

Holectypoid echinoids from Cenomanian and Turonian strata in the Mons Basin (Belgium). 1. *Discoïdes*

Joris F. GEYS

Abstract

Holectypoid specimens belonging to the genus *Discoïdes*, from the Cenomanian Tourtia-deposits of Belgium are systematically revised. SMISER's (1935) identification of the species concerned proves to be erroneous.

Key-words: Echinoidea - Cretaceous - Belgium.

Résumé

Des spécimens d'holectypoides appartenant au genre *Discoïdes* et provenant du Tourtia cénonomien de Belgique, sont révisés au point de vue systématique. L'identification spécifique des spécimens concernés, effectuée par SMISER (1935), est erronée.

Mots-clefs: Echinoidea - Crétacé - Belgique.

Echinoids belonging to the order Holectypoida are common in strata of mid-Cretaceous age. A fair number of specimens have been collected in the Tourtia deposits of the Mons Basin in Belgium. Most of them belong to the genus *Conulus*, while specimens of *Discoïdes* and a few other genera are considerably less numerous. Fossil specimens, which have been collected for the larger part during the second half of the 19th century, now belong to the collections of the Royal Belgian Institute of Natural Sciences. They have not been subjected to close scrutiny for almost fifty years. I therefore undertook a systematic revision of these interesting fossils, which I intend to publish in three short papers.

D'ARCHIAC (1846) was the first to draw attention to the presence of Holectypoid echinoids in the Cenomanian of Belgium. He mentioned only a single species:

Galerites subsphaeroidalis, nov. sp.

Subsequent 19th century-authors extended the list to three species.

CORNET & BRIART (1866):

Discoïdea subuculus, Agass.
Galerites subsphaeroidalis, d'Arch.
Pyrina Desmoulini, d'Arch.

DEWALQUE (1868):

Discoïdea (Galerites) subuculus, Goldf.

Galerites subsphaeroidalis, d'Arch.
Pyrina Desmoulini, d'Arch.

COTTEAU (1874):

Discoïdea subuculus, Klein, 1735
Echinoconus Rhotomagensis, d'Orbigny, 1856
Pyrina Des Moulinsi, d'Archiac, 1847

MOURLON (1881):

Discoïdea (Galerites) subuculus, Goldf.
Galerites subsphaeroidalis, d'Arch.
Pyrina Desmoulini, d'Arch.

SMISER (1935) distinguished no less than six species of holectypoids:

Discoïdes minimus AGASSIZ
Conulus nucula A. GRAS (*Galerites*)
Conulus subrotundus MANTELL
Conulus subsphaeroidalis D'ARCHIAC (*Galerites*)
Conulus laevis AGASSIZ (*Galerites*)
Pseudopyrina desmoulini D'ARCHIAC (*Pyrina*)

Order Holectypoida DUNCAN, 1889
Suborder Holectypina DUNCAN, 1889
Family DISCOIDIDAE LAMBERT, 1900
Genus *Discoïdes* PARKINSON, 1811

Type species: *Echinites subuculus* LESKE, 1778, by original designation.

Discoïdes subuculus (LESKE, 1778)
Fig. 1

- *.1778 *Echinites subuculus*, LESKE, p. 171, pl. 14, fig. L, M, N, O.
- .1789 *Echinites subuculus*, GMELIN & LINNÉ, p. 3189.
- .1811 *Discoïdes subuculus*, PARKINSON, p. 21
- *.1816 *Galerites rotularis*, LAMARCK, p. 21.
- .1820 *Galerites rotularis*, DEFRANCE, p. 86.
- .1824 *Galerites rotularis*, EUDES-DESLONGCHAMPS, p. 433.
- .1826 *Galerites subuculus*, GOLDFUSS, p. 129, pl. 49, fig. 2.

- .1830 *Echinoneus subuculus*, DE BLAINVILLE, p. 194.
 .1836 *Discoidea rotularis*, AGASSIZ, p. 186.
 .1837 *Galerites subuculus*, DES MOULINS, p. 54.
 .1840 *Discoidea subuculus*, AGASSIZ, p. 7.
 *.1840 *Discoidea minima*, AGASSIZ, p. 7.
 .1841 *Discoidea subuculus*, ROEMER, p. 31.
 .1842 *Discoidea subuculus*, DESOR, p. 54, pl. 7, fig. 5-7.
 .1842 *Discoidea minima*, DESOR, p. 54, pl. 7, fig. 1-4.
 *.1842 *Discoidea pisum*, DESOR, p. 57.
 .1847 *Discoidea subuculus*, AGASSIZ & DESOR, p. 146.
 .1847 *Discoidea minima*, AGASSIZ & DESOR, p. 147.
 .1847 *Discoidea subuculus*, MÜLLER, p. 8.
 .1848 *Discoidea subuculus*, GRAS, p. 44.
 .1848 *Discoidea minima*, BRONN, p. 430.
 .1848 *Discoidea pisum*, BRONN, p. 438.
 .1848 *Discoidea subuculus*, BRONN, p. 430.
 .1849 *Discoidea subuculus*, BRONN, p. 194.
 .1849 *Discoidea minima*, BRONN, p. 194.
 .1849 *Discoidea pisum*, BRONN, p. 194.
 .1850 *Galerites subuculus* var. B, FORBES in DIXON, p. 341.
 1850 *Discoidea subuculus*, D'ORBIGNY, p. 179.
 1850 *Discoidea subuculus*, SORIGNET, p. 39.
 1852 *Discoidea subuculus*, BRONN, p. 190, pl. 29, fig. 19a-c.
 .1854 *Discoidea subuculus*, MORRIS, p. 77.
 .1854 *Discoidea minima*, MORRIS, p. 77.
 .1857 *Discoidea subuculus*, DESOR, p. 176, pl. 24, fig. 1-2.
 .1859 *Discoidea subuculus*, COTTEAU & TRIGER, p. 170, pl. 24, fig. 12.
 .1861 *Discoidea subuculus*, COTTEAU, p. 23-28, pl. 1009, fig. 8-16.
 .1861 *Discoidea minima*, COTTEAU, p. 33-36, pl. 1012, fig. 1-7.
 .1865 *Discoidea subuculus*, COTTEAU, p. 236-240, pl. 68, fig. 9-15.
 (1866) *Discoidea subuculus*, CORNET & BRIART, p. 72, p. 181.
 (1868) *Discoidea (Galerites) subuculus*, DEWALQUE, p. 393.
 .1871 *Discoidea subuculus*, GEINITZ, p. 78, pl. 18, fig. 4.
 .1874 *Discoidea subuculus*, COTTEAU, p. 647.
 .1875 *Galerites subuculus*, QUENSTEDT, p. 414, pl. 76, fig. 36-41.
 1878 *Discoidea subuculus*, COTTEAU, PERON & GAUTHIER, p. 167.
 (1881) *Discoidea (Galerites) subuculus*, MOURLON, p. 89.
 .1885 *Discoidea subuculus*, QUENSTEDT, p. 888, pl. 69, fig. 56L.
 1887 *Discoidea subuculus*, COTTEAU, p. 647-648.
 *.1887 *Discoidea arizensis*, COTTEAU, p. 648-649, pl. 17, fig. 8-12.
 1887 *Discoidea subuculus*, ROUSSEL, p. 626.
 .1887 *Discoidea arizensis*, ROUSSEL, p. 626.
 1911 *Discoidea subuculus*, LAMBERT, p. 75.
 1911 *Discoidea arizensis*, LAMBERT, p. 75.
 .1920 *Discoidea subucula*, HAWKINS, p. 436, pl. 67, fig. 1.
 .1928 *Discoidea minima*, LAMBERT & JEANNET, p. 137 (X81).
 .1928 *Discoidea subuculus*, LAMBERT & JEANNET, p. 155 (P42).
 1931 *Discoidea subuculus*, LAMBERT, p. 158.
 1948 *Discoidea subucula*, MORTENSEN, p. 49, 51, 52, 53, fig. 37a, 38a-d, 43a.
 .1955 *Discoidea subucula*, SZÖRENYI, p. 48-52, pl. 4, fig. 7-8, 10-17, 21.
 1958 *Discoidea subucula*, MACZYNSKA, p. 89, pl. 1, fig. 6-7.
 1958 *Discoidea minima*, MACZYNSKA, p. 93-98, pl. 5, fig. 5-16, pls. 6-9.
 1966 *Discoidea subuculus*, MITROVIC-PETROVIC, tab. 1, tab. 2.
 .1966 *Discoidea subucula*, WAGNER & WYATT DURHAM, p. U44, fig. 330/3.
 .1968 *Discoidea subucula*, HYNDA, p. 205, pl. 42, fig. 1-3.
 1970 *Discoidea subucula*, BLASZKIEWICZ, p. 158.
 1970 *Discoidea minima*, BLASZKIEWICZ, p. 158.
 1976 *Discoidea subuculus*, MITROVIC-PETROVIC, p. 212.
 .1979 *Discoidea* cf. *subucula*, GONGADZE, p. 58-60, pl. 1, fig. 1a-c, 2a-c.
 .1979 *Discoidea* cf. *minima*, GONGADZE, pl. 60-62, pl. 2, fig. 1a-c, 2a-c.
 .1980 *Discoidea subuculus*, FISCHER, p. 268, pl. 133, fig. 8-10.
 .1985 *Discoidea subucula*, SMITH & PAUL, 29-37, fig. 2A-D.
 .1988 *Discoidea subuculus*, SMITH, PAUL, GALE & DONOVAN, p. 96-101, pl. 15, fig. 1-3.
 .1989 *Discoidea subucula*, MALINÓWSKA, p. 306, pl. 92, fig. 3a-c, fig. 6a-c.
- LOCI TYPICI:
E. subuculus: Westphalia, Germany.
G. rotularis: dept. Gers, France.
D. minima: unspecified locality in France.
D. pisum: not specified.
D. arizensis: Pradières, dept. Ariège, France.
- STRATI TYPICI:
E. subuculus: "Kreidemergel" bei Coesfeld.
G. rotularis: not specified.
D. minima: "Craie marneuse".
D. pisum: presumably Cenomanian.
D. arizensis: Cénomanien.
- OCCURRENCES OUTSIDE THE BENELUX-COUNTRIES
France. Cenomanian of Seine-Maritime, Eure, Yonne, Sarthe, Orne, Drôme, Bouches-du-Rhône (COTTEAU, 1861), Aude, Ariège (LAMBERT, 1911).
Germany. Cenomanian of Brunswick (COTTEAU, 1861), Saxony (GEINITZ, 1871), Westphalia (QUENSTEDT, 1875).
Great Britain. Cenomanian of Sussex, Essex, Kent, Dorset, Wiltshire (COTTEAU, 1861).
Switzerland. Cenomanian of Vaud (COTTEAU, 1861).
Poland. Cenomanian of Krakow (MACZYNSKA, 1858).
Hungary. Cenomanian of Bakony (SZÖRENYI, 1955).
Yugoslavia. Cenomanian of Serbia (MITROVIC-PETROVIC, 1966, 1976).
The Ukraine. Cenomanian of Podolia (HYNDA, 1968).
Georgia. Cenomanian (GONGADZE, 1979).
Algeria. Cenomanian of Aumale, Berougniah, Sour Djouab (COTTEAU, PERON & GAUTHIER, 1878).
- STUDIED SPECIMENS
 Sassegnies, dept. Nord, France; "Tourtia de Mons", Cenomanian; 1 specimen (IST-9127, figured by SMISER (1935), pl. 3, fig. 5a-d).
- DIMENSIONS
 D = 8.2 mm; h = 4.9 mm; dp = 1.8 mm.
 h/D = 0.59; dp/D = 0.33.

DESCRIPTION

Small *Discoidea*, with hemispherical adapical side ; the adoral side is slightly concave, with a sunken, funnel-shaped peristome.

The peristome is small and circular, situated in the centre of the adoral side. The periproct is elliptic, its long axis having a radial orientation. It is inframarginal, situated halfway between the peristome and the margin of the adoral side.

Ambulacra correspond to arcs of 20°. Poriferous zones are simple, straight and not sunken throughout. Pores are circular, forming oblique pore-pairs, with very narrow interporous partitions. Ambulacral tubercles are arranged in four vertical series. Adradial series are well developed and regular, with a small, perforate and crenulate tubercle for every three pore-pairs. The ambitus is convex throughout. The ambitus is convex throughout, with the radius of curvature in the perradial parts of the ambulacra slightly greater than the mean radius of the ambital test. Thus the adradial series of tubercles are positioned on low ridges, running from the apical system to the peristome. Perradial series of tubercles are irregular and less well developed. They disappear in the narrower parts of the ambulacra, close to the apex and in the vicinity of the peristome. The remaining space on the ambulacra is completely covered by a dense and fine granulation.

Interambulacra correspond to arcs of 52°. Every interambulacral plate carries five tubercles, perforation and crenulation of which are very difficult to observe on specimen KBIN IST-9127. Let us number these tubercles from 1 to 5, starting at the adradial suture. We can now state that tubercle nr. 1 lies close to the adoral suture. Tubercle nr. 2 is situated in the vicinity of the adapical suture. Tubercles 3, 4 and 5 lie on the longitudinal (horizontal) axis of the plate. Tubercle 3 is larger than the others. All tubercles are arranged in more or less regular, vertical series. Only the third series extends completely up from the peristome to the apical system. Interradial parts of the interambulacra, with tubercles 4 and 5, are less strongly curved (larger radius of curvature) than those parts bearing tubercle 3. Because of this feature, the third series of tubercles is situated on top of a weak, but distinct meridional ridge. Scrobicules are very small and surrounded by tiny scrobicular tubercles, which cannot be distinguished from extrascrobicular granules. Extrascrobicular surfaces are completely covered by a very dense, very fine granulation.

DISCUSSION

Relatively few species of *Discoidea* have been described from the Cenomanian and the Turonian of Western Europe. *D. subuculus* has been noticed in pre-Linnean times and has been redescribed from the Cenomanian of Germany, e.g. by LESKE (1778), GMELIN (1788), GOLDFUSS (1826) e.a. Early in the 19th century, LAMARCK (1816) introduced the name *Galerites rotularis* for specimens from the Cretaceous of France, which he recognised to be synonymous with Leske's species. Understandably, LAMARCK's name soon became obsolete and has not been used again, since 1836.

D. minima was described by AGASSIZ (1840) from unspecified Cretaceous strata in France. The species was thoroughly redescribed by COTTEAU (1861), who pointed out some differences with *D. subuculus*. AGASSIZ's species should be smaller than mean *D. subuculus* (a) ; its h/D-ratio should be higher (b) ; its adoral side should be more angular in outline (c) ; its peristome should not be sunken (d). As a matter of fact, at least one of these points of difference is related with smaller size (d) ; others (b, c) cannot be confirmed, not even on COTTEAU's own figures. The great similarity between *D. subuculus* and *D. minima* has already been noticed by FORBES (1850) and by DESOR (1857), who considered them to be synonymous. In my opinion, *D. minima* is no more than young and/or small specimens of *D. subuculus*.

An exceptionally well preserved single specimen of unknown provenance, induced DESOR (1842) to create the name *Discoidea pisum*, for what he believed to be a new species. The specimen shows a few characteristics which can only rarely be observed on small *Discoidea*. Yet, the differences between *D. pisum* and *D. subuculus* are so small and subtle, that I believe the former to be a junior synonym of the latter. Since BRONN (1849), the name *D. pisum* has not been used again in literature.

D. arizensis has been described by COTTEAU (1887) from the Cenomanian of the dept. Ariège, in the French Pyrenees. The specimens studied by COTTEAU are very similar to *D. subuculus*, being however unusually large. Other differences, such as the presence of more numerous interambulacral tubercles and a sunken peristome, are associated with larger size and/or higher age: they probably have little significance of their own. In my opinion, *D. arizensis* is a junior synonym of *D. subuculus*, based on a few exceptionally large specimens. The name has been used for the last time by LAMBERT (1911).

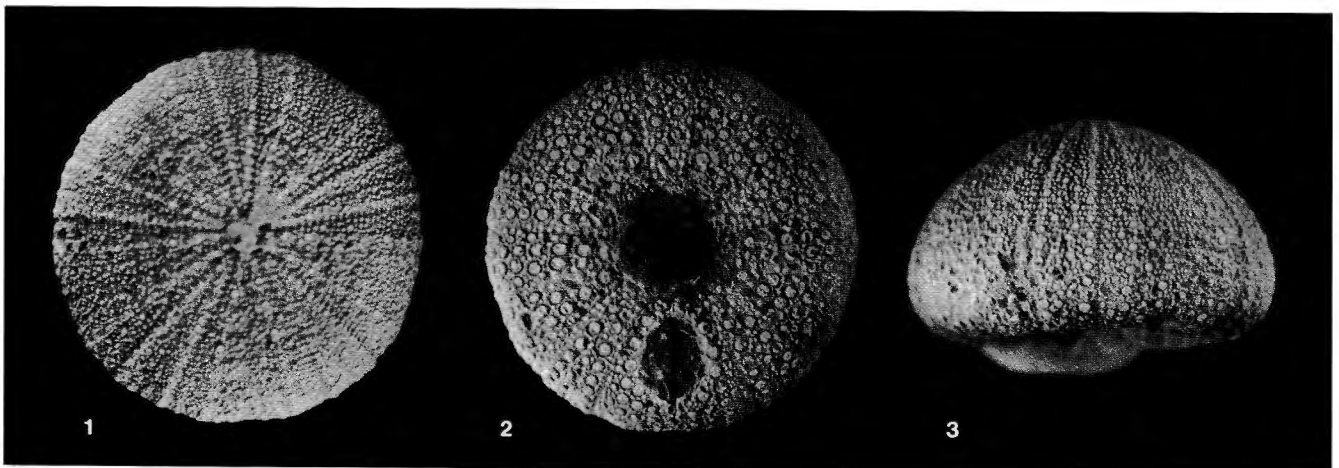


Fig. 1 — *Discoidea subuculus* (LESKE, 1778) ; Mons Tourtia, Cenomanian: Sassegnies, dept. Nord, France ; x 6 ; KBIN-collection IST-9127. 1, adapical view ; 2, adoral view ; 3, lateral view.

Differences between *D. subuculus*, *D. inferus* (DESOR, 1847) and *D. favrinus* (DESOR, 1842) have recently been thoroughly discussed and well illustrated by SMITH & PAUL (1985) and by SMITH, PAUL, GALE & DONOVAN (1988). I agree with their points of view, having little to add to their excellent work.

Three species of *Discooides* are known from the Tethyan Cenomanian: *D. jullieni* PERON & GAUTHIER, (in COTTEAU, PERON & GAUTHIER, 1879), from Algeria, *D. dendroides* BLANCKENHORN, 1925, from the Levant, *D. dubertreti* KELLER & VAUTRIN, 1937 and *D. forgemolli* COQUAND, 1864, from Algeria.

D. jullieni differs from *D. subuculus* in having five instead of four genital pores. According to the figures, published by COTTEAU, PERON & GAUTHIER, 1879 and by COTTEAU, 1861, the extrascrobicular granulation is much coarser in *D. subuculus* than in *D. jullieni*. The arrangement of tubercles is similar in both species. It must be stressed that only the holotype of *D. jullieni* is known. Therefore, I wonder if the subtle differences between the species and *D. subuculus* should not rather be attributed to intraspecific variability. Yet, not having been able to examine *D. jullieni* more closely, the question of its possible synonymy with *D. subuculus* must remain open.

References

- AGASSIZ, L., 1836. Note sur les fossiles du Jura neuchâtelois. *Mémoires de la Société des Sciences Naturelles de Neuchâtel*, 1, 141 pp.
- AGASSIZ, L., 1840. Catalogus systematicus ectyporum echinodermatum fossilium musei Neocomensis. Petitpierre, Neuchâtel, Switzerland, 20 pp.
- AGASSIZ, L. & DESOR, E., 1847. Catalogue raisonnée des familles, des genres et des espèces de la classe des Echinodermes II. *Annales des Sciences Naturelles, 3ième Série, Zoologie*, 7: 129-168 ; 8: 5-35, 355-380.
- BLANCKENHORN, M., 1925. Die Seeigelfauna der Kreide Palästinas. *Palaeontographica*, 67 : 83-113, pls. 7-8.
- BLASZKIEWICZ, A. e.a., 1970. Geology of Poland. II. Catalogue of fossils. 2. Mesozoic - Cretaceous. Publishing House Wydawnictwa Geologiczne, Warsaw, Poland, pp. 103-177.
- BRONN, H.G., 1848. Handbuch einer Geschichte der Natur. III A. Nomenclator Palaeontologicus. Schweitzerbart'sche Verlagsbuchhandlung, Stuttgart, Germany, 1381 pp.
- BRONN, H.G., 1849. Handbuch einer Geschichte der Natur. II B. Enumerator Palaeontologicus. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, Germany, 1106 pp.
- BRONN, H.G., 1852. Lethaea geognostica, oder Abbildungen und Beschreibung der für die Gebirgs-Formationen bezeichnendsten Versteinerungen, 3. Ed., Zweiter Band. 3. Mesolethaea, V. Kreide-Gebirge. Schweitzerbart'sche Verlag, Stuttgart, Germany, 412 pp., 33 pl.
- COQUAND, H., 1864. Géologie et Paléontologie de la région sud de la province de Constantine. Savey, Paris, France, 320 pp., 35 pls.
- CORNET, J. & BRIART, A., 1866. Description minéralogique, paléontologique et géologique du terrain Crétacé de la Province du Hainaut. Dequesne-Masquillier, Mons, Belgium, 199 pp., 4 pl.
- COTTEAU, G., 1857-1878. Etudes sur les Echinides Fossiles du département de l'Yonne. Baillière, Paris, France, 518 pp., 84 pl.
- D. forgemolli* (COQUAND, 1862) is very similar to *D. subuculus*. The most striking difference is again the presence of five genital pores in *D. forgemolli*. Moreover, *D. forgemolli* is considerably larger than *D. subuculus*. If it were not for the presence of a supplementary genital pore, I would not hesitate to consider *D. forgemolli* to be a junior synonym of *D. subuculus*. As long as the taxonomic significance of this feature is unclear, I reserve my opinion.
- Species such as "*Discooides*" *cylindricus* (AGASSIZ, 1840) and "*Discooides*" *dixonii* FORBES, 1850 are sufficiently different from *D. subuculus* to be classified in other genera, respectively *Camerogalerus* and *Dixonia*. The differences with true *Discooides* have been clarified by WAGNER & WYATT DURHAM (1966).

Acknowledgements

I would like to express my sincere gratitude to D. CAHEN, director of the Royal Belgian Institute of Natural Sciences in Brussels and to A. V. DHONDT, head of the section of Invertebrate Fossils, dept. of Palaeontology, for the opportunity to study the specimens in their care and for facilities during my visits at their institute.

COTTEAU, G., 1861-1867. Paléontologie Française. Description des animaux invertébrés commencée par Alcide d'Orbigny. Terrain Crétacé 7, Echinides Réguliers. Masson, Paris, France, 892 pp., pl. 1007-1204.

COTTEAU, G., 1874. Note sur les Echinides Crétacés de la province du Hainaut. *Bulletin de la Société Géologique de France, Série III*, 2 : 638-660.

COTTEAU, G., 1887. Catalogue des échinides recueillis par M. Roussel dans le terrain Crétacé des Petites Pyrénées et des Corbières. *Bulletin de la Société Géologique de France, 3ième Série*, 15: 639-665, pl. 16-20.

COTTEAU, G., PERON, P. & GAUTHIER, V., 1876-1884. Echinides fossiles de l'Algérie. Description des espèces déjà recueillis dans ce pays et considérations sur leur position stratigraphique. Terrains Secondaires. I. Terrains Jurassiques, étage Tithonique, Néocomien, Urgo-Aptien, Albien et Cénomaniens. Masson, Paris, France, 235 pp., 41 pl.

COTTEAU, G. & TRIGER, J., 1855-1869. Echinides du département de la Sarthe. J.B. Baillière, Paris, France, 458 pp., 75 pl.

D'ARCHIAC, A., 1846. Rapport sur les fossiles du Tourtia. *Mémoire de la Société Géologique de France, Série 2*, 2 : 291-351, pl. 13-25.

DE BLAINVILLE, H.M.D., 1830. Zoophytes, in: Dictionnaire des Sciences Naturelles, Tome 60. Levrault, Strasbourg, France, 546 pp.

DEFRANCE, M.J.L., 1820. Galérite, in: Dictionnaire des Sciences Naturelles Tome 18. Levrault, Strasbourg, France, pp. 85-87.

DE LAMARCK, J.B., 1816. Histoire naturelle des animaux sans vertèbres, Tome III. Verdière, Paris, France, 586 pp.

DESMOULINS, C., 1835-1837. Etudes sur les Echinides. *Actes de la Société Linnéenne de Bordeaux*, 79: 520 pp., 3 pl.

DESOR, E., 1842. Des Galérites, in: AGASSIZ, L., Monographie d'Echinodermes vivans et fossiles. Petitpierre, Neuchâtel, Switzerland, 94 pp., 13 pl.

- DESOR, E., 1855-1859. Synopsis des Echinides fossiles. Reinwald, Paris, France, 490 pp., 44 pl.
- DEWALQUE, G., 1868. Prodrome d'une description géologique de la Belgique. Decq, Brussels, Belgium, 442 pp.
- D'ORBIGNY, A., 1850. Prodrome de Paléontologie stratigraphique universelle des animaux mollusques et rayonnés, faisant suite au Cours élémentaire de Paléontologie et de Géologie Stratigraphique, Deuxième Volume. Masson, Paris, France, 427 pp.
- DUNCAN, P.M., 1889. On the Echinoidea of the Cretaceous of the Lower Narbada Region. *Quarterly Journal of the Geological Society of London*, 43: 150-155.
- EUDES-DESLONGCHAMPS, J.A., 1824. Histoire naturelle des Zoophytes, ou Animaux Rayonnés, in: Encyclopédie Méthodique (Dictionnaire Encyclopédique Méthodique), ou par ordre de matières ; par une société de gens de lettres, de savans et d'artistes... précédé d'un vocabulaire universel. Pancoucke, Paris, France.
- FISCHER, J.-C., 1980. Fossiles de France et des régions limitrophes Masson, Paris, 444 pp., 195 pl..
- FORBES, E., 1850. Notes on Cretaceous Echinodermata, in: DIXON, F., The Geology and Fossils of the Tertiary Formations of Sussex. Longman, Brown, Green and Longmans, London, England, 325 + 343 pp.
- GEINITZ, H.B., 1871. Das Elbthalgebirge in Sachsen. Erster Theil. Der Untere Quader. III. Seeigel, Seesterne und Haasterne des unteren Quaders und unteren Pläners. T. Fischer, Kassel, Germany, pp. 63-93, pl. 14-23.
- GMELIN, J.F., 1789. Caroli Linnaei... Systema Naturae sive regna tria naturae systematice proposita per classes, ordines, genera, et species cum characteribus, differentes, synonymis, locis. Tomus I. Editio decima tertia, aucta, reformata, cura J.F. Gmelin. G.E. Beer, Leipzig, Germany, 7 vols., 4120 pp.
- GOLDFUSS, A., 1826-1844. Petrefacta Germaniae. Abbildungen und Besreibungen der Petrefacten Deutschlands und der angrenzenden Länder. Arnz, Düsseldorf, Germany, 252 + 312 + 128 pp, 200 pl.
- GONGADZE, G.S., 1979. Pozdnemelovie echinoidei Gruzii i ich stratigraficeskoe znacenie. Izdatelstvo Tbilisskogo Universiteta, Tbilissi, Georgia, 151 pp., 33 pl.
- GRAS, C.J.A., 1848. Description des Oursins fossiles de l'Isère, précédée de notions élémentaires sur l'organisation et la glosologie de cette classe de Zoophytes et suivie d'une notice géologique sur les divers terrains de l'Isère. *Bulletin de la Société Statistique de l'Isère, Série 2*, 2, 96 pp., 6 pl.
- HAWKINS, H.L., 1920. The morphology and evolution of the ambulacrum in the Echinoidea Holecypoida. *Philosophical Transactions of the Royal Society of London*, B 209 : 377-480, pl. 61-69.
- HYNDA, V.A., 1968. Tip Echinodermata, in: S. PASTERNAK e.a., Stratigrafija i fauna kreidovich vidklediv zakhodu Ukraini - bez Karpat. Kiev: Doumka, Kiev, Ukrainia, pp. 192-232, pl. 40-50.
- KELLER, A. & VAUTRIN, H., 1937. Nouvelle contribution à l'étude des échinides de la Syrie et du Liban. *Notes et Mémoires, Haut-Commissariat de la République Française en Syrie et au Liban*, 2/2 : 137-164, pls. 5-7.
- LAMBERT, J., 1900. Etude sur quelques échinides de l'Infra-Lias et du Lias. *Bulletin de la Société des Sciences et d'Histoire Naturelle de l'Yonne*, 53, 3-57.
- LAMBERT, J., 1911. Etude sur les Echinides Crétacés de Rennesles-Bains et des Corbières. Bonnafous-Thomas, Carcassone, France, 120 pp., 3 pl.
- LAMBERT, J., 1931-1933. Etude sur les échinides fossiles du Nord de l'Afrique. *Mémoires de la Société Géologique de France*, Nouvelle Série, 16: 228 pp., 8 pl.
- LAMBERT, J. & JEANNET, A., 1928. Nouveau Catalogue des moules d'échinides fossiles du Musée d'Histoire Naturelle de Neuchâtel, exécutés sous la direction de L. Agassiz et E. Desor. *Denkschriften Schweizerischen Naturforschenden Gesellschaft*, 64: 83-233.
- LESKE, N.G., 1778. Jacobi Theodori Kleini naturalis dispositio echinodermatum ..., edita et descriptionibus novisque inventis et synonymis auctorem aucta. G.E. Beer, Leipzig, Germany, 278 pp., 54 pl.
- MACZYNSKA, S.S., 1958. Jezowce rodzaju *Discoidea* Cenomanu i Turonu okolic Krakowa, Miechowa i Wolbromia. *Prace Muzeum Ziemi*, 2: 87-168.
- MALINÓWSKA, L. (Editor), 1989. Geology of Poland. Volume III. Atlas of guide and characteristic fossils. Part 2c. Mesozoic - Cretaceous. Publishing House Wydawnictwa Geologiczne, Warsaw, Poland, 422 pp., 219 pl.
- MITROVIC-PETROVIC, J., 1966. Kredni i Miotsenski Ekhinidi Srbije. *Annales Géologiques de la Péninsule Balkanique*, 32: 87-164, 7 pl.
- MITROVIC-PETROVIC, J., 1976. Prikaz Mezozojske Ehinidske faune Srbije s posebnim osvrtim nanjen biostratigrafski i paleoekoloski znacaj. *8th Yugoslavian Geological Congress*, 2: 201-216.
- MORRIS, J., 1854. A Catalogue of British Fossils: comprising the genera and species hitherto described ; with references to their geological distribution and to the localities in which they have been found. J. Morris, London, England, 372 pp.
- MORTENSEN, T., 1948. A Monograph of the Echinoidea IV.1 Holecypoida, Cassiduloida. Reitzel, Copenhagen, Denmark, 363 pp., 14 pl.
- MOURLON, M., 1881. Géologie de Belgique. F. Hayez, Brussels, Belgium. 317 + 392 pp.
- MÜLLER, J., 1847. Monographie der Petrefacten der Aachener Kreideformation. Erste Abteilung. Henry und Cohen, Bonn, Germany, 48 pp.
- PARKINSON, J., 1804-1811. Organic remains of a former world. An examination of the mineralized remains of the vegetables and animals of the antediluvian world, generally termed extraneous fossils. Sherwood, Neely and Jones, London, England, 3 Vols., 461 + 286 + 455 pp., 9 + 19 + 22 pl.
- QUENSTEDT, F.A., 1875. Petrefactenkunde Deutschlands. 3. Echinodermen. Fues's Verlag, Leipzig, Germany, 714 pp.
- QUENSTEDT, F.A., 1885. Handbuch der Petrefactenkunde. Lapp'schen Buchhandlung, Tübingen, Germany, 1239 pp., 100 pl.
- ROEMER, F.A., 1840-1841. Die Versteinerungen des norddeutschen Kreidegebirges. Hannover, Germany, 4 + 145 pp., 16 pl.
- ROUSSEL, J., 1887. Etude sur le Crétacé des Petites Pyrénées et des Corbières. *Bulletin de la Société Géologique de France*, 3ième Série, 15: 601-639.
- SMISER, J.S., 1935. A monograph of the Belgian Cretaceous Echinoids. *Verhandelingen van het Koninklijk Belgisch Natuurhistorisch Museum*, 68: 98 pp., 9 pl.
- SMITH, A.B. & PAUL, C.R.C., 1985. Variation in the irregular echinoid *Discoides* during the early Cenomanian. *Special Papers in Palaeontology*, 33: 29-37.

SMITH, A.B., PAUL, C.R.C., GALE, A.S. & DONOVAN, S.K., 1988. Cenomanian and Lower Turonian echinoderms from Wilmington, south-east Devon, England. *Bulletin British Museum (Natural History), Geology*, 42: 245 pp.

SORIGNET, L.A., 1850. Oursins fossiles de deux arrondissements du département de l'Eure. Louviers & Andelys, Vernon, France, 4 + 83 pp.

SZŐRÉNYI, E., 1955. Bakonyi Kréta Echinoideák. *Geologica Hungarica Series Paleontologica*, 26: 336 pp., 22 pl.

WAGNER, C.D. & WYATT DURHAM, J., 1966. Holectypoids. In: MOORE, R.C. (Editor), *Treatise on Invertebrate Paleontology*,

Part U, Echinodermata 3. Geological Society of America, Boulder, U.S.A., pp. U440-U450.

J.F. Geys,
dept. of Biology,
State University Centre
(RUCA),
Groenenborgerlaan 171,
B-2020 Antwerpen, Belgium.

Typescript submitted: 05.07.1993

Revised typescript received: 27.09.1993