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## FRASNIAN AND VISEAN-NAMURIAN CONODONT FAUNAS AT PRAPROTNO, SLOVENIA

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*Key-words:* Conodonta, Devonian, Carboniferous, Slovenia.

*Riassunto.* Sono state rinvenute faune a conodonti nei ciottoli calcarei di un conglomerato di età paleozoica superiore in prossimità di Praprotno, Slovenia. Sono state identificate due faune: la più antica con *Palmatolepis subrecta* e *Polygnathus decorosus* è indicativa del Frasniano (Devoniano superiore). La più recente invece è dominata da *Gnathodus bilineatus* e contiene anche *Lochriea commutata* e *L. nodosa*. Tale fauna è caratteristica del tardo Viseano-Namuriano (Carbonifero inferiore).

*Abstract.* Conodont faunas from the limestone pebbles of the Upper Paleozoic conglomerate at Praprotno, Slovenia demonstrate the presence of two faunas. The older fauna, marked by *Palmatolepis subrecta* and *Polygnathus decorosus* is indicative of the Frasnian stage (Upper Devonian). The younger fauna is dominated by *Gnathodus bilineatus* and contains *Lochriea commutata* and *L. nodosa*. This fauna is characteristic of the Late Visean-Namurian (Lower Carboniferous).

### Introduction.

Chronostratigraphic definition of the Upper Paleozoic sediments of the western Sava fold belt has not yet been achieved. On the 1:100000 Kranj Sheet of the geological map of SFR Yugoslavia these strata were labelled as "Permo-Carboniferous" due to insufficient paleontological control (Grad & Ferjancic, 1976). They consist of dark grey shale, grey siltstone, sandstone and quartz conglomerate. Their lithostratigraphic succession has been reconstructed in the region of the Sava fold belt east of Ljubljana (Mlakar, 1987; Mlakar et al., 1993) and is valid also for the western continuation. The quartz conglomerate contains locally also pebbles and blocks of limestone in the entire Sava fold belt (Grad & Ferjancic, 1976; Premru, 1983; Mlakar et al., 1993) and various fossils have been used to determine their Silurian, Devonian and Carboniferous age (Flügel, 1958; Grad, 1961; Ramovs, 1969; Ramovs & Jurkovsek, 1976). In the lime-

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stone pebbles from the conglomerate near Praprotno in the Selca valley a conodont fauna with the Carboniferous species *Hindeodella ibergensis* Bischoff (D. Urosevic in Grad & Ferjancic, 1976), and from the pebbles of the conglomerate at Podlipoglav and Zgornja Lusa the Lower Devonian and Lower Carboniferous conodont faunas (Ramovs, 1990a) were found. An Upper Carboniferous megafloora was recovered (Kolar-Jurkovsek & Jurkovsek, 1985, 1986, 1987, 1990a, 1990b and unpublished data) in the sandstone of the subunit b<sub>3</sub> (Mlakar et al., 1993) in a wider area of the Sava fold belt. The paleorelief of the "Permo-Carboniferous" strata is overlain by the Middle Permian Val Gardena Formation.

In the Sava fold belt the quartz conglomerate of the subunit b<sub>3</sub> (Mlakar, 1987; Mlakar et al., 1993) differs greatly in grain size. The quartz conglomerate that outcrops on a river bank at Selska Sora, north of Praprotno (Fig. 1) contains some limestone pebbles, cobbles and boulders of a few cubic centimeters up to approximately one half of a cubic meter in size. They consist of dark grey and greyish-black micritic to micro-sparitic limestone. One of the largest boulders (sample PR 1A) belongs to dark grey crinoidal limestone.

In order to define the age and to describe fauna, fourteen samples of weight of 0.5 to 2.0 kg depending on the size of the pebbles were treated with 15% acetic acid, following standard conodont preparation techniques. Most contained identifiable conodont elements, however four (PR 1A, PR 8, PR 9, PR 13) were not productive. Conodont elements were found with pyritized sponge spicules (samples PR 3 and PR 10). A Late Devonian conodont fauna is recognized in a single sample (PR 1) while Lower Carboniferous genera *Gnathodus* and *Lochbriea* are present in the other samples. The composition of the conodont faunas recovered is shown in Table 1.

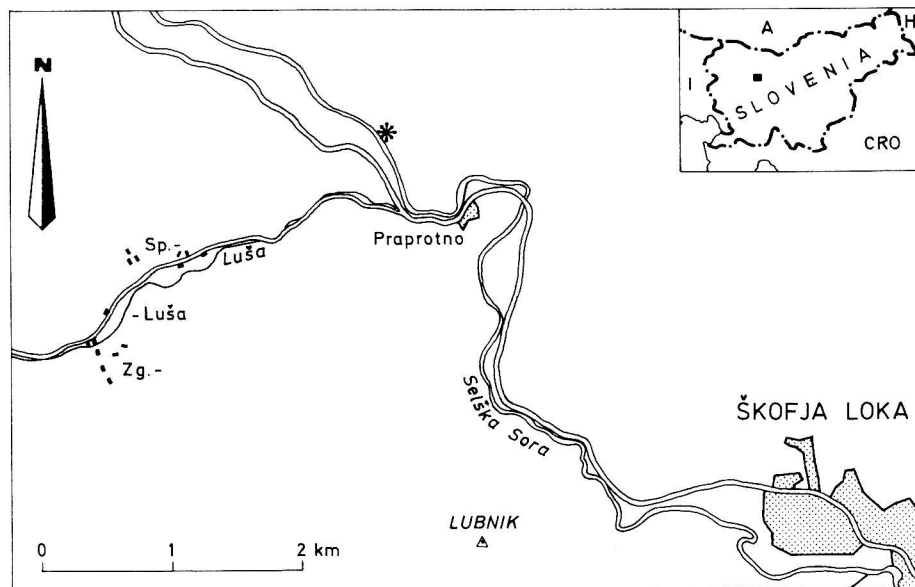


Fig. 1 - Location of the sampled outcrop at Praprotno, Slovenia.

### Conodont biostratigraphy and biofacies.

**Frasnian.** Sample PR 1 from Praprotno contains Pa-elements of *Palmatolepis subrecta* Miller & Youngquist and *Polygnathus decorosus* Stauffer (Tab. 1). The standard conodont zonation of Upper Devonian was originally proposed by Ziegler (1962) and was later refined and updated by several authors. Recognition of pelagic conodont zones enabled comparison of the Upper Devonian strata worldwide. *Palmatolepis subrecta* ranges from the upper *Polygnathus asymmetricus* Zone through the lower *Palmatolepis triangularis* Zone (sensu Sweet, 1988) and *Polygnathus decorosus* ranges from *Ancyrognathus triangularis* Zone through the uppermost *Palmatolepis gigas* Zone (Klapper in Ziegler, 1973). The conodont fauna is therefore Frasnian in age. In the ecologic model for conodonts of Seddon & Sweet (1971) the elements of *Palmatolepis* and *Polygnathus* characterize the pelagic depositional environment.

**Visean-Namurian.** Most of the examined samples yield the stratigraphically important conodont taxa: *Gnathodus bilineatus* (Roundy), *Lochriea commutata* (Branson & Mehl) and *L. nodosa* (Bischoff). Pa elements of *Gnathodus bilineatus* predominate (Table 1). The recovered conodonts indicate the Upper Visean - Namurian age. In this stratigraphic interval of Styria, Austria Ebner (1977) recognized two conodont zones, *Gnathodus commutatus nodosus* Zone (dated as cu IIIy - E<sub>1</sub>) and *Gnathodus bilineatus bollandensis* Zone (dated as E<sub>2</sub>). *Gnathodus* and *Lochriea* commonly dominate Visean and Early Namurian conodont faunas in Europe (Higgins, 1975). The diagnostic species of the uppermost Visean is *Lochriea nodosa* (= *Gnathodus nodosus*, *G. commutatus nodosus*). Stratigraphic position of the *nodosus* Zone varies from region to region. Belka (1982) stated "that differences in location of the lower limit of *Paragnathodus nodosus* zone result rather from the errors in correlation of particular conodont subdivisions

	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR10	PR11	PR12	Total
<i>Palmatolepis subrecta</i> , Pa element	2										2
<i>Polygnathus decorosus</i> , Pa element	2										2
<i>Gnathodus bilineatus</i> , Pa element		1	7	9	32	1	47	1		1	99
<i>Gnathodus</i> sp., Pa element					6	3	15		4	2	30
<i>Lochriea commutata</i> , Pa element			2		6	2	10				20
<i>Lochriea nodosa</i> , Pa element		2	1	7	9	1	8				28
<i>Vogelgnathus</i> sp., Pa element					5	2					7
Indet. Pa element	3	1	1	6	7		10				28
Indet. M element		1		1	2		5				9
Indet.? Sb element							2				2
Indet. Sc. element		3	4	10	5		34	2	1		59
Total counted conodonts	7	8	15	33	72	9	131	3	5	3	286

Tab. 1 - Distribution of conodonts recovered from the pebbles in the Upper Paleozoic conglomerate at Praprotno, Slovenia.

with standard goniatite zonation that they are conditioned by natural facies or evolutionary factors". Viséan and Namurian conodont faunas are known to be facies controlled. Faunas dominated by *Gnathodus* characterize basinal environments (Austin, 1974; Austin & Davies, 1984). Rhodes and Austin (1971) believed that ornamented species of *Gnathodus* (i.e. *G. bilineatus* and *G. punctatus* Bischoff) may have been deeper-water species. Druce (1973) placed *Gnathodus* in two biofacies II and III. The simpler unornamented forms such as *commutatus* and *homopunctatus* groups were thought to occur at intermediate depth, perhaps depth of up to 50 meters (biofacies II) whereas the more highly ornamented forms such as *bilineatus* and *girtyi* groups may have lived in biofacies III at depth higher than about 50 m.

### Conclusions.

Examined limestone pebbles in the Upper Paleozoic conglomerate yield two faunas: 1) the older fauna is marked by *Palmatolepis subrecta* and *Polygnathus decorosus* proving the Frasnian stage (Upper Devonian) and characterizing the pelagic depositional environment;

2) the younger fauna is dominated by *Gnathodus bilineatus* and contains *Lochriea commutata* and *L. nodosa*. This fauna is indicating the Late Viséan-Namurian age (Lower Carboniferous) and characterizing the basinal environment.

## Systematics

Platform conodonts or Pa elements predominate over the ramiforms in the faunas recovered. In describing the Pa elements a form element taxonomy has been used. The reconstruction of the multielement apparatuses was not feasible due to the small number of conodonts recovered and because of inadequate number of ramiform elements. All conodonts have a high colour alteration index (CAI) of 5.

All described and illustrated specimens have been deposited in the Ljubljana Geological Survey (GZL 2694-2708). SEM photographs were done by Mag. J. Rode (Institute of Biology, Ljubljana University).

Phylum **Conodonta** Pander, 1856

Class **Conodonta** Pander, 1856

Order **Ozarkodinida** Dzik, 1976

Family **Palmatolepidae** Sweet, 1988

Genus **Palmatolepis** Ulrich & Bassler, 1926

**Palmatolepis subrecta** Miller & Youngquist, 1947

Pl. 1, fig. 1

- 1962 *Palmatolepis subrecta* Miller & Youngquist - Ziegler, p. 79.  
 1968 *Palmatolepis subrecta* - Schulze, p. 208.  
 1975 *Palmatolepis subrecta* - Filipovic et al., pl. 10, fig. 20-25; pl. 12, fig. 19-21.  
 1979 *Palmatolepis (Manticolepis) subrecta* - Boogaard & Kuhry, p. 30, fig. 1, 2.  
 1980 *Palmatolepis subrecta* - Schönlaub et al., pl. 10, fig. 1-3.  
 1980 *Palmatolepis subrecta* - Perri & Spalletta, p. 302, pl. 6, fig. 1a-2c.  
 1983 *Palmatolepis subrecta* - Boogaard, pl. 3, fig. 8.  
 1987 *Palmatolepis subrecta* - Barskov et al., p. 42, pl. 7, fig. 20-25.  
 1989a *Palmatolepis subrecta* - Ji, pl. 1, fig. 1.  
 1989b *Palmatolepis subrecta* - Ji, pl. 1, fig. 21-23.  
 1989 *Palmatolepis subrecta* - Krstic & Sudar, p. 315, pl. 1, fig. 5-7.  
 1990 *Palmatolepis subrecta* - Lazreq, pl. 4, fig. 4, 7.

**Material.** 2 specimens, figured specimens GZL 2708.

**Description.** The Pa element is characterized by a prominent outer lateral lobe. The carina is slightly sigmoidal - its denticles decrease in height posteriorly. The posterior tip of the element is deflected downward. Upper surface of immature specimen is shagreen like with rare fine nodes. Lower surface is smooth and bears weak anterior and posterior keels.

**Remarks.** Schönlaub (1971) reported this species from the Kokra valley of the Karavanke Mountains.

**Range.** Upper Devonian (Frasnian), upper *Polygnathus asymmetricus* Zone through lower *Palmatolepis triangularis* Zone (Sweet, 1988).

#### Family *Polygnathidae* Bassler, 1925

##### Genus *Polygnathus* Hinde, 1879

##### ***Polygnathus decorosus* Stauffer, 1938**

Pl. 1, fig. 2a-c

- 1965 *Polygnathus decorosa* Stauffer - Ziegler, pl. 3, fig. 1-4; pl. 4, fig. 1-4.  
 1968 *Polygnathus decorosa* - Schulze, p. 212, pl. 19, fig. 17; pl. 20, fig. 10.  
 1970 *Polygnathus decorosus* - Klapper, Philip & Jackson, p. 652, pl. 3, fig. 1-6.  
 1971 *Polygnathus decorosa* - Mirauta, p. 21, pl. 3, fig. 1-4.  
 1973 *Polygnathus decorosus* - Klapper in Ziegler, p. 351, *Polygnathus*, pl. 1, fig. 5.  
 1975 *Polygnathus decorosa* - Filipovic et al., pl. 10, fig. 27, 28.  
 1980 *Polygnathus decorosus* - Perri & Spalletta, p. 305, pl. 6, fig. 7a-9c.  
 1981 *Polygnathus decorosus* - Huddle & Repetski, p. 29, pl. 17, fig. 13-15.  
 1983 *Polygnathus decorosus* - Boogaard, p. 6, pl. 4, fig. 1-10.  
 1986 *Polygnathus decorosus* - Barrick, pl. 6, fig. 7, 13.  
 1989 *Polygnathus decorosus* - Krstic & Sudar, p. 311, pl. 2, fig. 5-7; pl. 3, fig. 1, 2.  
 1990 *Polygnathus decorosus* - Lazreq, pl. 3, fig. 9-11.

**Material.** 2 specimens, figured specimen GZL 2708.

**Description.** Pa element is narrow and slender. Symmetrical platform is ornamented with nodes and short ridges normal to the rim. The anterior platform margins are upraised. The free blade is about half the length of the unit. The basal pit is located at the anterior platform end.

**Range.** Upper Devonian (Frasnian), *Ancyrognathus triangularis* Zone through uppermost *Palmatolepis gigas* Zone (Klapper in Ziegler, 1973).

Family *Gnathodontidae* Sweet, 1988

Genus *Gnathodus* Pander, 1856

***Gnathodus bilineatus*** (Roundy, 1926)

Pl. 2, fig. 1-8

- 1926 *Polygnathus bilineatus* Roundy, p. 13, pl. 3, fig. 10a-c.  
 1953 *Gnathodus bilineatus* - Hass, p. 78, pl. 14, fig. 25-29.  
 1968 *Gnathodus bilineatus* - Durdanovic, p. 96, pl. 1, fig. 16.  
 1969 *Gnathodus bilineatus* - Webster, p. 30, pl. 5, fig. 11, 12.  
 1971 *Gnathodus bilineatus* - Rhodes & Austin, pl. 2, fig. 1.  
 1974 *Gnathodus bilineatus bilineatus* - Austin et al., pl. 1, fig. 4, 5, 15.  
 1974 *Gnathodus bilineatus* - Austin & Husri, pl. 2, fig. 4, 5, 7, 8, 13.  
 1975 *Gnathodus bilineatus bilineatus* - Higgins, p. 28, pl. 11, fig. 1-4, 6, 7.  
 1977 *Gnathodus bilineatus bilineatus* - Ebner, p. 467, pl. 2, fig. 3; pl. 3, fig. 10, 11.  
 1979 *Gnathodus bilineatus bilineatus* - Buchroithner, pl. 2, fig. 14, 15, 16.  
 1980 *Gnathodus bilineatus bilineatus* - Ebner, pl. 15, fig. 5; pl. 16, fig. 19.  
 1981 *Gnathodus bilineatus* - Metcalfe, pl. 3, fig. 2, 3, 4.  
 1984 *Dryphenotus bilineatus bilineatus* - Alekseev et al., pl. 1, fig. 1, 10.  
 1984 *Gnathodus bilineatus bilineatus* - Austin & Davies, pl. 3, fig. 36.  
 1990b *Gnathodus bilineatus* - Ramovs, p. 91, pl. 4, fig. 2, 4, 5, 8, 9.  
 1990c *Gnathodus bilineatus* - Ramovs, p. 109, pl. 1, fig. 1-3, 11.

**Material.** 92 specimens, figured specimens GZL 2694, 2701, 2704, 2705.

**Description.** A very variable species characterized by robust Pa elements. Axis is gently curved. Shape of outer platform varies from semi-ovate or triangular in juveniles to more rectangular in adults. Upper surface of the outer platform is ornamented with numerous nodes which tend to be aligned in rows in adult forms. The inner platform is narrow and characterized by transverse ridge.

**Remarks.** This species is widespread and abundantly represented in most Upper Viséan and Namurian faunas; however, it shows great variations in shape and ornamentation and several morphotypes have been recognized (see Ramovs, 1990b).

**Range.** Lower Carboniferous (Upper Viséan-Namurian), *Gnathodus bilineatus bilineatus* Zone - *Gnathodus bilineatus bollandensis* Zone of Ebner (1977).

Family *Spathognathodontidae* Hass, 1959

Genus *Lochriea* Scott, 1942

***Lochriea commutata*** (Branson & Mehl, 1941)

Pl. 1, fig. 3, 4

- 1941 *Spathognathodus commutatus* Branson & Mehl, p. 98, pl. 19, fig. 1-4.  
 1969 *Gnathodus commutatus* - Webster, p. 31, pl. 5, fig. 13.  
 1971 *Gnathodus commutatus* - Rhodes & Austin, pl. 2, fig. 6.  
 1974 *Gnathodus commutatus* - Austin et al., pl. 1, fig. 7, 10, 12.  
 1974 *Gnathodus commutatus commutatus* - Austin & Husri, pl. 3, fig. 1, 2, 3, 12.

- 1975 *Paragnathodus commutatus* - Higgins, p. 70, pl. 7, fig. 7-9, 11, 13, 16, 20, 21.  
 1977 *Gnathodus commutatus commutatus* - Ebner, p. 468, pl. 3, fig. 1.  
 1977 *Paragnathodus commutatus* - Kozur & Mock, p. 303, pl. 1, fig. 9.  
 1979 *Gnathodus commutatus* - Buchroithner, pl. 1, fig. 8, 13.  
 1980 *Gnathodus commutatus commutatus* - Ebner, pl. 15, fig. 7.  
 1981 *Gnathodus commutatus* - Metcalfe, p. 21, pl. 7, fig. 6, 7.  
 1982 *Paragnathodus commutatus* - Belka, pl. 1, fig. 11.  
 1984 *Paragnathodus commutatus* - Alekseev et al., pl. 1, fig. 2.  
 1984 *Paragnathodus commutatus* - Austin & Davies, pl. 3, fig. 26, 31.  
 1990b *Lochriea commutata* - Ramovs, p. 94, pl. 4, fig. 6, 7, 10, 11.  
 1990c *Lochriea commutata* - Ramovs, p. 110, pl. 1, fig. 6, 7, 9, 12-14.

**Material.** 19 specimens, figured specimens GZL 2696, 2701.

**Description.** In upper view the Pa element is curved; however some specimens are nearly straight. Platform is variable in shape, it is mostly sub-elliptical. Blade bears denticles with free sharp tips; height of denticles decrease slightly towards posterior and it has straight lower edge in lateral view. Lower side of the unit is marked by large grooved basal cavity.

**Range.** Lower Carboniferous (Visean-Namurian), *Gnathodus typicus* Zone - *Gnathodus bilineatus bollandensis* Zone of Ebner (1977).

#### **Lochriea nodosa** (Bischoff, 1957)

Pl. 1, fig. 5-8

- 1957 *Gnathodus commutatus nodosus* Bischoff, p. 23, pl. 4, fig. 12, 13.  
 1971 *Gnathodus nodosus* - Rhodes & Austin, pl. 2, fig. 5.  
 1974 *Gnathodus nodosus* - Austin et al., pl. 1, fig. 2, 3, 6, 13.  
 1974 *Gnathodus commutatus nodosus* - Austin & Husri, pl. 3, fig. 4, 5, 6, 7, 8.  
 1975 *Paragnathodus nodosus* - Higgins, p. 72, pl. 7, fig. 12, 15, 17-19, 22, 23.  
 1977 *Gnathodus commutatus nodosus* - Ebner, p. 469, pl. 2, fig. 11; pl. 3, fig. 2.  
 1977 *Paragnathodus nodosus* - Kozur & Mock, p. 303, pl. 1, fig. 7, 8.  
 1979 *Gnathodus commutatus nodosus* - Buchroithner, pl. 2, fig. 13.  
 1980 *Gnathodus commutatus nodosus* - Ebner, pl. 15, fig. 8, 9.  
 1981 *Gnathodus nodosus* - Metcalfe, pl. 7, fig. 1-5.  
 1982 *Paragnathodus nodosus* - Belka, pl. 1, fig. 8, 9.  
 1984 *Paragnathodus nodosus* - Alekseev et al., pl. 1, fig. 3.  
 1984 *Paragnathodus nodosus* - Austin & Davies, pl. 3, fig. 29.  
 1990b *Lochriea nodosa* - Ramovs, p. 96.  
 1990c *Lochriea nodosa* - Ramovs, p. 110, pl. 1, fig. 4.

**Material.** 21 specimens, figured specimens GZL 2701, 2705.

**Description.** Axis of Pa element is straight or gently curved. Platform is subsymmetrical, varying from sub-elliptical; it occupies almost posterior half of the Pa element length and is pointed posteriorly. Platform is ornamented with irregular number of nodes: in some specimens a single node is present on each side while in others the nodes are arranged in rows of nodes, which radiate anteriorly at about 45°. Blade is sub-rectangular in outline; it usually possesses 7 discrete, laterally compressed and partly fused denticles. Carina is formed by a series of about 10 nodes; they show well

developed striations subparallel to their axes. In lower view, basal cavity reflects the shape of platform and is marked by strong median groove.

**Range.** Lower Carboniferous (Upper Visean-Namurian), *Gnathodus commutatus nodosus* Zone - *Gnathodus bilineatus bollandensis* Zone (sensu Ebner, 1977).

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#### PLATE 1

- Fig. 1 - *Palmatolepis subrecta* Miller & Youngquist. Pa element. Frasnian (Upper Devonian) limestone pebble in the Upper Paleozoic conglomerate at Praprotno. PR1, GZL 2708; 75 x.
- Fig. 2a, b, c - *Polygnathus decorosus* Stauffer. Pa element. Frasnian (Upper Devonian) limestone pebble in the Upper Paleozoic conglomerate at Praprotno. PR1, GZL 2708; 45 x, 50 x, 50 x.
- Fig. 3,4 - *Lochbriea commutata* (Branson & Mehl). Pa element. Late Visean-Namurian (Lower Carboniferous) limestone pebbles in the Upper Paleozoic conglomerate at Praprotno. PR5, GZL 2701 (fig.3); PR6, GZL 2696 (fig. 4); 50 x.
- Fig. 5-8 - *Lochbriea nodosa* (Bischoff). Pa element. Late Visean-Namurian (Lower Carboniferous) limestone pebbles in the Upper Paleozoic conglomerate at Praprotno. PR5, GZL 2701, (fig.5, 6); PR7, GZL 2705 (fig. 7,8); 50 x.

#### PLATE 2

- Fig. 1-8 - *Gnathodus bilineatus* (Roundy). Pa element. Late Visean-Namurian (Lower Carboniferous) limestone pebbles in the Upper Paleozoic conglomerate at Praprotno. PR3, GZL 2694 (fig. 1-3); PR7, GZL 2705 (fig. 4,8); PR4, GZL 2704 (fig. 5); PR5, GZL 2701 (fig. 6, 7); 50 x.

