Section 6

Rauchkofel Boden Section

(figs. 12-14)

by Hans Peter Schönlaub & Olga Bogolepova

This section is exposed on the southwestern slope of Mount Rauchkofel west of p.2175 m. It represents a continuously exposed and conformable limestone succession ranging from the Ashgillian to the Lower Devonian (Pragian). The major part of Lower Silurian strata, however, are missing at this section (fig. 12).

The Rauchkofel Boden section is one of the best known and most fossiliferous Upper Silurian sections of the Carnic Alps corresponding to the "Wolayer facies". A detailed description was published by H.R. v. GAERTNER 1931 and H.P. SCHÖNLAUB 1970, 1980. The fauna was studied by H. RISTEDT 1968 (orthoconic nautiloids), W. HAAS (trilobites, unpubl.), J. KRIZ (bivalves), and H.P. SCHÖNLAUB (conodonts).

The Upper Ordovician is represented by a 8.60 m thick cystoid bearing massive limestone horizon, the so-called Wolayer Limestone. Its lithology was recently studied by C. DULLO 1992 who suggested for its formation a shallow water environment with low energy in an moderate climatic setting. Besides undescribed cystoids and trilobites conodonts are fairly abundant suggesting a late Ordovician age within the Ashgillian Series.

The Wolayer Lst. is disconformably overlain by 3.90 m thick grey fossiliferous cephalopod limestones ("*Orthoceras* Lst."). The macrofauna includes the following nautiloids and bivalves (sample nos. 310-315, 319-324):

Michelinoceras (?) sp.
Sphaerorthoceras n.sp.
Merocycloceras declivis RISTEDT
Parasphaerorthoceras sp.
Isiola lyra KRIZ (nos. 319, 322, 325-65 cm)
Slava fibrosa (no.325-105 cm)
Cardiola aff. *signata* BARR. (322)
Cardiola contrastans (no. 325-105 cm)
Spanila sp. (322)

W. HAAS from Bonn University reported the following trilobites from the basal part (approx. 1.5 m) of the cephalopod limestone:

Aulacopleura haueri
Kielania n.sp.
"*Odontopleura*" *ovata*

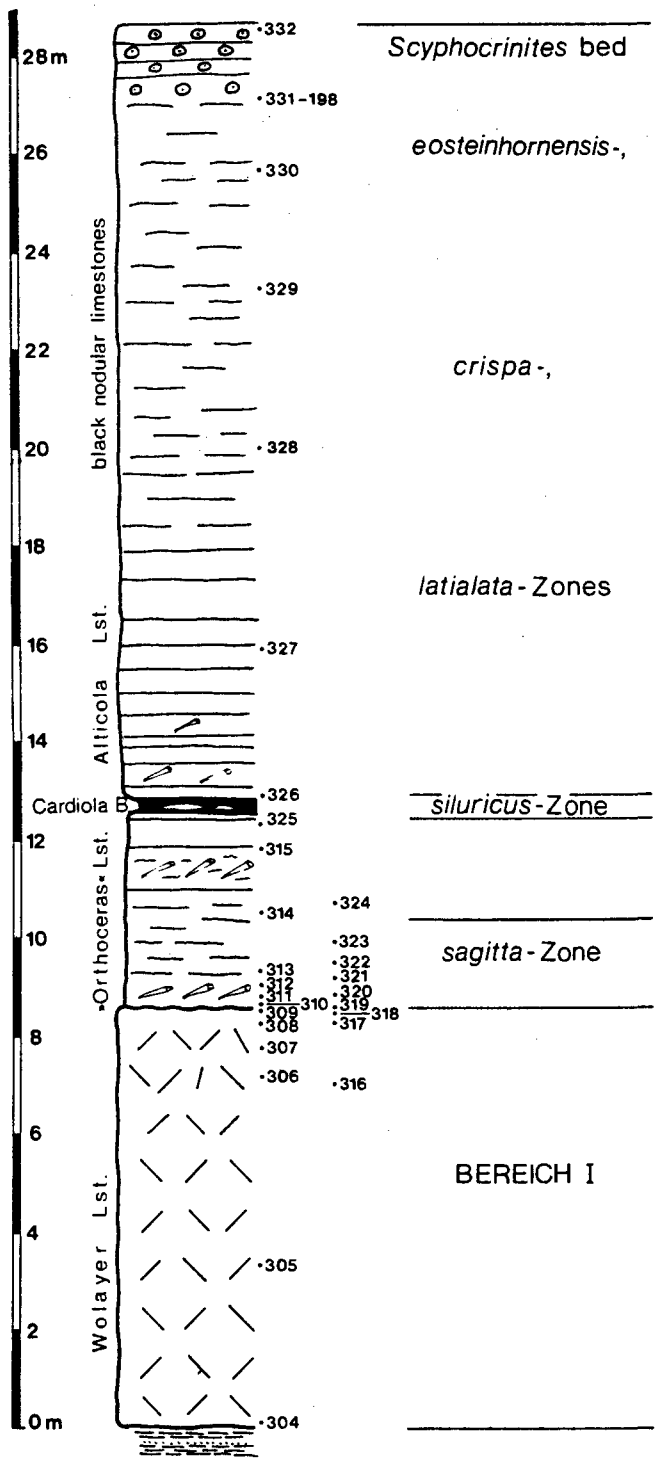


Fig. 12: The Rauchkofel Boden Section (Ordovician - Silurian part) after SCHÖNLAUB et al. 1980.

Eodrevermannia n.subg. n.sp.
Otarion (O.) sp.
Scharyia n.sp.
Leonaspis cf. *minuta*
Xanionurus n.sp.
Koneprusia n.sp.

In the middle part he found:

Kosovopeltis n.sp.
Otarion (O.) sp.
Leonaspis cf. *minuta*
Raphiophorus rouaulti

The upper part of the cephalopod limestone contains:

Raphiophorus rouaulti
Prionopeltis striatus
Otarion (O.) sp.
Leonaspis cf. *minuta*

The 10 cm thick black limestones bed above no. 325 (now badly exposed in the trench from the war) yielded the following bivalves (J. KRIZ):

Cardiola docens BARR.
Cardiola consanguis BARR.
Cardiola cf. *signata* BARR.
Mila complexa BARR.
Spanila aspirans BARR.

W. HAAS found in the Cardiola Fm. *Aulacopleura* cf. *muensteri*. The fauna above the Cardiola Fm. has not been restudied in detail yet. H.R. v. GAERTNER and F. HERITSCH reported the following taxa:

Base of Alticola Lst. (nos. 326-328):

Spirigera canaliculata BARR.
Spirigera obovata SOW.
Retzia ? umbra BARR.
Maminca italica GORT.
Dualina plicata MSTR.
Dualina cf. *sedens* BARR.
Tenka cf. *bohemica* BARR.
Loxonema commutatum PER.
Holopella compressa MSTR.

Holopella trochleata MSTR.
Platyceras otiosum BARR.
Platyceras praepriscum BARR.

Nos. 329-332:

Encrinurus transiens BARR.
Proetus romanicus GAERTNER
Petraia laevis POCTA
Holopella subcompressa MSTR.
Orthoceras tiro BARR.
Scyphocrinus sp.

According to W. HAAS (unpubl.) the follwing trilobites occur at the edge of the steep slope (sample no. R 5):

Goldillaenus nilssoni
Cornuproetus (C.) cf. *vertumnus*
Encrinurus subvariolaris
Encrinurus ploeckensis
Bohemoharpes n.sp.
Bohemoharpes cf. *crassifrons*
Cerauroides cf. *propinquus*
Phacopidella n.sp.
Ananaspis grimburgi
Ceratonurus sp.

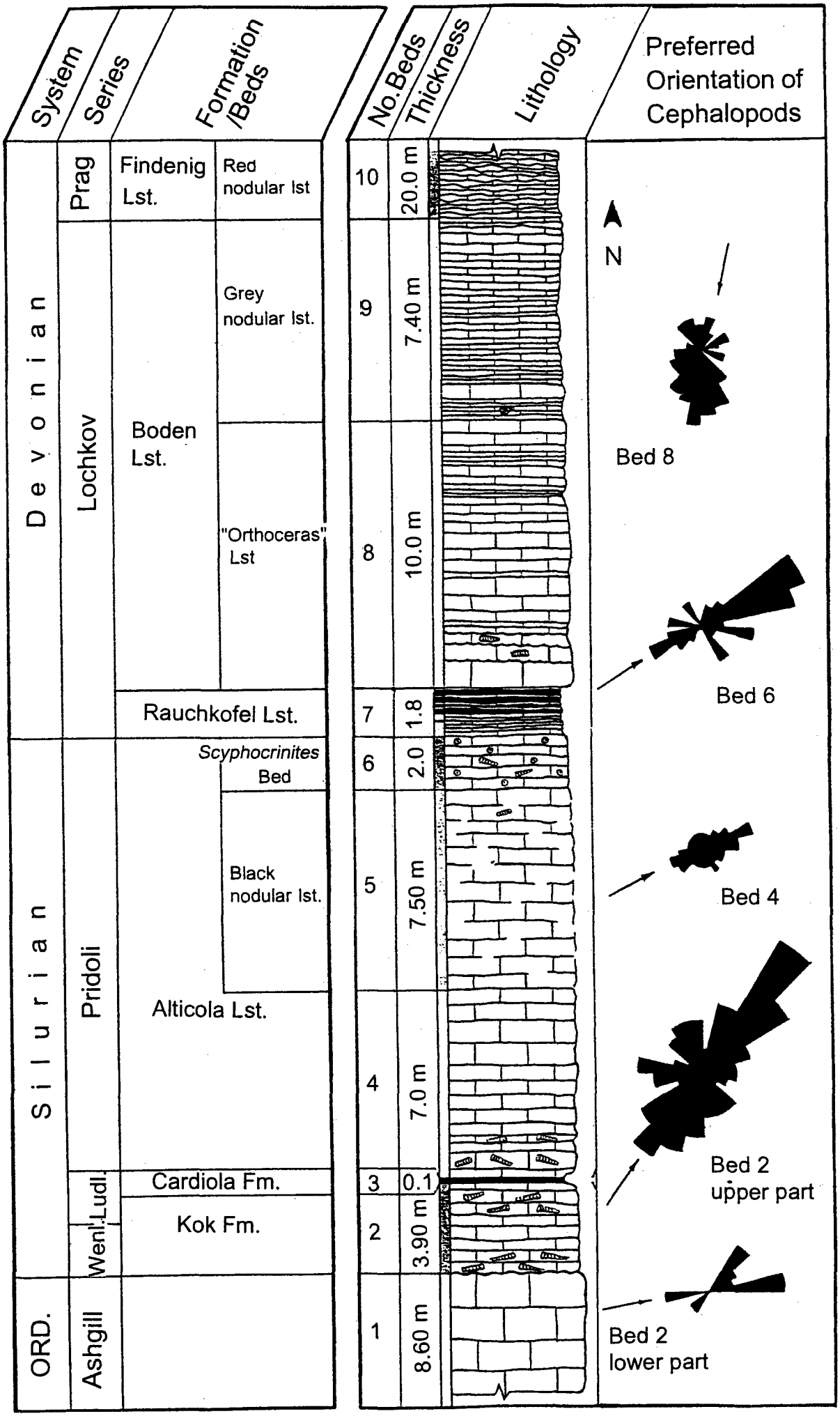
In the late Wenlock and the Upper Silurian conodonts are fairly abundant. A rich fauna representing the *O. sagitta* Zone occur from the base of the *Orthoceras* Lst. up to sample no. 313, i.e. 1.20 m above the base (fig. 12). Although resampled not a single specimen of *Ozarkodina bohemica* has yet been found in that interval.

In sample no. 314 Kockelella variabilis first occurs suggesting the base of the Ludlow Series by comparison with Bohemia (H.P. SCHÖNLAUB in I. KRIZ et al. 1993).

The following Cardiola Fm. corresponds to the *P. siluricus* Zone of the stratotype at Cellon. Conodonts from the uppermost part of the black nodular limestones (nos. 330. 331) belong to the apparatus of *Oz. r. eosteinhornensis*. In addition, *Oz. ortuformis* and *Oz. jaegeri* occur in this interval.

The Silurian/Devonian boundary is drawn at the base of grey and blackish platy crinoidal limestones containing *Scyphocrinites* (sample no. 331=198). At this horizon abundant loboliths of *Scyphocrinites* can be found. Bed no. 198 as well as the overlying sample no. 199 yielded common accurrences of *Oz. r. eosteinhornensis* and, more frequently, *Oz. r. remscheidensis*.

Fig. 13: The Orientation of orthocone nautiloids in the Rauchkofel Boden Section (O.K. BOGOLEPOVA)


System
Series
Formation /Beds
No.Beds
Thickness
Lithology
Preferred Orientation of Cephalopods
Devonian
Silurian
ORD.
Prag
Lochkov
Pridoli
Wenl.
Ludl.
Ashgill
Findenig Lst.
Red nodular lst
Grey nodular lst.
Boden Lst.
"Orthoceras" Lst
Rauchkofel Lst.
Scyphocrinites Bed
Black nodular lst.
Alticola Lst.
Cardiola Fm.
Kok Fm.
10
9
8
7
6
5
4
3
2
1
20.0 m
7.40 m
10.0 m
1.8
2.0
7.50 m
7.0 m
0.1
3.90 m
8.60 m
N
Bed 8
Bed 6
Bed 4
Bed 2 upper part
Bed 2 lower part

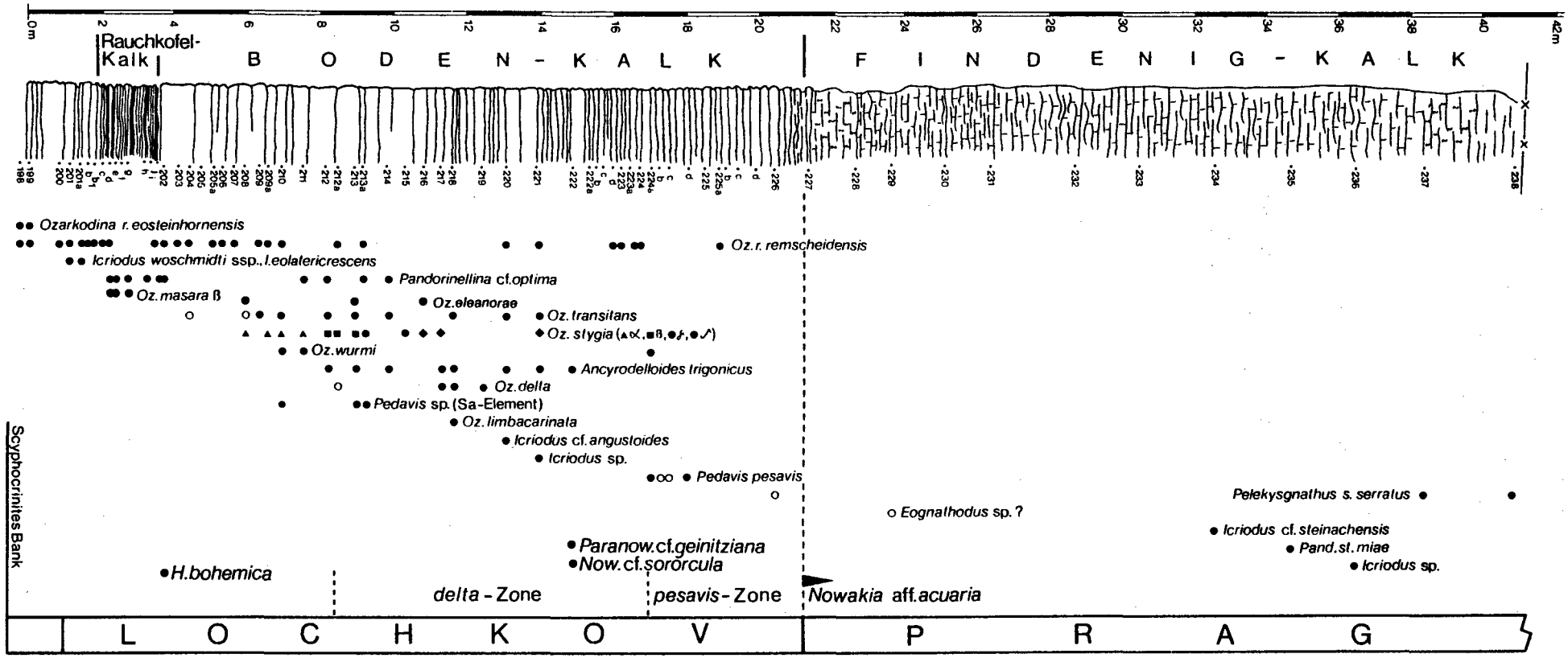


Fig. 14: Rauchkofel Boden Section, Lower Devonian part with basal 1.80 m thick Rauchkofel Limestone, above Boden Limestone and Findenig Limestone (after SCHÖNLAUB et al. 1980, modified)

The basal part of the overlying Lochkov sequence seems to be extremely condensed. This interval is represented by well bedded, thin and blackish limestone beds with shaly intercalations (nos. 201 b-201 j). The index conodont for the base of the Devonian, *Icriodus woschmidti*, was collected in sample nos. 201 and 201 a. However, as yet only juvenile specimens were found. Neither at this horizon nor in any other parts of the section graptolites have yet been recorded.

With regard to the orientation of orthoceracone cephalopods in the Rauchkofel Boden section O.K. BOGOLEPOVA is adding some preliminary data based on a study in 1993:

Many examples of orthoceracone cephalopod orientation and the use of the latter as indicator or paleocurrents have been published. Theoretical considerations indicate that orthoceracone cephalopods (like other elongate objects) are aligned parallel with a current. Though there are a number of publications based on the application of hydrodynamic modelling in experiments, which produce different and at times conflicting results, the author following the majority of the investigators, holds to the opinion that most orthocone shells of orthoceratids, tentaculites and high-spired gastropods found on bedding planes in mass accumulation are oriented by their apices against the current. A strong current orients orthocones in such a way that their apices point against the current. However, the discussion of the paleoflumenology problems, the merits and demerits of this method, the ways for different interpretation of the results and so on will be the subject of a future article. The task of the author here is to present preliminary data which were obtained as the result of measurements of cephalopod orientation at the Rauchkofel Boden section during a visit in 1993.

Orthoceracone cephalopods are abundant in the Kok Lst., the Cardiola Fm. and the Scyphocrinites bed of the Alticola Limestone. The highest concentration of orthocones occurs in bed 2 (lower and upper part) of the authors subdivision, bed 4 (lower part), bed 6 and bed 8 (see fig. 13). Orientations were measured on bedding planes (one or a few in each layer) and the condition of the majority of cones was noted. All measurements were done by the umbonal part of cephalopods. In each layer the orientation of each individual was plotted on the bar graph and then on the rose-diagram. All orientation measurements within 15 degrees were placed in one class.

Bed 2: In the lower part of the layer the orientation of 36 orthocones shows two trends, from SW to NE, and from W to E. The number of measurements does not allow to conclude any major preferable trend in the orientation of cephalopods. In the upper part of the bed on a different bedding plane the orientation of 187 orthocones was measured. The rose-diagram of layer 2, upper part shows the orientation of all measured cephalopods. There is one clear trend from SW to NE (between 30-45 degrees).

Bed 4: The orientation of 39 orthocones was measured. Most of the cones are oriented between 60 and 75 degrees indicating a direction from SW to NE.

Bed 6: The orientation of 82 orthocones was measured. They reflect one major trend from SW to NE (between 45 and 75 degrees) and minor secondary trends.

Bed 8 (Lower Devonian, Lochkov): The orientation is based on measurements of 85 cephalopods. The major direction runs from N-NE to S-SW (between 180 and 195 degrees).

Fig. 13 summarizes the main results of this preliminary study and shows the main tendency of preferred orientation of cephalopods in the Rauchkofel Boden section. C. HOLLAND (1984) noted many published examples of so-called "Orthoceras" limestones and wrote that "more observations could be quoted and new ones must be made, but the variety of situations is perhaps sufficient to inspire caution". Our data allow us to make the first very preliminary and careful conclusion about the existence of two major trends of the paleocurrent: a current running from south-west to north-east in the Upper Silurian and a Lower Devonian one prevailing a north-northeastward direction.

Comment by H.P. SCHÖNLAUB:

Regardless whether the current-direction hypothesis aginst the apex or in opposite direction is preferred, the statistics from orthocone cephalopod measurements from both the Carnic Alps and Bohemia show striking similarities with regard to shell alignement in the Silurian (J. KRIZ 1992, p. 24, 43, 55: Silurian Field Excursions, Prague Basin (Barrandian), Bohemia. National Mus. Wales, Geol. Series No.13, Cardiff). During the Lower Devonian the current direction suggests minor changes towards a north direction. This northern gyre may be related to the South Equatorial Current which according to M.S. OCZLON 1990 operated along the southern margin of Laurussia in the Middle Devonian. During the interval from the Silurian to the Devonian this system may be hold responsible for the distinct exchange of faunas between Siberia, the Urals and Central and Southern Europe. Also, it should be noted that during this time Siberia had an "upside-down position" with the Tajmyr Peninsula in a more southern position facilitating such an exchange (pers. comm. O.K. BOGOLEPOVA).

With regard to the Lower Devonian part of this section we refer to Fig.14 showing its lithology and faunal content.