NEW CRINOIDS FROM LIASSIC SEDIMENTS NEARBY TIVOLI (CENTRAL ITALY); REARRANGEMENT IN THE SYSTEMATICS OF EUDESICRINIDS AND COTYLEDERMATIDS

New fossil cystocrinid crinoids, coming from liassic sediments near Tivoli (Latium, Central Italy), are described. Besides the revision of the suborder Holopodina ARENDT, 1974 is made and a new suborder for eudesicrinids is established. The family Cotyledermatidae WRIGHT, 1876 is restituted. Lastly, evolutionary patterns are discussed.

Foreword

In our Department, since the time of its establishment, 1860, some searchers studied time to time fossil echinoderms. Among others G. Ponzi and G. Serra studied echinoids and crinoids. After them A.M. Maccaognó played this role, studying mainly paleozoic echinoderms from the Sardinian deposits. We are now keeping up the tradition and therefore we are now able to dedicate a new species of fossil crinoid to her.

Introduction

Some specimens of new cystocrinid crinoids were found nearly one and a half kilometre North of Tivoli (Roma). The outcrop, from which the studied fauna comes, is located along the trail joining Casale S. Angelo and Fontana Vecchia, at 380 m a.s.l., on the western side of Colle Vecchio (Fig. 1). The geographical position of the fossil bearing outcrop (sheet 150 Roma of the 1:100,000 geological map of Italy) is in the so called "facades di transizione". This facies consists of a relatively narrow belt of sediments showing widespread shelf type sediments resedimented into slope type limy-cherty thin bedded sediments. It lies in between the outcrops of the more strictly typical sediments of the Umbro-Marchean sequence and those of the Latium-Abruzzi sequence. In that belt olistostromal deposits, slumpings and resedimented material are widespread. They are the evidences of resedimentation of material coming from the upper slope; we ascribe the original position of the collected crinoids to that environment. The fossil bearing beds consist in fact of a small deposit, due to the outcropping of a slumped mass in a well bedded sequence of liassic mudstones. Both the mudstones and the marly-pebbly slump mass constituents have to be ascribed to the Corniola Fm. in its typical facies because of the lithological characters.

The fossil bearing layers contain a large number of taxa. The association on the whole is composed by perfectly preserved brachiopods, more or less poorly preserved mollusks (bivalvs, gastropods, ammonites, belemnites) and echinoderms (stereloids, crinoids, echinoids); foraminifers and spongias are also present. The more important group is represented by the brachiopods collected by hundreds. Ammonites let us able to ascribe the outcrop to the lower part of Upper Lias (probably the Serpeninus Zone). The crinoid assemblage is characterized by several isocrinid columnals and several cups and columnals of cystocrinids. Some new species from this material are here described.

Systematics

The suborder Holopodina ARENDT, 1974
(sensu Rasmussen, 1978) requests emendation to enclose our new findings. The unique character common to all the species of this suborder, was the presence of a dorsal element; but because we think that more groups of different orders can develop this same structure, we prefer to dismember this suborder, to erect a new suborder for the eudesocrinids and to validate again in the old family name for cotyledematids.

Subclassis Articulata Zittel, 1879  
Order Cyrtocrinida Sieverts-Doreck, 1952  
Suborder Eudesocrinina n. subor.

Diagnosis. Generally oblique cup without stem but with dorsal element. No basals. Radials, thick and unequal in size, five or four. Large and wide radial facets sloping inward. No interradial projections. Brachials stout.

Remarks. We prefer to raise the eudesocrinids to suborder level. In fact this group has characters very well defined that differentiate it from all other groups. The main character is the presence of one radial larger and wider than others. We prefer to take away the cotyledematids from the eudesocrinids; in fact, the eudesocrinids have thick walls, not too wide ventral cavity, radial facets wide and large and one radial larger, while cotyledematids have thin walls, very wide ventral cavity, radial facets very thin and radials equal in size.

Family Eudesocrinidae Bather, 1899 emend.  
Type genus: Eudesocrinus Loril 1882-84

Diagnosis. Cup, generally oblique, with five or four radials unequal in size. Radials separated from each other by distinct sutures. Ventral cavity not too wide and deep. Radial facets, generally sloping inward, wide and large, one of which larger. Ligament fossa rather large with ligament pit; interarticular ligament fossae apparently large, with a central axial canal; muscle fossae small. No stem but dorsal element, connected by close synostosis and attached by an expanded basis to substrate. Three genus: Eudesocrinus Loril, 1882-84, Bicleocrinus Manni & Nicosia, 1988 and Dinardocrinus n. gen.

Remarks. The family is emended because we have taken out the cotyledematids. It is interesting to note that the radial facets are of two types: one with very wide ligament pit and small muscle fossae (related with the largest facet), the other type with small and outwards sloping ligament pit and wide muscle fossae (related to all other facets). Probably it stands for a different functionality of the arms of the small facets in respect to those of the largest facet. In fact we think that the arms of the small facets were able to be very active as testified by the wide muscle fossae and by the high angle between theaboral and adoral surfaces; on the contrary, being the largest facet subhorizontal and with reduced muscles, its arm had probably less capacity of movement.

FIG. 1 — Location map of the outcrop.  
— Localizzazione dell'affioramento.

FIG. 2 — Schematic drawing of the views of the eudesocrinid cups: a) frontal view; b) posterior view; c) lateral view; d) ventral view; e) dorsal view.  
— Disegno schematico delle norme delle teche degli eudesocrinidi: a) norma frontale; b) norma posteriore; c) norma laterale; d) norma ventrale; e) norma dorsale.
Genus *Eudesicrinus* LORIOL, 1882-1884  
Type species: *E. mayalis* (DESLONGCHAMPS) 1858  
*Eudesicrinus curtii* n. sp.  
(Fig. 3-4-5)

**Description.** Cup large, oblique, barrel shaped, low and wide. The external surface is covered with grains. These grains are unequal in size: some are minute, others are large. The radials, without interradial projections, are delimited by distinct sutures and are different in size: the posterior radial is the largest, two lateral RR oblong and oblique, two frontal RR, the lowest and the smallest. The ventral cavity, circular and not too wide, is shallow. Its walls are characterized by narrow radial farrows and interradial sutures. The radial facets, subhorizontal, are wide, large and unequal in size. The larger one is characterized by an aboral articulation, outwards sloping, and a larger aboral one, inwards sloping, separated by an evident fulcrum ridge. The articulation elements of aboral surface are: one wide semilunate ligament fossa with an evident ligament pit; the elements of the aboral surface are: two subrectangular interarticular ligament fossae with a central axial canal and two small muscular fossae. The other radial facets, smaller, have a small and very outwards sloping ligament fossa with a small ligament pit, a not too wide rectangular interarticular ligament fossae, with a central axial canal, and two larger muscle fossae. Between the aboral fossa and adoral one there is a sharp fulcrum ridge. An adoral groove separates the left fossae from the right ones. A fulcrum ridge divides the adoral surface from the aboral one. The lower part of the cup shows a not too evident circular hollow. The dorsal side is large and wide with a wide and not too deep basal cavity. Its walls, smooth, with only radial sutures.

**Remarks.** This species for the general characters is similar only to *Eudesicrinus mayalis* and *Eugenticrinus mayalis* figured by LORIOL (1882-84) in Pl. 8 and Pl. 29 Fig. 5. In fact, morphologically these species are similar (same type of radial facets, same type of ornamentation, same general feature) but they differ from ours in the general and relative sizes: *Eud. mayalis* is smaller and with ventral cavity larger, *Eug. mayalis* is more oblong.

The presence of a continuous circular hollow in the lower part of the cup allow us to believe that there is an unknown dorsal element of attachment. Probably, the ventral cavity continued into the dorsal one.

**Holotype:** NS 6/359  
**Paratype:** NS 6/264  
**Material:** two specimens moderately well preserved.

**Derivatio nominis:** in honour of Mr. E. CURTI for the kind help given in the search of the material.

Genus *Dinardocrinus* n. gen.  
Type species: *D. tiburtinus* n. sp.

**Diagnosis.** Generally oblong cups characteri-
zied by unequal in size radials, one of which very large. Some radials are very reduced in size. It is possible to divide the cup in two parts: the “spoon like element” (the upper part) and the “stem like element” (the lower part) (for the mean of these terms see, Zitt, 1983, p. 70). The spoon part is sloping. The stem part is generally oblong and it is determined by a variable number of radials. Ventral cavity small and not too deep. The dorsal side characterized by a deep circular cavity.

Remarks. This genus for the main characters is an eudesicrinid: radial facets of eudesicrinid type, presence of a dorsal element and sloping cup; but its main character is very clear and unique. Up today only one genus is known with the “stem like element” constituted by the radials: *Torynocrinus* Seeley, 1866. This genus, of the hemicrinid group, has the cup divided in two parts; the “spoon like element” and the “stem like element”; this last part is constituted by radials. Also our genus has the same characteristics, but it differs from *Torynocrinus* because of the ventral cavity very reduced and the different kind of radial facets (type eudesicrinids). Besides its sutures among the radials are generally evident. Also the other genus of the hemicrinid group (*Hemicrinus* Orbigny, 1850) has the stem element but it is constituted by probably fused columnals (Zitt, 1983). Then, it is possible to think that *Torynocrinus* and *Dinardocrinus* n. gen. have developed a similar adaptative strategy. Because of the morphology of the dorsal side, we think that this genus was characterized by an unknown dorsal element of fixation to the substrate.

*Derivatio nominis:* in honour of Mr. R. Di Nardo, that kindly placed his collection at our disposal.

**Dinardocrinus tiburtinus** n. sp.  
*(Fig. 6-7)*

*Description.* Cup with five radials, not too wide, extremely high, cylindrical, oblique in upper part. The external surface is smooth, without ornamentation. The “spoon like element” is characterized by five radials different in shape and size: the posterior one, triangular shaped, is small, oblong and rileved; two frontal ones, rectangular shaped, are smallest and lowest; two lateral ones are very long, narrow and with the upper edge oblique. The “stem like element” is characterized by two radials and each touches the other one below three other radials. The sutures among the radials are not always well evident; those of the “stem part” are placed in the frontal and posterior side.
The ventral cavity is small and not too deep. The radial facets are wide, subhorizontal and heterometric. The hind one is the widest and it is characterized by an aboral surface, outwards sloping, and an adoral surface, a little inwards sloping. The adoral surface is largest than aboral one. A fulcral ridge not well evident separates these two articular surfaces. The articular elements of aboral surface are: a ligament fossa, semilunate and wide, with a deep ligament pit; the elements of the adoral surface are: two interarticular ligament fossae rectangular in shape and not too wide, with the axial canal, and two small subhorizontal muscle fossae. The other radial facets, smaller, have a small and very outwardly sloping ligament fossa with a small ligament pit, a not too wide rectangular interarticular ligament fossae, with a central axial canal, and two larger muscle fossae. Between the aboral fossa and adoral one there is a sharp fulcral ridge. A ventral radial groove separates the left fossae from the right ones. The dorsal side, a little tape-
red, is characterized by a dorsal cavity, narrow and deep.

Remarks. The characters of the specimens of this species are constant: in fact the main characters (shape of the RR and radial facets, slope of the "spoon like element") seem be constant.

This species differs from the other "spoonlike" crinoids species and from all the other crinoids up today known because of the particular morphology of the radial. In fact, the shape and the sizes of the radials and the type of "stem like element" are peculiar of this species. The unique crinoids so high are some of the hemicrinid group: Hemicrinus hersites (JAEKEL) 1891, Tyrannocrinus variabilis (ARENDT) 1974 and T. canon seeley, 1866. But all these species have different types of radial facets and ventral cavity wider. Besides this species differs from D. maccagnoi n. sp. in the different shape and dimension of the radials.

Holotype: NS 6/272
Paratype: NS 6/298

Material: five specimens moderately well preserved (NS 6/299-300, 325). Besides, we have studied many other specimens of the Mr. DI NARDO's collection.

Derivatio nominis: tiburtinus from Tibur, latin name of Tivoli, small town near Roma.

Dinardocrinus maccagnoi n. sp.
(Fig. 8-9)

Description. Cup high and oblique in the upper part. No interradial projections. The external surface is smooth. The radials are heterometric: the posterior radial is the highest; the frontal ones, triangular in shape, are the smallest (one of which generally is smaller than the other one). Two lateral radials are different in size since one is smaller because of the presence at its lower part of two very small additional plates. The ventral cavity is small and deep; its walls are crossed by radial grooves and by sutures. The radial facet of the largest radial is wide and large, and it is characterized by a wide half-moon and sloping outward aboral surface and by a wider subhorizontal adoral one. The aboral surface has a wide ligament fossa with a small and deep ligament pit. The adoral surface has two subrectangular interarticular ligament fossae, with a central axial canal, and two smaller muscle fossae. A radial groove divides the left fossae from the right ones. The other radial facets, smaller, have a small and very outwardly sloping ligament fossa with a small ligament pit, a not too
wide rectangular interarticular ligament fossae, with a central axial canal, and two larger muscle fossae. Between the aboral fossa and adoral one there is a sharp fulcral ridge. The dorsal side, circular and not too wide, is characterized by a wide and deep subcircular cavity.

**Remarks.** This species differs from *D. tiburcatus* n. sp. and from all the others species up to day known in the shape and sizes of the radials. *Torinocrinus cristatus* Lüt, 1983 is a little similar to this because of the stem part developed in height and with well evident sutures, but it differs in all the other characters (size of the radials, type of the radial facets and width of the ventral cavity).

For the moment, we prefer not to consider as diagnostic character the presence of those two additional plates in its lower part, because we have only one specimen with these plates. Besides we do not know what are these plates (anal plates or vestigial basals?). However, it is important to underline that these plates, with very clear outline, do not rise from the breakage of the adjacent radials. The specimen labelled NS 6/360 is very small and with the stem part not developed (probably a juvenile specimen); the only difference that we are able to note is that the two frontal radials are placed on the opposite side in respect to the holotype.

**Holotype:** NS 6/326
**Paratype:** NS 6/360
**Material:** only two specimens well preserved

**Derivatio nominis:** in honour of prof. A.M. Maccagno, to whom this paper is dedicated.

**Suborder** HOLOPODINA ARENDT, 1974 emend.

**Diagnosis.** Cups with thin "radials and dorsal element connected by close synostosis or completely fused without trace of sutures, and attached directly to substrate by slightly expaned base". Some species have also basals. "Arms divided at IBrBr 1 or 2. Some arms may be reduced or obliterared". Three families: **Holopodidae** BATTIER, 1899, **Hemibrachioinidae ARENDT, 1968** and **Cotyledermatidae WRIGHT, 1876** emend.

**Remarks.** We emend the suborder for including our new species characterized by basals. Besides we have taken out the eudesicrinids (see above).

The presence of some species with basal ring is very important from the phylogenetic point of view, because it shows that the representatives of the family evolved from an ancestor with the basals.

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**Fig. 9 — Dinardocrinus maccagnoi** n. gen., n. sp.
Reconstruction of a cup: a) right lateral view; b) frontal view; c) left lateral view; d) ventral view; e) dorsal view (× 3).

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**Fig. 8 — Dinardocrinus maccagnoi** n. gen., n. sp. (NS 6/326, holotype). Cup: a) frontal view; b) posterior view; c) lateral view; d) ventral view; e) dorsal view (× 2.1).

— Dinardocrinus maccagnoi n. gen., n. sp. (NS 6/326, olo-
tipo). Teca: a) norma frontale; b) norma posteriore; c) norma laterale; d) norma ventrale; e) norma dorsale (× 2.1).
Family Cotyledermitaeae Wright, 1876 emend.
[nom. correct. Rasmussen, 1978
(pro Cotyledermitae Wright, 1876)]

Diagnosis. Low cup, thin walled, with or without basal circle. Wide and large radial cavity, continued into the dorsal element. Dorsal element low or high, connected by close synostosis or completely fused and attached by expanded basis to substrate. Radial facets very thin. Ligament fossa with ligament pit very small; interarticual ligament fossae small; muscle fossae very small. Two genera: Cotylederma Quenstedt, 1852 and Paracotylederma n. gen.

Remarks. We validate again the family Cotyledermitae because of its characters very different from those of the true eudesicrinids. Besides, because the new findings have basals plates, it is necessary to emend this family for placing those in it.

Genus Cotylederma Quenstedt, 1852
(type species: C. lineati Quenstedt, 1852)

Cotylederma ambiguum n. sp.
(Fig. 10-11-12)

Description. Relatively large cup with five low and thin RR. Sutures among RR generally evident. The outline is pentagonal to circular. The RR are placed above a high and conical dorsal element of adhesion to substrate.

Each radial is asymmetrical. Such an asymmetry is due to one side lower than the other side; it determines articular facets sloping laterally and besides "false" interradial projections. It covers to the upper edge of the cup a characteristic serrate shape. To the extremity of the ventral side, each radial expands and on the whole these expansions determine the round outline of the ventral cavity.

The radial facets are very thin. The aboral side of each facet is very narrow and characteri-ized by a small half-moon ligament fossa in which there is the ligament pit. The aboral side is a little larger and is characterized by two flat, oblong and narrow interarticual ligament fossae, and by two very small muscle fossae separated from the adoral groove. The axial canal is between the interarticual ligament fossae. The fulcral ridge, that separates the aboral side from the adoral one, is long, straight and sharp and without crenulae. The ventral cavity, wide, large, and not too deep, continues into dorsal element. Externally this element presents evident concentric growth lines. The proximal part, where the cup is articulated to the dorsal element and it is evident only when the cup is disarticulated from this element, is smooth, sloping inwards and a little wavy. The distal part of the dorsal element, that attaches to substrate, unknown.

Remarks. Characteristic of the dorsal element is to show clear concentric growth lines. This element sometimes is similar to that of Cyathidium depressum Sieverts, 1931 as figured by Rasmussen (1961) in pl. 34, Fig. 4a-b, other times to that of Cy. vleksii Jagt, 1986 (see Fig. 1, pag. 217). Its outline, and consequently the cup one, is variable in form, circular to pentagonal. It is interesting to note that, being the dorsal element empty, generally high and communicating with the ventral cavity, on the whole the ventral cavity is very deep. Sometimes there are more dorsal elements inside each other; it means that the larvae of this species might utilize a dorsal element of a probably dead specimen, as substrate.

Our species is very similar to specimens of Cyathidium Steenstrup, 1847 in the type of dorsal element, in the dimensions, in the general shape of the cup but it differs in the RR not fused, in the fulcral ridge without crenulae and in the shape of the ventral side of the RR. In the type of radial facets and in the presence of sutures it is similar to Cotylederma, but it differs

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Fig. 10 — Cotylederma ambiguum n. sp. (NS 6/327, holotype). Cup: a) frontal view; b) lateral view; c) posterior view; d) ventral view (× 2.1).

— Cotylederma ambiguum n. sp. (NS 6/327, olotipo). Teca: a) norma frontale; b) norma laterale; c) norma posteriore; d) norma ventrale (× 2.1).
from the other species of this genus in the general dimensions and in the type of dorsal element. However we think that this species has to be ascribed to the genus Cotylederma for the radial facets of cotylederid type.

Holotype: NS 6/327
Paratypes: NS 6/361-362

Material: Material: three cups moderately well preserved and some dorsal elements.

Derivatio nominis: from latin ambiguus = ambiguous, because the species shows some characters of Cyathidium and some others of Cotylederma.

**Paracotylederma** n. gen.
(type species: *P. gracile* n. sp.)

Diagnosis. Oblique crinoids with RR and BB. No stem. Wide and deep ventral cavity. RR and BB walls thin; radial facets very thin type Cotylederma. Upper edge of the cup with serrate shape.

**Remarks.** This genus for the main characters (type of radial facets, presence of a dorsal element) is very similar to Cotylederma but it differs in the presence of BB. This presence is very interesting from a phylogenetic point of view: in fact, we believe that this genus is an ancestor of Cotylederma, or, at least, it has some intermediate or relict characteristics of that ancestor. In fact, for loss of the BB, it can form a classic cotylederid. The serrate shape of the upper edge of the cup is similar to that of Cotylederma ambiguum n. sp. but with opposite slope.

**Paracotylederma gracile** n. sp.
(Fig. 13-14)

Description. Not too wide and bell-shaped cup with partially fused RR and BB. The sutures among plates of a same ring are only little evident while those among RR and BB are not clear. The outline is pentagonal. The ventral cavity is wide, circular and deep and continued into the dorsal element. The external surface, covered with grains that determine a characteristic drawing, is a little lobate. The RR, thin and without interradial projections, are externally convex and a little asymmetrical. In fact, looking externally the radials, it is evident that the right side is higher than the left one. It, on the whole, conforms to the upper edge of the cup a clear serr-
ate shape. The ventral side of each radial is characterized by two lateral expansions that determine on the whole the round outline of the ventral cavity. The radial facets, very thin, have a very small aboral side and a larger adoral side. On the aboral side a very small ligament fossa and a ligament pit are evident. On the adoral side two subrectangular interarticular ligament fossae, with an axial canal, and two very small and circular muscle fossae are evident, they are separated by an adoral groove. A sharp, straight and long fulcrum ridge separates the aboral side from the adoral one.

In the dorsal side there is a wide and circular opening. The edge of this opening is flat and horizontal. The sutures among the BB are well evident.

Remarks. We have only one specimen moderately well preserved, but not entire. The main characters are evident; only the inside of the ventral cavity is not well known because this cavity in our specimen is partially filled by sediment. This species, because of particular morphology of dorsal side, seems to be without stem but with an unknown dorsal element. The radial facets are of the same type of those of Cotylederma. This species differs from P. mattei n. sp. essentially in the size, smaller, and in the external ornamentation. No other species up today known has the same characters.

Holotype: NS 6/313.

Material: only one specimen moderately well preserved.

Derivatio nominis: from latin gracilis = frail because of its minute dimensions.

Paracotylederma mattei n. sp.
(Fig. 15-16)

Description. Large and oblique cone shaped cup, pentagonal in outline, with radial and basal ring. No interradial projections. The sutures among the plates are little evident. The external surface, covered with grains, is lobate. The basals, with the same height of the radials, are pentagonal and little convex. Each radial, convex externally, is characterized by the left side lower than the right one. Then, on the whole, the upper edge of the cup is serratate-shaped. The radial facets, thin and oblong, have a minute aboral surface and a larger adoral surface. The aboral surface is characterized by a very narrow ligament fossa with a central ligament pit. The adoral surface, is characterized by a central axial canal and by two interarticular ligament fossae (narrow and subrectangular) and two very small circular muscle fossae. Between the left and right ones, there is clear adoral groove. A fulcrum ridge, sharp and long, divides the adoral surface from the aboral one. The dorsal side, wide and circular, is characterized by a concave edge and by a wide, circular and central opening. This opening is wide and subcircular.

Remarks. This species differs from P. gracile n. sp., in the size of the cup (larger) and in the different external ornamentation. Besides, the basal ring is more evident also if the sutures between the radial ring and basal one are little clear. Probably these plates are fused. Our specimen is broken but fortunately, the main characters are preserved. Only the inner of the cavity is unknown because it is filled by sediment. This cavity, wide and deep, probably communicates directly with the ventral cavity. The dorsal con-
cave edge is related probably with an unknown dorsal element.

**Holotype:** NS 6/328

**Material:** only one broken specimen.

**Derivatio nominis:** in honour of Mr. M. MATTEI that showed us the fossil-bearing outcrop.

All the here described crinoids are stored into the Museo di Paleontologia, Dipartimento di Scienze della Terra, Università “La Sapienza”, Roma, with collection number NS 6/... Besides we have compared our specimens with those of the personal collection of Mr. R. Di Nardo (Tivoli, Roma).

**Systematical conclusions**

The new material shows, from the purely systematical point of view, at least two important characteristics: 1) the presence of forms with the cup formed by RR and BB and others, closely re- lated to the first ones, made simply by RR; 2) the existence of forms of different phylogenetical origin closely resembling each other inside the order. The first point seems very important, for the future arrangement of the systematics of this group, showing that sharp artificial limits, as presence or absence of some characters, have to be considered cautiously for a systematics that takes in consideration mainly phylogenetic relationships. For what concerns the second point, it witnesses how important phenomena of convergence can be for the cyrtocrinids on the whole; we believe probable that nearly all the main groups of cyrtocrinids (perhaps with the exception of the phyllocrinids) give rise to their own bent forms, in response to particular environmental conditions. The same can occur concerning the origin of “spoon-like” forms, the development of interradial projections or the reduction of the stem.

At first sight is evident that in the current systematics a lot of bent forms were put together only on the basis of morphological and not genetic characters. For the above we believe that morphologies and functions of the bent forms are the result of convergence starting from truly different genetic groups. We know also that forms with morphologies like these were present, time to time, all along the Jurassic and lower Cretaceous. In fact bent forms are present among eudesicrinids, holopids, sclerocrinids, eugeniacrinids and hemicrinids. This seems to show only the persistence for a long time of a particular environment and not close phylogenetic relationships among these forms. If this is true, as we believe, it means that many forms will be take off from the groups to which they are ascribed in the current systematics and that this last might be deeply changed. A first step in this way is represented, for the moment, by the changes in the systematics of the major taxa in which the new findings are enclosed. After the new findings and the new interpretation of old knowledge the suborder Holopodina is emen-
ded; besides the family Eudesiciriniidae is traslated to suborder level and consequently the new suborder Eudesicrinina is established and the family Cotyledermatidae is revalidated. Thus the order Cyrtocrinida, according to our opinion, is now arranged as follows:

order Cyrtocrinida Sieverts-Doreck, 1952  
suborder Cyrtocrinina Sieverts-Doreck, 1952  
  » Holopodina Arendt, 1974 emend.  
  » Hyocrinina Rasmussen, 1978 (after Klikushin, 1987)  
  » Eudesicrinina n. suborder

Conclusions

Apart from the changes in systematics the new material suggest some tought concerning the evolution of cyrtocrinids that, together with previous knowledge, could be valid for the Articulata on the whole. In particular it suggests for the cyrtocrinids two different evolutionary patterns. It seems in fact that the lineages probably originated rapidly (by punctuation?) but were gradually evolving.

Concerning the first topic we see that after many years a new lot of work were recently published about the liassic crinoid faunas (DeLUGu & NICOSIA, 1987; Klikushin, 1987; MANNI & NICOSIA, 1990). The new works changed decidedly the knowledges about liassic crinoids, their total amount and the relationsships among pre-liassic, liassic and post-liassic crinoids (see also Castellana, MANNI & NICOSIA, 1989) and now we have a more clear picture of the evolutionary reports among cyrtocrinids. The cyrtocrinids rise in the Lias and do not show relationships with the triassic forms. The next younger group of cyrtocrinids is the Aalenian-Bajocian one (ARENDT, 1974; MANNI & NICOSIA, 1985; Castellana, MANNI & NICOSIA, 1989). This group of taxa is constituted by a lot of forms pertaining only to the families Phyllocrinidae JAEKEL, 1907 (Phyllocrinus OR-BIGNY, 1850), Eugeniocrinidae ROEMER, 1855 (Eugeniocrinites MILLER, 1981; Fischericrinus Castellana, MANNI & NICOSIA, 1989; Lorcherinus JAEKEL, 1907) and Psalidocrinidae ZITT, 1978 (Crataegoricinus MANNI & NICOSIA, 1985). None of them shows clear relationships with the forms pertaining to the Holopodina Arendt, 1974 typical of the Late Sinemurian - Early Toarcian. No relationships are evident in respect to liassic fottis, neither to known forms (QUENSTEDT, 1856-58; MORIERE, 1880; LORIOI 1882-84; DeLUGU & NICOSIA, 1987; Klikushin, 1987; MANNI & NICOSIA, 1990) nor to a lot of unpublished material (MANNI & NICOSIA in prep.). On the contrary clear rela-

otions tie this stock to the remaining Middle-Late Jurassic and Early Cretaceous genera. The lack of any relationships shows that in the Late Triassic and in the Aalenian-Torcan times were nearly complete faunal turnovers; the only exception to be considered being the Holopodus-Cyathidium lineage (scattered Late Jurassic, Upper Cretaceous, Upper Tertiary and Recent findings). Also the Eudesicrinus lineage continues in the Upper Jurassic if we consider valid the very doubtful point of Eudesicrinus sp. in the Tithonian of Rogoznik (PISER & DZIK, 1979). The same seems to occur in other orders for the Trias-Lias transition where we can consider the Hadocrinus-Neoadocrinus lineage (Anisian to Sinemurian). According to these data the cyrtocrinids seem to show a clear subdivision in two sub-units: the liassic one and the Aalenian-Valanginian one. In their inside each of these groups shows some persistent or/and gradually changing characteristics, but before their origin and in between there are sharp breaks. The origin of each group could correspond to a punctuation phenomenon. The recognized presence of visible BB in the new genus Paracotylederma, strictly related to Cotylederma, and the presence of Cotylederma ambiguun n. sp., that closely resembles Cyathidium also if does not show fused RR, seem to show that many species and genera were the result of a continue gradual transiction between forms with basals, forms with a five-plates cup and other in which the RR are reduced or fused. A gradual change seems also to be clear in the general reduction in the complexity of the nervous system in the cyrtocrinids. The same gradualistic change is shown in the reduction of the stem passing from the stemmed forms to the forms fixed by dorsal element (see ZITR, 1983). The same process seems to be able to explain the development of high interradial projections as shown by some forms transicional between Eugeniocrinites and Phyllocrinus (Ph. collott group) (on this topic see also MANNI & NICOSIA, 1987); in this case the process is accompanied (or controled) by the reduction in width of the radial facets. The same kind of gradualism is suggested for Hadocrinids [LEFELD, 1958 on Hadocrinus; MANNI & NICOSIA, 1990 on Neoadocrinus]. For the isocrinids, SIMMS (1988) suggests “intermittent anagenesis” with patterns that could correspond to ours.

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RIASSUNTO

Vengono descritte sei nuove specie di crinoidi cirtocrinidi raccolti in sedimenti lissaci presso Tivoli (Roma). Nell’ambito dell’ordine Crtocrinida viene revisionato il sottordine Holopodina ARENDT, 1974 e istituito un nuovo sottordine per gli eudesicrinidi. Nel sottordine Holopodina viene riconosciuta la famiglia Cotyledermatidae WRIGHT, 1876 per i co-
tiledermatidi. Viene infine ipotizzato un modello evolutivo per i cirtocrinidi che prevede, per ogni «lineage», origine rapida, forse dovute a fenomeni di puntauzione, seguite da una più classica evoluzione graduale.

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