

Institut royal des Sciences
naturelles de Belgique

BULLETIN

Tome XXXVIII, n° 5

Bruxelles, juillet 1962

Koninklijk Belgisch Instituut
voor Natuurwetenschappen

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OF SOME LOWER CARBONIFEROUS ECHINOIDS
FROM BELGIUM (*)

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OF SOME LOWER CARBONIFEROUS ECHINOIDS
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by Porter M. KIER (Washington).

The echinoids from the Lower Carboniferous Marbre noir de Dinant, at Denée, Belgium, constitute the largest and most remarkable fauna known of Paleozoic echinoids. This assemblage of 11 species includes several very peculiar forms, and the largest echinoid known, fossil or recent. A thorough study of these specimens was made by R. T. JACKSON in 1929.

Professor Georges UBAGHS, of the University of Liège, took me to see the marvelous collection of these specimens at the Abbaye de Maredsous. I was surprised to note that most of the specimens had never been cleaned. A layer of matrix 1 to 2 mm thick covered most of the surface of the tests. I borrowed specimens from the Abbaye, the Museum at the University of Liège, and Harvard and cleaned them with a dental drill and needles. Both the adapical and adoral surfaces were exposed of four of the specimens.

Cleaning revealed many new and some striking features in these echinoids. The adoral surfaces of both *Proterocidaris gigantea* KONINCK and *Proterocidaris deneensis* (JACKSON) are very different from the adapical surfaces. In both species, the ambulacra are much more developed adorally than adapically. In *P. deneensis* almost the whole adoral

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surface is ambulacra with the interambulacra reduced to just a single column in each area. JACKSON suggested that these species were sub-spherical in shape but it is apparent, considering the abrupt change in structure at their margins, that these echinoids were very flattened, like present sand dollars. JACKSON created a new genus, *Fournierechinus* for *P. deneensis*, but the cleaning of two specimens of this species reveals that it is very similar to *P. gigantea*, and *Fournierechinus* is herein considered a synonym of *Proterocidaris*. JACKSON's *Perischodorus fraiponti* is also a synonym of *Proterocidaris gigantea*. I cleaned the paratype and found the plate arrangement to be much different than that described by JACKSON, but very similar to *P. gigantea*. Furthermore, the specimen JACKSON referred to *Palaechinus elegans* is actually a small *P. gigantea*. A specimen of *Lovenechinus lacazei* (JULIEN) was cleaned, revealing for the first time the apical system and ambulacral structure of a Belgium specimen of this species.

I thank Dom. A. BROUWER at the Abbaye de Maredsous, Professor Georges UBAGHS at the University of Liège, and Dr. Harry WHITTINGTON at the Museum of Comparative Zoology at Harvard for permitting me to borrow and clean specimens from their museums.

SYSTEMATICS.

Family LEPIDOCENTRIDAE LOVEN.

Genus *Proterocidaris* KONINCK.

Proterocidaris KONINCK, 1882, type species, *P. gigantea* KONINCK, 1882, by monotypy.

Fournierechinus JACKSON, 1929, type species *F. deneensis* JACKSON, 1929, by original designation.

Eupholidocidaris KIER, 1956, type species *E. brightoni* KIER, 1956, by original designation.

Low often large forms with more than two columns of ambulacral and interambulacral plates in each area. Ambulacral plates imbricate adorally; interambulacral plates adapically. Adoral surface much different from adapical, having much more developed ambulacral areas. Small, perforated primary, tubercles on all interambulacral plates or just adambulacral plates.

Remarks. — JACKSON (1929, p. 67) established a separate genus, *Fournierechinus*, for his species *Fournierechinus deneensis*. However, the cleaning of two specimens of this species shows it to be much more similar to *Proterocidaris gigantea* than JACKSON realized. Both species

are low, and adapically, both have small, hexagonal ambulacral plates imbricating adorally, with small primary, perforate tubercles on all the interambulacral plates. Adorally, both species have greatly developed ambulacral areas with subsequent reduction in the interambulacra. In both, the pore-pairs are adorally in large peripodia. The two species differ only in the number of columns of plates. *Fournierechinus* is herein considered a junior, subjective synonym of *Proterocidaris*.

In 1956, I established a new genus *Eupholidocidaris* for a species *E. brightoni* from the Lower Carboniferous of Ireland. However, now that more is known about *Proterocidaris gigantea*, it is evident that both *E. brightoni* and *Eupholidocidaris belli* KIER from the Upper Carboniferous of Texas are congeneric with *P. gigantea*, and that *Eupholidocidaris* is a junior, subjective synonym of *Proterocidaris*.

Proterocidaris gigantea KONINCK.

(Pls. 1-3, 4, fig. B; text-figs. 1-4.)

Proterocidaris giganteus KONINCK, 1882. Compte rendu de la 10^e session. Alger, 1881, Paris 1882, p. 514, pl. 8.

Oligoporus soreili FRAIPONT, 1904. Mém. Soc. Géol. Belg., vol. 2, pt. 1, p. 10, pl. 3, fig. 2, pl. 4, figs. 1-2, pl. 5, fig. 1-2.

Oligoporus giganteus LAMBERT and THIÉRY, 1910, p. 121.

Proterocidaris giganteus JACKSON, 1912. Phylogeny of the Echini, p. 410, pl. 65, fig. 3, pl. 67, fig. 4-7.

Proterocidaris gigantea JACKSON, 1929. Mém. Mus. roy. Hist. nat. Belg., n° 38, p. 51-64, pl. 6, 7, 8, fig. 1-2; text-fig. 8-10.

Perischodomus fraiponti JACKSON, op. cit., p. 48, pl. 5, figs. -34.

Palaeechinus elegans M'COY, JACKSON, op. cit., p. 37, pl. 2, figs. 17, 18, Nat. M'COY.

Proterocidaris gigantea MORTENSEN, 1935. Monograph of the Echinoidea, vol. 2, p. 71, fig. 43.

Material. — Five specimens were cleaned varying in diameter from 55 to 250 mm. Two of the specimens are in the collections at the Abbaye de Maredsous : no. 73 referred to *Palaeechinus elegans* M'COY by JACKSON, and no. 71, the paratype of JACKSON's *Perischodomus fraiponti*. Two are in the Museum at the University of Liège, no. 11,228 and one formerly undescribed specimen. One specimen is at the Museum of Comparative Zoology at Harvard, n° 3330. In three of these specimens both the adapical and adoral surfaces have been exposed.

Shape. — JACKSON suggested that this species was originally sub-spherical in shape. However, he was not aware of the marked difference between the adapical and adoral surface and the abrupt change at the margin. Considering this abrupt change, it is probable that this species together with *Proterocidaris deneensis* were very flattened in life, similar to a present sand dollar.

Apical system. — Portions of the apical system are visible in two of the specimens. In the smallest, no. 72 in the collections of the Abbaye de Maredsous (pl. 4, fig. B; text-fig. 4), the genital plates are large, over twice the size of the oculars, with genital 2, the largest, pierced with madreporic pores. There are approximately ten small genital pores in each plate, situated along the adoral border. In the Harvard specimen (pl. 1, text-fig. 1), the largest studied, two genital plates are visible. These plates are much wider and lower than the genital plates in the smaller specimen. The apical system varies in width from $1/5$ to $1/7$ the diameter of the echinoid.

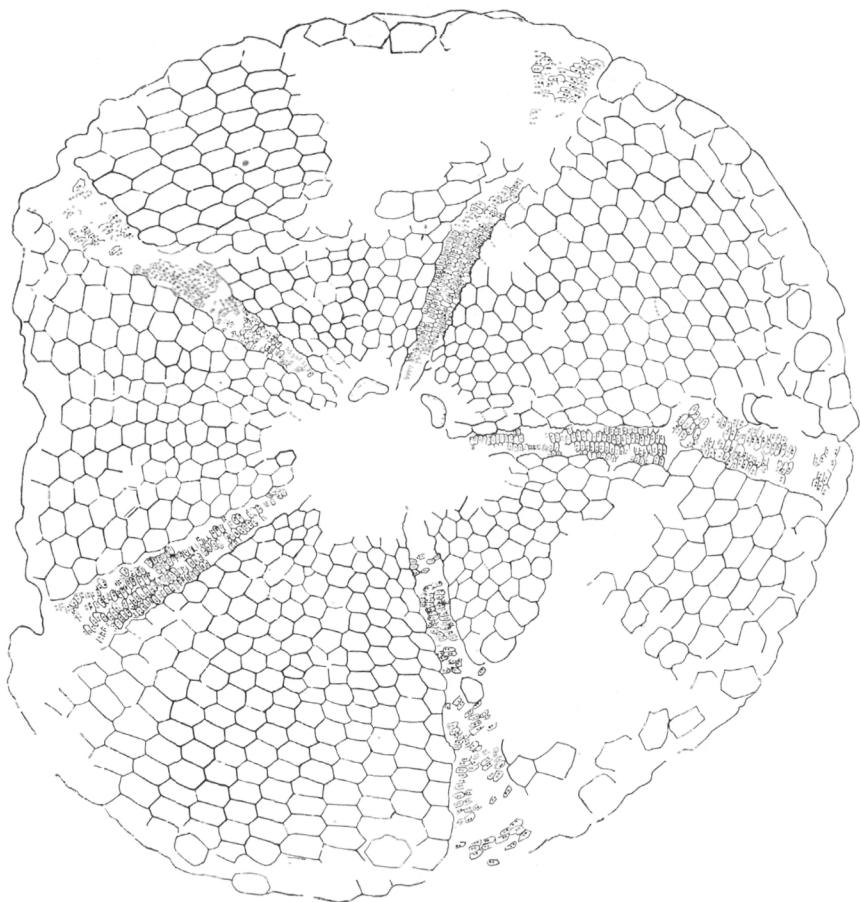


Fig. 1. — *Proterocidaris gigantea* KONINCK.

Adapical view of specimen 3330 in the Museum of Comparative Zoology, Harvard from the Lower Carboniferous Marbre noir de Dinant, Denée, Belgium. $\times 0.52$. Photograph of same specimen on pl. 1; text-fig. of adoral surface on text-fig. 2.

Ambulacra. — On the adapical surface (text-figs. 1, 3 A, 4) throughout most of the length of the ambulacrum, there are four columns of small hexagonal plates, except near the margin where there are six. In the smaller specimens (text-figs. 3 A, 4) midway between the apical system and the margin, each ambulacrum is approximately one third as wide as an interambulacrum, but in the larger specimen (text-fig. 1) each ambulacrum is only $1/8$ as wide. The plates of the median columns are similar to those of the outer columns. The pore-pairs are not in pronounced peripodia.

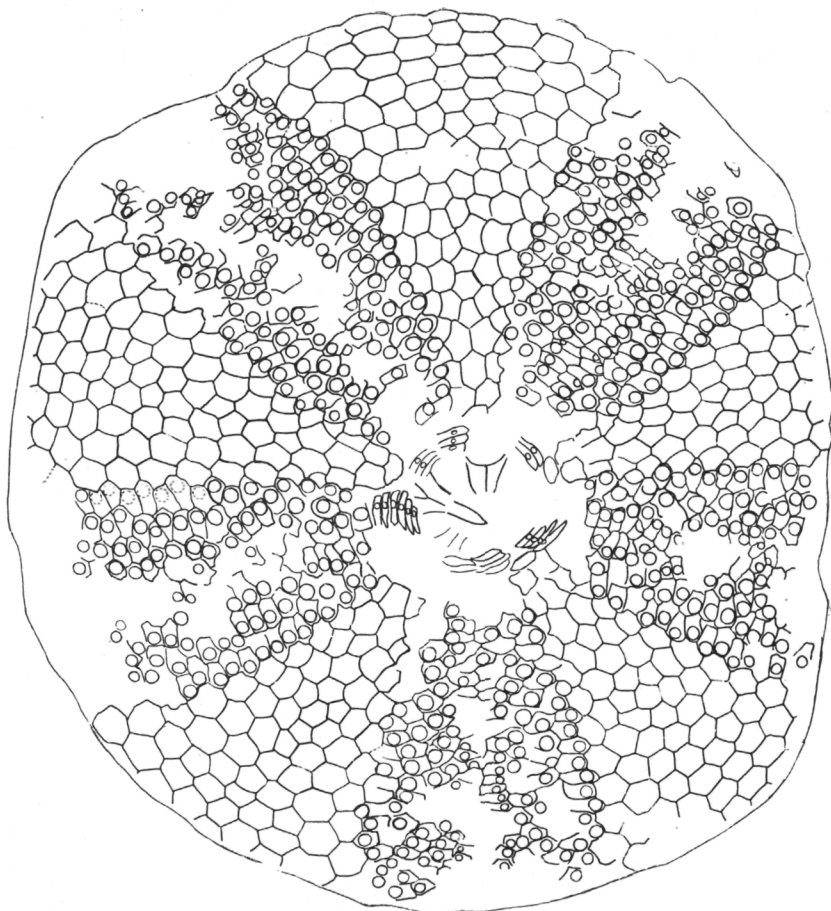


Fig. 2. — *Proterocidaris gigantea* KONINCK.

Adoral view of same specimen on text-fig. 1. $\times 0.57$. The pores in the peripodia have not been drawn. Photograph of same specimen on pl. 2.

Adorally, the ambulacral plates (text-figs. 2, 3 B) are much larger with each ambulacrum slightly wider than each interambulacrum. The plates are regularly hexagonal except for the pentagonal plates in the adradial series. The pore-pairs are extremely large (text-fig. 3 B), and

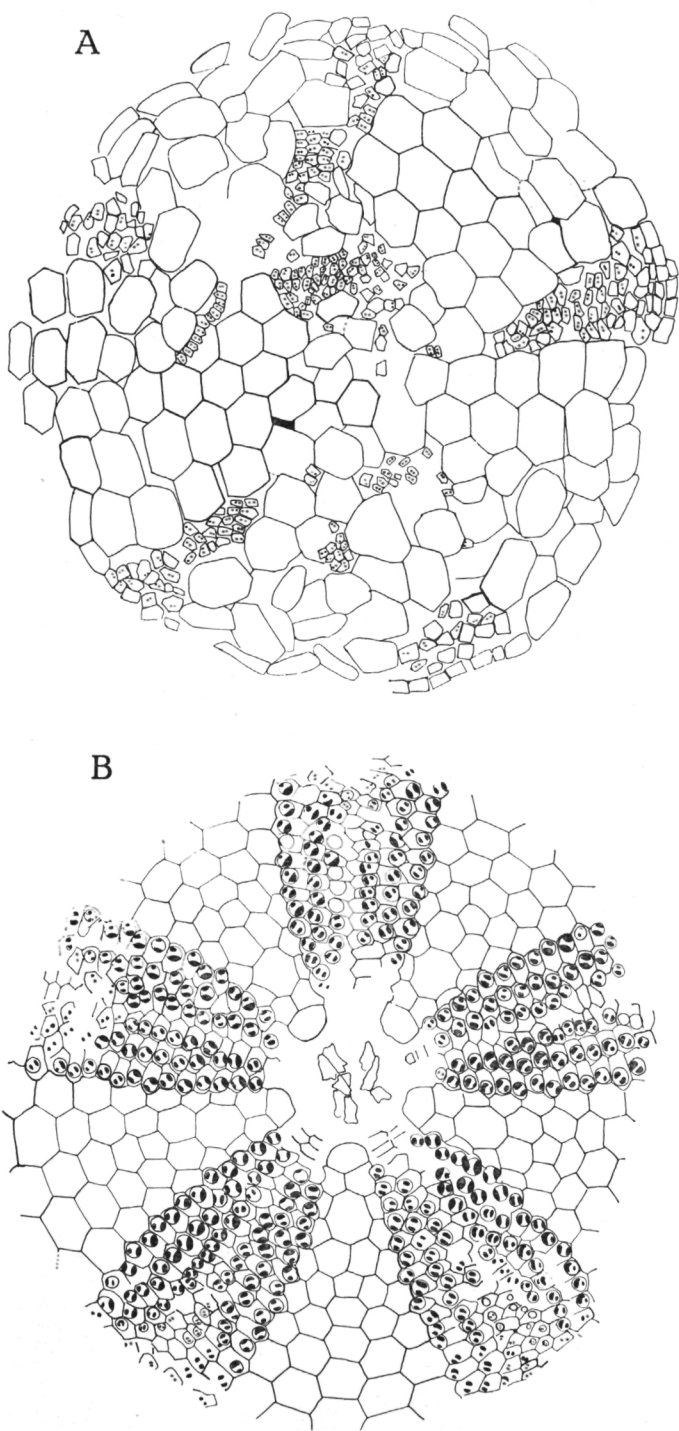


Fig. 3. — *Proterocidaris gigantea* KONINCK.
 Adapical (A) and adoral (B) view of specimen in Musée Liège from the Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium, $\times 0.7$. Photographs of specimen on pl. 3.

are oblique with the inner pore of a pair adoral to the outer pore. They are situated in large, oblique peripodia which are eccentrically located on the side of the plate away from the perradial suture. The presence or absence of tubercles on these plates is not known. All the plates imbricate adorally. In the smaller specimen (text-fig. 3 B) there are six or seven columns of plates in each ambulacrum, but in the larger (text-fig. 2) there are up to nine.

Interambulacra. — There are five columns in each area in the smaller specimens (text-figs. 3 A, 4) and twelve or thirteen in the largest (text-fig. 1). In the inner columns the plates are hexagonal; in the adambulacral columns pentagonal. The plate arrangement near the peristome is regular with a single primordial plate (text-fig. 3 B) followed by two plates, and then by three, the center plate being hexagonal or octagonal. In the smaller specimen (text-fig. 3 B) this center plate in the third row is considerably larger than any of the other interambulacral plates on the adoral surface, but in the larger specimen (text-fig. 2) it is no larger. All the plates imbricate adapically. A small perforate primary tubercle occurs on most of each of the plates.

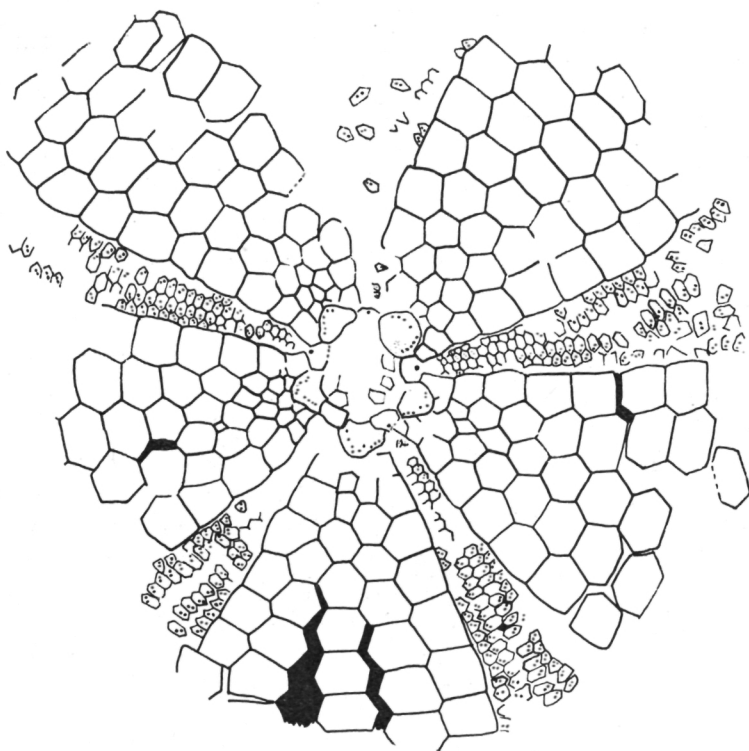


Fig. 4. — *Proterocidaris gigantea* KONINCK.

Adapical view of specimen n° 72 in Abbaye de Maredsous, from Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium, $\times 1.6$. Photograph of same specimen on pl. 4, fig. B.

Growth. — In the larger specimens the genital plates are relatively wider, the adapical ambulacra narrower, with a corresponding increase in the width of the interambulacra, and there are more columns in each ambulacrum and interambulacrum.

Discussion. — JACKSON's *Perischodomus fraiponti* is apparently a subjective synonym of *Proterocidaris gigantea*. I have cleaned and studied his paratype no. 71 (in the Abbaye de Maredsous) and although the plates are obscured by coarse silicification, there are more than two columns in each ambulacrum. JACKSON was not certain of the number but presumed two. In all its characters, this specimen corresponds to *Proterocidaris gigantea*.

JACKSON referred specimen no. 72 (in the Abbaye de Maredsous) to *Palaechinus elegans* M'COY. The cleaning of this specimen (pl. 4, fig. B; text-fig. 4) has revealed more than two columns in each ambulacrum. It agrees in all its characters with *Proterocidaris gigantea*.

Proterocidaris deneensis (JACKSON).

(Pls. 5-6; text-figs. 5-6.)

Fournierechinus deneensis JACKSON, 1929. Mém. Mus. roy. Hist. nat.

Belgique, no. 38, pp. 67-72, pl. 9, pl. 10, figs. 1-2.

Fournierechinus deneensis MORTENSEN, 1935. A Monograph of the Echinoidea, vol. 2, p. 72, fig. 44.

Material. — I have cleaned two of the three specimens known of this species. Both the adapical and adoral surfaces are exposed in specimen 142 (Abbaye de Maredsous), a well preserved specimen showing most of the test. In the other specimen (141 at the Abbaye) the test is partially silicified with the plate sutures obscured. Only the upper surface of this specimen was cleaned.

Shape. — The test is very low, similar to *Proterocidaris gigantea*. The marginal outline is lobed at the ambulacra.

Apical system. — In both the specimens studied the apical system was absent. During post-mortem flattening the lantern pushed up through the apical system, destroying it.

Ambulacra. — On the adapical surface (text-fig. 5) the ambulacra are narrower or almost as wide as the interambulacra, whereas on the adoral surface (text-fig. 6) the ambulacra cover most of the surface. Adapically the plates are small, hexagonal, with larger plates in the median columns bearing primary tubercles; none on the smaller plates. There are approximately 18 to 20 columns in each area. Adorally, there are the same number of columns but the plates are much larger with larger pores situated in well-developed peripodia, eccentrically located on the side of the plate away from the perradial suture. A primary perforated tubercle occurs on each plate. All the plates imbricate adorally.

Interambulacra. — Adapically (text-fig. 5), the interambulacra are wide with from 12-14 columns in each area. The plates of the inner columns are hexagonal; the outer pentagonal. Each bears a small perforated primary tubercle. Adorally (text-fig. 6) the interambulacra are greatly reduced with only one column in each area extending from the midlength of each adoral area to the peristome.

Lantern. — One serrated tooth is visible.

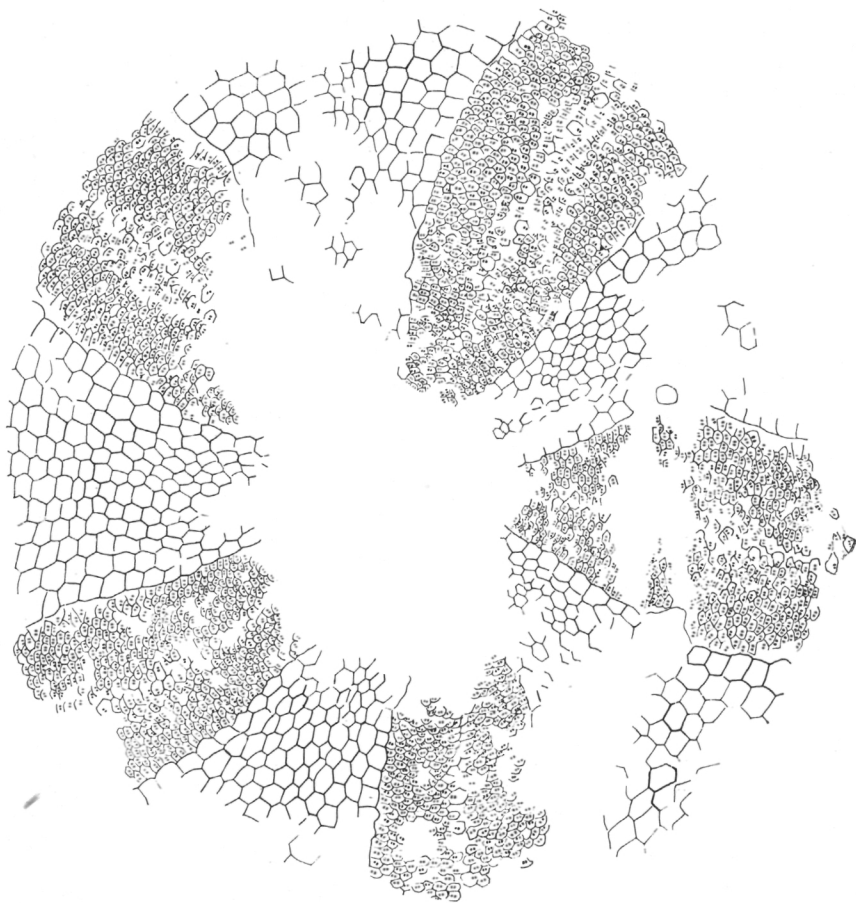


Fig. 5. — *Proterocidaris deneensis* (JACKSON).

Adapical view of specimen n° 142 in Abbaye de Maredsous, from Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium. Approximately $\times 0.25$. Photograph of same specimen on pl. 5.

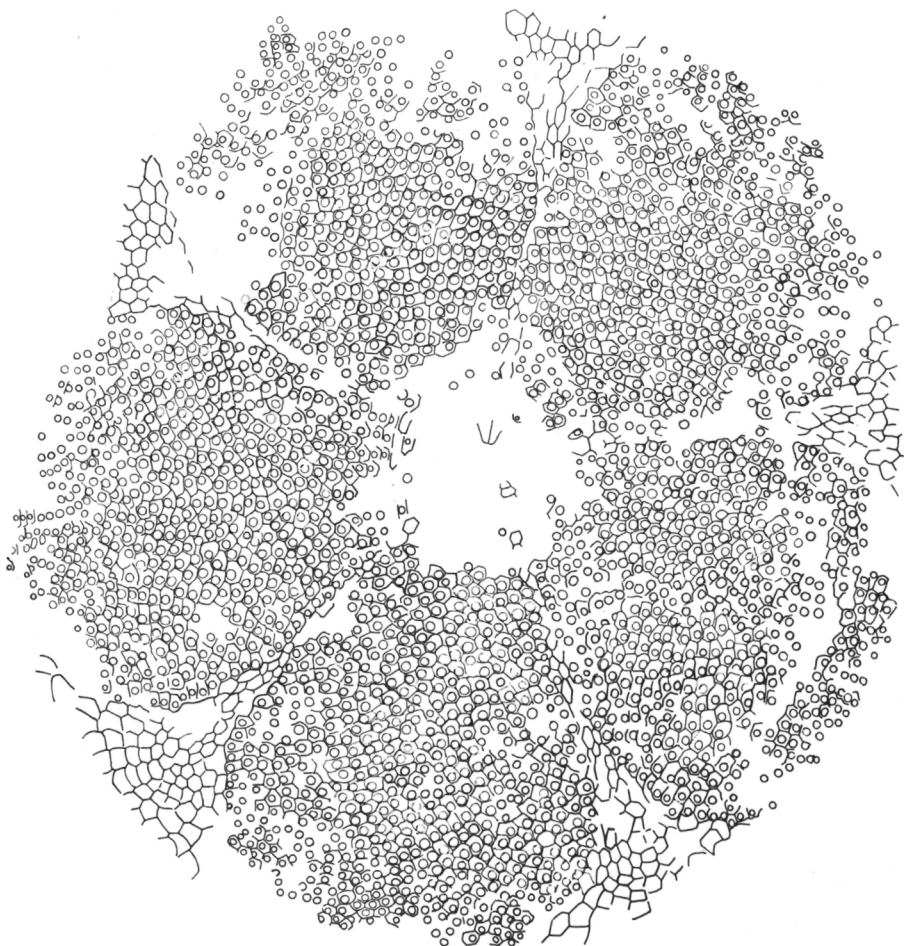


Fig. 6. — *Proterocidaris deneensis* (JACKSON).

Adoral view of same specimen in text-fig. 5. Approximately $\times 0.25$. Photograph of same specimen on pl. 6. The pores in the peripodia have not been drawn.

Lovenechinus lacazei (JULIEN).

(Pl. 4, fig. A; text-figs. 7-9.)

Palaeochinus lacazei JULIEN, 1896. Le terrain carbonifère Marin de la France centrale. Paris, p. 28, pl. 16, figs. 3-5.

Palaeochinus lacazei FRAIPONT, 1904, Mém. Soc. Géol. Belg. Liège, vol. 2, pt. 1, p. 9, pl. 1, fig. 8, pl. 2, figs. 1-5 (not fig. 6).

Palaeochinus sp. FRAIPONT, 1904. *Op. cit.*, p. 9, pl. 2, figs. 7-8.

Lovenechinus lacazei JACKSON, 1912 (including BATHER in JACKSON). Mem. Boston Soc. Nat. Hist., vol. 7, pp. 326-335, text-figs. 240-243, pl. 35, figs. 4-7, pl. 3q, figs. 1-8, pl. 38, figs. 1-3.

Lovenechinus lacazei JACKSON, 1929. Mém. Mus. roy. Hist. nat. Belg., vol. 38, pp. 40-45, pl. 3, figs. 2-4.

Remarks. — Although forty-five Belgium specimens of this species are known, the ambulacral plate structure and the apical system are not visible in any of them. Their structure is known only from British and French material. Through the kindness of Dr. UBAGHS, I was permitted to clean specimen number 11,226 in the Musée Liège, from Denée, which was figured by FRAIPONT (1904, pl. 2, fig. 8) and mentioned by JACKSON (1929, p. 43). The ambulacral structure and apical system was revealed by this cleaning.

This species has been so thoroughly described by JACKSON that no description here is warranted. The ambulacral structure and apical system are figured (text-figs. 8-9) herein. They do not differ significantly from the British specimens.

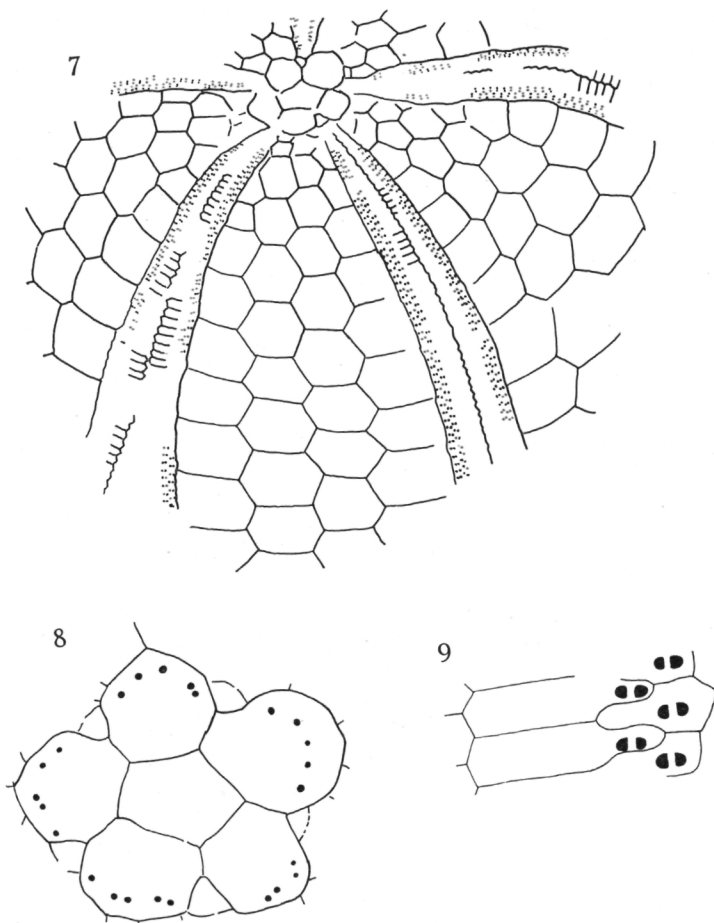


Fig. 7-9. — *Lovenechinus lacazei* (JULIEN).

7. — Adapical view of specimen n° 11,226 in Musée Liège, from Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium. $\times 1$. Photograph of specimen on pl. 4A.
8. — Adapical system of same specimen. $\times 4$.
9. — View of ambulacral plates near midzone of same specimen. $\times 5$.

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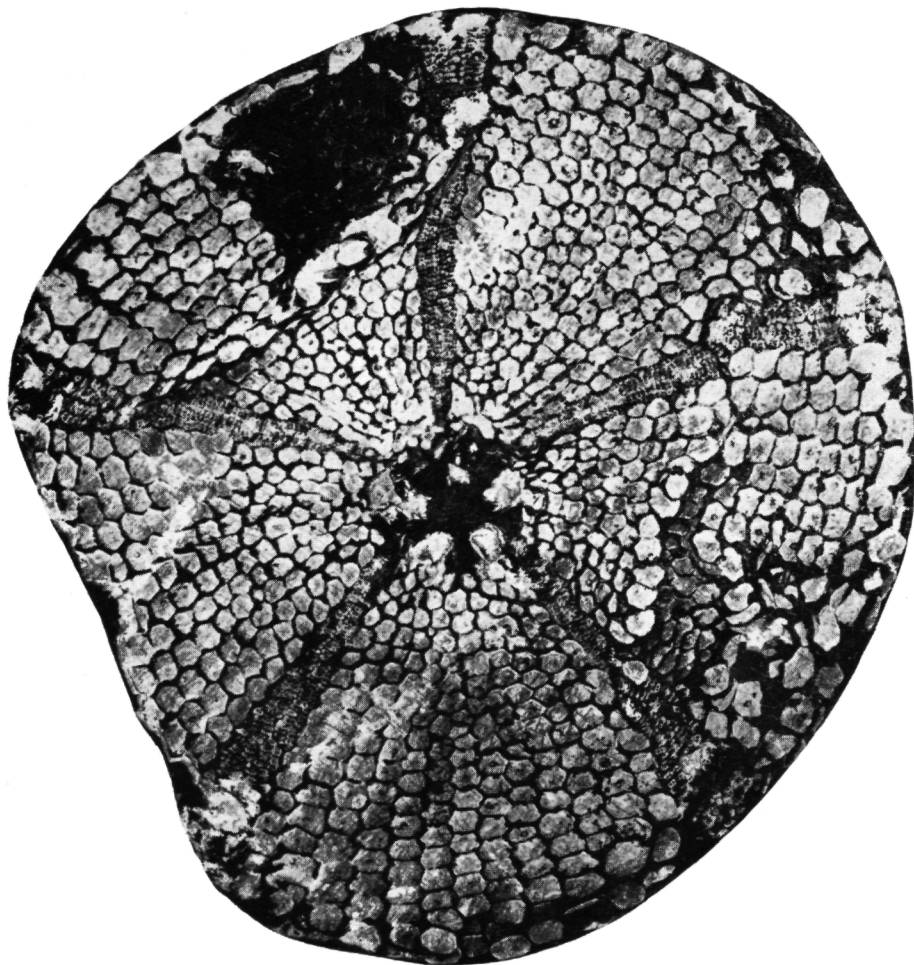
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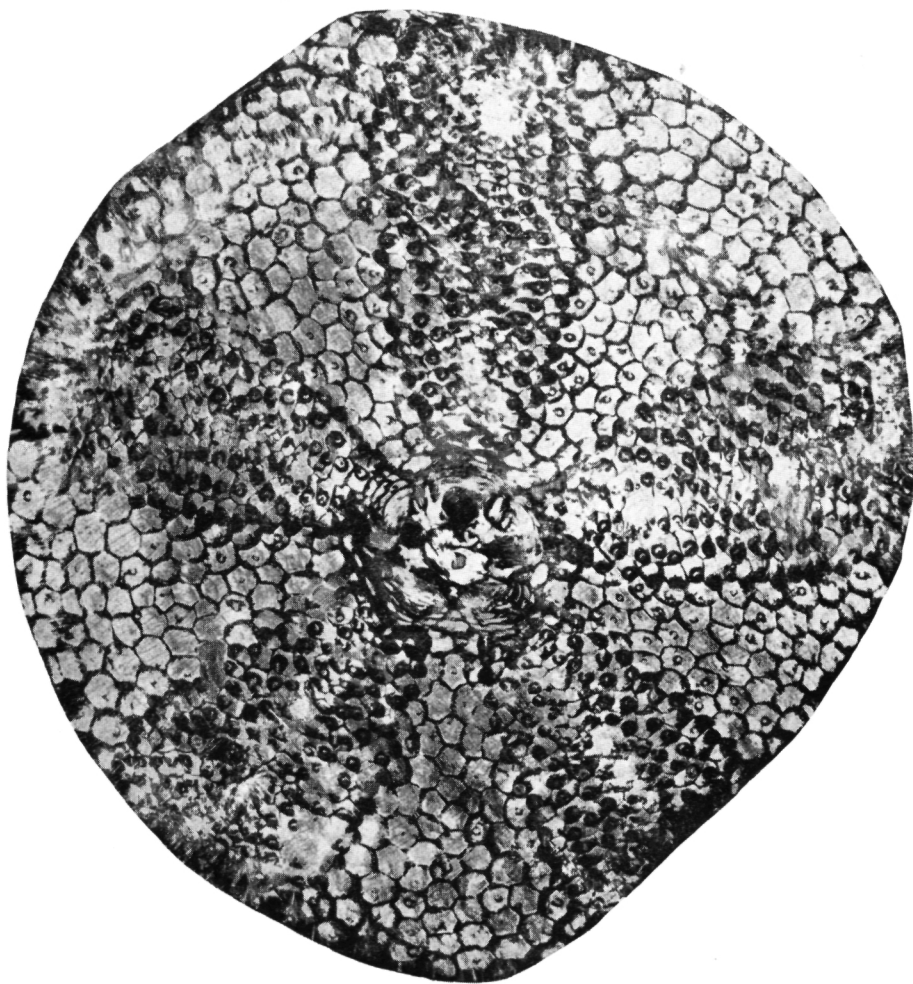
UNITED STATES NATIONAL MUSEUM, SMITHSONIAN INSTITUTION.
ASSOCIATE CURATOR, DIVISION OF INVERTEBRATE
PALEONTOLOGY AND PALEOBOTANY.



Proterocidaris gigantea KONINCK.

Adapical view of specimen n° 3330 in the Museum of Comparative Zoology, Harvard from the Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium. Photographed under glycerine. $\times 0.57$. Drawing of plate arrangement on text-fig. 1; photograph of adoral surface of same specimen on pl. 2.

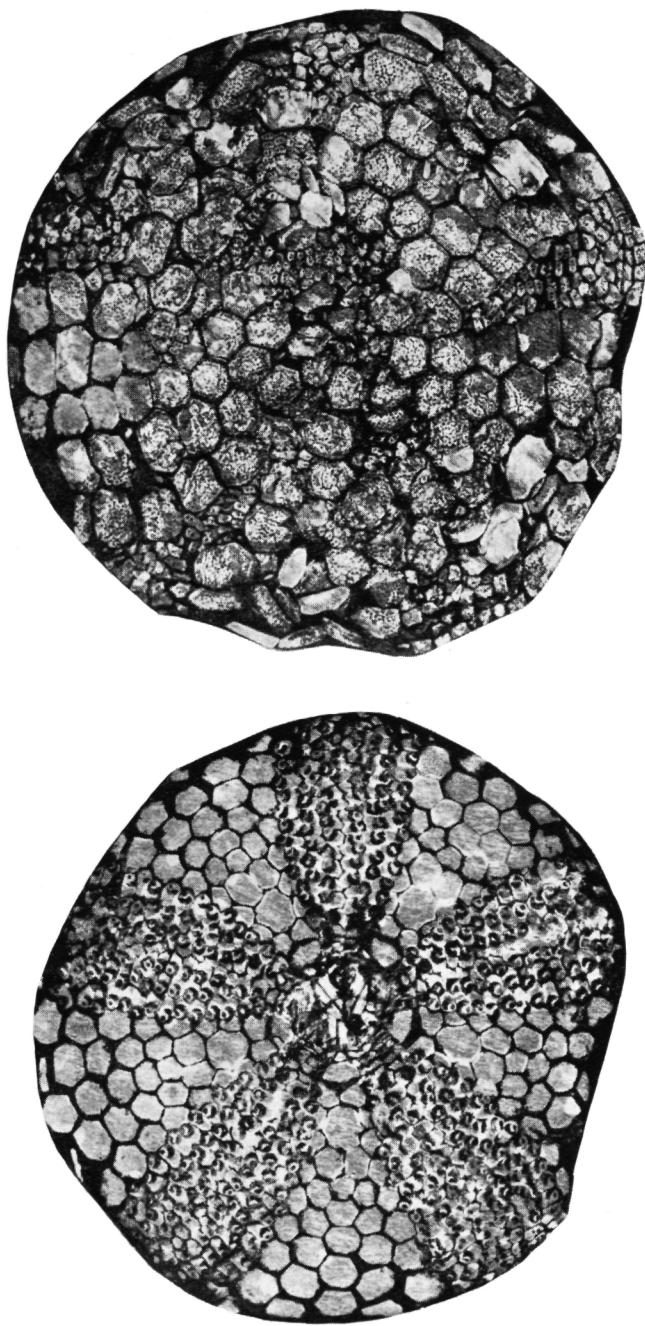
P. M. KIER. — Redescription
of Some Lower Carboniferous Echinoids from Belgium.



Proterocidaris gigantea KONINCK.

Adoral view of same specimen in pl. 1; photographed under glycerine. $\times 0.57$. Drawing of plate arrangement on text-fig. 2. Marginal area of specimen not exposed.

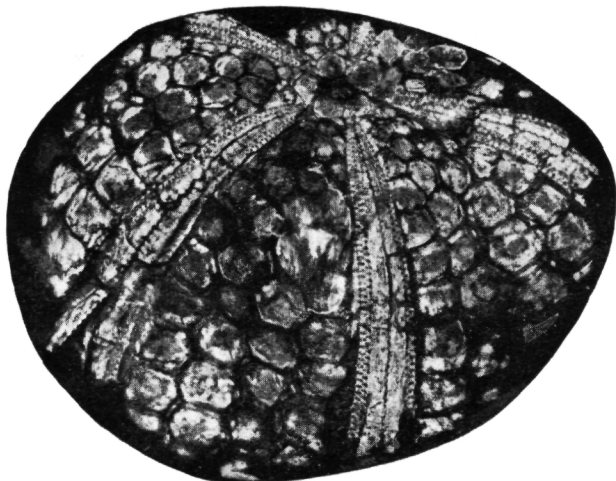
P. M. KIER. — Redescription
of Some Lower Carboniferous Echinoids from Belgium.



Proterocidaris gigantea KONINCK.

Adapical (A) and adoral (B) view of specimen in Musée Liège from the Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium. Photographed under glycerine. $\times 0.5$. Drawing of plate arrangement on text-fig. 3A. 3B.

P. M. KIER. — Redescription
of Some Lower Carboniferous Echinoids from Belgium.



A. *Lovenechinus lacazei* (JULIEN).

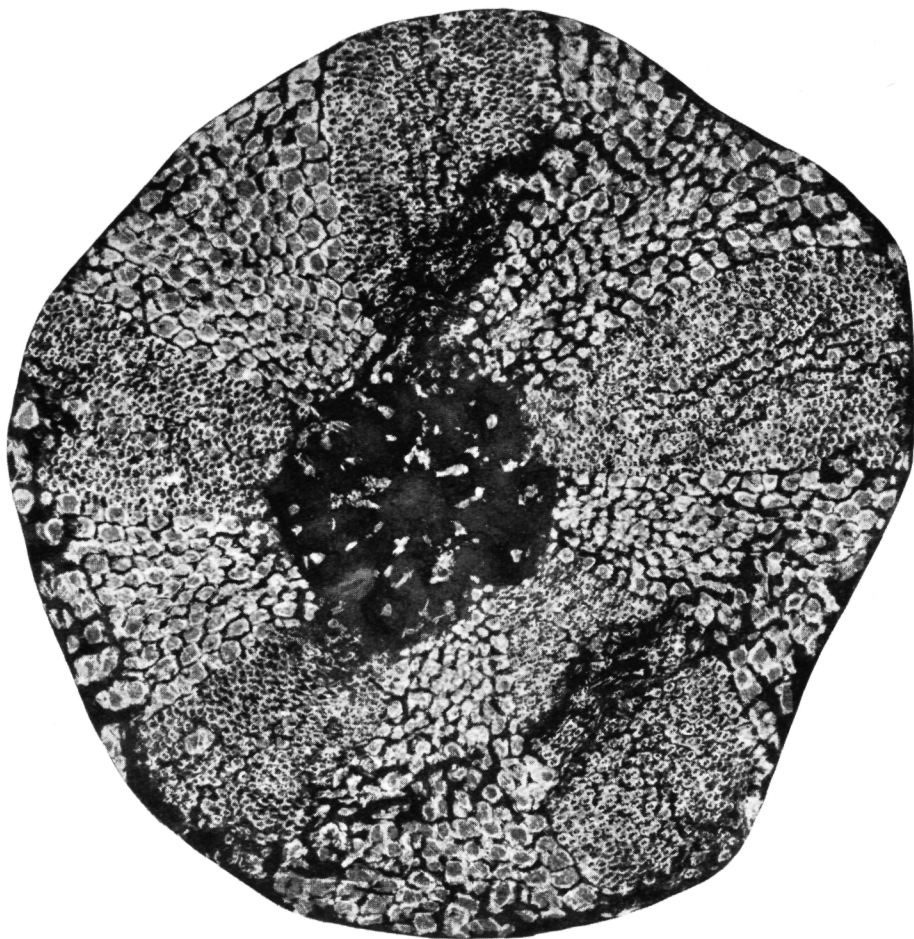
Adapical view of specimen n° 11,226 in Musée Liège, from Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium. Photographed under glycerine. $\times 1$. Drawings of plate arrangement on text-fig. 7-9. Photograph of specimen before cleaning in FRAIPONT (1904, pl. 2, fig. 8.)



B. *Proterocidaris gigantea* KONINCK.

Adapical view of specimen n° 72 in Abbaye de Maredsous, from Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium. Photographed under glycerine. $\times 1.3$. Drawing of plate arrangement on text-fig. 4. Photograph of specimen before cleaning in JACKSON (1912, pl. 2, fig. 17).

P. M. KIER. — Redescription
of Some Lower Carboniferous Echinoids from Belgium.



Proterocidaris deneensis (JACKSON).

Adapical view of specimen n° 142 in Abbaye de Maredsous, from Lower Carboniferous, Marbre noir de Dinant, Denée, Belgium. Photographed under glycerine. Approximately $\times 0.25$. Drawing of plate arrangement in text-fig. 5. Photograph of adoral surface on pl. 6.

P. M. KIER. — Redescription
of Some Lower Carboniferous Echinoids from Belgium.



Proterocidaris deneensis (JACKSON).

Adoral view of same specimen as in pl. 5. Photographed under glycerine $\times 0.25$. Drawing of plate arrangement on text-fig. 6. Photograph of specimen before cleaning in JACKSON (1929, pl. 10, fig. 2).

P. M. KIER. — Redescription
of Some Lower Carboniferous Echinoids from Belgium.

