A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. XVIII 1973 No. 2

ZBIGNIEW KOTAŃSKI & GEORGY A. ČATALOV

TRIASSIC DASYCLADACEAE FROM CENTRAL BALKAN AND FORE-BALKAN, BULGARIA

Abstract. — A very rich assemblage of Middle Anisian (Pelsonian) physoporellas is described. It belongs to the *Physoporella praealpina* group (*Ph. praealpina, Ph. dissita* and *Ph. minutula*) and to the group of *Ph. pauciforata* (*Ph. pauciforata* var. *pauciforata*, var. *sulcata* and var. *undulata*). A new variety *Ph. praealpina* var. *sulcata* is proposed. *Ph. praealpina* group characterises the Préalpes and Bransonian series in the Western Alps, as well as the High-Tatric series and Slovakian Karst in the Carpathians. Besides, *Gyroporella* cf. *ampleforata* and *G. vesiculifera* are described. This last species is an index Norian form and testifies to the close palaeogeographical connections between the Bulgarian, the Dinaric and the South Alpine seas in the Norian stage.

GENERAL REMARKS

Investigations of the Triassic algae (mainly Dasycladaceae) in Bulgaria are, as yet, in a very early stage. These fossils have never been used by stratigraphers of the Bulgarian Triassic. Limestones and dolomites with the Dasycladaceae were found in the following areas: Western Balkan (Milanovo), Central Fore-Balkan (Teteven anticlinorium, Zessidren), Central Balkan anticline (Cherni Ossum River), Shipka anticline (Stoletov Peak), Tvarditza anticline (north of Tvarditza) (Text-fig. 1). Representatives of Dasycladaceae were also found in South-Western Bulgaria (Gole Burdo Mountain and others). In the majority of these areas the amount of fossil remains is very small. It is known that they are common in the Central Balkan (in the upper part of the Cherni Ossum Valley) where they build thick layers of dolomites. As no other fossils except *Costatoria costata* Zenk are found in the same district the Dasycladaceae could have significant meaning for the Triassic stratigraphy in the Central Balkan.

Calcareous algae belonging to the Dasycladaceae were noted in the limestones and dolomites of the Middle and Upper Triassic. They are rare

Fig. 1. Schematic map showing distribution of Dasycladacean localities in Bulgaria.

in the Teteven anticlinorium and widely distributed in the Central Balkan. All the specimens included in this paper, with one exception, originate from one profile composed of sediments of the Lower and Middle Triassic (Text-fig. 2). *Gyroporella vesiculifera* Gümb. was found in Zessidren, east of Teteven (Text-fig. 1), in limestones underlying the Norian dolomite group (Čatalov 1970).

The formation of finely cristalline dolomites (Text-fig. 2) consists of gray to dark gray thick bedded dolomites. Their textures are fine-grained (0.01-0.06 mm), equi-granular, intraclastic, biodetritic and rarely micro-grained (0.003-0.007 mm). Because of dolomitization the fragments of the green algae are not well preserved. Chemical analyses reveal the presence of pure dolomites (95% of the dolomite). The origin of the dolomites is early-diagenetic. Primary lime mud was deposited in a subtidal or intertidal-subtidal zone.

The lithological and fossil materials were collected by G. A. Čatalov. Palaeontological determinations were carried out by Z. Kotański, on thin sections.

PALAEOBOTANICAL DESCRIPTIONS

The most common dasycladacean genus is *Physoporella* of Middle-Upper Anisian age. A completely subordinate role is played in this horizon by the genus *Teutloporella* and possibly by *Griphoporella*. *Gyroporella*

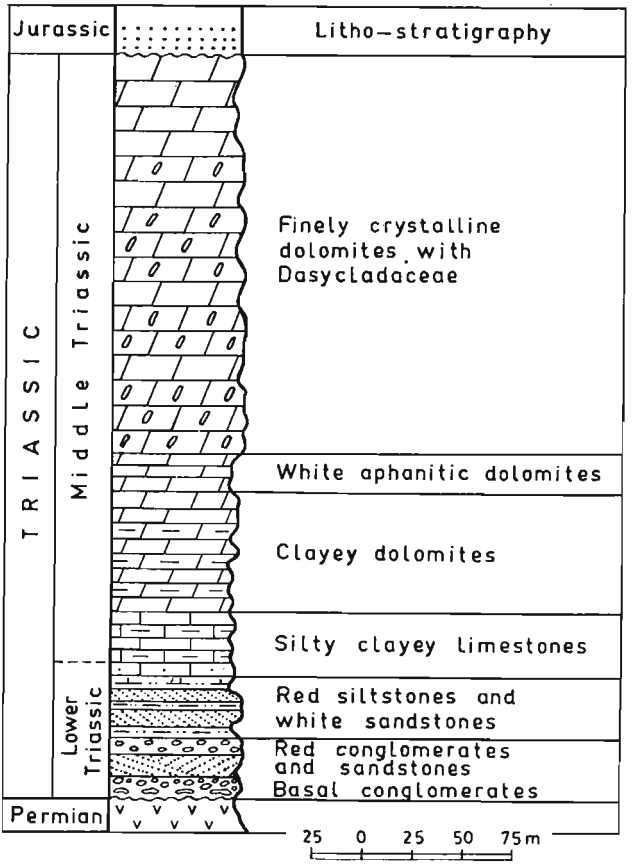


Fig. 2. Profile of the Triassic deposits of the Cherni Ossum river valley; locality Steneto, south of Troyan.

cf. *ampleforata* occupies a slightly higher stratigraphical position. *Gyroporella vesiculifera* has a great stratigraphical meaning, being an index fossil for the Upper Triassic (Norian).

Genus *Physoporella* Steinmann, 1903

This genus with pyriform pores closed in the cylindrical thallus, is very richly represented in our material. All the described species are characteristic for the Middle and Upper Anisian. The differentiation of the Anisian genus *Physoporella* and *Oligoporella* was described in details by Hurka (1967, 1969).

One can distinguish two main groups of species: the *Physoporella praealpina* group (two rows of alternate pores in one whorl) and *Physoporella pauciforata* group (one row of pores in one whorl).

Physoporella praealpina group
Physoporella praealpina Pia, 1920
(Pl. VI Figs. 1—12; Pl. VII, Figs 1—19)

1920. *Physoporella praealpina* Pia; J. Pia, Die Siphoneae..., p. 53, Pl. 3, Figs 1—9.
1935. *Physoporella* aff. *praealpina*; J. Pia, Die Diploporen..., p. 226, Figs 37—39.
1961. *Physoporella praealpina* Pia; G. Botteron, Étude géologique..., p. 62, Fig. 6, Pl. 6, Figs 1—4.
1964. *Physoporella* cf. *praealpina*; J. Bystrický, Slovenský Kras, p. 126, Pl. 19, Figs 1—9; Pl. 20, Figs 1—3.
1965. *Physoporella praealpina* Pia; J. Bystrický, J. Veizer, Triadische Dasycladaceen..., p. 14, Pl. 3, Figs 1, 2, 4, 6; Pl. 4, Figs 1, 2, 5, 6.
1965. *Physoporella* cf. *praealpina*; M. Herak, Comparative study..., p. 18, Pl. 12, Fig. 5.
1966. *Physoporella praealpina* Pia; J. Bystrický, La stratigraphie..., p. 251, Pl. 7, Figs 2*a*, 3, 4.

Material. — About 40 determinable sections.
Dimensions:

	Pl. VI, Fig. 1	Pl. VI, Fig. 3	Pl. VII, Fig. 2
D (external diameter) in mm	1.833	1.583	1.967
d (internal diameter) in mm	1.083	1.000	1.292
% D	59.00	63.16	68.26

Description. — This species is characterized by a cylindrical, generally undivided thallus and by alternately lying vertical branches (pores) forming two rows, belonging to one whorl. The lack of annulation and even of segmentation can be observed on all the specimens presented on Pls. VI and VII. Nevertheless on some specimens regular folds of the outer wall are visible, connected with the whorls and coating the pores (lower part of the most representative specimen from Pl. VI, Fig. 1, and 2, 3, 5, 12, Pl. VII, Fig. 11). Besides specimens with completely undivided cylinder, specimens with distinct fissuration do exist (Pl. VI, Figs 2, 6, 7, 11; Pl. VII, Figs 3, 15). Fissuration is not very frequent and is not strongly regular.

Variability. — The initial undulation, fissuration and arrangement of pores in two-row whorls are the features characteristic for *Ph. praealpina* and the regularity of pore arrangement is very stable (comp. Botteron, 1961; Bystrický, 1965). The range of variability of these features can be studied on the specimen on Pl. VI, Fig. 1, which is the best and longest specimen of this species ever reproduced in literature.

The shape of pores, particularly in oblique and transversal sections, is pyriform — pear-shaped (Pl. VI, Figs 4, 10; Pl. VII, Figs 2, 5, 8, 10, 11, 14). In longitudinal sections the pores are more elongated and may be slightly oblique to the wall (Pl. VI, Figs 1-3, 5, 7-9, 11, 12; Pl. VII, Figs 1, 3, 4, 6, 7, 9, 12, 16, 17). This feature together with initial segmentation approaches *Ph. praealpina* to *Ph. dissita* and *Ph. minutula* (comp. Bystrický, 1966). Pores transsecting the whole wall of the cylinder, are very

rare (Pl. VI, Fig. 1, basal part, left side), similarly as in Bystrický and Veizer's material from the hightatric Triassic (Bystrický and Veizer, 1965).

Remarks. — In some cases, fissuration is rather sporadic (Pl. VI, Figs 1, 2; Pl. VII, Fig. 2) but in others the fissures separate each whorl of two-row pores (Pl. VI, Figs 6, 7). This regular distribution of whorls and of initial external undulation, was described by Pia (1935) and confirmed by Botteron (1961) and Bystrický (1964, 1965), and considered by the latter as the feature characteristic for *Ph.* cf. *praealpina*. Neverthelles, besides the two above mentioned cases a third type does exist, i.e. when fissuration is not regular and separates one, two or even three whorls (Pl. VI, Fig. 11; Pl. VII, Fig. 15). This latter is the most typical for the first specimens described by Pia (1920) where the distance between whorls vary and the rows are grouped in two.

Two specimens (Pl. VII Figs 18 and 19) form a new variety of *Ph. praealpina*. The presence of oblique fissures (Pl. VII, Fig. 18) and obliquely oriented pairs of pores (Pl. VII, Fig. 19) are features comparable only with *Ph. pauciforata* var. *sulcata*, but the existence of two rows of pores in each whorl speaks for their assignment to *Ph. praealpina*. *Physoporella* cf. *praealpina* Pia with branches obliquely oriented to the main stem and without calcification between their proximal portion was described by Herak (1965). These features are outside the range of *Ph. praealpina* var. *praealpina*. For the new variety is proposed the name *Ph. praealpina* var. *sulcata* — per analogiam to *Ph. pauciforata* var. *sulcata* Bystrický.

Stratigraphical range and geographical distribution. — *Physoporella praealpina* Pia is a typical West Alpine species, described by Pia (1920) from the material yielded by Rabowski from the Préalpes Medianes. The name "praealpina" had been proposed by Rabowski (*fide* Pia, 1920, p. 55). This species is also typical for the Briansonian series, particularly in Vanoise (Ellenberger, 1958). In these two places, this species is considered as the characteristic fossil for the Upper Anisian, appearing here together with *Diplopora annulatissima* Pia, an index Illyrian fossil. *Ph. praealpina* appears here with *Ph. dissita* (Gümb.) Pia and *Ph. minutula* (Gümb.) Pia of the same group, but without the *Ph. pauciforata* group. *Physoporella* aff. *praealpina* together with *Ph. pauciforata* were described by Pia (1935) from Bosnia, by Herak (1965) from Dalmatia and by Bystrický (1964) from the Southern Slovakia (Western Carpathians). All these species of the genus *Physoporella* are considered rather as index fossils of Pelsonian but they reach the Illyrian, where they appear together with *Diplopora annulatissima* Pia. Bulgarian algae are rather Pelsonian in age, as *D. annulatissima* is absent.

In the Tatra Mts. (High-Tatric series, Polish and Slovakian Western Carpathians) *Physoporella praealpina*, determined by Bystrický and Veizer (1965) and Kotański (*in* Bac & Grochocka; 1965, Piotrowski, 1965), ap-

pears together with *Diplopora annulatissima* (Kotański, 1967) and its Illyrian age is not in doubt. *Physoporella praealpina* Pia, according to the most recent revision of dasycladacean flora from Upper Silesia (Kotański, 1973), is the most characteristic species (together with *Ph. minutula*) for this Middle European (Germanic) province of the Triassic sea with the most pronounced Alpine influences.

Physoporella dissita (Gümbel) Pia, 1912
(Pl. VIII, Figs 1—23)

1912. *Physoporella dissita* (Gümbel); J. Pia, Neue Studien..., p. 45, Pl. 6, Figs 1—4.
1920. *Physoporella dissita* (Gümbel) Pia; J. Pia, Die Siphoneae..., p. 55.
1957. *Physoporella dissita* (Gümbel) Pia; J. Bystrický, Prispevok k poznaniu..., p. 234, Pl. 6, Figs 6, 7.
1958. *Physoporella praealpina* Pia; F. Ellenberger, Étude géologique..., p. 190, Pl. 6, Fig. 17.
1964. *Physoporella dissita* (Gümbel) Pia; J. Bystrický, Slovenský Kras, pp. 127—129, Pl. 20, Fig. 6; Pl. 21, Figs 1—8, non Pl. 21, Fig. 9.
1965. *Physoporella* cf. *dissita*; J. Bystrický & J. Veizer, Tradische Dasycladaceen..., p. 16, Pl. 4, Fig. 3.
1966. *Physoporella dissita*; J. Bystrický, La stratigraphie..., p. 251, Pl. 6, Figs 4, 5; Pl. 7, Figs 1, 2b.
1966. *Physoporella dissita*; J. Bystriký in: M. Peržel, Stratigraphie..., Pl. 17, Figs 1—3.

Material. — About 30 determinable sections.

Dimensions:

	Pl. VIII, Fig. 3	Pl. VIII. Fig. 4	Pl. VIII, Fig. 22
D (external diameter) in mm	1.417	1.417	2.000
d (internal diameter) in mm	0.667	0.750	1.083
in % D	47,06	52.94	54.17

Description. — The most typical specimens from the Bulgarian materials are presented on the Plate VIII. These are markedly segmented or even annulated forms. Each segment is connected with one whorl, composed of two rows with alternating pores. This segmentation or undulation is very well developed and is an indispensable feature of this species, while in *Ph. praealpina* the initial minute undulation is subordinate and not a determinative feature.

The pores are pyriform, but not so remarkable pearshaped, as in the *Ph. praealpina*. Nevertheless, the pores never, or only very rarely, transsect the wall of the cylinder, which is decisive in assigning these forms to the genus *Physoporella* (Hurka, 1967, 1968).

Variability. — A considerable variability is expressed in undulation, annulation and in disposition of fissures between the whorls of the pores.

Remarks. — The main difference between *Ph. dissita* and *Ph. praealpina* exists in the presence of undulation or even annulation in the former. In connection with this the distances between whorls of two-row pores

are distinctly larger in *Ph. dissita*. This feature, remarked by Ellenberger (1958), is clearly detectable in our material. Ellenberger's specimen with vigorous annulation and great distances between whorls (Ellenberger, 1958, Pl. 6, Fig. 17), considered as an intermediate form between *Ph. praealpina* and *Ph. minutula*, belongs to *Ph. dissita*. On the contrary, Bystrický's specimens (Bystrický, 1964, Pl. 21, Fig. 9) with distinctly closer whorls composed of large, typical pyriform pores, belongs rather to *Ph. praealpina*, than to *Ph. dissita*. Fissuration, rather rare in Bystrický's material, is a very typical feature of *Ph. praealpina*. Disposition of pores in two-row whorls by two is a phenomenon of metameria, stressed by Pia (1920, p. 173). This feature is visible on Bystrický's specimen and is comparable with Pia's specimen (Pia, 1920, Pl. 3, Fig. 2), Ellenberger's specimen (Ellenberger, 1958, Pl. 6, Fig. 12) and ours (Pl. VI, Fig. 11). At any rate, it is a feature of *Ph. praealpina* and not of *Ph. dissita*.

Physoporella dissita is frequently considered as an intermediate form between the adult form, *Ph. praealpina*, and the juvenile form, *Ph. minutula* (Ellenberger, 1958, Botteron, 1961). Bystrický (1966, p. 251, Pl. 6, Fig. 4) identifies *Ph. dissita* with the basal part of *Ph.* cf. *praealpina*. In our material the basal part of *Ph. praealpina* (Pl. VI, Fig. 1) may be considered as *Ph. dissita*, but the segmentation even in this case may be a feature of *Ph. praealpina*. On the other hand, in many cases *Ph. dissita* is very frequent in rocks, while *Ph. praealpina* is absent or very rare (Bystrický, in Peržel, 1966, p. 159, Pl. 18, Figs 1—3). *Ph. dissita* is considered by Hurka (1967) as an independent species but this needs to be confirmed by further studies. At any rate, the stratigraphical range of *Ph. dissita* is frequently quite different from *Ph. praealpina*.

Stratigraphical range and geographical distribution. — *Physoporella dissita* is a typical West Alpine species (Pia, 1912, 1920) and is characteristic for the Prealpian Upper Anisian (Illyrian) because of its appearance together with *Diplopora annulatissima*. They occupy the same stratigraphical position in the Briansonian series, where they occur together with *Ph. praealpina*, *Ph. minutula* and *Ph. annulatissima* (Ellenberger. 1958). Of the same age is *Ph. dissita* in the High-Tatric series (Kotański, 1967), where it occurs together with *Ph. praealpina*, *Ph. minutula*, *Ph. pauciforata* and *Diplopora annulatissima*.

Ph. dissita from the Slovakian Karst is of Pelsonian age (Bystrický, 1957, 1964, 1966). Which also can be ascribed to this species in Bulgaria, where it occurs together with other species of genus *Physoporella*, but without *Diplopora annulatissima*. *Ph. dissita* is probably common in Upper Silesia (Kotański, 1973), but the bad state of preservation of the material makes it impossible to state this with certainty.

Physoporella minutula (Gümbel) Pia, 1912
(Pl. IX, Figs 1—35)

1912. *Physoporella minutula* (Gümbel) Pia; J. Pia, Neue Studien..., p. 45, Pl. 6, Figs 5—12.
1920. *Physoporella minutula* (Gümbel) Pia; J. Pia, Die Siphoneae..., p. 56, Pl. 2, Figs 19—22.
1958. *Physoporella minutula* (Gümbel) Pia; F. Ellenberger, Étude géologique..., p. 190, Pl. 6, Figs 18 and 19.
1961. *Physoporella minutula* (Gümbel) Pia; G. Botteron, Étude géologique..., p. 63, Pl. 6, Fig. 4.
1964. *Physoporella minutula* (Gümbel) Pia; J. Bystrický, Slovenský Kras, pp. 129—131, Pl. 20, Figs 4, 5; Pl. 21; Fig. 10.
1965. *Physoporella* cf. *minutula*; J. Bystrický & J. Veizer, Triadische Dasycladaceen..., p. 16, Pl. 3, Fig. 5.
1965. *Physoporella* cf. *minutula*; M. Herak, Comparative study..., p. 17, Pl. 12, Figs 3, 6.

Material. — About 40 sections.

Dimensions:

	Pl. IX, Fig. 2	Pl. IX, Fig. 4	Pl. IX, Fig. 29
D (external diameter) in mm	1.833	1.667	1.667
d (internal diameter) in mm	0.750	0.875	0,917
in % D	40.91	52.50	55,00

Description. — Specimens of this species are very abundant in the described material. They have an undivided cylinder (Pl. IX, Figs 2, 4, 10, 15, 21, 26), analogically as in some of Pia's specimens (Pia, 1912, Pl. XI, Figs 6, 5), but more frequently there are algae with divided-undulated or even annulated thallus (Pl. IX, Figs 1, 3, 5, 6, 8, 12, 13, 24, 25, 30, 31). Segments, if they exist, are sharper than in *Ph. dissita* and have a very characteristic shape (comp. Pl. IX, Fig. 25 with Pia's specimen, 1920, Pl. 2, Fig. 22 and with Ellenberger's specimen, 1958, Pl. 6, Figs 18 and 19). This feature is so characteristic, that Ellenberger (*l.c.*) used it for species determination in those cases where pores are not visible. The two rows of pores in one whorl are very well marked (Pl. IX, Figs 1, 2, 4, 8, 9, 11, 12, 14, 15, 18, 21, 25, 26, 29) and the shape of pores, although still pyriform, is as a rule elongated (Pl. IX, Figs 2, 4, 8, 17, 18, 25, 29, 34, 35), having according to Herak's expression a "sausage-like" character. Nevertheless, in some cases it is typically pyriform (Pl. IX, Figs 9, 10, 14, 20, 23, 28, 31—33). The contour of the inner tube of cylinder is straight, regular and very markedly separated from the wall (Pl. IX, Figs 2—8, 12—16, 21, 26, 27, 33).

Varability. — It is manifested by more or less pronounced undulation or annulation and the shape of pores. In some cases, only one row of frequent open branches in a whorl is visible, similarly as in the *Physoporella* cf. *minutula* (Herak, 1965, p. 18, Pl. 12, Fig. 3).

Remarks. — The above described features make our specimens in general view very similar to those of Pia, Ellenberger, Botteron, and Bystrický. Ellenberger (1958) and Botteron (1961) consider *Ph. minutula* as a juvenile form of *Ph. praealpina,* but this should be confirmed by detailed statistical investigations; the differences between the two above mentioned species are rather considerable.

Stratigraphical range and geographical distribution. — *Physoporella minutula* has in general a rather similar stratigraphical range and distribution as *Ph. dissita* and *Ph. praealpina.* It is a typical species of the Western Alps (Préalpes Medianes — Pia 1912, 1920; Ellenberger, 1958; Botteron, 1961), where it was first found by F. Rabowski. Its age here is Upper Anisian (Illyrian), as it appears together with *Diplopora annulatissima.* The same applies to this species in the Briansonian series (Ellenberger 1958), and in the High-Tatric series in the Tatra Mts. (Kotański, 1967). In the latter locality it occurs together not only with the *Physoporella praealpina* group and *Diplopora annulatissima,* but also with *Ph. pauciforata. Ph. minutula* is known from Upper Silesia, where it occurs in the Lower Muschelkalk (minuscule variety) and it is very particularly preserved (internal cast).

In Bulgaria, *Ph. minutula* occurs together with *Ph. praealpina* and *Ph. dissita,* as well as with *Ph. pauciforata,* however, without *D. annulatissima,* which establishes its Pelsonian age.

Physoporella pauciforata group

Algae with pyriform pores arranged in one row in each whorl, form the second group of species in the genus *Physoporella,* see Plates X and XI. Contrary to the *Physoporella pauciforata* group they do not form separate species, but are divided into variations (Pia, 1935; Bystrický, 1964).

Physoporella pauciforata (Gümbel) Steinmann 1903, var. *pauciforata* Bystrický, 1964

(Pl. X, Figs 1—6)

1903. *Physoporella pauciforata* (Gümbel) Steinmann; G. Steinmann, Einführung..., p. 17.
1912. *Physoporella pauciforata* (Gümbel) Steinmann; J. Pia, Neue Studien..., p. 44, Pl. 5, Figs 9—19.
1920. *Physoporella pauciforata* (Gümbel) Steinmann; J. Pia, Die Siphoneae..., p. 51, Pl. 3, Figs 10—15.
1935. *Physoporella pauciforata simplex* Pia; J. Pia, Die Diploporen..., p. 223.
1964. *Physoporella pauciforata* var. *pauciforata* Bystrický; J. Bystrický, Slovensky Kras, pp. 118—121, Pl. 13, Figs 1—6, Pl. 14, Figs 4, 5*b*, 6.
1965. *Physoporella pauciforata* var. *simplex*; M. Herak, Comparataive study..., p. 16, Pl. 9, Fig. 1*h*; Pl. 13, Fig. 5.

Material. — About 10 determinable sections.

Dimensions:

	Pl. X, Fig. 1	Pl. X, Fig. 2	Pl. X. Fig. 6
D (external diameter), in mm	1.500	1.583	1.083
d (internal diameter), in mm	1.000	0.917	0.833
in % D	66.67	57.89	76.92

Description. — The most typical representant of this variety is presented on Pl. X, Fig. 2. The cylindrical thallus is only very little undulated and the pores are oriented perpendicularly to the longitudinal axis. To the same variety belong probably the specimens illustrated on Pl. X, Figs 3—5 with pyriform pores forming one row. The long specimens of Figs 1 and 6 belong probably to the same variety (pyriform pores in one row, straight walls of cylinder), but the walls are very thin, little calcified (Pl. X, Fig. 1) or even corroded (Pl. X, Fig. 6), resulting from the apparent piercing of the wall by some pores.

Variability. — Some variability is expressed in the more or less pronounced undulation, the appearance of oblique initial fissuring (Pl. X, Fig. 2) and the varying thickness of the walls.

Remarks. — A detailed determination of the Bulgarian material studied in transverse sections (Pl. X, Figs 7—11) is not possible, but these forms most probably belong to *Ph. pauciforata* var. *pauciforata*. Our specimens have a little larger light of stem and relatively thinner walls than the typical ones. The basal part of pores (Pl. X, Fig. 4) is rarely as enlarged as in the specimens of Bystrický (1964, Pl. 13), but is similar to the thin pores of Pia's originate specimen (Pia 1912, Pl. 5, Fig. 18). Oblique fissuration present as in Herak's material (1965, Pl. 13, Fig. 5).

Stratigraphical range and geographical distribution. — *Physoporella pauciforata* var. *pauciforata* is an index form for the Upper Pelsonian and Lower Illyrian in Yugoslavia (Pia, 1935; Herak, 1965) and in the Slovakian Karst (Bystrický 1964). It has a similar stratigraphic range in the Eastern Alps and in the Transsilvania. In the High-Tatric series in the Polish Tatra Mts. this variety occurs together with other physoporellas of *praealpina* and *pauciforata* groups as well as with *Diplopora annulatissima* which determines the Illyrian age of Polish specimens. The Bulgarian specimens are probably the same age as the Slovakian ones because of the absence of *Diplopora annulatissima*.

Physoporella pauciforata (Gümb.) Steinm. var. *sulcata* Bystrický 1962
(Pl. XI, Figs 1—15)

1962. *Physoporella pauciforata* (Gümb.) Steinm. var. *sulcata* Bystrický; J. Bystrický, Slovenský Kras, pp. 121—122, Pl. 14, Figs 1—2, Pl. 15, Figs 1—3,5.

Material. — About 20 determinable sections.

Dimensions:

	Pl. XI, Fig. 1	Pl. XI, Fig. 5	Pl. XI, Fig. 8
D (external diameter), in mm	1.500	1.167	1.667
d (internal diameter), in mm	1.167	0.584	1.167
in % D	77.78	50.00	70.00

Description. — The main feature of this variety is the oblique undulation, more marked or less, connected with the oblique (30-40°) orientation of pores to the vertical axis. The shape of pores is very distinctly pyriform and their basal part is sharply enlarged (Pl. XI, Fig. 7). Arrangement of pores in one row is well visible.

Variability. — It concerns the scale of undulation and fissuration, as well as the angle of branches to the vertical axis.

Remarks. — Our specimens have rather moderate undulation, but this feature is comparable with that of Bystrický's specimens. Fissuration is less pronounced and is discernible mainly on the small specimens (Pl. XI, Figs 6, 9, 12, 15). The state of preservation of our specimen on Pl. XI, Fig. 13 is not very favourable, and one can't distinguish with certitude whether it has one or two rows of pores. In the latter case, this specimen would belong to *Physoporella praealpina* var. *sulcata* n.var. above described.

Stratigraphical range and geographical distribution. — *Physoporella pauciforata* var. *sulcata* is noted by Bystrický from the Pelsonian and Illyrian of the Slovakian Karst. In Bulgaria this variety belongs rather to the Pelsonian (lack of *Diplopora annulatissima*).

Physoporella pauciforata (Gümb.) Steinm. var. *undulata* Pia, 1935

(Pl. X, Figs 12—17)

1935. *Physoporella pauciforata* var. *undulata* Pia; J. Pia, Die Diploporen..., p. 221, Figs 33—34.
1957. *Physoporella pauciforata* var. *undulata* Pia; J. Bystrický, Prispevok k poznaniu..., p. 223, Pl. 6, Figs 3—4.
1962. *Oligoporella* ?; A. Michard, Premières données..., p. 39, Pl. 10, Fig. 2.
1964. *Physoporella pauciforata* var. *undulata* Pia; J. Bystrický, Slovenský Kras, p. 124, Pl. 17, Figs 1—6.
1965. *Physoporella pauciforata* var. *undulata*; M. Herak, Triassic Dasycladaceae..., p. 17, Pl. 12, Fig. 4.

Material. — About 10 sections.

Dimensions:

	Pl. X, Fig. 14	Pl. X, Fig. 16	Pl. X, Fig. 17
D (external diameter), in mm	1.000	1.167	1.250
d (internal diameter), in mm	0.500	0.584	0.667
in % D	50.00	50.00	53.33

Description. — The cylindrical thallus is intensively undulated; pores are arranged in separate rows and are oriented generally perpendicularly to the long axis of the thallus.

Variability. — It concerns the scale of undulation and arrangement of furrows.

Remarks. — The most typical dependence between the external undulation and arrangement of pores is visible on the Pl. X, Fig. 15. Undulation is not very intensive or regular and one can mark the intermediate forms between var. *undulata* and var. *pauciforata* (Pl. X, Fig. 16). The furrows are not deep and real annulation never occurs, as in Bystrický's specimens. This feature approaches our specimens to those of Pia's from Bosnia. In one specimen deeper furrows separating two whorls are visible, and more shallow ones — between rows of pores (Pl. X, Fig. 16). The deeper furrows alternate on the two walls of the thallus. This type of metameria is similar to the above described metameria in *Ph. praealpina*, but is more superficial, as the metameria of whorl arrangement does not exist in this case.

Our specimens have as a rule a little oblique orientation of pores, which approaches them to *Ph. pauciforata* var. *sulcata*. Generally speaking, the differences between the Bulgarian varieties of *Ph. pauciforata* are not so extremally pronounced, as in Bystrický's material. The specimen described by Michard (1962, Pl. 10 Fig. 2) from the Italian Western Alps as *Oligoporella?* belongs probably to *Ph. pauciforata* var. *undulata.*

Stratigraphical range and geographical distribution. — *Physoporella pauciforata* var. *undulata* is an index fossil of the Pelsonian in Bosnia (Pia 1935), Dalmatia (Herak 1965), and Southern Slovakia (Bystrický 1957, 1964), as well as in the Southern Alps (Ogilvie-Gordon 1935). In Bulgaria this variety has undoubtedly the same stratigraphic position.

Genus *Teutloporella* Pia, 1912

Teutloporella sp.

(Pl. XI, Fig. 17)

The irregular arrangement of trichophore pores makes it possible to assign the figured specimen to the genus *Teutloporella*. The tangential longitudinal section does not facilitate the determination. The direction of pores is probably oblique, which speaks for *Teutloporella tabulata* Pia (1935). In any case it is a Pelsonian form, occurring together with all the above described physoporellas.

Genus *Griphoporella* Pia, 1915

Griphoporella sp.

(Pl. XI, Fig. 16.)

Specimen with a very thin cylinder wall and without definitive shape of pores may belong eventually to the genus *Griphoporella*. This form also occurs together with Pelsonian physoporellas.

Genus *Gyroporella* Gümbel, 1872

This genus with typical vesiculiferous pores in the straight cylindrical thallus and aspondyle or euspondyle arrangement of pores occurs twice in the Bulgarian Triassic profiles. The first in the uppermost Anisian or Ladinian, and the second in the Norian.

Gyroporella cf. *ampleforata* Gümbel, 1874

(Pl. XII, Figs 1—6)

1874. *Gyroporella ampleforata* Gümbel; C. W. Gümbel, Über neue Gyroporellen..., p. 79.
1912. *Gyroporella ampleforata* Gümbel; J. Pia, Neue Studien..., p. 36, Pl. 2, Figs 18—26.
1940. *Gyroporella* cf. *ampleforata*; J. Pia, Die gesteinbildenden Algen..., p. 258—259.
1964. *Gyroporella* cf. *ampleforata*; J. Bystrický, Slovenský Kras, p. 102, Pl. 7, Figs 3, 4.
1965. *Gyroporella* cf. *ampleforata*; M. Herak, Triassic Dasycladaceae..., p. 13, Pl. 15, Figs 1—4.

Material. — About 10 determinable sections.

Dimensions:

	Pl. XII, Fig. 1	Pl. XII, Fig. 3	Pl. XII, Fig. 5
D (external diameter): in mm	1 045	1.591	1.364
d (internal diameter): in mm	0.818	1.182	0.955
in % D	78.26	74.29	70.00

Description. — The typical vesiculiferous pores are aspondyle, without arrangement in vertical nor horizontal rows. Intusannulation is slightly marked.

Variability. — It concerns the shape of pores and thickness of wall cylinder.

Remarks. — Our specimens have pores of a very well pronounced vesiculiferous shape. Pores are relatively broad at the base, later becoming constricted to swell abruptly at the end to form a spherical bladder (Pl. XII, Figs 1, 2, 3, 6). This feature is typical for the genus *Andrusoporella,* but in our specimens it is only slightly pronounced. This feature is anyway detectable in some specimens of Pia (1912, Pl. 2, Figs 22 and 26). Pores as a rule are perpendicular to the long axis, but in some cases they are oriented a little obliquely (Fig. 5). The shape of the pores of Pia's

Ladinian *Gyroporella* cf. *ampleforata* is different (1940, Pl. 6, Figs 14—16). They are enlarged consequently and there does not exist a radical difference between the handle and bladder. In some cases (Pl. XII, Fig. 15) there exist distinct narrowings. In consequence, the branches are separated in three or even four members. Intusannulation is not well pronounced, similarly as in the Bystrický's specimens. Longitudinal section, the best for observation of this feature, does not exist in our material. Some specimens are corroded (Pl. XII, Figs 1, 2, 5, 6), which results in an apparent opening of pores. Calcified membrana does not occur. This feature approaches our specimens to *Gyroporella ladinica* Bystrický, but it is an euspondyle species (arrangement of pores in horizontal rows), whereas our specimens belong to the aspondyle forms.

Stratigraphical range and geographical distribution. — *Gyroporella ampleforata* occurs in the Southern Alps in the uppermost Anisian (Upper Illyrian) (Pia 1912). Very similar specimens (*G.cf. ampleforata*) are considered by Pia (1940) as the Upper Ladinian ones. Of the same age are those in the Slovakian Karst, where they occur together with *Teutloporella herculea, Poikiloporella duplicata, Gyroporella ladinica* and *Andrusoporella fusani* (Bystrický 1964). The age of our specimens is not exactly determined due to lack of other algae. They may belong to the Uppermost Anisian or to Ladinian. The first possibility is the more probable, from the position of the fossils in the profile.

Gyroporella vesiculifera Gümbel, 1872
(Pl. XII, Figs 7—11)

1903—1908. *Gyroporella vesiculifera* Gümbel; F. Frech, Lethaea geognostica, Pl. 42, Fig. 15*a*, *b*.
1912. *Gyroporella vesiculifera* Gümbel; J. Pia, Neue Studien..., p. 35.
1920. *Gyroporella vesiculifera* Gümbel; J. Pia, Die Siphoneae..., pp. 35—37, Pl. 2, Figs 4—8.
1964. *Gyroporella vesiculifera* Gümbel; B. Sokač, et all., Fund von obertriadischen..., pp. 156—157, Figs 1, 2.
1965. *Gyroporella vesiculifera* Gümbel var. vesiculifera Zanin Buri; C. Zanin Buri, Le alghe calcaree..., p. 467, Pl. 46, 47.
1967. *Gyroporella* ex aff. *vesiculifera*; J. Bystrický, Die obertriadischen Dasycladaceen..., p. 291, Pl. 4, Fig. 4.

Material. — Five determinable sections in one thin section.

Dimensions:

	Pl. XII, Fig. 7	Pl. XII. Fig. 10	Pl. XII, Fig. 16
D (external diameter), in mm	1.571	3.000	3.143
d (internal diameter) in mm	1.107	2.000	2.393
in % D	70.45	66.67	75.68

Description. — The diameter of the calcareous body and particularly its inner diameter is very large. Number of branches in one transversal

section is rather great and they are perpendicular to the thallus. Pores have a very well pronounced vesiculiferous shape and show arrangement in two systems of rows (euspondyle feature).

Variability. — It concerns the thickness of walls, depending of calcification and the shape of vesiculiferous pores.

Remarks. — The shape of pores is perfectly vesiculiferous, the thin handle-like branch opens out into a large spherical bladder-like ending, well marked on some cross sections. This feature is comparable with Herak's specimen (1965, Pl. 15, Fig. 1) belonging to *Gyroporella* cf. *ampleforata* (comp. our Pl. XII, Figs 8,9). On the other hand, the round bladder-like endings and the very thin filiform handle (Pl. XII, Figs 7 and 10) is comparable with the shape of pores presented by Frech (1903—1908, Pl. 42, Fig. 15*b*), as well as the pores described by Herak (1965, Pl. 2, Fig. 4) in *Gyroporella maxima* Pia. A similar shape of pores is found in Bystrický's specimen (1967, Pl. 4, Fig. 4), determined as *Gyroporella* ex aff. *vesiculifera*. The arrangement of pores into a system of two rows may be recognized on the only tangential section at hand (Pl. XII, Fig. 11). The angle between two rows is a little greater than a right angle (97°) Orienta-

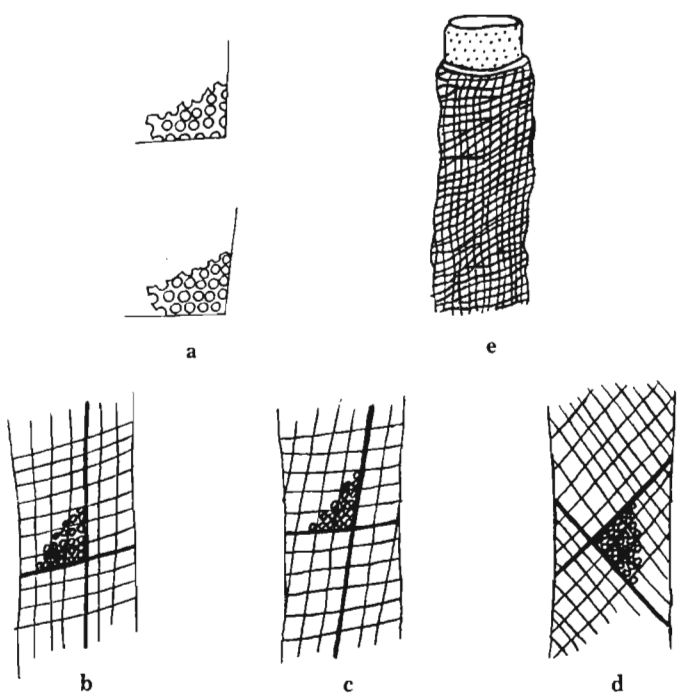


Fig. 3. Various possibilities of arrangement of group of pores of *Gyroporella vesiculifera* Gümbel, presented in Pl. XI, Fig. 11. *a* redrown fragment with rows of pores, *b* vertical arrangement of pores, *c* horizontal arrangement of pores, *d* oblique arrangement of pores (the case realised at the Zanin Buri's specimen, 1965, Pl. 46, Fig. 1), *e* vertical arrangement of pores at the Gümbel's specimen (in Frech, Pl. 42, Fig. 15*a*).

tion of this arrangement of pores in the calcareous wall is unknown (Text-fig. 3). Nevertheles, it is worth noting that the arrangement of pores on the described section (Pl. XII, Fig. 11) could easily be referred to the oblique arrangement of pores of *Gyroporella vesiculifera* Gümb. var. *vesiculifera* Zanin Buri (Zanin Buri, 1965, p. 467, Pl. 46, Fig. 1, the lower portion of the illustrated specimen; Pl. 47, the long specimen in the middle and the fragment of tangential section near the right margin in the upper part of this photo). In Zanin Buri's specimens pores are alternating — a feature also present on the described tangential section. On the other hand, a different arrangement of pore rows is possible. In Frech's specimen (Pl. 42, Fig. 15*a*) there is a general vertical orientation of pores with subordinate oblique arrangement. Vertical orientation of pore rows is mentioned also by Pia (1920), as characteristic for *Gyroporella vesiculifera*. Although a detailed determination of arrangement of pore rows in our material is not possible, the euspondyle arrangement of pores typical for *Gyroporella vesiculifera* is not in doubt.

The calcification of our specimens is very regular and the wall of cylinder relatively large. This feature distinguishes our specimens from the majority of described forms, where calcification is rather limited to the final bladder (comp. specimens of Sokač, Nikler & Ivanovič 1964, as well as that of Zanin Buri, 1967). The thick wall of cylinder with both preserved bladders and handles of vesiculiferous pores, approaches our specimens to the specimen of Herak (1965, Pl. 15, Fig. 1), determined by him as *Gyroporella* cf. *ampleforata* Gümb.

Stratigraphical range and geographical distribution. — *Gyroporella vesiculifera* is an excellent index form of the Norian in the Southern Alps (particularly environs of the Garda Lake), where it was determined by Gümbel (1872) and by Pia (1912, 1920). *Gyroporella vesiculifera* var. *vesiculifera* occurs in the Norian of the Lombardian Alps (among others near Bergamo), sometimes with *Griphoporella curvata*, and in the South-Tyrolian Main Dolomite. The second locality is Velebit in Yougoslavia (Sokač, Nikler & Ivanovič, 1964), where this species occurs together with *Griphoporella curvata* (Gümb.). The occurence of this species in Slovakian Karst, mentioned by the older investigators, was not confirmed by Bystrický (1964). It was found by him in the Dachstein limestone in the Muran Plateau and belongs here to the Uppermost Norian — the basis of Rhaetic (Bystrický, 1967). In this case, the discovery of *Gyroporella vesiculifera* Gümb. in Bulgaria makes it the fourth site in Europe and indicates that Bulgaria belonged to the warm meridional province in the Norian stage. The position of fossils confirmed the Norian age of limestones containing these algae and confirms the Norian age of the above lying dolomites in the Zessidern profile, covered by the Rhaetic conglomerates.

STARTIGRAPHICAL AND PALAEOGRAPHICAL SIGNIFICANCE OF DESCRIBED DASYCLADACEAE

Among the described Dasycladaceae the most important is a group of *Physoporella praealpina.* These physoporellas with two-row pyriform pores are known from Bosnia, where they were described together with *Physoporella pauciforata* (Pia, 1935) — the same association as in Bulgaria — and from the Slovakian Karst (Southern Slovakia — Bystrický 1964), also with the same floristic association. In these two places this flora determines the Middle Anisian (Pelsonian) and Upper Anisian (Illyrian). In the Bulgarian material the most remarkable feature is the complete lack of *Diplopora annulatissima,* usually appearing together with the *Physoporella* assemblage. This is why our physoporellas are probably characteristic for the Pelsonian.

Physoporella praealpina together with *Ph. pauciforata* and *Diplopora annulatissima* is determined from the High-Tatric series from the Tatra Mts. (Kotański *in* Bac & Grochocka 1965; Kotański *in* Piotrowski 1965; Kotański 1967). They represent Illyrian.

Very well known flora with *Physoporella praealpina* is characteristic for the Briansonian series of the Western Alps (Ellenberger 1958). These forms are very well correlated with the *Ph. praealpina* specimens, decribed for the first time by Pia (1920) on the F. Rabowski's materials. The type locality of *Ph. praealpina* is exactly in Préalpes, forming a facial analogy to the Briansonian series.

Ellenberger (1958) has stressed many times the strong faunistic analogies between the Briansonian — Préalpian provinces and the Upper-Silesian province. After the tentative revision of the dasycladacean flora from Upper-Silesia, the first of the present authors (Z. Kotański) is of the opinion, that the specimens determined by Pastwa-Leszczyńska and Śliwiński (1960) as *Diplopora annulata* var. *physoporelloidea* and *Diplopora* n.sp. are in reality *Physoporella praealpina* and *Ph. minutula,* respectively. From the floristical point of view the Upper-Silesian province was very strictly connected with the High-Tatric zone on one hand, and with the Briansonian-Préalpine province on the other hand. The facial analogies between the High-Tatric and Briansonian series were stressed by various authors (a.t. Kotański, 1959, 1964; Debelmas 1960).

The Bulgarian *Ph. praealpina* assemblage is very similar to the High-Tatric — Upper Silesian — Briansonian — Préalpian forms, which determines the rather external alpine character of this assemblage. This character depends probably on the palaeotectonic conditions — in all cases the substratum was rather rigid and the tectonic régime was subplatformian (Briansonian platform, High-Tatric platform) and even platformian (Mesean platform and its large periferies in Bulgaria).

The Bulgarian material confirms the former conclusion of Ellenberger (1958) that the three species forming *Physoporella praealpina* group (*Ph. praealpina*, *Ph. dissita* and *Ph. minutula*) are closely related. They appear together in the same thin section (and together with *Ph. praealpina*), forming the real *Physoporella praealpina* microfacies (Pl. XIII). Their geological age in reality is the same. In many cases species determination is difficult. May be, the differences between these three species are of the same value as the differencies between particular varieties in *Physoporella pauciforata*, introduced by Pia (1935) and Bystrický (1964). In any case, it doesn't seem possible that these three species, belong to the same species, *Physoporella praealpina* Pia, and that *Ph. minutula* forms the juvenile stade of *Ph. praealpina*, as considered by Ellenberger (1958).

It is worth mentioning that in Bulgaria the Ladinian dasycladacean algae hasn't been found as yet. *Gyroporella* cf. *ampleforata* is probably the Uppermost Anisian species, but it could represent the Ladinian species. In this case, very conspicuous is the lack of other Ladinian forms, as *Diplopora annulata* or *Teutloporella herculea* but future investigations may change this situation.

Gyroporella vesiculifera, a rather rare species, is one of the most stratigraphically and palaeogeographically important Triassic algae. It is an index fossil of the Norian from the Southern Alps, Dinarides, and from the southermost series in the West Carpathians. Their appearance in the Bulgarian Triassic indicates the close connection of the Bulgarian Upper Triassic sea with the Alpine and Dinarian seas. It is the last trace of the Alpine influence in the Bulgarian Triassic sea. The Rhaetic beds have rather an epicontinental, platform character and display many analogies with the Rhaetic beds of the Polish Lowland.

Z. Kotański
Laboratory of Geological Synthesis
Department of Geological Structures
of Polish Lowland
Geological Institute
Warszawa, ul. Rakowiecka 4, Poland
November, 1972

G. A. Čatalov
Geological Institute
Sofia 13, Str. "36" kv. Geo Milev, Bulgaria
November, 1972

REFERENCES

BAC M. & GROCHOCKA K. 1965. Budowa fałdu Czerwonych Wierchów na wschodnim zboczu Doliny Kościeliskiej w Tatrach. (La structure du pli de Czerwone Wierchy sur le versant est de la vallée Kościeliska) — *Acta Geol. Pol.*, **15**, 331—349, Warszawa.

BOTTERON G. 1961. Étude géologique de la région du Mont d'Or (Préalpes romandes). — *Ecl. Geol. Helv.*, **54**, 1, Basel.

BYSTRICKÝ J. 1957. Prispevok k poznaniu diplopor triasu gemerid. — *Geol. Sbornik*, **8**, 2, Bratislava.

— 1964. Slovenský Kras. Stratigrafia a Dasycladaceae mezozoika Slovenského krasu. — Bratislava.

— 1966. La stratigraphie et les Dasycladacées du Trias moyen de la série du Drienok. — *Geol. Sbornik Slov. akad. vied.*, **17**, 2, Bratislava.

— & Veizer J. 1965. Tradische Dasycladaceen in der Hochtatrischen Hüllen-Serien der Hohen Tatra. — *Geol Sborn. Slov. akad. vied.*, **16**, 1, Bratislava.

ČATALOV G. A. 1970. Lithostratigraphy of the Triassic sediments in the Teteven anticlinorium. — *Rev. Bulg. Geol. Soc.*, **31**, 2. Sofia.

DEBELMAS J. 1960. Comparaison du Trias haut-Tatrique avec celui des Alpes occidentales. Zone intra-alpine. — *Acta Geol. Pol.*, **10**, 2, Warszawa.

ELLENBERGER F. 1958. Étude géologique du pays de Vanoise. Paris.

FRECH F. 1903—1908. Lethaea geognostica. 2 Teil. Das Mesozoicum. Bd. I: die Trias, 623 pp. Stuttgart.

GÜMBEL C. W. 1872. Die sogenannten Nulliporen (Lithothamnium und Dactylopora) und ihre Betheiligung an der Zusammensetzung der Kalkgesteine. Zweiter Theil: Die Nulliporen des Thierreiches (Dactyliporideae) nebst Nachtrag zum ersten Theile. — *Abh. Bayer. Akad. Wiss.*, **11**, 1, München.

HERAK M. 1958. The Dasyclad genus Physoporella on the Anisian of Yugoslavia. — *Journ. Palaeont. Soc. India*, **3**, Lucknow.

— 1965. Comparative study of some Triassic Dascladaceae in Yugoslavia. — *Geol. Vjesnik Inst. Geol. Istraž.* **18**, 1(1964), Zagreb.

HURKA H. 1967. Variationsstatistische Untersuchungen an anisischen Dasycladaceen aus den Pragser Dolomiten in Südtirol. — *N. Jb. Geol. Paläont. Abh., B.* **128** H. 1 Stuttgart.

— 1967. Umbildungstendenzen der Astformen in Physoporella-Oligoporella-Populationen (Dasycladaceen) aus dem Anis der Pragser Dolomiten (Italien). — *N. Jb. Geol. Paläont. Mh., Jg.* H. 2., Stuttgart.

KOTAŃSKI Z. 1959. Stratigraphy, sedimentology and palaeogeography of the high-tatric Triassic in the Tatra Mts. (Stratygrafia, sedymentologia i paleogeografia triasu wierchowego w Tatrach) — *Acta Geol. Pol.*, **9**, 2, 113—144, Warszawa.

— 1964. Remarques sur le trias briançonnais des Alpes occidentales et sa comparaison avec le trias haut-tatrique des Tatras. — *Bull. Acad. Pol. Sci.*, **12**, 2, Varsovie.

— 1967. Palaeontological basis of Triassic stratigraphy in the Tatra Mts. — *Geol. Sbornik*, **18**, 2, Bratislava.

— 1973. Triasowe glony wapienne w Polsce. — Atlas skamieniałości polskich (in press).

MICHARD A. 1962. Premières données paléontologiques et stratigraphiques sur le Trias du Massif Maira Grana (Alpes Cottiennes méridionales). — *Boll. Soc. Italiana*, **80**, 4(1961).

OGILVIE GORDON M. M. 1943. Geologie von Cortina d'Ampezzo und Cardore.-*Jahrb. Geol. Bund.*, **84**, Wien.

PASTWA-LESZCZYŃSKA C. & ŚLIWIŃSKI S. 1960. Występowanie glonów (Dasycladaceae) w dolomitach kruszconośnych okolic Chrzanowa. — *Kwart. Geol.*, **3**, 679—699, Warszawa.

PERŽEL M. 1966. Stratigraphie der Trias der Chocdecke des Biele pohorie der Malé Karpaty. — *Geol. Sbornik Slow. akad. vier*, **17**, 1, Bratislava.

PIA J. 1912. Neue Studien über die tradischen Siphoneae verticillatae. — *Beitr. Geol. Pal. Österr.-Ung. Orient*, **25**, Wien.

— 1920. Die Siphoneae verticillatae vom Karbon bis zur Kreide. — *Abh. Zool.-Bot. Gesellsch.*, **11**, 2, Wien.

— 1935. Die Diploporen der Anisischen Stufe Bosniens. — *Ann. Géol. Pen. Balk.*, **12**, 2, Beograd.
— 1940. Die gesteinbildenden Algen des Höllengebirges. — *Jahrb. Ver. Land. Heim. Gau Oberdonau*, Linz.
PIOTROWSKI J. 1965. Trias środkowy masywu Kominów Tylkowych i jego tektonika. (Le Trias moyen et la tectonique du massif de Kominy Tylkowe). — *Acta Geol. Pol.*, **15**, 3, 355—386, Warszawa.
SOKAČ B., NIKLER L. & IVANIVIĆ A. 1964. Fund von obertriadischen Dasycladaceen im Gebiet des Velebit. — *Bull. Sci. Conseil Acad. RSF Yougoslavie*, 9, 6, Zagreb.
STEINMANN G., 1903. Einführung in die Paläontologie. Leipzig.
ZANIN BURI C. 1965. Le alghe calcaree delle Prealpi Lombarde. — *Riv. Ital. Paleont.*, **71**, 2, Milano.

ZBIGNIEW KOTAŃSKI & GEORGY A. ČATALOV

TRIASOWE DASYCLADACEAE Z CENTRALNEGO BAŁKANU I Z PRZEDBAŁKANU W BUŁGARII

Streszczenie

Glony wapienne z grupy Dasycladaceae nie były dotychczas znane z triasu bułgarskiego. Ostatnio zostały one znalezione przez drugiego z autorów w kilku punktach w Centralnym Bałkanie (Stara Płanina), na Przedbałkaniu i na SW od Sofii (Text-fig 1). Najliczniejsze są Dasycladaceae w górnej części doliny Czerni Ossum w Centralnym Bałkanie (Text-fig. 2). Jak wynika z oznaczeń pierwszego z autorów, najliczniejszy zespół tworzą tu środkowoanizyjskie Dasycladaceae z rodzaju *Physoporella*, które są organizmami skałotwórczymi (Pl. VIII). Znacznie rzadsze są Dasycladaceae z rodzaju *Gyroporella* (*Gyroporella* cf. *ampleforata* (Gümbel) Pia). W profilu Zessidren (antyklinorium teteweńskie) występuje ponadto gatunek *Gyroporella vesiculifera* (Gümbel) Pia, przewodni dla noryku.

Opisane glony z rodzaju *Physoporella* należą do dwóch grup: do grupy *Physoporella praealpina* i do grupy *Ph. pauciforata*. Do grupy *Physoporella praealpina* należą trzy gatunki: *Ph. praealpina* Pia, *Ph. dissita* (Gümbel) Pia i *Ph. minutula* (Gümbel) Pia. Wyróżniono nową odmianę, *Ph. prealpina* var. *sulcata*, która różni się od *Ph. praealpina* var. *praealpina* skośnym ustawieniem por i obecnością ukośnych szczelin, oddzielających okółki por ułożonych w podwójne rzędy. Do grupy *Ph. pauciforata* należy gatunek *Physoporella pauciforata* z trzema odmianami — *Ph. pauciforata* var *pauciforata* Bystrický, *Ph. Pauciforata* var. *sulcata* Bystrický i *Ph. pauciforata* var. *undulata* Pia. Cały ten bogaty zespół physoporell, typowy dla środkowego anizyku (pelsonu) i górnego anizyku (illyru) Bośni, Słowackiego Krasu i serii wierchowej w Tatrach, w Bułgarii należy zapewne tylko do pelsonu, gdyż nie występuje tu obok physoporell typowy dla illyru gatunek *Diplopora annulatissima*, obecny we

wszystkich wymienionych obszarach. Grupa *Physoporella praealpina* jest szczególnie typowa dla Alp Zachodnich — dla Prealp i dla serii briansońskiej, gdzie także reprezentuje illyr. Grupa ta jest również reprezentowana w triasie górnośląskim, co wynika z dokonanej ostatnio przez pierwszego z autorów prowizorycznej rewizji dawnych oznaczeń. Grupa ta jest zatem szczególnie charakterystyczna dla zewnętrznych stref alpejskich i dla górnośląskiej strefy zbiornika germańskiego, gdzie wpływy morza alpejskiego były najsilniejsze. Silny rozwój tej grupy glonów wapiennych również w Bułgarii można tłumaczyć warunkami paleotektonicznymi podobnymi do warunków w strefie zewnętrznej Alp, gdyż we wszystkich tych przypadkach była to strefa paraplatformowa.

Znaleziska *Gyroporella vesiculifera* Gümbel należą do rzadkości. Jest on dotychczas znany tylko z noryckiego dolomitu głównego Alp Południowych, z Welebitu w Jugosławii i z Płyty Murania w Słowacji. Występowanie tego gatunku w Bułgarii świadczy o bezpośrednich powiązaniach bułgarskiego morza noryckiego z ciepłym morzem dynarskim i alpejskim. Były to już ostatnie wpływy facji alpejskiej, gdyż retyk północnej Bułgarii ma już charakter germański, wykazując pewne analogie do retyku z Niżu Polskiego.

ЗБИГНЕВ КОТАНЬСКИ & ГЕОРГИ А. ЧАТАЛОВ

ТРИАСОВЫЕ DASYCLADACEAE ЦЕНТРАЛЬНОГО БАЛКАНА И ПРЕДБАЛКАНА В БОЛГАРИИ

Резюме

Известковые водоросли группы Dasycladaceae до сих пор не были известны в триасе Болгарии. В последнее время они были найдены вторым из авторов в нескольких точках Центрального Балкана (Стара-Планина), Предбалкана и юго-западнее Софии (фиг. 1). Наиболее многочисленные Dasycladaceae наблюдались в верхней части долины р. Черни-Осым в Центральном Балкане (фиг. 2). Согласно определениям, произведенным первым из авторов, самое богатое сообщество составляют среднеанизийские Dasycladaceae рода *Physoporella*, являющиеся породообразующими организмами (табл. VIII). Значительно реже встречаются Dasycladaceae рода *Gyroporella* (*Gyroporella* cf. *ampleforata* (Gümbel) Pia). В разрезе Зессидрен (Тетевенский антиклинорий) представлен, кроме того, руководящий вид норийского яруса — *Gyroporella vesiculifera* (Gümbel) Pia.

Водоросли рода *Physoporella* принадлежат к двум группам: *Physoporella praealpina* и *Ph. pauciforata*. К группе *Physoporella praealpina* относятся три вида:

Ph. praealpina Pia, *Ph. dissita* (Gümbel) Pia и *Ph. minutula* (Gümbel) Pia. Определена новая разновидность — *Ph. praealpina* var. *sulcata*, которая отличается от *Ph. praealpina* var. *praealpina* косым расположением пор и наличием косых щелей, отделяющих мутовки пор, распределенные двойными рядами. К группе *Ph. pauciforata* относится вид *Physoporella pauciforata* с тремя разновидностями: *Ph. pauciforata var. pauciforata* Bystrický, *Ph. pauciforata* var. *sulcata* Bystrický и *Ph. pauciforata* var. *undulata* Pia. Весь этот обильный комплекс фызопорелл, характеризующий среднеанизийский (пелсон) и верхнеанизийский (иллирий) подъярусы Боснии, Словацкого Карста и верховой серии в Татрах, относится в Болгарии, как кажется, единственно к среднеанизийскому подъярусу, так как здесь рядом с фызопореллами не встречается типичный верхнеанизийский вид *Diplopora annulatissima*. Группа *Physoporella praealpina* особенно характерна в Западных Альпах — в Предальпах и Брианconской зоне, где она тоже определяет иллирий. Эта группа представлена также в триасе Верхней Силезии, как можно судить по данным пересмотрения прежних определений, проведенного первым из авторов. Таким образом, эта группа является особенно характерным показателем в пределах внешних альпийских зон и Верхнесилезской зоны германского бассейна, в котором наиболее сильно проявлялись влияния альпийского моря. Буйное развитие этой группы известковых водорослей в Болгарии было обусловлено, по-видимому, сходными палеотектоническими условиями в сопоставлении с обстановкой во внешней зоне, так как все эти места представляли параплатформенную зону.

Находки *Gyroporella vesiculifera* Gümbel являются редкостью. Этот вид до сих пор наблюдался единственно в главном доломите норийского возраста в Южных Альпах, в районе хребта Велебит в Югославии и на плите Мурань в Словакии. Распространение этого вида на площади Болгарии свидетельствует о непосредственном сообщении между болгарским норийским морем и теплыми динарским и альпийским морями. Это были последние влияния альпийской фации, так как рэт Северной Болгарии характеризуется уже германскими признаками и обладает некоторым сходством с рэтом Польской низменности.

EXPLANATION OF PLATES

All material presented in thin sections

Plates VI—XI: Pelsonian of Staneto, S of Troyan. Slates No 255—205—IX.
Plate XII: Uppermost Anisian-Ladinian of Staneto, S of Troyan. Slates No 263—209—IX (Figs 1—6).
Norian of Lessidren, S of Teteven. Slates No 263—209—IX (Figs 7—11).
Plate XIII: Pelsonian of Staneto, S of Troyan. Slate No 54-70-VI.

Plate VI

Figs 1—12. *Physoporella praealpina* Pia. 1, 12 longitudinal sections; 2, 3, 5, 7—9 longitudinal oblique sections; 6 longitudinal tangential section; 11 longitudinal slightly oblique section; 4 transverse oblique section; 10 transverse slightly oblique section.

All figures × 12

Plate VII

Figs 1—17. *Physoporella praealpina* Pia.

Figs 18, 19. *Physoporella praealpina* var. *sulcata* var. nov. 10, 19 longitudinal sections; 1, 3, 4, 6, 7, 9, 12, 13, 16—18 longitudinal oblique sections; 15 longitudinal tangential section; 2, 5, 8, 11, 14 transverse oblique sections.

All figures × 12

Plate VIII

Figs 1—22. *Physoporella dissita* (Gümbel) Pia.

1—6, 10, 17, 18, 21, 22 longitudinal oblique sections; 8, 9, 12, 13 longitudinal tangential sections; 7, 11, 19, 20 transverse oblique sections.

All figures × 12

Plate IX

Figs 1—35. *Physoporella minutula* (Gümbel) Pia.

3, 5, 8, 12, 25 longitudinal sections; 2, 4, 6, 9, 11, 13, 15, 16, 18, 21, 22, 24, 26, 27, 30, 31 longitudinal oblique sections; 1, 19 longitudinal tangential sections; 7, 10, 14, 17, 20, 23, 28, 29, 32—35 transverse oblique sections.

All figures × 12.

Plate X

Figs 1—6. *Physoporella pauciforata* (Gümbel) Steinmann var. *pauciforata* Bystrický. 1, 2, 4, 6 longitudinal sections; 3 longitudinal oblique section; 5 transverse oblique section.

Figs 7—11. *Physoporella* sp. Transverse oblique sections.

Figs 12—17. *Physoporella pauciforata* (Gümbel) Steinmann var. *undulata* Pia. 12—16 longitudinal oblique sections; 17 longitudinal section.

All figures × 12.

Plate XI

Figs 1—15. *Physoporella pauciforata* (Gümbel) var. *sulcata* Bystrický. 1, 3—5, 9, 13, 15 longitudinal oblique sections; 2, 6—8, 10—12, 14 longitudinal sections.

Fig. 16. *?Griphoporella* sp. Transverse oblique section.

Fig. 17. *Teuloporella* sp. Longitudinal tangential section.

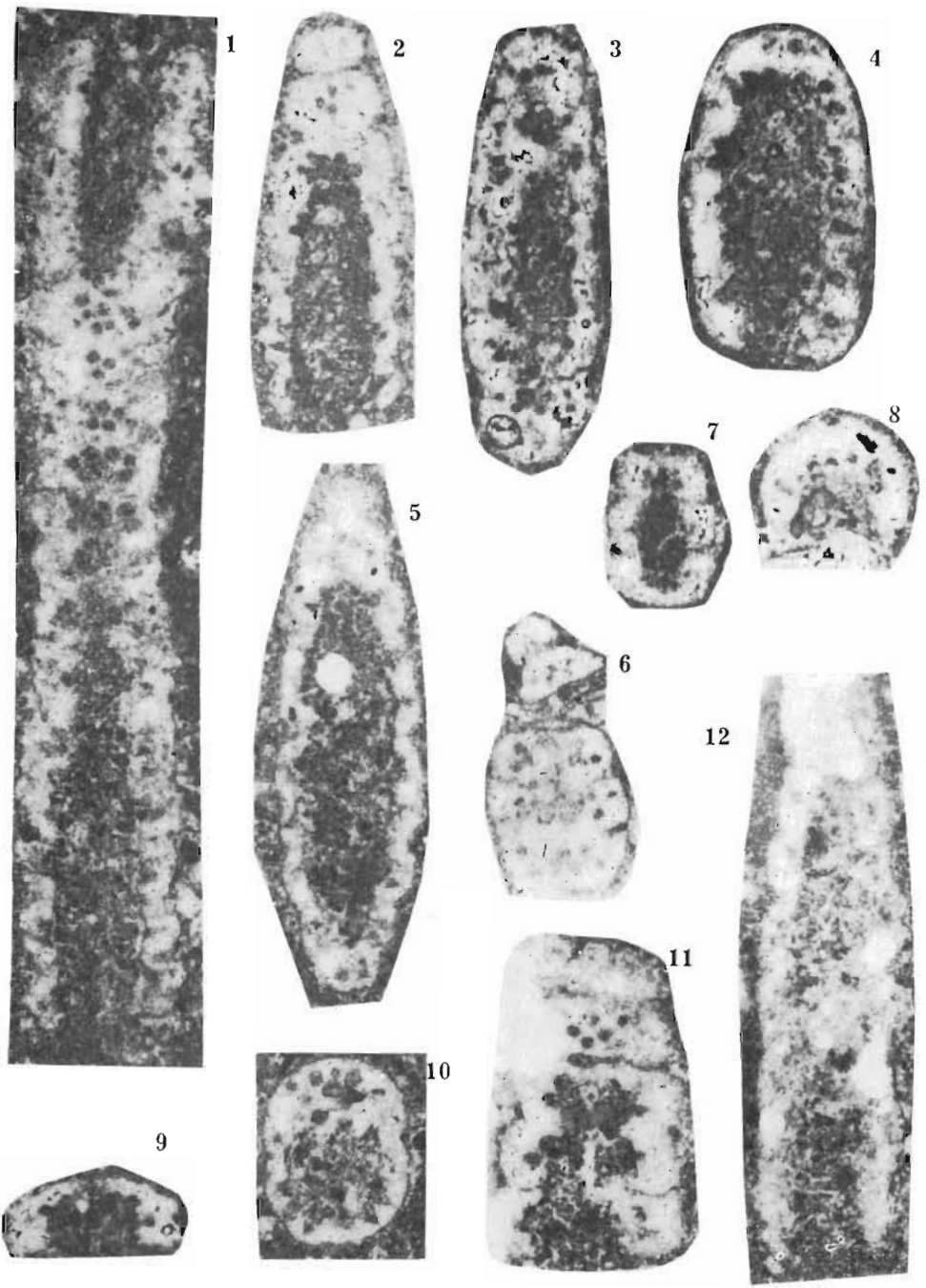
All figures × 12.

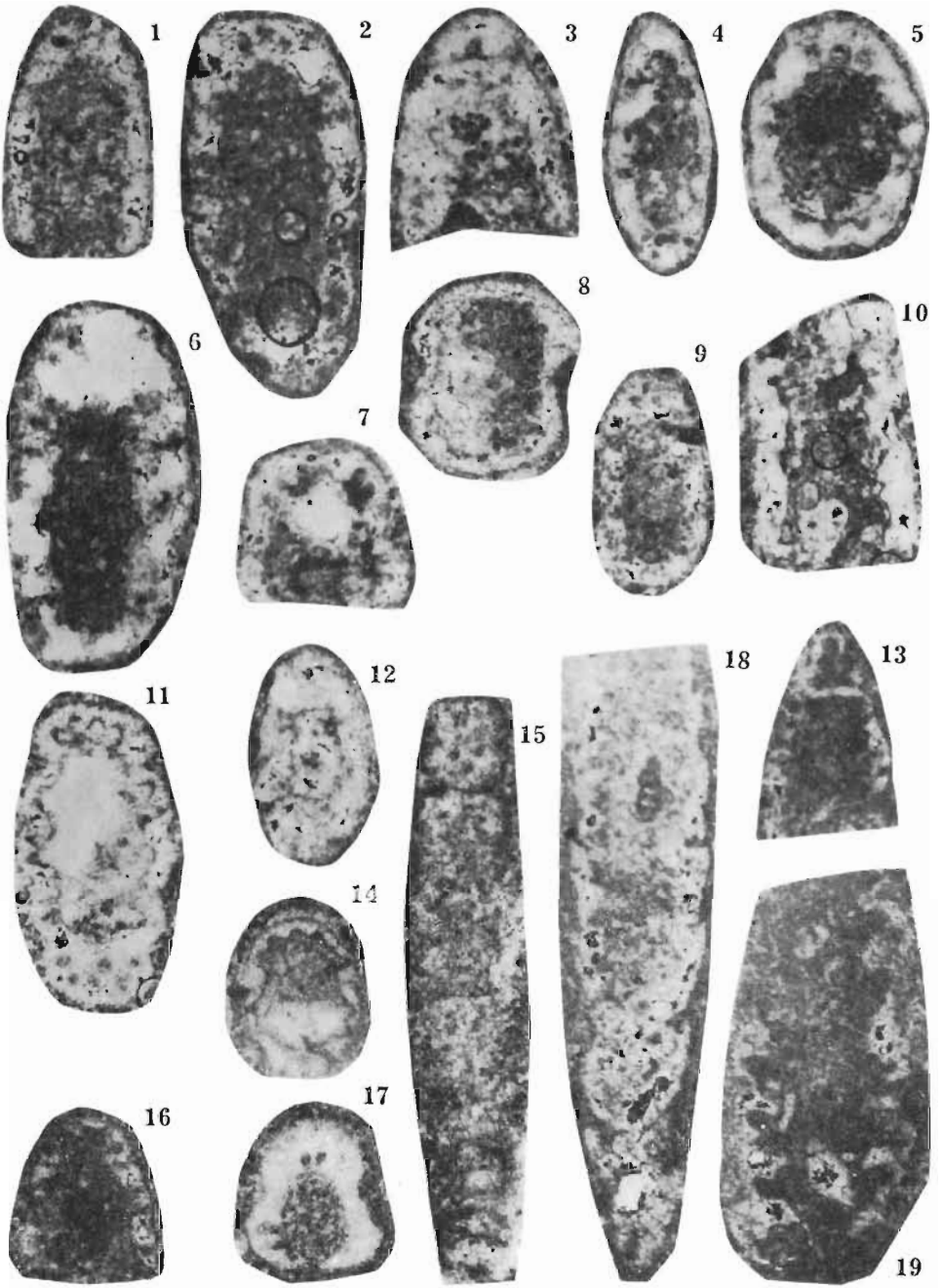
Plate XII

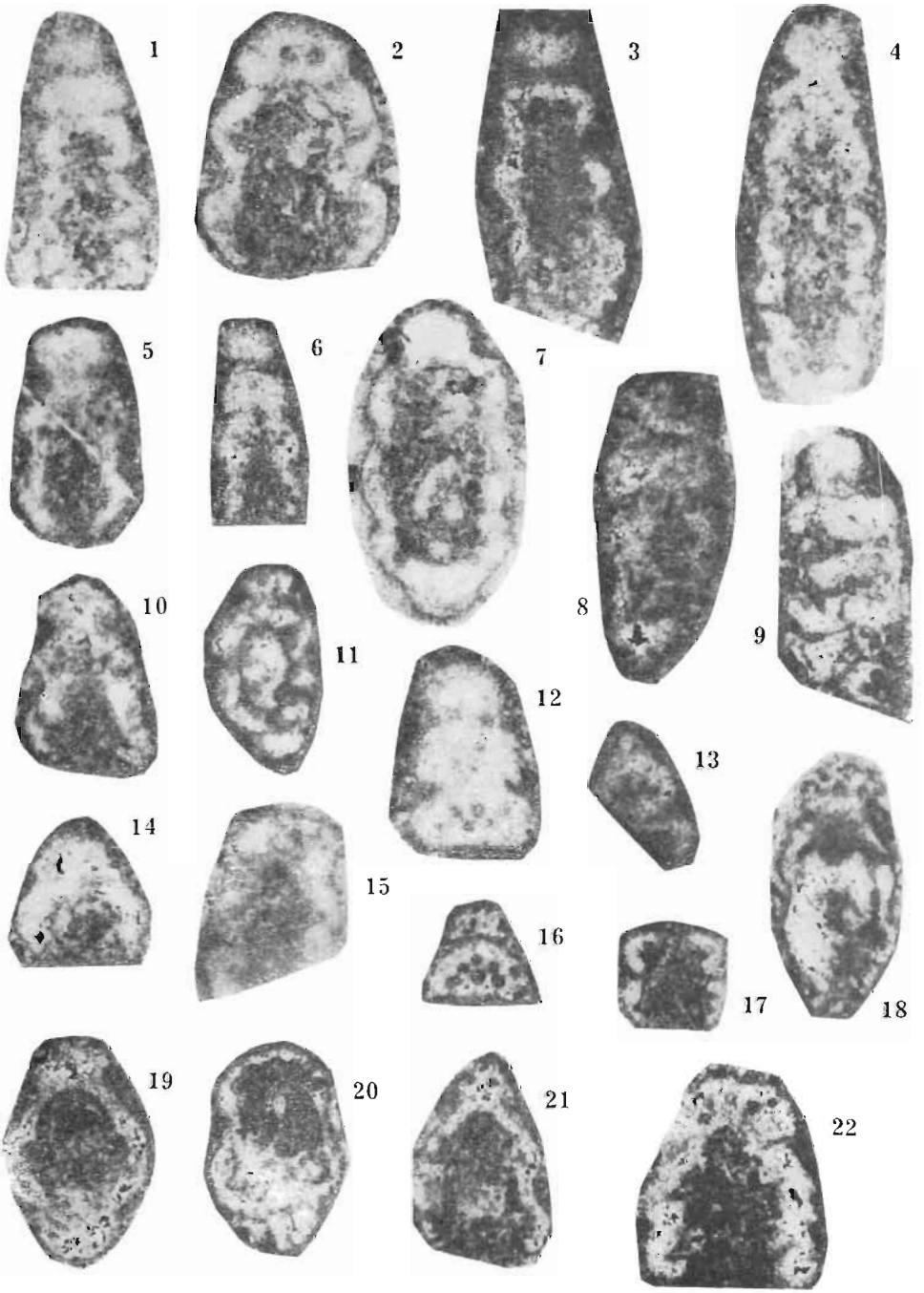
Figs 1—6. *Gyroporella* cf. *ampleforata* Gümbel. Transverse sections, × 22.
Figs 7—11. *Gyroporella vesiculifera* Gümbel.
7—10 transverse sections; 11 tangential section. Fig. 8 × 16; Figs 9—11 × 14.

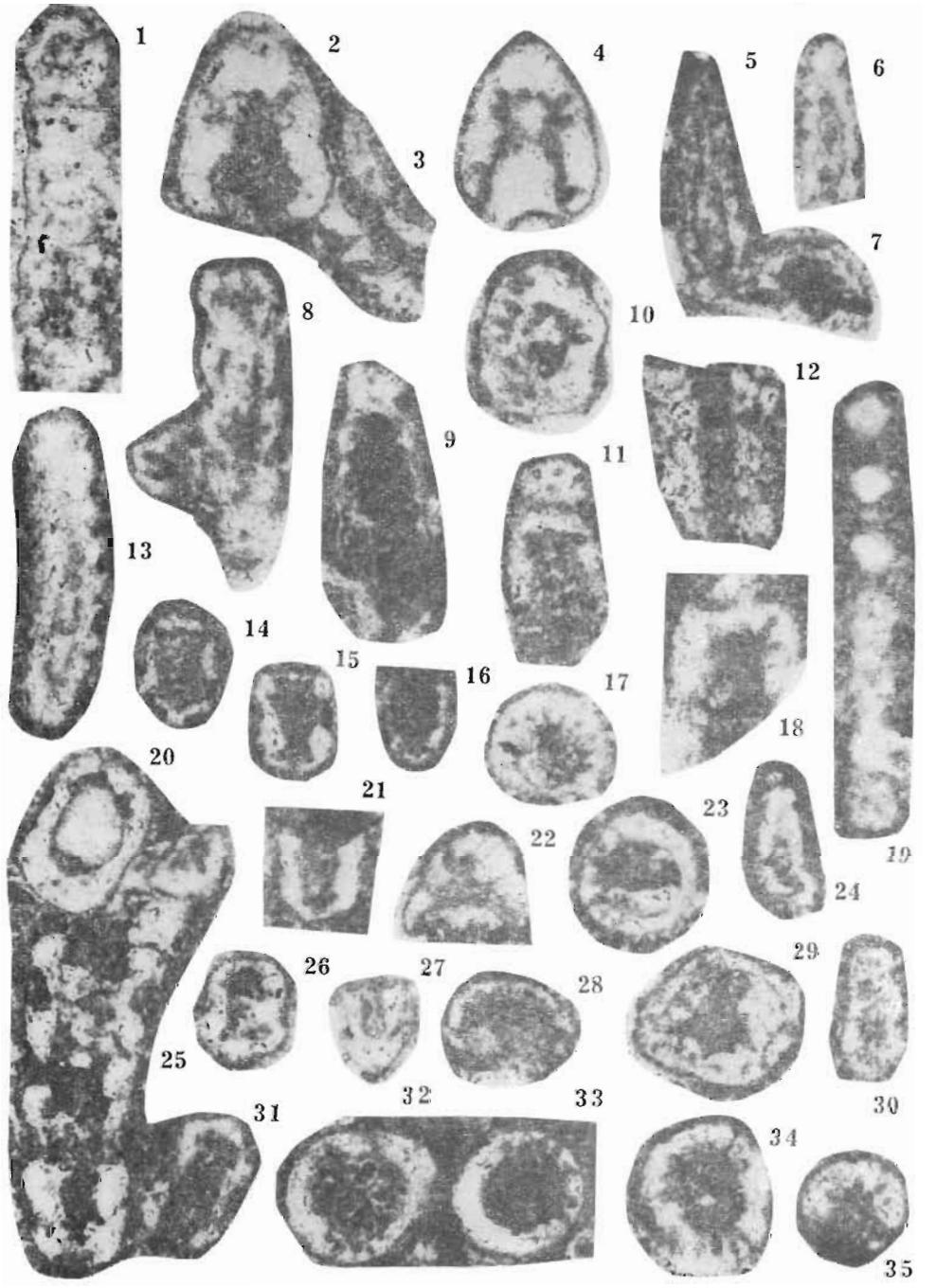
Plate XIII

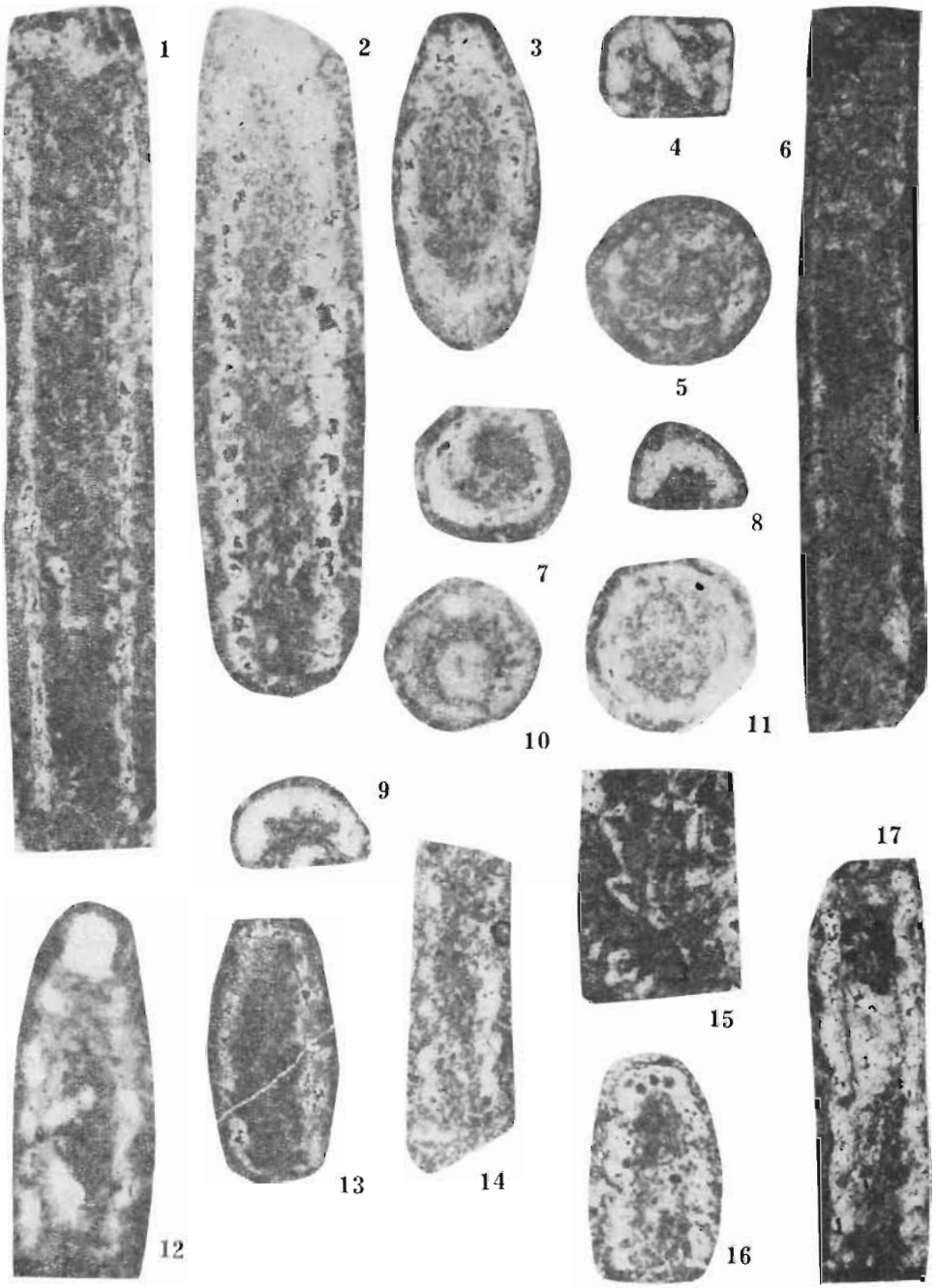
Physoporella microfacies. × 6.

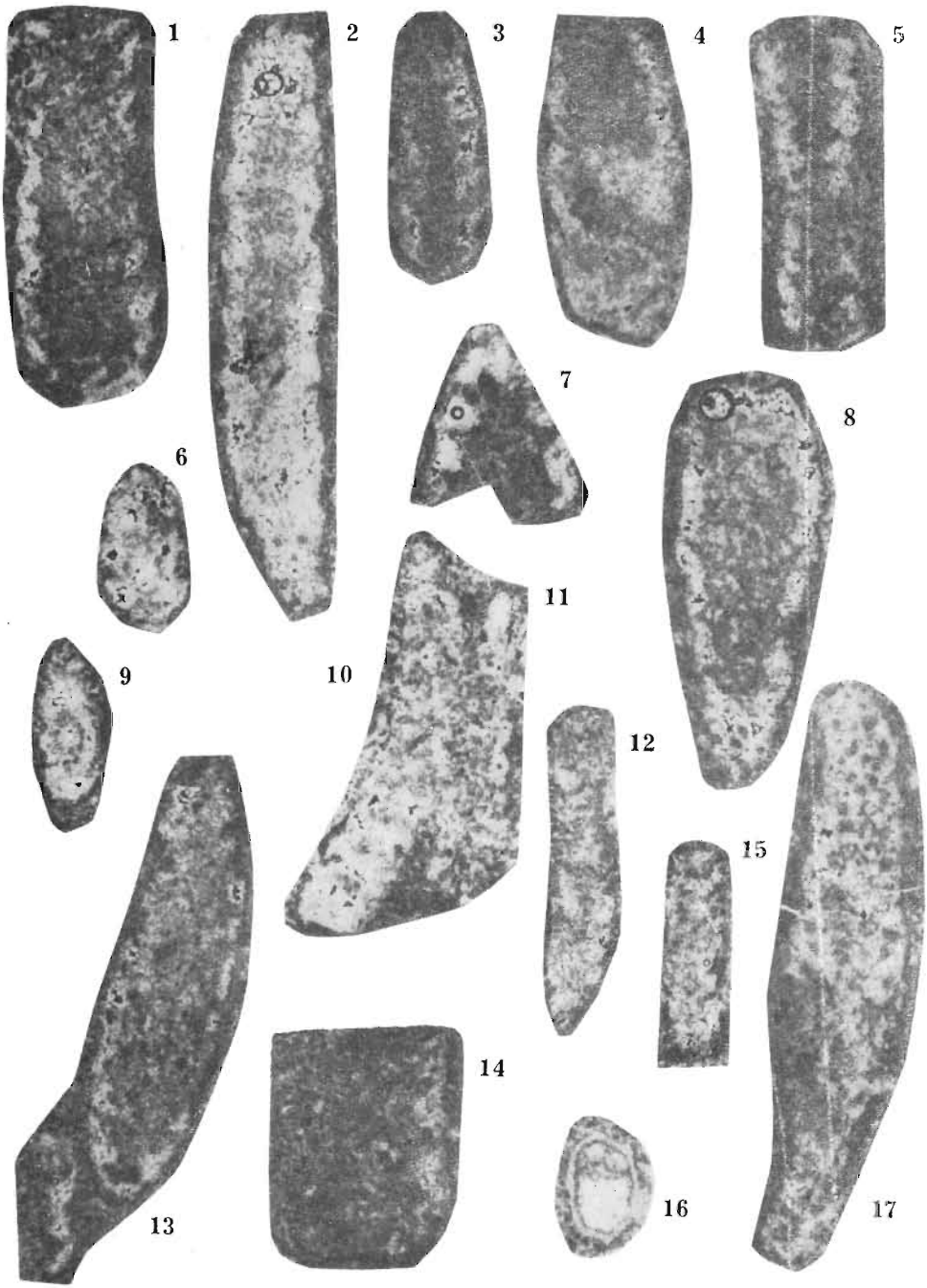

1
2
3
4
5
6
7
8
9
10
11
12

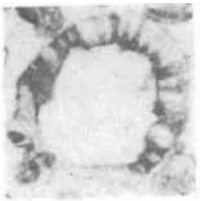

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

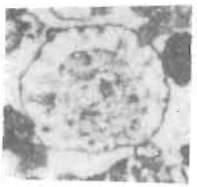

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35


1
2
3
4
6
5
8
7
10
11
9
17
15
12
13
14
16

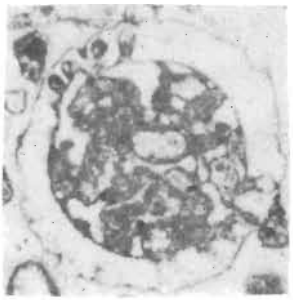

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17



1



2



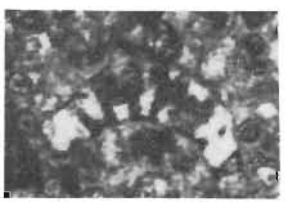
3

4

5

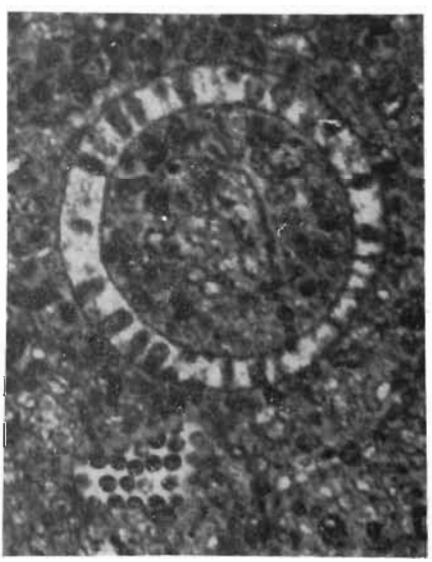
6

7



8

9



10

11