, with few exceptions, also differs from that described from the lowest Borden Group of Kentucky. This can be explained by possible reworking of Kinderhookian palynomorphs into the lower Borden formation (e.g., the Devonian forms *Ancyrospora* spp., *Hystricosporites* spp., *Retispora lepidophyta, Quisquilites buckhornensis* are present in the Indiana Borden Group samples) or that diachronism exists between the Borden deltaic sediments of southeast Kentucky and west-central Indiana.

PALYNO/CHRONOSTRATIGRAPHIC CORRELATIONS OF EARLY PENNSYLVANIAN STRATA IN SOUTHWESTERN INDIANA, U.S.A.

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Well-preserved and abundant miospores were recovered and identified from samples in five core holes and five outcrops from the Mansfield Formation of the Pennsylvanian Morrowan Series in southwestern Indiana. The samples are from Daviess and Martin Counties, Indiana, in the eastern portion of the Illinois Basin. The palynomorphs aid in the correlation and age differentiation of the Pennsylvanian rocks below the Desmoinesian cyclothems. The palynofloras are comparable to those reported from the Caseyville and Kilbourn Formations of Iowa and the Caseyville and Abbott rocks in Illinois. These formations are considered to be Morrowan and Atokan by Ravn and Peppers. The stratigraphic ranges of some of the taxa are modified by this study. For example, *Anafoveosporites avcinii* extends higher in the Atokan age sediments than previously reported.

Guennel used the term Pottsville Series for his studies on the Mansfield and Brazil Formations in Indiana. He did not utilize the standard Midcontinent Pennsylvanian chronostratigraphic nomenclature for differentiating the Morrowan and Atokan, which ranges in age from Namurian C to Westphalian B in the European stages. The top of the Morrowan (Westphalian A) has been interpreted by Ravn and Peppers as marked by the extinction of *Schulzospora rara*. Another miospore that became extinct at this time is *Radiizonates striatus*. Both of these taxa are present in the deepest shale at 277.2-290' in core hole 27-Kf-2 in Daviess County. We would place the Morrowan/Atokan boundary above this shale near the position of the Pinnick Coal Member of the Mansfield Formation. Several species of *Densosporites*, rare *Lycospora noctuina* and common *Lycospora pellucida* are present along with many taxa reported from the Caseyville Formation. Peppers places the Morrowan/Atokan boundary just above the St. Meinrad coal in Indiana. The Atokan is characterized by the miospores *Vestispora pseudoreticulata, V. fenestrata*, frequent *Endosporites globiformis*, consistent occurrences of *Dictyotriletes bireticulatus*, and the first occurrences of *Triquitrites sculptilus. Radiizonates difformis* and *Renisporites confossus*. A large number of miospore species reported from the Abbott and Kilbourn Formations of Illinois and Iowa are present in the shale samples analyzed.

Oil droplets, petrolic filament bodies, are present in several of the shale samples. The thermal alteration index (TAI) is 4/4+ with an interpreted Ro of 0.6. This would place the organic material at early peak oil generation. The Pennsylvanian sediments in this area must have been buried much deeper than at the present time to have this degree of thermal alteration.

The palynologic correlations coincide with extensive chronostratigraphic geophysical log correlations in southwestern Indiana which establishes a tie between the outcrop type sections and the subsurface. The time lines developed by integrating the palynological and geophysical data on the cross sections in Daviess and Martin Counties supports a northerly transgression onlap model for Mansfield Formation deposition. **(Poster)**

MIOSPORES AND CONODONTS FROM THE DEVONIAN STRATA OF THE WESTERN PART OF THE MICHIGAN BASIN

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The westernmost extent of Devonian strata of the Michigan Basin is represented by a narrow north-south trending belt in southeastern Wisconsin. Recent construction of deep sewer tunnels in Milwaukee has made available cores through most of the Devonian section. Devonian strata in Wisconsin have been assigned to four formations. These are, in ascending order, the Lake Church, Thiensville, Milwaukee, and Antrim Formations. The Antrim does not occur in surface outcrop, nor was it present in the available cores, and will not be considered herein. Dolostone is the dominant lithology of the lower three formations, although shales and argillaceous dolostones are common in the upper part. Interpreted depositional environments range from open marine to restricted peritidal. Samples from the cores, as well as from surface exposures, have been simultaneously processed for miospores and conodonts. Conodonts have been recovered from much of the section, and suggest a range in age from Late Eifelian (*kockelianus* Zone) to Late Givetian or possibly earliest Frasnian (*norrisi* Zone). Although miospores are present throughout the section, this is the first report of their occurrence in the Wisconsin Devonian. The miospores tend to be abundant, diverse, and well-preserved, and occur both in direct association with conodonts and in strata barren of conodonts. In general, the miospore floras appear to agree with the conodont-based age determinations. A possible exception to this is in the Thiensville Formation where a limited conodont fauna suggests an age no older than Givetian. Miospores from these samples, however, suggest that these strata may be Eifelian in age. Many of the miospore taxa appear to be endemic to the Midcontinent Region of North America. For example, some forms, such as *Dibrochosporites nodosus*, encountered in the Thiensville and Lake Church Formations, have elsewhere only been reported from the Wapsipinicon Group of Iowa and Illinois. Although these forms may be of limited biostratigraphic value outside of this area, some appear to have potential biostratigraphic utility within the Midcontinent region.

NON-MARINE ALGAL CYSTS FROM LOWER PALEOZOIC PARALIC ROCKS

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Some of the best-preserved Silurian and older assemblages of non-marine palynomorphs occur in mudstones interbedded with sandstones rich in trace fossils. These sequences, with abundant *Cruziana* and *Rusophycus*, can be quite depauperate in normal marine body fossils. But the same units have the potential to preserve a diverse palynoflora, as has been demonstrated for the Silurian Tuscarora Formation of Pennsylvania and the Middle Ordovician Hanadir Shale in Saudi Arabia. In these rocks, the cryptospores recovered represent convincing evidence of the presence of land-dwelling plants that had evolved beyond an algal grade.

The recent discovery of membrane-enclosed cells and cell clusters from the Middle Cambrian Bright Angel Shale in Arizona opens up the possibility that fresh-water algae may have contributed significantly to the "leiosphere" fraction that typically dominates shallow marine palynological assemblages in the lower Paleozoic. These presumed algal cysts are quite unlike the typical marine acritarchs which would normally occur in reduced fine-grained siliciclastics from this period. Morphologically, this fossil assemblage is comparable to the population-level variation that occurs when the extant freshwater alga, *Oöcystis lacustris* (?) is transported into brackish water, forming *Tetradeon*-like morphologies.

Pre-Devonian deposits that have preserved terrestrial organic remains are exceedingly rare. The palynological assemblage from the Bright Angel Shale, while remaining problematic, quite probably represents a rare glimpse into the fossil remains of freshwater, hence "terrestrial", organisms from the Middle Cambrian. The enclosing membranes of resistant organic composition which characterize these fossils seem to be a trait that carries over to early embryophytic cryptospores occurring in the Ordovician.

IMPLICATION OF THE DISCOVERY OF REWORKED AND IN SITU LATE PALEOZOIC AND TRIASSIC PALYNOMORPHS ON THE EVOLUTION OF SIRT BASIN, LIBYA

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The origin and age relationships of the Paleozoic and continental Mesozoic sediments in the Sirt Basin have remained obscure due to a scarcity of fossils. Palynological examination of sediments from the eastern flank of the Kalash Trough, Sarir 'C' Main Trough and western Abū Attiffel Graben in the southeast Sirt Basin has revealed the presence of reworked marine and non-marine Late Paleozoic palynomorphs in Mesozoic sediments. In situ and reworked palynomorphs are also recognized in the Waddān Shelf and Tagrifet Trough in the western Sirt Basin. The discovery of these palynomorphs is evidence of sedimentation during the Late Paleozoic spreading across the intra-cratonic basin of North Africa. Furthermore, the recently reported (El-Arnauti *et al.*, 1985) discovery of well-preserved Triassic palynomorphs in lacustrine-lagoonal shales within the Āmāl Formation (formerly Cambro/Ordovician) in Kalash Trough extends the Early Mesozoic sedimentation to Triassic times in the Sirt Basin.

Available biostratigraphic data permit the prediction of Silurian/Devonian and Early Carboniferous sediments preserved in grabens created by the Hercynian Orogeny. The presence of Late Carboniferous-Permian volcanoclastics and Triassic sediments represents the first Hercynian sedimentary fill of proto-Sirt Basin grabens.

These findings conflict with those of Bonnefous (1972) and Massa and Delort (1984), who postulated non-deposition of sediments in Sirt Basin from the Ordovician to the Jurassic, but are in agreement with Hea (1969) who predicted, on regional geological evidence, that the continental Mesozoic in the southern Sirt Basin may contain basal beds ranging in age from Paleozoic to Early Cretaceous. The existence of additional sedimentary sequences hitherto thought to be missing should be taken into consideration for future hydrocarbon exploration in Sirt Basin.

CHRONOSTRATIGRAPHIC CORRELATION OF THE MISSISSIPPIAN BORDEN GROUP OF THE NORTHERN ILLINOIS BASIN

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The geographic and stratigraphic distribution of palynomorphs within the Early to "Middle" Mississippian of the United States is not well documented. Well-preserved assemblages from this interval have been recovered from a surface exposure in Illinois and from two coreholes in Indiana. Samples analyzed are from the following three locations in the northern Illinois Basin: 1, type section of the Warsaw Shale, Hancock County, Illinois; 2, Borden Group (undifferentiated) Indiana Geological Survey Drill Hole 328, Fountain County, Indiana; and 3, Borden Group (undifferentiated) Indiana Geological Survey Drill Hole 331, Warren County, Indiana.

The assemblage is dominated by new species. Many can be assigned to the following genera: *Apiculatisporis, Auroraspora, Cirratriradites, Crassispora, Cyclogranisporites, Densoporites, Discernisporites, Duvernaysphaera, Grandispora, Granulatisporites, Grumosisporites, Lophozonotriletes, Neoraistrickia, Punctatisporites, Radiizonates, Raistrickia, Retusotriletes, Spelaeotriletes, Unellium, Vallatisporites* and *Verrucosisporites*. The assemblage cannot be directly compared to the spore zones (PC, CM, and PU) of western Europe, suggesting phytogeographic diversification between the two regions. The microflora is pre-*Lycospora* and contains *Vallatisporites/Radiizonates* types not assignable to the older (e.g., Kinderhookian) part of the geological column. These data suggest that an unconformity may exist in Fountain County where the Rockford Limestone may be the only Kinderhookian present above the Late Devonian New Albany Shale. Geophysical logs have been integrated with palynological data to subdivide the Borden Group into time intervals and to correlate them to the limestone formations (i.e., Choteau, Burlington, Keokuk and Ullin Limestones) of the Burlington-Keokuk shelf of west central Illinois. This chronostratigraphic correlation will allow paleogeographic mapping of time intervals within the Borden Group.

Sandstone is prevalent in the lower half of the Borden Group from Fountain County, west central Indiana to Coles County, east central Illinois. Siltstone dominates the Borden from Coles County to Fayette County, of central Illinois. The siltstone most likely interfingers across Montgomery County, Illinois with carbonates which become abundant in Macoupin County, west central Illinois. Future work will extend this analysis to the southern part of the Illinois Basin where it should be useful in delineating potentially productive reservoir hydrocarbon facies in the Warsaw Shale, which is time equivalent to the upper Borden of west central Indiana. (Poster)

PHYTOGEOGRAPHIC SIGNIFICANCE OF POLLEN AND SPORES FROM FUYANG BASIN COALS, ANHUI PROVINCE, PEOPLE'S REPUBLIC OF CHINA

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Core samples from two wells of the Fuyang Basin have yielded an extremely well preserved and diverse assemblage of pollen and spores. The assemblage includes *Anticapollis tornatilis, Apiculatisporites spinulistratus, Bactrosporites shaoshanensis, Calamospora sterosa, Crassispora kosankei, C. orientalis, Densosporites muricatus, Dictyotriletes reticulocingulum, Falcisporites nuthallensis, Florinites florinii, F. mediapudens, Gravisporites shanxiensis, Gulisporites cochlearis, G. laevigatus, Kaipingispora ornatus, Lophozonotriletes yanzhouensis, Macrotorispora gigantea, M. media, Perocanidospora clatrata, Pityosporites tongshanii, Platysaccus insignis, Radiizonates solaris, Raistrickia sp., Schizaeisporites microrugosus, Schopfipollenites sp., Shanxispora cephalata, Striatopodocarpites fusus, Striatosporites irregularis, Striolatospora major, Sulcatisporites ovatus, Torispora acanthus, T. attenuatus, T. hunanensis, T. incisus, T. securis, T. sinensis, T. tribullatus and Vesiculatisporites meristus.*

The section penetrated by these wells are assignable to, oldest to youngest, the Shanxi and Shihezi formations. Certain aspects of the microflora are very similar to assemblages that dominate the Upper Carboniferous (Westphalian-Stephanian) of the Euramerica floral province. These include *Macrotorispora, Torispora, Radiizonates* and *Triquitrites* which become extinct or exhibit a marked decline at the Carboniferous-Permian boundary in Euramerica. The presence of these taxa in the Permian-Cathaysian floral realm indicates that conditions in the South China plate were tropical-subtropical. During the Permian this region acted as a refugium for the parent plants. This supports paleogeogaphic information that suggests the South China Plate has moved northward since the Permian time. (Poster)

Titles of the Special Issue in Review of Palaeobotany and Palynology on **Palaeozoic Palynostratigraphy of the Kingdom of Saudi Arabia**, results of a joint study between Saudi Aramco and C.I.M.P.

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Special Issue

PALAEOZOIC PALYNOSTRATIGRAPHY OF THE KINGDOM OF SAUDI ARABIA

Results of a Joint Study between

The Geological Research & Development Division,
Geological Department, Saudi Arabian Oil Company (Saudi Aramco)

and the

Commission Internationale de Microflore du Paleozoique (CIMP)

Project Co-ordinators and Editors

B. Owens, H. Al-Tayyar, J.G.L.A. Van Der Eem, and **S. Al-Hajri**

The Loeblich-Tappan Festschrift: in press

In Acritarch Newsletter 5, we announced the preparation of a Festschrift to honour Drs Helen Tappan and Alfred R. Loeblich. This Festschrift is now complete. Reed Wicander has finished the editorial work and the volume is now in press as a special volume of the Review of Palaeobotany and Palynology. It includes the following papers:

Cornell, W.C. Preliminary report of dinoflagellate cysts from the Buda Limestone (Cenomanian), Cerro de Cristo Rey, Dona Ana County, New Mexico, U.S.A.

Damassa, S.P. *Evittosphaerula paratabulata* Manum 1979 and *Chaenosphaerula magnifica* n.gen., n. sp. from deep sea drilling project site 338, Norwegian Sea.

Le Hérissé, A., Gourvennec R., & Wicander, R.

Biogeography of Late Silurian and Early Devonian acritarchs and prasinophytes.

Miller, M.A., Playford, G., & Le Hérissé, A.

Clypeolus, a new acritarch genus from the Ordovician and Silurian.

Molyneux, S.G. & Leader, R.U.

Morphological variation in *Coryphidium* from the Arenig of northwest England.

Ribecai, C. & Tongiorgi, M.

Lusatia dramatica, a distinctive new species from the Upper Cambrian of Öland (Sweden).

Rubinstein, C.V. Tremadocian acritarchs from northwestern Argentina.

Servais, T. The Ordovician *Arkonia-Striatotheca* acritarch plexus.

Srivastava, S.K. Cell-wall morphology of a recent placoderm desmid species, *Straurastrum pingue*, from Lake Worth Dam, Tarrant County, Texas, U.S.A.

Vavrdová, M. Early Ordovician provincialism in acritarch distribution.

Wicander, R. & Wood, G.D.

The use of microphytoplankton and chitinozoans for interpreting transgressive/regressive cycles in the Rapid Member of the Cedar Valley Formation (Middle Devonian), Iowa.

Wood, G.D. Internal structures in the acritarch Hoegklintia digitata.

Yin Lei-ming Acanthomorphic acritarchs from Middle-Upper Proterozoic shales of the Ruyang Group, Shanxi, China.

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Dr. Volker WILDE, Forschungsinstitut Senckenberg, Senckenberganlage 25, D-60325 Frankfurt, Germany.

AGENDA OF FUTURE PALYNOLOGICAL CONFERENCES, SYMPOSIA, WORKSHOPS 1996:

9th INTERNATIONAL PALYNOLOGICAL CONGRESS, Houston, Texas (22-29 June 1996).
CIMP is sponsoring a half-day **CIMP symposium on Palaeozoic palynology** at the 9th International Palynologic Congress to be held in Houston, Texas. I agreed to chair this session and have sent a letter inviting CIMP members to participate in this symposium. It is hoped that by hosting a symposium under the CIMP banner, we can increase recognition of our organisation within the international palynological com-munity and let people know about some of the exciting research being undertaken in the Palaeozoic by our members. The papers can be on any aspect of Palaeozoic palynology and I am hoping for a wide range of topics to be presented. The talks will be 15 minutes long with 5 minutes for questions (20 minutes total time). If you did not receive your letter of invitation and would like to participate in our symposium, please send me the title of your talk as soon as possible as I have to let the Program Chairman know by December 1, 1995 how many will be in our symposium. Reed WICANDER

Contact: Sarah P Damassa, 3 Ridge Street, Winchester, MA 01890 USA or D.J. Nichols; Fax :303-236-5690;E-mail: dnichols@greenwood.cr.usgs.gov

THIRD BALTIC STRATIGRAPHIC CONFERENCE, TALLINN, ESTONIA (8-11 October, 1996). The main topic will be high-resolution biostratigraphy and Baltic regional stratigraphy. Two days excursion for study of early Palaeozoic outcrops around Tallinn.

Contact: Jaak NÕLVAK, Correspondence Secretary, Institute of Geology, 7 Estonia Ave, EE 0001, Tallinn, Estonia. Fax 372.6.312074, E-mail: jaak@pzgeol.gi.ee

30TH INTERNATIONAL GEOLOGICAL CONGRESS, BEIJING, CHINA, (4-14 August 1996). 30th IGC, P.O. box 823, Beijing 100037, P.R. China.

Erratum CIMP
Directory june 1995
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"Lycospora" First Occurrence Working Group
Contact person: Elzbieta Turneau, Instytut Nauk Geologicznych, Polska Akademia Nauk, Ul. Senacka 1/3, 31-002 Krakow, Poland.

Upper Devonian "Grandispora" Working Group
Contact person: Ken Higgs, Department of Geology, University College Cork, Cork, Ireland.

Reworked Palynomorphs Working Group
Contact person: Philippe Steemans, Lab. ass. de Paléontologie, Université de Liège, 7 Place du Vingt-Août, B-4000 Liège, Belgium

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Secretary: Thomas Servais, Lab. ass. de Paléontologie, Université de Liège, 7 Place du Vingt-Août, B-4000 Liège, Belgium

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