TAXONOMIC SURVEY OF FOSSIL ISOCRINIDS WITH A LIST OF THE SPECIES FOUND IN THE USSR

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ABSTRACT

The taxonomic scheme of the two families of the order *Isocrinida (Isocrinidae* and *Pentacrinidae)* is given. The first family is divided at five subfamilies : *Balanocrininae, Isocrininae, Metacrininae, Diplocrininae* and *Isselicrininae*. Six genera are included in subfamily *Balanocrininae : Balanocrinus* (four species found in USSR), *Laevigatocrinus* (USSR : 3 species), *Margocrinus* (USSR : 4 species), *Percevalicrinus* (USSR : 5 species), *Singularocrinus* nov. gen. (monotypic) and *Terocrinus* nov. gen. (USSR : 1 species). Five fossil genera are included in subfamily *Isocrininae : Chariocrinus* (USSR : 1 species), *Chladocrinus* (USSR : 4 species), *Isocrinus* (USSR : 6 species), *Raymondicrinus* nov. gen. (Oligocene of USA : 2 species) and *Tyrolecrinus* nov. gen. (6 triassic species). Fossil representatives of three genera, namely, *Metacrinus* (Miocene - Recent), *Nielsenicrinus* (USSR : 4 species) and *Cainocrinus* (USSR : 1 species) are noted in subfamily *Metacrininae*. Five genera are included in subfamily *Isselicrininae : Austinocrinus* (USSR : 5 species), *Buchicrinus* (USSR : 5 species), *Doreckicrinus* (USSR : 1 species?), *Isselicrinus* (USSR : 4 species) and *Praeisselicrinus* (USSR : 1 species). Two genera are included in family *Pentacrinidae : Pentacrinus* (USSR : 1 species) and *Seirocrinus* (USSR : 4 species). Besides, the localities of 24 isocrinid species, systematic position of which is unknown, are listed (from Triassic upon Cretaceous). Three erroneous attributions to *Isocrinida* in USSR are pointed out. In the conclusion an outline of the phylogeny of the *Isocrinida* is discussed. For a majority of the wide-spread species in USSR figures are given.

RÉSUMÉ

Il est présenté un schéma taxonomique de deux familles de l'ordre des *Isocrinida* : les *Isocrinidae* et les *Pentacrinidae*. La première famille est divisée en 5 sous-familles : les *Balanocrininae*, les *Isocrininae*, les *Metacrininae*, les *Diplocrininae* et les *Isselicrininae*. La sous-famille des *Balanocrininae* comporte 6 genres : *Balanocrinus* (4 espèces connues en URSS), *Laevigatocrinus* (URSS : 3 espèces), *Margocrinus* (URSS : 4 espèces), *Percevalicrinus* (URSS : 5 espèces), *Singularocrinus* nov. gen. (monotypique) et *Terocrinus* nov. gen. (en URSS : 1 espèce). La sous-famille des *Isocrininae* comporte 5 genres fossiles : *Chariocrinus* (URSS : 1 espèce), *Chladocrinus* (URSS : 4 espèces), *Isocrinus* (URSS : 6 espèces), *Raymondicrinus* nov. gen. (Oligocène des USA : 2 espèces) et *Tyrolecrinus* nov. gen. (6 espèces triasiques). Dans la sous-famille *Metacrininae* sont indiqués les représentants fossiles de trois genres : *Metacrinus* (Miocène - Actuel), *Nielsenicrinus* (URSS : 4 espèces) et *Cainocrinus* (URSS : 1 espèce). La sous-famille *Isselicrininae* comporte 5 genres : *Austinocrinus* (URSS : 5 espèces), *Buchicrinus* (URSS : 5 espèces), *Doreckicrinus* (URSS : 1 espèce?), *Isselicrinus* (URSS : 4 espèces) et *Praeisselicrinus* (URSS : 1 espèce). La famille *Pentacrinidae* comporte 2 genres : *Pentacrinus* (URSS : 1 espèce) et *Seirocrinus* (URSS : 4 espèces). En outre, on a indiqué les localités des 24 espèces d'*Isocrinida* dont la position systématique est indéfinie (du Trias au Crétacé). Trois cas d'erreur sur la localité d'origine des *Isocrinida* sont signalés. En conclusion les questions de la phylogénie des *Isocrinida* sont traitées brièvement. La plupart des espèces reconnues en URSS ont été figurées.

MOTS-CLÉS : CRINOÏDES, *ARTICULATA, ISOCRINIDA, ISOCRINIDAE, PENTACRINIDAE,* TRIAS, JURASSIQUE, CRÉTACÉ, TERTIAIRE, URSS.

KEY-WORDS : *CRINOIDEA, ARTICULATA, ISOCRINIDA, ISOCRINIDAE, PENTACRINIDAE,* TRIASSIC, JURASSIC, CRETACEOUS, TERTIARY, USSR.

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I — INTRODUCTION

The Sea-lilies Isocrinids are the main group of post-Paleozoic fixed *Echinodermata*. Characteristic fragments of their pentagonal stems in sea deposits of almost any age and composition could be found in many regions of the USSR. At present time in the Soviet Union 77 species of the Isocrinids are known at least and 11 of them from Triassic, 32 from Jurassic, 29 from Cretaceous and five species from Tertiary.

The composition of the review of fossil Isocrinids of the USSR leads to the necessity of a few revisions of the existing taxonomic scheme of the order.

H. Sieverts-Doreck (1952,1953) established the order *Isocrinida* with two suborders : *Encrinina* (familes *Encrinidae* and *Dadocrinidae*) and *Isocrinina* (families *Isocrinidae, Pentacrinidae* and *Holocrinidae*). The suborder *Encrinina* was excluded out of the order (Ubaghs, 1953) and to the *Isocrinina* were attributed four families : *Isocrinidae, Pentacrinidae, Holocrinidae* and *Proisocrinidae* (Rasmussen, 1978). Noted subdivision is taken as the basis at present work but it is made considerably more precise according to the new data (Klikushin, 1977a ; Roux, 1977,1978,1981).

The most important taxonomic features of Isocrinids are following :

– family features : the character of arm division ; the character of column-basis union ; the type of stem joints ; the presence or absence of ligament pores.

– subfamily features : the articulation's mode of IBrl-2 ; the number of primibrachials ; the nodal structure ; the arrangement of the ligament pores.

– genus features : the articulation mode of IIBrr ; the construction of basal ring ; the general feature of the stem and cirrus-socket structure ; the number of internodals ; the construction of alpha-stereom and the peculiarities of the ligament pores disposition.

The genera and subfamilies of the families *Pentacrinidae* and *Isocrinidae* are shortly characterized in the below-presented taxonomic scheme. The lists of including species are cited for new genera and several poor-known genera. The forms which were either mentioned or described in the reliable publications of the soviet paleontologists and those from the author's collection are particularly noted. It should be mentioned that the list of quotations for different species is very incomplete.

Almost all figured specimens, except for the holotype of *Buchicrinus florifer*, are kept at Structural and Marine Geology Chair of the Leningrad Mining Institute.

II — TAXONOMIC SURVEY

Class **CRINOIDEA**

Subclass **Articulata**

Order **Isocrinida** SIEVERTS-DORECK, 1952

Family **PENTACRINIDAE** GRAY, 1842

TYPE-GENUS : *Pentacrinus* BLUMENBACH, 1804. Arm branching is heterotomous. The radials and sometimes the basals are provided with the downdirected shoot. Conic top of the stem is leaned against infrabasals in theca. The petaloidum is narrow-petallic and incomplete or pseudo-complete. The ligament pores are absent. Upper Triassic - Middle Jurassic.

Genus **Pentacrinus** BLUMENBACH, 1804

TYPE-SPECIES : *Pentacrinites fossilis* BLUMENBACH, 1804.

The stem is short. The internodals are few or lack. The petaloidum is incomplete. Lower - Middle Jurassic.

REMARKS : Many authors prefer to use the name « *Pentacrinites* » instead of « *Pentacrinus* » for the genus. One should apply, however, for the History (see for example : Bather, 1898 ; Clark, 1908). G. Agricolae (1546) has described a crinoid stem fragments of two types : the round - « *Entrochos* » consisting of columnals « *Trochitis* » and the pentangular -« *Encrinos* » consisting of columnals « *Pentacrinis* ». The name « *Pentacrinis* » (in greek) is equivalent to « *Pentacrinus* » (in latin) and is synonymous of the name « *Encrinos* » (in greek) which is equivalent to « *Encrinus* » (in latin). Later this consideration was violated (Luidius, 1760) and the name « *Pentacrinus* » was erroneously applied for *Isocrinida* stems and the name « *Encrinus* » was used for *Encrinida* columns. At the end of the 18-th century the name « *Pentacrinus* » turned into « *Pentacrinites* ». Why such a case have taken place ? For the answer one should apply for « Lehrbuch der Zoologie » (Oken, 1815). In this work the family Seestraüsse was divided into three genera : Meerpalme, Meerlilie and Meerdolde. The first of them was noted (l.c., p. 108) as « Gattung Meerpalme, *Pentacrinus* ». Two species were included into composition of this genus : 1) « Art Meerpalme, *P. asteria* » and 2) « Art versteinerte Meerdolde, *Pentacrinites* ». This is clear, therefore, that the name « *Pentacrinites* » was used for fossil representatives of the genus *Pentacrinus* only. The above saying leads us to the following conclusions :

– firstly : it is necessary to refuse from the primary meaning of the names *Pentacrinus* and *Encrinus* (Springer, 1909) ;

– secondly : it is necessary to refuse from the name « *Pentacrinites* » in so far as primarly it was specific and it means fossil condition of the material (Wanner, 1950) ;

– in the third place : it is necessary to use the name « *Pentacrinus* » for the Blumenbach's genus (Oken, 1815 ; Agassiz, 1835) but not « *Pentacrinites* » (Blumenbach, 1804) and it is necessary to name the family as « *Pentacrinidae* » but not « *Pentacrinitidae* ».

P. fossilis BLUMENBACH, 1804 (= *Pentacrinus briareus* MILLER, 1821) was marked as *Extracrinus briareus* from Middle Lias of the Aldan-Basin.

Genus **Seirocrinus** GISLEN, 1924

TYPE-SPECIES : *Pentacrinites subangularis* MILLER, 1821.

The stem is long. The internodals are numerous. The petaloidum is pseudocomplete. Upper Triassic - Lower Jurassic.

S. alaska (SPRINGER, 1925) - pl. 1, fig. 1-4 ; pl. 2, fig. 1 ; Norian - Rhetian ; Novosibirsk's Islands, Chukotka and Soviet Far East (Klikushin, 1979a, 1981b).

S. goniogenos (POMPECKJ, 1897) - Lower-Middle Lias ; Crimea, North Caucasus and Georgia (Pompeckj, 1897 ; Nutsubidze, 1966).

S. laevisutus (POMPECKJ, 1897) - Middle Lias ; Crimea, North Caucasus and Georgia (Pompeckj, 1897 ; Nutsubidze, 1966).

S. subangularis (MILLER, 1821) - pl. 2, fig. 2 ; Sinemurian-Pliensbachian ; Eastern Siberia (the basins of the Lena River, Yana River, Indigirka River and Kolyma River), Chukotka and Soviet Far East.

Family **ISOCRINIDAE** GISLÉN, 1924

Arm branching is isotomous. The radials without downdirected shoot. Stem's top leanes against the basals. The petaloidum is wide-petallic and complete or, rarely, incomplete. The ligament pores are present. Middle Triassic - Recent.

REMARKS. The necessity of a division of the family *Isocrinidae* upon subfamilies is noted by some authors (Doderlein, 1912 ; Sieverts-Doreck, 1944 ; Roux, 1977). But for the first time the subfamilies have been established by the author (Klik ushin, 1977a). The articulation's type between IBrl and IBr 2 was used as the basis for this division. The forms with synarthryal articulation were attributed to the *Isocrininae*, the forms with syzygial articulation -to the *Metacrininae* and the forms with synostosial articulation - to the *Isselicrininae*. This taxonomic scheme was found to be inaccurate and it was completed and corrected by M. Roux (1978, 1981). However, not all Roux's corrections can be adopted. The system, as it seems to the author, is presented below.

Subfamily **Balanocrininae** ROUX, 1978

TYPE-GENUS : *Balanocrinus* AGASSIZ *in* DESOR, 1845.

The basal ring is continuous. Two primibrachials. The junction of the IBrl and IBr2 is synarthrial. The nodals are provided with one to five cirrus sockets. The alpha stereom is well-regulated or chaotic, the ligament pores are bordering or, rarely, bordering and inner. Middle Triassic - Lower Cretaceous.

Genus **Balanocrinus** AGASSIZ *in* DESOR, 1845 emend. LORIOL, 1879

TYPE-SPECIES : *Pentacrinites subteres* MÜNSTER *in* GOLDFUSS, 1831.

The stem is circular or pentalobate in section. The nodals are somewhat larger than the internodals. Five large cirrus sockets are directed sidelong upward. Simple hypozygal ridge is well-shaped. The number of internodals is not less than 30. Monotonous bordering crenelae are generally developed on the articulums. The petals are large and triangular. The alpha-stereom is very often chaotic, the ligament pores are situated inside of the petal or near its border. Upper Triassic - Lower Cretaceous.

B. gillieroni LORIOL, 1879 - pl. 2, fig. 3,4 ; Berriasian ; Crimea (Yanin, 1963 ; Arendt & Yanin, 1964 ; Klihushin, 1979c).

B. magnus KLIKUSHIN, 1981 (*in press*) - pl. 2, fig. 5 ; Norian ; North-Western Caucasus (Klikushin, 1981b).

B. pacomei LORIOL 1887 - Middle Jurassic ; Kenkeren Ridge on the Koryak Upland (Klikushin, 1979c).

B. subteres (MÜNSTER *in* GOLDFUSS, 1831) - pl. 2, fig. 6 ; Callovian-Oxfordian ; Carpathian Mountains, Crimea and Caucasus.

Genus **Laevigatocrinus** KLIKUSHIN, 1979

TYPE-SPECIES : *Pentacrinus laevigatus* MÜNSTER, 1841.

The stem is circular or pentalobate in section. The nodals are larger than the internodals. Two to four, rarely one or five, large projected cirrus sockets are directed outside. Simple hypozygal ridge is faint. Large bordering crenellae are developed on the articulums. The petals are small and drop-like or triangular. The alpha-stereom is chaotic, the ligament pores are bordered. Middle-Upper Triassic.

INCLUDING SPECIES :

L. insignis (TOULA, 1890) - pl. 6, fig.4 ; Carnian ; Bulgaria.

L. laevigatus (MÜNSTER, 1841) - Ladinian-Carnian ; Italy, Austria, Bulgaria ; this species noted in Carnian deposits of the Khabarovsk's area.

L. radiatus (SCHAUROTH, 1859) - Ladinian-Carnian ; Italy, Austria, Poland ; at USSR this species was founded in Amur-Basin.

L. subcrenatus (LAUBE, 1865) - Carnian ; Italy, Austria, Afghanistan.

Genus **Margocrinus** KLIKUSHIN, 1979

1979c – *Balanocrinus (Margocrinus)* : KLIKUSHIN, p. 94.

TYPE-SPECIES : *Pentacrinites pentagonalis* GOLDFUSS, 1830.

The stem is pentangular. The nodals are equal with the internodals in dimension. Five small, slightly depressed cirrus sockets are directed sidelong upward. No more than 20 internodals. The articulums are surrounded by small marginal crenellae. The petals are large and rhomboidal. The alpha-stereom is rectangular or blocked, the ligament pores are inner and bordered. Middle-Upper Jurassic.

M. marioni (LORIOL, 1887) - Oxfordian ; Crimea (Klikushin, 1979c).

M. merzbacheri (AMMON, 1901) - Middle Jurassic ; Daghestan (Ammon, 1901).

M. modestus (EICHWALD, 1868) - Callovian-Oxfordian ; Crimea (Eichwald, 1868 ; Krymholz, 1949).

M. pentagonalis (GOLDFUSS, 1830) - pl. 5, fig. 1-3 ; Oxfordian ; Kaliningrad's area, Lithuania, Moscow-environs, Volga-Basin, Crimea and Caucasus.

Genus **Percevalicrinus** KLIKUSHIN, 1977

TYPE-SPECIES : *Picteticrinus beaugrandi* LORIOL, 1875.

The infrabasals occupy practically the whole stem depression. The basals are equal to the radials in height. Five small, strongly depressed cirrus sockets are directed sidelong upward. Number of the internodals is 5-17. The articulums are surrounded with large crenellae. The petals are small and lancet-shaped. The alpha-stereom is blocked or zonal, the ligament pores are bordered. Upper Jurassic - Lower Cretaceous.

P. aldingeri KLIKUSHIN, 1979 - pl. 2, fig.7, 8 ; Valanginian ; Western Siberia and Taimyr (Klikushin, 1979a, 1981a).

P. asteriscus (MEEK & HAYDEN, 1859)(= *Isocrinus knighti* SPRINGER, 1909) - this species noted as *Pentacrinus* aff. *knighti* SPRINGER in Upper Jurassic of the Pamyr (Andreeva, 1977).

P. beaugrandi (LORIOL, 1875) - Volgian ; Moscow-environs, Volga-Basin, Arctic Ural and Taimyr (Klikushin, 1981a).

P. inderensis KLIKUSHIN, 1981 (*in press*) - pl. 2, fig. 9,10 ; Volgian ; Volga-Emba-region (Klikushin, 1981a).

P. tenellus (EICHWALD, 1868) - pl. 3, fig. 1-3 ; Berriasian ; Moscow-environs, Volga-Basin and Taimyr (Eichwald, 1868 ; Klikushin, 1979a,b, 1981a).

Genus **Singularocrinus** nov. gen.

TYPE-SPECIES : *Balanocrinus singularis* KLIKUSHIN, 1981.

The stem is circular or pentalobate in section. The nodals are larger than the internodals at two or three times. Five large projected cirrus sockets are directed outside. The hypozygal ridge is complex. The articulums are surrounded with a large marginal crenellae. The petals are small and drop-like. The alpha-stereom is blocked, the ligament pores are bordered. Upper Triassic. The genus is monotypic.

REMARKS : The genus *Singularocrinus* differs from the all other genera of the subfamily by extraordinary large nodals and by the complex hypozygal ridge.

S. singularis (KLIKUSHIN, 1981) (*in press*) - pl. 3, fig. 4,7 ; Norian ; North-Western Caucasus (Klikushin, 1981b).

Genus **Terocrinus** nov. gen.

TYPE-SPECIES : *Pentacrinites subteroides* QUENSTEDT, 1858.

The stem is circular or pentalobate in section. The nodals are equal with the internodals in dimensions. Five large deeping cirrus sockets are directed sidelong upward. Simple hypozygal ridge is well shaped. No less than 30 internodals. The articulums are surrounded with a large marginal and adradial crenellae. The petals are small and drop-like. Upper Triassic - Lower Jurassic.

REMARKS. The genus *Terocrinus* differs from the all other genera of the subfamily by the slender stem, by the large marginal crenellae and by small drop-like petals.

INCLUDING SPECIES : *T. jaworskii* nov. sp. (= *Isocrinus* nov. sp. *ex* aff. *sceptrum* BATHER : Jaworski, 1915) - Norian ; Indonesia and China. The stem fragments of this species were described in details by E. Jaworski (1915, p. 87-91, pl. 43, fig. 12-15). The lecto-holotype : *l.c.*, pl. 43, fig. 15.

T. malleatus (LORIOL, 1886) - Middle Lias of France.

T. penichensis (LORIOL, 1891) - Sinemurian of Portugal.

T. quiaiosensis (LORIOL, 1891) - Sinemurian of Portugal.

T. subteroides (QUENSTEDT, 1858) -Pliensbachian ; Portugal, Morocco, France, Switzerland, Germany, ?Poland ; this species was found in Pliensbachian of North Caucasus.

Subfamily **Isselicrininae** KLIKUSHIN, 1977

TYPE-GENUS : *Isselicrinus* ROVERETO, 1914.

The basals are small and disunite. Two primibrachials. The joint between IBrl and IBr2 is synostosial. The nodals are provided with 1-4, rarely 5, cirrus sockets. The hypozygal ridge is slight. The alpha-stereom is chaotic or, rarely, well-regulated ; the ligament pores are inner. Upper Cretaceous - Miocene.

Genus **Austinocrinus** LORIOL, 1889

TYPE-SPECIES : *Pentacrinus erckerti* DAMES, 1885.

The stem is circular or pentalobate in section. The nodals are larger than the internodals. One to five large cirrus sockets are directed outside. The distal cirrus are large. The number of internodals is 15-37. The nodal-infranodal joint is syzygial. The petaloidum is surrounded with a ring area covered by radial ridges. The petals are small and triangular or drop-like. The alpha-stereom is chaotic or zonal, the ligament pores disposed bordering the petals. Upper Cretaceous.

A. albaticus KLIKUSHIN, 1973 - pl. 3, fig. 5, 6 ; Coniacian ; Crimea (Klikushin, 1973b, 1974a,b, 1975).

A. bicoronatus (HAGENOW, 1840) noted in Campanian of Azerbaidjan.

A. erckerti (DAMES, 1885) - pl. 3, fig. 8, 9 ; Lower Maestrichtian ; Crimea, Caucasus, Turkmenia and Middle Asia.

A. mexicanus (SPRINGER, 1922) was erroneously noted as *Balanocrinus mexicanus* SPRINGER in Upper Triassic of the Pamyr (Kushlin, 1973). At this case, possibly, one of *Laevigatocrinus* species was meant.

A. rothpletzi STOLLEY, 1892 (= *A. solignaci* VALETTE, 1926) - Uppermost Santonian - Lower Campanian ; Crimea, Caucasus, Mangyshlack and Turkmenia (Klikushin, 1974a,b, 1975).

A. turkmenicus KLIKUSHIN, 1974 - pl. 4, fig. 1 ; Upper Campanian ; North Caucasus and Turkmenia (Klikushin, 1974b, 1975, 1980).

Genus **Buchicrinus** KLIKUSHIN, 1977

1977a – *Isselicrinus (Buchicrinus)* : KLIKUSHIN, p. 92.

TYPE-SPECIES : *Pentacrinites buchii* ROEMER, 1840.

The stem is circular or pentalobate in section. The nodals are equal with the internodals in dimensions. One to three small, depressed cirrus sockets are disposed at lower edge of a nodals. The distal cirrus are small. No less than 30 internodals. The nodal-infranodal joint is syzygial. The articulums are surrounded with a small marginal crenellae. The partitional zones are smooth. The petals are large and triangular. The alpha-stereom is blocked. Upper Cretaceous - Paleocene.

B. buchii (ROEMER, 1840) - Lower Maestrichtian ; Crimea, Caucasus, Mangyshlack, Turkmenia and Middle Asia.

B. florifer (EICHWALD, 1868) - pl. 4, fig. 3, 4 ; Lower Maestrichtian ; Volga-Basin (Eichwald, 1868 : Klikushin, 1977a, 1980).

B. paucicirrhus (NIELSEN, 1913) - Danian ; Crimea, Caucasus, Mangyshlack, Turkmenia and Chukotka (Klikushin, 1980).

B. stelliferus (HAGENOW, 1840) - Lower Maestrichtian ; Crimea.

B. tibiensis (DUPUY de LÔME & REVILLA, 1956) noted in Upper Cretaceous deposits (Pavlova, 1971).

Genus **Doreckicrinus** RASMUSSEN, 1961

TYPE-SPECIES : *Pentacrinus miliaris* NIELSEN, 1913.

The stem is pentangular, pentalobate or circular in section. The nodals are equal with the internodals in dimensions. One to three large protruding cirrus sockets are directed outside. The distal cirrus are large. The nodal-infranodal joint is syzygial. The bordering crenellae are large and not numerous. The petals are small and oval or drop-like. Upper Cretaceous - Lower Paleogene.

Doreckicrinus sp. - pl. 4, fig. 2 ; Upper Campanian ; Tuarkyr.

Genus **Isselicrinus** ROVERETO, 1914

TYPE-SPECIES : *Pentacrinites didactylus* d'ORBIGNY *in* d'ARCHIAC, 1846.

The stem is pentangular, pentalobate or circular in section. The nodals are equal in dimension with the internodals. One to five small, projecting cirrus sockets are situated at the lower edge of a nodals. The distal cirrus are small. No less than 30 internodals. The nodal-infranodal joint is petal-shaped. The articulums are surrounded with a small crenellae. The partitional zones are jagged or, rarely, smooth. The petals are rhomboidal or triangular. The alpha-stereom is chaotic. Eocene - Miocene.

I. diaboli (BAYAN, 1870) - pl. 4, fig. 5 ; Lower Eocene ; Armenia.

I. didactylus (d'ORBIGNY *in* d'ARCHIAC, 1846) noted in Middle Eocene of Crimea.

I. pellegrinii (MENEGHINI, 1876) (= *Pentacrinus inkermanensis* DE LORIOL, 1877) - pl. 4, fig. 6, 7 ; Upper Eocene ; Crimea (Klikushin, 1977b).

I. sulcifer (EICHWALD, 1871) - pl. 4, fig. 8 ; Upper Eocene ; Mangyshlack (Klikushin, 1977a).

Genus **Praeisselicrinus** KLIKUSHIN, 1977

1977a – *Isselicrinus (Praeisselicrinus)* : KLIKUSHIN, p. 92.

TYPE-SPECIES : *Isselicrinus atabekjani* KLIKUSHIN, 1973.

The stem is pentalobate in section. The nodals are slightly larger than the internodals. One or two small cirrus sockets are directed upward. The cirrus are small. The number of internodals is 14 or 15. Infranodal joint is petal-shaped. The articulums are surrounded with a small crenellae. The partitional zones are jagged. The petals are drop-like. The alpha-stereom is chaotic or blocked, the ligament pores are inner and bordering. Upper Cretaceous.

INCLUDING SPECIES : *P. atabekjani* (KLIKUSHIN, 1973) - pl. 4, fig. 9, 10 ; Campanian ; Turkmenia (Klikushin, 1973a, 1977a, 1980).

P. bryani (GABB, 1876) - Upper Cretaceous of USA.

P. limburgicus (RASMUSSEN, 1961) - Maestrichtian of Holland.

Subfamily **Metacrininae** KLIKUSHIN, 1977
emend. ROUX, 1978

1977a – *Metacrininae* : KLIKUSHIN, p. 89 (*ex-parte*).
1977 – Subfamily I : Roux, p. 63.
1978 – *Metacrininae* : Roux, p. 22, A7.
1981 – *Metacrininae* : Roux, p. 482.

TYPE-GENUS : *Metacrinus* CARPENTER, 1882.

The basal ring is disunite or, rarely, continuous. More than two primibrachials. The joint between IBrl and IBr2 is syzygial. The nodals are provided with five cirrus sockets. The alpha-stereom is chaotic, the ligament pores are external, rarely inner. Cretaceous - Recent.

Genus **Cainocrinus** FORBES, 1852

TYPE-SPECIES : *Cainocrinus tintinnabulum* FORBES, 1852.

The basal ring is continuous. The stem is pentangular or circular in section. The nodals are larger than the internodals. Five cirrus sockets are directed outside. The number of internodals is 6-12. The marginal crenellae are large. The petals are small and lancet-shaped. Paleogene.

INCLUDING SPECIES : *C. darchiaci* (PASOTTI, 1929) - Eocene of Italy.

C. gorbachae KLIKUSHIN, 1977 - pl. 4, fig. 11-14 ; Paleocene ; Crimea (Klikushin, 1977b).

C. tintinnabulum FORBES, 1852 - Eocene of England.

Genus **Metacrinus** CARPENTER, 1882
(= *Tauriniocrinus* ROVERETO, 1939)

TYPE-SPECIES : *Metacrinus wyvillei* CARPENTER, 1884.

The stem is pentangular or pentalobate in section. The nodals are larger than the internodals. Five deeping cirrus sockets are directed outside. The number of internodals is 7-12. The marginal crenellae are large. The petals are small and lancet-shaped. Miocene - Recent.

INCLUDING FOSSIL SPECIES : *M. gastaldii* (MICHELOTTI, 1847) - Miocene of Italy.

M. mazarronensis ROUX & MONTENAT, 1977 - Miocene of Spain.

M. sievertsae nov. sp. (= *Metacrinus* sp. : Sieverts, 1932) - Pliocene of Indonesia. The nodal and internodals columnals of this species were described in details by H. Sieverts (1932, p. 160-165, fig. 8-10). The lectoholotype : *l.c*, fig. 8.

Genus **Nielsenicrinus** RASMUSSEN, 1961

TYPE SPECIES : *Pentacrinus obsoletus* NIELSEN, 1913.

The stem is pentangular, pentalobate or circular in section. The nodals are larger than the internodals. Five deeping cirrus sockets are directed outside. The number of internodals is 7-11 and more. The marginal crenellae are large. The petals are small and lancet-shaped. Lower Cretaceous - Paleocene.

INCLUDING SPECIES : *N. agassizi* (HAGENOW, 1840) was erroneously noted as *Pentacrinus agassizi* MILLER in Upper Jurassic of the Pamyr (Andreeva, 1977).

N. fionicus (NIELSEN, 1913) - Danian ; Crimea and Mangyshlack (Klikushin, 1980).

N. rosenkrantzi RASMUSSEN, 1961 - Upper Maestrichtian ; Eastern Turkmenia (Favorskaya, 1980).

N. varians KLIKUSHIN, 1980 - pl. 4, fig. 15, 16 ; Danian ; Crimea, Mangyshlack and Turkmenia (Klikushin, 1980).

Subfamily **Isocrininae** KLIKUSHIN, 1977

TYPE-GENUS : *Isocrinus* MEYER *in* AGASSIZ, 1835.

The basals are small and often disunite. Two primibrachials. The junction of the IBrl and IBr2 is synarthrial. The nodals are provided with five cirrus sockets. The alpha-stereom is chaotic, the ligament pores are bordering. Upper Triassic - ?Recent.

Genus **Chariocrinus** HESS, 1972

TYPE-SPECIES : *Isocrinus andreae* DESOR, 1845.

The basal ring is continuous. The stem is pentangular in section. The nodals are equal with the internodals in dimensions. Large oval cirrus sockets are directed outside. The number of internodals is 5-11. The marginal crenellae are large. The petals are small and drop-like. Middle-Upper Jurassic.

C. cristagalli (QUENSTEDT, 1852) is noted in Upper Jurassic of Lithuania, Central Russia and Caucasus (Rjabinin, 1913 and others).

Genus **Chladocrinus** AGASSIZ, 1835
emend. SIEVERTS-DORECK, 1971

TYPE-SPECIES : *Pentacrinites basaltiformis* (MILLER, 1821).

The basals are small and disunite. The stem is stellate or pentangular in section. The nodals are larger than the internodals. Large cirrus sockets are directed outside or slightly upward. The number of internodals is 5-20. The crenellae are small and numerous. The petals are long and lancet-shaped, or drop-like. Upper Triassic - Lower Jurassic.

INCLUDING SPECIES : *C. basaltiformis* (MILLER, 1821) - Lower Jurassic ; Carpathian Mountains, Crimea, Caucasus, Yana-Basin, Chukotka.

C. californicus (CLARK, 1915) - Carnian ; Indigirka-Basin.

C. kolymaensis (KLIKUSHIN, 1981) (*in press*) - pl. 5, fig. 4 ; Carnian ; Kolyma-Basin (Klikushin, 1981b).

C. scalaris (GOLDFUSS, 1831) - Lower Jurassic ; Crimea and Caucasus.

C. tuberculatus (MILLER, 1821) - Lower Jurassic ; Yana-Basin, Chukotka, Soviet Far East.

Genus **Isocrinus** MEYER *in* AGASSIZ, 1835

TYPE-SPECIES : *Isocrinus pendulus* MEYER, 1837.

The basal ring is disunite. The stem is stellate or pentangular in section. The nodals are larger than the internodals. Large oval cirrus sockets are directed outside. The number of the internodals is 6-10. The crenellae are small and numerous. The petals are small and drop-like. Jurassic - Lower Cretaceous.

INCLUDING SPECIES : *I. amblyscalaris* (THURMANN *in* ETALLON, 1859) (? = *Isocrinus pendulus* MEYER, 1837) - Callovian - Oxfordian ; Moscow-environs, Crimea, Azerbaidjan ; ?Tithonian of Georgia.

I. annulatus (ROEMER, 1836) - Berriasian ; Crimea (Yanin, 1963).

I. astralis (QUENSTEDT, 1858) - Oxfordian ; Armenia and Pamyr.

I. cingulatus (MÜNSTER *in* GOLDFUSS, 1831) - Oxfordian ; Moscow-environs, North Caucasus, Armenia and Pamyr.

I. desori (THURMANN, 1862) - Oxfordian ; Lithuania.

I. pendulus MEYER, 1837 - pl. 6, fig. 1, 2 ; Oxfordian, Rjazan-region.

Genus **Raymondicrinus** nov. gen.

TYPE-SPECIES : *Isocrinus oregonensis* MOORE & VOKES, 1953.

The joint IIBrl-2 is muscular, the joint IIBr2-3 is muscular or, rarely, syzygial. The basals are small and disunite. The stem is stellate in section. The nodals are slightly larger than the internodals. Small cirrus sockets are directed outward. The number of the internodals is 6-7. The crenellae are small and numerous. The petals are lancet-shaped. Oligocene.

REMARKS. The genus *Raymondicrinus* differs from the all other genera of the *Isocrininae* by the muscular joint of the IIBrl-2 and by the small cirrus sockets directing outward. The muscular joint of the IIBrl-2 is known in *Metacrinus* and *Saracrinus*. But in this genera the junction of the IBrl-2 is syzygial and the number of primibrachials is always more than two.

INCLUDING SPECIES : the type of the genus and *R. nehalemensis* (MOORE & VOKES, 1953) - both from Oligocene of USA.

Genus **Tyrolecrinus** KLIKUSHIN

1981c – *Tyrolecrinus :* KLIKUSHIN (*in press*).

TYPE-SPECIES : *Pentacrinus tyrolensis* LAUBE, 1865.

The stem is pentalobate or circular in section. The columnals are high and smooth. The nodals are equal with the internodals. Cirrus sockets are small, strongly depressed and directed sidelong downward. The number of internodals is 3-10. The marginal crenellae are large. The petals are small and drop-like or lancet-shaped. Middle - Upper Triassic.

REMARKS. The genus *Tyrolecrinus* differs from the all other genera of the *Isocrininae* by the small cirrus sockets directing downward and by large marginal crenellae.

INCLUDING SPECIES : *T. anulatus* (LEONARDI & LOVO, 1950) - Carnian of Italy.

T. candelabrum (BATHER, 1909) - Carnian of Hungary.

T. dubius (GOLDFUSS, 1831) - Middle Triassic ; Switzerland, Austria, Germany, Poland, Bulgaria, North-Western Caucasus.

T. sceptrum (BATHER, 1909) - Carnian of Hungary.

T. scipio (BATHER, 1909) - Carnian of Hungary and Austria.

T. tyrolensis (LAUBE, 1865) - Carnian of Italy, Austria, Hungary, Germany, Bulgaria, Afghanistan and China.

ISOCRINIDAE inc. gen.

The isocrinids species which are known from Mesozoic deposits of the USSR are listed below at alphabetic order under the primary generic names. The systematic position of these species is unknown.

Isocrinus ? argenteus BATHER, 1918 - pl. 5, fig. 5 ; Carnian ; Eastern Siberia (Klikushin, 1979a, 1981b).

Pentacrinus ? arzierensis LORIOL, 1879 - Valanginian ; Crimea.

Isocrinus ? balchanicus KLIKUSHIN, 1973 - pl. 5, fig. 6 ; Campanian ; Turkmenia (Klikushin, 1973a, 1980).

Pentacrinus ? carinatus ROEMER, 1840 - Coniacian to Campanian ; Western Ukrainia, Crimea, Caucasus, Volga-Emba-Region, Mangyshlack.

Isocrinus ? cenomanensis d'ORBIGNY, 1850 - pl. 6, fig. 3 ; Albian-Cenomanian ; Crimea (Klikushin, 1980).

Pentacrinus ? dumortieri OPPEL, 1865 - Callovian-Oxfordian ; Nera-Basin in North-Eastern Siberia (Paraketsov & Polubotko, 1970).

Pentacrinus ? exilis EICHWALD, 1868 - Upper Cretaceous ; Western Ukrainia (Eichwald, 1868 ; Hynda, 1969 ; Klikushin, 1980). The species required the redescription upon the new type material in so far as the holotype was lost.

Pentacrinus ? jurensis QUENSTEDT, 1852 - Jurassic ; Azerbaidjan, Pamyr, North-Eastern Siberia.

Pentacrinus ? laevis MILLER, 1821 - Jurassic ; Crimea (Favre, 1877).

Pentacrinus ? lanceolatus ROEMER, 1840 - Senonian ; Daghestan, Mangyshlack and Turkmenia.

Pentacrinus ? lissajousi LORIOL, 1904 - Valanginian ; Crimea (Yanin, 1963 ; Pavlova, 1971).

Pentacrinus ? mieryensis LORIOL, 1886 -Aalenian ; North Caucasus.

Balanocrinus ? minutus VALETTE, 1917- pl. 7, fig. 3, 4 ; Santonian ; Mangyshlack and Turkmenia (Klikushin, 1973a, 1980).

Pentacrinus ? neocomiensis DESOR, 1845- Hauterivian-Barremian ; Carpathian Mountains, Crimea and Eastern Caucasus.

Pentacrinus ? nodulosus ROEMER, 1840 - Campanian ; North Caucasus and Armenia.

Pentacrinus ? oxyscalaris THURMANN, 1862- Callovian-Oxfordian ; Moscow-environs and Crimea (Gherassimov, 1955).

Isocrinus ? patrickensis STRIMPLE, 1973 - pl. 6, fig. 5 ; Bathonian ; Lena-Basin.

Pentacrinus ? propinquus MÜNSTER, 1834 - Norian ; Crimea and North Caucasus (Klikushin, 1981b).

Pentacrinus ? shastensis CLARK, 1915 - pl. 7, fig. 1,2 ; Volgian ; Taimyr (Klikushin, 1979a).

Isocrinus ? trechmanni BATHER, 1918 - Ladinian-Carnian ; Amur-Basin.

Pentacrinus ? cf. *zeltbergensis* WOLLEMANN, 1902 is noted in Campanian of Azerbaidjan.

ERRONEOUS «ISOCRINIDA» species

With exception of listed above species, another three forms are known in the USSR. They are noted under genus name «*Pentacrinus*» but in reality they have nothing in common with *Isocrinida*.

Pentacrinus ambiguus EICHWALD, 1868 is described from the Upper Cretaceous deposits of Western Ukrainia (Eichwald, 1868). This species is an Echinoid spine like of *Dorocidaris reussi* (GEINITZ) (Rasmussen, 1961 ; Klikushin, 1980).

Pentacrinus marcousanus d'ORBIGNY, 1850 is noted in Oxfordian of North Caucasus. This species is attributed to Crinoid order *Millericrinida.*

Pentacrinus priscus GOLDFUSS, 1830 is noted in Oxfordian of Amur-Basin. This species is described from Ordovician system and is attributed possibly to the genus *Baltocrinus* (Stukalina, 1979).

III – PHYLOGENY OF THE ISOCRINIDS

The time of the Isocrinids emergence is referred, possibly, to the beginning of the Middle Triassic (fig. 1). Authentic Lower Triassic Isocrinids are unknown and at the end of Middle Triassic entirely well developed and specialized groups are already observed. Lower Triassic *Holocrinidae* might be the ancestors of the Isocrinids.

Soon after their isolation the Isocrinids have divided into two branches : *Balanocrininae* and *Isocrininae*. In the first subfamily the genus *Laevigatocrinus* is, perhaps, initial. The *Laevigatocrinus* species were spread at south provinces of the Tethys. In Upper-Triassic the *Laevigatocrinus* put the beginning of the two genera : *Terocrinus* and *Balanocrinus*. The both genera were alike with each other but the species of the first genus were spread in southern regions and the species of the second were inhabited almost everywhere, except the boreal area. The genus *Terocrinus* existed up to Lower Jurassic and *Balanocrinus* existed up to Lower Cretaceous. At Middle Jurassic the genus *Margocrinus* derivated from the *Balanocrinus* and it existed up to Upper Jurassic in temperate zone. The *Percevalicrinus* derived from the *Margocrinus* and was typically boreal.

The *Isocrininae* in Upper Triassic have divided at the number of the branches : *Isocrinus, Chladocrinus, Tyrolecrinus* and others. At the end of Upper Triassic the family *Pentacrinidae* has isolated. This family has derivated, probably, from the *Chladocrinus*. One of the genus of this family *(Pentacrinus)* has spread in Lower and Middle Jurassic of southern basins and has died out soon, serving as a beginning for unstalked *Comatulida*. The second genus of the *Pentacrinidae (Seirocrinus)* was very wide-spread in Upper Triassic and Lower Jurassic times both in tethysian and boreal zones.

The ancestor of the *Isselicrininae* was, possibly, the genus *Balanocrinus*. The authentic finds of the same ancient *Isselicrininae* genus (*Austinocrinus*) are known from Coniacian age but transitional forms from the *Balanocrininae* to the *Isselicrininae* to present times are unknown. The *Isselicrininae* reached its highest development at Upper Cretaceous. The genus *Austinocrinus* (Coniacian-Maestrichtian) put the beginning of short-lived tethysian genera *Praeisselicrinus* (Campanian) and *Doreckicrinus* (Santonian-Danian). The *Praeisselicrinus* was ancestor of the *Buchicrinus* (Maestrichtian-Danian). The latter captured more larger areas and at the end of its existence appeared even at boreal regions. The *Buchicrinus* put the beginning of the genus *Isselicrinus* (Lower Eocene-Lower Miocene) which was wide-spread as its ancestor. The transitional forms (*Buchicrinus - Isselicrinus*) which existed at Upper Paleocene for the present are unknown. The *Isselicrininae*'s existence lasted up to Miocene.

The *Metacrininae* has derived, possibly, from the *Isocrininae*. They appeared at Lower Cretaceous and they are wide-spread in recent Western Pacific Ocean. The fossil genera of this subfamily were tethysian in the USSR, namely *Nielsenicrinus* (Upper Cretaceous-Paleogene) and *Cainocrinus* (Paleogene).

At *Isocrinida* development three turning points could be marked and each of them are caused by a change of the generic composition. The first one took place at Lower Cretaceous. At that time the *Balanocrininae* and almost all *Isocrininae* have disappeared. At the same time the *Isselicrininae* and *Metacrininae* have appeared. The second turning point took place in the Middle Paleocene and it is less clearly distinguished. The majority of the *Isselicrininae* genera and the genus *Nielsenicrinus* of the subfamily *Metacrininae* have disappeared at that time and *Cainocrinus* has appeared. The latter turning point is itself the Miocene-Pliocene boundary. All fossil groups have disappeared then and many new genera of the subfamilies *Isocrininae, Metacrininae* and *Diplocrininae* have appeared at the same time.

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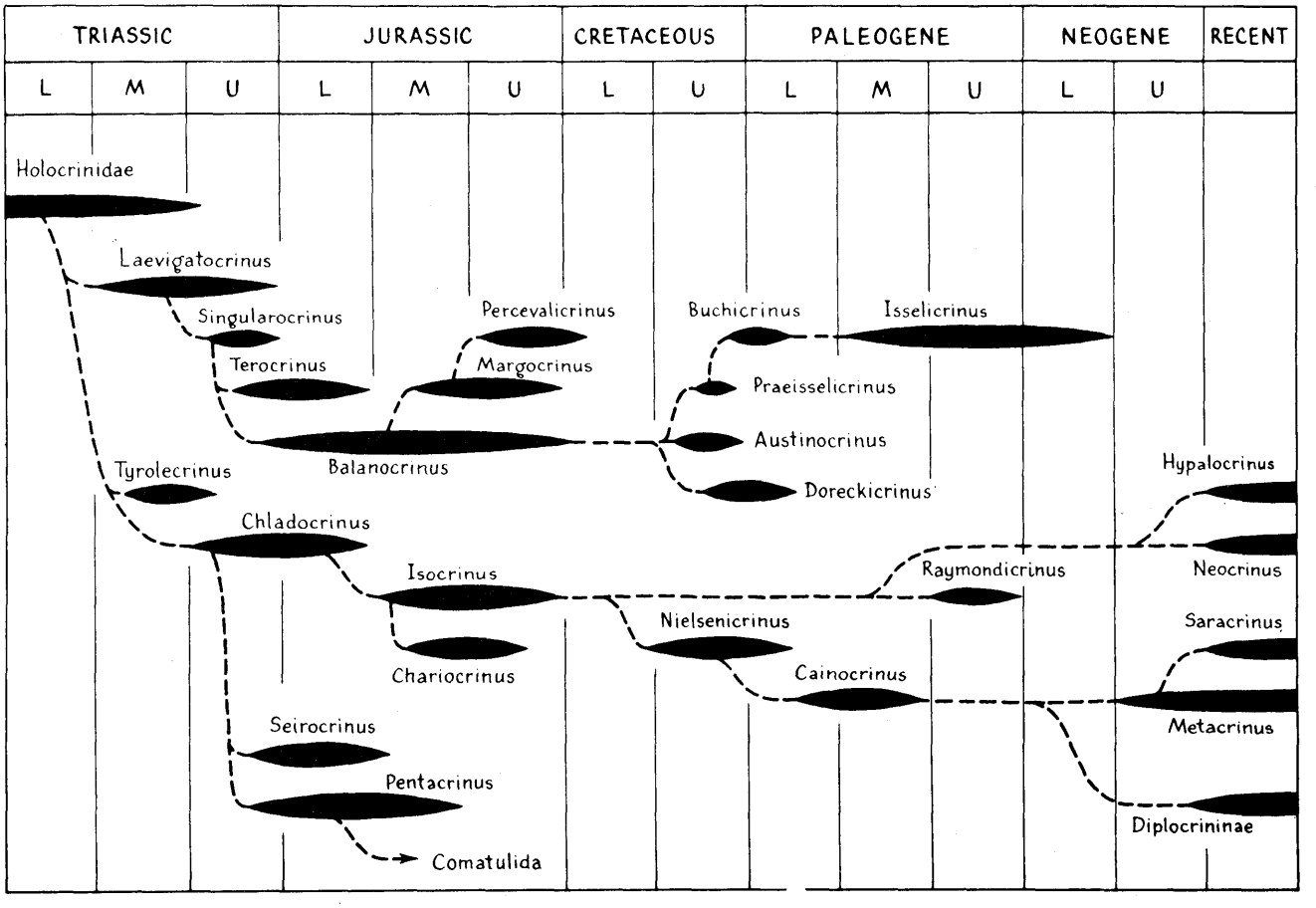

Fig. 1 – **Phylogenetic scheme of the Isocrinids**(abbreviation : L - Lower, M - Middle, U - Upper).
Schéma phylogénétique des Isocrinidés (abbréviations : L - inférieur, M - moyen, U - supérieur).

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PLATE 1

Fig. 1 - 4 – ***Seirocrinus alaska*** **(SPRINGER).**

1. TH-1-1 : crown (x 1).

   TH-1-1 : couronne (x 1).

2. TH-1-7 : proximal part of a crown (x 1).

   TH-1-7 : partie proximale de la couronne (x 1).

3. TH-1-8 : distal parts of a crown (x 1).

   TH-1-8 : partie distale de la couronne (x 1).

4. TH-1-4 : fragments of proximal (left) and middle (right) parts of a stem (x 1).

   TH-1-4 : fragment proximal (à gauche) et fragment de la partie médiane de la tige (à droite) (x 1).

Novosibirsk Islands, Kotelny Island ; Norian - Rhetian (coll. D.A. Volnov, V.P. Gavrilov & M.K. Kosko).

Îles de Novossibirsk, île Kotelny ; Norien et Rhétien (coll. D.A. Volnov, V.P. Gavrilov et M.K. Kosko).


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PLATE 2

Fig. 1 – ***Seirocrinus alaska* (SPRINGER).**

TH-1-5 : fragments of stems (x 1). Novosibirsk Islands, Kotelny Island ; Norian-Rhetian (coll. D.A. Volnov, V.P. Gavrilov & M.K. Kosko).

TH-1-5 : fragments des tiges (x 1). Îles de Novossibirsk, île Kotelni ; Norien et Rhétien (coll. D.A. Volnov, V.P. Gavrilov et M.K. Kosko).

Fig. 2 – ***Seirocrinus subangularis* (MILLER).**

ИС-33-1 : fragments and columnals of stems (x 1,5). Olenek-Basin ; Pliensbachian (coll. V.A. Bassov).

ИС-33-1 : fragments et articles de tige (x 1,5). Bassin de la rivière Olenek ; Pliensbachien (coll. V.A. Bassov).

Fig. 3, 4 – ***Balanocrinus gillieroni* LORIOL.**

3. CK-34-1 : columnal articular face (x 6,4).
4. CK-34-3 : fragment of stem with a nodal (x 6,1).
Crimea ; Berriasian (coll. B.T. Yanin).

3. CK-34-1 : facette articulaire de l'article (x 6,4).
4. CK-34-3 : fragment de tige avec une nodale (x 6,1).
Crimée ; Berriasien (coll. B.T. Yanin).

Fig. 5 – ***Balanocrinus magnus* KLIKUSHIN.**

The holotype, ТБ-3-2 : columnal articular face (x 5,6).
North-Western Caucasus, Laba-Basin ; Norian.

Holotype, ТБ-3-2 : facette articulaire de l'article (x 5,6).
Caucase nord-ouest, bassin de la rivière Laba ; Norien.

Fig. 6 – ***Balanocrinus subteres* (MÜNSTER *in* GOLDFUSS).**

ИК-2-1 : columnal articular face (x 5,4).
Crimea ; Callovian-Oxfordian (coll. G.F. Veber).

ИК-2-1 : facette articulaire de l'article (x 5,4).
Crimée ; Callovien et Oxfordien (coll. G.F. Veber).

Fig. 7, 8 – ***Percevalicrinus aldingeri* KLIKUSHIN.**

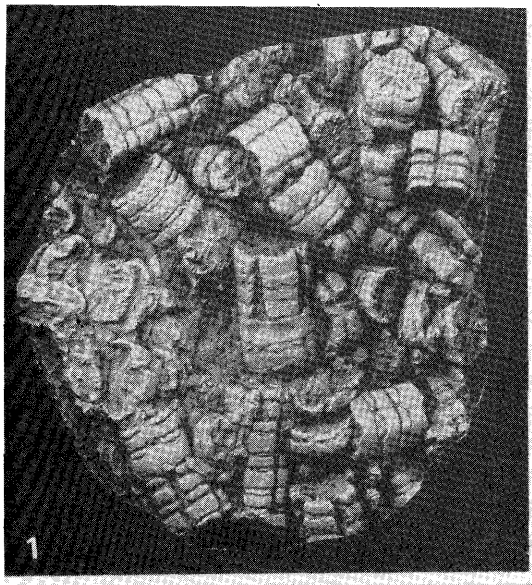
7. C3-3-1 : crown and stem (x 2,0). Western Siberia, boring Kholmogorsk 6 (2564-2572) ; Valanginian (coll. K.V. Skvortsova).
8. CH-7-2 : columnal articular face (x 7,1). Tgaimyr, Maimecha River ; Valanginian (coll. O.N. Simonov).

7. C3-3-1 : couronne et tige (x 2,0). Sibérie ouest, sondage de Kholmogorsk 6 (2564-2572) ; Valanginien (coll. K.V. Skvortsova).
8. CH-7-2 : facette articulaire de l'article (x 7,1). Taimyr, la rivière Maimecha ; Valanginien (coll. O.N. Simonov).

Fig. 9, 10 – ***Percevalicrinus inderensis* KLIKUSHIN.**

9. ИЭ -1-22 : columnal articular face (x 7,2).
10. The holotype ИЭ -1-6 : stem fragment with a nodal (x 4,8).
Caspian Depression, Inder-Lake ; Volgian.

9. ИЭ -1-22 : facette articulaire de l'article (x 7,2).
10. Holotype, ИЭ -1-6 : fragment d'une tige avec une nodale (x 4,8).
Dépression de la Caspienne, lac d'Inder ; Volgien.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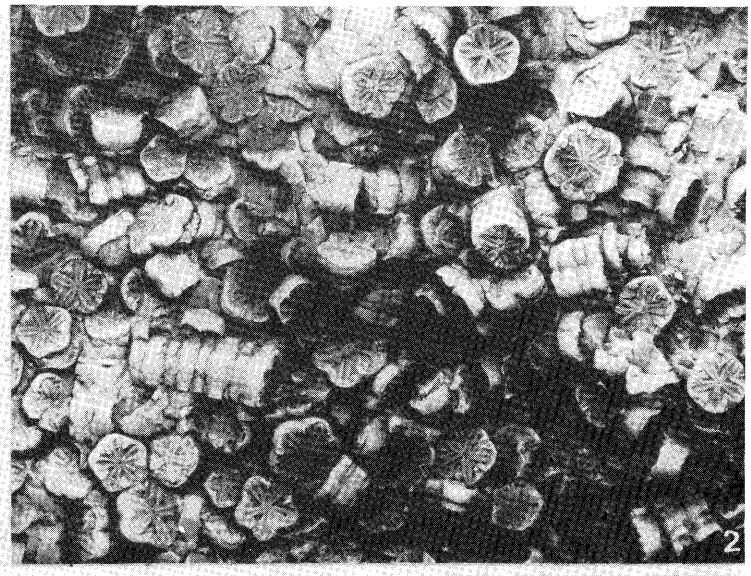
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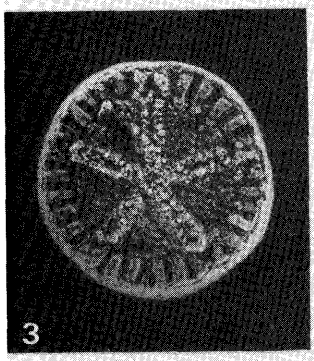
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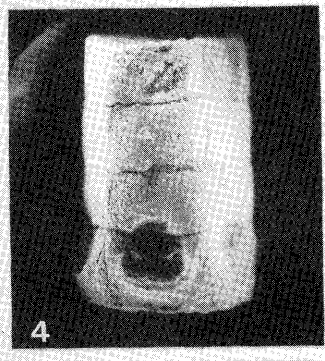
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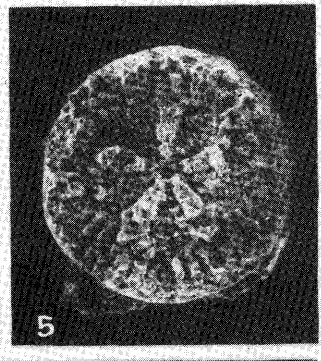
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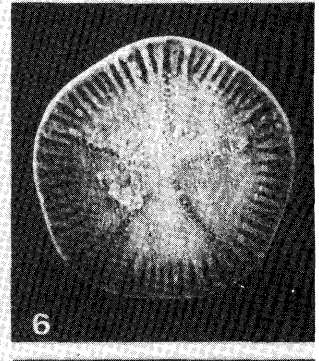
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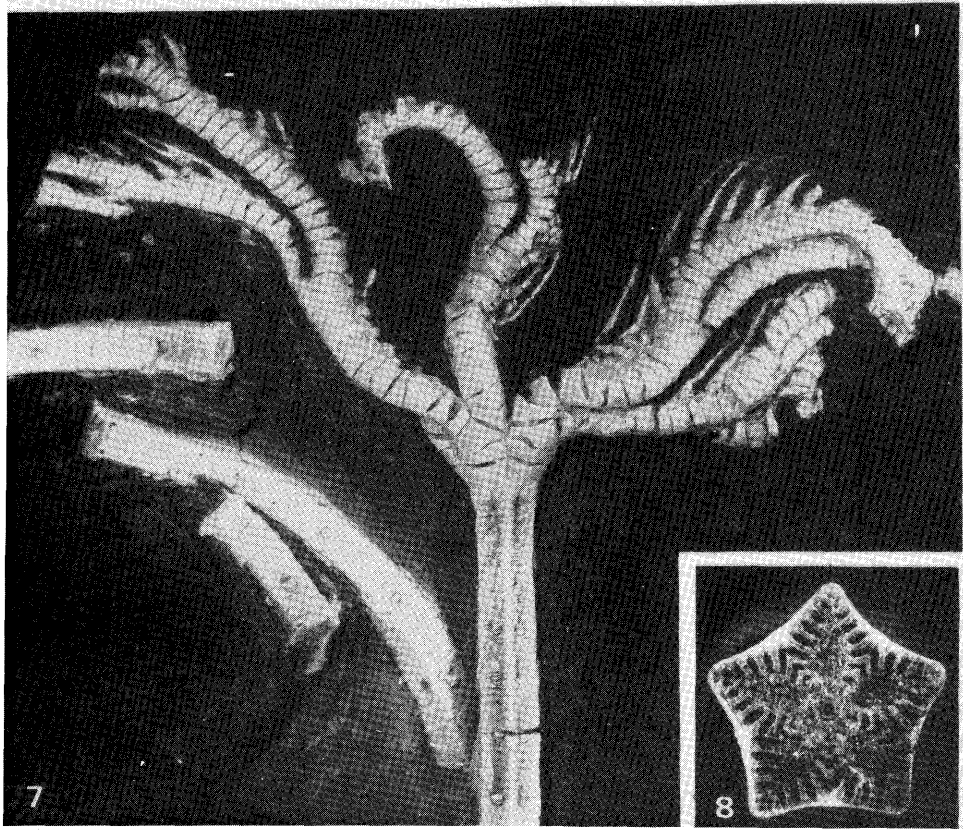
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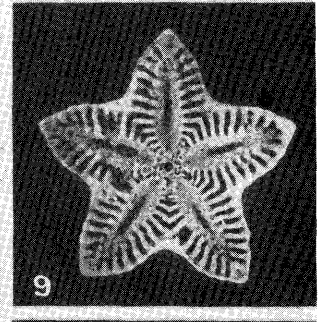
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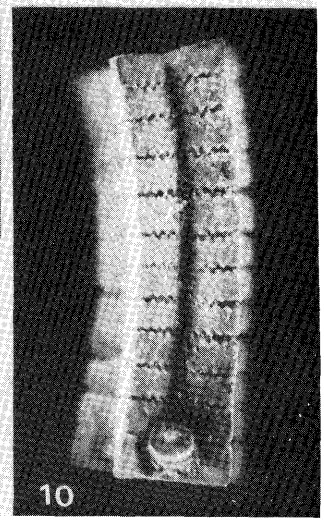
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PLATE 3

Fig. 1 - 3 – ***Percevalicrinus tenellus* (EICHWALD).**

1. CH-6-3 : Fragment of stem with nodals (x 5,2).
2. CH-6-1 : articular face of a small columnal (x 10,0).
3. CH-6-2 : articular face of a large columnal (x 6,8).
Taimyr, Malaya Romanikha River ; Berriasian (coll. O.N. Simonov).

1. CH-6-3 : fragment de tige avec deux nodales (x 5,2).
2. CH-6-1 : facette articulaire d'un petit article (x 10,0).
3. CH-6-2 : facette articulaire d'un grand article (x 6,8).
Taimyr, la rivière Malaya Romanikha ; Berriasien (coll. O.N. Simonov).

Fig. 4, 7 – ***Singularocrinus singularis* (KLIKUSHIN).**

4. ТБ-5-18 : articular face of a proximal cirral (x 14,4).
7. ТБ-5-6 : articular face of a columnal (x 11,1).
North-Western Caucasus, Laba-Basin ; Norian.

4. ТБ-5-18 : facette articulaire du cirral proximal (x 14,4).
7. ТБ-5-6 : facette articulaire de l'article (x 11,1).
Caucase nord-ouest, bassin de la rivière Laba ; Norien.

Fig. 5, 6 – ***Austinocrinus albaticus* KLIKUSHIN.**

5. The holotype, KK-47-1 : fragment of stem (x 5,4).
6. KK-47-2 : articular face of a columnal (x 5,1).
Crimea ; Coniacian.

5. Holotype, KK-47-1 : fragment de tige (x 5,4).
6. KK-47-2 : facette articulaire de l'article (x 5,1).
Crimée ; Coniacien.

Fig. 8, 9 – ***Austinocrinus erckerti* (DAMES).**

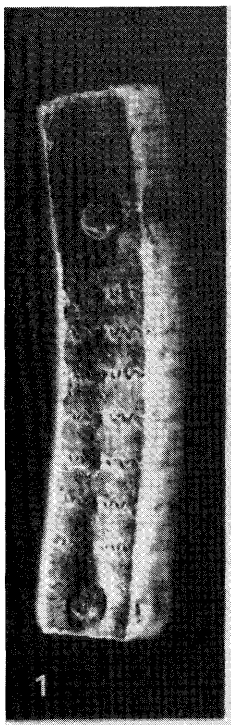
8. KT-20-3 : articular face of a proximal columnal (x 6,3).
9. KT-18-1 : articular face of a distal columnal (x 4,6).
Turkmenia, Maly Balkhan Ridge ; Maestrichtian.

8. KT-20-3 : facette articulaire d'un article proximal (x 6,3).
9. KT-18-1 : facette articulaire d'un article distal (x 4,6).
Turkménie, la crête de Maly Balkhan ; Maestrichtien.

Fig. 10, 11 – ***Austinocrinus rothpletzi* STOLLEY.**

10. KT-13-1 : articular face of a columnal from middle part of a stem (x 6,0).
11. KT-14-1 : articular face of a distal columnal (x 6,0).
Turkmenia, Maly Balkhan Ridge ; Campanian.

10. KT-13-1 : facette articulaire d'un article de la partie médiane de tige (x 6,0).
11. KT-14-1 : facette articulaire d'un article distal (x 6,0).
Turkménie, la crête de Maly Balkhan ; Campanien.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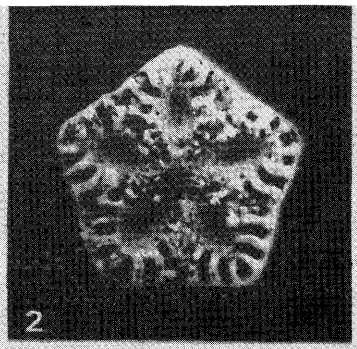
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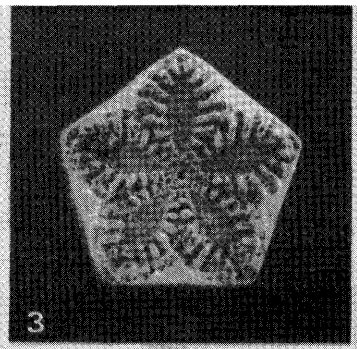
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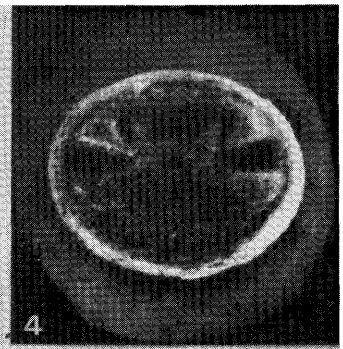
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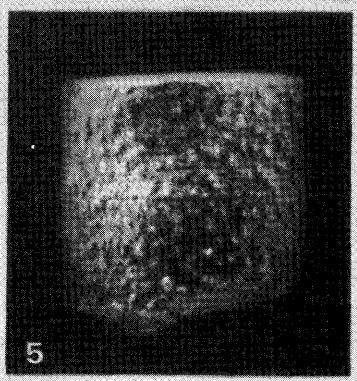
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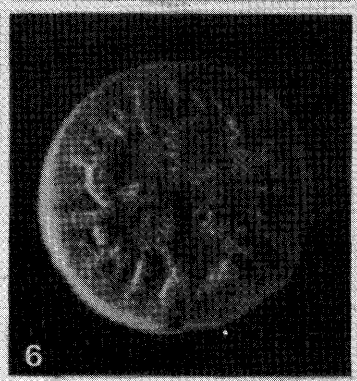
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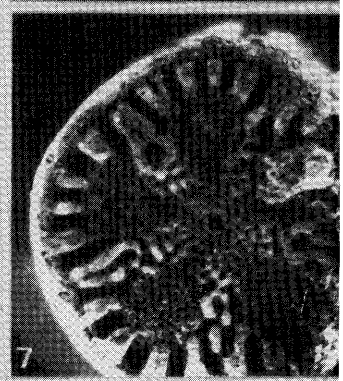
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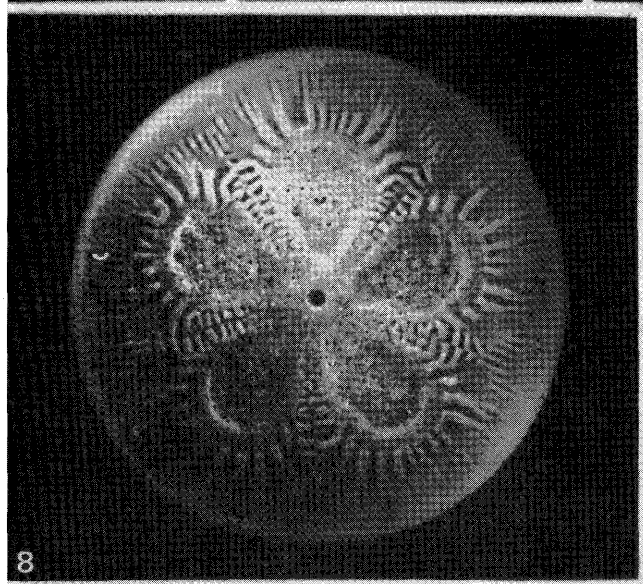
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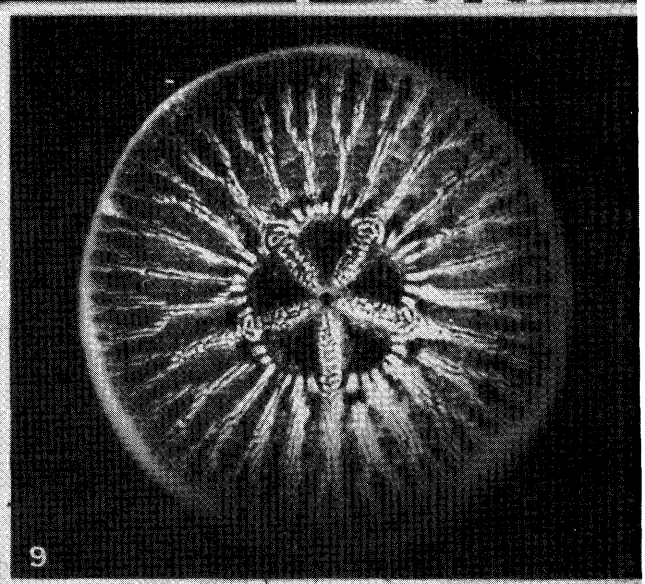
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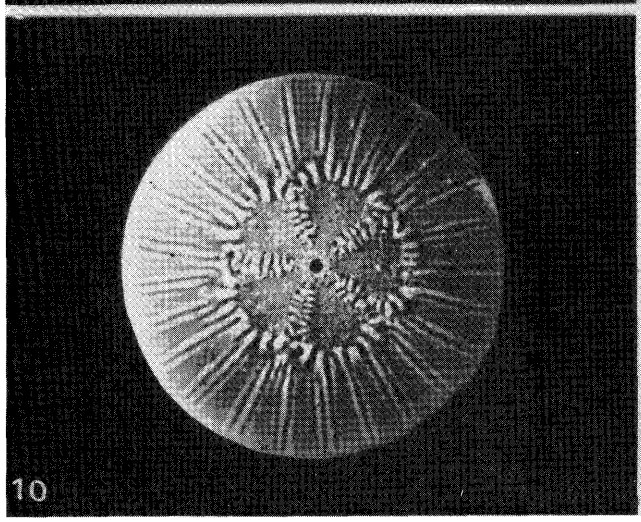
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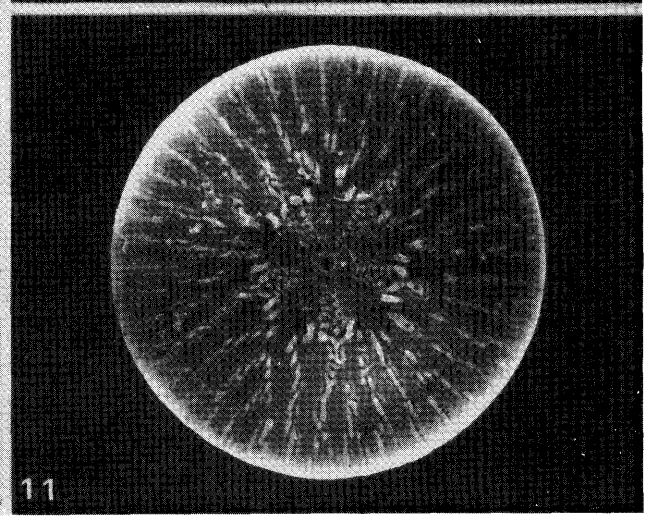
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PLATE 4

Fig. 1 – ***Austinocrinus turkmenicus* KLIKUSHIN.**
KT-15-3 : fragment of a stem with nodal (x 4,2).
Turkmenia, Maly Balkhan Ridge ; Campanian.
KT-15-3 : fragment de tige avec une nodale (x 4,2).
Turkménié, la crête de Maly Balkhan ; Campanien.

Fig. 2 – ***Doreckicrinus* sp.**
KT-25-1 : articular face of a columnal (x 10,5).
Tuarkyr, Akkol ; Campanian (coll. M.V. Titova).
KT-25-1 : facette articulaire de l'article (x 10,5).
Touarkyr, Akkol ; Campanien (coll. M.V. Titova).

Fig. 3, 4 – ***Buchicrinus florifer* (EICHWALD).**
The holotype, n° 2/248 (Leningrad University).
Volga-Basin, Yazykovo ; Maestrichtian (coll. E. Eichwald).
3. articular face of a columnal (x 5,5).
4. in side view (x 4,1).
Holotype, n° 2/248 (Université de Léningrad).
Bassin de la rivière Volga, Jazikovo ; Maestrichtien (coll. E. Eichwald).
3. facette articulaire de l'article (x 5,5).
4. vue latérale (x 4,1).

Fig. 5 – ***Isselicrinus diaboli* (BAYAN).**
П6-5-1 : articular face of a columnal (x 4,5).
Northern Caucasus,Kuban River ; Eocene (coll. L.P. Gorbach).
П6-5-1 : facette articulaire d'article (x 4,5).
Caucase du nord, la rivière Kuban ; Eocène (coll. L.P. Gorbach).

Fig. 6, 7 – ***Isselicrinus pellegrinii* (MENEGHINI).**
6. ПK-1-4 : articular face of a distal columnal (x 6,5).
7. П K-1-16 : articular face of a proximal columnal (x 7,8).
Crimea, Eocène.
6. П K-1-4 : facette articulaire d'un article distal (x 6,5).
7. П K-1-16 : facette articulaire d'un article proximal (x 7,8).
Crimée ; Eocène.

Fig. 8 – ***Isselicrinus sulcifer* (EICHWALD).**
ПM-1-10 : articular face of a distal columnal (x 3,8).
Mangyshlack ; Eocene.
ПM-1-10 : facette articulaire d'un article distal (x 3,8).
Mangysklack ; Eocène.

Fig. 9, 10 – ***Praeisselicrinus atabekjani* (KLIKUSHIN).**
9. KT-9-1 : articular face of a columnal (x 4,3).
10. The holotype, KT-9-2 : fragment of stem with a nodal (x 3,9).
Turkmenia, Maly Balkhan Ridge ; Campanian.
9. KT-9-1 : facette articulaire de l'article (x 4,3).
10. Holotype, KT-9-2 : fragment de tige avec une nodale (x 3,9).
Turkménie, la crête de Maly Balkhan ; Campanien.

Fig. 11 - 14 – ***Cainocrinus gorbachae* KLIKUSHIN.**
11. PK-1-3 : nodal of a large stem (x 7,2).
12. PK-1-4 : nodal of a small stem (x 9,7).
13. PK-1-2 : articular face of a proximal columnal (x 7,5).
14. PK-1-1 : articular face of a distal columnal (x 9,6).
Crimea ; Paleocene.
11. PK-1-3 : grand article nodal (x 7,2).
12. PK-1-4 : petit article nodal (x 9,7).
13. PK-1-2 : facette articulaire d'un article proximal (x 7,5).
14. PK-1-1 : facette articulaire d'un article distal (x 9,6).
Crimée ; Paleocène.

Fig. 15, 16 – ***Nielsenicrinus varians* KLIKUSHIN.**
15. KM-7-3 : articular face of a columnal (x 7,1).
16. KM-7-12 : fragment of stem with a nodal (x 6,6).
Mangyshlack, Danian.
15. KM-7-3 : facette articulaire de l'article (x 7,1).
16. KM-7-12 : fragment de tige avec une nodale (x 6,6).
Mangychlack ; Danien.

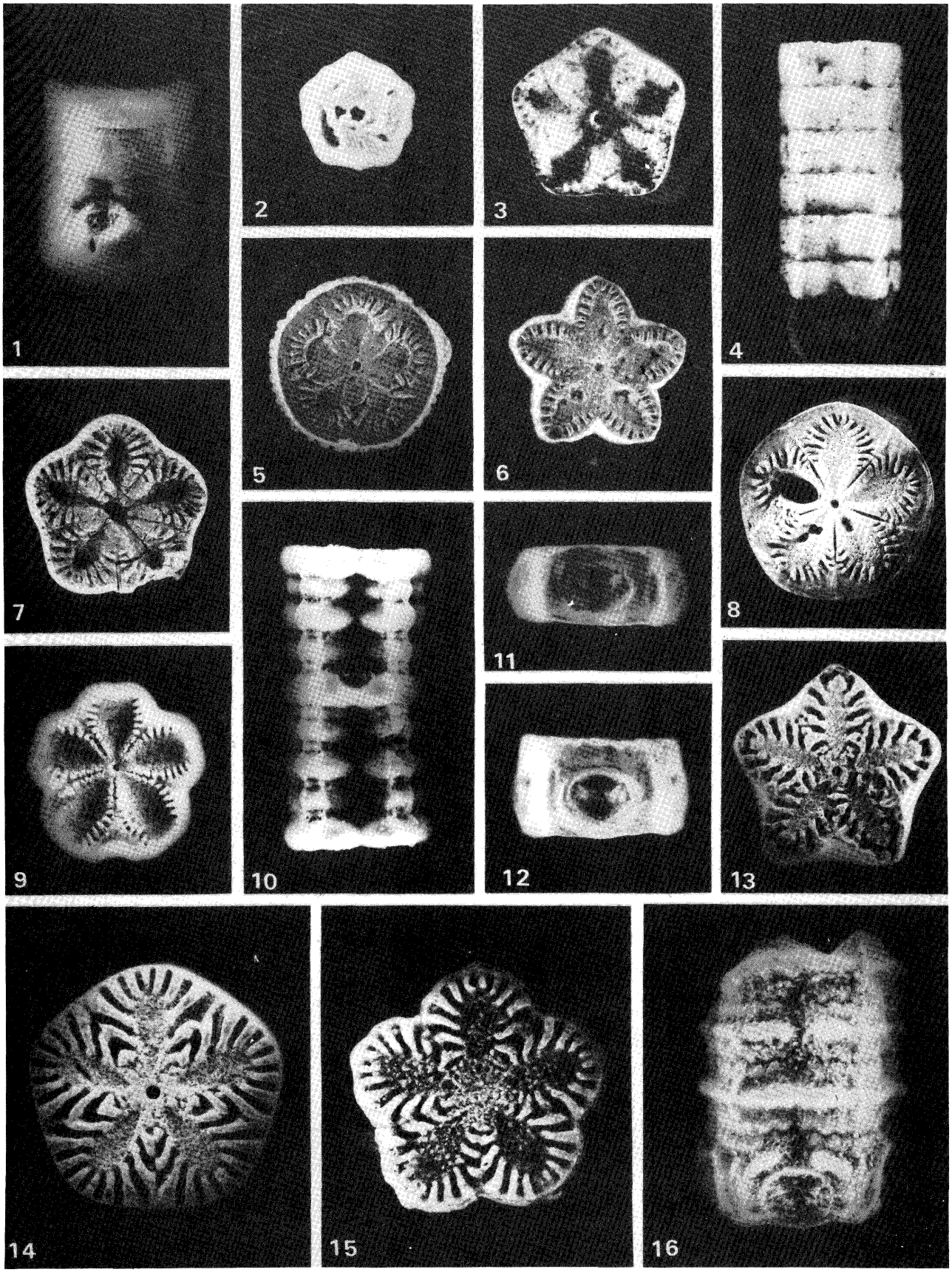
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PLATE 5

Fig. 1 - 3 – ***Margocrinus pentagonalis* (GOLDFUSS).**

1. ИП-3-1 : articular face of a columnal (x 8,4).
2. ИП-4-1 : articular face of a columnal (x 36,8).
3. ИП-4-2 : opening of the central canal on lower articular face of a nodal (x 41,4).
Lithuania, Papile ; Oxfordian (coll. L.M. Rotkite).

1. ИП-3-1 : facette articulaire de l'article (x 8,4).
2. ИП-4-1 : facette articulaire de l'article (x 36,8).
3. ИП-4-2 : orifice du canal central sur la facette articulaire basale de nodale (x 41,4).
Lithuanie, Papile ; Oxfordien (coll. L.M. Rotkite).

Fig. 4 – ***Chladocrinus kolymaensis* (KLIKUSHIN).**

TC-8-2 : upper articular face of a nodal (x 5,0).
Kolyma-Basin ; Carnian (coll. K.I. Kalugin).

TC-8-2 : facette supérieure articulaire de nodale (x 5,0).
Bassin de la rivière Kolyma ; Carnien (coll. K.I. Kalughin).

Fig. 5 – ***Isocrinus ? argenteus* BATHER.**
TC-6-1 : articular face of a columnal (x 6,2).
Kolyma-Basin ; Carnian (coll. K.I. Kalugin).

TC-6-1 : facette articulaire de l'article (x 6,2).
Bassin de la rivière Kolyma ; Carnien (coll. K.I. Kalughin).

Fig. 6 – ***Isocrinus ? balchanicus* KLIKUSHIN.**

The holotype, KT-10-1 : articular face of a columnal (x 5,8).
Turkmenia, Maly Balkhan Ridge ; Campanian.

Holotype, KT-10-1 : facette articulaire de l'article (x 5,8).
Turkménie, la crête de Maly Balkhan ; Campanien.

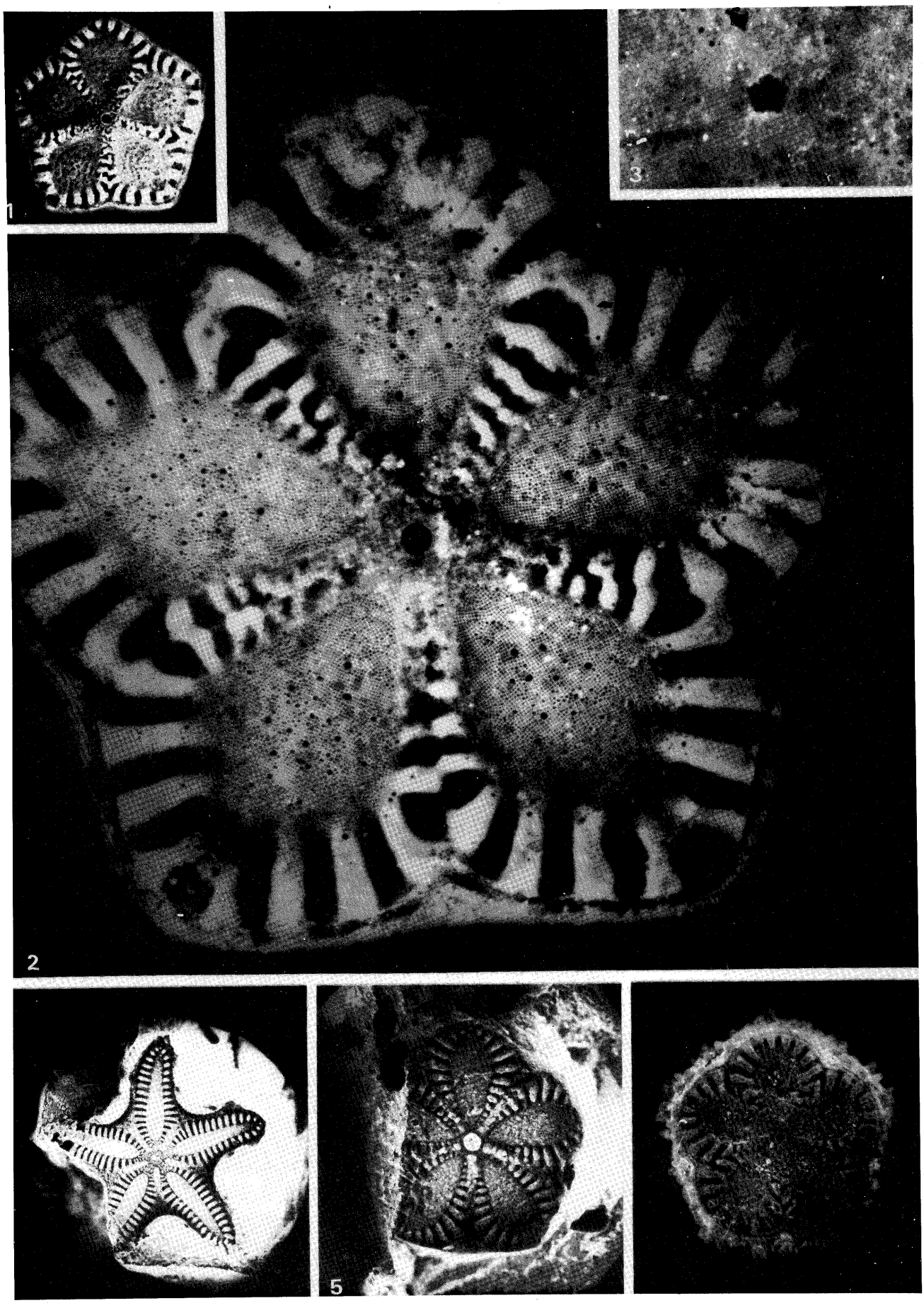
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PLATE 6

Fig. 1,2 – ***Isocrinus pendulus* MEYER.**

ИВ-1-1. Rjazan-region, Novossiolki ; Oxfordian (coll. L.V. Giulkhadjan).
1. articular face of a columnal (x 12,0).
2. same (x 43,0).

ИВ-1-1. Région de Rjazan, Novossiolki ; Oxfordien (coll. L.V. Ghulkhadgan).
1. facette articulaire de l'article (x 12,0).
2. même facette articulaire (x 43,0).

Fig. 3 – ***Pentacrinus ? cenomanensis* d'ORBIGNY.**

KK-4-6 : articular face of a columnal (x 6,1).
Crimea ; Cenomanian.

KK-4-6 : facette articulaire de l'article (x 6,1).
Crimée ; Cénomanien.

Fig. 4 – ***Laevigatocrinus insignis* (TOULA).**

ТГ-1-1 : articular face of a distal columnal (x 6,4).
Bulgaria, Kotel ; Carnian (coll. T.S. Manchev).

ТГ-1-1 : facette articulaire d'un article distal (x 6,4).
Bulgarie, Kotel ; Carnien (coll. T.S. Manchev).

Fig. 5 – ***Isocrinus ? patrickensis* STRIMPLE.**

И - С-11-1 : fragment of a stem with the cirrus (x 1,6).
Lena-Basin ; Bathonian (coll. V.N. Zinchenko).

И - С-11-1 : fragment de tige avec les cirrus (x 1,6).
Bassin de la rivière Lena ; Bathonien (coll. V.N. Zintchenko).

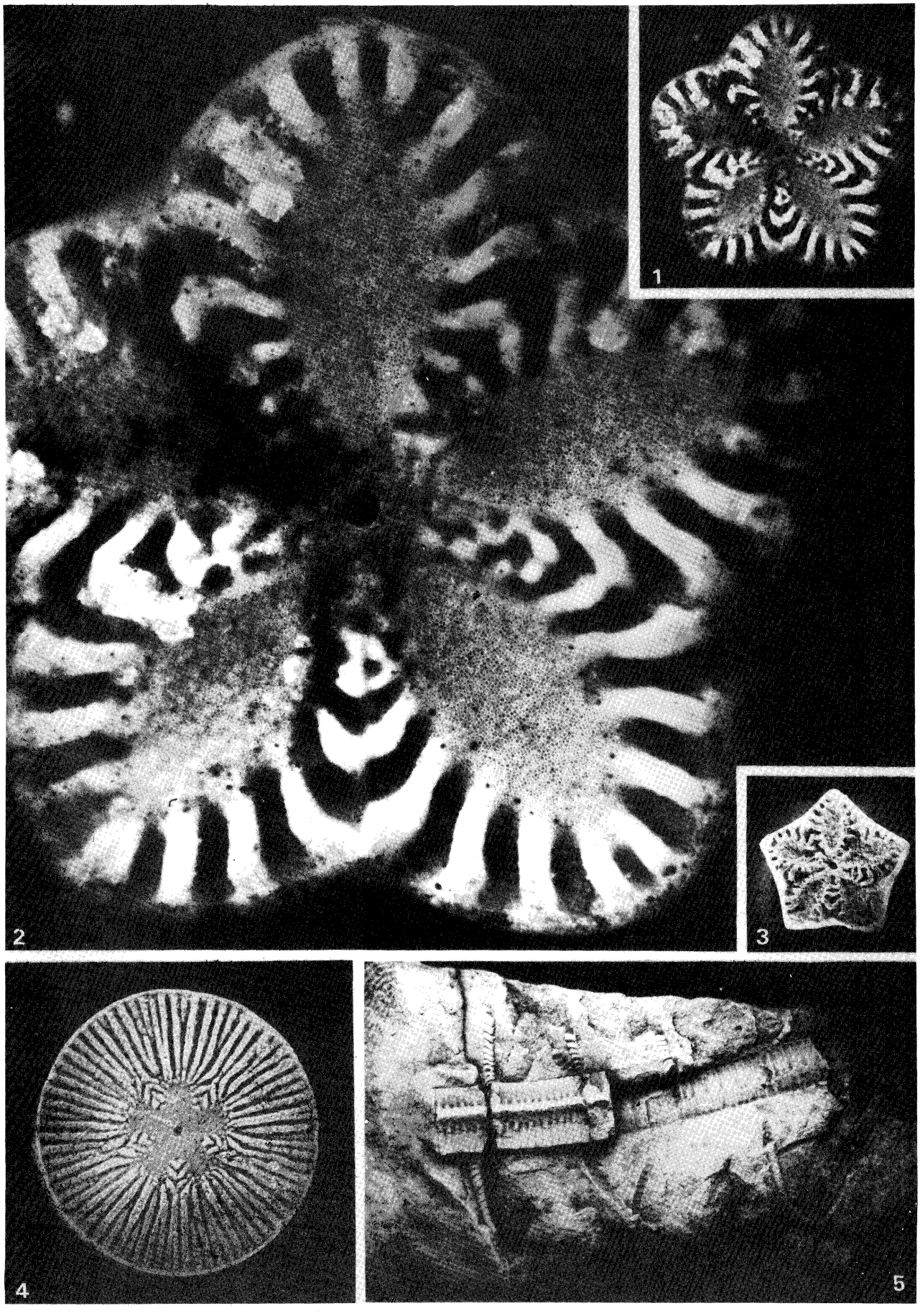
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PLATE 7

Fig. 1, 2 – ***Pentacrinus ? shastensis*** **CLARK.**

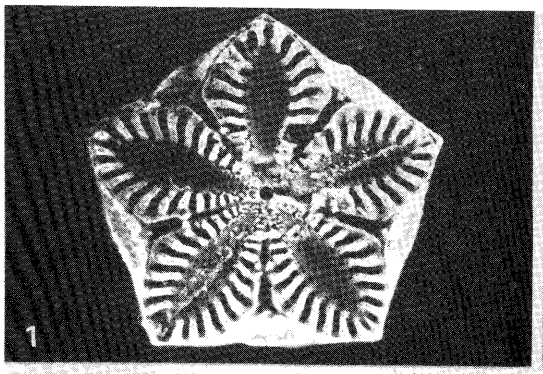
ИТ-9-1 : Taimyr, Debiaka-Tary River ; Volgian (coll. S.N. Alekseev).
1. articular face of a columnal (x 5,2).
2. same (x 38,8).

ИТ-9-1 : Taimyr, la rivière Debiaka-Tary ; Volgien (coll. S.N. Alekseev).
1. facette articulaire de l'article (x 5,2).
2. même facette articulaire (x 38,8).

Fig. 3, 4 – ***Balanocrinus ? minutus*** **VALETTE.**

KT-2-1 : Turkmenia, Maly Balkhan Ridge ; Santonian.
3. articular face of a columnal (x 12,0).
4. side view (x 10,0).

KT-2-1 : Turkménie, la crête de Maly Balkhan ; Santonien.
3. facette articulaire de l'article (x 12,0).
4. vue latérale (x 10,0).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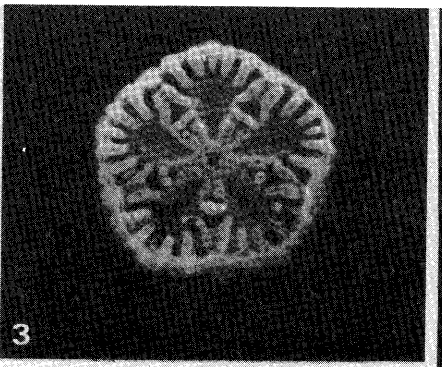
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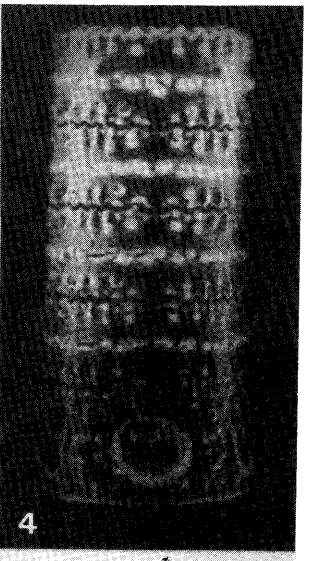
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