

## THE GENUS *Pygmaeocrinus* BOUŠKA, 1947 (CRINOIDEA, INADUNATA) IN THE DEVONIAN OF THE BARRANDIAN AREA (CZECH REPUBLIC)

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Abstract: A systematic study is undertaken here, of the minute, morphologically remarkable and stratigraphically significant inadunates of the genus *Pygmaeocrinus*, which are a common constituent of the crinoid fauna in the Devonian rocks of the Barrandian area. Until now, the only known species of the genus was *P. kettneri* BOUŠKA, 1947, known from the Dvorce-Prokop Limestone, Pragian (Lower Devonian). The authors have revised Bouška's types, and supplement by rich new material from the Bohemian Devonian (esp. from the so-called "white beds"), and have erected 7 new Lower Devonian species: *P. rotundus* sp. n. from the Lochkovian; *P. campanulatus* sp.n., *P. fallax* sp. n., and *P. notabilis* sp. n. from the Pragian; *P. fabulosus* sp. n. from the Zlíchovian (Lower Emsian); *P. catharinae* sp. n. and *P. decoratus* sp.n. from the Dalejan (Upper Emsian); the latter two species have been ascertained also in the overlying Eifelian (Middle Devonian).

■ Crinoidea, *Pygmaeocrinus*, systematics, Devonian, Bohemia.

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### Introduction

Minute inadunates of the genus *Pygmaeocrinus* BOUŠKA, 1947 are the most abundant crinoids in the Devonian of the Barrandian area. Their isolated skeletal elements, common aboral cups and complete thecae have been discovered at nearly all stratigraphical levels of the Barrandian Devonian, from the Lochkovian (lower Lower Devonian) up to the Eifelian (lower Middle Devonian). From the palaeoecological point of view, it ought to be stressed that pygmaeocrinids are markedly connected with carbonate sedimentation. They are especially common in micritic and biomicritic limestones; they are rare in sparitic and biosparitic limestones and particularly rare in bioclastic limestones. Most of the specimens at our disposal have been obtained from the washed fine-grained fraction of the weathered portions of the Barrandian carbonates (so-called "white beds") but some have been found also directly on the weathered bedding planes of solid limestone slabs. On the other hand, pygmaeocrinids are totally unknown from clayey shales, siltstones or other siliciclastic sediments. Outside the famous Barrandian area, skeletal elements of the crinoid genus *Pygmaeocrinus* have been discovered only in NE Bohemia, into which Barrandian strata extend and underlie Cretaceous sediments at great depths. Here, *Pygmaeocrinus* has been reported from a well near Benátky nad Jizerou where the drill hole,

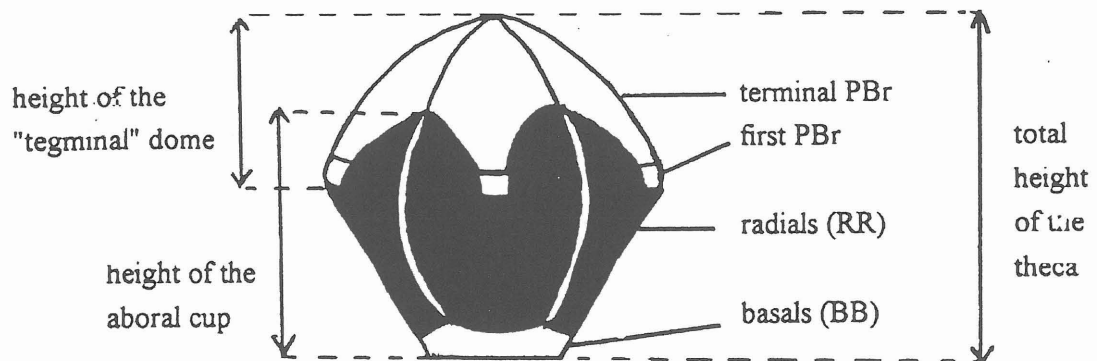
at a depth of 331 to 435 m, reached Upper Palaeozoic sediments, particularly Permocarboneous conglomerates. They contained pebbles derived from Silurian and Devonian rocks. The lithological and faunal content of the pebbles corresponds to Lower Devonian carbonates of the Barrandian area, being nearly identical to the Loděnice Limestone (Pragian) in the vicinity of Praha. From these pebbles typical second (terminal) PBrBr of pygmaeocrinids have been isolated (Zikmundová et Holub 1965). The genus *Pygmaeocrinus* has been established by Bouška (1947) on the basis of a single species, *P. kettneri* BOUŠKA, 1947, from the Dvorce-Prokop Limestone (Pragian). Bouška gave a description that is very brief, however, he correctly remarked that in the diverse stratigraphical levels of the Bohemian Silurian and Devonian, there are several other congeneric forms of pygmaeocrinids differing from the type species only in special morphological and ornamental characteristics of the cup. Moreover, Bouška also noted that the pygmaeocrinids are of great stratigraphical importance (Bouška 1947, p.3).

Of course, there are also some errors in Bouška's original paper. For instance, his report of pygmaeocrinids from the Upper Silurian rocks is wrong. The exact reason for this mistake is clear for all Barrandian specialists because the lo-

<b>Eifelian</b>		Acanthopyge Lmst.	Choteč Lmst.	7	8
<b>Dalejan</b>	<b>Upper Emsian</b>	Suchomasty Lmst.	Třebotov Lmst.	7	8
				Daleje Shale	
<b>Zlíchovian</b>	<b>Lower Emsian</b>	Suchomasty & Chýnvice Lmst.			
		Zlíchov Lmst.		Kaplička Coral Horizon 6	
<b>Pragian</b>		5 Koněprusy Lmst.	4 3 Slivenec Lmst.	4 3 2 Loděnice Lmst.	4 3 2 Dvorce-Prokop Lmst.
<b>Lochkovian</b>		1 Kotýs Lmst.	Radotín Lmst.		

Tab. I: Stratigraphical distribution of the particular pygmaeocrinid species in the Bohemian Lower (Lochkovian-Dalejan) and lower Middle Devonian (Eifelian). The lithostratigraphic units are adopted from Chlupáč (1983).

1 - *Pygmaeocrinus rotundus* n. sp.; 2 - *P. kettneri* BOUŠKA, 1947; 3 - *P. fallax* n. sp.; 4 - *P. campanulatus* n. sp.; 5 - *P. notabilis* n. sp.; 6 - *P. fabulosus* n. sp.; 7 - *P. catharinae* n. sp.; 8 - *P. decoratus* n. sp.



Text-fig. 1: Schematic sketch of the theca of the genus *Pygmaeocrinus* BOUŠKA: its morphology and main parameters.

wermost Devonian stage, Lochkovian, had been formerly placed without question within the Upper Silurian by all previous authors (because of the presence of graptolites!). In addition his placement of the genus *Pygmaeocrinus* within the Family *Pisocrinidae* is wrong. The latter mistake has been corrected by Strimple (1963), who erected a new Family, *Pygmaeocrinidae*, within which he, surprisingly also classified the very strange inadunate crinoid *Stortingocrinus* SCHULTZE, 1867 from the Devonian of Germany. The latter genus is, however, characterized by a markedly different bauplan of the theca, with well-developed anal series. We are of the opinion that the genus *Stortingocrinus* does not belong to the Family *Pygmaeocrinidae* and that it is possibly a representative of camerate crinoids related to the Family *Platycrinidae* (see Schultze, 1867).

### Systematic part

Subclass: Inadunata WACHSMUTH et SPRINGER, 1885

Order: Disparida MOORE et LAUDON, 1943

Family: Pygmaeocrinidae STRIMPLE, 1963

Emended diagnosis: Minute monocyclic crinoids bearing a perfect pentamerous symmetry of the theca, without any anal structure, more or less bipyramidal in lateral view and pentastellate, pentalobate or nearly pentagonal as seen from above or below. Cup cone- or bowl-shaped, generally with subhorizontal base. Circular stem facet is hidden within a depression of a deep basal pit. Basals pentagonal, tiny, in side view their upflared distal tips generally visible, but laterally well-observable BB only in some species. Most of the cup is built by 5 identical, laterally protruding radials, distally terminating in angular interradsial (interbrachial) processes with crenulate lateral surface for the insertion of two brachials. Radial facets themselves are narrow, deeply notched into the upper surfaces of RR. Arms composed of only 2 primibrachials; first one is tiny, quadrangular, deeply set into the notch of the radial facet. Second (terminal) PBrBr are large, spearhead-shaped, partly set into the deep, crenulated notches of RR. Distally, at the terminal part of the theca, the distal portions of second (terminal) PBrBr are interconnected laterally by crenulate sutures, forming a "tegminal" dome or pentagonal pyramid, completely covering the whole ventral cavity of the aboral cup. Stem *in situ* unknown.

Genera: Only the genus *Pygmaeocrinus* BOUŠKA, from the Lower and Middle Devonian of Bohemia, Czech Republic.

Genus: **PYGMAEOCRINUS** Bouška, 1947

Type species: *Pygmaeocrinus kettneri* BOUŠKA. Lower Devonian, Pragian, Dvorce-Prokop Limestone, Bohemia.  
Diagnosis: See that of the Family.

Remarks: Except adults and some geronts, a number of juvenile pygmaeocrinids has been ascertained in the washings. They are of all growth stages, including also tiny early juveniles (height of their thecae is about 0,6 - 0,8 mm).

Morphological changes during ontogeny are associated especially with allometric growth which lead to a change in the parameters of the width:height ratio of the aboral cup and/or of the "tegminal" dome composed of interconnected second (terminal) PBrBr. Similarly, the subpentagonal outline of the cup also undergoes allometric developmental changes, becoming much more lobate in adults than in smaller, immature specimens.

Pathological individuals are relatively common among all known species of *Pygmaeocrinus*. Their morphology is influenced most frequently by mechanical irregularities which appeared during the growth of the theca, probably affected by a constant, unidirectional current pressure and/or growth within a very dense populations of overcrowded crinoid "carpets" or "gardens". Relatively rare abnormalities had possibly resulted from non-lethal injuries during the larval and/or premature stages of ontogenetic development (e.g., lack of an arm or even absence of a whole ray in quadrilaterally symmetrical cups).

Species: Lower Devonian: *Pygmaeocrinus rotundus* sp.n. (Lochkovian), *P. campanulatus* sp.n., *P. fallax* sp.n., *P. kettneri* BOUŠKA, 1947, *P. notabilis* sp.n. (Pragian), *P. fabulosus* sp.n. (Zlíchovian = Lower Emsian), *P. catharinae* sp.n., *P. decoratus* sp.n. (Dalejan = Upper Emsian). Middle Devonian: *P. catharinae* sp.n., *P. decoratus* sp.n. (Eifelian).

### *Pygmaeocrinus kettneri* BOUŠKA, 1947

Pl. 1, figs 7-9

1947 *Pygmaeocrinus kettneri* n. gen., n. sp.; Bouška, p. 1-4, pl. 1, figs 1-4 (drawings)

1991 *Pygmaeocrinus kettneri* BOUŠKA; Prokop and Petr, p. 30, pl. 5, figs 8-10. (first photographs)

Holotype: L 7971, figured by Bouška (1947) on pl. 1, figs 1-1b and herein on Pl. 1, figs 7-8.

Type locality: Praha-Klukovice.

Type stratum: Lower Devonian, Pragian, Dvorce-Prokop Limestone.

Material: More than 200 complete thecae, aboral cups and isolated RR and SBrBr.

Description: Theca relatively large, proportionally bipyramidal, with vermicular surface of the plates. Cup of medium-thick wall, low, cone-shaped (height: width ratio = 1:2), pentastellate with protruding rays and straightly truncated tips in oral or basal view. Cup base flat, broad, with narrow, cylindrical, deep basal pit. Basal cirlet thickened, subhorizontal, with distal tips of BB upflared, laterally well visible. Radials strongly convex, slightly concave in lateral outline, with prominent rounded median ridges and distinct, rounded radial ribs. The width of radial facets forms 1/3 of the total width of RR. The distal interradsial (interbrachial) processes of RR are slightly bent downward into the ventral cavity of the cup. First PBrBr minute, uniformly quadrangular, set within the notches of the radial facets. Second (terminal) PBrBr large, spearhead-shaped, strongly vaulted, with prominent median ridges and radial ribs of the same type as in the radials. Distal portions of terminal PBrBr laterally interconnected, embracing almost entire oral side of cup and forming a terminally rounded "tegminal" dome almost/or exactly as high as the aboral cup itself. Stem "*in situ*" unknown, stem facet as wide as the basal pit, smooth, round, with minute, rounded lumen.

Dimensions of the holotype (in mm): total height of the theca = 2.0, max. width of the theca = 3.0, min. width of the theca = 2.5, height of the aboral cup = 1.4, height of the "tegminal" dome = 1.4 (for explanation see the description), width of the cup base = 0.8.

Occurrence: *Pygmaeocrinus kettneri* BOUŠKA, 1947 is a typical and relatively abundant species in the Praha Formation (Pragian) in the Barrandian area. It occurs most frequently in its type stratum, i.e. in the grey, micritic, well-bedded, commonly nodular Dvorce-Prokop Limestone. These limestones represent a deep, subtidal, very low-energy environment of the Benthic Assemblages 5 to 6 in Boucot's classification. *P. kettneri* is also relatively common in the rose or reddish-grey biosparitic and biomicritic Loděnice Limestone, representing a subtidal, shallower but still low-energy environment (most likely Benthic Assemblage 4 in Boucot's classification). Immature specimens differ from adults only in having a higher and broader aboral cup.

Localities: 1. Dvorce-Prokop Limestone: Praha-Klukovice, east part of the "Červený lom" quarry (type locality); Praha-Hlubčepy, "St. Prokop's" quarry; Praha-Řeporyje, "U kantiny" quarry (170-90 cm below the base of the Zlíchov limestone).

2. Loděnice Limestone: Praha-Klukovice, west part of the "Červený lom" quarry; Praha-Smíchov, abandoned quarries "Na Konvářce" and "Dívčí hrady"; Choteč, a small quarry at the forest margin near the road to Kosof.

#### *Pygmaeocrinus rotundus* sp. n.

Pl. 1, figs 1-6

Holotype: L 30511, figured herein on Pl. 1, fig. 1.

Type stratum: Lowermost Devonian, Lochkovian, Kotýs Limestone.

Type locality: Praha-Řeporyje, "Černá skála" quarry.

Material: 26 aboral cups and their fragments and about 150 isolated RR and SBrBr.

Description: Aboral cup thick-walled, bowl-shaped, broadly pentalobate, with rounded, indistinctly protruding rays in oral or basal view. Surface of the cup plates smooth. Cup base flat, broad, with shallow, cylindrical basal pit. Basals subhorizontal, forming a markedly pronounced encirclement around the base. Distal tips of BB upflared, well visible in the side view. Radials convex, rounded, without distinct median ridge. Radial facets broad, forming about 1/3 of the whole width of RR. Interradial (interbrachial) processes of RR are only slightly bent downward into the ventral cavity of the cup. First and terminal PBrBr probably of relatively large size but not preserved *in situ* in available specimens. Stem facet as wide as the basal pit, subpentagonal, with minute, rounded lumen. Stem unknown.

Dimensions of the holotype (in mm): height of the aboral cup up to the tips of IBrBr processes = 2.0, height of the cup up to the radial facets = 1.5, max. width of the cup = 2.8, width of the cup base = 1.0.

Occurrence: *Pygmaeocrinus rotundus* sp. n. is relatively common in the middle and upper levels of the Kotýs

Limestone, i.e. in thick-bedded, light-grey sparitic to medium bioclastic limestones. These carbonates probably represent a well-aerated shallow subtidal environment (Benthic assemblage 3 in Boucot's classification).

Localities: Praha-Řeporyje, "Černá skála" quarry; Bubovice, "Solway" quarries; Loděnice-Na Branžovech, "Záloženský lom" quarry; Trněný Újezd, "Čížovec" quarry (20-40 cm below the base of the Koněprusy limestone - Pragian).

#### *Pygmaeocrinus campanulatus* sp. n.

Pl. 2., figs 5-10, Pl. 3., figs 1-9

Holotype: L 29526, complete theca figured herein on Pl. 2, fig. 5.

Type stratum: Lower Devonian, Pragian, Loděnice Limestone.

Type locality: Praha-Klukovice, "Červený lom" quarry.

Material: More than 2000 isolated thecae, aboral cups, RR and SBrBr washed from the Slivenec, Loděnice and Dvorce-Prokop Limestone "white beds".

Description: Theca minute, disproportionally bipyramidal, with high aboral cup and low "tegminal" dome. The surface of thecal plates smooth. Aboral cup thin-walled, medium cone- to bell-shaped (ratio of height of the cup : width of the cup about 1 : 1.4), pentalobate, with rounded, slightly protruding rays in oral or basal view. Cup base flat, narrow, with broad, cylindrical, deep basal pit. Proximal parts of BB subhorizontal, thickened, distal parts thin, upflared, with their lateral connections and the tips well visible in the side view. Radials high, convex, with straight or slightly concave lateral outline, thickened in their distal part. Median ridges prominent, rounded. Width of the radial facets forms 1/4 to 1/5 of the total width of RR. The interradial (interbrachial) processes strongly bent downward into the ventral cavity of the cup. First PBrBr tiny, low oblong in shape, submersed into the notches of RR. SBrBr relatively small, short, weakly vaulted, bearing an indistinct, rounded median ridge only. Distal parts of second (terminal) PBrBr laterally interconnected, embracing distinct middle portion of the oral side of the cup and forming a rounded to often flat "tegminal" dome, slightly concave at the central point, markedly lower than the aboral cup itself. Ratio height of the aboral cup : height of the "tegminal" dome is about 2.1:1.

Dimensions of the holotype (in mm): height of the theca = 1.4, height of the aboral cup = 1.2, max. width of the theca = 1.9, width of the cup base = 0.6, height of the "tegminal" dome = 0.5 (for explanation see the description).

Occurrence: *Pygmaeocrinus campanulatus* sp. n. is certainly the most abundant species of pygmaeocrinids in the Praha Formation. Especially noteworthy is the mass occurrence in the Loděnice and Dvorce-Prokop Limestone. The latter carbonates were deposited in deeper parts of the Barrandian basin, in low-energy, relatively poorly aerated environment (Benthic Assemblages 4 to 6 in Boucot's classification). *P. campanulatus* is found also, but rarely, in the thick-bedded, reddish, sparitic, mostly crinoidal Slivenec Limestone (representing a shallow, subtidal, high-energy environment, and Benthic Assemblage 3 in Boucot's classification).

Localities: Dvorce-Prokop Limestone: Praha-Hlubočepy, "St. Prokop" quarry; Praha-Řeporyje, "U kantiny" quarry; Praha-Klukovice, "Červený lom" quarry (east part); Praha-Malá Chuchle, abandoned quarry near the forest road to Slivenec; Praha-Smíchov, road cut about 300m north-west from the abandoned quarry "Na Konvářce".

Loděnice Limestone: Praha-Klukovice, "Červený lom" quarry (west part); Praha-Smíchov, "Na Konvářce" quarry; Praha-Radotín, "Na Špici" quarry, in the Radotín Valley.

Slivenec Limestone: Praha-Klukovice, "Červený lom" quarry, (west part); base of the "white beds" about 40cm below the boundary with the overlying Loděnice Limestone; Srbsko near Beroun, an abandoned quarry in the Kačák Valley where the Kačák Creek reaches the Berounka River.

Remarks: Although the species is morphologically distinct, a marked variability in size and form of its theca has been observed, especially in the ratio height: width of the cup, in the ratio height of the aboral cup: height of the "tegminal" dome, in the width of the base, and the angle of the cup walls. A range of variability has also been observed in the character of the median ridges, which sometimes may be broader, more rounded and less prominent. From the latter reason the whole cup also varies from a pentastellate (more common) to pentalobate shape in oral or dorsal view. Interestingly, thecae also change their size and form in relation to the particular carbonate facies. The average height of the cup in *P. campanulatus* sp.n. from the Dvorce-Prokop Limestone is 1.8 - 2 mm, the average width 2.2 - 2.6 mm, while the ratio of height of the aboral cup:height of the "tegminal" dome is about 6:1. On the other hand, specimens from the Loděnice Limestone are generally smaller. The average height of their cups is 1.2 - 1.5 mm, the average width 2,0 - 2,1 mm, while the ratio of height of the aboral cup: height of the "tegminal" dome is about 5:1.

*Pygmaeocrinus fallax* sp. n.

Pl. 3, fig. 11, Pl. 4, figs 1-10

Holotype: L 29534, theca with terminal PbrBr partly preserved "in situ", figured herein on Pl. 3, fig. 11.

Type stratum: Lower Devonian, Pragian, Loděnice Limestone

Type locality: Praha-Klukovice, "Červený lom" quarry.

Material: More than 800 isolated thecae, aboral cups, RR and PBrBr from the Slivenec, Loděnice and Dvorce-Prokop limestones.

Description: Theca minute, with relatively low, wide aboral cup. The "tegminal" dome formed of interconnected terminal PBrBr is large and extremely high. The surface of thecal plates smooth or slightly vermicular (bearing tiny wrinkles). Aboral cup thin-walled, low bowl-shaped, ratio height: width of the aboral cup is about 1:4. In basal or oral view the cup is pentalobate, with roundedly or almost straightly truncated tips. Cup base subhorizontal, built mostly of thickened proximal parts of BB that form a conspicuous "collar" around the wide, shallow basal pit. Distal parts of BB thin, partly upflared, with distal tips only slightly visible in lateral view. Radials low, convex, generally with straight walls in lateral outline, bearing only rounded, indistinct, weakly developed median ridges. Radial facets narrow, forming about 1/4 of the total width of RR. The interbranchial

processes of RR wide and high, only slightly bent downward into the ventral cavity of the cup. First PBrBr tiny, rarely preserved. Second (terminal) PBrBr large, strongly vaulted, rounded, but without any median ridge. The latter are laterally interconnected, embracing practically all the ventral cavity of the cup. Ratio of height of the aboral cup: height of the "tegminal" dome is about 1:1 or the "tegminal" dome may be slightly higher.

Dimensions of the holotype in mm: height of the theca = 1.6, height of the aboral cup in interradial = 1.2, height of the cup in radial = 0.7, max. width of the theca = 2.1, width of the cup base = 0.4.

Occurrence: This species, together with *P. campanulatus* sp. n., comes from all known localities and all known carbonate facies of the Pragian in the Barrandian area, except for the Koněprusy and Vinařice Limestones. It is most frequent in the Loděnice Lmst., less common in the Dvorce-Prokop Lmst., and rare in the Slivenec Lmst. *Pygmaeocrinus fallax* sp. n. represents a distinct, well-distinguishable, and morphologically constant crinoid species. We have observed only a little variability in the prominence of the sculpture and in the whole outline of the cup.

*Pygmaeocrinus notabilis* sp. n.

Pl. 2, figs 1-4

Holotype: L 32003, complete theca preserved on the surface of an organoclastic limestone fragment, figured herein on Pl. 2, figs 1-4

Type stratum: Lower Devonian, Pragian, Koněprusy Limestone

Type locality: "Na Plešivci" quarry near Suchomasty ("Čertovy schody" - East, quarries).

Material: Except the holotype only 7 isolated radials and 3 isolated terminal PBrBr derived from washings of weathered parts of limestones at the type locality.

Description: This form seems to be most closely related to *Pygmaeocrinus kettneri* BOUŠKA, 1947. Its theca is proportionally bipyramidal, with low to medium cone-shaped aboral cup. *Pygmaeocrinus notabilis* sp.n. differs from the type species in that the "tegminal" dome (composed of laterally interconnected terminal PBrBr), is narrower, higher and more pointed terminally. The aboral cup itself is also less wide. On the other hand, BB are lower than in *P. kettneri*, only the distal tips of BB are laterally visible. RR proximally pointed (in the type species rounded or polygonal), with distinct median ridges distally broadened up to the radial facets. Therefore, RR are thickened around the radial notches. First PBrBr roundedly quadrangular, second (terminal) PBrBr thin-walled, smooth, only with markedly vaulted but rounded median ridges. The latter are laterally interconnected, embracing practically all the ventral cavity of the cup. Ratio of height of the aboral cup: height of the "tegminal" dome is 1:1.

Dimensions of the holotype (in mm): height of the theca = 3.8, height of the aboral cup in radial = 1.5, height of the aboral cup in interradial = 2.5, max. width of the theca = 3.8, width of cup base = 1.0.

Occurrence: *Pygmaeocrinus notabilis* sp. n. is found rarely at the quarry "Na Plešivci", in the biosparitic Koněprusy Limestone formed of detritic material of the perireefal carbonate sediments of the talus zone, representing a relatively more quiet, low-energy environment of the bioherm, far from the high-energy reef core.

*Pygmaeocrinus fabulosus* sp. n.

Pl. 6, figs 8-12

Holotype: L 32004, complete theca figured herein on Pl. 6, figs 8-11.

Type stratum: Lower Devonian, Lower Emsian (= Zlícho-  
vian), "Kaplička Coral Horizon" at the base of Zlíchov  
Limestone.

Type locality: Praha-Zlíchov, "U kapličky" quarry.

Material: Except the holotype, two isolated thecae washed  
from the bioclastic carbonates of the "Kaplička Coral  
Horizon".

Description: Theca relatively large, subproportionally bi-  
pyramidal. Thecal plates moderately thick, with smooth sur-  
face. The aboral cup low cone-shaped (ratio max. height :  
max. width is about 1 : 2.5), rapidly expanding from the ba-  
se, with straight to slightly concave walls in lateral outline.  
Cup base flat, the basal pit cylindrical and very shallow.  
Basal circlet low, not thickened, subhorizontal, with distal  
tips of basals upflared and well visible laterally. Radials  
convex, but straight or slightly concave in lateral outline,  
with distinct, rounded median ridges. Radial facets deeply  
submersed within the radial notches, forming about 1/4 of  
the total width of RR. They are slender, extending for a con-  
siderable distance laterally, so that the cup is extraordinari-  
ly pentalobate ("starfish-shaped") in oral or basal view (Pl.  
6, figs 10-12). Therefore, the interradial (interbrachial) pro-  
cesses of RR are protruding, but having straightly truncated  
tips in oral or basal view. First PBrBr tiny, trapezoidal.  
Second (terminal) PBrBr lancet-shape, slender, with roun-  
ded median ridges. The latter are laterally interconnected,  
embracing the whole ventral cavity of the cup. Ratio of he-  
ight of the aboral cup : height of the "tegminal" dome is 1:1  
or the "tegminal" dome is slightly higher.

Dimensions of the holotype (in mm): height of the theca  
= 3.5, height of the aboral cup in interradii = 1.6, height of  
the aboral cup in radii = 2.2, max. width of the theca = 4.0,  
width of the cup base 1.2.

Occurrence: *Pygmaeocrinus fabulosus* sp. n., the most ra-  
re of the pygmaeocrinids in the Bohemian Devonian, is  
a very infrequent constituent of an otherwise extremely di-  
verse, crinoid-dominated "Coral Chapel" assemblage, pro-  
bably having inhabited the gentle slopes of a detritic talus on  
outer margins of a perireefal environment, far from the bio-  
herm core. All the three known specimens have been obtain-  
ed at the type locality, "U kapličky" quarry. They come  
from the collection of the late F. Hanuš, who recognized  
them incorrectly as *Lageniocrinus* (a Carboniferous genus)  
and listed them under this name in his publications (Hanus  
1923, 1927).

*Pygmaeocrinus catharinae* sp. n.

Pl. 7, figs 1-7, Pl. 8, figs 1-6

Holotype: L 29544, complete theca figured herein on Pl. 7,  
fig. 1.

Type stratum: Lower Devonian, Upper Emsian (Dalejan),  
Třebotov Limestone.

Type locality: Praha-Holyně, abandoned quarry "Prastav"

Derivatio nominis: In honour of the late Ing. Kateřina Ši-  
máková and her important investigations in the  
Barrandian area which deserve our deep gratitude.

Material: Several hundreds of isolated thecae, aboral cups,  
RR and PBrBr, washed from the Třebotov Lmst. (upper  
Lower Devonian) and overlying Choteč Lmst. (lower  
Middle Devonian).

Description: Theca relatively large, disproportionally bi-  
pyramidal, with high aboral cup and low to nearly flat "teg-  
minal" dome. The surface of thecal plates smooth or slight-  
ly vermicular. Aboral cup thick-walled, medium bowl-sha-  
ped, in oral or basal view pentalobate to almost subpentan-  
gular, with straight or gently concave truncated tips. Cup ba-  
se generally convex but narrow, with a cylindrical, relative-  
ly deep basal pit. Distal parts of BB relatively high, upfla-  
red, well visible in side view. Radials convex, without me-  
dial keels. Width of the radial facets 1/3 - 1/4 of the total  
width of RR, the interbrachial processes strongly bent  
downward into the ventral cavity. First PBrBr trapezoidal,  
submersed into the deep radial notches. Second (terminal)  
PBrBr small, spearhead-shaped, weakly vaulted, without di-  
stinct median ridges. They are interconnected laterally, co-  
vering generally only the middle part of the ventral cavity of  
the cup. Ratio of height of the aboral cup: height of the  
"tegminal" dome is generally 7-8:1 but in juveniles the abo-  
ral cup is only slightly higher (see below).

Dimensions of the holotype (in mm): height of the theca  
= 1.9, height of the aboral cup in interradii = 1.8, height of  
the aboral cup in radii = 1.4, max. width of the theca = 1.8,  
height of the cup base = 0.2, width of the cup base = 0.4.

Ontogeny: In addition to the skeletal elements of adults,  
we have commonly observed also thecal ossicles and thecae  
of immature specimens (with a height of theca about 0.8 and  
width 0.7 mm - see Pl. 8, fig. 6). These juveniles possess la-  
terally well-visible BB and the characteristic pentalobate  
outline of the cup in oral or basal view as do the adults. The  
juvenile specimens differ only in having a higher "tegminal"  
dome (composed of laterally interconnected terminal  
PBrBr, covering the whole ventral cavity of the cup).

Occurrence: *Pygmaeocrinus catharinae* sp. n. is an abun-  
dant species, frequently encountered in the uppermost part  
of the Třebotov Limestone (Upper Emsian) and in the lower  
part of the Choteč Limestone (Eifelian), at all known locali-  
ties, e.g. at Praha-Holyně, Praha-Hlubočepy etc. In a well-  
stratified section of the Lower/Middle Devonian boundary  
interval, studied in great detail and being well-exposed in  
a roadcut of the highway at Praha-Barrandov (see Lukeš  
1989), these crinoids occur in the Třebotov Limestone, 4.5  
m below the Lower/Middle Devonian boundary (= Dalejan/Eifelian,  
i.e. Třebotov Lmst./Choteč Lmst.), rang-  
ing upward into the first two metres of the basal sediments  
of the Choteč Limestone (the preserved sequence of sedi-

ments, unfortunately, does not continue). The species *Pygmaeocrinus catharinae* sp. n. is most abundant in the Třebotov Limestone, 2.5 - 2 m below the Lower/Middle Devonian boundary, and in the Choteč Limestone, 20 cm above that boundary (interestingly, in the latter layer fossils of juveniles are much more common than those of adults).

*Pygmaeocrinus decoratus* sp. n.

Pl. 5, figs 1-6, Pl. 6, figs 1-7

Holotype: L 29546, aboral cup figured herein on Pl. 5, fig. 5  
Type stratum: Lower Devonian, Upper Emsian (Dalejan), Třebotov Limestone.

Type locality: Praha-Holyně, abandoned quarry "Prastav".  
Material: Several hundred isolated thecae, aboral cups, RR and terminal PBrBr washed from the Třebotov Lmst. (Lower Devonian) and Choteč Lmst. (Middle Devonian).

Description: The largest known pygmaeocrinid species, with theca disproportionately bipyramidal, possessing a low, bowl-shaped aboral cup and a very low "tegminal" dome. The surface of the thecal plates densely and distinctly sculptured by sharp, horizontally arranged vermicular ribs. Aboral cup medium thick-walled, in oral or basal view pentastellate with narrow, protruding and straightly truncated tips. Cup base subhorizontal. Basals flat, unobservable in side view. Their distal parts form a smooth encirclement a-

round the relatively wide and shallow basal pit. Radials strongly convex, with a weakly developed median ridge but with extremely distinct radial ribs that branch two or three times toward the basals. Radial facets narrow (they occupy 1/4 - 1/5 of the total width of RR), protruding laterally but not thickened in the area of radial notches. The interradial (interbrachial) processes of RR are straight or only slightly curved downward into the ventral cavity of the cup. First PBrBr tiny, with the shape of a relatively high trapezoid, second (terminal) PBrBr large, vaulted, distinctly sculptured, bearing a thin but prominent median rib. The latter are interconnected laterally, covering generally the whole ventral cavity of the cup. Ratio of height of the aboral cup: height of the "tegminal" dome is generally 2-3 :1.

Dimensions of the holotype (in mm): height of the aboral cup in interradial = 1.6, height of the aboral cup in radial = 1.2, max. width of the theca = 3.4, width of the cup base = 1.0, width of the basal pit = 0.6.

Ontogeny: At all known localities of the Třebotov Limestone, in addition to adults, a large number of thecae and aboral cups of immature specimens have been found, attaining a width of the theca from about 1.4 to 1.6 mm. The juveniles especially differ from adults in having markedly laterally protruding radial notches, in lower to almost flat "tegminal" dome (composed of laterally interconnected terminal PBrBr) and in having more prominent median ribs on RR, generally crossing the lateral margin of the radial facets.

Tab. II: Key to the species of the genus *Pygmaeocrinus* in the Bohemian Devonian.

Species of <i>Pygmaeocrinus</i>	theca	cup shape	cup outline	RR in lateral outline	IRR processes	tegminal dome
<i>P. kettneri</i> BOUŠKA, 1957	proportionally bipyramidal	low cone	pentastellate with straightly truncated tips	slightly concave	slightly bent downward	high, vaulted, pointed roundedly, covering the whole ventral cavity
<i>P. rotundus</i> sp. n.	—	bowl	broadly pentastellate	convex	unknown	
<i>P. campanulatus</i> sp. n.	disproportionally bipyramidal	bell	pentalobate	straight or slightly concave	strongly bent downward	very low to nearly flat, covering only the middle part of ventral cavity
<i>P. fallax</i> sp. n.	disproportionally bipyramidal	low bowl	pentalobate with roundedly truncated tips	straight	slightly bent downward	extremely vaulted, almost covering the ventral cavity
<i>P. notabilis</i> sp. n.	proportionally bipyramidal	medium cone	pentastellate with straightly truncated tips	straight	slightly bent downward	high, vaulted, pointed terminally, covering the whole ventral cavity
<i>P. fabulosus</i> sp. n.	subproportionally bipyramidal	low cone	narrowly pentalobate "starfish shape"	straight or slightly concave	straight	high, pyramidal, covering the whole ventral cavity
<i>P. catharinae</i> sp. n.	disproportionally bipyramidal	medium bowl	broadly pentalobate to roundedly pentangular	convex	strongly bent downward	low, covering only the middle part of the ventral cavity
<i>P. decoratus</i> sp. n.	disproportionally bipyramidal	bowl	pentastellate with straightly to concave truncated tips	convex	straight or slightly bent downward	very low to nearly flat, covering the whole ventral cavity

Occurrence: *Pygmaeocrinus decoratus* sp. n., together with *P. catharinae* sp. n., occurs frequently in the Třebotov Limestone (Dalejan = Upper Emsian) and in the Choteč Limestone (Eifelian). From the stratigraphical point of view, it is to be stressed that both the latter species cross the boundary Lower/Middle Devonian. Skeletal elements of *Pygmaeocrinus decoratus* sp. n. are extremely distinct morphologically and easily distinguishable in the field.

Localities: 1. Třebotov Limestone (Upper Emsian): Praha-Holyně, abandoned "Prastav" quarries; Praha-Hlubočepy, "U jezírka" quarry and "V háji" quarry; Praha-Barrandov, section in a roadcut of the Plzeň highway. It has been discovered 4.5 m below the boundary Třebotov Lmst./Choteč Lmst. (Lower/Middle Devonian), it is common 2.5-2.2 m, 1.7 m, 1.5-1.4 m (maximal occurrence, including abundant juvenile thecae) and 0.2-0m below that boundary. 2. Choteč Limestone (Eifelian): Continuation of the section at Praha-Barrandov, i.e. 0-0.2 m above the boundary Třebotov Lmst./Choteč Lmst. (here esp. the juvenile specimens are very abundant), it is common 1.5-1.7 m and 1.7-2.0 m above that boundary (end of the sequence). Praha-Hlubočepy, "V háji" quarry.

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### Explanations to the plates:

SEM photos by dr. Čejková (National Museum, abbrev. NM), except Pl. 1, figs 7-9 (dr. V. Turek, NM), and Pl. 2, figs 1-4; Pl. 3, figs 8-12 (dr. R. Horný, NM). All types and referred specimens are housed in the collections of the Palaeontological Department of the National Museum-Museum of Natural History, Praha, in the catalogue "L".

### PLATE 1

*Pygmaeocrinus rotundus* sp. n.  
Kotýs Limestone, Lochkovian, Lower Devonian

1. L 30511, holotype, basal view of the cup, Praha-Řeporyje, NE margin of the "Černá skála" quarry. ×18.
2. L 30510, dorsolateral view of a gerontic cup, Praha-Řeporyje, NE margin of the "Černá skála" quarry. ×18.
3. L 30512, oral view of the ventral cavity of the cup, Praha-Řeporyje, NE margin of the "Černá skála" quarry. ×20.
4. L 32008, lateral view of the aboral cup, Bubovice, the uppermost etage of the abandoned quarry Solway. ×28.
5. L 32007, lateral view of the aboral cup, Bubovice, the uppermost etage of the abandoned quarry Solway. ×25.
6. dtto as in fig. 2, basal view. ×17.

*Pygmaeocrinus kettneri* BOUŠKA, 1947  
Dvorce-Prokop Limestone, Pragian, Lower Devonian

7. L 7971, holotype, lateral view of the theca. ×19.
8. dtto, basal view of the aboral cup. ×18.
9. L 7972, paratype oral view of the aboral cup. ×18.

### PLATE 2

*Pygmaeocrinus notabilis* sp. n.  
Koněprusy Limestone, Pragian, Lower Devonian

1. L 32003, holotype, lateral view of the theca (radial), "Na Plešivci" quarry near Suchomasty.
2. dtto, basal view.



3. dtto, lateral view (interradial).
4. dtto, latero-basal view. All figs cca. ×12.

*Pygmaeocrinus campanulatus* sp. n.

Loděnice Limestone, Pragian, Lower Devonian

5. L 29526, holotype, lateral view of the theca, Praha-Klukovice, west part of the “Červený lom” quarry. ×24.
6. L 32010, lateral view of the aboral cup, Praha-Klukovice. “Červený lom” quarry. ×22.
7. L 29523, lateral view of the aboral cup, Praha-Klukovice. west part of the “Červený lom” quarry. ×18.
8. L 30496, basal view, Praha-Klukovice. “Červený lom” quarry. ×27.
9. L 29527, isolated radial plate, Praha-Klukovice. west part of the “Červený lom” quarry. ×26.
10. L 30497, basal view of a juvenile, Praha-Klukovice, “Červený lom” quarry. ×34.

PLATE 3

*Pygmaeocrinus campanulatus* sp. n.

1-2 Dvorce-Prokop Limestone, Pragian, Lower Devonian  
3-10 Loděnice Limestone, Pragian, Lower Devonian

1. L 32009, lateral view of the aboral cup, Praha-Hlubočepy, “St. Prokop” quarry. ×23.
2. L 29530, oral view of the aboral cup, Praha-Hlubočepy, “St. Prokop” quarry. ×20.
3. L 29529, outer surface of an isolated terminal PBr, Praha-Klukovice. west part of the “Červený lom” quarry. ×27.
4. L 29528, inner surface of an isolated terminal PBr, Praha-Klukovice. west part of the “Červený lom” quarry. ×27.
5. L 30498, ventrolateral view of a complete theca, Praha-Klukovice. “Červený lom” quarry. ×26.
6. L 29522, oral view of the aboral cup, Praha-Klukovice. west part of the “Červený lom” quarry. ×24.
7. L 29525, basal view of the cup, Praha-Klukovice. west part of the “Červený lom” quarry. ×24.
8. L 32011, oral view of the aboral cup, Praha-Klukovice. west part of the “Červený lom” quarry. ×25.
9. L 29524, oral view of the theca showing the “tegminal” dome, Praha-Klukovice. west part of the “Červený lom” quarry. ×25.
10. dtto as in fig. 5, oral view. ×28.

*Pygmaeocrinus fallax* sp. n.

Loděnice Limestone, Pragian, Lower Devonian

11. L 29534, holotype, ventrolateral view of the theca, two arms in the “tegminal” dome are lacking, Praha-Klukovice. west part of the “Červený lom” quarry. ×31

PLATE 4

*Pygmaeocrinus fallax* sp. n.

Loděnice Limestone, Pragian, Lower Devonian

1. L 29532, basal view of the cup, Praha-Smíchov, “Na Konvářce” quarry. ×23.
2. L 30500, lateral view of a complete theca, Praha-Klukovice. “Červený lom” quarry. ×26.

3. L 29531, oral view of the aboral cup, Praha-Smíchov, “Na Konvářce” quarry. ×21.
4. L 30501, basal view of the cup, Praha-Klukovice. “Červený lom” quarry. ×27.
5. L 30499, oral view of a complete theca, Praha-Klukovice. “Červený lom” quarry. ×21
6. L 29537, inner view of an isolated terminal PBr, Praha-Klukovice, west part of the “Červený lom” quarry. ×33.
7. L 29538, external view of an isolated terminal PBr, Praha-Klukovice, west part of the “Červený lom” quarry. ×26.
8. L 29535, oral view of a complete theca, Praha-Klukovice, west part of the “Červený lom” quarry. ×32.
9. L 29533, lateral view of the aboral cup, Praha-Smíchov, “Na Konvářce” quarry. ×28.
10. L 29536, lateral view of a complete theca, Praha-Klukovice, west part of the “Červený lom” quarry. ×31.

PLATE 5

*Pygmaeocrinus decoratus* sp. n.

Třebotov Limestone, Dalejan (Upper Emsian), Lower Devonian, Praha-Holyně, “Prastav” quarry.

1. L 32012, basal view of the cup (after SCAN photographing this specimen is disarticulated). ×18.
2. dtto, dorsolateral view.
3. L 29548, lateral view of the aboral cup. ×20.
4. L 29545, oral view of the aboral cup. ×21.
5. L 29546, holotype, basal view of the cup. ×20.
6. L 29547, theca, vertically broken off. ×17.

PLATE 6

*Pygmaeocrinus decoratus* sp. n.

Třebotov Limestone, Dalejan (Upper Emsian), Lower Devonian  
Praha-Holyně, “Prastav” quarry

1. L 30507, oral view of a juvenile aboral cup. ×22.
2. L 30508, oral view of the theca, two arms in the “tegminal” dome are lacking. ×22.
3. L 29551, external surface of an isolated terminal PBr. ×21.
4. L 29552, inner surface of an isolated terminal PBr. ×21.
5. dtto as in fig. 1, ventrolateral view. ×22.
6. L 29550, inner view of an isolated radial plate. ×20.
7. L 30509, lateral view of a juvenile theca. ×22.

*Pygmaeocrinus fabulosus* sp. n.

“Chapel Coral Horizon”, Zlíchovian (Lower Emsian), Lower Devonian, Praha-Zlíchov, “U Kapličky” quarry

8. L 32004, holotype, lateral view of the theca (radial).
9. dtto, lateral view of the theca (interradial).
10. dtto, oral view of the theca showing the “tegminal” dome.
11. dtto, basal view of the theca.
12. L 32005, oral view of the theca, one terminal PBr from the “tegminal” dome is lacking. All figs ×12.

PLATE 7

*Pygmaeocrinus catharinae* sp. n.

Třebotov Limestone, Dalejan (Upper Emsian), Lower Devonian,  
Praha-Holyně, “Prastav” quarry

1. L 29544, complete theca with sculptured surface of platelets, lateral view. ×29.
2. L 29541, lateral view of the aboral cup. ×26.
3. L 29540, basal view of the cup. ×23.
4. L 30504, basal view of the cup. ×24.
5. L 30506, lateral view of the aboral cup. ×22.
6. L 30503, holotype, oral view of the theca, showing the flat “tegmental” dome, one terminal PBr lacking. ×22.
7. L 29539, oral view of the aboral cup. ×22.

#### PLATE 8

*Pygmaeocrinus catharinae* sp. n.

Třebotov Limestone, Dalejan (Upper Emsian), Lower Devonian,  
Praha-Holyně, “Prastav” quarry

1. L 30505, ventrolateral view of the aboral cup. ×23.
2. dtto, oral view. ×23.
3. L 29542, lateral view of the aboral cup. ×20.
4. L 32014, lateral view of the early juvenile theca, one arm is lacking. ×75.
5. dtto, oral view. ×75.
6. L 32015, lateral view of an early juvenile theca. ×93.

