

VOLUME 55

**COLLOQUE
SUR LA STRATIGRAPHIE
DU CARBONIFÈRE**

Compte-rendus de la 8^e Réunion de la
Commission Internationale de Microflore du Paléozoïque (C.I.M.P.)
et de l'assemblée générale de
I.U.G.S. Subcommission on Carboniferous Stratigraphy (S.C.C.S.)
tenues à Liège, du 15 au 20 avril 1969.

Ouvrage publié par les soins de
M. Streef (Liège) et R.H. Wagner (Sheffield)

**Palynology
of the Devonian-Carboniferous boundary**

B. OWENS,

Institute of Geological Sciences, Leeds, England

M. STREEF,

Laboratoire de Paléontologie végétale, Université de Liège, Belgique

UNIVERSITÉ DE LIÈGE

1970



Palynology of the Devonian-Carboniferous Boundary

(Report on Project B of the 3rd C.I.M.P.
Meeting on Palaeozoic Stratigraphy)

B. OWENS¹ & M. STREEL²

The organisation of Project B was entrusted to M. Streel by the Secretary General in December 1968.

Two circulars were sent out in December 1968 and February 1969 to palynologists likely to be interested in this particular stratigraphic interval. In order to promote discussions, the important palynological data concerning this interval in the Ardennes-Rhine Basin, data in part unpublished, was sent with the second circular. Very few palynologists replied in the detailed manner that was requested. We however wish to thank Drs. Kedo (Minsk) and Peniguel (Pau) who sent details of the stratigraphic distribution of the principal species in Bielorussia and France, Africa and Australia respectively. Several other palynologists have sent details of works in press : Lanzoni & Magloire (1969) on the western Sahara ; Eames & Graham, who have amplified the results previously obtained by Winslow in Ohio. Other palynologists provided details of texts or resumes of the principal points in the communications that they were to present at the meeting, i.e. Combaz (Pas-de-Calais), Kaiser (Bear Island), McGregor (Canada) and von Almen (Oklahoma).

In an introductory account, Streel proposed a precise terminology which could be used in the subsequent discussions. He described the various classic reference sections in the Ardennes-Rhine Basin and outlined the correlation possible between the sections as follows :

1. The boreholes from Tournai and Leuze in the Tournaisian and the sections designated as Lower and Middle Tournaisian by Legrand, Mamet & Mortelmans 1966.
2. The sections from the Avesnois : Etroeungt, Avesnelles and St. Hilaire designated by Conil *et al.* at Sheffield and by Mamet at Calgary to serve as a basis for a precise definition of the Famennian/Tournaisian boundary.

1 Institute of Geological Sciences, Ring Road Halton, Leeds, Great Britain.

2 Laboratoire de Paléontologie végétale, Université de Liège, Belgique.

3. The section at Hastières, reference section of Tn1b as defined by Conil (1964) or of the former T1a of the Belgian Geological Map.
4. The section at Rivage-gare, reference section for the Assise de Comblain-au-Pont (Mourlon 1875).
5. The section at Ratingen. Reference section for the easternmost part of the calcareous facies of the Carboniferous.
6. The sections from Hönnetal. International reference sections for the succession based on the cephalopods and conodonts.

These sections are published in detail in the Liège symposium volume in order to show the possible palaeontological correlations between British Isles, France, Belgium and Germany for the beds at the horizon of the Devonian - Carboniferous transition (see Austin *et al.* 1970).

On the basis of this evidence Streeel commented on the principal non-palynological guide fossils. The most important is without doubt the appearance of the goniatite fauna including *Gattendorfia subinvoluta* in zone cu I, marking the base of the Carboniferous (in the sense defined by the Heerlen Congress in 1935). He recalled that unfortunately *Gattendorfia* was not found in the other sections where another cephalopod, *Cymaclymenia euryomphala* is present. The latter had been found not only in the shales below the limestone with *Gattendorfia* but also at the top of the section of the Etroeungt in the Avesnois. Streeel noted next the apparent absence of conodont zones in the Hangenberg Shales below the limestones with *Gattendorfia* (1). Conodont assemblages were however present in the limestone with *Gattendorfia* (*Siphonodella* zones) and also in the Wocklumer Kalk below the Hangenberg shales (*costatus* zone). Streeel showed next that *Siphonodella* is found in the Dinant region near to the type section at Hastières and that *Spathognathodus costatus ultimus* (= to VI) has been found in the section recently defined as Fa 2d in the Ourthe Valley (see Excursion Guide, 13th April). The conodonts and cephalopods present in the Franco-Belgian and German sections show well that the Etroeungt section is, at least in part, of Devonian age in the sense defined at Heerlen in 1935. This has resulted in the permanently confusing situation in which in France, Belgium and the USSR, one calls part of the Tournaisian the Etroeungt Beds which are of Devonian age according to the decisions of the Heerlen Congress. Streeel next pointed out the additional difficulties which had resulted from the fact that the termino-

(1) *Postscript* : a *Protognathodus*-Fauna has recently been described by Ziegler (1969) from a limestone lens inserted within the Hangenberg Shales at Stockum.

logy of Lower Tournaisian chronostratigraphic connotations covered very diverse stratigraphic interpretations. He stated that the Lower Tournaisian defined at Tournai by Legrand, Mamet & Mortelmans possessed only a guide fauna of foraminifera which transgressed the Dev./Carb. boundary *sensu* Heerlen 1935. There was not, therefore enough non-palynological proof that the Lower Tournaisian defined at Tournai was to be regarded as Devonian or Carboniferous.

Streel then recalled that an assemblage of spores had been described in 1962 by Mrs. Caro-Moniez from the Tournai borehole in Belgium. He showed that his assemblage contained in reality both *Hymenozonotriletes lepidophytus* Kedo and *H. pusillites* Kedo and he then attempted to place this assemblage in the succession of spore assemblages encountered in the Ardennes-Rhine Basin.

It was next pointed out by Streel that the assemblage isolated from the uppermost Famennian deposits (in the sense of Legrand, Mamet & Mortelmans 1966), is in reality of Lower Tournaisian age and seems to correspond to that part of Tn1b that could be of Carboniferous age in the sense of the Heerlen Congress of 1935.

Finally summarising the different quantitative and qualitative palynological characteristics which occur from Fa2c (Evioux) to Tn2a, Streel suggested by comparison with the reference sequence in the Ardennes-Rhine Basin, correlations for the different sets of detailed information that had been received. He placed particular importance on the quantitative characteristics of species such as *Hymenozonotriletes lepidophytus* and *H. pusillites* and noted particularly new important information received from Lanzoni & Magloire where assemblages rich in *Vallatisporites* had been found in samples from the Algerian Sahara occurring above the level of *Gattendorfia*. In conclusion, Streel proposed to supply a report on the stratigraphical value of those species. (This report is published in the present volume : see p. 121).

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The principal palynological results of an examination of the Lower Carboniferous of Bear Island were then outlined by Dr. Kaiser. The succession examined is summarised below,

Upper Carboniferous

Culm Series	Lower Carboniferous plant fossils
Tunheim Series (coal bearing)	<i>Cyclostigma</i> - <i>Archaeopteris</i> flora
Flözleeres	
Misery Sandstone Series (coal bearing)	

Ordovician

Kaiser reported that he had recorded *Hymenozonotriletes lepidophytus* var. *minor* from the Tunheim Series which had also yielded a macroflora containing *Cyclostigma* and *Archaeopteris*. He suggested therefore that this unit was of Tn1a age. He noted that *H. lepidophytus* var. *minor* occurred in considerable numbers from its first appearance and that *Lophozonotriletes rarituberculatus* (Luber) Kedo occurred in the middle part and *Hymenozonotriletes explanatus* (Luber) Kedo in the upper part of the stratigraphical range of *H. lepidophytus* var. *minor*. Kaiser concluded that the sequence of miospores occurred in Bear Island in the same order as in the Belgian deposits described by Streeel.

A report from Dr. von Almen on the microfloral assemblages from the Woodford Shale in Oklahoma was then read by Dr. Streeel. The Woodford Shale spans the Devonian - Mississippian boundary. *Hymenozonotriletes lepidophytus* has not been recorded by von Almen and he therefore claimed that the assemblages from the upper part of the Woodford Shale were younger than Strunian. In general, the assemblages that have been recovered are dominated by leiospheres and *Tasmanites* but contain distinctive miospore species including *Pustulatisporites gibberosus* (Hacquebard) Playford, *Murospora subtera* (Waltz) comb. nov., *Perotrillites perinatus* Hughes & Playford, *Lophozonotriletes dentatus* Hughes & Playford, *Discernisporites irregularis* Neves and *D. concentricus* Neves. A Tournaisian age has been established for the upper part of the Woodford Shale which is supported by Woodford conodont assemblages from a nearby area as reported by Hass & Huddle (1965). The absence of *Hymenozonotriletes lepidophytus*, *Dicrospora multifurcata* Winslow, *Lophozonotriletes rarituberculatus* and *Vallatisporites vallatus* Hacquebard from the Woodford Shale assemblages may well result from some ecological control on the composition of the assemblages or from inadequate sample coverage of the section.

Dr. McGregor next reported on the palynological work carried out in three widely separated parts of Canada at the horizon of the Devonian - Carboniferous boundary.

1) Maritime Provinces : There is unfortunately no stratigraphic control available for the assemblages that have been recovered from the lower part of the Horton Group in Nova Scotia. *Hymenozonotriletes lepidophytus*, *H. pusillites*, *Retusotriletes incohatus* Sullivan and spores with processes with multifurcate terminations belonging to either *Dicrospora* or *Hystricosporites* were however all recorded in the assemblages.

2) Southern Ontario : Miospore assemblages have been recovered from the Kettlepoint Formation, Bedford Shale, Berea Sandstone and Sunbury Formation from both surface and borehole material. Support-

ing palaeontological evidence is available from conodonts in the case of the Kettelpoint Formation ; this evidence was, however, obtained from different horizons to the spore assemblages. The assemblages from the Kettelpoint Formation contain the following distinctive elements : *Emphanisporites* sp. (rare), *Reticulatisporites fimbriatus* Winslow, *Hymenozonotriletes famenensis* Kedo, *H. pusillites* (including large spinose forms), and *Lophozonotriletes cristifer* (Luber) Kedo. The overlying Bedford Shale assemblages also contain *Hymenozonotriletes famenensis* and *H. pusillites* and, in addition, contain *Hymenozonotriletes lepidophytus*, ? *Dicrospora multifurcata* and *Corbulispora* cf. *cancelatus*. Winder (1966), commenting on the conodonts recorded from this interval, has noted that the presence of *Spathognathodus inornatus* Branson & Mehl suggests an uppermost Famennian age for the formation.

McGregor has recorded the presence of *Hymenozonotriletes lepidophytus*, *H. pusillites*, *H. famenensis* and *Reticulatisporites fimbriatus* from the overlying Berea Sandstone which he therefore also considers to be of Strunian age.

3) Yukon : McGregor reported that he had recorded similar assemblages from the Imperial Formation on the eastern flank of the Richardson Mountains (no independent palaeontological evidence was available from the Imperial Formation to support the palynological results). The assemblages recorded by McGregor, which are considered to be of Strunian age, contained representatives of the following species : *Hymenozonotriletes lepidophytus*, *H. pusillites*, *Vallatisporites vallatus*, *Lophozonotriletes rarituberculatus*, *L. malevkensis* (Naumova) Kedo, *L. cristifer* and *Reticulatisporites fimbriatus*.

Details of the palynological work carried out on the Devonian - Lower Carboniferous boundary in Southern England and Southern Ireland were then presented. Dolby presented a palynological report on the transitional microfloras from the Upper Old Red Sandstone to Lower Carboniferous from four widely separated sections : Hook Head in Southern Ireland ; West Angle Bay, Pembroke, South Wales ; Baggy Point in North Devon ; and Burrington Combe, Somerset. As a result of this study Dolby has reported that it is possible to recognise three distinct associations of miospores which are characterised in ascending stratigraphical order by the following species : *Hymenozonotriletes lepidophytus*, *Verrucosisorites nitidus* (Naumova) Playford and *Vallatisporites vallatus* Hacquebard (with *V. verrucosus* Hacquebard). In the section at Hook Head in Eire, Dolby reported that *Hymenozonotriletes lepidophytus* was restricted in occurrence to the Old Red Sandstone, between 380 ft. and 415 ft. below the Lower Limestone Shales. *Verru-*

cosisporites nitidus appeared at an horizon 155 ft. below the Lower Limestone Shales. The gap of 225 ft. between these two assemblages contained mainly red beds, with three horizons containing neither the *H. lepidophytus* nor the *V. nitidus* associations but only the species common to both. The stratigraphic range of *Verrucosisporites nitidus* extends to the top of the overlying Lower Limestone Shales. The *Vallatisporites vallatus* - *V. verrucosus* association appears first some 42 feet above the base of the Lower Limestone Shales which are approximately 160 feet thick at Hook Head.

In the West Angle Bay succession Dolby has recorded *Hymenozonotriletes lepidophytus* from the Skrinkle Sandstone and *Vallatisporites* spp. as appearing in the Lower Limestone Shales which are up to 560 feet thick in Pembrokeshire. The sequence is comparable to the situation in the Burrington Combe succession where Dolby reported finding *Hymenozonotriletes lepidophytus*, *Corbulispora subalveolaris* (Luber) Sullivan, *Dictyotriletes trivialis* Naumova, *Knoxisporites literatus* (Waltz) Playford and *Dicrospora multifurcata* from the upper part of the Old Red Sandstone. *Vallatisporites* spp. did not appear in the Burrington Combe section until the middle of the Lower Limestone Shales.

At Baggy Point in North Devon, Dolby reported that *Hymenozonotriletes lepidophytus* had been found in the Baggy Beds and in the succeeding Pilton Beds. Local tectonic disturbances had led to extensive deformation of the microfossil residues in the Baggy Point succession.

Finally, Utting reported on a palynological study carried out in classic Lower Carboniferous section in the Avon Gorge, Bristol. Spore assemblages were described from the Lower Limestone Shales and Bryozoa Bed of K Zone age, the Shirehampton Beds of Km Zone age and the Portishead Beds of the Upper Old Red Sandstone. Utting reported the appearance of *Hymenozonotriletes lepidophytus* in the Portishead Beds at an horizon approximately 190 feet below the Bryozoa Bed. He noted that *Hymenozonotriletes pusillites* and *Vallatisporites* spp. were absent in the assemblages from the Portishead Beds but that *Hymenozonotriletes famenensis*, *Hystricosporites* sp. and *Ancyrospora* sp. were present. The assemblage recovered from a thin green shale with plant fragments belonging to *Rhacophyton* at the top of the Portishead Beds contained no representatives of *Hymenozonotriletes lepidophytus* but did contain *Retusotriletes incohatus* and *Knoxisporites literatus*. *Hymenozonotriletes lepidophytus* was also absent from the overlying Shirehampton Beds which yielded assemblages closely comparable in composition to those described by Sullivan (1964) from the Lower Limestone Shales of the Forest of Dean, Gloucestershire, England.

- SULLIVAN, H.J. (1964) : Miospores from the Lower Limestone Shales (Tournaisian) of the Forest of Dean Basin, Gloucestershire. *C.R. 5^e Congrès Carbonifère, Paris 1963, III* : 1249-1259, pls 1-2.
- UTTING, J. & NEVES, R. (1970) : Miospores from the Devonian-Carboniferous transition beds of the Avon gorge, Bristol, England. In « Colloque sur la Stratigraphie du Carbonifère ». *Congrès et colloques Univ. Liège*, 55.
- VON ALMEN, W. F. (1970) : Miospores from the Devonian-Mississippian boundary, Carter Country, Oklahoma, U.S.A. In « Colloque sur la Stratigraphie du Carbonifère ». *Congrès et colloques Univ. Liège*, 55.
- WINDER, C.G. (1966) : Conodont zones and stratigraphic variability in Upper Devonian rocks, Ontario. *Jour. Paleontology*, 40 : 1275-1293.
- ZIEGLER, W (1969) : Eine neue Conodonten Fauna aus dem höchsten Ober-Devon *Fortschr. Geol. Rheinl. Westf*, 17 : 343-360, Tafn 1-2.
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REFERENCES

- AUSTIN, R., CONIL, R., DOLBY, G., LYS, M., PAPROTH, E., RHODES, F.H.T., STREEL, M., UTTING, J. & WEYER, D. (1970) : Les couches de passage du Dévonien au Carbonifère du Hook Head (Irlande) au Bohlen (D.D.R.). In « Colloque sur la Stratigraphie du Carbonifère ». *Congrès et Colloques Univ. Liège*, 55.
- COMBAZ, A. & STREEL, M. (1970) : Microfossiles végétaux du Tournaisien inférieur dans le « coredrill » de Brévillers (Pas-de-Calais). In « Colloque sur la Stratigraphie du Carbonifère ». *Congrès et colloques Univ. Liège*, 55.
- CONIL, R. (1964) : Localités et coupes-types pour l'étude du Tournaisien inférieur. *Mém. Acad. R. Belg., Cl. Sci.*, 15, (4) : 1-87, pls 1-14.
- CONIL, R., PIRLET, H., LYS, M. & coll. (1967) : Echelle biostratigraphique du Dinanien de la Belgique. *Service Géol. Belg., Prof. Paper*, 13 : 1-56, pls 1-5.
- DOLBY, G. (1970) : Spore assemblages from Devonian-Carboniferous transition measures in South-West Britain and Southern Eire. In « Colloque sur la Stratigraphie du Carbonifère ». *Congrès et colloques Univ. Liège*, 55.
- EAMES, L. E. & GRAHAM, A. : New taxa of Devonian-Mississippian Palynomorphs from Northeastern Ohio. (In preparation).
- HASS, W.H. & HUDDLE, J.W. (1965) : Late Devonian and Early Mississippian age of the Woodford Shales in Oklahoma, as determined from Conodonts. *Geol. Survey. Prof. Paper*, 525-D : 125-132.
- KAISER, M. (1970) : Die *Hymenozonotriletes lepidophytus*-Zone auf der Bäreninsel. In « Colloque sur la Stratigraphie du Carbonifère » *Congrès et colloques Univ. Liège*, 55.
- LANZONI, E. & MAGLOIRE, L. (1969) : Associations palynologiques et leurs applications stratigraphiques dans le Dévonien supérieur et Carbonifère inférieur du Grand Erg occidental (Sahara algérien). *Rev. Inst. Fr. Pétr.*, XXIV : 441-466, pls I-VII.
- LEGRAND, R., MAMET, B. & MORTELMANS, G. (1966) : Sur la stratigraphie du Tournaisien de Tournai et de Leuze. Problèmes de l'étage tournaisien dans sa localité-type. *Bull. Soc. belge Géol. Paléont. Hydrol.*, 74, 2-3 : 140-188.
- Mc GREGOR, D. C. (1970) : *Hymenozonotriletes lepidophytus* Kedo and associated spores from the Devonian of Canada. In « Colloque sur la Stratigraphie du Carbonifère ». *Congrès et colloques Univ. Liège*, 55.
- MAMET, B. (1968) : The Devonian-Carboniferous boundary in Eurasia. *Proc. Int. Symposium Devonian System, Calgary 1967*, II, 995-1007.
- MOURLON, M. (1875) : Monographie du Famennien. *Bull. Acad. Roy. Belg.*, (2), 39, 5 : 602-659.