Schultze, H.-P. & C.G. Maples (1992). Comparison of the Late Pennsylvanian faunal assemblage of Kinney Brick Company Quarry, New Mexico, with other Late Pennsylvanian Lagerstätten. In : Zidek, J. (ed.), Geology and paleontology of the Kinney Brick Quarry, Late Pennsylvanian, central New Mexico. *New Mexico Bur. Mines & Miner. Res. Bull.*, 138 : 231-242.

Schultze, H.-P., C.G. Maples & C.R. Cunningham (1994). The Hamilton Konservat-Lagerstätte : Stephanian terrestrial biota in a marginal-marine setting. In : Rolfe, W.D.I., E.N.K. Clarkson & A.L. Panchen (eds), Volcanism and early terrestrial biotas. *Tr. Roy. Soc. Edinburgh : Earth Sci.*, 84 [1993] : 443-451.

Sorokin, V.S. (1978). Etapy razvitiya severo-zapada Russkoy platformy vo Franskom veke [Stages of development of the north-western part of the Russian platform in the Frasnian]. Zinatne publ., Riga, 282 p. [In Russian.]

Streel, M., K. Higgs, S. Loboziak, W. Riegel & P. Steemans (1987). Spore stratigraphy and correlation with faunas and floras in the type marine Devonian of the Ardenne-Rhenish regions. *Rev. Palaeobot. Palynol.*, 50 : 211-229.

Streel, M. & S. Loboziak (2000). Correlation of the proposed conodont based Upper Devonian substage boundary levels into the neritic and terrestrial miospore zonation. *Subcomm. Devon. Stratigr. Newsletter*, 17 : 12-14.

Thorez, J., M. Streel, J. Bouckaert & M.J.M. Bless (1977). Stratigraphie et paléogéographie de la partie orientale du synclinorium de Dinant (Belgique) au Famennien supérieur : un modèle de bassin sédimentaire reconstitué par analyse pluridisciplinaire sédimentologique et micropaléontologique. *Meded. Rijks Geol. Dienst*, N.S., 28 (2): 17-28.

Traverse, A. (2003). Dating the earliest tetrapods: A Catskill palynological problem in Pennsylvania. In: Wilde, V. (ed.), Studies on fossil and extant plants and floras. Dedicated to Friedemann Schaarschmidt on the occasion of his 65th birthday. *Cour. Forsch.-Inst. Senckenberg*, 241: 19-49.

Trewin, N.H. ed. (2002). *The Geology of Scotland* (4th edition). The Geological Society, London, 576 p.

Vorobyeva, E.I. (1977). Morfologija i osobennosti evolyutsii kisteperykh ryb [Morphology and peculiarities of the evolution of the crossopterygian fishes.] *Akademia Nauk SSSR, Trudy Paleontologischeskogo Instituta*, 163: 1-239; Nauka publ., Moskva [In Russian].

Williams, E.A., P.F. Friend & B.P.J. Williams (2000). A review of Devonian time scales: databases, construction and new data. In: Friend, P.F. & B.P.J. Williams (eds), New Perspectives on the Old Red Sandstone. *Geol. Soc. London Spec. Publ.*, 180: 1-21.

Young, G.C. (1993). Middle Palaeozoic macrovertebrate biostratigraphy of eastern Gondwana. In: Long, J.A. (ed.), *Palaeozoic vertebrate biostratigraphy and biogeography*. Belhaven Press, London, chap. 9: 208-251.

Young, G.C. (1996). Devonian (Chart 4). In: Young, G.C. & J.R. Laurie (eds), *An Australian Phanerozoic Timescale*. AGSO / Oxford University Press, Melbourne, p. 96-109.

Young, G.C. (1999). Preliminary report on the biostratigraphy of new placoderm discoveries in the Hervey Group (Upper Devonian) of central New South Wales. In: Baynes, A. & J.A. Long (eds), Papers in vertebrate palaeontology. *Rec. W. Austral. Mus., Suppl.* 57: 139-150.

Young, G.C., J. Long & C. Burrow (2000a). Vertebrata. Pp. 209-219 and 250, in: Talent, J.A., R. Mawson *et al.*, Devonian palaeobiogeography of Australia and adjoining regions. Pp. 167-257, in: Wright, A.J., G.C. Young, J.A. Talent & J.R. Laurie (eds), Palaeobiogeography of Australasian faunas and floras. *Assoc. Australas. Palaeontol., Mem.* 23; Canberra.

Young G.C., L. Sherwin & O.L. Raymond (2000b). Late Devonian : Hervey Group. In: Lyons, P., O.L. Raymond & M.B. Duggan (eds.), Explanatory Notes - Forbes 1:250,000 Geological Sheet S155-7, 2nd edition. *AGSO Record* 2000/20 : 125-149 ; Canberra.

Zhu, M. (2000). Catalogue of Devonian vertebrates in China, with notes on bio-events. In: Blieck A. & S. Turner (eds), Palaeozoic Vertebrate Biochronology and Global Marine/Non-Marine Correlation – Final Report of IGCP 328 (1991-1996). *Cour. Forsch.-Inst. Senckenberg*, 223: 373-390.

Zhu, M., P.E. Ahlberg, W. Zhao & L. Jia (2002). First Devonian tetrapod from Asia. *Nature*, 420: 760-761.

Zhu, M., N.-z. Wang & J.-q. Wang (2000). Devonian macro- and microvertebrate assemblages of China. In: Blieck A. & S. Turner (eds), Palaeozoic Vertebrate Biochronology and Global Marine/Non-Marine Correlation – Final Report of IGCP 328 (1991-1996). *Cour. Forsch.-Inst. Senckenberg*, 223: 361-372.

SUBDIVISION OF THE FAMENNIAN STAGE INTO FOUR SUBSTAGES AND CORRELATION WITH THE NERITIC AND CONTINENTAL MIOSPORE ZONATION

239

(SDS Business Meeting Florence, August 23, 2004)

M. Streel

University of Liège, Geology Department, Sart-Tilman Campus, B18, LIEGE, Belgium

e-mail : Maurice.Streel@ulg.ac.be

The present report was partly submitted at the IGC Rio de Janeiro SDS Meeting in August 2000 (Streel & Loboziak, 2001) based on proposals made during the Bologna SDS Meeting in June 1998 (Streel et al. 1999, Streel & Loboziak 1999). The subdivision of the Famennian suggested then and proposed again now, is shown on fig. 1. These four subdivisions of the Famennian Stage correspond to respectively 6, 5, 7 and 4 conodont zones.

Base of a Middle Famennian Substage at the base of the Latest *crepida* Zone.

Sandberg & Ziegler 1999, SDS Newsletter 15, p. 45: "The only other usable position (for the Lower/Middle Famennian limit), easely recognized in conodont faunas is the Latest *crepida* Zone (but this position is too low for approximately equal threefold subdivision of the Famennian)".

Miospores are poorly represented in the early Famennian of western Europe and eastern North America, the tropical southern Euramerica. They are abundant, on the contrary, in eastern Europe and western North America, the equatorial northern Euramerica (Streel *et al.* 1990) where the genus *Cornispora* ,a very distinctive miospore, has its first occurrence in the early-middle Famennian range. In eastern Europe (Pripyat Depression), *Cornispora monocornata* first occurs (Avkhimovitch *et al.* 1993, p. 88) within a *rhomboidea* conodont Zone (Krutchek 1974). In western Canada, *Cornispora monocornata* and *C. varicornata* characterize a very distinctive biozone which, in the Arctic Red River section, yielded an upper *crepida* conodont assemblage, close to the lower boundary of the miospore zone (Braman & Hills 1992, p. 12).

The first occurrence of *Cornispora* in the northern Euramerican belt belongs to the interval late *crepida* to late *rhomboidea* conodont zones and might therefore serve as a miospore guide for the base of a Middle Famennian Substage in these regions..

Base of an Upper Famennian Substage at the base of the Latest *marginifera* Zone.

Becker, SDS Newsletter 15, p. 15: "...*Pemoceras* and *Protomoceras* (which) spread slighly below the entry of *Scaphignathus velifer* in conodont terms, the base of the old *velifer* Zone (now Uppermost or Latest *marginifera* Zone) seems an acceptable level."

A very distinctive miospore, *Retispora macroreticulata,* first occurs in the lower part of the Montfort Formation in the Comblain-au-Pont/Bon Mariage section in the Ourthe Valley, Dinant Synclinorium, into a rock sequence containing conodonts of the Latest *marginifera* Zone (Bouckaert *et al.* 1968). *R. macroreticulata* is considered (Streel et al. 1999) as an ancestor of *R. lepidophyta.*

Base of an Uppermost Famennian Substage at the base of the Late *expansa* Zone

The relation of the neritic microfaunas and continental microfloras with the conodont and other pelagic faunas within the latest part of the Famennian is demonstrated by Streel et al., in press (SDS Newsletter 20) at the SDS Annual meeting Rabat, March 2004 and again during the Florence IGC (August 2004) (See Streel et al., in preparation). The base of the Late *expansa* Zone is the nearest level to the original definition of the Etroeungt (Strunian) in the type region, a subdivision of the Famennian used by many authors in huge regions around the world.

This level corresponds to a distinct level within the biometric range of *Retispora lepidophyta*, a very abundant miospore with a worldwide distribution (The quantitative change from *Retispora lepidophyta lepidophyta* to *Retispora lepidophyta minor* in Maziane et al. 2002).

References

Avkhimovitch, V.I., Tchibrikova, E.V., Obukhovskaya, T.G., Nazarenko A.M., Umnova, V.T., Raskatova, L.G., Mantsurova, V.N., Loboziak, S., Streel, M., 1993. Middle and Upper Devonian miospore zonation of eastern Europe. Bull. Cent. Rech. Expl. Prod. Elf Aquitaine 17 (1): 79-147.

Becker, R.T. , 1999. Prospects for an international substage subdivision of the Famennian. SDS Newsletter 15 (1998): 14-17.

Bouckaert, J., Streel, M., Thorez, J., 1968 : Schéma biostratigraphique et coupes de référence du Famennien belge. Note préliminaire. Ann. Soc. géol. Belg. 91: 317-336.

Braman, D.R., Hills, L.V., 1992. Upper Devonian and Lower Carboniferous miospores, western District of Mackenzie and Yukon Territory, Canada. Palaeontographica Canadiana 8: 1-97.

Krutchek, S.A., 1974. On the Middle Devonian conodonts in Belorussia. *In*: Problems of regional geology in Belorussia. Minsk Bel-NIGRI: 118-126 (In russian).

Maziane, N., Higgs, K.T., Streel, M., 2002 Biometry and paleoenvironment of *Retispora lepidophyta* (Kedo) Playford 1976 and associated miospores in the latest Famennian nearshore marine facies, eastern Ardenne (Belgium) - Review of Palaeobotany and Palynology, 118, 211-226.

Sandberg, C.A., Ziegler, W., 1999. Comments on Proposed Frasnian and Famennian Subdivisions. SDS Newsletter 15 (1998): 43-46.

Streel, M., Loboziak, S. 1999. Proposal of boundaries for subdivision of the Famennian Stage: miospore implications. SDS Newsletter 15 (1998): 46-47.

Streel, M., Loboziak, S. 2001, Correlation of the proposed conodont based Upper Devonian Substage boundary levels into the neritic and terrestrial miospore zonation. SDS Newsletter 17, 12-14.

Streel, M., Fairon-Demaret, M., Loboziak, S., 1990. Givetian-Frasnian phytogeography of Euramerica and western Gondwana based

CONODONTS			Proposed Substages
OLD ZONATION	STANDARD ZONATION		
S. sulcata	*sulcata*		
L. Protognathodus	*praesulcata*	L	UPPERMOST FAMENNIAN
		M	
U. costatus		E	
M. costatus	*expansa*	L	
L. costatus		M	UPPER FAMENNIAN
U. styriacus		E	
M. styriacus	*postera*	L	
L. styriacus		E	
U. velifer	*trachytera*	L	
M. velifer		E	
L. velifer	*marginifera*	L*	
U. marginifera		L	MIDDLE FAMENNIAN
L. marginifera		E	
U. rhomboidea	*rhomboidea*	L	
L. rhomboidea		E	
U. crepida	*crepida*	L*	
		L	LOWER FAMENNIAN
M. crepida		M	
L. crepida		E	
U. triangularis	*triangularis*	L	
M. triangularis		M	
L. triangularis		E	
U. gigas*	*linguiformis*		
U. gigas	*rhenana*	L	
L. gigas		E	

on miospore distribution. In: McKerrow, W.S., Scotese, C.R., (eds.), Palaeozoic Paleogeography and Biogeography. Geol. Soc. Mem. 12, 291-296.

Streel, M., Brice, D., Degardin, J.-M., Derycke, C., Dreesen, R., Groessens, E., Hance, L., Legrand-Blain, M., Lethiers, F., Loboziak, S., Maziane, N., Milhau, B., Mistiaen, B., Poty, E., Rohart, J.-C., Sartenaer, P., Thorez, J., Vachard, D., Blieck, A., 1999. Proposal for a Strunian Substage and a subdivision of the Famennian Stage into four Substages. I.U.G.S. Subcommission on Devonian Stratigraphy, Newsletter 15 (1998): 47-52.

Streel, M., Belka, Z., Dreesen, R., Durkina, A.V. Groos-Uffenorde, Hance, L., Hartkopf-Fröder, C., Haydukiewicz, J., Korn, D., Perri, M.C., Piecha, M., Spalletta, C., in press. Relation of the neritic microfaunas and continental microfloras with the conodont and other pelagic faunas within the latest part of the Famennian. SDS Annual Meeting Rabat, March 1 and 2, 2004, SDS Newsletter 20

Streel, M., Belka, Z., Dreesen, R., Durkina, A.V. Groos-Uffenorde, Hance, L., Hartkopf-Fröder, C., Haydukiewicz, J., Korn, D., Perri, M.C., Piecha, M., Spalletta, C., Relation of the neritic microfaunas and continental microfloras with the conodont and other pelagic faunas within the latest part of the Famennian with a few, new additional data and a synthetic correlation chart. SDS Business Meeting, Florence, August 23, 2004, in preparation

SDS Business Meeting Florence, August 23, 2004

RELATION OF THE NERITIC MICROFAUNAS AND CONTINENTAL MICROFLORAS WITH THE CONODONT AND OTHER PELAGIC FAUNAS WITHIN THE LATEST PART OF THE FAMENNIAN WITH A FEW, NEW ADDITIONAL DATA AND A SYNTHETIC CORRELATION CHART

(SDS Annual Meeting Rabat, March 1st and 2nd, 2004)

(new data given below in Courier New)

238

M. Streel[1], Z. Belka[2], R. Dreesen[3], AV.Durkina[4], H. Groos-Uffenorde[5], L. Hance[6], C. Hartkopf-Fröder[7], J. Haydukiewicz[8], D. Korn[9], M. C. Perri[10], M. Piecha[7], C. Spalletta[10]

(1)Liège, Belgium, (2) Tuebingen, Germany, (3) Mol, Belgium, (4) Ukhta, Russia, (5) Gottingen, Germany, (6) Louvain-la-Neuve, Belgium, (7) Krefeld, Germany, (8) Wroclaw, Poland, (9) Berlin, Germany, (10) Bologna, Italy.

The existence of a transitional Devonian-Carboniferous fauna was mentioned by Gosselet as early as 1857 in the Etroeungt area (Avesnois, northern France). The base of the Etroeungt Formation (Bultynck & Dejonghe 2001), in the recent Bocahut Quarry for instance, corresponds approximately to the transition between the foraminifers *Quasiendothyra communis* and *Q. kobeitusana* (Mamet & Préat 2003). A chronostratigraphic unit (Latest Famennian) has now to be recognized which would make an end to the long standing uncertainties regarding the definition of the so widely and internationally used terms Strunian or Etroeungt (Sartenaer 1997, Becker 1998).

Some of the formerly proposed bases for this unit (Tn1a base in Conil et al. 1964 and following papers) are found in the railroad section of Avesnelles (now partly walled), starting at the Epinette transgressive level which corresponds approximately to the base of the *Eoendothyra communis radiata* (Df3δ) foraminifer Zone and to the base of the *Retispora lepidophyta – Knoxisporites literatus* (LL) miospore Zone. The next *Quasiendothyra kobeitusana kobeitusana* (Df3ε) foraminifer Zone starts higher but well below the Etroeungt Limestone **(Fig. 1).** Foraminifer *Q. kobeitusana* and miospore *R. lepidophyta* have a wide distribution around the world (Streel et al. 1998, fig. 3).

The calibration of these biostratigraphic markers with the conodont standard zonation needs moving to central and eastern Belgium and western Germany.

In the Anseremme section (Meuse valley, central Belgium, Dreesen & Thorez, 1994 and C.A. Sandberg in Casier et al. 2004) the succession Middle/Late *expansa* is found near but slightly above the base of *Quasiendothyra kobeitusana kobeitusana*.

In the Chanxhe section (Ourthe valley, eastern Belgium) the Late *expansa* conodont Zone is present between Df3δ and Df3ε foraminifer Zones. Above the Df3ε foraminifer Zone occurs the next *Retispora lepidophyta–Indotriradites explanatus* (LE) miospore Zone (Streel et al. 2003, fig. 1). Until very recently the base of the Late *expansa* Zone was unknown in the area but new data from the Refrath 1 borehole (Bergisches Land, western Germany) allow now to fill this gap in our knowledge. The lower part of the LL miospore Zone (with presumed ancestor *Retispora macroreticulata* and large specimens of *R. lepidophyta*) corresponds to the Middle *expansa* conodont Zone and to the early *hemisphaerica-dichotoma* entomozoacean Zone (Groos-Uffenorde, in press; Hartkopf-Fröder, in press; Piecha, in press) **(Fig. 2).** The conclusion is that the base of the Late *expansa* conodont Zone and the base of the *Q. kob. kobeitusana* (Df3ε) foraminifer Zone are obviously much closer than believed so far. The continental to neritic facies scheme shows now **(Fig. 5)** three steps of potential biostratigraphic markers to help defining a Latest Famennian.

This scheme can be applied to huge regions in Eurasia particularly in Belarus and Timan-Pechora (Durkina, Dreesen & Streel in Streel 2001, tab. 2) and, partly by miospores (Filipiak 2004), in the Kowala trench (Holy Cross Mountains, Poland).

The transition from the neritic to the pelagic facies is stratigraphically progressive in Poland near the Variscan Front. On the Holy Cross Mountains side, at a level higher than the lower LL Zone known in the Kowala trench, the Kowala 1