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GYMNOCODIACEAN CALCAREOUS ALGAE IN THE PERMIAN OF YUGOSLAVIA

With 6 plates and 1 tabulated list

ABSTRACT

Gymnodiacean fossil remains in Yugoslav Permian sediments are described. They are attributed to the species *Gymnocodium bellerophontis*, *Gymnocodium* ? sp., *Permocalculus fragilis*, *P. tenellus*, *P. aff. tenellus*, *P. cf. plumosus* and *Permocalculus* sp. As to the species *P. moniliformis* and *P. solidus*, suggestions were given to unite them with *P. fragilis*. Consequently, the emendation of its diagnostic description is proposed. Concerning the geological duration it is to be mentioned that *Gymnocodium bellerophontis* and *Permocalculus tenellus* appeared already in the Lower Permian. Their remains were recorded in the equivalents of »Rattendorfer Schichten« in the Carnian Alps.

INTRODUCTION

During our investigations of the Dasyclad calcareous algae from the Young Palaeozoic of Yugoslavia, which is being referred to in this number of »Geološki vjesnik«, we encountered also numerous thin-sections of different Gymnodiacean calcareous algae. These fossil algae were from time to time transferred from one algal group to another (*Dasycladaceae*, *Codiaceae* and *Chaetangiaceae*). At least Elliot (1955) established an independent family in status equal to the *Chaetangiaceae*. In this paper we are following him in treating the Gymnodiacean algae as a family.

As already mentioned in connexion with Dasyclad algae, samples were collected by numerous explorers. Among them are to be mentioned M. Salopek and his assistants, further A. Ramovš, V. Kostić, N. Pantić, M. Miladinović, and at last V. Kochanski.

Besides, M. Herak had the opportunity to study the original specimens from J. Pia's collection. We are indebted to Dr. E. Gsche, Chief of the Geological Department of the Museum of the Natural History, Basle, for making that possible.

The slides, with the exception of those in J. Pia's collection, are kept in the collection of the Geological and Palaeontological Institute of the University of Zagreb.

SISTEMATIC DESCRIPTIONS

Family: *Gymnocodiaceae* Elliot 1955.

The fossil remains of this family were divided by Elliot (1955) into two groups in the rank of genus. For the first group he retained the name *Gymnocodium*, while for the second group he proposed the name *Permocalculus*.¹

Genus *Gymnocodium* Pia 1920 ex Elliot 1955

The thallus is segmented or unsegmented. The segments or ^{jedini}units show varying size, form and degree of calcification. The pores are situated obliquely to the main axis and are widened outwards. The sporangia are internal.

1927. *Gymnocodium bellerophontis*, Ogilvie Gordon, Abh. geol. B. A. 24, 2, pp. 69-71, Textfig. 1-4, pl. 9, fig. 7, pl. 10, figs. 1-3, pl. 13, figs. 4, 5.
1934. *Gymnocodium bellerophontis*, Heritsch, Vesnik geol. inst. Beograd, 3, p. 15-16, pl. 2, figs. 16², 17, 18, 20.
1937. *Gymnocodium bellerophontis*, Pia, 2^e. Congr. Stratigr. carbon.; Herleen 1935, C. R., 2, p. 882-883, pl. 11, figs. 1-6.
1953. *Gymnocodium bellerophontis*, Kochansky-Devidé, Geol. vjesnik, Zagreb, 5-7, p. 296, pl. 2, figs. 1, 2.
1955. *Gymnocodium bellerophontis*, Elliot, Micropaleontology, New York, 1, No 1, p. 85, pl. 1, figs. 3-7.
1956. *Gymnocodium bellerophontis*, Accordi, Journ. Palaeont. Soc. India, 1, pp. 82-83, pl. 7, fig. 1; pl. 8, fig. 4; pl. 9, fig. 4; pl. 11, figs. 1-9.

Fragments of a number of fossil remains are generally in accordance with the existing descriptions of this species. The form of the thallus is highly varied; exceptionally are to be found straight and very long tubular fragments. Such a fragment, reproduced on Pl. I, Fig. 1, measures 18 mm. in length. More often fragments of irregular form are preserved, which are partially constricted or expanded, sometimes curved. The thickness of the calcareous wall and the diameter of the cortical pores are relatively great. The widening of the pores outwards is marked. The medullar fibres are very rarely noticed. In our opinion there are no notable differences between this species and *G. nodosum* Ogilvie Gordon, which would not be connected with transitory forms.

¹ When this paper was already in print there was published the paper »Permian Algae from Saudi Arabia« by R. Rezak (J. Pal. 33, No 4, 531-539; 2 pl; July 1959), in which the author describes the species *Gymnocodium bellerophontis* and *G. moniliforme*. We could not take this paper into consideration.

Therefore in the case of bulbous fragments it is very difficult to decide which species is in question. We should not be surprised if in the future new fossil material should cast a shadow of doubt upon the existence of the two species.

Dimensions (in millimeters):

Slide number	D (great diameter)	d (inner diameter)	P (pores)	s (sporangia)	L (Length)	Localities
696	1.13	0.60	0.058	0.14	—	Sustaši
718	1.45	0.90	0.052	—	—	Sustaši
1866	0.80	0.13	0.045	—	18.0	Brušane
1878	1.25	0.68	0.048	—	8.4	Cerkno
1773	0.53	0.33	0.040	—	2.0	Samija

Occurrence and age:

1. Robijača near Medak in Lika, Croatia; upper part of lower Permian (upper Rattendorf layers). Remains are rarely found.
2. Environs of Brušane in Lika, Croatia, above a fish pond; Kalvarija in the third zone of limestone); S of elevation 820. Age: Upper Permian.
3. Parića Livada in Velika Paklenica, SW Velebit, Croatia. Age: Upper Permian.
4. The Mountains of Škofja Loka and Polhov Gradec: Samija, Žažar, Vrzenec (in the layer with *Productus callocreneus*), W of Vrzenec, southern slope of Blegoš; above Tisovnik, Cerkno-valley of Idrija. Age: Upper Permian.
5. Han Orahovica near Prača in Bosnia. Age: Upper Permian.
6. Sustaši, Crni Potok and Bujači near Virpazar in southern Montenegro. Age: Lower part of Upper Permian.

Remark:

We believe that some fragments of this species from Parića Livada in Velika Paklenica were primarily described as *Stoleyella velebitana* Schubert. Consequently, afterwards they were registered as *Vermiporella velebitana* in many localities in the Dinaric Alps. However, as it is impossible to prove it, we would not suggest any nomenclatorial changes concerning this subject.

Gymnocodium ? sp.

Pl. VI., fig. 5

We possess only one cross-section with a diameter of 3.4 mm. The pores are extraordinary large (0.050–0.065 mm.) and somewhat widened outwards. Their ramification is not great. There is some similarity to the figured specimen of *G. nodosum* (in P i a 1937, pl. 95, fig. 7) and its description, but it should be borne in mind that P i a's fragment is not in accordance with the original description of the species (O g i l v i e - G o r d o n; 1927, III, p. 71, pl. IX, fig. 9).

Occurrence and age:

Crne Grede near Brušane in Lika (Croatia). Age: Middle Permian or lower part of Upper Permian (second zone of dark limestone).

Genus *Permocalculus* Elliot 1955

The essential organization is equal to the genus *Gymnocodium*. Differences relate first of all to the form and the diameter of the pores, which are finer and mostly ramified, while the segments are usually larger. The calcification is of various degrees – from very thin to massive or solid.

In Yugoslav localities remains were recorded which show great variability in almost all features. Differences can be noticed not only in various localities but also within each of them. Specific determination was therefore very difficult. A comparison of different species resulted in uniting some former species under a common name. Thus we reduced the number of species in the Yugoslav Permian. We could record representatives of the following species: *P. fragilis*, *P. tenellus*, *P. aff. tenellus*, *P. cf. plumosus* and *Permocalculus* sp.

Permocalculus fragilis (Pia).

Pl. II, figs. 1-4; pl. III, figs. 1-8

- 1937, *Gymnocodium fragile* – Pia, 2^e Congr. stratigr. carbon.; Heerlen 1935, C. R., 2, p. 834 (70).
 1937, *Gymnocodium moniliforme* – Pia, 2^e Congr. stratigr. carbon.; Heerlen 1935, C. R., 2, p. 834 (70).
 1937, *Gymnocodium solidum* – Pia, 2^e Congr. stratigr. carbon.; Heerlen 1935, C. R., 2, p. 833 (69).
 1955, *Permocalculus fragilis* – Elliot, Micropaleontology (New York), 1, No 1, p. 86.
 1955, *Permocalculus solidus* – Elliot, Micropaleontology (New York), 1, No 1, p. 86.
 1955, *Permocalculus digitatus* – Elliot, Micropaleontology (New York), 1, No 1, p. 86.

Examining fossil remains of calcareous algae from Yugoslavia, i. e. eastern Bosnia (environs of Prača) and western Serbia (the Stira Brook south of Loznica and Bastav, west of Valjevo), J. Pia (1937) established some new species, among them also *Gymnocodium fragile*, *G. moniliforme* and *G. solidum*. Regrettably, the descriptions were insufficient.

According to the author's brief description the segments of *G. moniliforme* and *G. fragile* generally are spherical. The differences exist in the size of the sporangia and in the degree of calcification. Only *G. fragile* was figured and no dimensions were mentioned in the text. Therefore a precise distinction among the mentioned species was impossible. Ovoid sporangia, heavy calcification, fine pores – there are the main characteristics of *G. solidum*, while the form of the segments

varies in a high degree, as is seen in the specimens reproduced (Pia 1937, Pl. 97 [13], figs. 1-2). Later, Johnson (1951) designated two American fragments without sporangia as *G. cf. fragile*.

Rao and Varma (1953) described a smaller Indian form with medullar sporangia as *G. piai*.

Elliot (1955) describes a new fossil material from Iraq. In spite of the fact that the Iraq specimens somewhat differ from Yugoslav forms, especially concerning the pores and the sporangia, the author attributes them to Pia's species supplying the descriptions with some details. But even he did not determine characteristics according to which one could faultlessly distinguish specimens belonging to each one of the three species mentioned.

In contrast, Endo (1957) described similar fragments - without sporangia and differing only by somewhat scattered and bigger pores - as a new species named *Permocalculus piai*. (He evidently did not know of the Indian species already described under this name).

This short review shows that each new discovery of fossil remains brings specimens which, in spite of a general similarity with the topotype specimens, differ from them in many details, which prompted some authors to establish new species. Therefore we took into consideration not only the remains from different new localities from Yugoslavia but also the new topotype material as well as the holotype specimens from Pia's collection (especially the specimens designated as *G. moniliforme*). Besides, we had the opportunity to see fossil material from Bükk Mountain in Hungary, (already mentioned by Pia).

Having analysed the mentioned rich fossil material, we came to the conclusion - like the authors before us - that the specimens do not correspond to one another in features that are limited to the mentioned species. Differences among the specimens are greater than they should be between two of the mentioned species. Thus we had to choose between establishing new species and uniting under one name species that correspond to one another in some essential features. We chose the latter, because the variability of the representatives of the family *Gymnociaceae* is very great. It is especially to be seen in the species *G. bellerophontis* and *G. (= Permocalculus) kanmerai*, which show that even the segments of one individual can vary to a great extent. This is to be assumed still more within the species, especially concerning the form of the segments. A greater significance for distinguishing the different species ought to have the type and the dimensions of the pores, also the form and the location of the sporangia. In this respect our three species, including *P. digitatus* Elliot, show great similarity.

The cortical pores are very thin and ramified. The medullar fibres are rarely to be noticed. The dimensions of the thallus are relatively great; the sporangia are mainly oviform (cross-sections are rounded) and situated completely or partially in the cortical layer. It is probable that some terminal segments can be completely filled with sporangia.

Such a frame is wide enough – not only for the above-mentioned specimens but also for a number of fragments from new Yugoslav localities. On the other hand all these fragments are very easily distinguishable from the other precisely defined species. Therefore we consider it necessary to comprise the mentioned species as an entity under the name *P. fragilis* (Pia) which name is best known and most often mentioned in the literature.

Consequently, we are going to give a widened diagnosis of the species: The thallus is composed of numerous segments. After the death of the organism they mostly set apart, because the calcification in the connecting zone between two segments is very slight. The segments can be almost spherical, like a dog-rose berry, elongated-subquadratical, club-shaped or simply elongated. Their cross-section is usually rounded.

The cortical pores are mostly thin and dense, so that the calcification among them is still thinner. However, the variation of the diameter of the pores is great (0.007–0.050 mm.). The maximal »pores« are most probably due to the ramification of the filaments under the surface of the thallus. Commonly the pores do not widen outwards. The calcification is very heavy, so that sporadically the pores are not to be noticed at all.

In some older segments the calcification reaches deep into the interior of the thallus, so that it can become almost solid.

The sporangia are in connexion with the cortical layer. Their form is usually lemon-like with rounded cross-section; in position they are mostly somewhat oblique to the axis of the segment. Their diameter varies from 0.18 to 0.35 mm., their length from 0.26–0.48 mm.

The medullar fibres are rarely preserved, cca. 0.085 mm. in diameter. They are mostly to be found in some club shaped segments which are almost completely filled with sporangia.

	D	d	w	p	s	L	
703	3.35	2.77	0.20–0.30	0.032–0.040	—	4	Škofje
703A	2.7	—	—	0.025–0.040	0.31×0.48	4.1	Škofje
700	1.60	1.43	0.065	—	0.30×0.58	1.70	Škofje
700A	5.5	—	—	—	0.33×0.60	—	Škofje
694	1.80	1.40	0.18	0.010–0.015	0.20×0.30	—	Vrzdeneč
699	1.35	0.85	—	—	0.24×0.33	2.05	Škofje
1876	2.32	—	—	0.025	—	—	Prača-
							Orahovica
1873	2.40	1.42	0.5	0.040	0.43	6.0	Đukovine

Occurrence and age:

1. Han Orahovica near Prača in Bosnia; Bellerophon – limestone; Age: Upper Permian.
2. The Stira Brook near Zajača, south of Loznica, western Serbia; Age: Upper Permian.

3. Bastav, between Pecka and Bela Crkva, west of Valjevo, western Serbia; Age: Upper Permian.
4. Šabačka Kamenica, western Serbia; Age: Upper Permian.
5. Dukovine, western Serbia; Age: Upper Permian.
6. Vrzdenc and Škofje, The Mountains of Škofja Loka and Polhov Gradec in Slovenia; Age: Upper Permian.
7. Uncertain is the locality Pariča Livada in Velika Paklenica, Croatia; Age: Upper Permian.

Remarks: It is most probable that also *Permocalculus piai* Endo belongs to the described species. However, no definite conclusion is possible without new fossil remains. As to the other species of the genus *Permocalculus*, the described species is nearest to *P. tenellus*, which has a relatively smaller diameter of the segments and mostly bigger pores that commonly widen outwards.

Permocalculus tenellus (Pia)

Pl. IV, figs. 1-3; pl. V, figs. 1-5

1937, *Gymnocodium tenellum*, - Pia, 2^e. Congr. stratigr. carbon.; Heerlen 1935, C. R., 2, p. 834, pl. 12, fig. 3, 4; pl. 13, fig. 3.

1955, *Permocalculus tenellus*, - Elliott, *Micropaleontology*, 1, No 1, p. 86; pl. 3, fig. 1.

The thallus is composed of elongated peg-shaped segments which occasionally are branching. The calcification in the connecting zone between two segments is very slight. Therefore we find the segments mostly separated. The calcification of the cortical layer of each segment is rather thick and pierced by numerous ramified pores. The pores usually widen outwards, with a diameter varying from 0.015-0.035 mm.

The medullar fibres are relatively frequently observed. Their dimensions are only somewhat greater than those of the cortical pores.

The sporangia are oviform and cortical in position. But they are rarely to be found.

Dimensions:

	D	d	w	p	s	m. fibres	
1538	1.67	—	—	0.025	—	0.025	Turčini
1538a	2.01	1.03	0.5	0.032	—	—	Turčini
1539	2.05	0.80	0.37	0.030	0.22	—	L = 2.6 Turčini
1537	1.27	—	—	0.028	—	0.030	Turčini
188	1.55	1.1	0.35	0.035	0.21×0.28	—	Crne Grede
176	1.40	0.78	0.28	0.030	0.20×0.25	0.032	Crne Grede
1861	3.4	2.45	0.46	0.027	0.23×?	—	L = 6 Brušane
1860	3.2	2.2	0.42	0.030	0.20×0.32	—	L = 5 Brušane
1860a	4.9	4.1	0.40	0.030	—	—	Brušane
1860b	1.8	1.1	0.40	0.032	—	0.040	Brušane

It is necessary to point out that some specimens are markedly large ($D = 4.9$, $d = 4.1$). Comparing them with those from Iraq and Bükk Mountain in Hungary, which are smaller than the topotype specimens from Bastav, we can see that the variability in the various localities can be very high.

Occurrence and age:

1. Bastav, between Pecka and Bela Crkva, west of Valjevo, western Serbia (already recorded by P i a 1937).
2. Turčini, environs of Bar, southern Montenegro (Crna Gora); Age: Middle Rattendorf-layers (= Grenzlandbänke); Lower Permian. The accompanying fossils: *Pseudoschwagerina carniolica*, *P. velebitica*, *Rugosofusulina*, *Mizzia* and *Epimastopora*.
3. Environs of Brušane in Lika, (Kalvarija, Crne Grede, S of elevation 820) Croatia in the *Neoschwagerina limestone* (III zone of dark limestones). Age: Upper Permian.

Permocalculus aff. *tenellus* (P i a)

Pl. VI, figs. 1-3

There are several cross-sections of considerably calcified fragments which show some features similar to the above described species, but differ from it in the form and the dimensions of the pores.

The form of the segments is unknown because of lack of longitudinal or at least oblique section. The diameter of the segments varies between 2-3 mm. The pores are somewhat larger than in *P. tenellus* and measure 0.035-0.042 mm. in diameter. Their ramification is marked. They do not widen outwards. It is possible that we have to do with a new species. However, as long as we miss specimens which would show all features needed for a complete diagnosis it is better to consider this question as unsolved.

Occurrence and age:

Cerkno - the valley of the Idrijca; The Mountains of Škofja Loka and Polhov Gradec. The accompanying calcareous algae: *Gymnocodium bellerophontis* and *Vermiporella nipponica*. Age: Upper Permian.

Permocalculus cf. *plumosus* Elliot

Pl. I, figs. 4-7

In the rich collection of fossil remains of different representatives of the family *Gymnocodiaceae* there are also some specimens that are very similar to the Iraq specimens of *P. plumosus*.

The thallus is mostly elongated. The periodical constriction of the thallus is also to be noticed, but not so regularly as in the Iraq specimens. There are even fragments which measure up to 3.7 mm. in length and do not show any marked constriction of the thallus.

The pores are less ramified than in the other mentioned species. In position they are commonly oblique to the main axis of the segments. Their outer terminations are expanded but not like those of *P. tenellus*. The calcareous wall is usually regular, mostly uniform in thickness. The inner hollow is without medullar fibres. No sporangia have as yet been noticed.

Dimensions:

	D	d	w	p	s	L	
191	0.45	—	—	0.040	—	0.7	Palež Kameniti
191	0.70	0.58	0.09	0.025?	—	0.78	Palež Kameniti
190	1.02	0.68	0.13	0.035	—	1.4	Palež Kameniti
309	1.1	0.81	0.15	0.020	—	3.4	Borovničići

Occurrence and age:

1. Palež Kameniti near Raduč, Lika, Croatia. Accompanied by *Mizzia velebitana*. Age: Middle Permian.
2. Borovničići, Vel. Paklenica, Velebit, Croatia. Age: Upper Permian.

Permocalculus sp.

Pl. VI, fig. 4

In our collection there is present one cross-section with a 3 mm. diameter. The calcification reaches rather deep, but it is not regular. The pores are about 0.045 mm. in diameter, thus somewhat larger than it is usual for the genus *Permocalculus*. They are ramified and very dense. Besides, there are some other fragments.

These fossil remains are mostly similar to the above described *P. aff. tenellus* from Cerkno, but they differ from it in greater diameter and density of the pores.

Occurrence and age:

Takalice near Brušane in Lika (Croatia); Age: Upper Permian.

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<i>Gymnocodium belleophonis</i>	○	Mountains of Škofja Loka and Polhov Gradec	○	● ○	Paklenica-Delebit-Lika	○	○	E Bosnia (Prača etc)	○	○	W Serbia	○	○	S Montenegro
<i>Gymnocodium?</i> sp.				●										
<i>Permocalculus fragilis</i>	○							○	○					
<i>Permocalculus tenellus</i>				○					○				●	
<i>Permocalculus aff. tenellus</i>	○													
<i>Permocalculus cf. plumosus</i>				○	○									
<i>Permocalculus</i> sp.	○			○										
○ Upper Permian ○ Middle Permian (Leonard-Ward) ● Lower Permian														

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GIMNOKODIJACEJSKE VAPNENAČKE ALGE U PERMU JUGOSLAVIJE

U permu Jugoslavije veoma su rasprostranjeni fosilni ostaci gimnokodijaceja. Opisane su vrste: *Gymnocodium bellerophontis* (Rothpletz), *Gymnocodium* ? sp., *Permocalculus fragilis* (Pia), *P. tenellus* (Pia), *P. aff. tenellus* (Pia), *P. cf. plumosus* (Elliot) i *Permocalculus* sp.

Prilikom obrade vrste *P. fragilis* došli smo do uvjerenja, da se s njom trebaju spojiti dosadašnje vrste *P. moniliformis* i *P. solidus*, te smo za novu šire shvaćenu vrstu zadržali ime *P. fragilis*. Kod toga smo upotrebili materijal s raznih nalazišta, topotipove i originalne Pijine primjerke, koji svi potječu s jugoslavenskih nalazišta.

Kod vrste *P. tenellus* zapažena je od nalazišta do nalazišta velika varijabilnost osobito u veličini. Slična se pojava može zapaziti i kod najrasprostranjenije vrste *Gymnocodium bellerophontis* koja prema nalazištima varira u veličini talusa, širini pora i obliku koji može biti pravilno cjevast ili donekle člankovito izgrađen.

P. cf. plumosus, dosad nepoznata vrsta u Jugoslaviji, utvrđena je u Lici i Velebitu. Ima osim valovito-člankovitih i posve cjevastih ulomaka.

Teritorijalna rasprostranjenost vrsta prema glavnim permskim područjima vidi se iz priložene tabele.

Osobito ističemo, da su neke vrste, kao *Gymnocodium bellerophontis* i *Permocalculus tenellus* utvrđene u donjem permu, u ekvivalentima gornjih i srednjih ratendorfskih slojeva.

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Plate I - Tabla I

- 1-3. *Gymnocodium bellerophonis* (Rothpletz). $\times 10$. Upper Permian (Gornji perm)
1. Brušane, Croatia (1866)
2. Cerklje, Slovenia (1879)
3. Sustaše, Montenegro (718)
- 4-7. *Permocalculus* cf. *plumosus* Elliot $\times 10$
4. Borovničiči, Vel. Paklenica, Croatia. Upper Permian (gornji perm) (309)
5-7. Palež Kameniti, Lika, Croatia. Middle Permian (srednji perm) (190, 191)



1



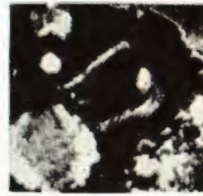
2



4



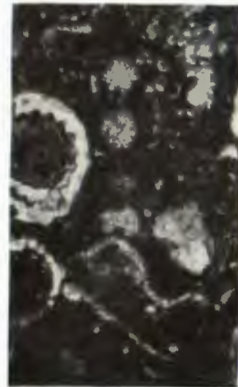
3



5



6

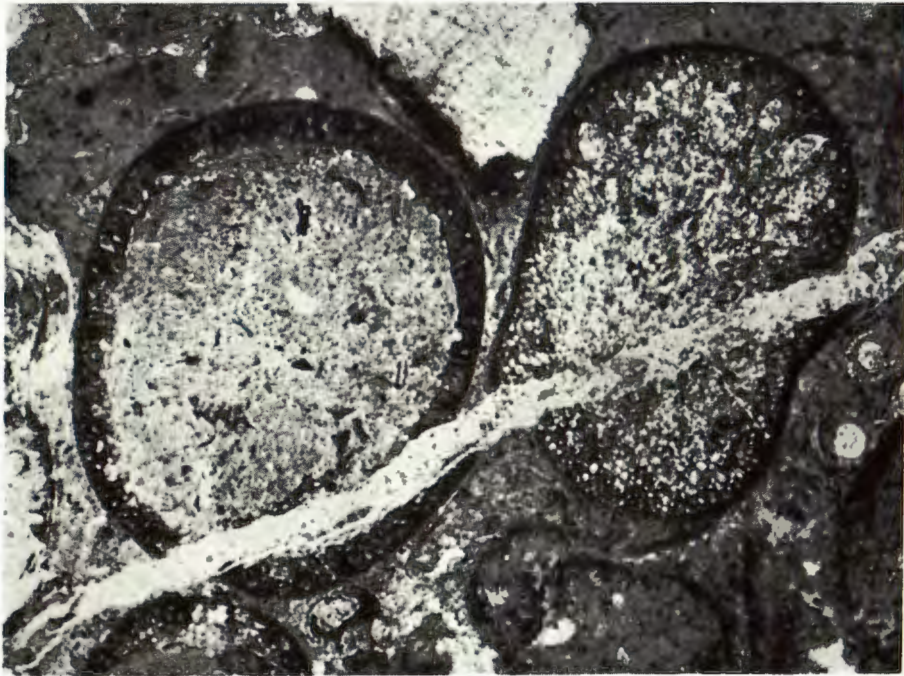


7

Plate II. - Tabla II.

1-4. *Permocalculus fragilis* P i a. Skofje near Cerkno, Slovenia. Upper Permian.

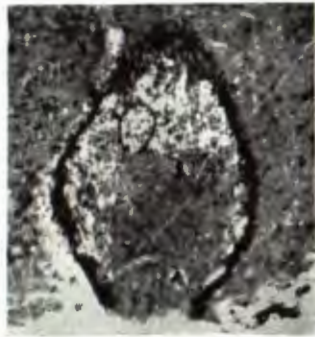
1. Left sterile, right fertile segment (703). $\times 15$. Lijevo sterilni, desno fertilni članak.
2. Part of giant segment and one fertile segment. Dio golemog članka i jedan fertilni članak. (700). $\times 20$.
3. Terminal fertile segment. Vršni fertilni članak. (699). $\times 20$.
4. Cross-section of fertile segment. Poprečni prerez fertilnog članka (700). $\times 20$.



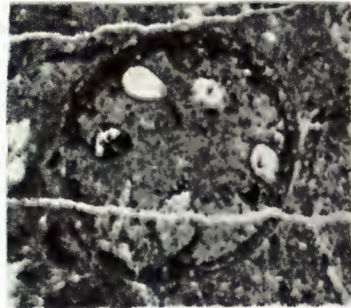
1



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3



4

Plate III. - Tabla III.

- 1-8. *Permocalculus fragilis* (P i a); Upper Permian (gornji perm).
- 1-3. Types of *Gymnocodium moniliforme* P i a. Bastav, W Serbia. Collection J. P i a. Tipovi »vrste« *G. moniliforme*, Zbirka J. P i a -e (146a, 149a, 149a).
×20.
4. Cross-section (poprečni prerez) Vrzdenc, Slovenia. (694) ×20.
- 5-6. Oblique sections of elongated segments. Poprečni prerezi produljenih segmenata. Đukovine, W Serbia (1873). ×10.
- 7-8. Han Orahovica near Prača, Bosnia. (1877, 1876) ×10.

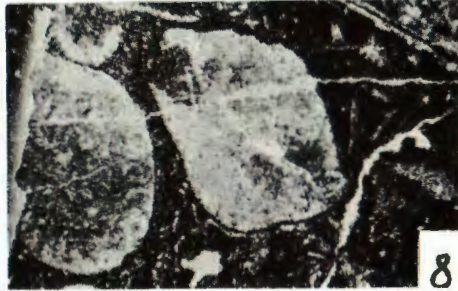
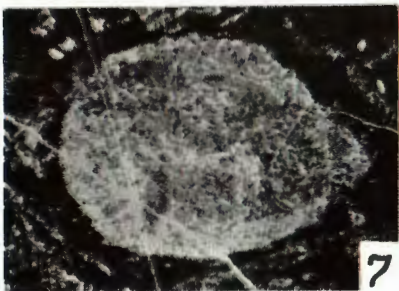
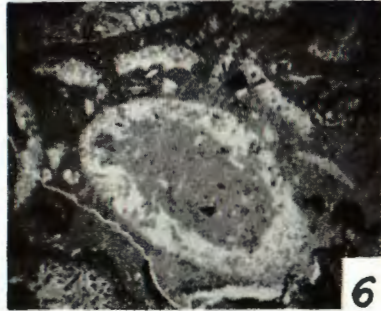
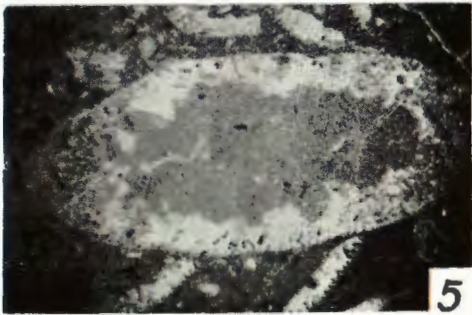
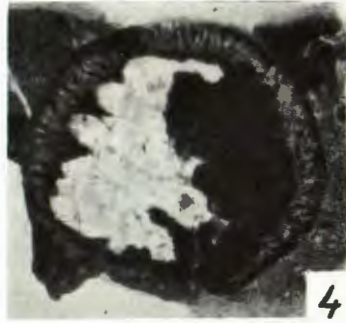
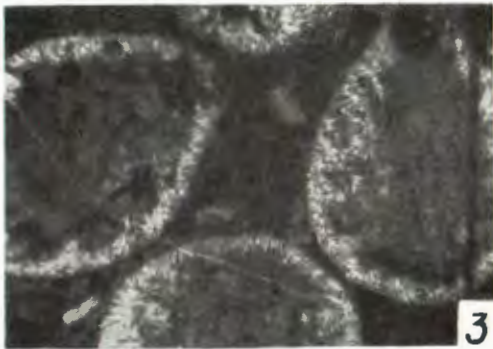
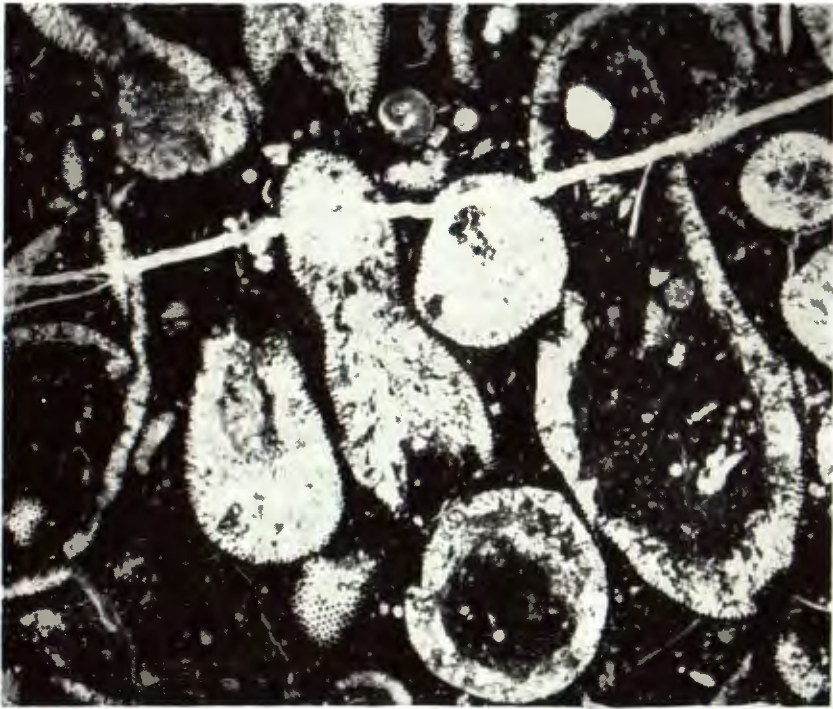
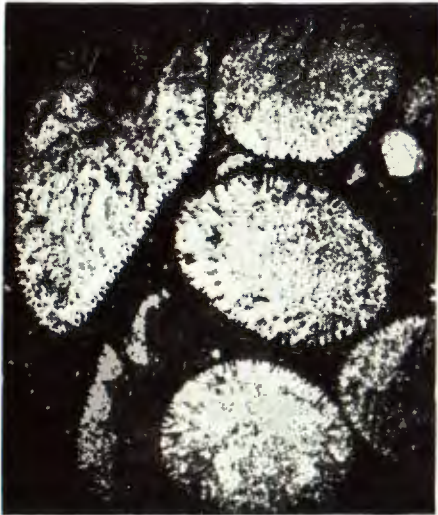


Plate IV. - Tabla IV.

- 1-3. *Permocalculus tenellus* (P i a) from Brušane. Upper Permian (gornji perm) (1861)
×10.
Three parts of the same slide containing different sections (Tri dijela istog
izbruska s različitim prerezima).



1



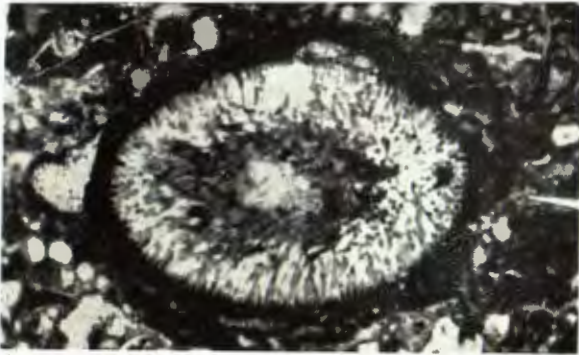
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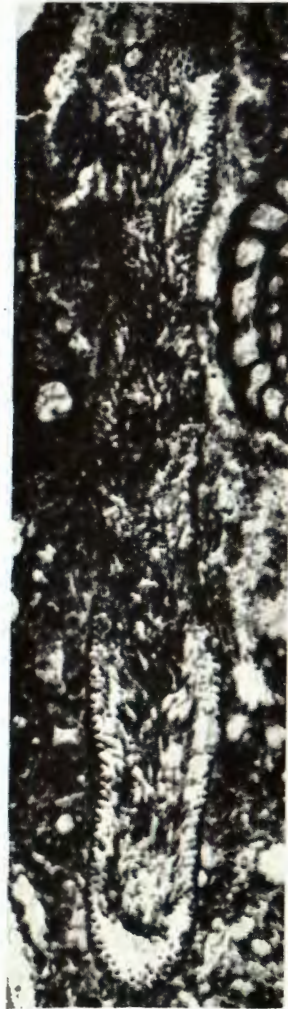
3

Plate V. - Tabla V.

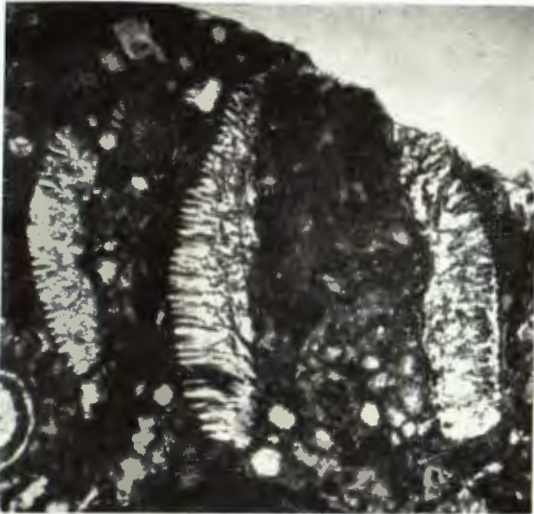
- 1-5. *Permocalculus tenellus* (Pia). Turčini near Bar, Montenegro. Lower Permian (donji perm) $\times 20$.
1. Oblique section (kosi prerez) (1538).
 - 2-3. Parts of oblique-longitudinal sections (dijelovi koso-uzdužnih prereza. (1538, 1537).
 4. Longitudinal section of three small segments (uzdužni prerezi triju malih segmenata (1540).
 5. Cross-sections (poprečni prerezi) (1537).



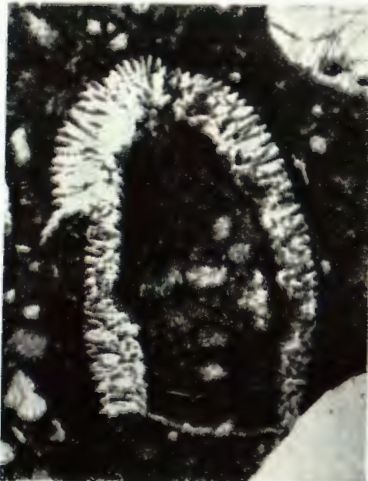
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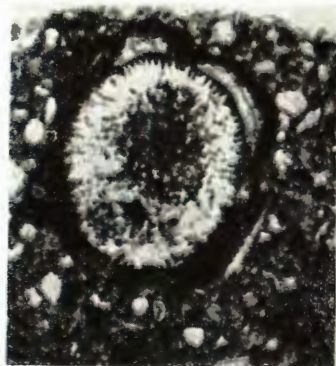
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2



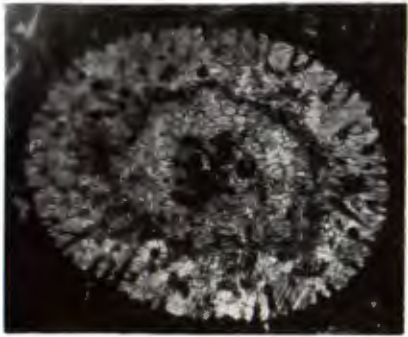
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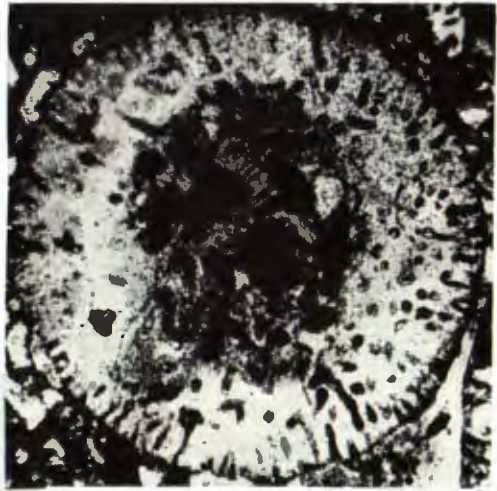
5

Plate VI. - Tabla VI.

- 1-3. *Permocalculus* aff. *tenellus* (P i a). Cerčno, Slovenia. Upper Permian (gornji perm) $\times 20$ (1879).
4. *Permocalculus* sp. Takalice near Brušane, Croatia, Upper Permian (gornji perm) $\times 20$ (48).
5. *Gymnocodium* ? sp. Crne Grede near Brušane, Croatia, Upper Permian (gornji perm) $\times 20$ (36).



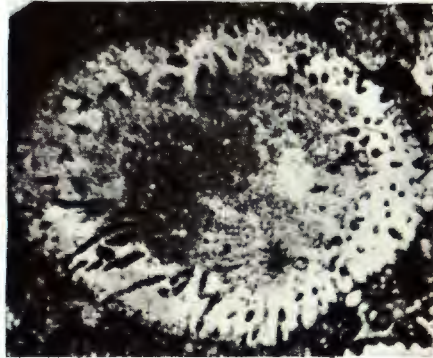
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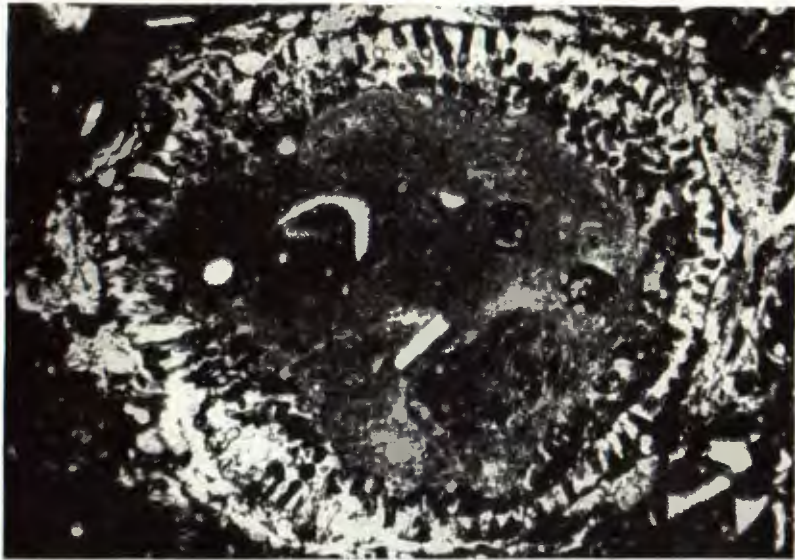
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