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A Preliminary Study of Echinoderms with the Aid of a Scanning Electron Microscope

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A microcrinoid *(Passalocrinus)*, camerate crinoid *(Dichocrinus)* and small blastoid *(Diploblastus)* are examined at high magnification and reveal latticework endoskeletal plates with slightly varied patterns of voids and interlocking rods. Cirrals from the base of a modern comatulid are illustrated for comparison.

INDEX DESCRIPTORS: Echinoderms; Endoskeleton; Latticework Structure; Mississippian; Mahaska County, Iowa; Pella Formation; *Passalocrinus; Dichocrinus; Diploblastus;* Modern Comatulid.

A preliminary study of minute and small echinoderms with the aid of a S4 Cambridge Stereoscan (scanning electron microscope), located in the Zoology Department, The University of Iowa, Iowa City, was made possible by a grant of $150 from the Geological Society of Iowa in 1973. Specimens were plated with a thin carbon coating overlain by gold. The original intention was to study microcrinoids from the McCraney Limestone, Kinderhookian Stage, Mississippian of Franklin County, Iowa. Unfortunately, the surfaces of the specimens were obscured by an overlay of microcrystals. Specimens from the Pella Formation, Meramecan Stage, Mississippian Age, of Mahaska County, Iowa were much better subjects for viewing and are considered herein. A microcrinoid, *Passalocrinus* sp., a camerate crinoid, *Dichocrinus* sp., and a blastoid, *Diploblastus* sp., are illustrated.

A portion of dried cirrals from a comatulid is included (Figure 1: *1-3*) to demonstrate porosity of a modern crinoid. The latticework pattern is known to differ in different parts of a comatulid.

No effort is made toward specific identification of the specimens because the taxonomy is being studied elsewhere.

The Echinoderm Endoskeleton

The endoskeleton, so termed because of a thin, film-like tissue known to cover the skeleton of living echinoderms, is composed of numerous ossicles; each ossicle appears to be an optically continuous crystal, but is in fact very porous. Skeletal elements appear very early in the ontogeny of comatulids during the *doliolaria* larval stage as a single spicule of calcium carbonate inside a mesenchyme cell (Hyman, 1955, p. 80). Each spicule begins to branch and other mesenchyme cells gather around in the formation of more branches. Eventually three-dimensional plates are produced in this fashion. The body or visceral mass of a crinoid (whether recent or ancient) is encased in a calyx, or theca, which is also true of the extinct blastoids. Crinoids expand their plates (ossicles) by both lateral and external secretion of latticework-like interlocking rods, whereas plates of blastoids are reported to grow only by lateral secretion. Observations made herein do not fully support this view, as there appears to be some increase in the thickness of the plates of blastoids in ontogeny, though perhaps not as pronounced or as rapid as in crinoids. If there were no outward extension of plate thickening in blastoids, there would only be a single series of interconnecting rods which is obviously not so in the blastoid *Diploblastus* sp., as exhibited by Figure 2: *2*. As a matter of fact the illustrations show there is little fundamental difference between the surfaces of *Diploblastus* sp. (Figure 2: *1, 2*) and *Dichocrinus* sp. (Figure 2: *3, 4*) other than the pronounced lateral growth lines exhibited by *Diploblastus*. The plates of most crinoids do tend to be thicker than those of most blastoids and therefore must have more numerous overlying series of latticework-like skeletal elements than blastoids, but the difference is not as pronounced as one would be led to believe. For example, many *Pentremites* develop a special "overlay" on the basals which is so pronounced that it could almost be, and on occasion has been considered as, another set of plates.

A comprehensive study of stereomic microstructure of blastoids made with the aid of an SEM has been recently presented by Macurda (1973).

Latticework Surfaces

The cirral of the modern crinoid is slightly less than three-fourths solid, with deep voids between the stereom (Figure 1: *3*). *Diploblastus* sp. has such an irregular surface, with series of highs marking the growth lines, that any measurements of voids is superficial; however, very deep apertures (voids) are readily apparent (Figure 2: *2*). The rods of *Dichocrinus* sp. occupy about two-thirds of the surface and one-third is void. There is some collapsing or closing of the apertures deep down. Rods in *Passalocrinus* sp. are more or less intertwining and have numerous projections. Voids are present but obscure and any measurements would be superficial (Figure 4:*1*). For several years the writer has thought that *Passalocrinus* might be the juvenile stage of a blastoid rather than a crinoid. As growth lines which show the dominant lateral growth ascribed to blastoid plates are not present, the affinities of *Passalocrinus* remain obscure. It is hoped that future studies will provide more information about the matter.

Literature Cited

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MACURDA, D. B., JR. 1973. The stereomic microstructure of the blastoid endoskeleton. *Univ. Mich. Contr. Museum of Paleont.,* 24 (8), p. 68-83, 8 pls.

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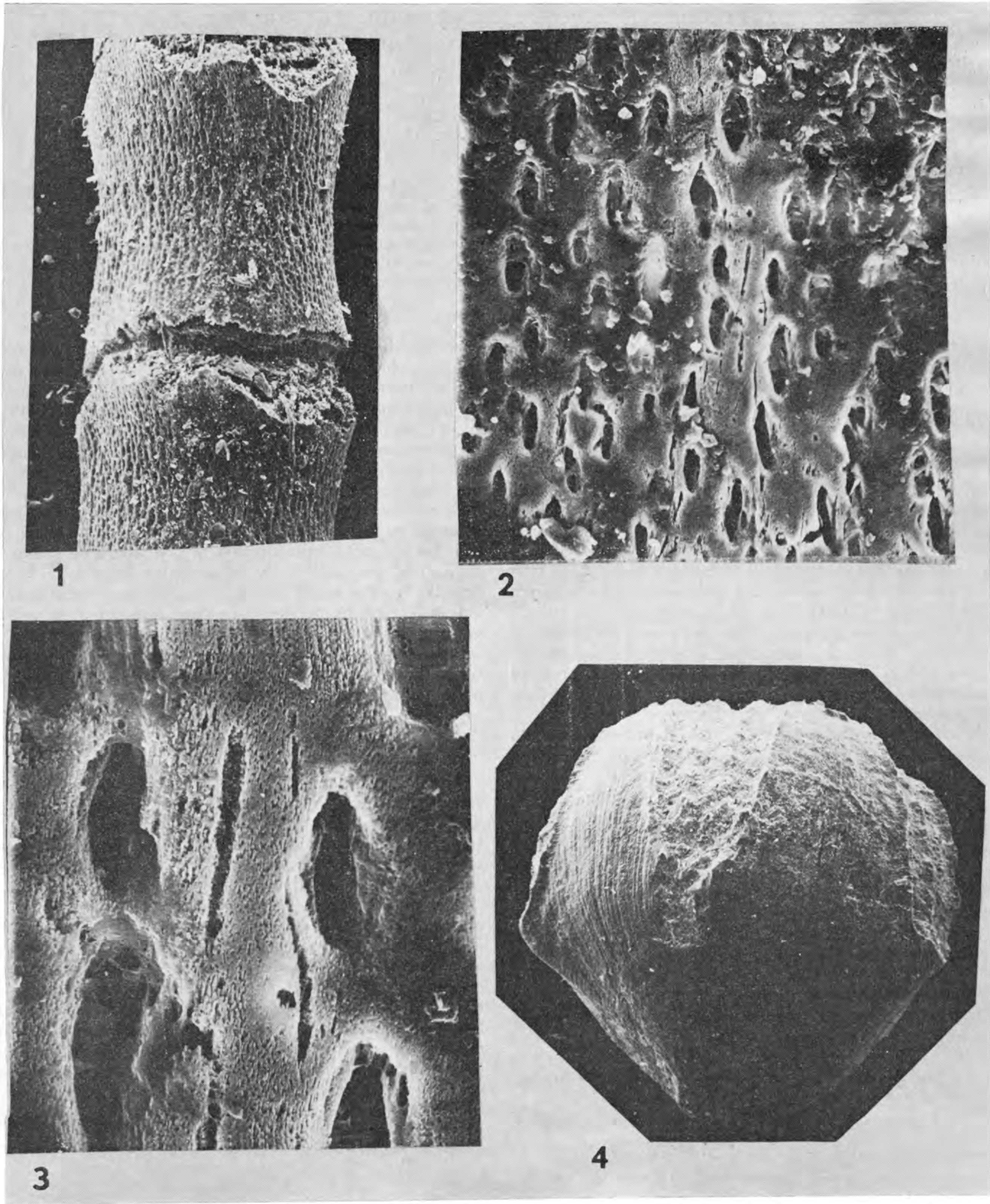


Figure 1. *1-3.* Modern comatulid crinoid cirri: *1.* Jointed pair, X53; *2.* X500; *3.* X2,000; *4. Diploblastus* sp. (a blastoid) from the Pella Formation, X33.

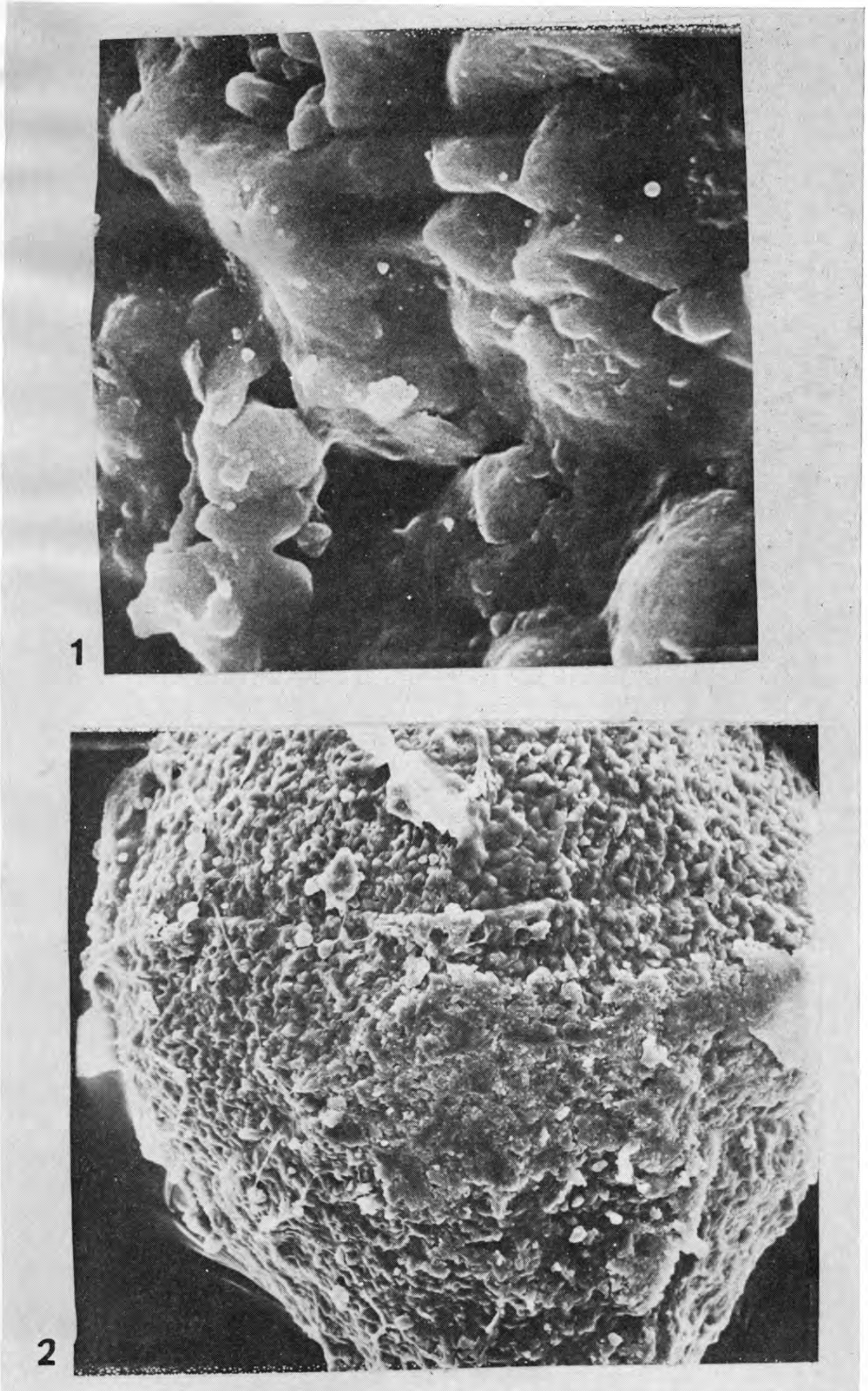
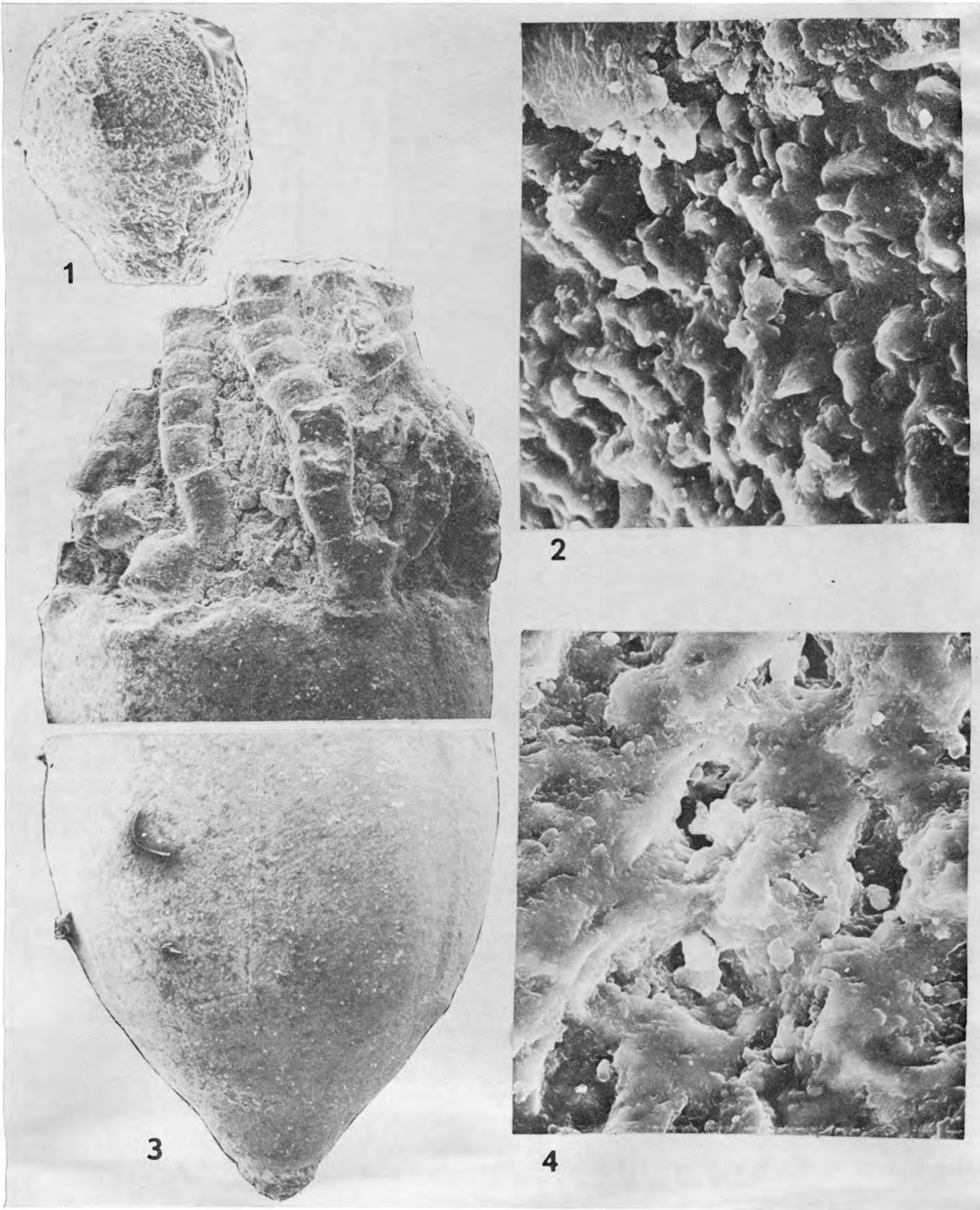


Figure 4. *1, 2. Passalocrinus* sp. from the Pella Formation:
1. Same as Figure 3: *4,* X5,200;
2. Same as Figure 3: *1,* X520.

Figure 3. *1, 2. Passalocrinus* sp. (crinoid?) from the Pella Formation: *1.* Complete theca composed of three circlets of plates (basals, radials and orals), X210; *2.* Portion of above, X2,080. *3, 4. Dichocrinus* sp. (crinoid) from the Pella Formation: *3.* Partial crown (composite photograph), posterior view, X24; *4.* Portion of radial (see Figure 2: *3, 4*), X2,350.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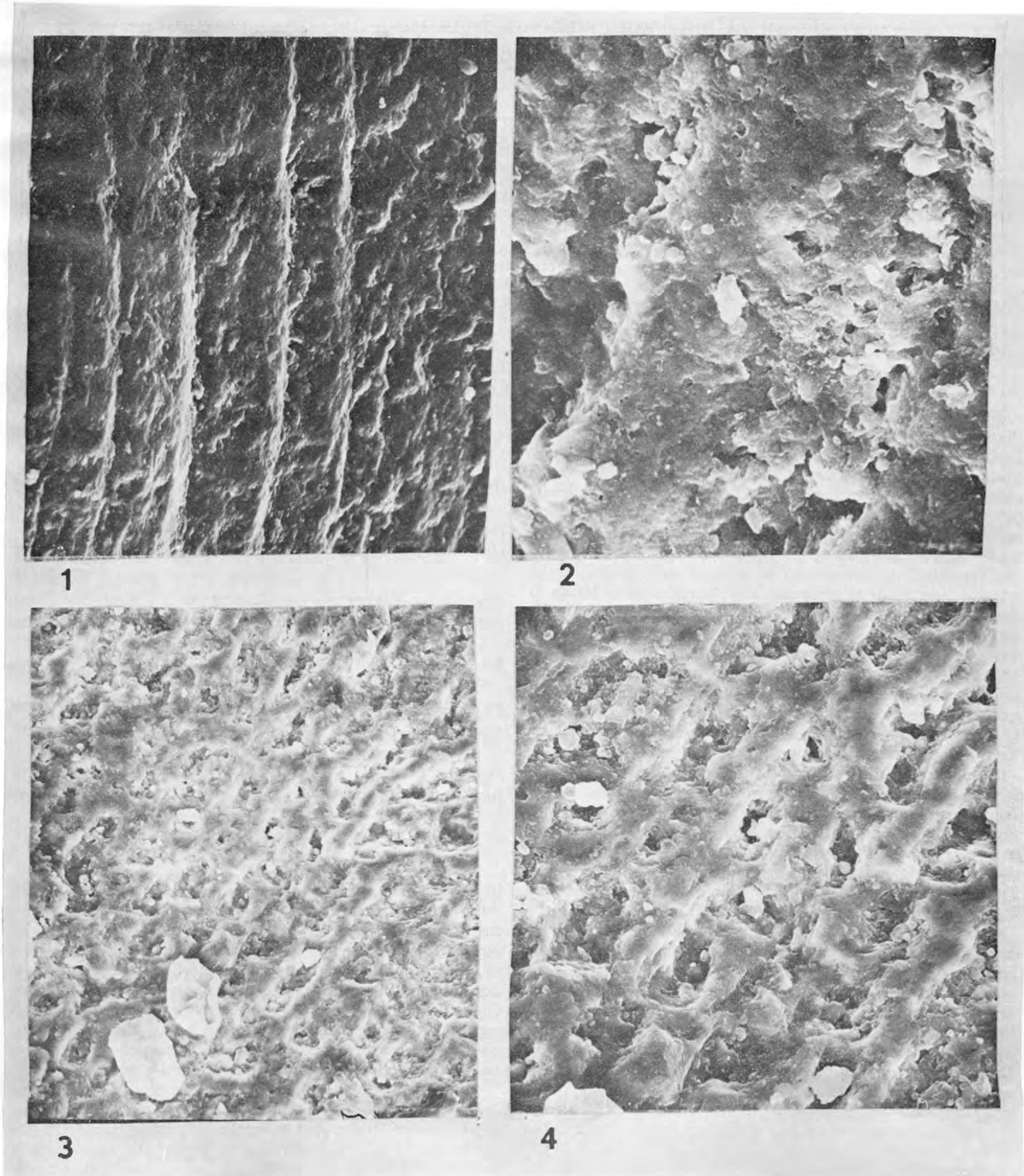

1 2 3 4

Figure 2. *1, 2. Diploblastus* sp. from the Pella Formation; *1.* Upper left portion (radial plate), (see Figure 1: *4*), X550; *2.* Same, X2,200. *3, 4. Dichocrinus* sp. (crinoid) from the Pella Formation: *3.* Portion of radial plate of partial crown (see Figure 3: 2), X590; *4.* Same, X1,190.