DEVONIAN SERIES BOUNDARIES: Decisions of the IUGS Subcommittee

by Willi Ziegler and Gilbert Klapper

The Commission on Stratigraphy is by far the largest in IUGS, with Subcommissions, Working Groups and Regional Committees studying all the major intervals and boundaries in the geological column. As an example of how its Subcommissions may progress towards the definition of boundary stratotypes, the authors present here an account of the debates and voting procedures which have led recently to agreement on two important boundaries within the Devonian.

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The IUGS Subcommittee on Devonian Stratigraphy was organized at a meeting in Marburg, F.R.G. in December 1973. The consensus of this and all subsequent meetings was to give highest priority to the resolution of the controversies surrounding the Lower-Middle Devonian and Middle-Upper Devonian Series Boundaries. Members also agreed to follow the procedure established by the Silurian-Devonian Boundary Committee (summarized by McLaren, 1977) in first deciding on a critical biostratigraphic level and subsequently selecting a corresponding boundary stratotype at which to define the series boundary. Guidelines for the selection of series-boundary stratotypes were unanimously adopted at the 1975 Subcommittee meeting in Morocco.

Since 1974 intensive annual discussion meetings have been held by the Subcommittee together with field trips, except for 1980 (Ziegler and Klapper, 1982a). As a result of these activities and in response to the need for more refined information on stratigraphic correlation at the levels under consideration, a number of significant results of research have been published, enabling the Subcommittee to reach the decisions discussed here.

The Lower-Middle Devonian Series Boundary

At the 1979 meeting in Sigüenza, Spain, the discussion on the Lower-Middle Devonian boundary focused on two biostratigraphic levels: the lower boundaries of the *patulus* conodont Zone and the *partitus* conodont Zone (hereafter referred to as the *patulus* and *partitus* boundaries). The former level corresponds essentially to the base of the Couvinian Stage in the Ardennes, southern Belgium, and the latter almost exactly to the base of the Eifelian Stage (Heisdorf-Lauch boundary) in the Eifel Mountains, F.R.G. (See Fig. 1). Two other levels in the conodont sequence that had been considered at previous meetings (the base of the *dehiscens* Zone, corresponding to the boundary favoured within the Soviet Union, and the base of the *costatus costatus* Zone, corresponding to the basal Chotec boundary in the Barrandian area of Czechoslovakia) were eliminated as a consequence of a vote in 1979.

The Devonian Subcommittee, like those dealing with other systems, includes both titular members who have voting rights and corresponding members who do not. At Sigüenza an informal ballot led to seven votes plus two postal ballots cast for the *partitus* boundary and three plus one postal vote for the *patulus* boundary; there was one abstention. In order to inform titular members, corresponding members were also asked to vote and did so seven to two in favour of the *partitus* boundary. Then in 1980 a formal postal vote resulted in eleven for *partitus*, three for *patulus* and one abstention, with corresponding members voting 11 for *partitus*, four for *patulus* and two abstentions.

Potential boundary stratotypes for the *partitus* boundary were discussed in 1979 and 1980, and formal proposals were received at the Binghamton, New York, meeting in July 1981, from the Federal Republic of Germany (Werner and Ziegler,

Figure 1. The relationship of the Lower-Middle Devonian Boundary (the *partitus* boundary) to the phyletic lineage from *Polygnathus costatus patulus* to *P. c. costatus*, to the lineage from *P. linguiformis bultyncki* to the *P. robusticostatus* group (sensu Weddige and Ziegler), and to the Heisdorf-Lauch and Trebotov-Chotec boundaries (From Ziegler and Klapper, 1982a).

1982) and from Ivo Chlupáč of the Geological Survey of Czechoslovakia (Chlupáč, 1982). By a vote of nine to four with two abstentions, the Wetteldorf Richtschnitt (Prüm Syncline, Eifel Mountains) was chosen as the holostatotype section for the Lower-Middle Devonian boundary (Fig. 2) and the Holyně Prastav Quarry (Barrandian area) as the parastatotype. The base of the *partitus* Zone is 1.90 m below the Heisdorf-Lauch boundary at the Wetteldorf Richtschnitt, which had been established by Rudolf Richter and his co-workers in the 1930s (Fig. 3).

At Binghamton an additional resolution, passed with one abstention, states that the base of the Middle Devonian Series will coincide exactly with the base of the lower stage of the Middle Devonian (name unspecified in this vote). A third resolution passed unanimously at the Binghamton meeting contains the statement that the Subcommittee accepts Eifelian and Givetian at the stage names for the Middle Devonian and the Frasnian and the Famennian as the stage names for the Upper Devonian.

The result of these resolutions requires that the lower boundary of the type Eifelian (previously equivalent to the base of the Lauch Formation) be adjusted downward 1.90 m into the upper part of the Heisdorf Formation in the Wetteldorf Richtschnitt to coincide exactly with the Series boundary at the lower limit of the *partitus* Zone (see Weddige et al., 1979; and Weddige, 1982).

Figure 2 (opposite): Locality map of site of the boundary stratotype of the *partitus*-boundary at the Wetteldorf Richtschnitt. Upper right is columnar section of stratotype showing distribution of conodonts in marl/limestone alteration. Horo I to III and Libra I are bentonite layers. The Heisdorf-Lauch Formation junction is the previously used Lower-Middle Devonian boundary (from Werner and Ziegler, 1982).

The Middle-Upper Devonian Series Boundary

At Sigüenza in 1979 the discussion of potential biostratigraphic levels for this boundary (Fig. 4) concentrated on:

- level 1 — entry of *Pharciceras amplexum* (ammonoid)
- level 2 — a range of stratigraphy extending from the entry of multilobate *Pharciceras* species (including *P. lunulicosta*) up to the entry of *Palmatolepis disparilis* (conodont) and the first *Ponticeras* (ammonoid; for the *disparilis* Zone see Ziegler and Klapper, 1982b),

Figure 3: The Subcommittee on the Devonian examines the stratotype for the Lower-Middle Devonian Series Boundary at Prüm, Wetteldorf Richtschnitt, in August 1982. The trench was initially dug in the 1930s to enable a study of the sequence and megafauna and reopened in the 1970s to allow an examination of conodonts and other fossils. It was then filled in to protect the section from amateur collectors and reopened once again in 1982 for the Subcommittee's visit. Plans are for a permanent building to be erected over the key portion of the trench allowing access only to bona fide researchers.

	Conodont Zonation		Ammonoid Faunas
	Previous	Present	
asymmetricus Zone	Upper Zone	Upper Zone	<i>Mantrioceras cordatum</i> Belgium, W-Germany ?
	Middle Zone	Middle Zone	
	Lower Zone	Lower Zone	
	Lowermost Zone	Lowermost Zone	
		<i>disparilis</i> Zone	
hermanni-cristatus Zone	Upper Subzone	Upper Subzone	<i>Ponticeras pernai</i> Morocco, W-Germany
	Lower-Subzone	Lower Subzone	multilobate <i>Pharciceras</i> Morocco
varcus Zone	Upper Subzone	Upper Subzone	<i>Pharciceras amplexum</i> (New York, Morocco) <i>Maenioceras terebratum</i> (Morocco, W-Germany)
	Middle Subzone	Middle Subzone	

Figure 4: Diagram showing the stratigraphic relationship between conodont zonation and ammonoid faunas (from Ziegler & Klapper, 1982b). The three original candidate levels for the Middle-Upper Devonian Series Boundary are also shown: 1) *Pharciceras amplexum* level, 2) range of stratigraphy from multilobate *Pharciceras* species up to the first *Ponticeras* species and the entry of the *disparilis* Zone, 3), the base of the Lower asymmetricus Zone. The latter was selected as the Middle-Upper Devonian boundary level.

- level 3 — the base of the Lower asymmetricus conodont Zone (Ziegler 1971; and Bultynck, 1982).

An informal vote taken showed six titular members for level 2, three for level 3 and none for level 1.

In 1981, new analyses of European material and new collections from Morocco showed that the entry of multilobate *Pharciceras* species occurs in the Upper hermanni-cristatus conodont Subzone, and that the entries of *Palmatolepis disparilis* and early *Ponticeras* species coincide. *Pharciceras* aff. *P. amplexum* was found in Morocco to coincide with the entry of *Ozarkodina semialternans* (conodont), occurring in the uppermost part of the Middle varcus Subzone as *P. amplexum* does in the Tully Limestone of New York.

Discussion at the 1979-1981 meetings indicated that level 1 corresponds essentially to the basal Upper Devonian boundary widely agreed upon by participants at the International Geological Congresses toward the end of the last century (House, 1982). Level 2 is very close to the base of the Upper Devonian as used by ammonoid workers in Germany since the time of Denckmann in 1900 (see House and Ziegler, 1977), and according to P. Sartenaer (Belgium), level 3 corresponds almost exactly to the base of the Frasnian, the lower stage of the Upper Devonian.

In Binghamton a vote was considered to adopt the base of the Lower asymmetricus Zone (level 3) as the biostratigraphic level for the Middle-Upper Devonian Series boundary, but the members were still divided. Likewise, after extensive discussion at the Frankfurt meeting in August, 1982, a vote to accept the base of the *disparilis* Zone (Ziegler and Klapper, 1982b) as the level for the Middle-Upper Devonian Series boundary was split. However a motion to accept the base of the Lower asymmetricus Zone as the level for the boundary gained the support of seven members with three against, and one abstention. In a subsequent discussion, the minority against the Lower asymmetricus boundary agreed to support the majority, provided that the latter would in turn agree that the boundary stratotype be located in the pelagic facies.

Thus, a motion that the base of the Lower asymmetricus Zone be accepted as the biostratigraphic level for the Middle-Upper Devonian boundary resulted in ten votes for the motion, none against, and one abstention. Corresponding members were eight for, none against, with four abstentions. A second motion stating that the boundary holostatotype be located in the pelagic facies and the parastratotype in the neritic facies was adopted unanimously by both titular and corresponding members.

In view of this progress, we fully expect that a definitive boundary stratotype will be selected at the 1983 meeting of the Subcommittee. The results of all decisions will then be presented to the International Commission on Stratigraphy which meets next at the 1984 International Geological Congress in Moscow.

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LIST OF ABBREVIATIONS

(aside from those identified in the text or in Directory of IUGS Bodies)

AAPG	American Association of Petroleum Geologists
ASCE	American Society of Civil Engineers
ASEAN	Association of South East Asian Nations
BRGM	Bureau de Recherches Géologiques et Minières (France)
CCOP	ESCAP Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas
CNRS	Centre National de la Recherche Scientifique (France)
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CSPG	Canadian Society of Petroleum Geologists
ESCAP	UN Economic and Social Commission for Asia and the Pacific
GSC	Geological Survey of Canada
IAEA	International Atomic Energy Agency
IAHR	International Association for Hydraulic Research
IAHS	International Association of Hydrological Sciences
IAMAP	International Association of Meteorology and Atmospheric Physics
ICSOPA	International Committee for the Study of Bauxites, Alumina and Aluminum
IDRC	International Development Research Centre (Canada)
IHP	International Hydrological Programme
ILP	ICSU/IUGS/IUGG International Lithosphere Program
IMM	Institute of Mining and Metallurgy (UK)
ISSMFE	International Society for Soil Mechanics and Foundation Engineering
IUTAM	International Union of Theoretical and Applied Mechanics
NATO	North Atlantic Treaty Organization
NOAA	National Oceanographic and Atmospheric Administration (U.S.A.)
SEPM	Society of Economic Paleontologists and Mineralogists
UNESCO	UN Educational, Scientific and Cultural Organization
WEDC	Water and Waste Engineering for Developing Countries (Loughborough University of Technology, U.K.)