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GEMMACRINUS PERPLEXUS n. gen., n. sp. (CRINOIDEA, ?CAMERATA OR ?INADUNATA) FROM LOWER DEVONIAN OF BOHEMIA

INTRODUCTION

Several hundreds of isolated cup plates and also several cups of a new crinoid have been collected from Lower Devonian „white beds" (weathered limestones) of Bohemia. They have been found in Loděnice and Dvorce-Prokop Limestone (Pragian Stage), in the so-called „Chapel Coral Horizon" at the base of the Zlíchov Limestone (Zlíchovian Stage = Lower Emsian), and in the Třebotov Limestone (Dalejan Stage = Upper Emsian). These crinoids constitute a new genus and a new species described here as *Gemmacrinus perplexus* n. gen., n. sp., which is of exceptional geological duration, and of extremely high intraspecific variability in shape of the cup. The simple nature of its calyx plate configuration makes difficulties in assignment of this new crinoid even to subclass level. It seems that it is related to very similar camerate or inadunate genus *Elicrinus* Prokop, 1973 coming from Lower Devonian (Pragian and Zlíchovian) of Bohemia. In the latter genus we place also a species formerly known as *Codiacrinus rarus* Jell et Holloway, 1983 coming from Siluro-Devonian transition beds of Victoria, Australia. Both genera (*Elicrinus* and *Gemmacrinus*) are characterized by perfectly pentagonally symmetrical cup with dicylic base bearing three IBB (two wide, identical, and one narrow) and five identical BB, and with five RR showing no anal structures. The same cup plate configuration is also represented by a third crinoid genus — *Codiacrinus* Schultze, 1867 (invariably placed within Inadunata) coming from Lower and ?Middle Devonian of Europe. However, the three genera differ from each other by shape of the radial facet and arms.

The rich material of *Gemmacrinus perplexus* n. gen., n. sp. is deposited in collections of the Paleontological Department of the National Museum in Prague (below abbreviated as NM).

DESCRIPTIVE PART

Class: *Crinoidea* Miller, 1821

Subclass: ?*Inadunata* Wachsmuth et Springer, 1885

or ?*Camerata* Wachsmuth et Springer, 1885

Gemmacrinus n. gen.

Type species: *Gemmacrinus perplexus* n. gen., n. sp.
Diagnosis: see characteristic of the type species.

Gemmacrinus perplexus n. gen., n. sp.
(Pl. I. II; all figures)

Holotype: Complete cup NM L 25009, figured here on Pl. I, fig. 1 (and a sketch on the text-fig. 3e)

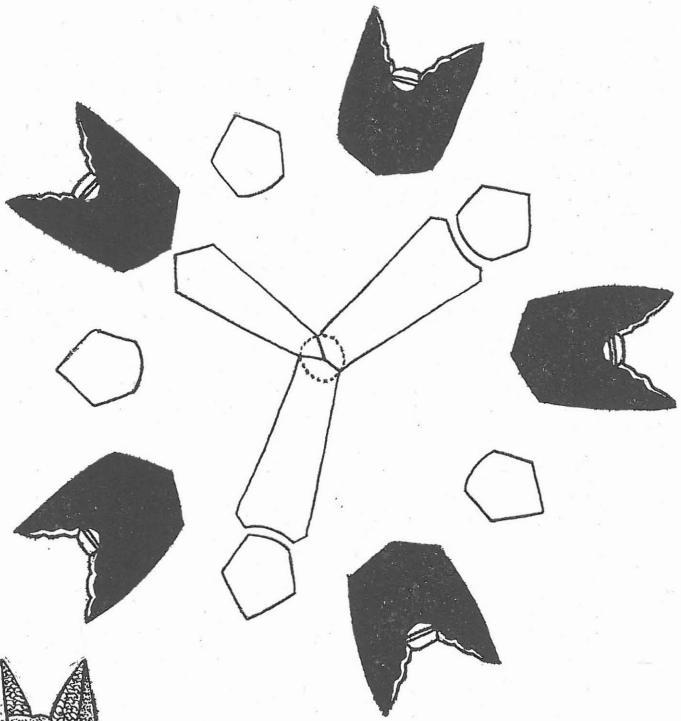
Type stratum: Lower Devonian, Pragian, Dvorce-Prokop Limestone.

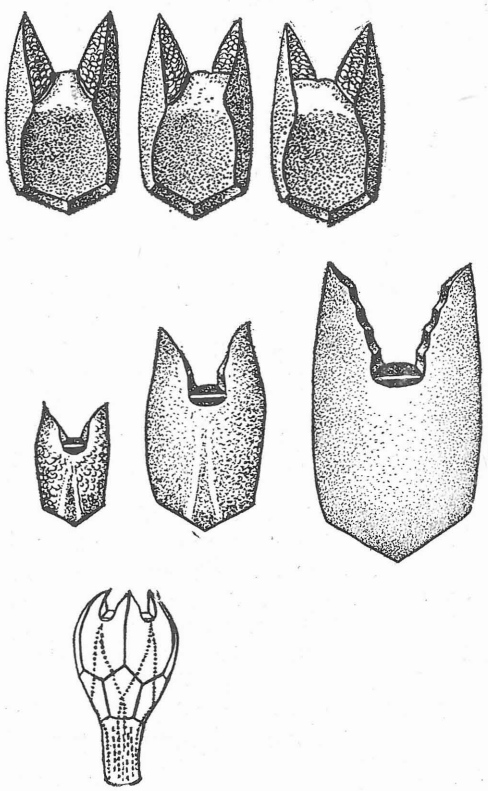
Type locality: „Červený lom" („Red quarry") near Klukovice.

Material: Except types several incomplete cups, several bases, and several hundreds of isolated radials.

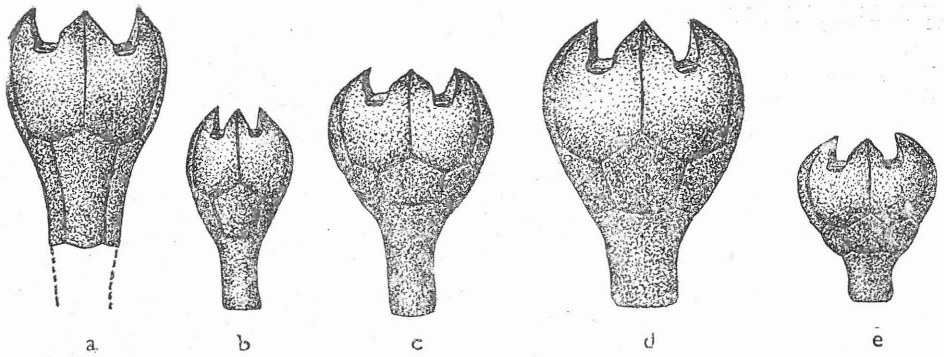
Description: Cup slenderly to plumpy flower-bud-shaped, perfectly pentagonally symmetrical. Cup plates are very thick, formed of 3 IBB, 5 BB, and 5 RR. No anal structure, no anal plate or anal opening developed in the aboral cup. Two of IBB are identical, distinctly elongated, subhexagonal; the third IB is narrower, also distinctly elongated, subpentagonal. It seems that in old specimens the IBB circlet is completely fused. BB generally very small (but not invariably as seen from Pl. I., fig. 11), identical, of the same subpentagonal shape, with distinctly convex, rounded proximal margins. RR from the outer view identical, of the same subpentagonal shape, with high interradial processes. The interradial processes of RR are more or less bent toward the cup centre, forming about 1/4 or 1/3 or 2/5 (sometimes slightly more, but never 1/2) of the whole height of R. Radial notch generally narrow, broadening more or less distinctly ventrally (distally). The radial notch bottom is smooth, slightly convex; its transition into the central cavity is indicated by very conspicuous rounded edge. Radial facet is relatively small, well-developed, provided with sharp transverse fulcral ridge. Proximally from the fulcral ridge there is a relatively shallow but large, sickle-shaped outer ligament field (or ligament fossa). Distally and adorally from the fulcral ridge, neighbouring the radial notch bottom, there are two coalesced, flat muscle fields (or muscle fossae). The adradial sides of the interradial processes of RR are provided with a dentation, simple in small, young individuals, and complicated in large, old adults. The inner sides of the interradial processes of RR are characterized by densely granulated fields of uncertain function, sharply limited proximally by a groove. Observing the limits of the granulated fields, we can distinguish three types of iso-

Text-fig. 1.: *Gemmacrinus perplexus* n. gen., n. sp.
Plate diagram. Radials black.





Text-fig. 2: *Gemmacrinus perplexus* n. gen., n. sp.
above: Inner sides of radials. The radials of the left type are three in the cup. Idealized sketch after many specimens. Enlarged.
middle: Outer sides of radials of three ontogenetic stages showing changes of sculpture formed of ribs and granules (very similar to that of *Elicrinus procerus* Prokop, 1973 or of *Codiacrinus granulatus* Schultze, 1867). The ornamentation disappears continuously during the ontogeny. Schematic sketch after many specimens. Enlarged.
below: Schematic sketch of the course of the slender ribs on the surface of the cup of small specimen. Idealized. Enlarged.



Text-fig. 3: *Gemmacrinus perplexus* n. gen., n. sp.
Idealized schematic sketch of the shape of five cups. x2.5.
a . . . after specimen NM L 25025 (Pl. I., fig. 11) coming from „Červený lom" quarry, Klukovice, Loděnice Limestone.
b . . . after specimen NM L 25043 from „Červený lom" quarry, Klukovice, Loděnice Limestone.
c . . . after specimen NM L 25011 (paratype B, Pl. I., fig. 4) from „Červený lom" quarry, Klukovice, Dvorce-Prokop Limestone.
d . . . after specimen NM L 25044 from the quarry near bathing pool, Klukovice, Dvorce-Prokop Limestone.
e . . . after holotype (NM L 25009, Pl. I., fig. 1) from „Červený lom" quarry, Klukovice, Dvorce-Prokop Limestone.

lated RR (the granulated fields are not visible in whole cups because of poor preservation). In the first type, the granulated fields of the left and right interradial processes of a R are identical, with their lower (proximal) limits reaching symmetrically the edge of the central cavity. In a washing, 3/5 of the whole number of RR of the discussed species belong to this type. (For this type and for the following two ones see text-fig. 2 above). In the second type, the limit of the granulated field of the left interradial process is shifted distinctly distally. In a washing, this type forms 1/5 of the whole number of RR. The third type, which is the case of mirror symmetry with the second type, forms also 1/5. Therefore, it is evident, that in the cup of the discussed species three RR of the first type, one of the second, and one of the third types are present, and that the latter two RR are neighbouring in the cup.

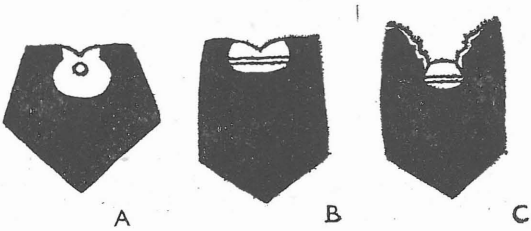
The ornamentation of the cup disappears continuously during the ontogeny. Small, young specimens are sculptured with dense, tiny granules, and with slender ribs radiating from the centre of BB, crossing the sutures with neighbouring RR and IBB, ending proximally at about the level of stem facet, and meeting distally near the ligament field of the radial facet. Large, old adults are smooth. Arms not preserved. The first brachial, touching the fulcral ridge, was probably very small. The second brachial was possibly large, shaped so as to completely fill the hollow of the radial notch, being possibly able to close over the ventral side of the cup (as in pygmaeocrinids). This capability could be facilitated by

the above mentioned dentation on the adradial sides of the interradial processes of RR, and by premised similar dentation on proximal parts of lateral sides of the second brachials.

Stem not preserved. Stem facet is small, circular, slightly impressed into the IBB circlet, with short, distinct crenellae at its periphery.

Remarks: The monotypic genus *Gemmacrinus* n. gen. is possibly related to the genus *Elicrinus* Prokop, 1973 from which it differs conspicuously only in one feature — in presence of very high interradial processes of RR with their dentation on adradial sides, and with their granulated fields on inner sides, and, therefore, in entirely different type of arms (see the description above). The genus *Codiacrinus* Schultze, 1867 differs strongly from both the latter genera by absence of fulcral ridge on the radial facet, and by presence of small circular opening for passage of the longitudinal axial canal in the centre of each radial facet (see text-fig. 5A here). These features of *Codiacrinus,* however, are known only in the type species *C. granulatus* Schultze, 1867 (see SCHULTZE, 1867, p. 143—144, text-fig. 4, and Pl. III, fig. 9,9a—c, and also MOORE, LANE and STRIMPLE, 1978, in Treatise on Invert. Paleont., p. T606—T607, fig. 393 2a, b). It is necessary to notice that well-known species *C. schultzei* Follmann, 1887 coming from the „Hunsrückschiefer" of Bundenbach (FRG) needs a revision. Nothing is known about the radial facet of this species (see FOLLMANN, 1887, p. 123—125, Pl. III, fig. 1,1a—b). Also *Codiacrinus* spec. do not show fully its radial facets (Emsian of Spain, see BREIMER, 1962, p. 159—160, Pl. XV, fig. 15). On the other hand, *C. rarus* Jell et Holloway, 1983 from Siluro-Devonian transition beds of Victoria, Australia, is evidently a member of the genus *Elicrinus* Prokop, 1973, because of presence of distinct fulcral ridge on the radial facet (see JELL et HOLLOWAY, 1983, p. 16, and photo Fig. 9 E—F).

Text-fig. 4: *Gemmacrinus perplexus* n. gen., n. sp.
Schematic draving of the specimen NM L 25025 (see also Pl. I., fig. 11, and text-fig. 3a) showing a fragment of encrusting type of crinoid holdfast attached to the left radial. It is a portion of a cirrus covered by an unjointed crust of secondary stereom that extend into the cup of *Gemmacrinus perplexus* and tends to cover the radial plate and to fill the whole radial facet. Because the cup is not disarticulated (except the IBB circlet), there seems to be a possibility that the „holdfast" attached to *Gemmacrinus perplexus* during its life and caused loos of one of its arms. Enlarged.



Text-fig. 5. Sketch of the only diference between three genera: Codiacrinus (A), Elicrinus (B), and Gemmacrinus (C), showing isolated radials with radial facets.

We are surprised that *Gemmacrinus perplexus* n. gen., n. sp. is of such long gelogic duration (Pragian, Zlíchovian, and Dalejan), but in general, the ecological conditions were characterized by carbonate sedimentation in well-aerated environment without any impressive changes. The very high intraspecific variability in the discussed species, consequently, is the same in formations of different geologic ages. At last, it is necessary to note that the plates given in this paper cannot show the amazed variability to the real extent.

Occurrence: All specimens come from the so-called „white beds" (weathered limestones) of the Barrandian area. The localities are following: Červený lom („Red quarry") near Klukovice (in Loděnice and Dvorce-Prokop Limestone); quarry near St. Prokop, Praha-Hlubočepy (in Dvorce-Prokop Limestone); „Konvářka", Praha-Smíchov (in Loděnice Limestone); „U kapličky" quarry, Praha-Zlíchov (in the so-called „Chapel Coral Horizon at the base of Zlíchov Limestone): „U kantiny" quarry, Praha-Řeporyje (in uppermost Dvorce-Prokop Limestone); Praha-Holyně (in Třebotov Limestone).

Dimensions (in mm.):

Dimensions of the holotype:

height of cup	8.0
height of IBB circlet	3.5
height of BB circlet	2.0
height of RR circlet	4.5
height of RR up to the level of fulcral ridge	3.5
max. width of cup	6.2
max. width of RR	3.8
width of IBB circlet at level of stem facet	1.8
width of the stem facet	1.4

Dimensions of the paratype A (NM L 25010), cup without RR figured on Pl. I., fig. 2, 3.:

height of the whole base (IBB+BB)	8.5
height of IBB	6.0
width of IBB at level of stem facet	2.5
width of the stem facet	1.9
width of base at level of distal end of IBB	5.0

Dimensions of the paratype B (NM L 25011), whole cup figured on Pl. I., fig. 4.:

height of cup	11.0
approx. max. width of cup	8.0

Dimensions of other types:

specimen	locality	max. width of cup	max. height of cup measured from prox. end of BB
NM L 25015 (Pl. I., fig. 5) cup without IBB	Schwarz. quarry near St. Prokop (Dvorce-Prokop L.)	10.0	12.0
NM L 25016 (Pl. I., fig. 6) cup with incomplete IBB	Schwarz. quarry near St. Prokop (Dvorce-Prokop L.)	7,5	7.2

NM L 25017 (Pl. I., fig. 7) cup without IBB	Schwarz. quarry near St. Prokop (Dvorce-Prokop L.)	9.3	11.0
NM L 25018 (Pl. I., fig. 8) cup without IBB	Schwarz. quarry near St. Prokop (Dvorce-Prokop L.)	9.0	10.0
NM L 25023 (Pl. I., fig. 9) cup without IBB, with incomplete BB	„Červený lom" Klukovice (Loděnice L.)	6.0	—
NM L 25024 (Pl. I., fig. 10) cup without IBB	„Červený lom" Klukovice (Loděnice L.)	4.0	7.0
NM L 25025 (Pl. I., fig. 11) cup without IBB	„Červený lom" Klukovice (Loděnice L.)	8.5	13.0
NM L 25036 (Pl. II., fig. 18—19) RR circlet	Praha-Holyně (Třebotov L.)	7.0	—

isolated R plate	max. height of R	height of R up to level of fulcral ridge	max. width of R
NM L 25019 (Pl. II., fig. 1)	3.7	2.5	2.5
NM L 25020 (Pl. II., fig. 2)	5.2	3.8	3.0
NM L 25021 (Pl. II., fig. 3)	6.0	4.0	4.0
NM L 25022 (Pl. II., fig. 4)	7.0	4.4	4.5
NM L 25012 (Pl. II., fig. 5)	3.0	2.2	1.9
NM L 25013 (Pl. II., fig. 6)	3.6	2.5	2.0
NM L 25014 (Pl. II., fig. 7)	6.9	4.5	4.9
NM L 25026 (Pl. II., fig. 8)	3.3	2.5	2.0
NM L 25020 (Pl. II., fig. 9)	3.6	2.5	2.3
NM L 25028 (Pl. II., fig. 10)	5.0	3.2	3.1
NM L 25029 (Pl. II., fig. 11)	5.7	3.3	3.5
NM L 25030 (Pl. II., fig. 12)	5.5	4.0	3.6
NM L 25031 (Pl. II., fig. 13)	6.0	4.4	4.0
NM L 25032 (Pl. II., fig. 14)	6.5	4.1	4.0
NM L 25033 (Pl. II., fig. 15)	9.2	5.5	6.0
NM L 25034 (Pl. II., fig. 16)	8.0	5.1	5.6
NM L 25035 (Pl. II., fig. 17)	7.5	5.0	5.2
NM L 25037 (Pl. II., fig. 20)	3.9	2.6	2.6
NM L 25038 (Pl. II., fig. 21)	6.5	4.5	4.0
NM L 25039 (Pl. II., fig. 22)	7.0	4.2	4.0
NM L 25040 (Pl. II., fig. 23)	7.0	4.7	5.0
NM L 25041 (Pl. II., fig. 24)	8.0	5.5	4.3
NM L 25042 (Pl. II., fig. 25—26)	10.2	6.0	6.0

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EXPLANATIONS TO THE PLATES

Photographs by V. Petr. All specimens coated with ammonium chloride before photographing. All plates and figures x4.

PLATE I

1——11— *Gemmacrinus perplexus* n. gen., n. sp.: 1— holotype (NM L 25009), lateral view of the whole cup; 2— paratype A (NM L 25010), lateral view of the dicyclic base; 3— ditto, view of the stem facet; 4— paratype B (NM L 25011), lateral view of the whole cup; 5— cup without IBB (NM L 25015), lateral view; 6— cup with incomplete IBB circlet (NM L 25016), lateral view; 7— cup without IBB (NM L 25017), lateral view; 8— cup without IBB (NM L 25018), lateral view; 9— cup without IBB, and with incomplete BB (NM L 25023), lateral view; 10— cup without IBB (NM L 25024), lateral view; 11— cup without IBB (NM L 25025), lateral view. Lower Devonian, Pragian, Dvorce-Prokop Limestone, „Červený lom" quarry, Klukovice (1—4); Lower Devonian, Pragian, Dvorce-Prokop Limestone, „Schwarzenb. lom" quarry, Praha-Hlubočepy (5—8); Lower Devonian, Pragian, Loděnice Limestone, „Červený lom" quarry, Klukovice (9—11).

PLATE II

1——26— *Gemmacrinus perplexus* n. gen., n. sp.: 1— isolated R (NM L 25019), outer view; 2— isolated R (NM L 25020), outer view; 3— isolated R (NM L 25021), inner view; isolated R (NM L 25022), outer view; 5— isolated R (NM L 25012), outer view; 6— isolated R (NM L 25013), outer view; 7— isolated R (NM L 25014), outer view; 8— isolated R (25026), outer view; 9— isolated R (NM L 25027), outer view; 10—isolated R (NM L 25028), outer view; 11— isolated R (NM L 25029), outer view; 12— isolated R (NM L 25030), outer view; 13— isolated R (NM L 25031), outer view; 14— isolated R (NM 25032), outer view; 15— isolated R (NM L 25033), outer view; 16— isolated R (NM L 25034), inner view; 17— isolated R (NM 25035), outer view; 18— RR circlet (NM L 25036), lateral view; 19— ditto, ventral view; 20— isolated R (NM L 25037), outer view; 21— isolated R (NM L 25038), outer view; 22— isolated R (NM L 25039), outer view; 23— isolated, pathologically developed R (NM L 25040), outer view; 24— isolated R (NM L 25041), outer view; 25— isolated R (NM L 25042), outer view; 26— ditto, inner view. Lower Devonian, Pragian, Dvorce-Prokop Limestone, quarry at St. Prokop, Praha-Hlubočepy (1—4); Lower Devonian Pragian, Dvorce-Prokop Limestone, „Červený lom" quarry, Klukovice (5—7); Lower Devonian, Pragian, Loděnice Limestone, „Konvářka", Praha-Smíchov (8—14); Lower Devonian, Zlichovian, „Chapel Coral Horizon", at the base of Zlíchov Limestone, „Kaplička" quarry, Praha-Zlíchov (15—17); Lower Devonian, Dalejan, Třebotov Limestone, Praha-Holyně (18—26).

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GEMMACRINUS PERPLEXUS n. gen., n. sp. (CRINOIDEA, ?CAMERATA, ?INADUNATA) ZE SPODNÍHO DEVONU ČECH

Ze spodnodevonských „bílých vrstev" (zvětralých vápenců) Čech byly shromážděny stovky kališních destiček a několik celých kalichů nového krinoida. Pocházejí z loděnických a dvoreckoprokopských vápenců (stupeň prag), z tzv. korálového obzoru od kapličky" na bázi vápenců zlíchovských (stupeň zlíchov) a z vápenců třebotovských (stupeň dalej). Tento krinoid je zde popsán jako *Gemmacrinus perplexus* n. gen., n. sp. a je pozoruhodný svým značným stratigrafickým rozsahem a extrémní vnitrodruhovou variabilitou projevující se na tvaru kalicha. Díky jednoduché stavbě kalicha je obtížné jej bezpečně přiřadit k určité krinoidové podtřídě. Pravděpodobná je jeho příbuznost s rodem *Elicrinus* Prokop, 1973 (spodní devon Čech). V této práci přeřazujeme do rodu *Elicrinus* také druh *Codiacrinus rarus* Jell et Holloway, 1983, který pochází z přechodných siluro-devonských vrstev státu Victoria (Austrálie). Oba rody (*Elicrinus* Prokop a *Gemmacrinus* n. gen) je možné stručně charakterizovat dokonale pentagonální symetrií kalicha složeného ze tří infrabazálií (2 jsou široké, stejné, a třetí je úzká), z pěti stejných bazálií a z pěti stejných radiálií. Aborální kalich nevykazuje ani náznak análních struktur. Stejné složení kalicha je vidět i u rodu *Codiacrinus* Schultze, 1867 ze spodního a středního devonu Evropy. Všechny tři zmíněné rody se navzájem odlišují pouze stavbou radiální facety, a tedy i stavbou ramen.

Bohatý materiál zde popsaného druhu *Gemmacrinus perplexus* n. gen., n. sp. je uložen ve sbírkách paleontologického oddělení Národního muzea v Praze.

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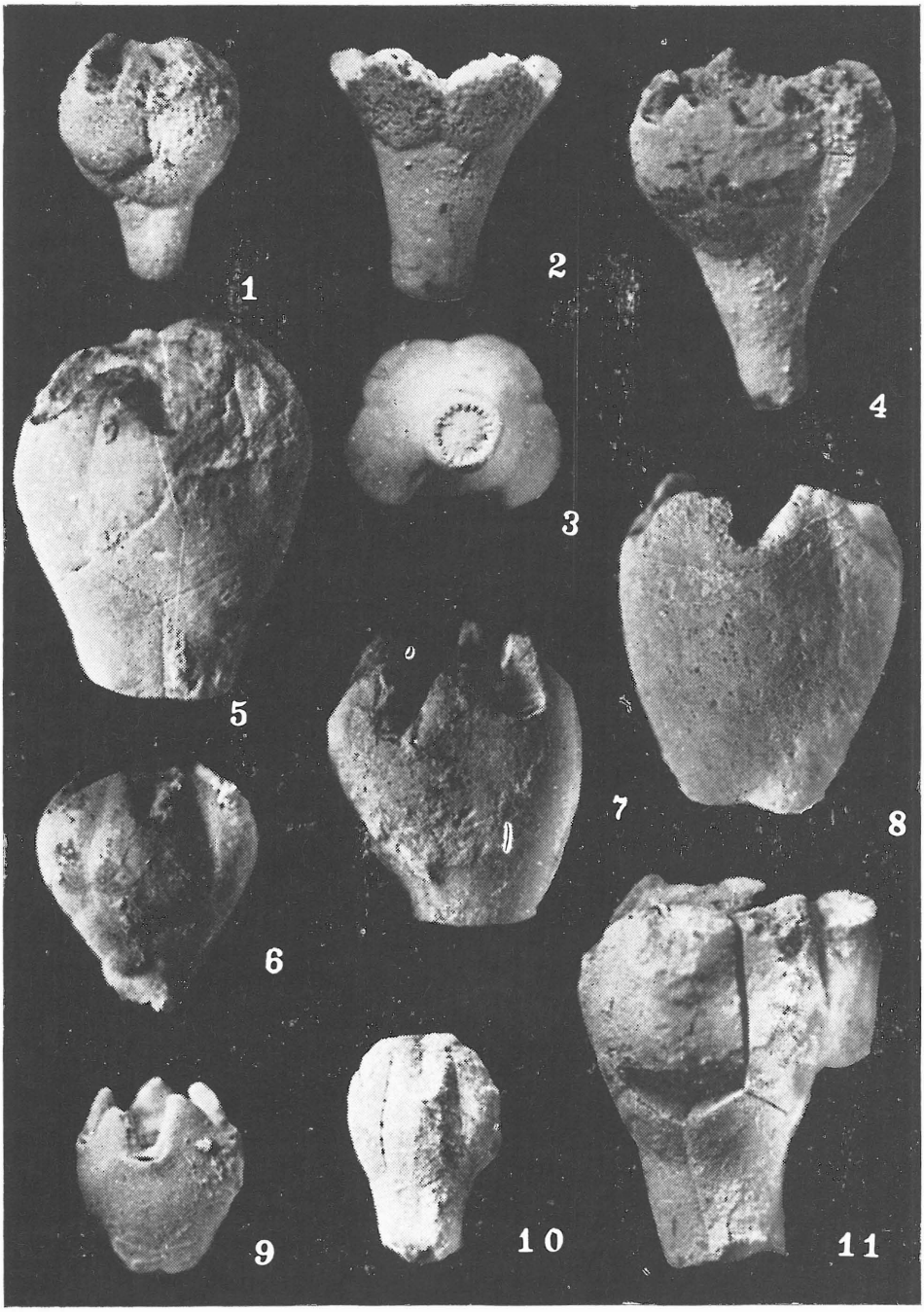
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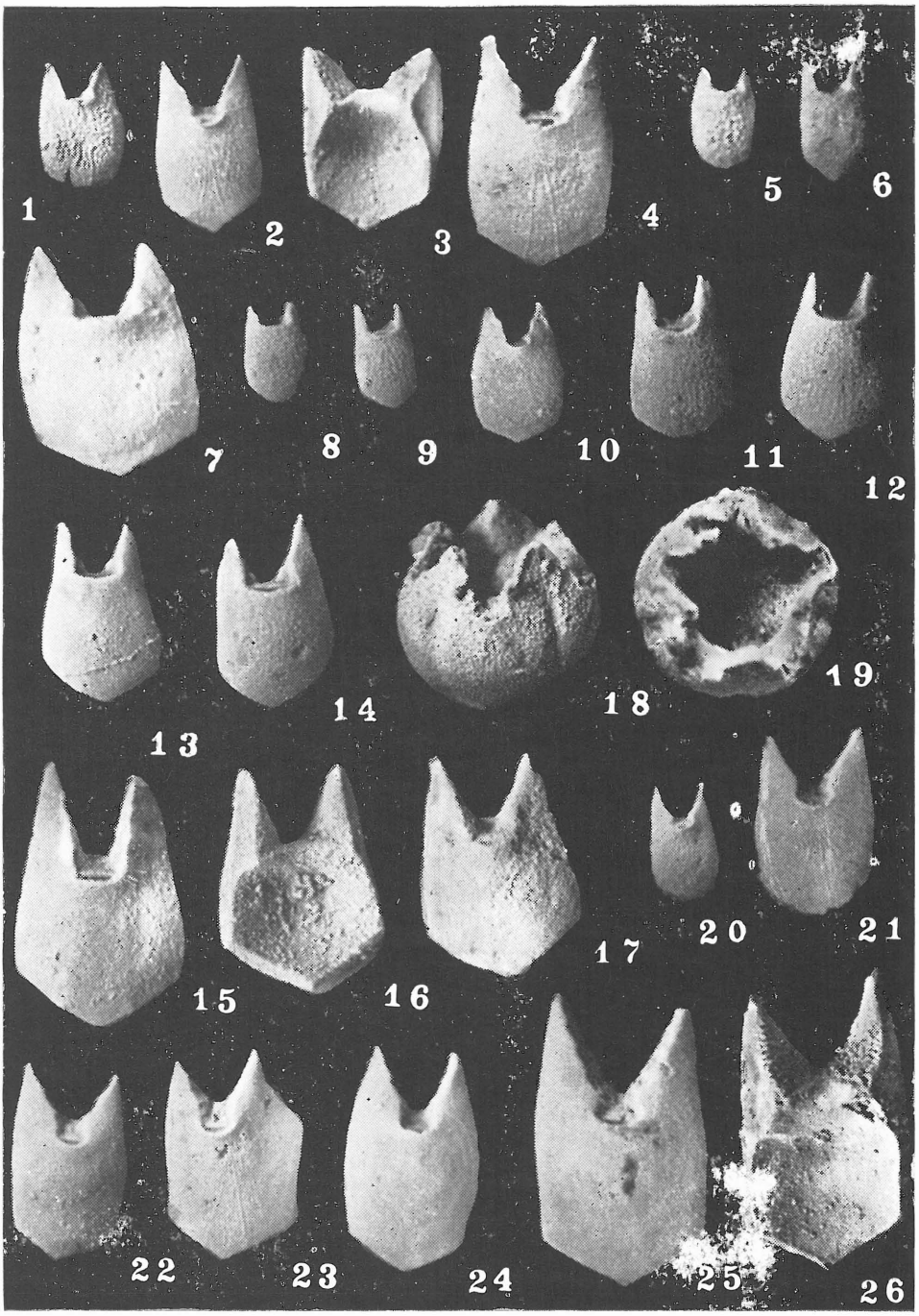
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