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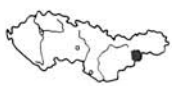
PHYSOPORELLA CROATICA HERAK, 1958 OF THE SLOVAK KARST ANISIAN (SLOVAKIA, THE WEST CARPATHIANS MTS.)

(Pls. V, Figs. 5, Tabs. 17)



A b s t r a c t: The paper deals with dasyclads of the Slovak Karst Anisian: *Physoporella pauciforata* (GÜMB.) STEINM. var *undulata* PIA, *Physoporella croatica* HERAK and gives their qualitative as well as biometric characteristics. A form, by its qualitative signs very close to *Physoporella croatica*, by the quantitative ones to *Physoporella pauciforata* var. *undulata* is also described. The author, despite results of biometric data considers the form to be more probably a variety of *Physoporella croatica* than *Physoporella pauciforata* and he reports it as *Physoporella aff. croatica* HERAK.

Р е з ю м е: Работа занимается мутовчатыми сифонеями (Dasycladaceae) анисского яруса Словацкого карста: *Physoporella pauciforata* (GÜMB.) STEINM. var. *undulata* PIA, *Physoporella croatica HERAK* и дает их качественную и биометрическую характеристику. Описана и форма, которая своими качественными признаками очень похожа на вид *Physoporella croatica* и количественными признаками на вид *Ph. pauciforata* var. *undulata*. Несмотря на результаты биометрических данных автор считает более правдоподобным, что эти формы представляют скорее разновидность вида *Physoporella croatica* чем *Ph. pauciforata* и обозначает их как *Physoporella aff. croatica HERAK.*

Introduction

In recent years, statistical methods have been used more often (H u r k s, 1967; Z o r n, 1972, 1975) and new ways have been searched for to define taxons more exactly and solve their relations in solving taxonomic phylogenetic as well as ecologic problems of dasyclads. However, relatively few biometric data on Triassic dasyclads taxons have been published so far. In this paper, I present also basic biometric data in descriptions of the above species trying to provide specialists dealing with statistical evaluation of dasyclads at least the basic biometric data. The material I deal with is modest at present; it does not give a complex picture of individual biometric data relations, yet, it does — in my opinion — show that only those specimens are to be included into the basic statistical sample which do not differ in their qualitative signs from each other. Otherwise we get a considerably false picture not only of individual taxons, but also of their population.

In the computation part of the paper, I use formulas mentioned almost in every statistical publication, however mainly in the work by W e b e r (1957), thus they are not quoted respectivelly.

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Physoporella croatica HERAK, 1958
(Pl. I, Figs. 1–4, Pl. II, Fig. 11, Pl. III, Figs. 12–16, Pl. V, Figs. 24, 25)

1958 *Physoporella croatica*, sp. nov. – M. Herak: The Dasyclad Genus Physoporella in the Anisian of Yugoslavia, pp. 61–63, Pl. 14, Figs. 1–5, Textfig. 2.

The original descripion: "The stem is elongated; in the cross section predominantly polygonal and generally isodiametrical. The branches are closed at their distal end. The calcareous wall is very thin. The proximal part of each branch is large and lies with a broad base on the stem. The branches are pressed together and therefore polygonal in the cross section of the whorl. The width of the proximal part of the branches in the section perpendicular to the main stem, is narrower than in the section parallel to the main stem. This concerns especially its base. The distal cone-like part of the branch is tapered and covered with a thin calcareous wall.

The branches are situated in whorls consisting only of one row. Some whorls become somewhat irregular. In most cases there are 7 branches in one whorl. One specimen of our material has only 5 branches. Most probably it is a section of an end portion of the stem. Two oblique, nearly cross sections show more than 7 branches, but not strictly in one plane."

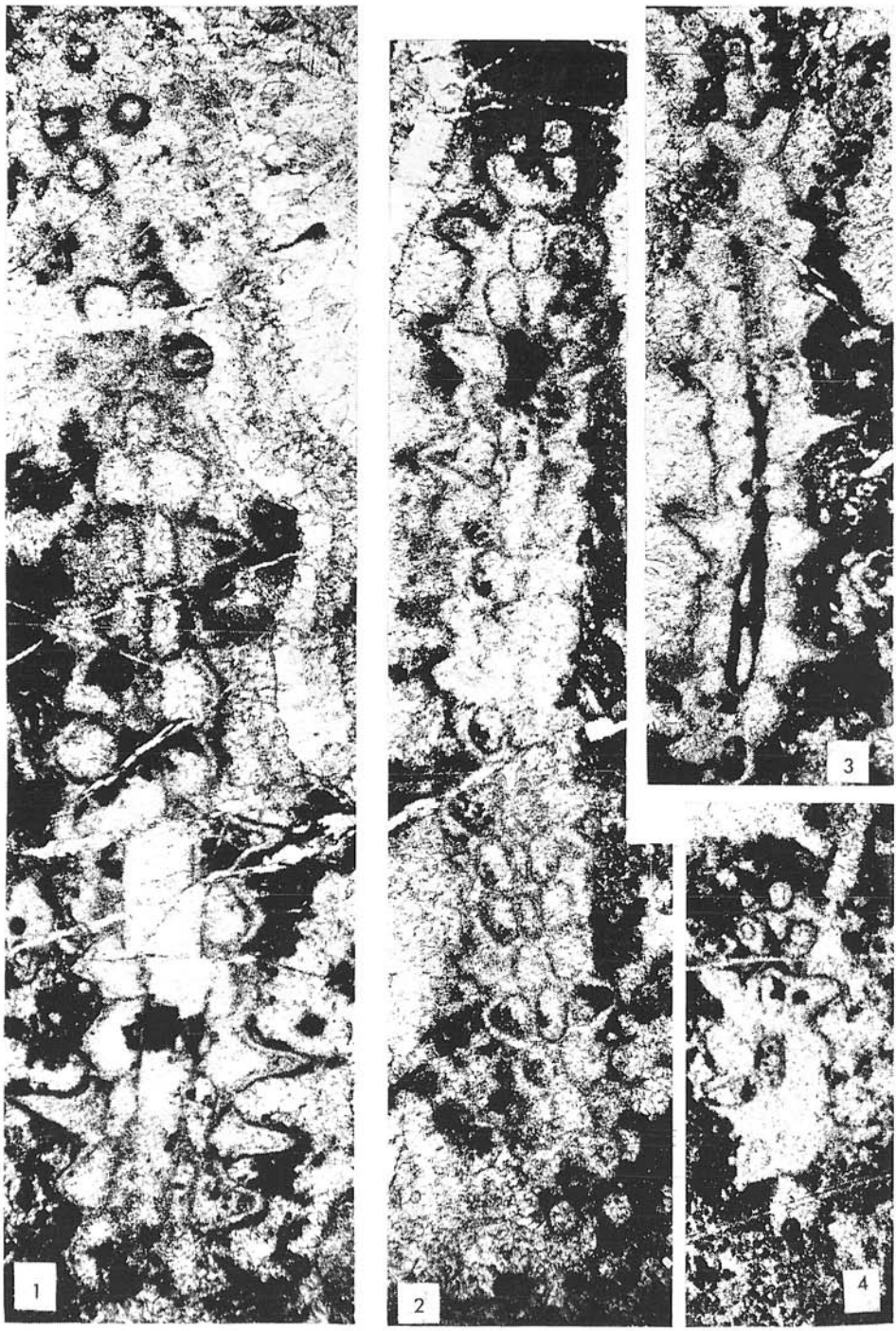
Locus et stratum typicum: Anisian limestone, Miljevici, NW Knin.

The material studied consists of 42 different sections in the thin sections No. 4968, 5018, 5019, 5062, 5063 made from one sample of the Steinalm limestone which are deposited in the collections of the Geological Institute of the Slovak Academy of Sciences, Bratislava (coll. of J. Bystrický).

Description: The thallus is cylindrical with a very thin central stem – cell cavity. The wall of the calcareous sleeve is very thin and covers each branch individually, so the thallus is of a "horn-like" shape. The interior surface of the thallus is completely smooth, so it can be assumed to have adhered closely to the central stem-cell. The branches are by the shape of the pyripherous type. They are considerably thick in their basal part connected with the central stem only by a very thin and short pore (Pl. I, Figs. 1, 4 a whorl down on the right side of the section, Fig. 3 filled with a dark pigment), but they quickly taper off in the outward direction and they are ussually covered by a thin layer of the calcareous sleeve wall from the outer side. Thus they are mostly "closed". In some cases, however, distal ends of the branches are prolonged and in a form of a fine pore reach the outer surface of the sleeve (Pl. I, Fig. 3. Pl. II, Fig. 11, V, Fig. 25). Most probably, the branches tapered off in the outward direction and when as thin as a hair, they perforated the sleeve.

Plate I

Figs. 1–4. *Physoporella croatica* HERAK.
Figs. 1–2: thin-sec. No. 5019; Fig. 3: thin-sec. No. 5018; Fig. 4: thin-sec. No. 4968


1
2
3
4

Proximal parts of the branches are vertically prolonged, their transversal section (parallel to the central stem axis) is thus oval but polygonal as well. Distal parts of the branches are on the contrary, of a round section. The branches are arranged in one-rowed whorls occuring closely above each other. The arrangement of the branches in the neighbouring whorls is either alternating or their branches are above each other and form in some parts of the thallus vertical rows (Pl. I, Fig. 2). 6–7, in rare cases 8 branches fall into one whorl. However, transversal sections with 5 branches in a whorl also occur.

Biometric data

The thallus outer diameter – D

With regard to the whole shape and sculpture of the thallus (of the "horn-like" type), it is not possible to measure its diameter directly from sections (either transversal or oblique). That is why we have measured the value of D as a sum of the maximum lengths of the branches on the both sides of the ellipse of the oblique or transversal sections with the central stem diameter – st.

Table 1

Physoporella croatica HERAK
Frequency distribution of D : st (in mm)

Class	n	%	Diameter of the thallus - D			Diameter of the central stem - st		
			range	mean	stand. dev.	range	mean	stand. dev.
0.50–0.99	7	16.66	0.644–0.972	0.833	0.1194	0.094–0.278	0.158	0.0688
1.00–1.49	12	28.57	1.006–1.467	1.202	0.1524	0.183–0.436	0.241	0.0709
1.50–1.99	12	28.57	1.514–1.944	1.700	0.1409	0.214–0.458	0.320	0.0734
2.00–2.49	6	14.28	2.000–2.450	2.176	0.1764	0.278–0.589	0.385	0.1177
2.50–2.99	4	9.52	2.556–2.939	2.726	0.163	0.389–0.750	0.512	0.1624
3.00–3.49	1	2.38	3.242	3.242	–	0.708	0.708	–
Sum	42	100.00	0.644–3.242	1.616	0.6378	0.094–0.750	0.307	0.1454

Correlation coefficient, r = 0.792817

The frequency distribution (Tab. 1) as well as the frequency polygon (Fig. 1) indicate a high degree of symetry and the normal distribution. From the total number of 42 sections, 57 percents fall into the diameter of the 1.00–2.00 mm class.

The central stem diameter – st

With regard to the central cavity of completely smooth walls and thus to its correspodence to the original diameter of the central stem, the accuracy of the measurement is not influenced by its morphology. The central stem is round in the transversal section and probably was so in its whole length.

No deformations have been found in any case. The frequency polygon (Fig. 1) also indicates a high degree of symetry and the normal distribution. Since the specimen of the largest measurements found in our material (Pl. I, Fig. 1) is according to all diagnostical signs Physoporella croatica, we suppose that the gap in the 0.6–0.7 mm class is due only to a very limited number of sections through the largest specimens.

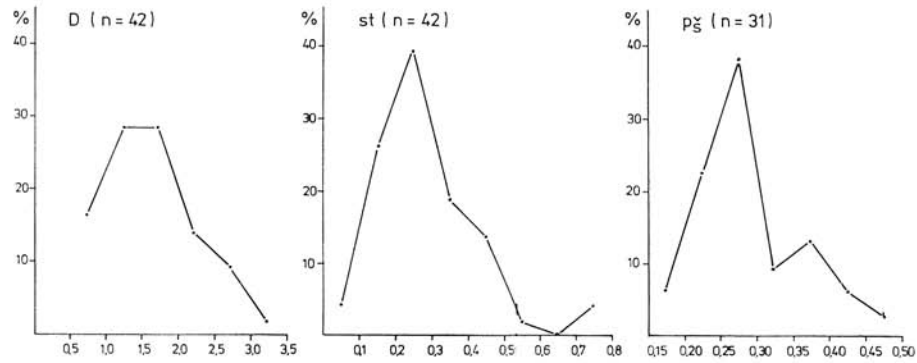


Fig. 1. *Physoporella croatica*, frequency polygon (in mm and %).

The D and st correlation

The relation of D and st is illustrated by the scattergram (Fig. 5) showing, similarly as the frequency distribution (Tab. 1) the growth of the central stem diameter with the thallus diameter D. As the correlation line only one line is drawn in the scattergram i. e. the so called "reduced major axis-b" used in correlations more frequently than the regression line (Z o r n, 1972, p. 358). The correlation coefficient $r = 0.792817$ is greater than $r_{0.01}$ of the testing table (see Tab. 5), thus it is statistically significant. The regresion coefficient $b = 0.18074$.

The width of the branches – p_s

As I have already mentioned, the proximal parts of the branches are pressed on their sides, vertically prolonged and of the oval, in some cases polygonal, section. With regard to the correlation with the branches of *Physoporella pauciforata* var. *undulata* which are only round in their proximal parts, the maximum width of the branches of the specimens has been included into the pair values with D and st.

The frequency distribution (Tabs. 2, 3) as well as the frequency polygon (Fig. 1) indicate a high degree of symetry and the normal distribution. Both tables of the frequency distribution – i. e. of $D : p_s$ as well of $st : p_s$ show the growth of the p_s with the thallus diameter D as well as with the central stem diameter st. The correlation coefficient $r_{D\ ps} = 0.7973116$ and the correlation coefficient $r_{st\ ps} = 0.868593$ are greater than $r_{0.01}$ of the testing table (Tab. 5), thus they are statistically significant. The partial correlation (see Tab. 6) indicates some dependence at the level of $r_{0.01}$ only in st. The partial coefficent $r_{st\ ps}\ (yz\ .\ x) = 0.6524$. It is greater than $r_{0.01} = 0.4487$.

Table 2

Physoporella croatica HERAK
Frequency distribution of D : p_s (in mm)

Class	n	%	Diameter of the thallus - D			Diameter of the branches		
			range	mean	stand. dev.	range	mean	stand. dev.
0.50—0.99	3	9.09	0.833—0.939	0.891	0.0534	0.161—0.208	0.179	0.0258
1.00—1.49	11	33.33	1.006—1.467	1.182	0.1433	0.203—0.322	0.260	0.0355
1.50—1.99	10	30.30	1.603—1.944	1.705	0.1357	0.211—0.372	0.294	0.0463
2.00—2.49	5	15.15	2.000—2.450	2.202	0.1847	0.278—0.375	0.325	0.0487
2.50—2.99	3	9.09	2.556—2.939	2.748	0.1917	0.311—0.411	0.375	0.0555
3.00—3.49	1	3.03	3.242	3.242	—	0.483	0.483	— — —
Sum	33	99,99	0.833—3.242	1.673	0.6227	0.161—0.483	0.290	0.0710

Correlation coefficient, r = 0.7973116

Table 3

Physoporella croatica HERAK
Frequency distribution of st : p_s (in mm)

Class	n	%	Diameter of the central stem st			Diameter of the branches		
			range	mean	stand. dev.	range	mean	stand. dev.
0.00—0.09	1	3.03	0.097	0.097		0.208	0.208	
0.10—0.19	5	15.15	0.111—0.197	0.172	0.0344	0.161—0.242	0.212	0.0315
0.20—0.29	13	39.39	0.203—0.278	0.251	0.0315	0.167—0.317	0.266	0.0394
0.30—0.39	8	24.24	0.306—0.389	0.338	0.0331	0.278—0.375	0.310	0.0398
0.40—0.49	4	12.12	0.436—0.472	0.457	0.0151	0.322—0.403	0.367	0.0335
0.50—0.59	0							
0.60—0.69	0							
0.70—0.79	2	6.06	0.708—0.750	0.729	0.0295	0.411—4.483	0.447	0.0511
Sum	33	99.99	0.097—0.750	0.309	0.1431	0.161—0.483	0.290	0.0710

Correlation coefficient, r = 0.8685931

The height of the branches — p_v

The actual height of the branches has been counted out by reduction of the maesured value counted with the help of the right-angled triangle (P i a, 1920, p. 11). Since there are few oblique sections with the whole ellipse of the central stem preserved (10 section as a whole) and only the maximum height of the branches of all these specimens respectively have been included into the statistical sample, the number of the branches examined has been considerably reduced to 10. The range varies between 0.199—0.611 mm (the mean = 0.327 mm) and the pressing of $p_s : p_v$ in the range 1 : 1.048—1.630.

Testing of the correlation coefficients r in the relation to D, st and h (Tab. 6) has proved no relationship. Dependence of the branch height on the above

Table 4

Physoporella croatica HERAK
Frequency distribution of st : $\bar{h}$ (in mm)

Class	n	%	Diameter of the central stem			Distance between the whorls – $\bar{h}$		
			range	mean	stand. dev.	range	mean	stand. dev.
0.10–0.19	1	11.11	0.111	0.111	–			
0.20–0.29	3	33.33	0.217–0.278	0.251	0.0312	0.243–0.552	0.390	0.1553
0.30–0.39	3	33.33	0.317–0.389	0.346	0.0378	0.422–0.832	0.582	0.2195
0.40–0.49	2	22.22	0.444–0.461	0.453	0.0118	0.320–0.538	0.428	0.1524
Sum	9	99.99	0.111–0.461	0.312	0.1116	0.243–0.832	0.462	0.1710

Correlation coefficient, r = 0.339354

variables thus remains, most probably due to a small number of the values measured, unexplained.

Length of the branches – p_l

Actual length of the branches can be found only in sporadic cases in spite of the branches being perpendicular to the plant axis. In such a structured morphology of the thallus there is only a very little probability that the section plane will cut the branch in the middle in its whole original length. If we count to that even a possibility of the branches distal parts being secondary destructed by transport or by other factors, the probability of the branches original length preservation is even more limited. Of the whole sample of the sections studied, it was possible to find branches with their length original only in 10. This ranges between 0.650–1.367 mm (the mean = 0.952). Of the variables measured, the direct dependence of the branches length has been indicated only on the thallus outer diameter D. Testing of the correlation coefficient $r_{D\,pl} = 0.962416$ shows that this relation is statisticaly significant, which is natural because the outer diameter D is nothing else than the sum of the maximum lengths of the branches on both sides of the central stem ellipse and its diameter.

Distance between the whorls of the branches – h

The actual distance between the whorls of the branches can be, in addition to tangencial sections found also from oblique sections by reduction of the values measured, counting them over with the help of the right-angled triangle. "h" has been found only in 9 oblique sections by this method (it requires preservation of the whole ellipse of the central stem). Of 23 this way found values, distance between the whorls ranges between 0.243–0.832 mm (the mean = = 0.462), but dependence of h on the other variables D, st, p_s, p_v, (Tabs. 5, 6) has not been found. Testing of the correlation coefficients r of the above paired variables has not been proved.

On the basis of H e r a k 's (l. c.) description and the above data, the diagnosis can be given as follow:

Table 5

Physoporella croatica HERAK
Testing of correlation coefficients

Corel. coeff.		n	d. f.	$r_{0.01}$	Hyp.	$r_{0.05}$	Hyp.	t	$t_{0.01}$	Hyp.	$t_{0.05}$	Hyp.
$r_{D\,st}$	= 0.792817	42	40	0.3932	H_1	0.3044	H_1	8.2273	2.704	H_1	2.021	H_1
$r_{D\,st}$	= 0.780546	33	31	0.4426	H_1	0.3445	H_1	6.9594	2.745	H_1	2.021	H_1
$r_{D\,ps}$	= 0.797312	33	31		H_1		H_1	7.355002		H_1		H_1
$r_{st\,ps}$	= 0.868593	33	31		H_1		H_1	9.7596		H_1		H_1
$r_{D\,st}$	= 0.630663	10	8	0.7646	H_0	0.6319	H_0	2.2985	3.355	H_0	2.306	H_0
$r_{st\,pv}$	= 0.224978	10	8		H_0		H_0	0.6531		H_0		H_0
$r_{D\,pv}$	= 0.624253	10	8		H_0		H_0	2.2601		H_0		H_1
$r_{D\,st}$	= 0.807394	9	7	0.7977	H_1	0.6664	H_1	3.6205	3.499	H_1	2.365	H_1
$r_{D\,h}$	= 0.702122	9	7		H_0		H_1	2.6088		H_0		H_0
$r_{st\,h}$	= 0.339354	9	7		H_0		H_0	0.9545		H_0		H_0
$r_{st\,pv}$	= 0.534194	6	4	0.9172	H_0	0.8114	H_0	1.2638	4.604	H_0	2.776	H_0
$r_{st\,h}$	= 0.506522	6	4		H_0		H_0	1.1175		H_0		H_0
$r_{pv\,h}$	= 0.412589	6	4		H_0		H_0	0.9059		H_0		H_0

H_0 = Accepted hypothesis H_0,
H_1 = Rejected hypothesis H_0, accepted alternative hypothesis H_1

Table 6

Physoporella croatica HERAK
Partial correlation

Correl. coeffic.		Partial. corr.		n	d. f.	$r_{0.01}$	Hyp.	$r_{0.05}$	Hyp.	t	$t_{0.01}$	Hyp.	$t_{0.05}$	Hyp.
$r_{D\,st}$	= 0.7805	$r_{xy.z}$	= 0.2942	33	30	0.4487	H_0	0.3494	H_0	1.7142	2.750	H_0	2.042	H_0
$r_{D\,ps}$	= 0.7973	$r_{xz.y}$	= 0.3853	33	30		H_0		H_1	2.3242		H_0		H_1
$r_{st\,ps}$	= 0.8686	$r_{yz.x}$	= 0.6524	33	30		H_1		H_1	4.7935		H_1		H_1
$r_{D\,st}$	= 0.6307	$r_{xy.z}$	= 0.6440	10	7	0.7977	H_0	0.6664	H_0	2.3811	3.499	H_0	2.365	H_1
$r_{D\,pv}$	= 0.6242	$r_{xz.y}$	= 0.6379	10	7		H_0		H_0	2.3429		H_0		H_0
$r_{st\,pv}$	= 0.2249	$r_{yz.x}$	= −0.2783	10	7		H_0		H_0	−0.8195		H_0		H_0
$r_{D\,st}$	= 0.8074	$r_{xy.z}$	= 0.8497	9	6	0.8343	H_1	0.7067	H_1	4.2636	3.707	H_1	2.447	H_1
$r_{D\,h}$	= 0.7021	$r_{xz.y}$	= 0.7714	9	6		H_0		H_1	3.2073		H_0		H_1
$r_{st\,h}$	= 0.3394	$r_{yz.x}$	= −0.5416	9	6		H_0		H_0	−1.7045		H_0		H_0
$r_{st\,pv}$	= 0.5342	$r_{xy.z}$	= 0.4141	6	3	0.9587	H_0	0.8783	H_0	0.9098	5.841	H_0	3.182	H_0
$r_{st\,h}$	= 0.5065	$r_{xz.y}$	= 0.3716	6	3		H_0		H_0	0.8004		H_0		H_0
$r_{pv\,h}$	= 0.4126	$r_{yz.x}$	= 0.1948	6	3		H_0		H_0	0.3973		H_0		H_0

The thallus is inarticulated, morphologically considerably disserted, of an irregular transversal section. The calcareous sleeve consists of only a very thin layer, covering each branch individually. Branches of the pyripherous type are pressed in their proximal part and vertically prolonged, but their distal parts ending often in prolonged hair reaching to the outer surface of the sleeve are of a round section. The branches are arranged in one-rowed whorls perpendicular to the plant axis and they are sepparated from each other only by a very thin layer of the calcareous sleeve. The central stem is of a round section and in correlation with the outer diameter of the thallus of a small diameter.

Measurements (in mm)

		M. Herak, 1958	Slovak karst
D		not given	0.644–3.242
st		0.27–0.61	0.094–0.750
p_l	(the branch length)	1.3	0.650–1.367
p_s	(the width of the branches)	0.14–0.33	0.161–0.483
p_v	(the height of the branches)	0.53–1.00	0.199–0.611
h	(the distance between whorls)	0.61–0.75	0.243–0.832
w	(the number of the branches in one whorl)	5–7	5–7 (?8)

Notes

The specimens I have studied are completely identical with those of Dalmatia described by Herak (l. c.). Differences in the values of the branches heights and of the distances between whorls are very probably due to the fact that the values of the Dalmatian specimens were not reduced to the actual ones, but they are related only to the measured ones.

Accompanying flora: *Physoporella* aff. *croatica* HERAK (nov. var.?), *Physoporella dissita* (GUMB.) PIA.

The age: The Steinalm limestone, Anisian, most probably the Pelsonian or the Lower Illyrian.

Measurements of the illustrated specimens (in mm)

Thin. sec. No	D	st	st % D	p_v	p_s	
5019	3.242	0.708	21.85	0.736	0.483	Pl. I, Fig. 1
5019	2.450	0.461	18.82	0.625	0.375	Pl. I, Fig. 2
5018	2.156	0.333	15.46	0.356	0.278	Pl. I, Fig. 3
4968	1.606	0.306	19.03		0.278	Pl. I, Fig. 4
5018	1.944	0.278	14.29		0.273	Pl. II, Fig. 11
4968	1.328	0.203	15.27		0.278	Pl. III, Fig. 12
5018	1.039	0.183	17.65		0.194	Pl. III, Fig. 13
4968	1.569	0.333	21.23		0.297	Pl. III, Fig.14
4968	2.328	0.278	11.93		0.278	Pl. III, Fig. 15
5019	2.556	0.750	29.35		0.411	Pl. III, Fig. 16
5018	1.944	0.278	14.29		0.292	Pl. V, Fig. 24
5062	2.750	0.369	14.14		0.311	Pl. V, Fig. 25

Physoporella pauciforata (GÜMB.) STEINM. var. *undulata* PIA, 1935 (Pl. III, Fig. 17, Pl. IV, Figs. 20–22, Pl. V, Fig. 23)

1920 *Physoporella pauciforata* var. *?lotharingica* BEN. – J. Pia: Die Siphonease verticillatae etc. p. 52, Tab. 3, Figs. 11–14

1935 *Physoporella pauciforata* var. *undulata* nov. var. – J. Pia: Die Diploporen der anisischen Stufe Bosniens. p. 221, Textfigs. 33, 34

1957 *Physoporella pauciforata undulata* PIA — J. Bystrický: Beitrag zur Kenntniss der Diploporen der Gemeriden-Trias. p. 233, Tab. 6, Figs. 3—4
1964 *Physoporella pauciforata* (GUMB.) STEINM. var. *undulata* PIA, 1935 — J. Bystrický: Slovenský kras, pp. 124, 190, Tab. 17, Figs. 1—6
1964 *Physoporella pauciforata* (GÜMB.) STEINM. var. *undulata* PIA — I. Dieni et G. Spagnulo: Alghe calcare nell' Anisico del Dosso dei Morti, Tav. II, Figs. 3, 6
? 1965 *Physoporella pauciforata* (GÜMB.) var. *undulata* PIA, 1935 — M. Herak: Comparative Study etc, p. 17, Pl. 12, Fig. 4
non 1969 *Physoporella pauciforata* (GÜMB.) STEINM. var. *undulata* PIA, 1935 — M. Diaconu et O. Dragastan: Triassic calcareous Algae etc., p. 85, Pl. IV, Fig. 3
? 1972 *Physoporella pauciforata* (GÜMB.) STEINM. var. *undulata* BYSTRICKÝ: M. Bleachu, C. Tomescu, S. Panin: Contribution a la biostratigraphie des depôts triassiques etc. p. 10, Pl. II, Figs. 1, 2
? 1973 *Physoporella pauciforata* (GÜMB.) Steinm. var *undulata* PIA, 1935 — S. Kotaňski, G. A. Čatalov: Triassic Dasylcladaceae from Central Balkan etc., p. 197, Pl. 10, Figs. 12—17

Original description (translation from German): "Physoporells, the calcareous sleeve of which is between the whorls very strongly squeezed. Points of individual branches are slightly outlined on the outer side as tubercles. The whorls are one-rowed, the pores taper off considerably in the direction to the outer side, but they are almost always closed by a thin calcareous layer. Otherwise they would have to be filled by a sediment just in their distal parts. There, however, they contain a clear crystalic calcite, often badly contrasting with the sleeve. I name this alga "*Physoporella pauciforata* var. *undulata*."

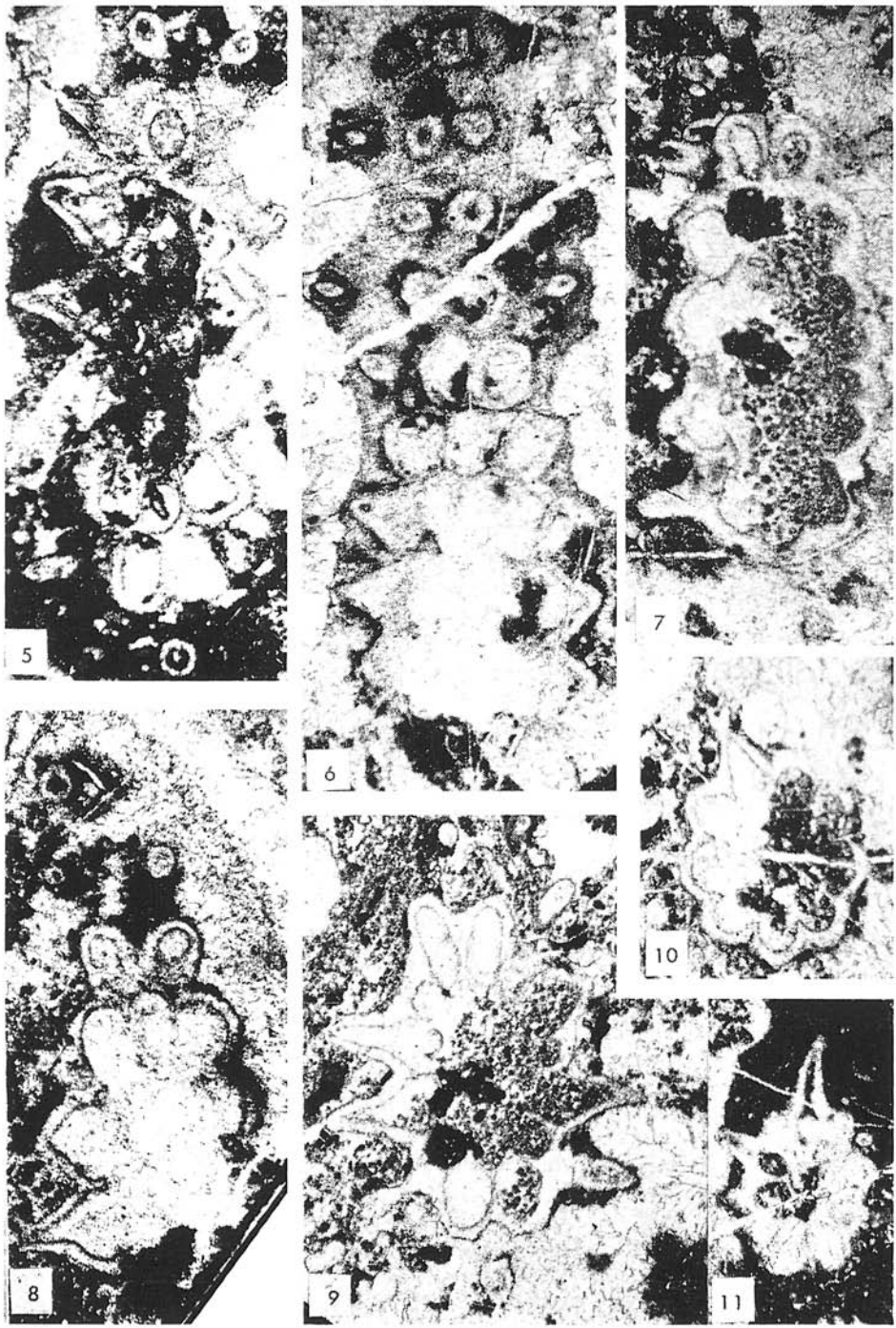
Locus et stratum typicum are not given in the original publication. Since only two sections are illustrated of the above species, of which the Fig. 34 is the most characteristic, this section can be taken for the lectotype and the locality h (in Pia, l. c.) can be taken for its locus typicus described by Pia in his other work (1935, p. 115) more detailly as follows: "There, where the road NW from the P. 1247 crosses the WNW ridge of the Trebevič, there white or meatred and yellowish diplopore limestone appear (the locality h). White skeletons of the algae stand up prettily in the colourful rocks".

The material studied here comes from the locality the Silická planina pl., East from Brzotín (Bystrický, 1964 pp. 124, 190) and it consists of 26 different sections in the thin sections No. 36—41, 744, 747, deponated in collections of the Geological Institute of the Slovak Academy of Sciences, Bratislava (coll. of J. Bystrický). All the thin-sections were made from one piece of a Steinalm limestone sample.

Description: The thallus is a simple cylinder with a completely smooth inner surface, but a strongly undulated outer surface. The sleeve articulation

Plate II

Figs. 5—10. *Physoporella* aff. *croatica* HERAK (var. nov.?).
Figs. 5, 7, 9, 10: thin-sec. No. 5062; Fig. 6: thin-sec. No. 5018; Fig. 8: thin-sec. No. 5019
Fig. 11. *Physoporella croatica* HERAK, thin-sec. No. 5018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is restricted to fissures (gaps); it is irregular and the height of the segments limited by them varies considerably even within one specimen. Branches are of the typical pyriferous type, mostly with their distal ends closed by a fine layer of the calcareous sleeve. However, branches with their distal ends open also occur (Pl. IV, Fig. 20). It is not always possible to decide whether it is a primary phenomenon or only a secondary abrasion of the most external parts of the sleeve by transport or by other destruction. The cavities after branches could have been filled by a sediment also from the inner side, through the central cavity (Pl. IV, Fig. 20 — upward). The transversal section through the branches is round or almost round not only in their distal part, but also in the proximal one adhering to the central stem.

The branches are arranged in one-rowed whorls, but not always exactly in the same plane (Pl. IV, Fig. 21). The whorls are almost perpendicular to the plant axis. Though the thallus inner cavity is completely smooth, it very probably does not completely correspond to the central stem diameter. A pore, connecting a branch with the central stem has not been observed even in one case. The number of the branches in a whorl (found in transversal sections) is 14 ± 1.

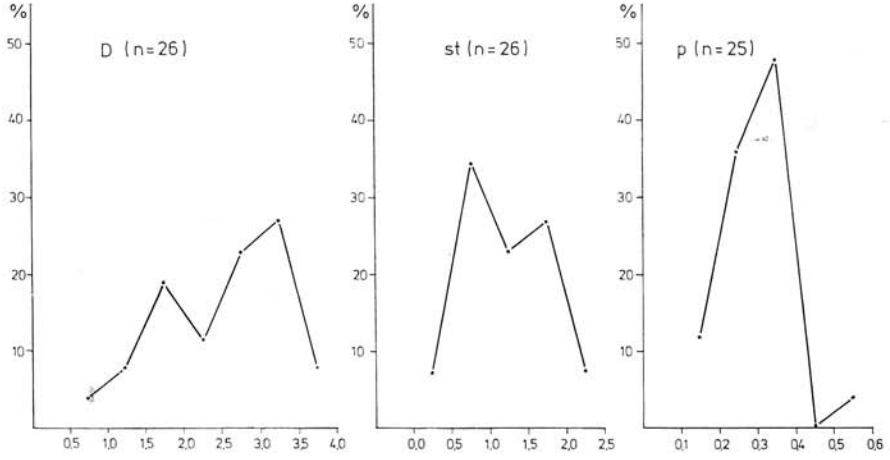

Fig. 2. *Physoporella pauciforata* v. *undulata*, frequency polygon (in mm and %).

Biometric data

The thallus outer diameter — D

It has been measured in the plane of a whorl. It is not of a completely symetric distribution (the frequency polygon, Fig. 2), but probably (according to the normal probability graph paper) it is of the normal distribution. Its range varies between 0.708—3.661 mm (the mean = 2.501 mm). Distribution into classes is more detailly illustrated in the frequency distribution table (Tab. 7).

Table 7

Physoporella pauciforata (GÜMB.) STEINM. v. *undulata* PIA
Frequency distribution of D : st (in mm)

Class	n	%	Diameter of the thallus -D			Diameter of the central stem-st		
			range	mean	stand. dev.	range	mean	stand. dev.
0.50—0.99	1	3.80	0.708	0.708	—	0.175	0.175	—
1.00—1.49	2	7.69	1.382—1.436	1.413	0.0339	0.458—0.528	0.493	0.0491
1.50—1.99	5	19.23	1.675—1.917	1.797	0.1097	0.508—0.806	0.663	0.1293
2.00—2.49	3	11.54	2.222—2.472	2.333	0.1273	0.847—1.056	0.966	0.1071
2.50—2.99	6	23.08	2.500—2.778	2.626	0.1078	0.964—1.867	1.289	0.2517
3.00—3.49	7	26.92	3.144—3.292	3.212	0.0581	1.486—2.078	1.760	0.2031
3.50—3.99	2	7.69	3.611—3.661	3.636	0.0354	1.717—2.078	1.878	0.2278
Sum	26	99.95	0.708—3.661	2.501	0.7620	0.175—2.078	1.200	0.5487

Correlation coefficient, r = 0.953335

The inner cavity (central stem) — st.

The diameter of 26 sections varies between 0.175—2.078 mm (the mean = = 1.200 mm). The distribution is shown by he frequency polygon (Fig. 2), indicating similarly as in the case of D some irregularity in the class of 1.0—1.5 mm, due probably to the small amount of the specimens studied. However, as a whole, it is of the normal distribution proved by the normal probability graph paper.

Correlation between D and st.

Relation between D and st is illustrated by the scattergram (Fig. 5) and by the frequency distribution (Tab. 7). The correlation coefficient r = 0.95334, the regression coefficient b = 0.686510. Since r is greater than $r_{0,01}$ of the testing table, the relation od D : st can be taken for statistically significant (Tab. 12).

Branches width — p

It has been measured in the widest part and only the maximum values of specimens have been included into the statistical sample. The frequency polygon (Fig. 2) shows a high degree of symetry and the normal distribution. The p value varies between 0.106—0.500 mm (the mean = 0.289).

Correlation D : p

It is given in the frequency distribution (Tab. 8) showing the growth of the branches width with the value D increase. The correlation coefficient r = = 0.842800, the regression coefficient b = 0.089462.

Correlation st : p

It is given in the frequency distribution table (Tab. 9). The correlation coefficient r = 0.874802, the regression coeficient b = 0.129086.

The partial correlation (Tab. 13) between D and p, with elimination of st influence gives the value r = 0.0605000 which excludes dependence of the branch width on the thallus outer diameter. The partial correlation between st and p

Table 8

Physoporella pauciforata (GÜMB.) STEINM. v. *undulata* PIA
Frequency distribution of D : p (in mm)

			Diameter of the thallus - D			Diameter of the branches - p		
			range	mean	stand. dev.	range	mean	stand. dev.
0.50—0.99	1	4.00	0.708	0.708	—	0.106	0.106	—
1.00—1.49	2	8.00	1.389—1.436	1.413	0.0334	0.186—0.194	0.190	0.0059
1.50—1.99	5	20.00	1.675—1.917	1.797	0.1060	0.206—0.236	0.223	0.0131
2.00—2.49	3	12.00	2.222—2.472	2.333	0.1273	0.211—0.333	0.279	0.0621
2.50—2.99	5	20.00	2.500—2.778	2.608	0.1130	0.289—0.378	0.318	0.0350
3.00—3.49	7	28.00	3.144—3.292	3.212	0.0608	0.278—0.500	0.357	0.0720
3.50—3.99	2	8.00	3.611—3.661	3.636	0.0354	0.347—0.347	0.347	0.0000
Sum	25	100.00	0.708—3.661	2.418	0.7766	0.106—0.500	0.289	0.0824

Correlation coefficient, r = 0.8427800

Table 9

Physoporella pauciforata (GÜMB.) STEINM. v. *undulata* PIA
Frequency distribution of st : p (in mm)

Class	n	%	Diameter of the central stem			Diameter of the branches - p		
			range	mean	stand. dev.	range	mean	stand. dev.
0.00—0.49	2	8.00	0.175—0.458	0.317	0.2003	0.106—0.186	0.146	0.0569
0.50—0.99	9	36.00	0.508—0.994	0.739	0.1829	0.194—0.333	0.239	0.0448
1.00—1.49	5	20.00	1.017—1.486	1.266	0.2228	0.292—0.378	0.324	0.0340
1.50—1.99	7	28.00	1.594—1.944	1.724	0.1236	0.278—0.389	0.331	0.0571
2.00—2.49	2	8.00	2.039—2.078	2.058	0.0276	0.347—0.500	0.424	0.1080
Sum	25	100.00	0.175—1.944	1.192	0.5587	0.106—0.389	0.285	0.0824

Correlation coefficient, r = 0.874802

with elimination of D influence is of r = 0.455601 and shows some relation on the 5 percent level of probability.

Distance between whorls — h

It has been counted out by reduction of the values measured to the actual ones with the help of a right-angled triangle. Since h between individual whorls varies even within one specimen, average values $\bar{h}$ have been used in solving the st : h relation. The average distance between whorls in 17 specimens varies between 0.446—0.996 mm (the mean = 0.792 mm) and as the frequency distribution table (Tabs. 10, 11) shows, it grows with the increase of the D and st value.

Table 10

Physoporella pauciforata (GÜMB.) STEINM. v. *undulata* PIA
Frequency distribution of D : $\bar{h}$ (in mm)

Class	n	%	Diameter of the thallus - D			Distance between the whorls — $\bar{h}$		
			range	mean	stand. dev.	range	mean	stand. dev.
0.50—0.90	1	5.88	0.708	0.708	—	0.446	0.446	—
1.00—1.49	1	5.88	1.389	1.389	—	0.636	0.636	—
1.50—1.99	3	17.65	1.797—1.917	1.869	0.06353	0.655—0.889	0.765	0.117372
2.00—2.49	2	11.76	2.222—2.306	2.264	0.058926	0.660—0.739	0.700	0.055584
2.50—2.99	4	23.53	2.500—2.778	2.594	0.124936	0.806—0.969	0.859	0.075572
3.00—3.49	5	29.41	3.144—3.250	3.188	0.053877	0.768—0.932	0.850	0.058702
3.50—3.99	1	5.88	3.611	3.611	—	0.996	0.996	—
Sum	17	99.99	0.708—3.611	2.480	0.768558	0.446—0.996	0.792	0.137177

Correlation coefficient, r = 0.815397

Table 11

Physoporella pauciforata (GÜMB.) STEINM. v. *undulata* PIA
Frequency distribution of st : $\bar{h}$ (in mm)

Class	n	%	Diameter of the central stem			Distance between the whorls — $\bar{h}$		
			range	mean	stand. dev.	range	mean	stand. dev.
0.0—0.49	2	11.76	0.175—0.458	0.317	0.200347	0.446—0.636	0.541	0.134331
0.5—0.99	6	35.29	0.508—0.994	0.800	0.182354	0.655—0.889	0.750	0.08894
1.0—1.49	3	17.65	1.017—1.486	1.268	0.236394	0.768—0.849	0.810	0.040263
1.5—1.99	4	23.53	1.594—1.944	1.713	0.159109	0.851—0.969	0.904	0.055770
2.0—2.49	2	11.76	2.039—2.078	2.058	0.027499	0.836—0.996	0.916	0.113414
Sum	17	99.99	0.175—2.078	1.189	0.583837	0.446—0.996	0.792	0.137177

Correlation coefficient, r = 0.759039

Table 12

Physoporella pauciforata (GÜMB.) STEINM. v. *undulata* PIA
Testing of correlation coefficients

Correl. coeff.		n	d.f.	$r_{0.01}$	Hyp.	$r_{0.05}$	Hyp.	t	$t_{0.01}$	Hyp.	$t_{0.05}$	Hyp.
$r_{D\,st}$	= 0.953335	26	24	0.4793	H_1	0.3746	H_1	15.4892	2.779	H_1	2.056	H_1
$r_{D\,st}$	= 0.953298	25	23	0.5071	H_1	0.3978	H_1	15.1369	2.807	H_1	2.069	H_1
$r_{D\,ps}$	= 0.842800	25	23		H_1		H_1	7.5097		H_1		H_1
$r_{st\,ps}$	= 0.874802	25	23		H_1		H_1	8.6596		H_1		H_1
$r_{D\,st}$	= 0.951277	17	15	0.6055	H_1	0.4821	H_1	11.9488	2.947	H_1	2.131	H_1
$r_{D\,h}$	= 0.815397	17	15		H_1		H_1	5.4552		H_1		H_1
$r_{st\,h}$	= 0.759039	17	15		H_1		H_1	4.5154		H_1		H_1
$r_{D\,p}$	= 0.858358	17	15		H_1		H_1	6.4797		H_1		H_1
$r_{D\,h}$	= 0.815397	17	15		H_1		H_1	5.4552		H_1		H_1
$r_{p\,h}$	= 0.676640	17	15		H_1		H_1	3.5591		H_1		H_1

Table 13

Physoporella pauciforata (GÜMB.) STEINM. v. *undulata* PIA
Partial correlation

Correl. coeff.		Partial corr.		n	d.f.	$r_{0.01}$	Hyp.	$r_{0.05}$	Hyp.	t	$t_{0.01}$	Hyp.	$t_{0.05}$	Hyp.
$r_{D\,st}$	= 0.9533	$r_{xy.z}$ =	0.8284	25	22	0.5170	H_1	0.4061	H_1	7.0927	2.819	H_1	2.074	H_1
$r_{D\,p}$	= 0.8428	$r_{xz.y}$ =	0.0605	25	22		H_0		H_0	0.2907		H_0		H_0
$r_{st\,p}$	= 0.8748	$r_{yz.x}$ =	0.4556	25	22		H_0		H_1	2.4545		H_0		H_1
$r_{D\,st}$	= 0.9513	$r_{xy.z}$ =	0.8818	17	14	0.6226	H_1	0.4973	H_1	7.2429	2.977	H_1	2.145	H_1
$r_{D\,h}$	= 0.8154	$r_{xz.y}$ =	0.4650	17	14		H_0		H_0	2.0341		H_0		H_0
$r_{st\,h}$	= 0.7590	$r_{yz.x}$ =	−0.0932	17	14		H_0		H_0	−0.3624		H_0		H_0
$r_{D\,p}$	= 0.8584	$r_{xy.z}$ =	0.7194	17	14		H_1		H_1	4.0108		H_1		H_1
$r_{D\,h}$	= 0.8154	$r_{xz.y}$ =	0.6210	17	14		H_0		H_1	3.0686		H_1		H_1
$r_{p\,h}$	= 0.6766	$r_{yz.x}$ =	−0.0783	17	14		H_0		H_0	−0.3043		H_0		H_0
$r_{st\,p}$	= 0.8713	$r_{xy.z}$ =	0.7462	17	14		H_1		H_1	4.3405		H_1		H_1
$r_{st\,h}$	= 0.7590	$r_{xz.y}$ =	0.4690	17	14		H_0		H_0	2.0568		H_0		H_0
$r_{p\,h}$	= 0.6766	$r_{yz.x}$ =	0.0479	17	14		H_0		H_0	0.1857		H_0		H_0

Correlation st : $\bar{h}$

The correlation coefficient r = 0.815397, the regression coefficient b = = 0.145537.

Correlation st : $\bar{h}$

The correlation coefficient r = 0.79039, the regression coefficient b = 0.178342. Since the correlation coefficient is greater than $r_{0.01}$ of the testing table (Tab. 12), the relation of D : $\bar{h}$ and of st : $\bar{h}$ can be taken for statistically proved.

The partial correlation, however, does not prove such a relation. (Tab. 13). Thus, dependence of the distance between whorls has to be looked for in other factors.

Measurements (in mm)

	J. Pia, 1935 Bosna	I. Dieni, 1964 Italy	Slovak karst Silica pl.
D	1.8–3.9	1.68–2.1	0.708–3.661
d (st) . . .	0.5–1.9	32.57 % D	0.175–2.078
p	0.26–0.60	0.2–0.3	0.106–0.500
$\bar{h}$	0.6–1.0	— — —	0.447–0.996
w	14–19	13	14±1

Notes

Physoporella pauciforata (GÜMB.) STEINM. var. *undulata* PIA belongs to well identifiable Physoporells. They are prominent by their sleeve sculpture, prominent undulation as well as one-rowed whorls of their pyripherous bran-

ches. However this variety belongs to generally less known Physoporells. Data published so far are mostly not documented by illustrations. Not all illustration I know of the species correspond with its diagnosis. E. g. the specimen illustrated in the work by Diaconu – Dragastan (1969, Pl. IV, Fig. 3) and refered to from Ladinian can hardly be taken for this variety. Illustrations by Kotaňski – Čatalov, (1973, Pl. X, Figs. 12–17) are unidentifiable, the illustration do not show "the thallus is intensively undulated" (l. c. p. 198) at all.

Accompanying flora: *Physoporella varicans* PIA, *Diplopora* cf. *proba* PIA, *Diplopora hexaster* (PIA) PIA var. *hexaster*.

Age: Not even one of the Bosna localities published by Pia (1935, 1935 a) is according to him proved Pelsonian. In spite of this, Pia (1935 a, p. 131) takes the dasyclad flora of the Bosna Anisian, thus including var. *undulata* for "in its substantial part Pelsonian" and doubts it would reach the Illyrian, however, he admits it can begin already in the "Upper Hydaspian". Hurka (1967, p. 89) published this variety in the association of *Diplopora cellulata* HURKA, *Physoporella intusannulata* HURKA, *Physoporella varicans* PIA and *Diplopora* cf. *proba* PIA, taken by him (sensu Pia, 1937) for the "Upper Hydaspian".

To find the exact stratigraphic position of any locality with dasyclads in such a lithostratigraphic unit as the Slovak Karst Steinalm limestone without a control by other macrossils (which are relatively very rare in it) is impossible. So far we know only that the Anisian dasyclad association in the Steinalm limestone begins under the horizon with *Decurtella decurtata* and it extends to the close underlier of the Schreyeralm limestone or Steinalm limestone with *Diplopora annulatissima* PIA which we take for the Upper Illyrian (Bystrický, 1964). Whether the above horizon with *Decurtella decurtata* is the base of the Pelsonian remains problematic. Since occurrence of var. *undulata* PIA is relatively rare in the Slovak Karst Steinalm limestone, its stratigraphic position can be given only as the Pelsonian or the Lower Illyrian.

Measurements of the illustrated specimens (in mm)

Thin. sec. No	D	st	st % D	p	$\bar{h}$	
41	3.611	2.039	56.46	0.347	0.996	Pl. IV, Fig. 20
41	3.244	2.078	64.04	0.500	0.836	Pl. IV, Fig. 21
41	tangencial section					Pl. IV, Fig. 22
744	3.144	1.625	51.68	0.306		Pl. V, Fig. 23
744	tangencial section					Pl. V, Fig. 23

Physoporella aff. croatica (nov. var.?)
(Pl. II, Figs 5–10, Pl. III, fig. 18, Pl. V, Figs 26, 27)

Description: In the association with *Physoporella croatica* HERAK described above, also forms by their measurements close to *Physoporella paucifo-*

rata var. *undulata*, but by all qualitative signs resembling *Physoporella croatica* occur. Their most prominent signs are thick pyripherous branches pressed on their sides, ends of which, similarly as in *Ph. croatica*, taper off into a fine pore and this way communicate with the outer side (Pl. II, Fig. 8 – down left, Fig. 10 up). The central cavity of the thallus is spacious, there is no sign after the original stem-cell outline. The number of branches in a whorl is after a transversal section 10.

Measurements of the illustrated specimens (in mm)

Thin. sec No	D	d	d % D	p_v	p_s	
5062	2.933	0.800	27.27	0.800x		Pl. II, Fig. 5
5018	2.730	1.439	52.69	0.667	0.375	Pl. II, Fig. 6
5062	2.500	1.111	44.44	0.603x	0.575	Pl. II, Fig. 7
5019	3.422	1.200	35.06	0.744	0.522	Pl. II, Fig. 8
5062	3.333	0.922	27.76	0.603x	0.575	Pl. II, Fig. 9
5062	3.208	1.319	41.13		0.555	Pl. II, Fig. 10
5019	2.722	0.833	30.61		0.411	Pl. III, Fig. 18
5063	2.625	1.111	42.33		0.466	Pl. V, Fig. 26
5018	2.778	1.250	45.00		0.450	Pl. V, Fig. 27

x = values counted over.

Biometric data.

The outer diameter of the thallus – D

Its value has been found the same way as in *Physoporella croatica*. With regard to the small amount of sections (14) distribution into classes has not been possible.

The range of D varies between 1.806–3.422 mm (the mean = 2.845 mm).

Diameter of the central cavity – d

varies between 0.399–1.667 mm (the mean = 1.0901 mm).

Correlation between D and d

The correlation coefficient r = 0.596981, the regression coefficient b = = 0.445106.

Plate III

Figs. 12–16. *Physoporella croatica* HERAK.
Figs. 12, 14, 15: thin-sec. No. 4968; Fig. 13: thin-sec. No. 5018; Fig. 16: thin-sec. No. 5019
Fig. 17. *Physoporella pauciforata* (GÜMB.) STEINM. var. *undulata* PIA, thin-sec. No. 41
Fig. 18. *Physoporella* aff. *croatica* HERAK (var. nov.?), thin-sec. No. 5019
Fig. 19. *Physoporella dissita* (GÜMB.) PIA, thin-sec. No. 5063


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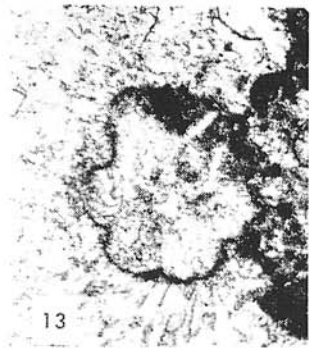
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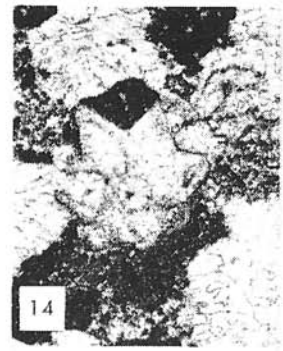
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Table 14

Analysis of variance and testing of the mean

		F – test, 1 %			T – test, 1 %		F – test			T — test
		comput.	tabulat.	Hypoth.	comput.	tabulat.	Hypoth.	d.f.1	d.f.2	d.f.
Between I and III:	D	1.4492	2.2159	H_0	5.16	2.66	H_1	25	41	66
	d	14.4607	2.2159	H_1	10.02	2.66	H_1	25	41	66
	p	1.3609	2.4327	H_0	0.05	2.68	H_0	24	32	56
Between I and II:	D	3.0998	3.5735	H_0	1.56	2.71	H_0	25	13	38
	d	2.8916	3.5735	H_0	0.68	2.71	H_0	25	13	38
	p	1.3667	3.7805	H_0	18.51	2.72	H_1	24	12	36
Between II and III:	D	2.1389	3.4169	H_0	6.71	2.70	H_1	41	13	54
	d	5.0009	2.5694	H_1	12.65	2.70	H_1	13	41	54
	p	1.0042	3.6926	H_0	7.29	2.70	H_1	32	12	44

I = *Physoporella pauciforata* v. *undulata*
II = *Physoporella* aff. *croatica*
III = *Physoporella croatica*

H_0 = accepted hypothesis H_0
H_1 = rejected hypothesis H_0 and accepted alternative hypothesis H_1

Table 15

The values for counting the "general distance" (in units of micrometre, 1 mm = = 360 units)

a) Means:					
$\overline{D_1}$	897.32	$\overline{D_2}$	1010.666667	$\overline{D_3}$	611.00
$\overline{st_1}$	429.12	$\overline{st_2}$	394.50	$\overline{st_3}$	111.00
p_1	104.04	p_2	162.083333	p_3	104.161290
b) Sums of squares:					
$S\,(D_1)^2$	22005503.0	$S\,(D_2)^2$	12541818.0	$S\,(D_3)^2$	13136019.0
$S\,(st_1)^2$	5574336.0	$S\,(st_2)^2$	2019214.0	$S\,(st_3)^2$	463655.0
$S\,(p_1)^2$	291745.0	$S\,(p_2)^2$	321361.0	$S\,(p_3)^2$	357099.0
c) Sums of multiplication results:					
$S\,D_1 . st_1$	10912881.0	$S\,D_2 . st_2$	4913009.0	$S\,D_3 . st_3$	2388037.0
$S\,D_1 . p_1$	2501753.0	$S\,D_2 . p_2$	1988736.0	$S\,D_3 . p_3$	2119233.0
$S\,st_1 . p_1$	1241450.0	$S\,st_2 . p_2$	779559.0	$S\,st_3 . p_3$	394345.0
d) Sums:					
$S\,D_1$	22433.0	$S\,D_2$	12128.0	$S\,D_3$	18941.0
$S\,st_1$	10728.0	$S\,st_2$	4734.0	$S\,st_3$	3441.0
$S\,p_1$	2601.0	$S\,p_2$	1945.0	$S\,p_3$	2601.0

Plate IV

Figs. 20–22. *Physoporella pauciforata* (GÜMB.) STEINM. var. *undulata* PIA.
Figs. 20, 21: thin-sec. No. 41; Fig. 22: thin-sec. No. 747

20

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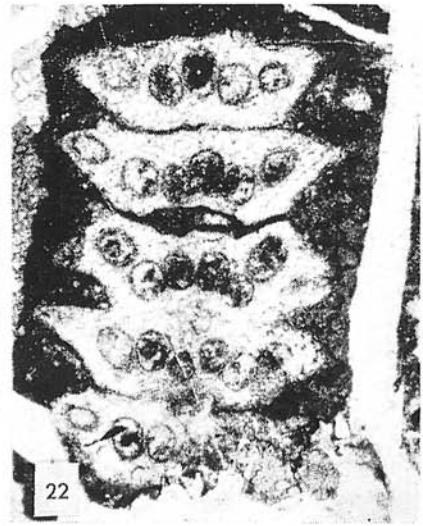

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Table 16

The general distance between Group I and III
(*Physoporella pauciforata* v. *undulata* I and *Ph. croatica* III)

q_{11}	3438991.44	s_{11}	63685.02667	c_{11}	0.0000693674	d_1	286.32
q_{22}	1052440.64	s_{22}	19489.64148	c_{12}	−0.0000583163	d_2	318.12
q_{33}	41899.1536	s_{33}	775.91025	c_{13}	−0.0002956755	d_3	−0.12129
q_{12}	1572018.04	s_{12}	29111.44519	c_{22}	0.0001740327		
q_{13}	314137.6853	s_{13}	5817.36454	c_{23}	−0.0002324665		
q_{23}	161234.8802	s_{23}	2985.83111	c_{33}	0.0049002043		
b_1	0.0013455552	Test of the result correctness:					
b_2	0.0386943554	$s_{11} \cdot c_{11} + s_{12} \cdot c_{12} + s_{13} \cdot c_{13}$ is to equal 1.000					
b_3	−0.1591437542	$4.417664719 - 1.697679771 - 1.72005217 = 0.99994$					

$D^2 = 4.295911$; $D = 2.072658$

$$F = \frac{n^1 \cdot n^3}{n^1 + n^3} \cdot \frac{n^1 + n^3 - m - 1}{n^1 + n^3 - 2} \cdot D^2 = 57.250404 \qquad F_{0.01}\,(3; 52) = 4.18$$

d.f.: between the groups: $\alpha + m - 2 = 2 + 3 - 2 = 3$
: within the groups: $n - \alpha - m + 1 = 56 - 2 - 3 + 1 = 52$

Table 17

The general distance between Group II and III
(*Physoporella* aff. *croatica*, II and *Physoporella croatica*, III)

q_{11}	1847520.670	s_{11}	45061.47976	c_{11}	0.0000139489	d_1	399.666667
q_{22}	233355.000	s_{22}	5691.585366	c_{12}	−0.0000875764	d_2	283.5000
q_{33}	6108.9167	s_{33}	148.9979663	c_{13}	0.0003042604	d_3	57.922043
q_{12}	414099.0333	s_{12}	10099.97634	c_{22}	0.0002702274		
q_{13}	169235.964	s_{13}	4127.706439	c_{23}	0.0002948628		
q_{23}	48182.500	s_{23}	1175.182927	c_{33}	−0.0040429963		
b_1	−0.0016292314	Test of the result correctness:					
b_2	0.0586871558	$s_{11} \cdot c_{11} + s_{12} \cdot c_{12} + s_{13} \cdot c_{13} = 0.99994$					
b_3	−0.0289822659	$b_1 \cdot s_{11} + b_2 \cdot s_{12} + b_3 \cdot s_{13} = d_1 = 399.6930$					
		$b_1 \cdot s_{12} + b_2 \cdot s_{22} + b_3 \cdot s_{23} = d_2 = 283.5082$					
		$b_1 \cdot s_{13} + b_2 \cdot s_{23} + b_3 \cdot s_{33} = d_3 = 57.9248$					

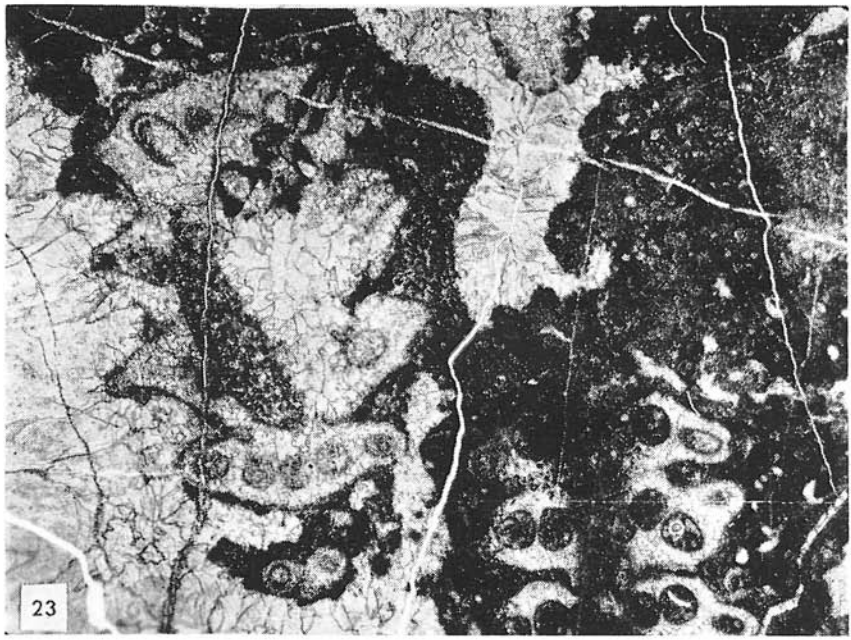
$D^2 = 4.770466$; $D = 2.184139$

$F = 38.322222$; $F_{0.01}\,(3; 39) = 4.325$

d.f. between the groups : 3
within the groups : 39

Plate V

Fig. 23. *Physoporella pauciforata* (GÜMB.) STEINM. var. *undulata* PIA, thin-sec. No. 744
Figs. 24–25. *Physoporella croatica* HERAK.
Fig. 24: thin-sec. No. 5018; Fig. 25: thin-sec. No. 5062
Figs. 26–27. *Physoporella* aff. *croatica* HERAK (var. nov.?).
Fig. 26: thin-sec. No. 5063; Fig. 27: thin-sec. No. 5018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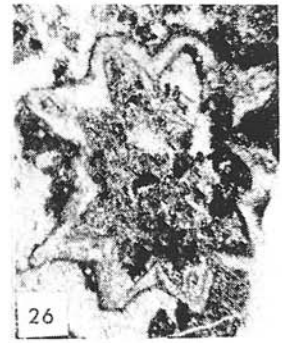
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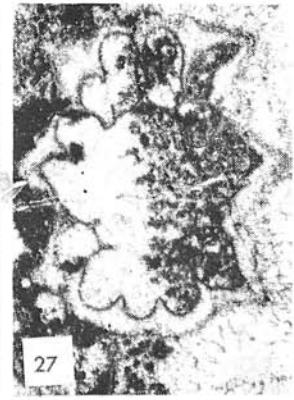
27

Width of the branches – p_s

The number of measurements is 13. Width of the basal parts of the branches varies between 0.322–0.575 mm (the mean = 0.458 mm). The correlation coefficient r between D and p_s = 0.590074, regression coefficient b = 0.092337, between d and p_s r = 0.440287 and regression coefficient b = 0.09563. Partial correlation between D and p_s and d and p_s:

$r_{xy.z} = 0.519510$, $r_{xz.y} = 0.447445$, $r_{yz.x} = 0.103996$

All the values found are smaller than the r values of the testing table and they do not prove any relation between D and d, D and p, nor between d and p.

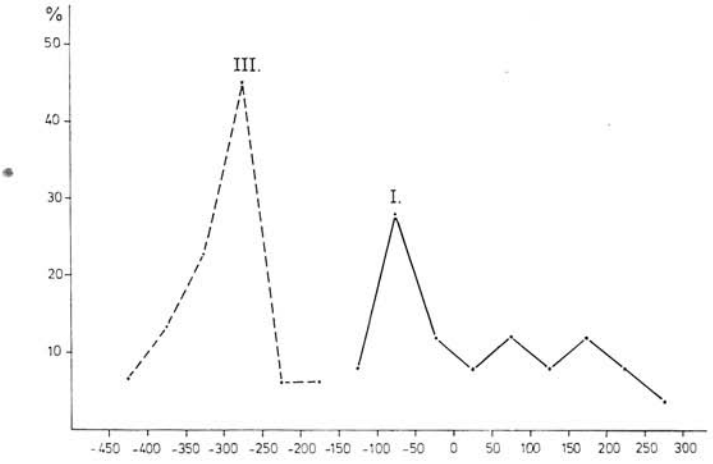

Fig. 3. "General distance" between *Physoporella pauciforata* v. *undulata* (Group I) and *Ph. croatica* (Group III) after the equation: $x = 0.7266_{x1} + 2.089495_{x2} - 8.59376_{x3}$.

Distance between the whorls – h

The whorls are separated from each other by a fine layer of the calcareous sleeve, or the branches of the neighbouring whorls touch each other and leave no space for a calcareous bar to be formed there. (Pl. II, Fig. 9). With regard to the small amount of sections, the actual value $\bar{h}$ (reduced by counting with the help of a right-angled triangle) could be found only in four specimens. It varies between 0.4394–1.0672 mm. Under this conditions I do not consider evaluation of the relation of $\bar{h}$ to the other variables (D, d, p).

Testing of the variance and the arithmetic means diffences between *Physoporella croatica* and *Physoporella* aff. *croatica*, or between *Physoporella* aff. *croatica and Physoporella pauciforata* v. *undulata* see in Table 14.

"The general distance" by P. C. Mahalanobis

The relation between *Physoporella pauciforata* v. *undulata*, *Physoporella* aff. *croatica* and *Physoporella croatica* has been solved also with the help of the

method of the "general distance", as quoted by E. W e b e r (1957, pp. 376–383). The values in the tables 15, 16, 17 are related to units of the microocular (1 mm = 360 units).

Group I = *Physoporella pauciforata* var. *undulata*,
Group II = *Physoporella* aff. *croatica*,
Group III = *Physoporella croatica*.

R e s u l t s:
D I/III = 2.0727, $F_{0,01}$ (3;52) = 4.18
D II/III = 2.1841, $F_{0,01}$ (3;39) = 4.325

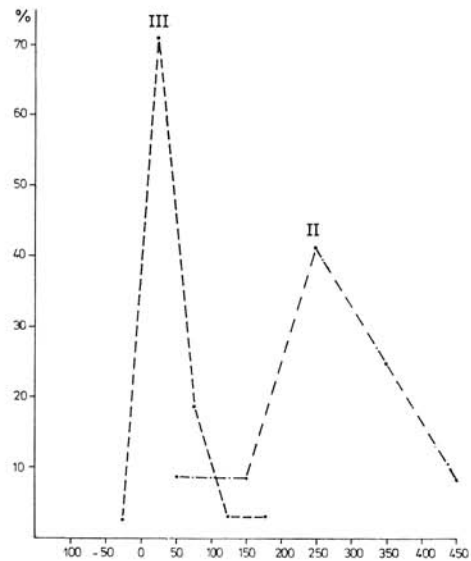

Fig. 4. "General distance" between *Physoporella croatica* (Group III) and *Ph.* aff. *croatica* (Group II) after the equation: $x = 0.072660_{x1} + 2.089459_{x2} - 8.593763_{x3}$.

There is a significant statistical difference among the above groups (Figs. 3, 4). The group II is substantially closer to the group I than to the groups III. With regard to the results of the "general distance", I take the forms here described as *Physoporella* aff. *croatica* rather for a variety of *Physoporella croatica* than for a new variety of *Physoporella pauciforata*.

Summary

Physoporella pauciforata (GÜMB.) STEINM. *var. undulata* PIA, occurring in the association with *Physoporella varicans* PIA, *Diplopora* cf. *proba* PIA and *Diplopora hexaster* (PIA) PIA var. *hexaster* and *Physoporella* aff. *croatica* occurring together with *Physoporella croatica* HERAK and *Physoporella dissita*

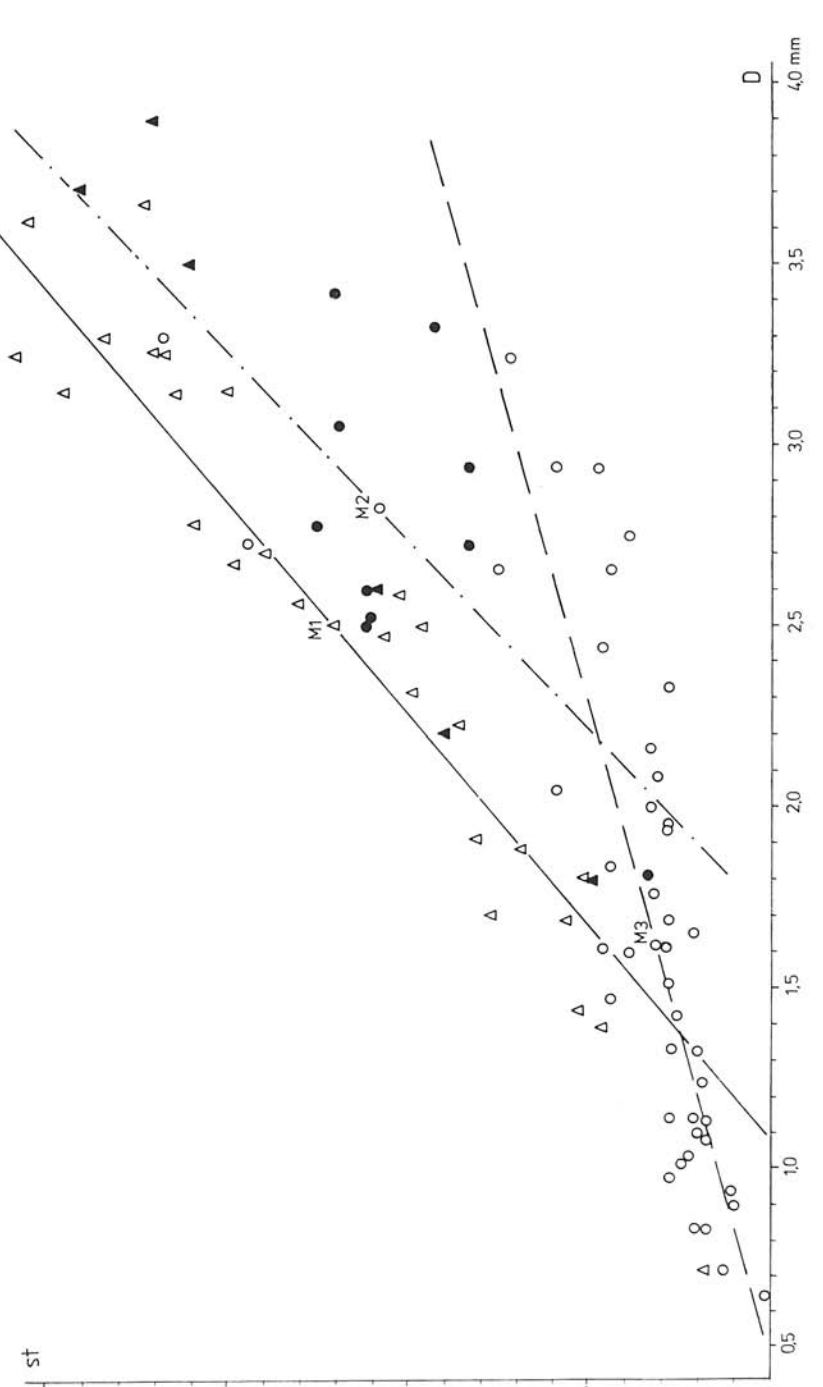

Fig. 5. D:st scattergram (in mm): circles – *Physoporella croatica*; light triangles – *Ph.* p. *undulata* of Slovak Karts localities; black triangles – *Ph.* p. *undulata* from Bosna (ex Pia, 1935); black dots – *Ph* off. *croatica*.

(GÜMB.) PIA have been examined by statistic methods. The algae at the first sight morphologically very similar show statistically significant differences almost in all variables measured. Dependence of the distance between whorls ($\bar{h}$) on the other variables (D, st, p) has not been proved even in one of the species studied.

Translated by K. Bystrická

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