Acta Musei Nationalis Pragae, Series B, Natural History, 59 (3–4): 151–162 issued December 2003
Sborník Národního muzea, Serie B, Přírodní vědy, 59 (3–4): 151–162

PLASIACYSTIS MOBILIS, GEN. ET SP. N., A STRANGE "CARPOID" (ECHINODERMATA, ?HOMOIOSTELEA: SOLUTA) IN THE BOHEMIAN ORDOVICIAN (CZECH REPUBLIC)

RUDOLF J. PROKOP
Department of Palaeontology, Museum of Natural History, National Museum, Václavské nám. 68, 115 79 Praha 1, Czech Republic; e-mail: rudolf.prokop@nm.cz

VÁCLAV PETR
Zoological Library, Faculty of Science, Charles University, Viničná 7, 128 44 Praha 2, Czech Republic; e-mail: vpetr@natur.cuni.cz

Prokop, R. J. and Petr, V. (2004): *Plasiacystis mobilis*, gen. et sp. n., a strange "carpoid" (Echinodermata, ?Homoiostelea: Soluta) in the Bohemian Ordovician (Czech Republic). – Acta Mus. Nat. Pragae, Ser. B, Hist. Nat., 60 (2004) (3–4): 151–162. Praha. ISSN 0036-5343

Abstract. This is a first report on the occurrence of a new, very unusual "carpoid" echinoderm, described here as *Plasiacystis mobilis* gen. et sp. n., that is relatively common in the Middle Ordovician of Bohemia (Czech Republic) and Spain. *Plasiacystis* has a large, armless, sac-like theca, composed of numerous polygonal, poreless plates and the flexible cylindrical proxistele followed with rigid dististele which is transformed into a flat, elongated paddle, composed of two columns of transverse plates. *Plasiacystis* gen. n., is placed here provisionally within the echinoderm Class Homoiostelea GILL et CASTER, 1960, Order Soluta JAEKEL, 1901 and Family Plasiacystidae fam. n. (here stated). A note on the concept of Calcichordata is added.

■ Echinodermata, "Carpoidea", "Calcichordate Theory", Homoiostelea, Soluta, *Plasiacystis* gen. n., Plasiacystidae fam. n., Lower Palaeozoic, Ordovician, Barrandian.

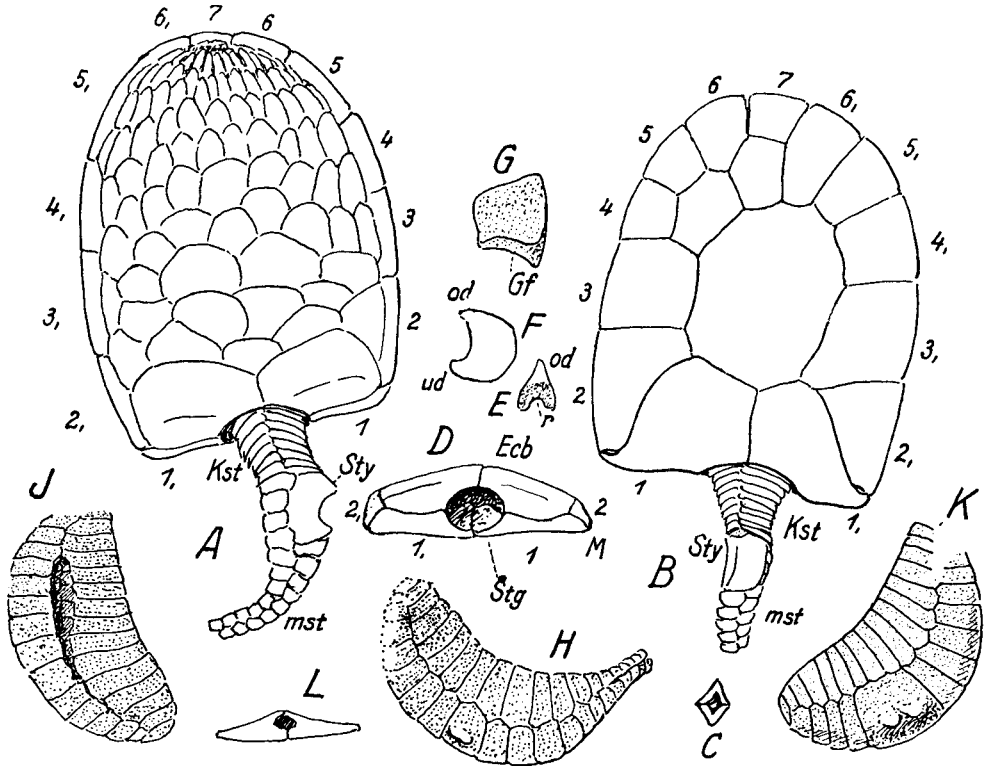
Received October 24, 2003

Introduction

Fragments of the unique carpoid genus *Plasiacystis* gen. n. described here and coming from the Šárka and Dobrotivá Formations (Middle Ordovician, Barrandian area) had been already known to some former palaeontologists as Joachim Barrande, Otto Jaekel, and Ferdinand Prantl. The animal has been described for the first time by Barrande (1887) who supposed that the *Plasiacystis*'s many-plated theca with pore-less plates belonged to a cystoid, particularly to a rather problematical specimen of *Echinosphaerites infaustus* BARRANDE 1887. Jaekel (1918), on the other hand, described *Plasiacystis*'s rigid paddle-like dististele as a "root" ("Wurzel") of the mitrate "carpoid" *Mitrocystella barrandei* JAEKEL 1918. Ferdinand Prantl collected fragments of *Plasiacystis*'s proxisteles and designated them as *Lepidocoleus bohemicus* sp. n. (Machaeridia) but did not publish any paper on them.

Certainly, *Plasiacystis* gen. n. is almost as strange as ophiocistioid echinoderms, bearing characteristics of different groups of animals. It has a large, polyplated and probably sac-like theca. All thecal plates are clearly echinoderm-like and without pores. In some specimens there seem to be present also slender marginal plates (resembling partly mitrates) but they are clearly pseudomarginals resulting from post-mortem collapse of theca. *Plasiacystis* gen. n., has a very low, almost cystoid-like anal pyramid. The stele is remarkably shaped. The flexible proxistele is cylindrical and resembles structurally a very high turret or "Theka-Turm" of pyrgocystid and rhenopyrgid edrioasteroids, composed of distinctly imbricating scale-like plates arranged in numerous horizontal rings. The rigid dististele or "tail" is transformed into a rather flat, elongated paddle, with dimerous plan, composed of two columns of transverse plates, rather unevenly paired; this distal paddle bears one distinct, hollow thorn. *Plasiacystis* gen. n. is placed here provisionally within Homoiostelea GILL et CASTER, 1960: Soluta JAEKEL, 1901 and Family Plasiacystidae fam. n. (designated herein).

We are convinced that the whole bauplan of *Plasiacystis* gen. n. creates one of arguments against the so-called "Calcichordate Theory" of R.P.S. Jefferies. Jefferies (1990) has extended his Calcichordate Theory to embrace also the solutan "carpoids", however, many authors (see e.g. Parsley 1997) disagree with such an extension, and, in fact, many specialists disagree with the whole concept of Calcichordata and Dexiothetica (e.g. Philip 1979; Ubaghs 1981; Kolata and Jollie 1982; Lefebvre, Racheboeuf and David 1998; Lefebvre and Vizcaino 1999; and even Ruta 1999; see also the short note on the Calcichordate Theory below). Morphological characteristics of the new solutan species rather support the old echinoderm concept (e.g. Ubaghs 1967).



Text-fig. 1: Schematic sketch of dististele (paddle) of *Plasiacystis mobilis* gen. et sp. n. drawn by Jaekel (1918) (his figure 110 H, J, K, L on page 121), erroneously associated with *Mitrocystella Barrandei* JAEKEL.

Systematic part

Phylum **Echinodermata**
? Class **Homoiostelea** GILL et CASTER, 1960
? Order **Soluta** JAEKEL, 1901

Family **Plasiacystidae** fam. n.

Diagnosis: Solutans (?) with the skeleton distinctly composed of the large sac-like theca without rigid arms and the relatively long, flexible cylindrical proxistele composed of imbricating scale-like platelets arranged in numerous horizontal rings. Proxistele is followed with flat, elipsoidal "paddle" composed of two columns of transverse plates (dististele).

Genus assigned: *Plasiacystis* gen. n.

Plasiacystis gen. n.

Type species: *Plasiacystis mobilis* gen. et sp. n.; Middle Ordovician, Barrandian area, Bohemia, Czech Republic.

Diagnosis: The same as for the family.

Stratigraphic and palaeogeographic distribution: Šárka and Dobrotivá Formations, Middle Ordovician, Barrandian area (Bohemia, Czech Republic); Middle Ordovician of Spain.

Remarks: A distant relative (?) of *Plasiacystis* gen. n. seems to be the homoiostelean genus *Castericystis* UBAGHS et ROBISON, 1985 from the Middle Cambrian of Utah, USA. Both genera have sac-like thecae composed of irregular polygonal plates and have almost identical morphology of proxistele. Of course, *Castericystis* differs clearly from *Plasiacystis* gen. n. in presence of relatively long arm and by the different shape and structure of the anal pyramide. The flat dististele of *Castericystis* also consists of the transversaly arranged plates but differs markedly from the dististele of *Plasiacystis*: it is relatively long, slender and terminated by a whip-like tip (see Text-fig. 4)

Plasiacystis mobilis sp. n.

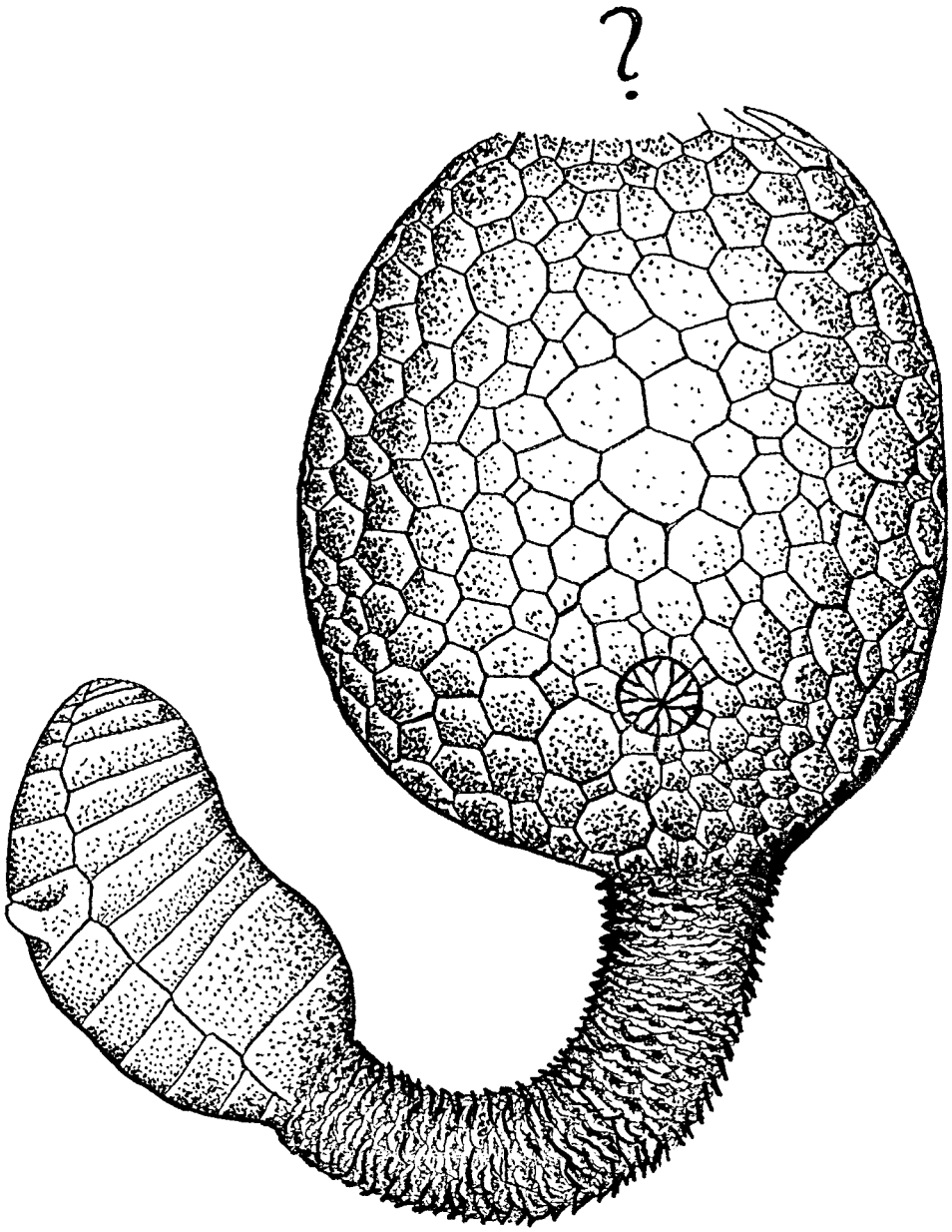
Text-figs 1–4; Pls 1–4

1887 *Echinosphaerites infaustus* BARRANDE; Barrande, Pl. 25, fig. 15 (specimen with anterior-posteriorly strongly compressed theca, and also with a proxistele preserved); Pl. 39, fig. 29. (Fig. 30 shows a specimen that represents probably true "*Echinosphaerites*" with theca composed of large plates bearing both tubercules as well as short transverse channels on their borders)

1918 *Mitrocystella Barrandei* JAEKEL; Jaekel, p. 121, fig. 110 H, J, K, L (rigid paddle-like dististele belonging probably to two specimens or even more)

1947 *Lepidocoleus bohemicus* sp. n., PRANTL MS (proxistele)

Holotype: specimen inv. n. NM L 13216 coming



Text-fig. 2: Schematic sketch of idealized specimen of *Plasiacystis mobilis* gen. et sp. n. showing theca, proxistele and dististele (paddle with a thorn).

from the Šárka Formation, Osek near Rokycany, with theca, proxistele and dististele, herein photographed on Pl. 1, figs 1, 2.

Locus typicus: Osek near Rokycany, Barrandian area, Czech Republic.

Stratum typicum: Šárka Formation, Llanvirnian, Middle Ordovician.

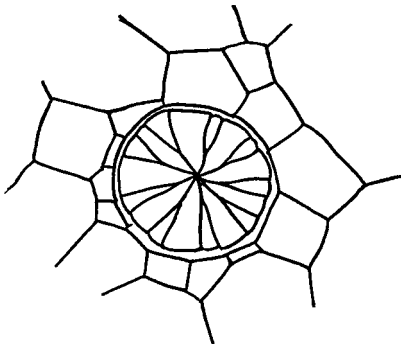
Material: Šárka Formation: 31 thecae or fragments of thecae, 17 proxisteles and 3 isolated dististeles preserved in the siliceous (originaly calcareous) nodules (called conventionally "Šárka" or "Rokycany" balls). Localities: Osek near Rokycany, Mýto, Praha-Šárka and Praha-Libuš.

Dobrotivá Formation: 2 parts of thecae, preserved in the nodules from the locality Praha-Šárka.

Middle Ordovician (Llanvirnian?): 18 pieces of proxistele preserved in the nodules (very similar to the Bohemian ones), coming from Casalla de la Sierrra near Sevilla, Spain (given by our friend, Dr. Juan-Carlos Gutiérez Marco).

Derivatio nominis: after Vladimír Plas (* 18. 4. 1905, † 10. 3. 1980), the famous collector of fossils and custodian of the geological and palaeontological collections of the former Central Geological Survey (now the Czech Geological Survey), Prague.

Description: A carpoid echinoderm with body built



Text-fig. 3: Schematic sketch of idealized specimen of *Plasiacystis mobilis* gen. et sp. n. showing enlarged, flat anal pyramid.

up of two distinct skeletal parts: theca and stele, the latter being composed of equally distinct proxistele and dististele. Even in the best-preserved specimen with both theca and stele, there is no arm retained. If there was any arm or arm-like appendage in the living animal it had probably no skeletal elements (!) and nothing is known about it. The theca is slightly elongated and was probably sac-like in life. Theca is polyplated, composed of numerous irregularly polygonal plates, with slender sutures between them. Each plate represents a typical adult echinodermal skeletal ossicle, behaving like a single crystal of calcite and bearing no pores. Thecal plates are flat or very slightly swollen, relatively small and numerous, smooth (eroded?) or sculptured (better preservation?) with tiny, very dense granulation on the surface. The plates are very thin and, therefore, in each case, the thecae are more or less compressed (sometimes partly disintegrated) as a result of the decay of soft tissues in the sediment (which possibly suggests elasticity of theca in living animal). All around the theca there are no significant plating differences. In the proximal part of the theca (some distance from the base of the stele) there is an almost rounded anal opening, covered with an extremely flat anal pyramid, composed of slender, elongated trigonal plates, long and short alternating (e.g. Pl. II, figs 1–4 shows the specimens with a well-preserved anal pyramid in which 9 long and 9 short trigonal plates are alternating).

The stele is composed of proxistele and a unique dististele. No gradational passage from proxistele to dististele, i.e. no mesistele has been observed (we are uncertain whether it is simply not preserved or, more probably, not developed). The cylindrical proxistele is composed of distinctly imbricating scale-like plates arranged in numerous vertical columns and horizontal rings, imbricating distally as in other homoiosteleans, but resembling structurally much more clearly a high turret or "Theka-Turm" of pyrgocystid and rhenopyrgid edrioasteroids. The arrangement of scale-like plates in the proxistele suggests its extreme flexibility in both vertical and horizontal direction. The dististele is a relatively large, oval to kidney-shaped and distinctly flattened rigid paddle, with dimerous plan, composed of two columns of transverse plates, rather unevenly paired. One column of transverse plates of the paddle bears asymmetrically one very distinct, extremity resembling a "thorn" with rounded apex. This "thorn" seems to be hollow and we are completely uncertain about its purpose – it may have probably served for some kind of steering or may have been a kind of anchorage of the animal or it may have served for digging or it had been some specific kind of sexual dimorphism?

Dimensions (in mm):

Specimen L 13216 (holotype)		
approx. dimensions	width	length
Theca	30	40
proxistele	5	30
dististele	10	20
approx. whole		90

Specimen L 29120		
approx. dimensions	width	length
Theca	25	35
proxistele	3	20
dististele	4	10
approx. whole		65

Specimen L 29115		
approx. dimensions	width	length
Theca	60	75

Note on the Calcichordate Theory

(V. Petr)

Echinoderms are often and probably correctly considered as the closest relatives of chordates. The features in common include the presence of an ectodermal neural system, an endoskeleton, and some embryological similarities. However, since 1967, Richard P. S. Jefferies (British Museum, Natural History), a biologist and one of leading proponents of the application of cladistic analysis to fossils to obtain information for phylogenetic reconstructions, has been arguing that the morphologically curious and extravagant members of the Lower Palaeozoic echinoderm group, Class Stylophora (Cornuta and Mitrata) – or in his vision Phylum Calcichordata – are the direct ancestors of Vertebrata – Cornuta as "stem chordates" and Mitrata as "primitive crown chordates" (see e.g. Jefferies 1967, 1986, 1988, 1991, 1997; Cripps 1991; Daley 1992; Ruta 1997). Some palaeontologists are convinced that his hypothesis or the so-called Calcichordate Theory is correct, but others still believe in some form of the Garstang's Paedomorphic Hypothesis proposing derivation of vertebrates from bilaterally symmetrical larvae of Tunicata or tunicate-like animals. Really, are echinoderms (including "carpoids") and chordates so much alike that specialists are unable to conclude without hesitation, which is which?

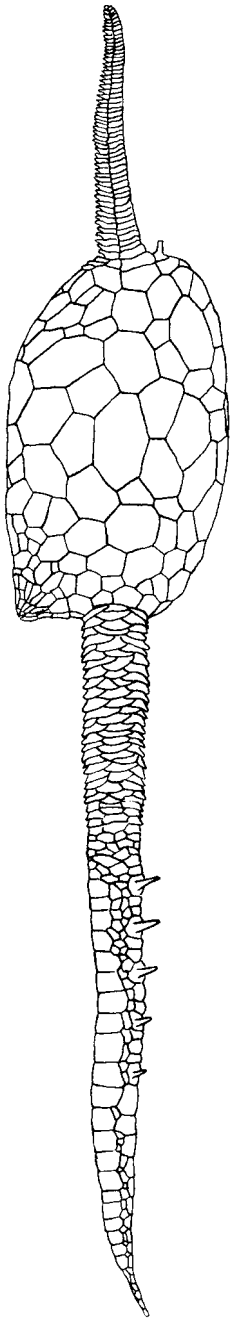
According to James Sprinkle (see his review article in

Science 236 (4807): 1476. 1987) the Calcichordate Theory (see esp. Jefferies 1986) is not very successful in demonstrating that it is correct. The reliance on the so-called Haeckel's law to test relationships and the "dominance of recapitulation" over paedomorphosis may be problematic because morphological similarities, although commonly taken to indicate a close relationship, may exist along *different* phylogenetic lineages, due to repeatedly evolving identical bauplans in independent animal groups without any known reason or due to similar mode of life, due to mimicry or camouflage (see Kácha and Petr 1996) or other convergences.

For example, one of the most popular heterogeneous group comprising repeatedly evolved identical bauplan are sabre-toothed carnivores possessing blade-like, very long and slender upper canine teeth. Very similar sabretooths appeared at various times and various places during the approximately 50-million-year history. They occurred repeatedly and independently in at least four distinct mammalian groups: in completely extinct nimravids, hyaenodontid creodonts, thylacosmilid marsupials, as well as in modern felids. Each time they coexisted successfully with their short-canined relatives, and it seems to be a matter of chance that we have no sabretooth with us today (Radinsky and Emerson 1982).

In echinoderms, morphological convergences between various families of sea-stars exhibiting very *variable mode of life* are both well-known and striking (Hotchkiss 2000). In fact, occurrences of the development of similar bauplans and skeletal characteristics in independent echinoderm groups are rather common (see e.g. Regnéll 1960; Lane 1976; Prokop and Petr 1998). Every echinoderm specialist can certainly recall the strange Ophiocistioidea with their ophiuroid-like arms, echinoid-like theca and jaw apparatus, and holothuroid-like sieve plates and wheel-like ossicle elements (see e.g. Richter 1930; Haude and Langenstrassen 1976).

On the other hand, all echinoderms possess a unique skeleton secreted by lime-depositing cells of mesenchyme (Ubaghs 1967), each skeletal element being initiated intracellulary as a primordial granule, which is rapidly transformed into the so-called trifid spicule, which bifurcates. The bifurcations fuse at the points of contact and a very small young fenestrated plate is formed. From repeated branchings and fusions a complicated three-dimensional calcareous network is formed – a typical adult echinodermal skeletal ossicle. Skeletal ossicles are the most important portions of the echinoderm body. When any individual echinodermal skeletal plate, spine, spicule, ossicle or tooth, is examined in polarized light or by X-ray diffraction, it behaves as a single crystal of calcite. This startling phenomenon represents one of the most intriguing puzzles in biomineralization, which has been under discussion for almost a century. "Carpoids", such as mitrates, have an echinoderm skeleton of typically echinoderm type and it is unlikely that they lost their specialized echinoderm calcite plates during the proposed evolutionary transformation and developed an entirely new bony skeleton. Therefore, many echinoderm specialists believe that calcichordates are true echinoderms, not ancestors of vertebrates (see esp. Ubaghs's Aulacophore Theory and Philip's Stele Theory, etc.).



Text-fig. 4: Schematic drawing of *Castericystis vali* UBAGHS et ROBISON, 1985 (Middle Cambrian of Utah), the closest known relative of *Plasiacystis mobilis* gen. et sp. n. (from Ubaghs and Robison 1985).

Finally, let us recall the great neo-Lamarckian American biologist and palaeontologist Edward Drinker Cope (1840–1897) and his important empirical "*Law of Unspecialized Ancestor*". There are, for example, well-document-

ed cases of persisting body-size increases in numerous higher taxa within the fossil record. It seems that majority of higher taxa have clearly evolved from ancestors of relatively smaller body sizes. Large (descendant) forms are specialists (opportunists) while small (ancestral) types are generalists. The so-called "Cope's Rule" (of the within-lineage body-size increases during phylogeny) has been rediscovered and confirmed in recent years in articles of many scientists. For example, Alroy (1998) has found that the body mass estimates for 1534 North American fossil mammal species show that new species are on average 9.1% larger than older species of the same genera and that this "within-lineage effect" is not a sampling bias because it persisted throughout the Cenozoic, accounting for the gradual overall increase in average mass. The original formulation of the "Cope's Law of Unspecialized Ancestor" (or simply "*Law of the Unspecialized*" or "*Doctrine of the Unspecialized*") is still poorly known:

"*... the highly developed, or specialized types of one geologic period have not been the parents of the types of succeeding periods, but ...the descent has been derived from the less specialized of preceding ages... ... plants not especially restricted to definite soils, temperatures, or degrees of humidity, would survive changes in these respects better than those that have been so restricted. Animals of omnivorous food-habits would survive where those, which required special foods, would die. Species of small size would survive a scarcity of food, while large ones would perish... ... the lines of descent of Mammalia have originated or been continued through forms of small size. The same is true of all other Vertebrata... Degeneracy is a fact of evolution ... and its character is that of an extreme specialization, which has been, like an overperfection of structure, unfavorable to survival... In general, then, it has been the "golden mean" of character which has presented the most favourable condition of survival, in the long run.*" (Cope 1896, p. 173–174).

According to Cope's Law of Unspecialized Ancestor, practically all the so-called "carpoids", including even the Middle Cambrian solutes, are clearly highly specialized animals. Therefore, the "Aulacophore Hypothesis" of Georges Ubaghs is accepted here rather than the "Calcichordate Theory" of R. P. S. Jefferies. The superficial similarity may result simply from a peculiar convergent evolution of both groups, echinoderms and chordates. Moreover, cephalochordate-like animals are well known from the Burgess Shale faunas and Shu et al. (1999) have discovered two distinct types of agnathans, *Myllokummingia* and *Haikouichthys*, in the Lower Cambrian of China. The latter discovery is possibly one of the best arguments for the echinoderm "Aulacophore Hypothesis" of "carpoids".

Really, from strictly scientific point of view, Cope's Law is, in fact, everything we have at our disposal. It can be applied to practically every higher taxon. Cope's Law is an *empirical* law about patterns visible in the fossil record and is far from being a mere speculation like theories about causes of evolution and extinction. It can be applied to trilobites, echinoderms, chordates as well as dinosaurs. Today, the most striking feature of, for instance, the dinosaur life history, their obvious success and progressive "perfection" and specialization is well-documented and undeniable. The more generalized forms of the Triassic period are followed in the fossil record by more and more specialized "advanced" ones, exhibiting more and more distinct morphotypes. Each of a particular dinosaur group shows a conspicuous trend from relatively small and unspecialised forms to the familiar impressive "end products" of Late Jurassic and especially Late Cretaceous time.

Regarding the solutan "carpoids", Jefferies (1990) has surprisingly proposed that solutes *Castericystis vali* and *Dendrocystoides scoticus* are "stem chordates", because they have a locomotory tail and that the latter is more closely related to chordates than *C. vali* UBAHGS et ROBINSON, 1985. *Dendrocystites scoticus* has also a well defined mid-tail (i.e. mesistele), a quadriserial fore-tail (i.e. proxistele) and a gill slit at the left posterior angle of the head. According to Jefferies, mitrates and cornutes are chordates, while solutes are closest to the hypothetical *Cephalodiscus*-like ancestor of the Dexiothetica. *Cephalodiscus* is a free-living genus of recent pterobranchs, while Dexiothetica represents a monophyletic group proposed by Jefferies (1979, 1986) in which chordates and echinoderms form "sister groups" (see also the discussion in Daley 1996). Of course, almost any outcome is possible in such a sort of analysis and we can consider many cladograms that put extremely unrelated animals at the same position. At least, it must be clear that "having a locomotory tail" cannot say anything about phylogeny (sharks are not "stem dolphins" and ichthyosaurs and dolphins still do not form "sister groups").

"Cope's Law of Unspecialized Ancestor" applied to the Calcichordate Theory and the relationship of echinoderms and chordates says that mitrates, cornutes and solutes are echinoderms; and, moreover, highly specialized ones, *Plasiacystis* gen. n. seems to be an extremely specialized one.

Acknowledgements

The authors are very indebted to Dr. Radvan Horný (National Museum, Praha) for critical reading of the manuscript. Our thanks also go to Ing. Vladimír Vonka (Praha 5) who gave to the Museum's collections a wonderful specimen of *Plasiacystis mobilis* inv. n. L 37454 (Pl. IV, fig. 1, 2) from Mýto and to Juan Carlos Gutiérrez Marco (UEI de Paleontología, Instituto de Geologia Económica, Madrid) who provided us material of *Plasiacystis* for comparison of proxisteles from the Middle Ordovician locality Casalla de la Sierra near Sevilla (Spain).

References

Alroy, J. (1998): Cope's rule and the dynamics of body mass evolution in North American fossil mammals. – Science, 280: 731–734. Washington, D.C.

Barrande, J. (1887): Classe des Échinodermes, I, Ordre des Cystidées. *In*: Barrande, J.: Systéme silurien du centre de la Bohéme, 7, 1–233. Leipzig – Prague.

Cope, E. D. (1896): The Primary Factors in Organic Evolution. – The Open Court Publishing Library, Chicago, London.

Cripps, A. P. (1991): A cladistic analysis of the cornutes. – Zoological Journal of the Linnean Society, 102: 333–366. London.

Daley, P. E. J. (1992): Two new cornutes from the Lower Ordovician of Shropshire and Southern France. – Palaeontology, 35: 127–148. London.

Daley, P. E. J. (1996): The first solute which is attached as an adult: a Mid-Cambrian fossil from Utah with echinoderm and chordate affinities. – Zoological Journal of the Linnean Society, 117: 405–440. London.

Haude, R. – Langenstrassen F. (1976): *Rotasaccus dentifer* n. g. n. sp., ein devonischer Ophiocistioide (Echinodermata) mit "holothuroiden" Wandskleriten und "echinoidem" Kauapparat. – Paläontologische Zeitschrift, 50(3/4): 130–150. Stuttgart.

Hotchkiss, F. H. C. (2000): On the number of rays in starfish. – American Zoologist, 40: 340–354. Chicago.

Jaekel, O. (1918): Phylogenie und System der Pelmatozoen. – Paläontologische Zeitschrift, 3: 1–128. Berlin.

Jefferies, R. P. S. (1967): The Ancestry of the Vertebrates. – British Museum, Natural History. London.

Jefferies, R. P. S. (1979): The origin of chordates: a methodological essay. *In*: M. R. House (ed.): The Origin of Major Invertebrate Groups. – Systematics Association Special Volume, 12: 442–477. London.

Jefferies, R. P. S. (1986): The Ancestry of Vertebrates. 376 pp. – Cambridge University Press and British Museum (Natural History). London.

Jefferies, R. P. S. (1988): How to characterize the Echinodermata – some implications of the sister-group relationship between echinoderms and chordates, p. 3–12. *In:* C. R. C. Paul and A. B. Smith (eds.): Echinoderm Phylogeny and Evolutionary Biology, Oxford University Press (Clarendon Press) for Liverpool Geological Society. Oxford, New York.

Jefferies, R. P. S. (1990): The solute *Dendrocystoides scoticus* from the Upper Ordovician of Scotland and the ancestry of chordates and echinoderms. – Palaeontology, 33: 631–679. London.

Jefferies, R. P. S. (1991): Two types of bilateral symmetry in the Metazoa: chordate and bilaterian, p. 94–120. *In*: G. R. Bock and J. Marsh (eds): Biological Asymmetry and Handedness, *Ciba Foundation Symposium 162*, John Wiley & Sons. Chichester, New York.

Jefferies, R. P. S. (1997): How chordates and echinoderms separated from each other and the problem of dorso-ventral inversion. *In*: J. A. Waters and Ch. G. Maples (eds): Geobiology of Echinoderms. – Paleontological Society Papers, 3: 249–266. Pittsburgh.

Kácha, P. – Petr, V. (1996): Camouflage and mimicry in fossils, I: General part. – Acta Musei Nationalis Pragae, Ser. B., Historia Naturalis, 51(1–4): 53–82. Praha.

Kolata, D. R. – Jollie, M. (1982): Anomalocystid mitrates (Stylophora – Echinodermata) from the Champlainian (Middle Ordovician) Guttenberg Formation of the Upper Mississippi Valley region. – Journal of Paleontology, 56: 631–653. Lawrence.

Lane, N. G. (1976): A crinoid tegmen composed of holothurian sclerites. – Journal of Paleontology, 50(2): 240–244. Menasha.

Lefebvre, B. – Racheboeuf, P. – David, B. (1998): Homologies in Stylophoran echinoderms, p. 103–109. *In*: R. Mooi and M. Telford (eds): Echinoderms. – A. A. Balkema. San Francisco.

Lefebvre, B. – Vizcaino, D. (1999): New Ordovician cornutes (Echinodermata, Stylophora) from Montagne Noire and Brittany (France) and a revision of the order Cornuta Jaekel, 1901. – Geobios, 32(3): 421–458. Villeurbanne.

Parsley, R. (1997): The echinoderm classes Stylophora and Homoiostelea: non Calcichordata, p. 225–248. *In*: J. A. Waters and C. G. Maples (eds): Geobiology of echinoderms. – The Paleontological Society Papers, 3. Pittsburgh, PA.

Philip, G. M. (1979): Carpoids – echinoderms or chordates? – Biological Reviews, 54(4): 439–471. Cambridge (UK).

Plas, V. – Prokop, R. J. (1979): ?*Argodiscus rarus* sp. n. (Edrioasteroidea) from the Šárka Formation (Llanvirn) of Bohemia. – Věstník Ústředního ústavu geologického, 54(1): 41–43. Praha.

Prokop, R. J. – Petr, V. (1998): How the echinoderm changed its symmetry or On the search for common mechanisms to generate the archetypal forms. – Bulletin of the Czech Geological Survey, 73(4): 351–354. Praha.

Radinsky, L. – Emerson, Sh. (1982): The late, great sabertooths. – Natural History, 91(4): 50–57. New York.

Regnéll, G. (1960): "Intermediate" forms in early Palaeozoic echinoderms. – Report of the International Geological Congress (Norden 1960), XXI Session, Part 22, 71–80. Copenhagen.

Richter, R. (1930): Schuppenröhren als Anzeiger von zwei im deutschen Devon neuen Echinodermen-Gruppen (Edrioasteroidea Billings und Ophiocistia Sollas?). – Senckenbergiana, 12(4/5): 279–304. Frankfurt a.M.

Ruta, M. (1997): A new mitrate of Southern France. – Palaeontology, 40: 363–383. London.

Ruta, M. (1999): Brief review of the stylophoran debate. – Evolution & Development, 1(2): 123–135. London.

Shu, D. G. – Luo, H. L. – Conway Morris, S. – Zhang, X. L. – Hu, S. X. – Chen, L. Han, J. – Zhu, M. – Li, Y. – Chen, L. Z. (1999): Lower Cambrian vertebrates from south China. – Nature, 402(6757): 42–46. London.

Ubaghs, G. (1967): General characters of Echinodermata, p. *S*3–*S*60. *In*: R. C. Moore (ed.): Treatise on Invertebrate Paleontology, Part S, Echinodermata 1, Geological Society of America, Boulder, and The University of Kansas, Lawrence.

Ubaghs, G. (1981): Réflexions sur la nature et la function de l'appendice articulé des "Carpoides" Stylophora (Echinodermata). – Annales de Paléntologie (Invertébres), 67: 33–48. Paris.

Ubaghs, G. – Robison, R. A. (1985): A new homoiostelean and a new eocrinoid from the Middle Cambrian of Utah. – University of Kansas Paleontological Contributions, 115: 1–24. Lawrence.

Plasiacystis mobilis, gen. et sp. n., (Echinodermata, ?Homoiostelea: Soluta) zvláštní karpoid z českého ordoviku

Rudolf Prokop, Václav Petr

Abstrakt. Předložená práce je první zprávou o výskytu nového, velmi podivně stavěného „karpoidního“ ostnokožce, zde popsaného jako *Plasiacystis mobilis* gen. et sp. n. *Plasiacystis* má velkou, protáhle vakovitou téku, složenou z mnoha polygonálních destiček. Tékální destičky jsou tenkostěnné a postrádají póry. Rovněž pevná ramena, případně brachioly chybí. *Plasiacystis* má velmi nízkou, téměř plochou análí pyramidu, spíše podobnou análním pyramidám cystoidů. Stvol je rovněž pozoruhodně stavěný: ohebná proximální část je poměrně dlouhá, válcovitá a strukturou připomíná „věžičku“ pyrgocystidních a rhenopyrgidních edrioasteroidů; je složena z výrazně se překrývajících šupinovitých destiček uspořádaných v četných horizontálních prstencích. Pevná distální či „ocasní“ část (dististéle), je u *Plasiacystis mobilis* přetvořena v plochou pádlovitou ploutvičku, tvořenou dvěma sloupci transverzálně uspořádaných destiček, nepříliš přesně spárovaných. Na povrchu této „ploutvičky“ je výrazný dutý trn se zaobleným vrcholem. Jeho funkce není jasná. *Plasiacystis mobilis* gen. et sp. n., se vyskytuje relativně hojně v konkrecích šáreckého souvrství Barrandienu (Llanvirn). Dvě neúplné theky byly nalezeny i v souvrství dobrotivském (Llandeilo). Hojné úlomky proximálních částí stvolu pocházejí i ze středního ordoviku Španělska.

Plasiacystis n. gen. je v této práci prozatím řazen do kmene ostnokožců, třídy Homoiostelea GILL et CASTER, 1960, řádu Soluta JAEKEL, 1901 a do nové, zde stanovené čeledi Plasiacystidae fam. n. V práci je návazně diskutována tzv. kalcichordátová teorie.

Explanations to the plates

All photographed specimens come from the Middle Ordovician (Llanvirnian), Šárka Formation, Barrandian area (Central Bohemia, Czech Republic).

All specimens are housed in the collection of the Department of Palaeontology, National Museum (Natural History), Prague, Catalogue L.

Photographs by Ronald L. Parsley, Rudolf J. Prokop, Vojtěch Turek and Kamil Zágoršek.

PLATE 1

Plasiacystis mobilis gen. et sp. n., Osek near Rokycany,

1. NM L 13216, holotype, external mould of almost complete specimen showing theca, proxistele and dististele (paddle), × 2.
2. dtto, internal mould, × 2.
3. NM L 29120, internal mould of specimen showing theca and proxistele, × 2.
4. dtto, latex cast, × 2.
5. dtto, detail of posterior part of theca in contact with proxistele, × 4.5.

PLATE 2

Plasiacystis mobilis gen. et sp. n., Mýto near Rokycany,

1. NM L 29112, external mould of dorsoventrally compressed specimen showing theca with distinct, flat anal pyramid, × 1.3.
2. dtto, detail of pyramid, × 8.
3. NM L 29115, external mould of *Plasiacystis*'s theca with anal pyramid and attached specimen of edrioasteroid ?*Argodiscus rarus* PLAS et PROKOP, 1979, × 1.
4. dtto, enlarged posterior part of theca with anal pyramid, × 2.

PLATE 3

Plasiacystis mobilis gen. et sp. n.

1, 2. NM L 21129, so-called “Rokycany ball” (silicified nodule or concretion) with internal and external mould of isolated proxistele, Praha – Libuš, × 3.1.
3, 4. dtto, latex cast, × 4.
5. NM L 29116, external mould of isolated dististele (paddle), Osek near Rokycany, × 3.
6. dtto, latex cast, × 3.

PLATE 4

Plasiacystis mobilis gen. et sp. n.

1, 2. NM L 37454, external mould and its latex cast of anterior-posteriorly compressed theca showing internal connection with proxistele marked by arrow, Mýto near Rokycany, × 1.2.
3. NM L 13123, Barrande's original specimen: external mould of compressed theca with two fragments of proxistele, Osek near Rokycany, × 1.3.
4. dtto latex cast, × 1.3.
5. Barrande's original description of “*Echinosphaerites infaustus*” (= *Plasiacystis mobilis*).
6. Barrande's original figure of “*Echinosphaerites infaustus*” (= *Plasiacystis mobilis*), fragments of proxistele marked by arrow, Osek near Rokycany, × 1.

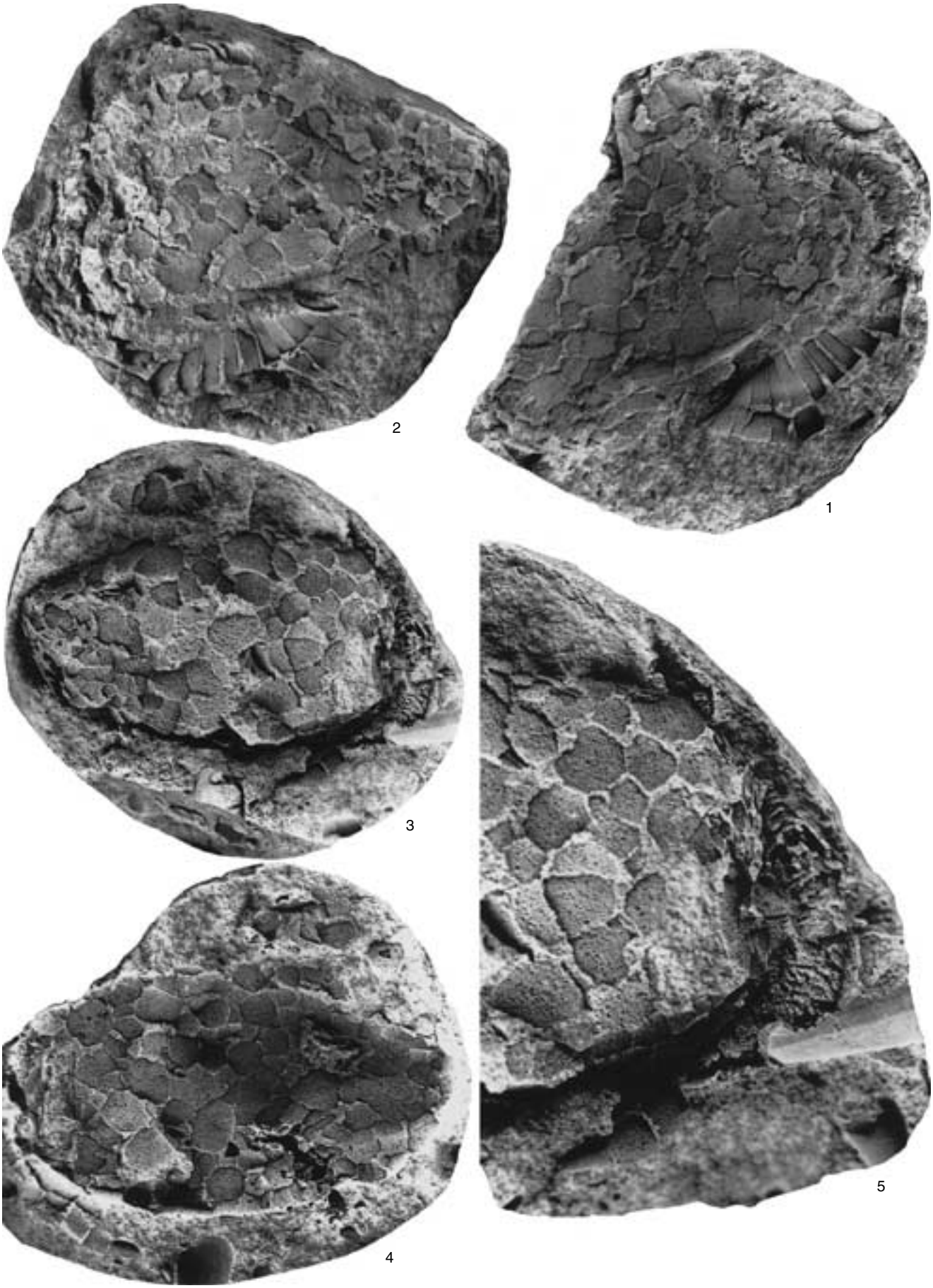
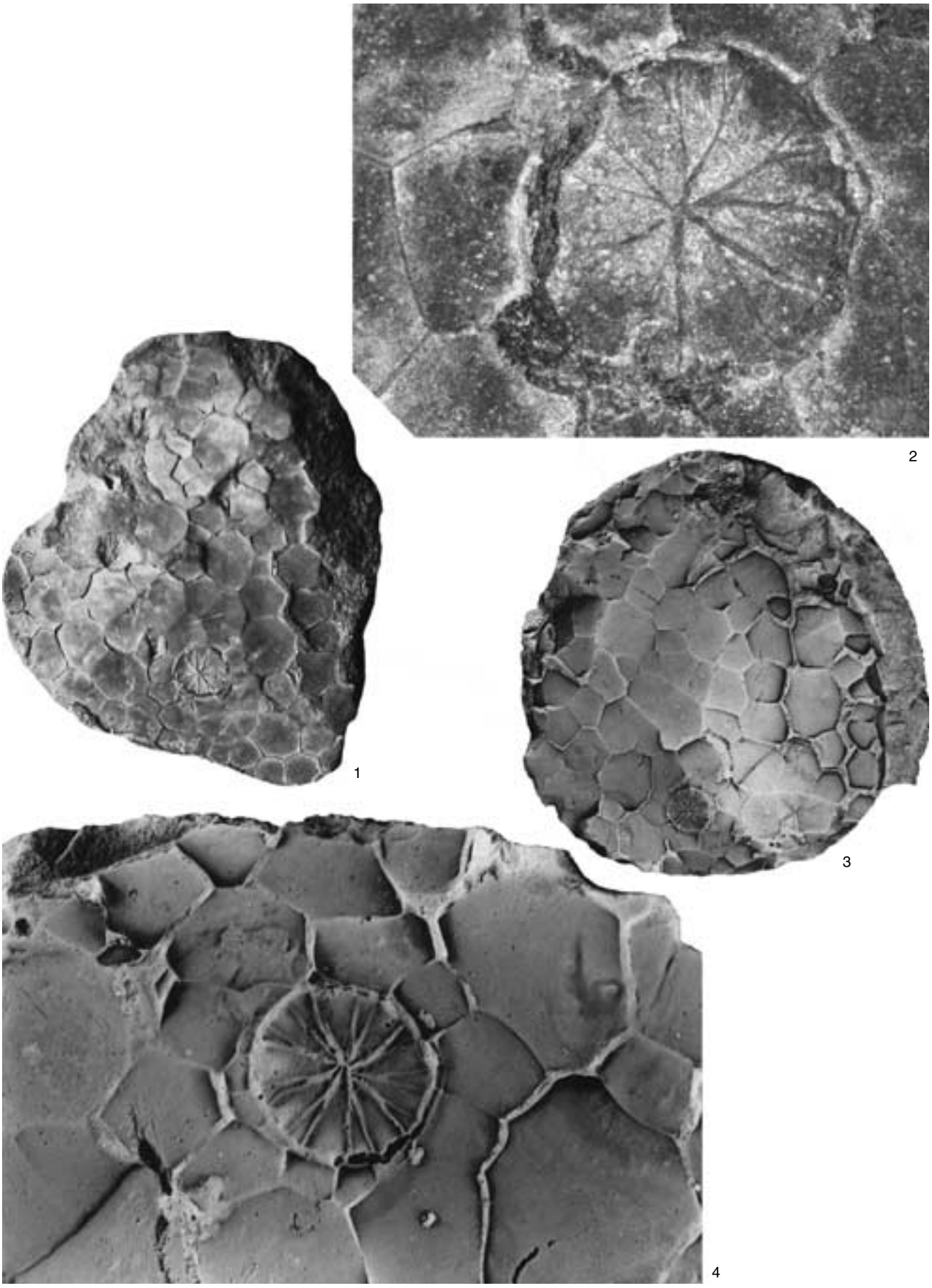

2
1
3
5
4

Plate 2



1

2

3

4

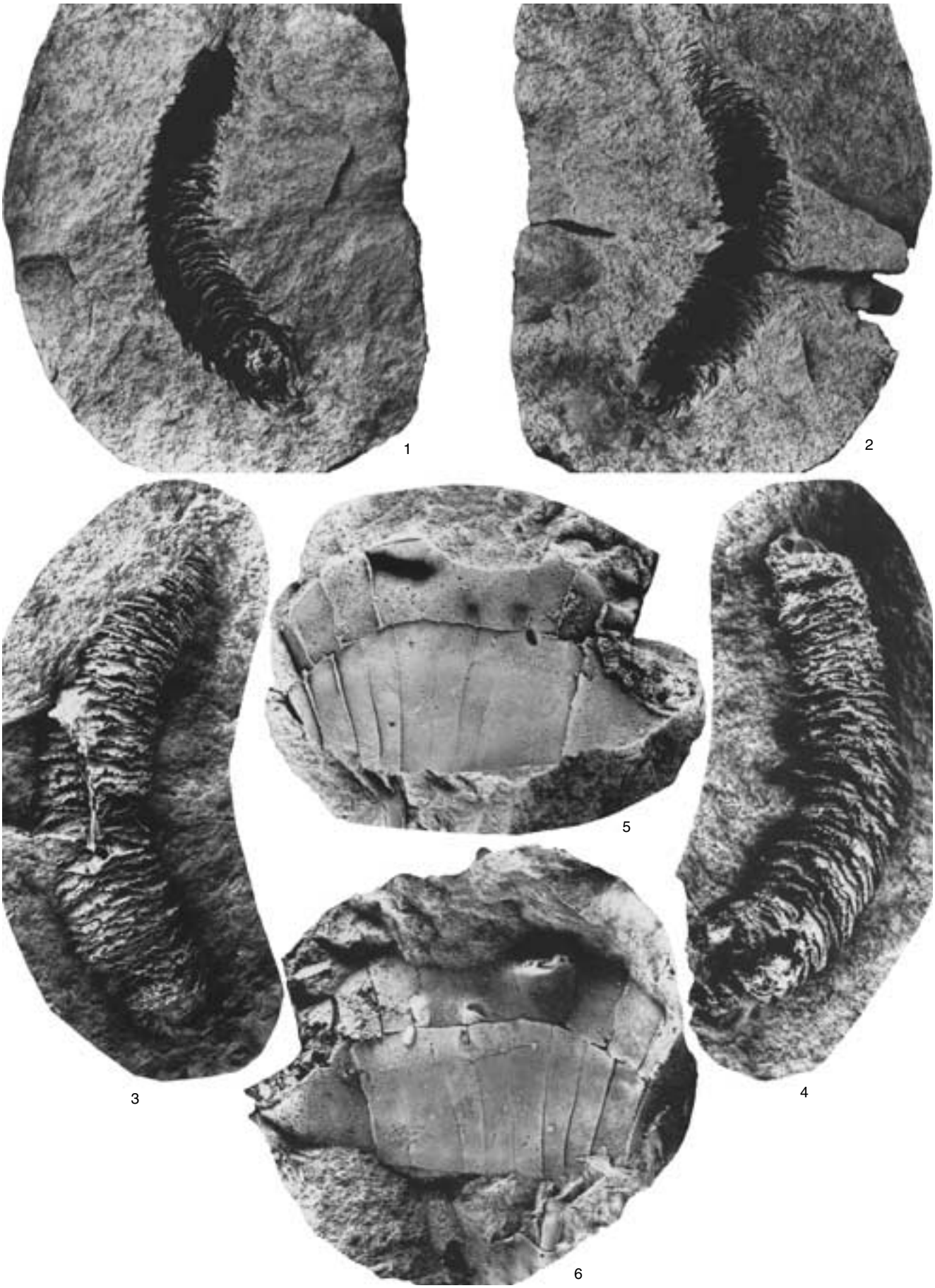
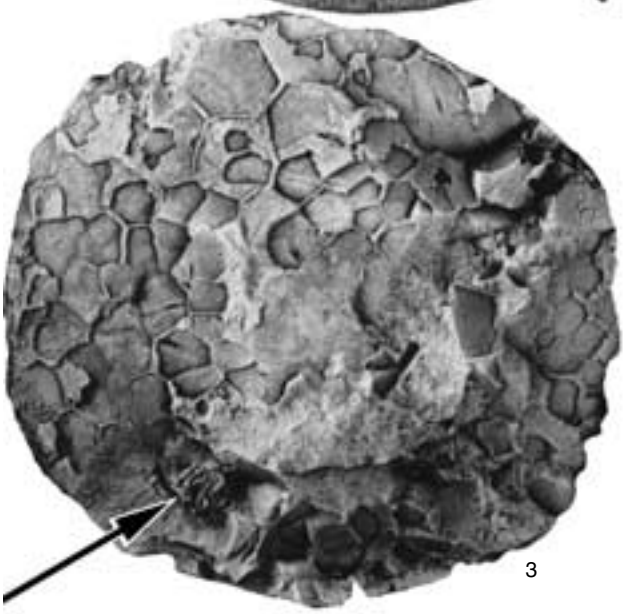

1
2
3
4
5
6

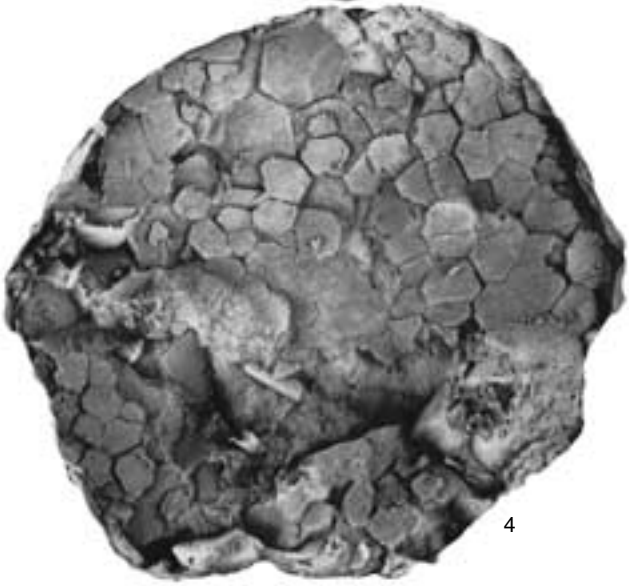
Plate 4

1

2



3



4

Pl. 25. (suite)

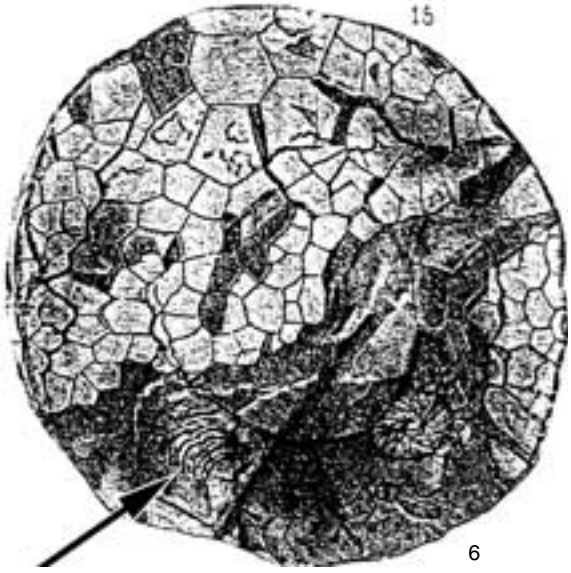
Fig. Etage

Echinosphaer. *infaustus.* Barr. . **D**
Voir Pl. 22—23—24—39.

15. Spécimen de grande taille et de forme sphéroïdale. Sa surface détériorée montre seulement l'empreinte des plaquettes lisses, très inégales, sans aucun caractère particulier. Des fragments, qui paraissent étrangers, sont appliqués vers le bas de la surface — *Wosek* — **d 1.**

Nous ne figurons ce spécimen mal caractérisé qu'à cause de la rareté de formes semblables dans la bande **d 1.**

C'est le seul spécimen à notre connaissance. La surface de toutes les plaquettes est sans trace des rhombes et sans tubercules. Ainsi, la nature générique de ce spécimen reste douteuse.



15

5 6