# CRETACEOUS AND PALEOGENE *BOURGUETICRININA* (*ECHINODERMATA*, *CRINOIDEA*) OF THE USSR

by

VLADIMIR G. KLIKUSHIN

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# CRETACEOUS AND PALEOGENE *BOURGUETICRININA* (*ECHINODERMATA*, *CRINOIDEA*) OF THE USSR

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ABSTRACT

The theca and the columnals of twenty-two late Cretaceous species of the genus *Bourgueticrinus* (including two new species), of one species of the genus *Democrinus*, of four species of the genus *Conocrinus* (including one new species) and of one species of the genus *Paleobathycrinus* known from USSR are figured and shortly described. Biometric reconstructions of stems for *B. aequalis, B. bellus, B. danicus, B. fischeri* and *C. tauricus* nov. sp. are given. A new index is used to suggest the relative flexibility of stem. Decrease in dimension and flexibility of the arms in several species take place simultaneously with an increase of stem flexibility. This fact seems to be closely related to environmental changes.

RÉSUMÉ

Les coupes dorsales et les columnales de vingt-deux espèces du genre *Bourgueticrinus* (dont deux espèces nouvelles), d'une espèce du genre *Democrinus*, de quatre espèces du genre *Conocrinus* (dont une espèce nouvelle) et d'une espèce du genre *Paleobathycrinus* connues en URSS sont figurées et brièvement décrites. Des reconstructions biométriques des pédoncules sont proposées pour les espèces *B. aequalis, B. bellus, B. danicus, B. fischeri* et *Conocrinus tauricus* nov. sp. Un indice numérique permet d'exprimer la flexibilité relative du pédoncule. Corrélativement à l'augmentation de la flexibilité du pédoncule, il se produit une diminution de la taille et de la mobilité des bras chez plusieurs espèces. Ce fait semble en relation avec des modifications de l'environnement.

KEY-WORDS : *CRINOIDEA, ARTICULATA, BOURGUETICRINUS, DEMOCRINUS, CONOCRINUS, PALEOBATHYCRINUS,* CRETACEOUS, PALEO GENE, USSR.

MOTS-CLÉS : CRINOÏDES, *ARTICULATA, BOURGUETICRINUS, DEMOCRINUS, CONOCRINUS, PALEOBATHYCRINUS,* CRÉTACÉ, PALÉOGÈNE, URSS.

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# TABLE OF CONTENTS



## I — INTRODUCTION

Sea-lilies of the suborder *Bourgueticrinina* are a relatively young branch of the *Articulata*. They appear during late Cretaceous and they are a wide-spread distribution into recent seas. The *Bourgueticrinina* lightly differ from major others groups of the post-paleozoic *Crinoidea* especially by the stem with synarthrial joints between columnals. The same stem feature rarely permit to determine exactly the found remains belong to one species or to another one. The species well distinguished by the theca only, therefore short diagnosis are composed, in the present work mainly, from theca caracteristics.

As a summary, the stratigraphical distribution of the following forms is given. The *Bourgueticrinina* are known from USSR since early Turonian. Rare undistinguish *Bourgueticrinus* columnals were found in lower Turonian limestones of Crimea, for instance. We know a species from Coniacian (tabl. 1), seven ones from Santonian, eight ones from Campanian, seven ones from Maastrichtian, four ones from Danian, only one from Upper Paleocene and three ones are known from Upper Eocene. Various *Bourgueticrinus* species are found in late Cretaceous and Danian. They reached the higher development in Santonian and Campanian. Rhyzocrinoid stem type of *Bourgueticrinus* we meet in Campanian for the first time (in *B. constrictus*), since Danian, has been the only one (in *B. danicus* for example). *Conocrinus*-species have been found since the late Paleocene only. Moreover, most species of the genus *Conocrinus* have been described from Eocene both in the USSR and abroad. *Democrinus* and *Paleobathycrinus* are known from Danian only.

## II — TAXONOMIC DESCRIPTION (1)

Order **MILLERICRINIDA** SIEVERTS-DORECK, 1953
Suborder **Bourgueticrinina** SIEVERTS-DORECK, 1953
Family **BOURGUETICRINIDAE** LORIOL, 1884
Subfamily **Bourgueticrininae** ROUX, 1978

1) The taxonomic order's scheme, elaborating by M. Roux (1978c) is used in the present work.

Genus **Bourgueticrinus** d'ORBIGNY, 1840

**Bourgueticrinus aequalis** d'ORBIGNY, 1840
(fig. 1A-I ; pl. 1, fig. 1-5)

The theca of young specimens (fig. 1B) are conical with a straight basal basis. The former ones have high radials and lower proximals. The theca of large specimens (fig. 1, A,C,D,E) are cylindrical and slightly

| Section | Subsection | Stage | Name of species |
|---|---|---|---|
| Eocene | upper | | C. cf. elongatus<br>C. cf. veronensis<br>C. vogdti |
| | middle | | |
| | lower | | |
| Paleocene | upper | | C. tauricus |
| | lower | Montian | P. endelmani |
| | | Danian | B. bruennichinielseni<br>B. danicus<br>D. maximus<br>P. endelmani |
| Upper Cretaceous | | Maastrichtian | B. aequalis<br>B. constrictus<br>B. crassus<br>B. hagenowii<br>B. sp.1, B. sp.2<br>B. succinctus |
| | | Campanian. | B. bellus<br>B. constrictus<br>B. elegans<br>B. ellipticus<br>B. sulcatus<br>B. tenuis<br>B. utriculatus<br>B. baculatus |
| | | Santonian | B. brydonei<br>B. cylindricus<br>B. ellipticus<br>B. fischeri<br>B. granulosus<br>B. cf. maximus<br>B. naidini |
| | | Coniacian | B. fischeri |

Tabl. 1 — **Stratigraphical distribution of the *Bourgueticrinina*- species in the USSR.**
**Distribution stratigraphique des espèces de *Bourgueticrinina* en URSS.**

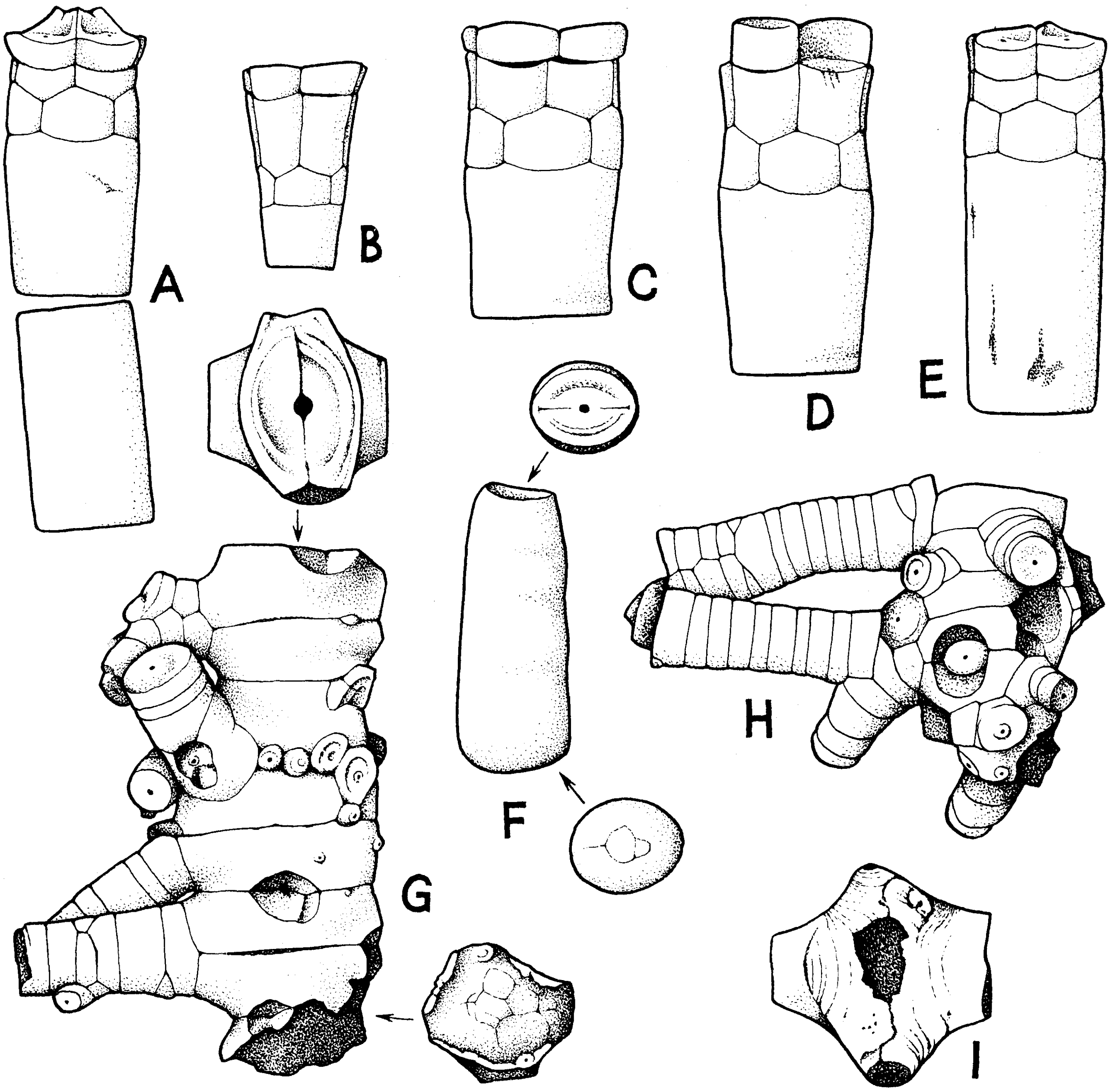



Fig. 1 — **Skeleton fragments of *Bourgueticrinus aequalis***
A - KK-36-1 : theca with the IBr 1 ring and with a proximal columnal (x 5).
B - KK-25-1 : theca of a young specimen (x 5).
C - KK-57-2 : theca (x 5).
D - KK-36-2 : theca (x 5).
E - KK-36-3 : theca (x 5).
F - KK-36-6 : bud from a proximal stem part (x 5).
G - KK-43-2 : distal stem end (x 3).
H - KK-43-3 : distal stem end (x 3).
I - KK-43-4 : lower regenerated surface of a distal columnal (x 3).
Crimea, Belbek-Valley (KK-25 and KK-36), Kuchuk-Karassu-Valley (KK-43) and Churuk-Ssu-Valley (KK-57) ; Lower Maastrichtian.

**Fragments du squelette de *Bourgueticrinus aequalis***
A - KK-36-1 : coupe dorsale avec le cercle de IBr 1 et avec une columnale proximale.
B - KK-25-1 : coupe dorsale de l'exemplaire jeune.
C - KK-57-2 : coupe dorsale.
D - KK-36-2 : coupe dorsale.
E - KK-36-3 : coupe dorsale.
F - KK-36-6 : bourgeon dans la partie proximale du pédoncule.
G - KK-43-2 : extrémité distale du pédoncule.
H - KK-43-3 : extrémité distale du pédoncule.
I - KK-43-4 : surface inférieure régénérée d'une columnale distale.
Crimée, vallée du Belbek (KK-25 et KK-36), vallée du Koutchouk-Karassou (KK-43) et vallée du Tchourouk-Ssou (KK-57) : Maestrichtien inférieur.

convex, with a curved shape downwards basal basis. The radial height and the basal one are almost equal. The proximal height is 1.5 - 2 times as much as the rest of theca. The proximal basis is round and smooth. The height of theca is 5.1 - 11.9 mm ; the diameter of proximal basis is 2.0 - 4.2 mm ; the greater diameter of theca is 3.9 - 4.7 mm ; the greater diameter of columnals is 2.0 - 12.0 mm ; the height of columnals is 1.8 - 8.0 mm.

REMARKS : The present species was determined erroneously as *B. suedicus* in one of author's publications (Klikushin, 1980). It is quite possible the *Bourgueticrinus* columnals from lower Maastrichtian of Volga-Basin which were described or mentioned as *B. ellipticus* (Yazikov, 1844 ; Eichwald, 1846, 1868 ; Murchison & *alii*, 1849 ; Lahuzen, 1873) may be attributed to *B. aequalis*. The study of the Lahuzen's collection kept at Leningrad Mining Museum and the author's investigations near Ulianovsk and Saratov are confirmed such a view.

The tracks of regeneration are discovered during the study of stem remains of *B. aequalis*. A stem broken in radicular part shows broken columnal curing itself by the development of small polygonal plates (fig. 1G below). A stem broken in its most viable part shows the lower surface of the last remaining columnal covering itself by calcitic new-formations which grew from the two hands to the fulcral ridge (fig. 1, I). The « Blinde Knospen » closed from below (fig. 1, F) was formed by stem gap in its proximal part. Such « bud » may be the beginning of new radicular cirrhus during fastening again the animal upon bottom. The analogous « buds » are known also in triassic *Encrinidae* (Meyer, 1849 ; Hagdorn, 1978).

DISTRIBUTION : Lower Maastrichtian of Crimea, Volga-Basin and Mangyshlack (fig. 16-1).

**Bourgueticrinus bellus** KLIKUSHIN, 1975
(fig. 2 A-G ; pl. 2, fig. 1-11).

The theca is cyclindrical or slightly widened out above. The basals are small, convex, triangular and disunite or lightly adjoined by their lateral sides. The radials are high and convex. The radial ring section is pentalobate. The proximal is low, convex, with a round basis. The lower articular face of a proximal is smooth or it bears rare and poorly expressed tubercules. The height of theca without a proximal is 3.5 - 4.2 mm ; the height of proximal is 1.4 mm ; the diameter of proximal basis is 4.2 mm ; the larger diameter of theca is 5.1 - 5.6 mm ; the larger diameter of columnals is 1.4 - 5.7 mm ; the height of columnals is 1.3 - 11.5 mm.

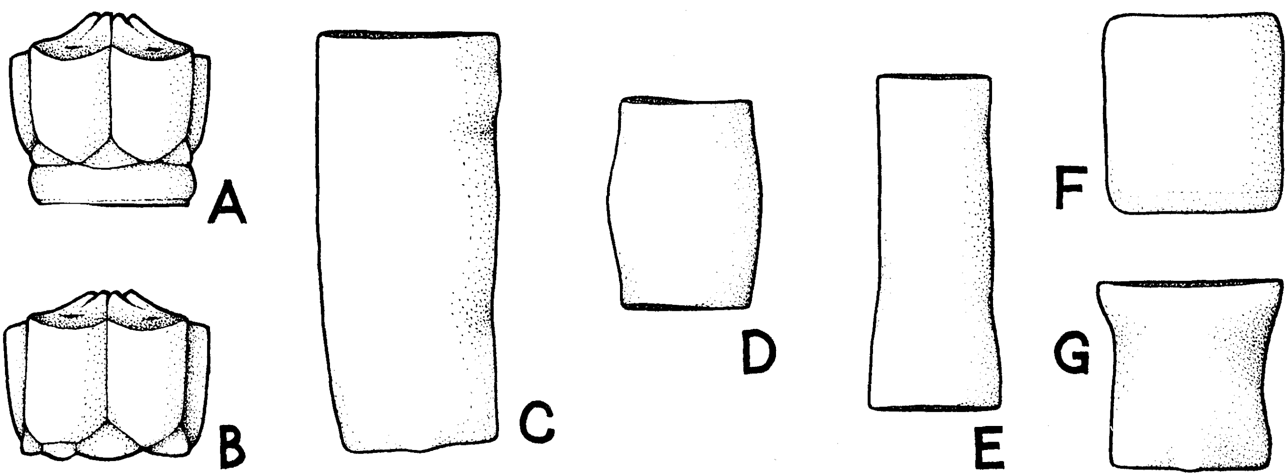



Fig. 2 — **Skeleton fragments of *Bourgueticrinus bellus*** (x 5).
A - holotype KM-29-1 : theca.
B - KM-64-1 : theca with six basals.
C - KM-29-4 : columnal from the middle part of a stem.
D - KM-29-5 : columnal from the middle part of a stem.
E - KM-29-6 : columnal from the middle part of a stem.
F - KM-29-2 : columnal from the proximal part of stem.
G - KM-29-3 : columnal from the distal part of a stem.
Mangyshlack, Teyu-Ssu-Mountain (KM-29) and Ssullukapy-Ravine (KM-64 ; coll. D.P. Naidin) ; Lower Campanian.

**Fragments du squelette de *Bourgueticrinus bellus*** (x 5).
A - holotype KM-29-1 : coupe dorsale.
B - KM-64-1 : coupe dorsale avec six basales.
C - KM-29-4 : columnale de la partie moyenne du pédoncule.
D - KM-29-5 : columnale de la partie moyenne du pédoncule.
E - KM-29-6 : columnale de la partie moyenne du pédoncule.
F - KM-29-2 : columnale de la partie proximale du pédoncule.
G - KM-29-3 : columnale de la partie distale du pédoncule.
Manghychlak, montagne Teu-Ssou (KM-29) et ravin Ssoulloukapy (KM-64 ; coll. D.P. Naidin) ; Campanien inférieur.

REMARKS : Six basal plates are observed on one of handing theca of *B. bellus* (fig. 2, B) instead of five ones as it is usually. The additional basal is small and situated just under one of the radials. The suture between the radial and the additional basal is straight and the lower side of this basal is curved downwards.

A few columnals of *B. bellus* (fig. 2 C,E) have large height up to 10-11 mm and relatively small diameter. Hardly visible depressions on these columnal sides show these columnals are built by two-three adhered previous columnals.

DISTRIBUTION : Lower Campanian of Mangyshlack (fig. 16-2).

**Bourgueticrinus bruennichinielseni** ODUM, 1923
(fig. 3 B)

The theca is conical, widening out above. The basals are high, sixangular and closed. The radials are as twice lower than the basals. The proximal is low. The proximal basis is round and smooth. The height of theca is 4.5 - 5.3 mm ; the greater diameter of theca is 2.1 - 2.9 mm.

DISTRIBUTION : Danian of Mangyshlack (fig. 16-3).

**Bourgueticrinus brydonei** RASMUSSEN, 1961
(fig. 3 A)

The basals are closed. The basal basis is curved downwards. The proximal is conical, widening out towards basis. The proximal basis is round and smooth apparently. The height of proximal is 3.5 mm ; the proximal diameter below is 4.3 mm ; the proximal diameter above is 3.9 mm.

DISTRIBUTION : Upper Santonian of Mangyshlack (fig. 16-4).

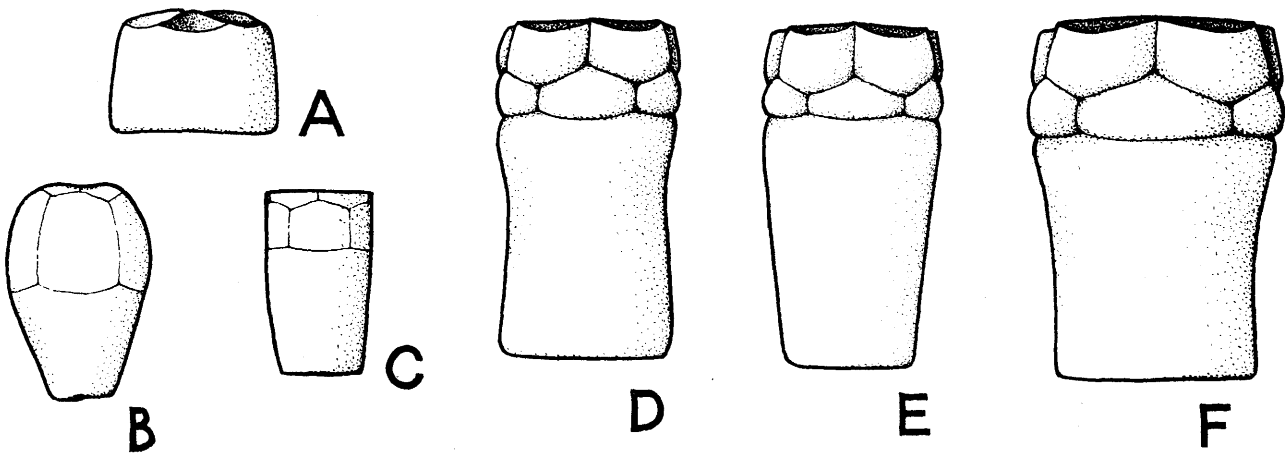



Fig. 3 — **Theca and theca fragments of *Bourgueticrinus*** (x 5).
A - *B. brydonei*, KM-60-1 : proximal. Mangyshlack, Ssullukapy-Ravine ; Upper Santonian (coll. D.P. Naidin).
B - *B. bruennichinielseni*, KM-9-1 : theca. Mangyshlack, Kapam-Ravine ; Danian.
C - *B. constrictus*, KM-90-1 : theca. Mangyshlack, Aksyr-Tau-Mountain ; Lower Campanian (coll. D.P. Naidin)
D - *B. crassus*, KM-22-1 : theca. Mangyshlack, Kugussem-Well ; Lower Maastrichtian.
E - *B. crassus*, holotype KM-36-1 : theca. Mangyshlack, Teyu-Ssu-Mountain ; Lower Maastrichtian.
F - *B. crassus*, KM-36-2 : theca. Mangyshlack, Teyu-Ssu-Mountain ; Lower Maastrichtian.

**Coupes dorsales et fragments de coupes dorsales de *Bourgueticrinus*** (x 5).
A - *B. brydonei*, KM-60-1 : proximale. Manghychlak, ravin Soulloukapy ; Santonien supérieur (coll. D.P. Naidin).
B - *B. bruennichinielseni*, KM-9-1 : coupe dorsale. Mangychlak, ravin Kapam ; Danien.
C - *B. constrictus*, KM-90-1 : coupe dorsale. Manghychlak, montagne Akssyr-Taou ; Campanien inférieur (coll. D.P. Naidin).
D - *B. crassus*, KM-22-1 : coupe dorsale. Manghychlak, puits Kougoussem ; Maestrichtien inférieur.
E - *B. crassus*, holotype KM-36-1 : coupe dorsale. Manghychlak, montagne Teu-Ssou ; Maestrichtien inférieur.
F - *B. crassus*, KM-36-2 : coupe dorsale. Manghychlak, montagne Teu-Ssou ; Maestrichtien inférieur.

**Bourgueticrinus constrictus** (HAGENOW, 1876)
(fig. 3 C ; pl. 1, fig. 6)

The theca is conical, widening out above. The basals are equal to the radials and they have pentangular outlines. The basal basis is slightly curved downwards. The proximal is high. The proximal basis is elliptic with the poorly pronounced fulcral ridge. The height of theca is 4.9 mm ; the diameter of theca above is 2.8 mm ; the diameter of theca below is 2.0 - 2.3 mm.

DISTRIBUTION : Lower Campanian and Lower Maastrichtian of Mangyshlack and Turkmenia (fig. 16-5).

**Bourgueticrinus crassus** KLIKUSHIN, 1975
(fig. 3 D, E, F)

The theca is pear-shaped or conical, widening out above. The basals are low, pentangular and convex. The basal basis is almost horizontal. The radials are convex and they are a few higher than the basals. The proximal is high and massive with the even or slightly concave sides. The proximal basis is round and smooth. The height of theca is 9.0 - 9.6 mm ; the larger diameter of theca is 4.7 - 6.8 mm.

DISTRIBUTION : Lower Maastrichtian of Mangyshlack (fig. 16-6).

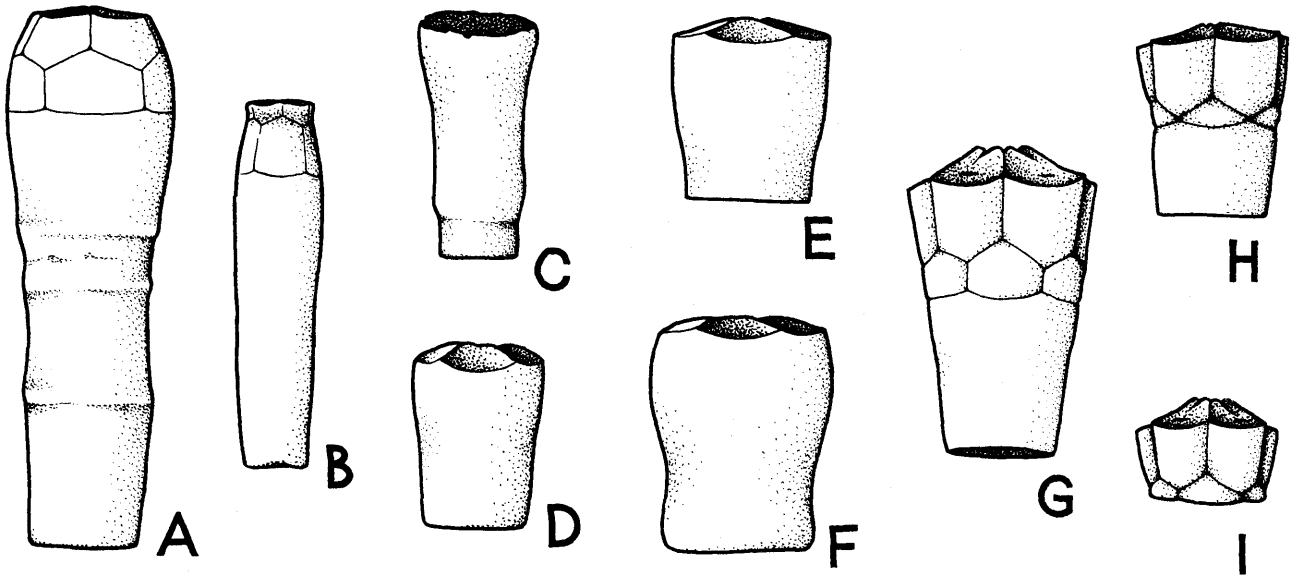



Fig. 4 — **Theca and theca fragments of *Bourgueticrinus*** (x 5).
A - *B. cylindricus*, KM-58-1 : theca. Mangyshlack, Ssullukapy -Ravine ; Upper Santonian (coll. D.P. Naidin).
B - *B. danicus*, KM-3-1 : theca. Mangyshlack, Kapam-Ravine ; Danian.
C - *B. elegans*, KM-17-1 : proximal with a broken upper surface. Mangyshlack, Kugussem-Well ; Santonian.
D - *B. ellipticus*, KM-23-1 : proximal. Mangyshlack, Kugussem-Well ; Santonian.
E - *B. ellipticus*, KM-41-1 : proximal. Mangyshlack, Akssyr-Tau-Mountain ; Lower Campanian.
F - *B. ellipticus*, KM-31-1 : proximal. Mangyshlack, Teyu-Ssu-Mountain ; Lower Campanian.
G - *B. fischeri*, KT-1-1 : theca. Turkemenia, Little-Balkan-Mountains ; Coniacian.
H - *B. fischeri*, KM-38-1 : theca. Mangyshlack, Akssyr-Tau-Mountain ; Coniacian.
I - *B. fischeri*, KM-19-1 : theca without a proximal. Mangyshlack, Kugussem-Well ; Lower Santonian.

**Coupes dorsales et fragments de coupes dorsales de *Bourgueticrinus*** (x 5).
A - *B. cylindricus*, KM-58-1 : coupe dorsale. Mangyshlack, ravin Ssoulloukapy ; Santonien supérieur (coll. D.P. Naidin).
B - *B. danicus*, KM-3-1 : coupe dorsale. Manghychlak, ravin Kapam ; Danien.
C - *B. elegans*, KM-17-1 : proximale avec surface supérieure cassée. Manghychlack, puits Kougoussem ; Santonien.
D - *B. ellipticus*, KM-23-1 : proximale. Manghychlak, puits Kougoussem ; Santonien.
E - *B. ellipticus*, KM-41-1 : proximale. Manghychlak, montagne Akssyr-Taou ; Campanien inférieur.
F - *B. ellipticus*, KM-31-1 : proximale. Manghychlak, montagne Teu-Ssou ; Campanien inférieur.
G - *B. fischeri*, KT-1-1 : coupe dorsale. Turkménie, crête du Petit Balkhan ; Coniacien.
H - *B. fischeri*, KM-38-1 : coupe dorsale. Manghychlak, montagne Akssyr-Taou ; Coniacian.
I - *B. fischeri*, KM-19-1 : coupe dorsale sans proximale. Manghychlak, puits Kougoussem ; Santonien inférieur.

**Bourgueticrinus cylindricus** M'COY, 1848
(fig. 4 A)

The theca is high and clavae-shaped. The basals are high and pentangular with almost horizontal basis. The radials are pentangular and they are equal to the basals. The proximal is very high with a depression giving evidence in its complex structure. The proximal basis is elliptical with a distinct fulcral ridge. The height of theca is 14.0 mm ; the larger diameter of theca is 4.4 mm ; the height of proximal is 11.3 mm ; the diameter of proximal basis is 2.4 - 2.6 mm.

DISTRIBUTION : Upper Santonian of Mangyshlack (fig. 16-7).

**Bourgueticrinus danicus** NIELSEN, 1913
(fig. 4 B ; pl. 1, fig. 7-11)

The theca is spindle-shaped. The basals are relatively high and pentangular. The basal basis is slightly curved downwards. The radials are low and pentangular. The proximal is very high. The proximal basis is elliptic with a distinct fulcral ridge. The height of theca is 6.0 - 10.7 mm ; the greater diameter of theca is 1.8 - 3.0 mm ; the diameter of columnals is 1.6 - 8.0 mm ; the height of columnals is 2.0 - 6.4 mm.

REMARKS : *B. danicus* was noted from Danian deposits of Crimea (Naidin, 1964 ; Mulika, 1971 ; Maslskova, 1971 ; Gorbach, 1972 ; Klikushin, 1975a, 1980 and others), of West Georgia (Moskvin & Naidin, 1960) and of Mangyshlack (Klikushin, 1975b). The *Bourgueticrinus*- columnals from Danian of Crimea which were erroneously determined often as *B. ellipticus* (Romanovsky, 1867, 1868 ; Sloudsky, 1911 ; Malycheff, 1913 ; Pavlinov, 1938 ; Khanin, 1950 ; Vassilenko, 1952 ; Morozova, 1960 ; Vialov, 1961, 1976 and others), are attributed to *B. danicus* really.

DISTRIBUTION : Danian of Crimea, Caucasus, Mangyshlack and Turkmenia (fig. 16-8).

**Bourgueticrinus elegans** GRIFFITH & BRYDONE, 1911
(fig. 4 C)

The theca is high. The basals are conjoint with the proximal. The proximal is enlarged in upper part and it has concave sides. The proximal basis is elliptic with a poorly expressed fulcral ridge. The height of theca is 6.2 mm ; the maximum diameter of theca is 3.0 mm ; the diameter of proximal basis is 1.8 - 1.9 mm.

DISTRIBUTION : Lower Campanian of Mangyshlack (fig. 16-9).

**Bourgueticrinus ellipticus** (MILLER, 1821)
(fig. 4 D, E, F)

The proximal is high with concave sides. The basal basis is strongly curved downwards. The proximal basis is almost round with a poor expressed fulcral ridge. The height of proximal is 3.7 - 6.0 mm ; the greater diameter of proximal is 3.2 - 5.1 mm ; the diameter of proximal basis is 2.4 - 4.1 mm.

REMARKS : *B. ellipticus* was noted in Upper Santonian and Lower Campanian of Northern Caucasus, of Daghestan and of Kopet-Dagh (Poslavskaya & Moskvin, 1959 ; Moskvin, 1968).

DISTRIBUTION : Upper Santonian - Lower Campanian of Crimea, Caucasus, Mangyshlack and Turkmenia (fig. 16-10).

**Bourgueticrinus fischeri** (GEINITZ, 1872)
(fig. 4 G, H, I ; pl. 3, fig. 1-8)

The theca is conical, widening out above. The basals are low, pentangular and slightly convex. The basal basis is curved downwards. The radials are high and convex. The proximal is not large. The proximal basis is round and smooth or with a poorly visible fulcral ridge. The height of theca is 5.0 - 8.1 mm ; the larger diameter of theca is 3.9 - 4.7 mm ; the diameter of proximal basis is 2.7 - 2.9 mm ; the diameter of columnals is 1.7 - 7.1 mm ; the height of columnals is 1.4 - 6.3 mm.

REMARKS : The columnals and the proximals from Turonian-Coniacian of West Ukrainia which were determined as *B. ellipticus* and *B.* cf. *hagenowii* (Hynda, 1969, 1971), might be attributed to the present species.

DISTRIBUTION : Coniacian - Lower Santonian of West Ukrainia, Turkmenia and Mangyshlack (fig. 16-11)

**Bourgueticrinus granulosus** PERON, 1887
(pl. 4, fig. 1,2)

The theca is unknown in the USSR. The columnals from the proximal stem part are high with flat or slightly concave sides. Distal columnals are low and barrel-shaped. The external surface of columnals is covered by chaotic disposed hillocks. The fulcral ridge is poorly expressed. The diameter of columnals is 2.5 - 3.8 mm ; the height of columnals is 3.1 - 7.5 mm.

DISTRIBUTION : Santonian of Mangyshlack ; Lower Campanian of Turkmenia (fig. 16-12).

**Bourgueticrinus hagenowii** (GOLDFUSS, 1840)
(fig. 5 A, B ; pl. 4, fig. 3-5)

The theca is spindle-shaped. The basals are high. The basal basis is horizontal. The radials are small. The proximal is large. The proximal basis is elliptic with a well pronounced fulcral ridge. The height of theca is 4.6 - 9.1 ; the maximum diameter of theca is 1.9 - 3.7 mm ; the diameter of proximal basis is 1.7 - 3.3 mm.

DISTRIBUTION : Maastrichtian of Mangyshlack, and Aral-Sea-Region (fig. 16-13).

**Bourgueticrinus** cf. **maximus** (VALETTE, 1917)
(fig. 5 F ; pl. 4, fig. 6)

The theca is unknown in the USSR. The columnals are large and barrel-shaped. The articulums are round and almost smooth. The fulcral ridge is poorly expressed. The diameter of columnals is up to 6.1 mm ; the height of columnals is up to 7.0 mm.

DISTRIBUTION : Upper Santonian of Mangyshlack (fig. 16-14).

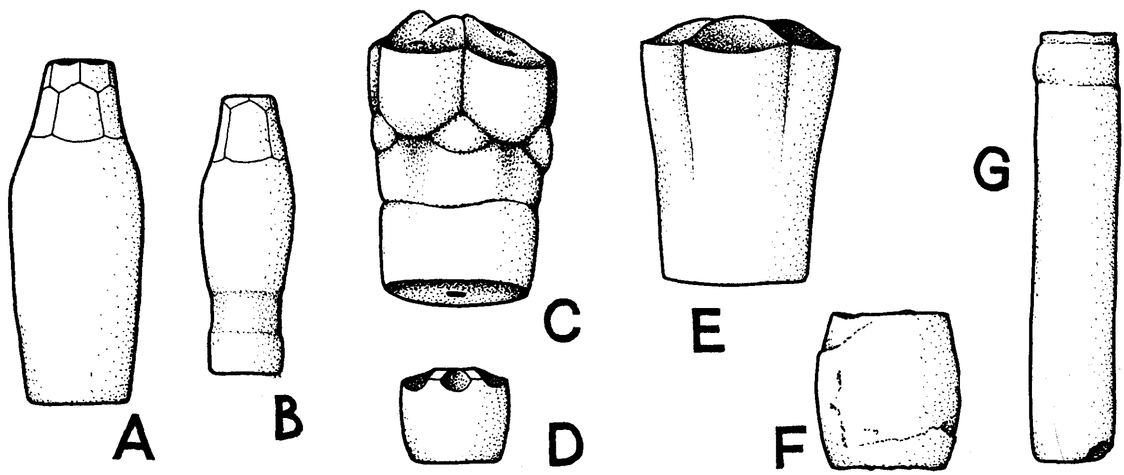



Fig. 5 — **Skeleton fragments of *Bourgueticrinus*.**
A - *B. hagenowii*, KM-10-1 : theca (x 5). Mangyshlack, Kapam-Ravine ; Upper Maastrichtian.
B - *B. hagenowii*, KM-10-2 : theca (x 5). Mangyshlack, Kapam-Ravine ; Upper Maastrichtian.
C - *B. naidini*, holotype KM-91-1 : theca with a proximal columnal (x 7). Mangyshlack, Shah-Bogota-Mountain ; Lower Santonian (coll. D.P. Naidin).
D - *B. naidini*, KM-52-1 : proximal (x 5). Mangyshlack, Ssullukapy-Ravine ; Santonian (coll. D.P. Naidin).
E - *B. sulcatus*, holotype KM-30-1 : proximal (x 5). Mangyshlack, Teyu-Ssu-Mountain ; Lower Campanian.
F - *B.* cf. *maximus*, KM-68-1 : columnal (x 3). Mangyshlack, Zhalgan-Mountain ; Upper Santonian (coll. D.P. Naidin).
G - *B. tenuis*, KK-22-1 : theca (x 5). Crimea, Belbek-Valley ; Upper Campanian.

**Fragments du squelette de *Bourgueticrinus*.**
A - *B. hagenowii*, KM-10-1 : coupe dorsale. Manghychlak, ravin Kapam ; Maestrichtien supérieur.
B - *B. hagenowii*, KM-10-2 : coupe dorsale. Mangyshlak, ravin Kapam ; Maestrichtien supérieur.
C - *B. naidini*, holotype KM-91-1 : coupe dorsale avec une columnale proximale (x 7). Manghychlak, montagne Schah-Bogota ; Santonien inférieur (coll. D.P. Naidin).
D - *B. naidini*, KM-52-1 : proximale. Manghychlak, ravin Ssoulloukapy ; Santonien (coll. D.P. Naidin).
E - *B. sulcatus*, holotype KM-30-1 : proximale. Manghychlak, montagne Teu-Ssou ; Campanien inférieur.
F - *B. cf. maximus*, KM-68—1 : columnale. Manghychlak, montagne Jalgan ; Santonien supérieur (coll. D.P. Naidin).
G - *B. tenuis*, KK-22-1 : coupe dorsale. Crimée, vallée du Belbek ; Campanien supérieur.

**Bourgueticrinus naidini** KLIKUSHIN, 1981 (*in press*)
(fig. 5 C, D)

The theca is cylindrical. Small basals are divided by the radials. The basal basis is well curved downwards. The radials are high and convex. The proximal is small. The proximal basis is round and flat with a scanty hillock. The height of theca is 3.6 mm ; the height of proximal is 1.5 - 2.5 mm ; the diameter of proximal basis is 2.4 - 2.5 mm ; the diameter of radial ring is 3.4 mm.

DISTRIBUTION : Santonian of Mangyshlack (fig. 16-15).

**Bourgueticrinus sulcatus** KLIKUSHIN, 1975
(fig. 5 E)

The complete theca is unknown. Small basals are divided by the radials. The basal basis is flat. The proximal is high and smooth with a slightly convex sides. The proximal basis is round and smooth. Well pronounced vertical furrows run under basals on external proximal surface. The height of proximal is 5.6 - 7.1 mm ; the diameter of proximal above is 3.8 - 5.1 mm and one below is 3.2 - 3.9 mm.

DISTRIBUTION : Lower Campanian of Mangyshlack (fig. 16-16).

**Bourgueticrinus tenuis** RASMUSSEN, 1961
(fig. 5 G)

The theca is cylindrical, high and slender. Small basals form the ring with flat basis. The radials are poorly preserved. The proximal is very high with unequal external surface. The proximal basis is elliptic with pronounced fulcral ridge. The height of theca is 11.4 mm ; the height of radial and basal rings is 1.6 mm ; the diameter of theca is 2.2 mm.

DISTRIBUTION : Upper Campanian of Crimea (fig. 16-17).

**Bourgueticrinus utriculatus** (VALETTE, 1917)
(fig. 6 A)

The theca is pear-shaped. The basals are high. The basal basis is curved downwards. The radials are almost twice smaller than the basals. The proximal is not high with a concave external surface. The proximal basis is broken. The height of theca is 5.4 mm ; the diameter of basal ring is 4.0 mm ; the diameter of proximal basis is 2.9 mm.

DISTRIBUTION : Lower Campanian of Mangyshlack (fig. 16-18).

**Bourgueticrinus** sp. 1
(fig. 6 B)

The theca is pear-shaped. The sutures between the proximal, the basals and the radials are not visible. The proximal basis is broken. The height of theca is 5.3 mm ; the greater diameter of theca is 3.7 mm ; the diameter of proximal basis is 1.9 mm.

DISTRIBUTION : Lower Maastrichtian of Turkmenia (fig. 16-19).

**Bourgueticrinus** sp. 2
(fig. 6 C)

The theca is enlarged above. The basals are convex and they form a continuous ring. The basal basis is flat. The radials are broken. The proximal is high and barrel-shaped. The proximal basis is elliptic with a well pronounced fulcral ridge. The height of the preserved part of theca is 6.0 mm ; the diameter of proximal is 5.5 mm.

DISTRIBUTION : Maastrichtian of Amu-Daria-Basin (fig. 16-20).

**Bourgueticrinus baculatus** nov. sp.
(fig. 6 D-I, 7 A ; pl. 4, fig. 7-11)

DERIVATIO NOMINIS : The name of the species comes from « *baculatus* » (in Latin) - stick-shaped.

HOLOTYPE : The specimen KT-8-1 (fig. 6 D and pl. 4, fig. 7) ; Structural and Marine Geology chair of Leningrad Mining Institute ; Turkmenia, Little-Balchan-Mountains, station Akhchakuima ; Lower Campanian.

MATERIALS : KT-8 : one theca from the type locality ; KT-27 : two thecas, 110 stem fragments and columnals (Turkmenia, West Kopet-Dagh, settlement Kara-Kala ; Lower Campanian) ; KT-29 : one theca, one proximal and 25 columnals (Turkmenia, West Kopet-Dagh, settl. Kara-Kala ; Upper Campanian).

DESCRIPTION : The theca of young specimen (fig. 6 F) is conic and enlarged above. The basal ring is high with a flat basis. The radials are low. The diameter of radial ring is equal to the diameter of basal ring. The theca of large specimens (fig. 6 D, E, 7 A) are stick-shaped, slightly widening out above. The basals are high. The basis of the basal ring is flat or slightly curved downwards. The diameter of the radial ring is slender than the basal ring one. The radials are lower than the basals. The upper radial border is clearly lapelled outside. The proximal basis is round and smooth. Theheight of theca is 5.1 - 11.2 mm ; the maximum diameter of theca is 1.4 - 3.7 mm.

COMPARISON : The described species is closely related to *B. constrictus, B. hagenowii* and *B. danicus* by the construction of the theca. It differs from all the three species by the round and smooth proximal basis and by the considerable lapel of the upper radial edge.

DISTRIBUTION : Campanian of Turkmenia (fig. 16-21).

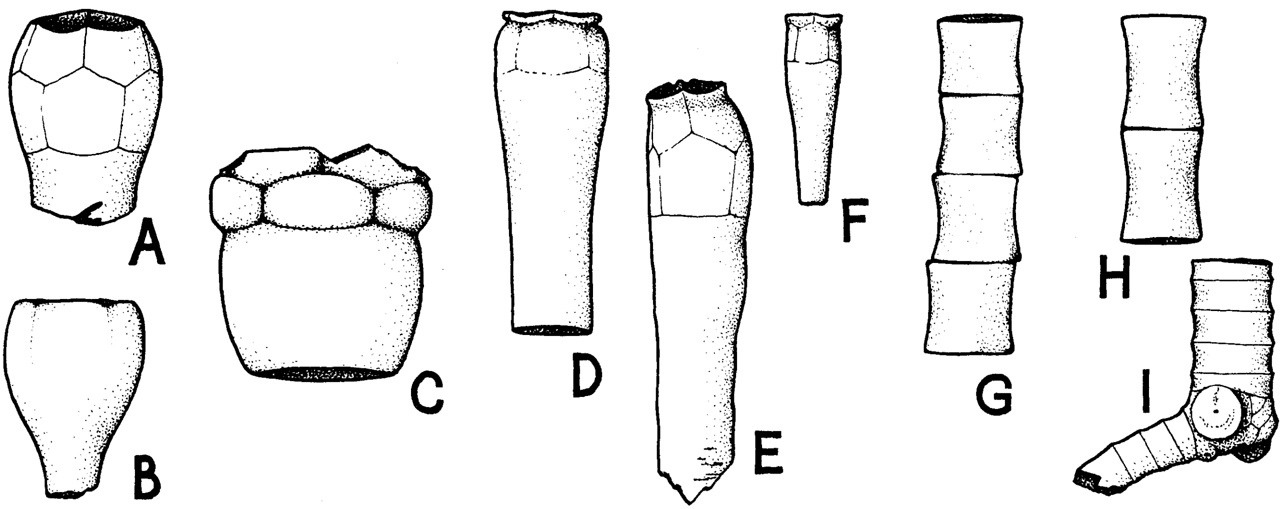



Fig. 6 — **Skeleton fragments of *Bourgueticrinus***

A - *B. utriculatus*, KM-42-1 : theca with a broken proximal basis (x 5). Mangyshlack, Akssyr-Tau-Mountain ; Lower Campanian.

B - *Bourgueticrinus* sp. 1, KT-39-1 : theca with a broken basis (x 5). Turkmenia, Little-Balkhan-Mountains ; Lower Maastrichtian (coll. M.P. Ssukachiova).

C - *Bourgueticrinus* sp. 2, KT-41-1 : theca with the radial ring (x 5). Turkmenia, Amu-Darya-Bassin ; Maastrichtian (coll. T.A. Favorskaya).

D-I - *B. baculatus*

D - holotype KT-8-1 : theca (x 5).
E - KT-29-1 : theca with a broken proximal (x 5).
F - KT-27-L : theca of a young specimen (x 5).
G - KT-27-2 : fragment from the middle stem part (x 3).
H - KT-27-3 : fragment from the proximal stem part (x 3).
I - KT-27-4 : distal radicular part of a stem (x 3).
Turkmenia : Little-Balkhan-Mountains, Lower Campanian (KT-8) ; West Kopet-Dagh, Lower Campanian (KT-27) ; West Kopet-Dagh, Upper Campanian (KT-29).

**Fragments du squelette de *Bourgueticrinus***

A - *B. utriculatus*, KM-42-1 : coupe dorsale avec une proximale cassée. Manghychlak, montagne Akssyr-Taou ; Campanien inférieur.

B - *Bourgueticrinus* sp. 1, KT-39-1 : coupe dorsale avec la base cassée. Turkménie, crête du Petit Balkhan ; Maestrichtien inférieur (coll. M.P. Ssoukatchova).

C - *Bourgueticrinus* sp. 2, KT-41-1 : coupe dorsale avec le cercle de radiales. Turkménie, bassin du Amou-Daria ; Maestrichtien (coll. T.A. Favorskaya).

D-I - *B. baculatus*

D - holotype KT-8-1 : coupe dorsale.
E - KT-29-1 : coupe dorsale avec une proximale cassée.
F - KT-27-1 : coupe dorsale d'un exemplaire jeune.
G - KT-27-2 : fragment de la partie moyenne du pédoncule.
H - KT-27-3 : fragment de la partie proximale du pédoncule.
I - KT-27-4 : racines distales du pédoncule.
Turkménie : crête du Petit Balkhan, Campanien inférieur (KT-8) ; Kopet-Dagh occidental, Campanien inférieur (KT-27); Kopet-Dagh occidental, Campanien supérieur (KT-29).

### **Bourgueticrinus succinctus** nov.sp. (fig. 7 B-D)

DERIVATIO-NOMINIS : The name of the species comes from « *succinctus* » (in Latin) - girdled.

HOLOTYPE : The specimen KT-31-1 (fig. 7 B) ; Structural and Marine Geology Chair of Leningrad Mining Institute ; Turkmenia, West-Kopet-Dagh, settl. Kara-Kala ; Lower Maastrichtian.

MATERIALS : KT-31 : one theca and ten columnals from the type locality ; KT-49 : one proximal and four columnals (Turkmenia, West Kopet-Dagh, settl. Tersakhan ; Lower Maastrichtian).

DESCRIPTION : The theca is high, widening out above. The basals are small, triangular and separated. The basal basis is curved downwards. The radials are relatively high and convex. The radial ring section is pentalobate. The proximal is very high and evenly widening upwards or having a pronounced pressings. The proximal basis is round with a pronounced fulcral ridge. The columnals are high, massive and cylindrical or spindle-shaped. The height of theca is 19.0 mm ; the height of proximal is 14.8 - 15.5 mm ; the larger diameter of theca is 6.9 mm ; the height of columnals is up to 15.5 mm ; the diameter of columnals is up to 5.8 mm.

COMPARISON : The described species is closely related to *B. bellus* by construction of basal and radial rings. It differs from this species by the very large proximal.

DISTRIBUTION : Lower Maastrichtian of Turkmenia (fig. 16-22).

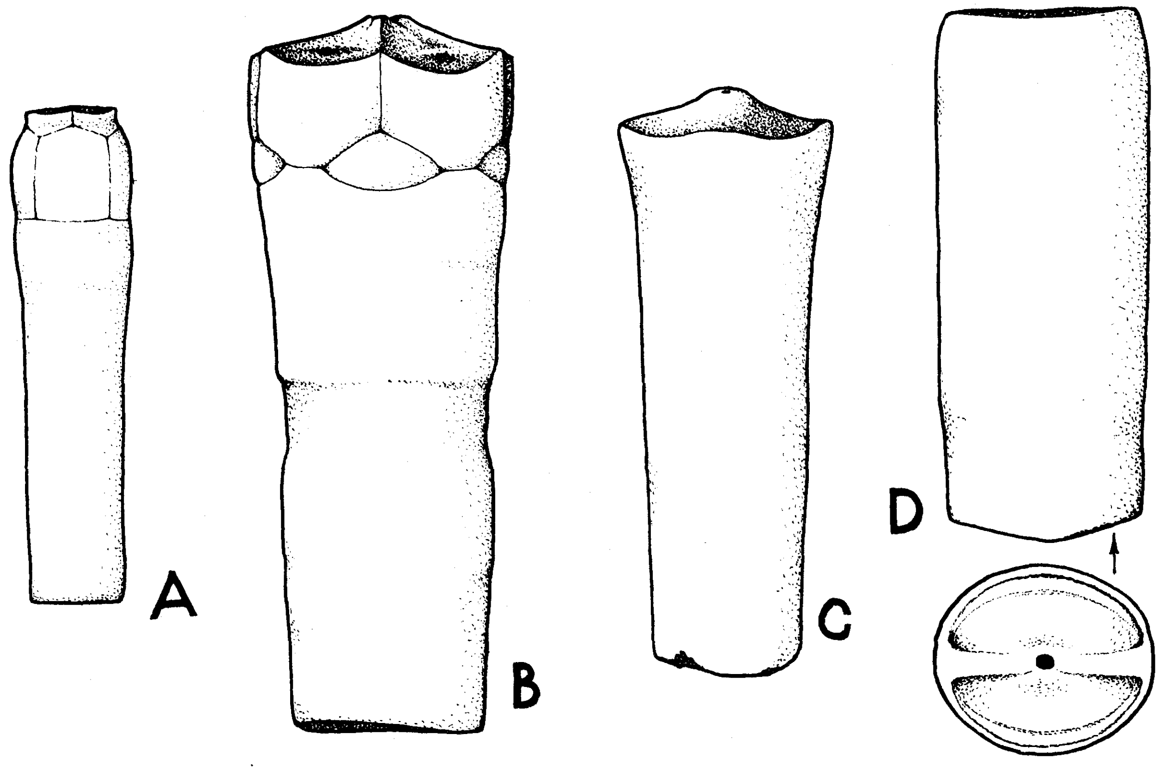



Fig. 7 — **Skeleton fragments of *Bourgueticrinus*** (x 5).
A - ***B. baculatus***, KT-27-2 : theca. Turkmenia, West Kopet-Dagh, settl. Kara-Kala ; Lower Campanian.
B - ***B. succinctus***, holotype KT-31-1 : theca.
C - ***B. succinctus***, KT-49-1 : proximal.
D - ***B. succinctus***, KT-31-2 : columnal.
Turkmenia, West Kopet-Dagh, settl. Kara-Kala (KT-31) and settl. Tersakhan (KT-49) ; Lower Maastrichtian.

**Fragments du squelette de *Bourgueticrinus*.**
A - ***B. baculatus***, KT-27-2 : coupe dorsale. Turkménie, Kopet-Dagh occidental, Kara-Kala ; Campanien inférieur.
B - ***B. succinctus***, holotype KT-31-1 : coupe dorsale.
C - ***B. succinctus***, KT-49-1 : proximale.
D - ***B. succinctus***, KT-31-2 : columnale.
Turkménie, Kopet-Dagh occidental, Kara-Kala (KT-31) et Tersakhan (KT-49) ; Maestrichtien inférieur.

### Genus **Democrinus** PERRIER, 1883

**Democrinus maximus** (NIELSEN, 1915)
(pl. 3, fig. 9-11)

The theca is conic, widening above or spindle-shaped, without a proximal. The radials and the basals are high. The sutures between the radials and the basals are visible. The basal basis is round, smooth and concave. The radial facets are directed upwards. The height of theca is 3.3 mm ; the diameter of theca is 1.7 - 3.5 mm.

DISTRIBUTION : Upper Danian of Manghyshlack and Crimea (fig. 16-23).

### Genus **Conocrinus** d'ORBIGNY, 1850

**Conocrinus** cf. **elongatus** ROUX, 1978
(fig. 8 A)

The theca is cylindrical and high. The sutures between the radials are visible. The basals are completely confluent. The upper muscular radial facets are directed upwards and form a closed pentalobate ring. The diameter of this ring is almost equal to the diameter of theca. The height of theca is 4.5 - 5.1 mm ; the diameter of theca is 1.5 - 1.8 mm.

REMARKS : The described species, which is present in author's collection with two thecae only, differs from *C. elongatus* from Eocene of France (Roux, 1978b) by absence of morphological isolation of the radials and by faint but even convexity of theca.

DISTRIBUTION : Upper Eocene of Crimea (fig. 16-24).

**Conocrinus** cf. **veronensis** (JAEKEL, 1891)
(fig. 8 B)

The theca is conical and slightly convex. The radials and the basals are confluent. The sutures between them are not visible. The upper muscular radial facets are sloping inside and they are divided by large thorn-shaped projections. The common diameter of the radial ring is equal to the greater diameter of theca. The height of theca is 3.9 mm ; the diameter of theca is 2.4 mm.

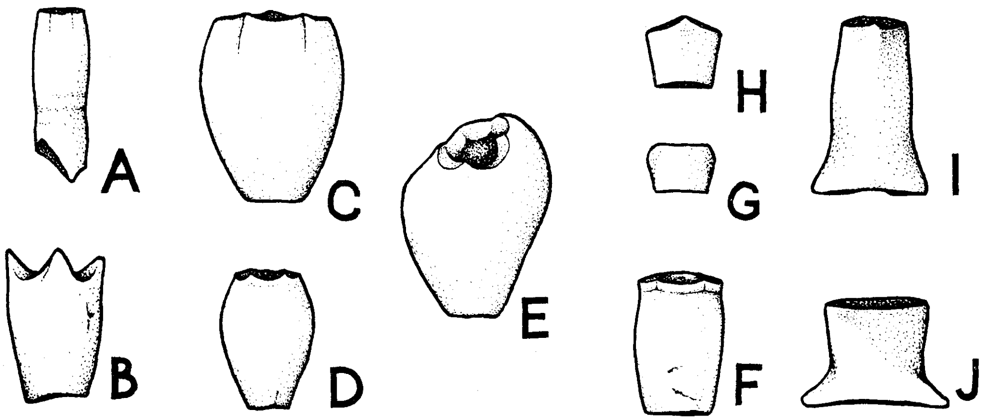



Fig. 8 — **Skeleton fragments of** ***Conocrinus*** (x 5).
A - *C.* cf. *elongatus*, IIK-4-1 : theca with a broken basis. Crimea, Alma-Valley ; Upper Eocene.
B - *C.* cf. *veronensis*, IIK-4-3 : theca. Crimea, Alma-Valley ; Upper Eocene.
C-E - *C. vogdti*
C - IIK-4-4 : theca.
D - IIK-4-7 : theca.
E - IIK-4-6 : distorted theca.
Crimea, Alma-Valley ; Upper Eocene.
F-J - *C. tauricus*
F - holotype PK-2-1 : theca.
G - PK-2-2 : prlmibrachial.
H - PK-2-3 : axillar primibrachial.
I - PK-2-4 : columnal from the proximal stem part.
J - PK-2-5 : columnal from the distal stem part.
Crimea, Belbek-Valley ; Upper Paleocene.

**Fragments du squelette de** ***Conocrinus*** (x 5).
A - *C.* cf. *elongatus*, IIK-4-1 : coupe dorsale cassée à la base. Crimée, vallée du Alma ; Éocène supérieur.
B - *C.* cf. *veronensis*, IIK-4-3 : coupe dorsale. Crimée, vallée de l'Alma ; Éocène supérieur.
C-E - *C. vogdti.*
C - IIK-4-4 : coupe dorsale.
D - IIK-4-7 : coupe dorsale.
E - IIK-4-6 : coupe dorsale tordue.
Crimée, vallée de l'Alma ; Éocène supérieur.
F-J - *C. tauricus*
F - holotype PK-2-1 : coupe dorsale.
G - PK-2-2 : primibrachiale.
H - PK-2-3 : primibrachiale axillaire.
I - PK-2-4 : columnale de la partie proximale du pédoncule.
J - PK-2-5 : columnale de la partie distale du pédoncule.
Crimée, vallée du Belbek ; Paléocène supérieur.

REMARKS : It is known two species of *Conocrinus*, the dorsal cups of which possess interradial thorns. These are namely *C. veronensis* and *C. archiaci*. O. Jaekel (1891) established the genus *Tormocrinus* for the first of them. This genus was transfered into range of subgenus by M. Roux (1978a,c). The described form, undoubtly, comes into composition of this subgenus. But *C.* cf. *veronensis* differs from *C. veronensis* and, at more degree, from *C. archiaci*, by the weak isolation of thorns and by the smaller dimensions. *C.* cf. *veronensis* is like to the paratype of *C. archiaci* (Roux, 1978b, fig. 1Da) by form of the interradial projections, but it is like to *C. veronensis* (Jaekel, 1891, taf. 42, fig. 6) by common shape of theca. Our materials (one theca only) do not permit to develop a more complete comparison.

DISTRIBUTION : Upper Eocene of Crimea (fig. 16-25).

**Conocrinus vogdti** (WEBER, 1949)
(fig. 8 C-E ; pl. 5, fig. 1,2)

The theca is pear-shaped, widening out above. The sutures between the radials are visible but the basals are almost full confluent. The upper muscular radial facets are directed upwards or slightly inside and they are divided by small projections. The radial ring facet has the diameter strongly smaller than the diameter of theca. The height of theca is 3.0 - 5.0 mm ; the greater diameter of theca is 1.8 - 4.0 mm.

REMARKS : G. Weber (1949) has noted on the Montian age of *Rhyzocrinus vogdti* during description of this species erroneously. The thecae of this species are found together with a stem fragments and columnals of *Isselicrinus pellegrinii* (MENEGHINI) in Upper Eocene marls of south-western Crimea.

DISTRIBUTION : Upper Eocene of Crimea (fig. 16-26).

**Conocrinus tauricus** nov. sp.
(fig. 8 F-J ; pl. 5, fig. 3-7)

DERIVATIO NOMINIS : The name of species come from « Tauria » - the Crimea.

HOLOTYPE : The specimen PK-2-1 (fig. 8 F ; pl. 5, fig. 3) ; Structural and Marine Geology Chair of Leningrad Mining Institute ; Crimea, Belbek-valley, settl. Tankovoe ; Upper Paleocene, Thanetian.

MATERIALS : PK-2 : one theca, three brachials and 47 columnals from the type locality.

DESCRIPTION : The theca is almost cyclindrical with a slightly convex sides. The sutures between the radials are well visible. The radials are slightly turn out. The diameter of radial ring facet is equal to the greater diameter of theca. The height of theca is 3.6 mm ; the maximum diameter of theca is 2.1 mm.

COMPARISON : The described species differs from majority of distinguishing *Conocrinus*-species by radial ring isolation, but it is similar, in this respect, to *C. doncieuxi* from Lower Eocene of France (Roux, 1978d) and to *C. elongatus*, which is mentioned above. Our species differs from the latter by low radials and by faint but even convexity of theca. It differs from *C. doncieuxi* by its thecae having greater diameter in the upper part (the basal ring is barrel-shaped or it has swelling in basis in *C. doncieuxi* ).

DISTRIBUTION : Upper Paleocene of Crimea (fig. 16-27).

Family **BATHYCRINIDAE** BATHER, 1898

Genus **Paleobathycrinus** ROUX, 1978

**Paleobathycrinus endelmani** nov. sp.
(pl. 5, fig. 8-10)

DERIVATIO-NOMINIS : The name of the species is given in honour of Leonid G. Endelman (Moscow) - paleontologist.

HOLOTYPE : The specimen KM-116-1 (pl. 5, fig. 8) ; Structural and Marine Geology Chair of Leningrad Mining Institute ; Manghyshlack, Burliu-Well ; Upper Danian.

MATERIALS : KM-107, KM-110, KM-113, KM-116, KM-118, KM-130, KM-131 : 392 columnals from the type locality (coll. L.G. Endelman, 1968, 1970).

DESCRIPTION : Theca is unknown. The columnals are low, round or elliptical rarely. The columnal sides are smooth, flat or slightly convex. The articulums are depressed. The fulcral ridges are low, broad, oval, interrupting near the central canal and not reaching to the articulum periphery. The fulcral ridge structure is complex. The stereom inside the fulcral ridge is surrounded by the compact stereom. The central canal is broad and round or subsquare. The blunt thorns are observed on ends of fulcral ridges in the several distal columnals. The diameter of columnals is 3.4 -9.1 mm ; the height of columnals is 1.9 - 4.5 mm.

COMPARISON : The described species differs from *P. windi* from Danian of Danmark (Rasmussen, 1961) by the thorns on columnal sides, by well developed fulcral ridges and by larger dimensions.

DIMENSIONS : Upper Danian and Montian of Manghyshlack (fig. 16-28).

## III — BIOMETRIC RECONSTRUCTION

Our material permits to develop a biometric reconstruction of stem for several species. Herewith, the following parameters are used (fig. 9 A) : D - length of the articulum along the fulcral ridge, d - diameter of the articulum perpendicularly to the fulcral ridge, h - height of the columnal. The following index are taken: the elliptic shape of articulum ( $\mathcal{E}$ = D-d/D) and the relative lengthening of the columnal (H = h/D). The angular parameters were measured except for the linear dimension (fig. 9 B, C) : $\beta$ - the angle between the lower fulcral ridge and the upper one in one columnal ($\beta_1 < 90°$ - columnal is right ; $\beta_2 > 90°$ - the columnal is left). The curve of frequency is build for the angles $\beta_1$ and $\beta_2$, and a figure analogous with one presented in fig. 10A is received (Klikushin, 1975a). Two tops of this curve correspond to modal meanings for $\beta_1$ and $\beta_2$.

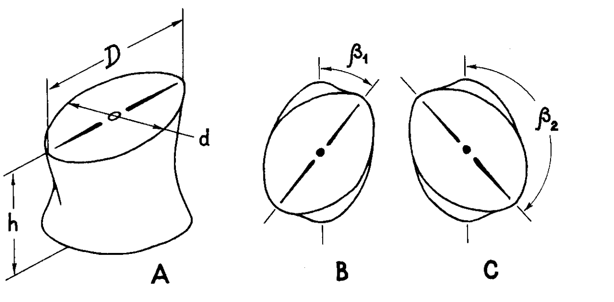



Fig. 9 — **Main dimensions of a *Bourgueticrinidae*-columnal. Dimensions principales d'une columnale de *Bourgueticrinidae*.**
A - linear dimensions (D - diameter along a fulcral ridge, d - diameter across a fulcral ridge, h - height). Dimensions linéaires (D - diamètre selon la crête fulcrale, d - diamètre perpendiculairement à la crête fulcrale, h - hauteur).
B - right columnal with the angle $\beta_1$ between fulcral ridges. Columnale detre avec l'angle $\beta_1$ entre les crêtes fulcrales.
C - left columnal with the angle $\beta_2$ between fulcral ridges. Columnale sénestre avec l'angle $\beta_2$ entre les crêtes fulcrales.

Investigated material shows that right and left columnals are joined into stem with alternating. But the theorical number of right and left columnals may be not coincide with results from analyzed samples. In this case, correlation between the numbers of left columnals and right ones is marked by coefficient K = $N\beta_2/N\beta_1$ (where : $N\beta_2$ is the number of left columnals and $N\beta_1$ is the number of right ones). The lower part of the curve (see fig. 10A) correspond to the angle $\gamma = \beta_1 + \beta_2/2$. When the angle $\gamma$ = 90° the fulcral ridge return to initial position through two columnals. However this case is rarely observed. A stem, as a rule, has spiral turning (W = average of 90° - $\gamma$ ) because of some differences of the angles between fulcral ridges or because of random notcoincidence of the number of right columnals and left ones. When W > O the main spiral turning is left, when W < O it is right.

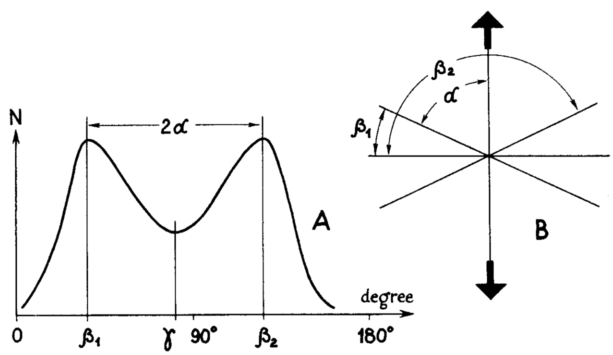



Fig. 10 — **Angular index of *Bourgueticrinidae*-stems**
**Indices angulaires des pédoncules de *Bourgueticrinidae*.**
A - distribution curve of the turn angles of the fulcral ridges (N -number of measurements). Distribution des angles mesurés entre les crêtes fulcrales (N - nombre de mesures).
B - stem anisotropism if $\alpha$ -angle is not equal to the zero (the predominating flexibility direction is marked by the arrows). Anisotropisme du pédoncule si l'angle $\alpha$ n'est pas égal à zéro (la direction de la flexibilité prédominante est marquée par les flèches).

When the angles $\beta_1$ and $\beta_2$ are not equal to 90°, the direction on which a stem lightly bent is appeared, i.e. stem anisotropism appears :

$$A = \sin\left(\frac{\beta_2 - \beta_1}{2}\right) = \sin \alpha \text{ (fig. 10 B).}$$

The anisotropism shows a possibility of preferential flexibility direction for a stem as a consequence of different disposition of fulcral ridges. When $\alpha = 0$, i.e. ridges in a stem are respectively perpendicular, the anisotropism is absent (here are not directions of preferential flexibility). When $\alpha = 90°$, i.e. fulcral ridges in the whole stem are parallel to each other, anisotropism is equal to unit (a stem is maximally anisotropic curving one direction only, which is perpendicular to the orientation of fulcral ridges).

Potentialities for flexibility of a segment ($F_C$) is equal to $F_O + F$, where $F_O$ is the flexibility of a round stem with respectively perpendicular fulcral ridges depending on articulum construction, and F is the relative flexibility depending on columnal shape. The relative flexibility increases by growth of the stem anisotropism (A) and by development of elliptical articulum ($\mathcal{E}$), but it is decreased by growth of the relative columnal height (H). Therefore the formula of relative flexibility can be written in the following way :

$$F = \frac{\mathcal{E} . A}{H} \quad \text{or } F = \frac{\mathcal{E} . \sin \alpha}{H} \quad \text{or } F = \frac{(D-d) . \sin \alpha}{h.}$$

The relative flexibility may fluctuate from zero to a few units (not more than the unit practically, up to infinity in theory)[2].

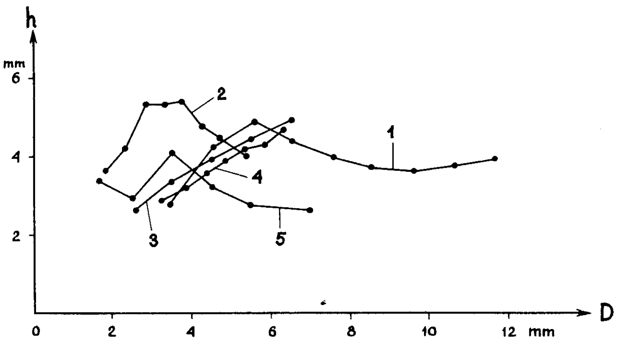



Fig. 11 — **Relationships between the columnal height (h) and the columnal diameter (D).**
**Relations entre la hauteur des columnales (h) et leur diamètres (D).**
1 - *B. aequalis* (KK-43) ; 2 - *B. bellus* (KM-29) ; 3 - *B. danicus* (KK-35) ; 4 - *B. danicus* (KK-26) ; 5 - *B. fischeri* (KT-1).

2) The greater elliptical shape index value is equal 0.48 (for *C. tauricus*) in all samples of the investigated materials and the greater anisotropism value is equal 0.35 (for *C. tauricus*). The minimum of a relative columnal height value is equal 0.26 (for *B. aequalis*). The greater relative flexibility value is equal 0.645 from these data.

**Bourgueticrinus aequalis**

SAMPLES : KK-25 (75 specimens - Crimea, Belbek-Valley, May-Tepe-Mountain) ; KK-36 (46 specimens - Crimea, Belbek- Valley, Burun-Kaya-Mountain) and KK-43 (196 specimens - Crimea, Kuchuk-Karassu-Valley, Burunduk-Kaya-Mountain).

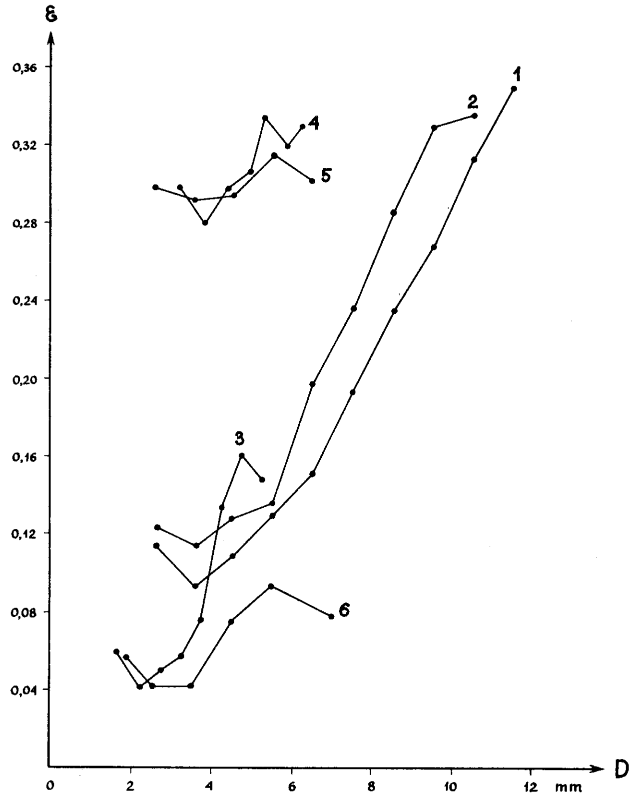



Fig. 12 — **Relationships between the articulum elliptical shape ($\mathcal{E}$) and the columnal diameter (D).**
**Relations entre la forme elliptique de la facette articulaire ($\mathcal{E}$) et le diamètre des columnales (D).**
1 - *B. aequalis* (KK-43) ; 2 - *B. aequalis* (KK-25) ; 3 - *B. bellus* (KM-29) ; 4 - *B. danicus* (KK-35) ; 5 - *B. danicus* (KK-26) ; 6 - *B. fischeri* (KT-1).

The fragments of my collections show that the stems was built with high and cylindrical columnals proximally and with relatively low and elliptic ones distally. The area of a stem transverse section increases downwards from the cup. This increase was mainly the result of the D-increase, just as « d » changes in much less degree. The columnal height is closely related to the position of a columnal into the stem. During D-increase the columnal height quickly increases and then it slowly decreases (fig. 11-1). The

| N° | Sample | N | ε | H | K | $\beta_1^o$ | $\beta_2^o$ | $\alpha^o$ | W° | F |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | KK-25 | 75 | 0,170 | 0,93 | 0,74 | 73,0 | 106,0 | 16,5 | +0,5 | 0,052 |
| 2 | KK-36 | 46 | 0,198 | 0,78 | 1,11 | 74,5 | 106,5 | 16,0 | -0,5 | 0,070 |
| 3 | KK-43 (p) | 33 | 0,077 | 0,88 | 0,89 | 78,1 | 107,1 | 14,5 | -2,6 | 0,022 |
| 4 | KK-43 (m) | 119 | 0,176 | 0,63 | 1,00 | 71,7 | 103,4 | 15,9 | +2,5 | 0,077 |
| 5 | KK-43 (d) | 44 | 0,310 | 0,37 | 1,32 | 74,8 | 110,4 | 17,8 | -2,6 | 0,255 |
| 6 | Average | 318 | 0,186 | 0,71 | 0,97 | 73,5 | 105,9 | 16,2 | +0,3 | 0,073 |

Tabl. 2 — **Main parameters of *Bourgueticrinus aequalis* stems.**
**Paramètres principaux des pédoncules de *Bourgueticrinus aequalis*.**

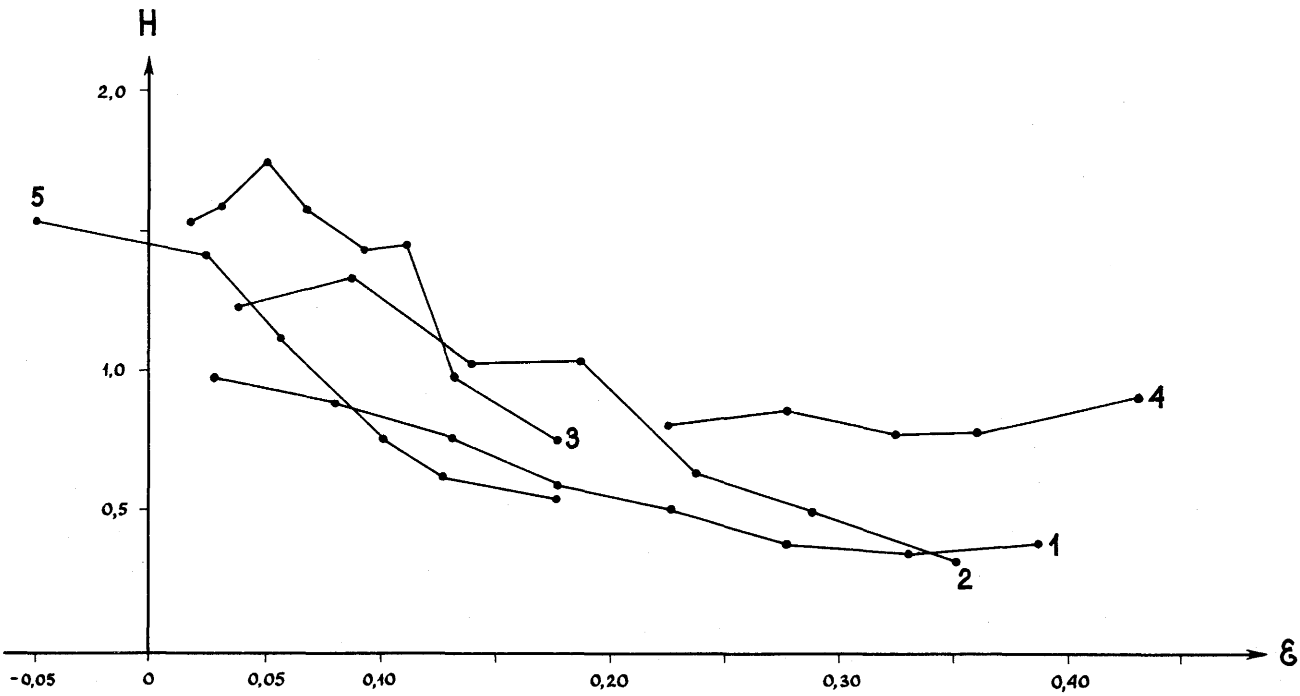



Fig. 13 — **Relationships between the columnal height (H) and the articulum elliptical shape ( ε ).**
**Relations entre la hauteur des columnales (H) et la forme elliptique de la facette articulaire ( ε ).**
1 - *B. aequalis* (KK-43) ; 2 - *B. aequalis* (KK-25) ; 3 - *B. bellus* (KM-29) ; 4 - *B. danicus* (KK-35) ; 5 - *B. fischeri* (KT-1).

articulum elliptical shape grows during D-increase (fig. 12-1,2). The absolute and relative columnal height decreases during ε -increase, i.e. downwards along a stem (fig. 13-1,2). Stem parameters for the KK-25 and the KK-36 samples are gathered in table 2 (N° 1 and 2). Our data shows clearly the coincidence of stem anisotropism for various samples. At the same time, the largest and most distal columnals are predominated into sample KK-36. With this view in mind, ε -increase, H-decrease and F-increase are taken. The conclusion on the direct variation of flexibility is confirmed by the figures on table 2 (n° 3,4 and 5). The sample KK-43 was divided into three conditional groups namely : ε ⩽ 0.10 (proximal stem region - p) ; $0.11 \leqslant \varepsilon \leqslant 0.25$ (middle stem region - m) and $\varepsilon \geqslant 0.26$ (distal stem region - d). The stem anisotropism increases and the relative columnal height decreases distally, simultaneously with the increase of elliptical shape. The variation of the relative flexibility is mostly significant. The numbers of right and left columnals are equal in middle part of stem (K = 1), but number of right columnals is greater proximally (K < 1) and number of left columnals is greater below (K > 1). Functional interpretation of this fact is unknown. Can be suppose that small values of the W are the results of lack of precision for $\beta_1$ and $\beta_2$ measurement or for sample significance.

| N° | N | $\varepsilon$ | H | K | $\beta_1^\circ$ | $\beta_2^\circ$ | $\alpha^\circ$ | W° | F |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 54 | 0,017 | 1,53 | 1,43 | 77,3 | 99,3 | 11,0 | +1,7 | 0,002 |
| 2 | 117 | 0,031 | 1,59 | 1,43 | 78,4 | 104,5 | 13,3 | -1,5 | 0,004 |
| 3 | 43 | 0,051 | 1,75 | 0,76 | 75,4 | 103,4 | 14,0 | +0,6 | 0,007 |
| 4 | 50 | 0,067 | 1,58 | 0,88 | 70,9 | 106,1 | 17,6 | +1,5 | 0,013 |
| 5 | 42 | 0,091 | 1,43 | 0,91 | 79,2 | 99,7 | 10,3 | +0,5 | 0,011 |
| 6 | 20 | 0,111 | 1,45 | 1,33 | 80,6 | 100,8 | 10,1 | -0,7 | 0,013 |
| 7 | 25 | 0,131 | 0,99 | 0,86 | 73,6 | 94,4 | 10,4 | +6,0 | 0,023 |
| 8 | 35 | 0,180 | 0,75 | 0,75 | 75,8 | 103,5 | 13,9 | +0,3 | 0,058 |
| Average | 386 | 0,067 | 1,46 | 1,08 | 76,3 | 102,8 | 13,3 | +0,4 | 0,011 |

Tabl. 3 — **Main parameters of *Bourgueticrinus bellus* stems.**
**Paramètres principaux des pédoncules de *Bourgueticrinus bellus*.**

### Bourgueticrinus bellus

SAMPLE : KM-29 (386 specimens - Mangyshlack, Teyu-Ssu-Mountain).

The columnal height increase during D-increase (from theca downwards) but it decreases then (fig. 11-2). The elliptical shape of articulum increases during D-increase (fig. 12-3). The absolute columnal height firstly increases and then slowly decreases during $\varepsilon$ - increase, i.e. downwards along a stem. The relative columnal height changes in the same way (fig. 13-3). The sample of 386 specimens was divided into eight groups according to the elliptical shape, i.e. approximately according to their stem position. The parameters revealing main features, which were quoted for *B. aequalis* above, are enumerated in tabl. 3. It is clear from this table, that the stem flexibility almost regularly increases distally from 0.002 up to 0.058. The fluctuations of the angles $\beta_1$, $\beta_2$, $\alpha$ and W are connected, probably, with a insufficient significance of the sample. Parameters means permit to compare *B. bellus* with *B. aequalis* described above. The columnal elliptical shape of the first species is less than the one of the second species. Round columnals are numerous in the sample *B. bellus* but there are rare in *B. aequalis*. Besides, the two columnals of *B. bellus* show articulums which are larger perpendicularly to the fulcral ridge than along its (and $\varepsilon < 0$). Further, the relative columnal height of *B. bellus* is two times greater than the one of *B. aequalis*, but the anisotropism is smaller. The relative stem flexibility of *B. aequalis* is therefore strongly greater (0.073) than the *B. bellus* one (0.011). At the same time, the W-values of both species are close to the zero and the K-values are close to the unit.

### Bourgueticrinus danicus

SAMPLES : KK-26 (461 specimens - Crimea, Belbek-Valley, May-Tepe-Mountains) and KK-35 (121 specimens - Crimea, Black-River-Valley).

*B. danicus* differs from many others *Bourgueticrinus* - species by the changes directions of a many parameters. The elliptical shape of articulums is almost constant during D-increase, i.e. downwards along a stem (fig. 12-4,5) and it decreases during d- increase. Consequently, the more stretch articulums are inherent to a young stem and the more round ones are characteristic of an adult stem. Calculations of the principal parameters were made therefore relatively to the diameter, in so far as the articulum elliptical shape is not sure exponent for a stem position of the columnals (fig. 13-4). The absolute columnal height even increases during D-increase (fig. 11-3,4). The relative columnal height decreases during D-increase (tabl. 4). The sample KK-26 was divided into few groups according to their diameter. The angular parameters ( $\beta_1$, $\beta_2$ and $\alpha$) changes insignificantly from the middlemeanings during D-increase, i.e. during theastem dimensions increase (and-or downwards along a stem ?). At the same time, coefficient K is greater considerably than the unit in the sample KK-35 but it decreases gradually in the sample KK-26 during D-increase. The spiral turning is small and it is left in all cases.

| N° | Sample | D (mm) | N | $\varepsilon$ | H | K | $\beta_1^\circ$ | $\beta_2^\circ$ | $\alpha^\circ$ | W° | F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | KK-35 | | 121 | 0,312 | 0,81 | 1,47 | 73,1 | 105,4 | 16,2 | +0,7 | 0,107 |
| 2 | KK-26 | $\leq$3,0 | 58 | 0,297 | 1,02 | 0,71 | 70,3 | 107,0 | 18,4 | +1,3 | 0,092 |
| 3 | KK-26 | 3,1-4,0 | 149 | 0,291 | 0,94 | 1,26 | 70,7 | 107,8 | 18,6 | +0,7 | 0,099 |
| 4 | KK-26 | 4,1-5,0 | 196 | 0,295 | 0,88 | 0,80 | 69,5 | 108,4 | 19,5 | +1,0 | 0,112 |
| 5 | KK-26 | 5,1-6,0 | 49 | 0,316 | 0,83 | 0,63 | 69,7 | 108,8 | 19,6 | +0,7 | 0,128 |
| 6 | KK-26 | $\geq$6,1 | 9 | 0,302 | 0,76 | 0,50 | 73,0 | 106,3 | 16,7 | +0,3 | 0,114 |
| 7 | Average | | 582 | 0,300 | 0,89 | 0,98 | 70,5 | 107,4 | 18,5 | +1,0 | 0,107 |

Tabl. 4 — **Main parameters of *Bourgueticrinus danicus*** stems.
Paramètres principaux des pédoncules de ***Bourgueticrinus danicus*.**

| N° | Stem part | N | $\varepsilon$ | H | K | $\beta_1^\circ$ | $\beta_2^\circ$ | $\alpha^\circ$ | W° | F |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | proximal | 52 | 0,016 | 1,42 | 1,89 | 79,6 | 99,9 | 10,2 | +0,2 | 0,002 |
| 2 | middle | 54 | 0,073 | 0,98 | 0,80 | 78,1 | 104,9 | 13,4 | -1,5 | 0,017 |
| 3 | distal | 17 | 0,152 | 0,61 | 1,13 | 72,5 | 109,0 | 18,3 | -0,8 | 0,078 |
| 4 | Average | 123 | 0,060 | 1,12 | 1,20 | 77,8 | 102,8 | 12,5 | -0,3 | 0,012 |

Tabl. 5 — **Main parameters of *Bourgueticrinus fischeri* stems.**
**Paramètres principaux des pédoncules de *Bourgueticrinus fischeri*.**

## Bourgueticrinus fischeri

SAMPLES : KT-1 (123 specimens - Turkmenia, Little-Balkhan-Mountains).

The changes of the principal parameters of *B. fischeri* is similar to the *B. bellus* ones. So, during D- increase the absolute columnal height quickly increases and then it slowly decreases (fig. 11-5). The elliptical shape of articulum increases during D-increase. Moreover, the elliptical shape of *B. fischeri* and of *B. bellus* one are coincide proximally, but distally the elliptical shape of *B. fischeri* is smaller than the one of *B. bellus* (fig. 12-6). The absolute and relative columnal height decreases during $\varepsilon$-increase (fig. 13-5). The sample KT-1 was divided into three conditional groups (tabl. 5), namely : $\varepsilon \leqslant 0.040$ (proximal stem region - p) ; $0.041 \leqslant \varepsilon \leqslant 0.120$ (middle - m) and $\varepsilon \geqslant 0.121$ (distal - d). The relative columnal height quickly decreases towards a distal stem part. The anisotropism increases simultaneously with the $\varepsilon$ -increase. Strong increase distally of the stem flexibi lity (at ten times) is the consequence of the directed changes $\varepsilon$ , $\alpha$ and H. The cause of a considerable K-change is unknown.

| Stem part | B. aequalis | | | | B. bellus | | | | B. danicus | | | | B. fischeri | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\varepsilon$ | H | $\alpha°$ | F | $\varepsilon$ | H | $\alpha°$ | F | $\varepsilon$ | H | $\alpha°$ | F | $\varepsilon$ | H | $\alpha°$ | F |
| proximal | 0,077 | 0,88 | 14,5 | 0,022 | 0,027 | 1,57 | 12,4 | 0,003 | 0,293 | 0,96 | 18,5 | 0,097 | 0,016 | 1,42 | 10,2 | 0,002 |
| middle | 0,176 | 0,63 | 15,9 | 0,077 | 0,075 | 1,57 | 13,7 | 0,011 | 0,295 | 0,88 | 19,5 | 0,112 | 0,073 | 0,98 | 13,4 | 0,017 |
| distal | 0,310 | 0,37 | 17,8 | 0,255 | 0,160 | 0,85 | 12,4 | 0,043 | 0,314 | 0,82 | 19,2 | 0,126 | 0,152 | 0,61 | 18,3 | 0,078 |

Tabl. 6 — **Main parameters variations in a proximal, middle and distal stem parts of the four *Bourgueticrinus*-species.**
**Variations des paramètres principaux dans les parties proximale, moyenne et distale des pédoncules des quatre espèces de *Bourgueticrinus*.**

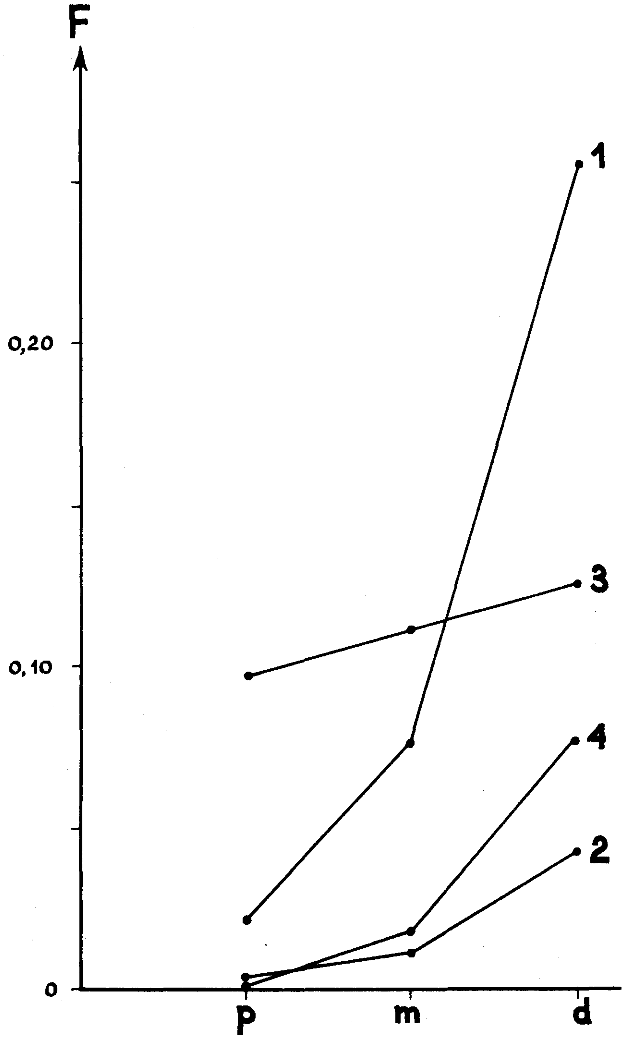



Fig. 14 — **Change in the relative flexibility in different stem parts.** (proximally-p ; middly-m ; distally-d). 1 - *B. aequalis* ; 2 - *B. bellus* ; 3 - *B. danicus* ; 4 - *B. fischeri.*
**Changement de la flexibilité relative dans les diverses parties du pédoncule** (p-proximalement ; m-au milieu ; d-distalement).

## Conocrinus tauricus

SAMPLE : PK-2 (30 specimens - Crimea, Belbek-Valley).

The main parameters meanings are following : $\varepsilon = 0.310$ ; $H = 1.48$ ; $\alpha = 20.2°$ ; $F = 0.072$. The large values of the articulum elliptical shape and of the anisotropism are typical for the genus *Conocrinus*. The $\alpha$ -angle is larger than in all *Bourgueticrinus*- species. At the same time, the stem flexibility is relatively small.

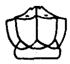
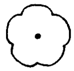
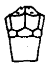
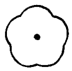
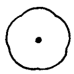
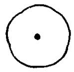
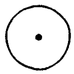
| name of species | $\varepsilon$ | H | $\alpha°$ | F | dorsal cupe | section of radial ring |
|---|---|---|---|---|---|---|
| B. bellus | 0,067 | 1,46 | 13,3 | 0,011 |  |  |
| B. fischeri | 0,060 | 1,12 | 12,5 | 0,012 |  |  |
| C. tauricus | 0,310 | 1,48 | 20,2 | 0,072 |  |  |
| B. aequalis | 0,186 | 0,71 | 16,2 | 0,073 |  |  |
| B. danicus | 0,300 | 0,89 | 18,5 | 0,107 |  |  |

Fig. 15 — **Morphological change of *Bourgueticrinus* and *Conocrinus* theca in dependence on stem flexibility** ($\varepsilon$-articulum elliptical shape, H-relative columnal height, $\alpha$°-anisotropism angle into degrees, F-relative flexibility).
**Changement de la morphologie des coupes dorsales de *Bourgueticrinus* et de *Conocrinus* en relation avec la flexibilité du pédoncule** (« name of species »-nom des espèces, $\varepsilon$ -forme elliptique de la facette articulaire, H-hauteur relative des columnales, $\alpha$°-angle de l'anisotropisme en degrés, F-flexibilité relative, « dorsal cup »-coupe dorsale, « section of radial ring »-section du cercle de radiales).

The samples of the four *Bourgueticrinus*-species were divided into three groups according to the ε-meaning and to the D-meaning, i.e. probably into proximal, middle and distal parts (tabl. 6). Herewith the decrease of the relative columnal height, the increase of anisotropism and the important increase of the stem flexibility take place distally with the increase of the elliptical shape of articulums (fig. 14). At the same time, the anisotropism is greater into middle stem part in *B. bellus* and in *B. danicus*, but the relative columnal height is equal with each other in proximal and middle stem parts in *B. bellus*, for instance.

Common informations on the biometric data are presented in fig. 15. The *B. bellus*-remains were found in a chalk and the *B. fischeri*-remains were found in a clay marl. In such similar environments where these species inhabited, the stem shows equal flexibilities. However, the equal flexibilities were reached by the diverse combinations of the separate parameters. The *C. tauricus*-columnals were found in a aleurolitic marl and the *B. aequalis*-remains were found in a sandy marl. Accordingly, the stem flexibility of this forms is a few times greater than it was for the former species. At the same time, the separate stem parameters of *B. aequalis* and of *C. tauricus* are considerably dissimilar. The *B. danicus*-columnals composes a crinoidal limestones accumulated by currents and the stem flexibility is greatest. Our data shows that the species inhabiting into environment with currents have the more flexible and more anisotropic stems. At the same time, different species, which are belong to different genera but which inhabited into similar conditions, have equal stem flexibilities.

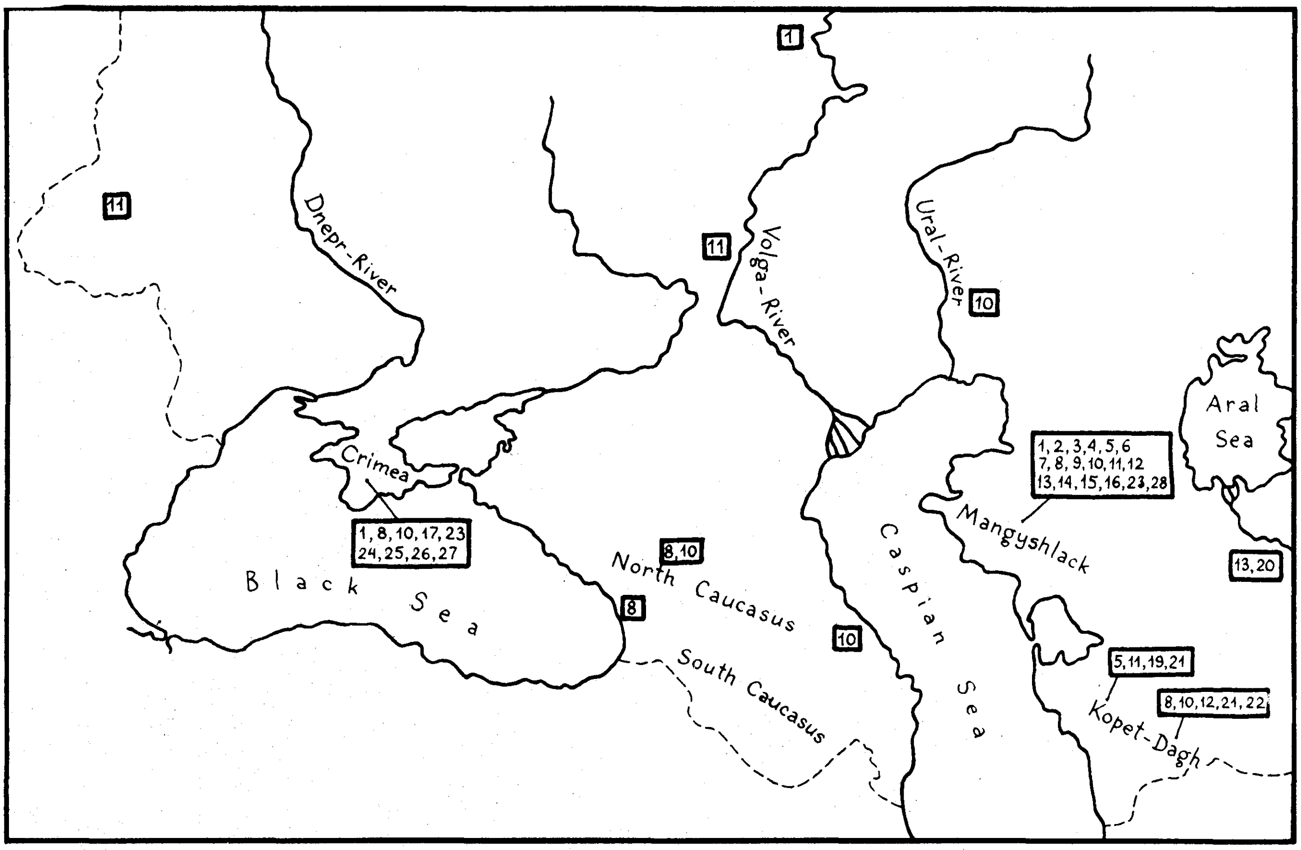



Fig. 16 — **Geographical distribution of the fossil species of *Bourgueticrinina* found in USSR.**
**Répartition géographique des espèces fossiles de *Bourgueticrinina* en URSS.**

1 - *B. aequalis*, 2 - *B. bellus*, 3 - *B. bruennichinielseni*, 4 - *B. brydonei*, 5 - *B. constrictus*, 6 - *B. crassus*, 7 - *B. cylindricus*, 8 - *B. danicus*, 9 - *B. elegans*, 10 - *B. ellipticus*, 11 - *B. fischeri*, 12 - *B. granulosus*, 13 - *B. hagenowii*, 14 - *B.* cf. *maximus*, 15 - *B. naidini*, 16 -*B. sulcatus*, 17 - *B. tenuis*, 18 - *B. utriculatus*, 19 - *B.* sp. 1, 20 - *B.* sp. 2, 21 - *B. baculatus*, 22 - *B. succinctus*, 23 - *D. maximus*, 24 -*C.* cf. *elongatus*, 25 - *C.* cf. *veronensis*, 26 - *C. vogdti*, 27 - *C. tauricus*, 28 - *P. endelmani*.

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# PLATE 1

**Columnals facets of *Bourgueticrinus***

Facettes articulaires des columnales de *Bourgueticrinus*

Fig. 1 — **B. aequalis**, KK-43-7 : columnal from the proximal part of a stem (x 8,3).
Columnale de la partie proximale du pédoncule.

Fig. 2 — **B. aequalis**, KK-43-8 : columnal from the middle part of a stem (x 6,0).
Columnale de la partie moyenne du pédoncule.

Fig. 3 — **B. aequalis**, KK-43-6 : columnal from the distal part of a stem (x 4,4).
Columnale de la partie distale du pédoncule.

Fig. 4 — **B. aequalis**, KK-36-9 : columnal from the middle part of a stem (x 10,4).
Columnale de la partie moyenne du pédoncule.

Fig. 5 — **B. aequalis**, KK-43-5 : columnal from the distal part of a stem (x 6,7).
Columnale de la partie distale du pédoncule.

Fig. 1 to 5 : Crimea, Belbek-Valley (KK-36) and Kuchuk-Karassu-Valley (KK-43) ;Lower Maastrichtian.
Fig. 1 à 5 : Crimée, vallée du Belbek (KK-36) et vallée du Koutchouk-Karassou (KK-43) ; Maestrichtien inférieur.

Fig. 6 — **B. constrictus**, KM-26-1 : columnal from the middle part of a stem (x 12,0). Manghyshlack, Kugussem-Well ; Campanian.
Columnale de la partie moyenne du pédoncule. Manghychlak, puits Kougoussem ; Campanien.

Fig. 7 — **B. danicus**, KK-35-5 : columnal from the proximal part of a stem (x 7,2).
Columnale de la partie proximale du pédoncule.

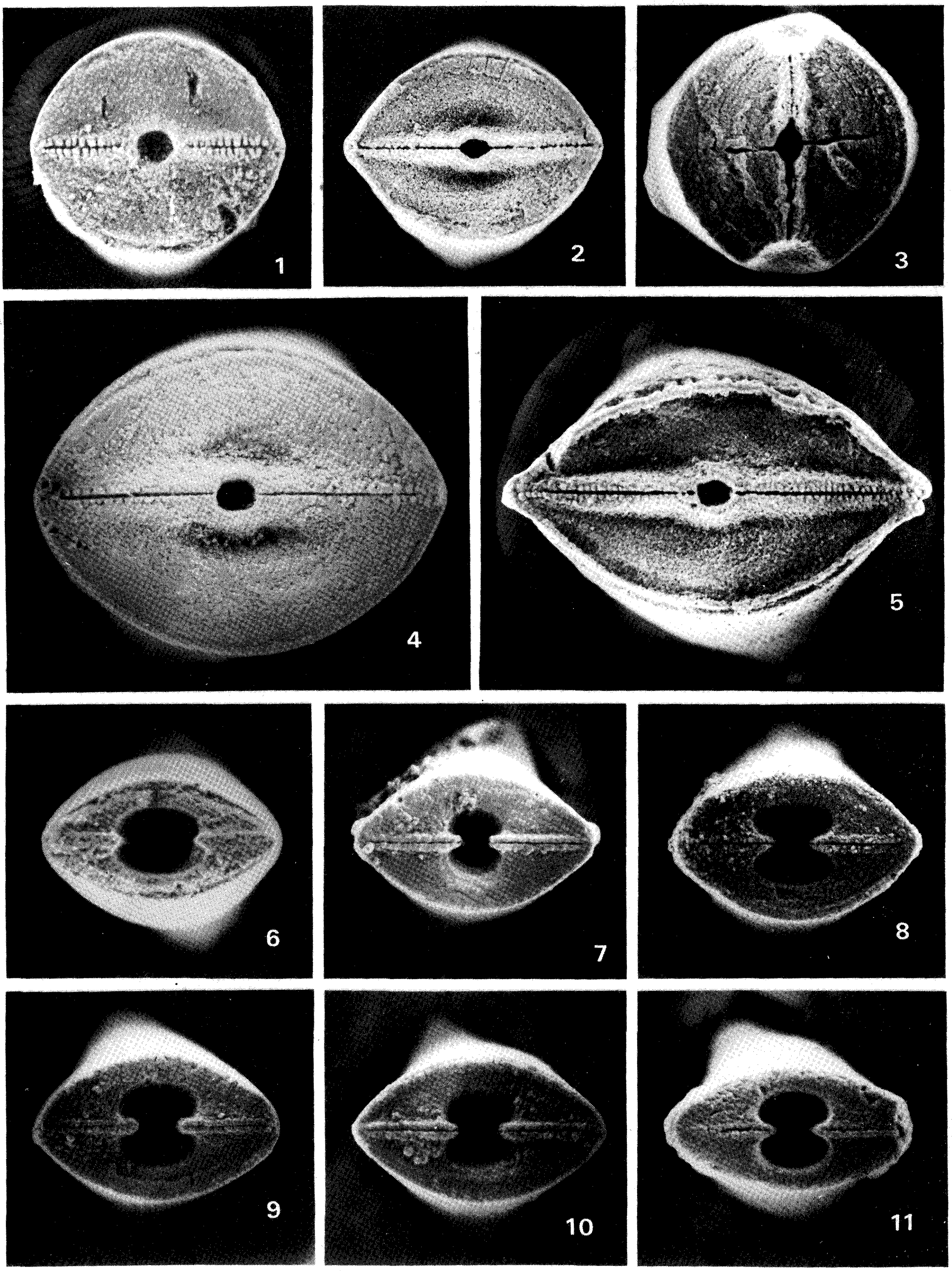
Fig. 8 — **B. danicus**, KK-35-4 : columnal from the middle part of a stem (x 7,6).
Columnale de la partie moyenne du pédoncule.

Fig. 9 — **B. danicus**, KK-35-3 : columnal from the middle part of a stem (x 8,0).
Columnale de la partie moyenne du pédoncule.

Fig. 10 — **B. danicus**, KK-35-7 : columnal from the middle part of a stem (x 9,1).
Columnale de la partie moyenne du pédoncule.

Fig. 11 — **B. danicus**, KK-35-1 : columnal from the distal part of a stem (x 9,3).
Columnale de la partie distale du pédoncule.

Fig. 7 to 11 : Crimea, Black-River-Valley ; Danian.
Fig. 7 à 11 : Crimée, vallée de la Rivière Noire ; Danien.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# PLATE 2

**Upper articular facets of radials and columnals of *Bourgueticrinus bellus***
Facettes articulaires supérieures des radiales et des columnales de *Bourgueticrinus bellus*.

Fig. 1 — Holotype KM 29-1 : radial ring (x 13,9).
Cercle des radiales.

Fig. 2 — KM-64-1 : radial ring (x 12,5).
Cercle des radiales.

Fig. 3 — KM-29-13 : columnal from the most proximal part of a stem (x 12,2).
Columnale de la partie la plus proximale du pédoncule.

Fig. 4 — KM-29-24 : columnal from the proximal part of a stem (x 10,8).
Columnale de la partie proximale du pédoncule.

Fig. 5 — KM-29-15 : columnal from the proximal part of a stem (x 10,7).
Columnale de la partie proximale du pédoncule.

Fig. 6 — KM-29-9 : columnal from the proximal part of a stem (x 11,6).
Columnale de la partie proximale du pédoncule.

Fig. 7 — KM-29-14 : columnal from the middle part of a stem (x 11,3).
Columnale de la partie moyenne du pédoncule.

Fig. 8 — KM-29-20 : columnal from the middle part of a stem (x 13,1).
Columnale de la partie moyenne du pédoncule.

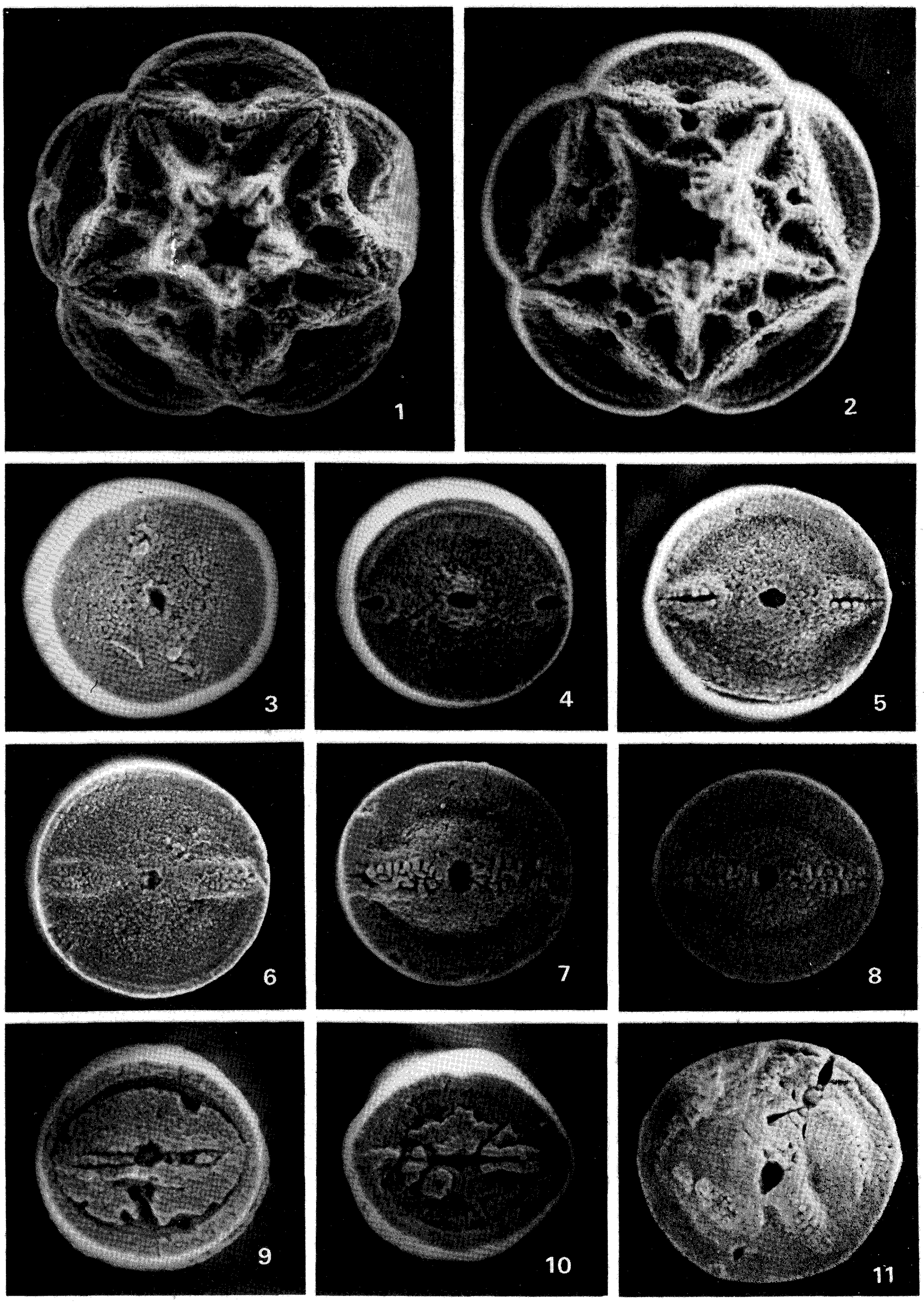
Fig. 9 — KM-29-23 : columnal from the middle part of a stem (x 10,2).
Columnale de la partie distale du pédoncule.

Fig. 10 — KM-29-19 : columnal from the distal part of a stem (x 10,2).
Columnale de la partie distale du pédoncule.

Fig. 11 — KM-29-17 : columnal spoiling by a parasite (x 9,0).
Columnale altérée par un parasite.

Mangyshlack, Teyu-Ssu-Mountain (KM-29) and Ssullukapy-Ravine (KM-64 ; coll. D.P. Naidin) ; Lower Campanian.

Manghychlak, montagne Teu-Ssou (KM-29) et ravin Ssoulloukapy (KM-64 ; coll. D.P. Naidin) ; Campanien inférieur.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# PLATE 3

**Upper articular facets of radials and columnals of *Bourgueticrinus* and *Democrinus*.**
Facettes articulaires supérieures des radiales et des columnales de *Bourgueticrinus* et de *Democrinus*.

Fig. 1 — **B. fischeri,** KM-19-1 : radial ring (x 18,4). Mangyshlack, Kugussem-Well ; Lower Santonian.
Cercle des radiales. Manghychlak, puits Kougoussem ; Santonien inférieur.

Fig. 2 — **B. fischeri,** KT-1-2 : columnal from the distal part of a stem (x 10,0).
Columnale de la partie distale du pédoncule.

Fig. 3 — **B. fischeri,** KT-1-9 : columnal from the middle part of a stem (x 10,2).
Columnale de la partie moyenne du pédoncule.

Fig. 4 — **B. fischeri,** KT-1-10 : columnal from the middle part of a stem (x 9,0).
Columnale de la partie moyenne du pédoncule.

Fig. 5 — **B. fischeri,** KT-1-8 : columnal from the middle part of a stem (x 7,1).
Columnale de la partie moyenne du pédoncule.

Fig. 6 — **B. fischeri,** KT-1-16 : columnal from the distal part of a stem (x 8,2).
Columnale de la partie distale du pédoncule.

Fig. 7 — **B. fischeri,** KT-1-6 : columnal spoiling by a parasite (x 10,9).
Columnale altérée par un parasite.

Fig. 8 — **B. fischeri,** KT-1-15 : columnal spoiling by a parasite (x 11,0).
Columnale altérée par un parasite.

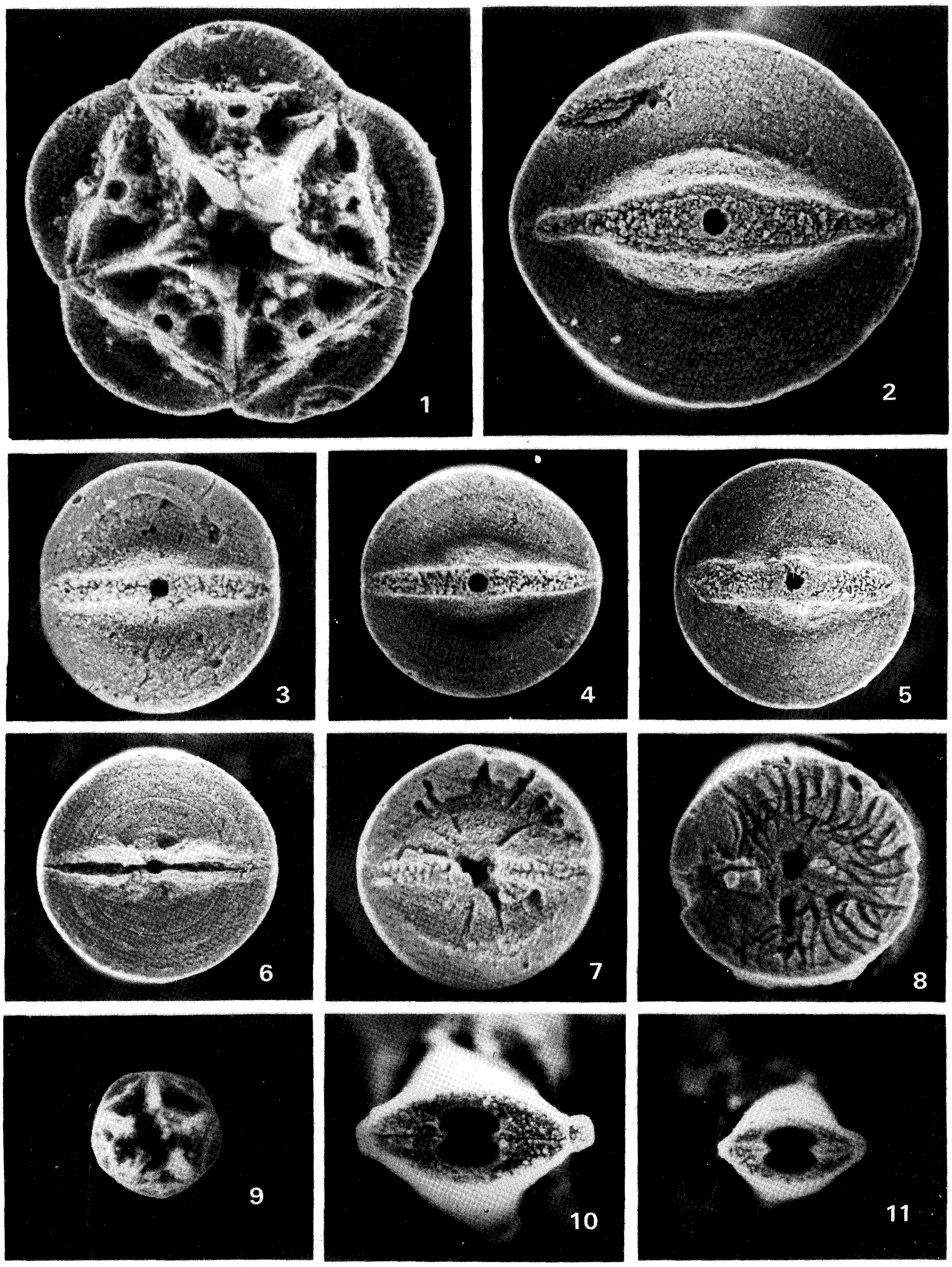
Fig. 2 to 8 : Turkmenia, Little-Balkhan-Mountains ; Coniacian.
Fig. 2 à 8 : Turkménie, Montagne du Petit Balkhan ; Coniacien.

Fig. 9 — **D. maximus,** KK-66-1 : radial ring (x 13,2).
Cercle des radiales.

Fig. 10 — **D. maximus,** KK-66-2 : large columnal (x 12,6).
Grande columnale.

Fig. 11 — **D. maximus,** KK-66-3 : small columnal (x 13,1).
Petite columnale.

Fig. 9 to 11 : Crimea, Black-River-Valley ; Upper Danian (coll. L.P. Gorbach).
Fig. 9 à 11 : Crimée, vallée de la Rivière Noire ; Danien supérieur (coll. L.P. Gorbatch).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# PLATE 4

**Thecae, stem fragments and columnal facets of *Bourgueticrinus*.**
Coupe dorsale, fragments du pédoncule et facettes articulaires des columnales de *Bourgueticrinus*.

Fig. 1 — **B. granulosus**, KM-87-1 : three columnals (x 11,2). Mangyshlack, Akssyr-Tau-Mountain ; Santonian (coll. D.P. Naidin).
Trois columnales. Manghychlack, montagne Akssyr-Taou ; Santonien (coll. D.P. Naidin).

Fig. 2 — **B. granulosus**, KM-93-1 : columnal (x 10,2). Mangyshlack, Shah-Bogota-Mountain ; Santonian (coll. D.P. Naidin).
Columnale. Manghychlak, montagne Schah-Bogota ; Santonien (coll. D.P. Naidin).

Fig. 3 — **B. hagenowii**, KM-10-11 : columnal from the proximal part of a stem (x 8,2).
Columnale de la partie proximale du pédoncule.

Fig. 4 — **B. hagenowii**, KM-10-13 : columnal from the middle part of a stem (x 12,3).
Columnale de la partie moyenne du pédoncule.

Fig. 5 — **B. hagenowii**, KM-10-12 : columnal from the distal part of a stem (x 6,8).
Columnale de la partie distale du pédoncule.

Fig. 3 to 5 : Mangyshlack, Kapam-Ravine ; upper Maastrichtian.
Fig. 3 à 5 : Manghychlak, ravin Kapam ; Maestrichtien supérieur.

Fig. 6 — **B.** cf. **maximus**, KM-68-1 : columnal (x 7,0). Mangyshlack, Zhalgan-Mountain ; Upper Santonian (coll. D.P. Naidin).
Columnale. Manghychlak, montagne Jalgan ; Santonien supérieur (coll. D.P. Naidin).

Fig. 7 — **B. baculatus**, holotype KT-8-1 : radial ring (x 15,3). Turkmenia, Little-Balkhan-Mountains ; Lower Campanian.
Holotype KT-8-1 : cercle des radiales. Turkménie, crête du Petit Balkhan ; Campanien inférieur.

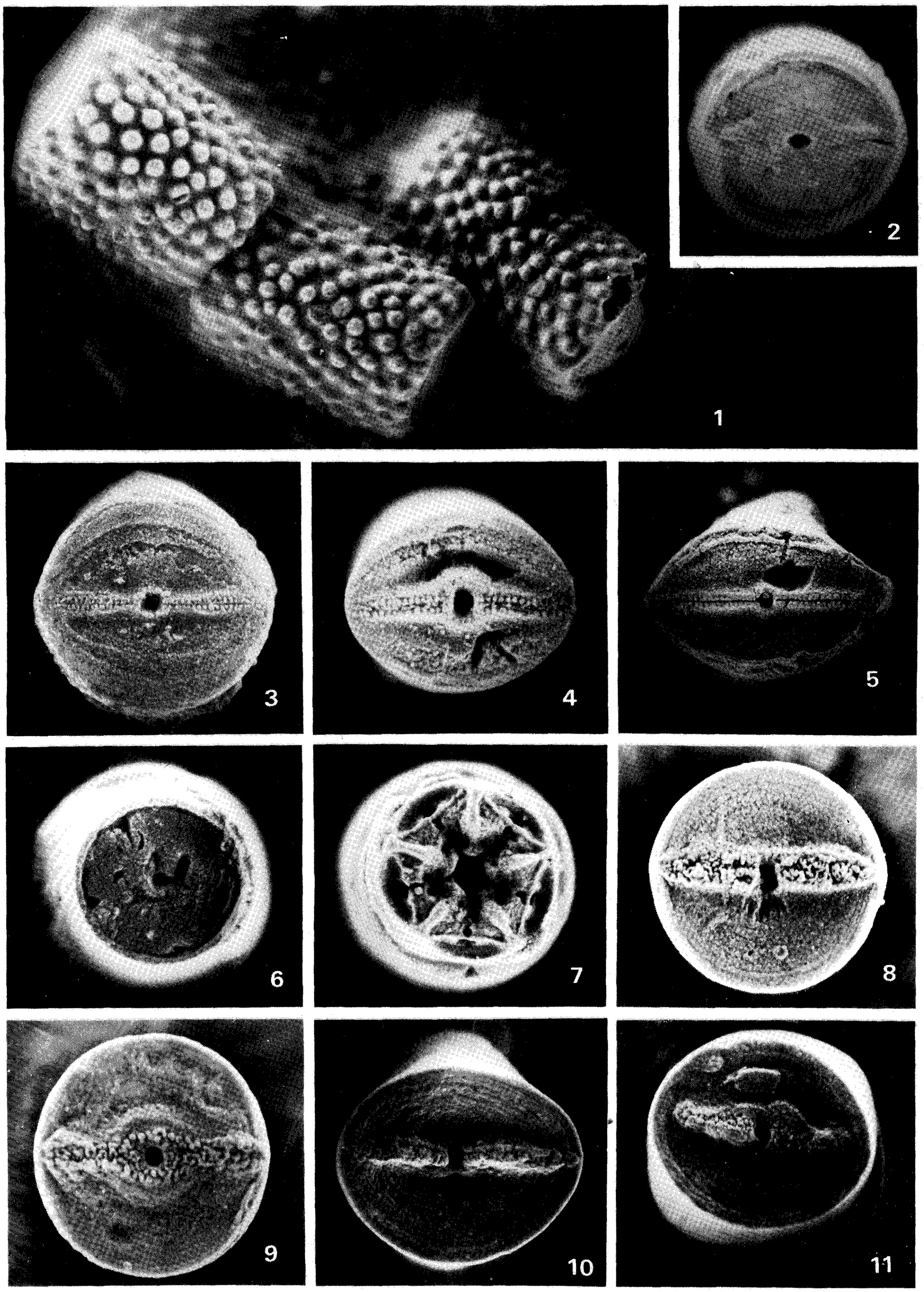
Fig. 8 — **B. baculatus**, KT-27-8 : columnal from the middle part of a stem (x 12,3).
Columnale de la partie moyenne du pédoncule.

Fig. 9 — **B. baculatus**, KT-27-6 : columnal from the middle part of a stem (x 12,3).
Columnale de la partie moyenne du pédoncule.

Fig. 10 — **B. baculatus**, KT-27-3 : columnal from the distal part of a stem (x 8,2).
Columnale de la partie distale du pédoncule.

Fig. 11 — **B. baculatus**, KT-27-2 : columnal from the distal part of a stem (x 8,4).
Columnale de la partie distale du pédoncule.

Fig. 8 to 11 : Turkmenia, West Kopet-Dagh ; Lower Campanian.
Fig. 8 à 11 : Turkménie, Kopet-Dagh occidental ; Campanien inférieur.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# PLATE 5

**Thecae, brachials and columnal articulums of *Conocrinus* and *Paleobathycrinus***

Coupes dorsales, brachiales et facettes articulaires des columnales de *Conocrinus* et de *Paleobathycrinus*

Fig. 1 — **C. vogdti**, IIK-4-4 : above-view of theca (x 16,2).
Vue de dessus d'une coupe dorsale.

Fig. 2 — **C. vogdti**, IIK-4-5 : above-view of theca (x 19,3).
Vue de dessus d'une coupe dorsale.

Fig. 1-2 : Crimea, Alma-Valley ; Upper Eocene.
Crimée, vallée de la Rivière Alma ; Éocène supérieur.

Fig. 3 — **C. tauricus**, holotype PK-2-1 : above-view of theca (x 26,3).
Vue de dessus d'une coupe dorsale.

Fig. 4 — **C. tauricus**, PK-2-2 : lower face of primibrachial (x 28,6).
Facette inférieure d'une primibrachiale.

Fig. 5 — **C. tauricus**, PK-2-6 : columnal from the proximal part of a stem (x 20,7).
Columnale de la partie proximale du pédoncule.

Fig. 6 — **C. tauricus**, PK-2-7 : columnal from the middle part of a stem (x 15,9).
Columnale de la partie moyenne du pédoncule.

Fig. 7 — **C. tauricus**, PK-2-9 : columnal from the distal part of a stem (x 17,6).
Columnale de la partie distale du pédoncule.

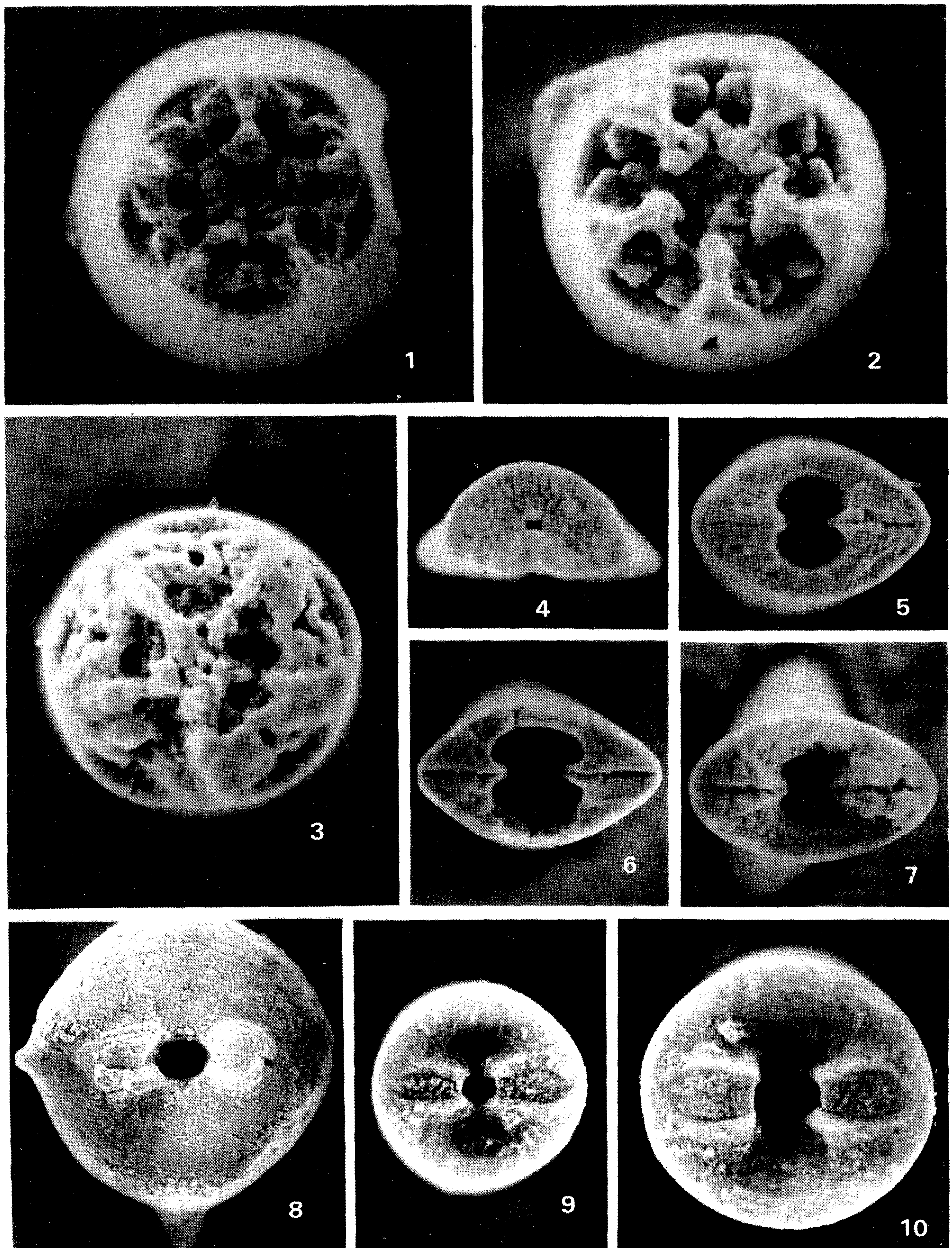
Fig. 3 to 7 : Crimea, Belbek-Valley ; Upper Paleocene.
Fig. 3 à 7 : Crimée, vallée de la Rivière Belbek ; Paléocène supérieur.

Fig. 8 — **P. endelmani**, holotype KM-116-1 : large columnal form the distal part of a stem (x 6,7).
Grande columnale de la partie distale du pédoncule.

Fig. 9 — **P. endelmani**, KM-113-3 : small columnal from the proximal part of a stem (x 12,6).
Petites columnale de la partie proximale du pédoncule.

Fig. 10 — **P. endelmani**, KM-116-2 : columnal from the middle part of a stem (x 8,1).
Columnale de la partie moyenne du pédoncule.

Fig. 8 to 10 : Mangyshlack, Burliu-Well ; Upper Danian (coll. L.G. Endelman).
Fig. 8 à 10 : Manghychlak, puits Bourlu ; Danien supérieur (coll. L.G. Endelman).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