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KOMUNIKAT

Encrinus cf. *liliiformis* LAMARCK, 1801, THE YOUNGEST CRINOID FROM THE POLISH MUSCHELKALK (MIDDLE TRIASSIC)

Encrinus cf. *liliiformis* Lamarck, 1801, najmłodszy liliowiec z polskiego wapienia muszlowego (środkowy trias)

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Abstract: The paper reports first undoubted occurrence of crinoid species *Encrinus* cf. *liliiformis* from the Upper Muschelkalk (Middle Triassic) of Poland. Contrary to previous records, it has been found that the species occurs only in Upper Muschelkalk sediments. On the basis of known evidence, it seems that *E.* cf. *liliiformis* migrated east to west through the reactivated East-Carpathian Gate.

Key words: Holy Cross Mountains, Silesia, Triassic, Muschelkalk, Germanic Basin, *Encrinus* cf. *liliiformi*s

Treść: Po raz pierwszy udokumentowano pewną obecność liliowca *Encrinus* cf. *liliiformis* w osadach górnego wapienia muszlowego (środkowy trias) Polski. W przeciwieństwie do poprzednich doniesień wykazano, że gatunek ten występuje jedynie w górnym wapieniu muszlowym. Szereg przesłanek świadczy o migracji *E.* cf. *liliiformi*s ze wschodu na zachód przez reaktywowaną bramę wschodniokarpacką.

Słowa kluczowe: Góry Świętokrzyskie, Śląsk, trias, wapień muszlowy, zbiornik germański, *Encrinus* cf. *liliiformis*

INTRODUCTION

The species *Encrinus* cf. *liliiformis* (the most uncommon crinoid found in Poland), characteristic of the Upper Muschelkalk, was mentioned in the Holy Cross Mountains (central Poland): Zeuschner (1868), Michalski (1884), Czarnocki (1958a, b, c), Senkowiczowa & Kotański (1979); from Silesia (southern Poland) by Noetling (1880), Leśniak (1978), Senkowiczowa (1998), Niedźwiedzki (2002) and Salamon (2002, 2003). Prior to this paper, there was a lack of convincing evidence that *E. liliiformis* occurred in Muschelkalk

sediments of northern Poland. Apart from the epicontinental basin, *E. liliiformis* is a common species in the Austroalpine province and noted by Senkowiczowa & Kotański (1979) in the Anisian – Ladinian (?) of the Tatra Mountains (southern Poland). Reports of *E. liliiformis* from the Lower and the Middle Muschelkalk, however, are doubtful. It concerns mentioned previously different encrinids species of which are hard to identify: *E. aculeatus* Meyer, *E. koeneni* Assmann (= *E. brahli* Koenen according to Salamon 2003), *E. robustus* Assmann, *E. spinosus* Michael, *Carnallicrinus carnalli* (Beyrich), *Chelocrinus* aff. *carnalli* Beyrich) or even dadocrinids (*Dadocrinus kunischi* Wachsmuth & Springer, *D. gracilis* (Buch), *D. grundeyi* Langenhan and *D*. sp. nov.), that are typical for Lower Muschelkalk (Assmann 1937, Głuchowski 1986, Głuchowski & Boczarowski 1986, Hagdorn & Głuchowski 1993, Hagdorn *et al*. 1996, Salamon 2003).

GEOLOGICAL SETTING

Encrinus cf. *liliiformis* has been documented from the Upper Muschelkalk (the upper part of the *Entolium discitis* Beds and the *Ceratites* Beds) of the most eastern part of the Holy Cross Mountains (Fig. 1) (Nietulisko – for stratigraphic column see Salamon & Boczarowski 2003; Bukowie and Jarugi; for details see Salamon 2003). The *E. discitis* Beds are c. 10 m thick and are composed of light grey or yellowish finely crystalline limestones containing numerous *E. discitis* (Schlotheim) bivalves.

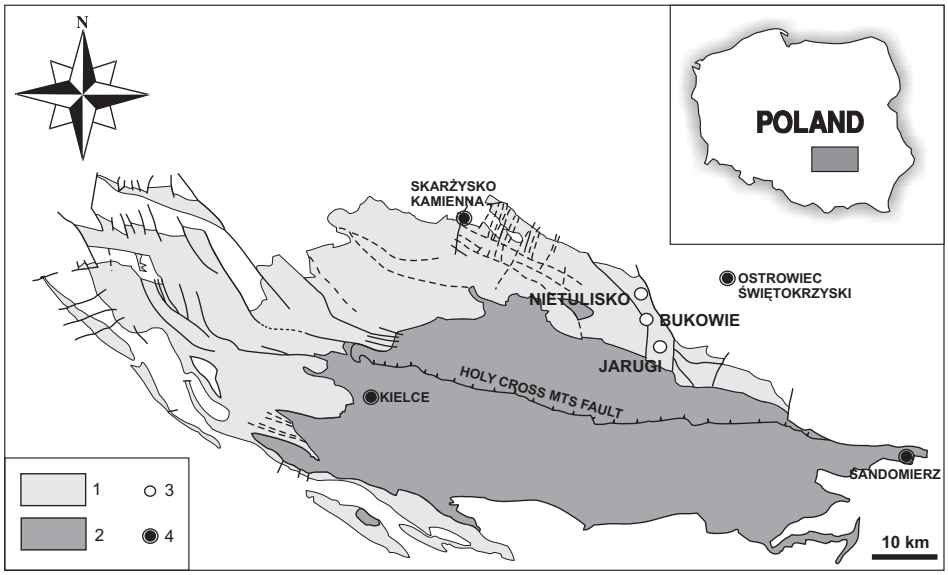

Fig. 1. Schematic geological map of the Holy Cross Mountains (after Marynowski *et al*. 2002, slightly modified): 1 – Triassic, 2 – Palaeozoic, 3 – outcrops with *Encrinus* cf. *liliiformis*, 4 – larger towns

Fig. 1. Schematyczna mapa geologiczna Gór Świętokrzyskich (za Marynowski *et al*. 2002, nieznacznie zmienione): 1 – trias, 2 – paleozoik, 3 – odsłonięcia z *Encrinus* cf. *liliiformis*, 4 – większe miasta

The Ceratities Beds do not exceed 9 m (Senkowiczowa 1970), are built of organodetritic limestone with marl layers, and glauconitic limestone containing bivalves, gastropods, brachiopods, the ammonite Ceratites, and echinoderms (Salamon & Boczarowski 2003). *Encrinus* cf. *liliiformis* has been recorded from Gołuchowice, Upper Silesia (Tarnowice Beds – Wilkowice Beds (?); Fig. 2), in the weathered part of the organodetritic limestone (Salamon *et al*. 2003). A survey undertaken in the vicinity of Izbicko, Opole Silesia (southern Poland), in a abandoned quarry consisting of yellowish, fine crystalline beds with white-grey limestone and grey micritic limestones (Tarnowice Beds; Fig. 2), showed a paucity of marine fauna (Stawarski 1972). Echinoid elements were found in the *Ceratities* Beds of the Holy Cross area (Nietulisko; Fig. 1) (Salamon & Niedźwiedzki 2003), as were ophiuroids (Salamon & Boczarowski 2003).

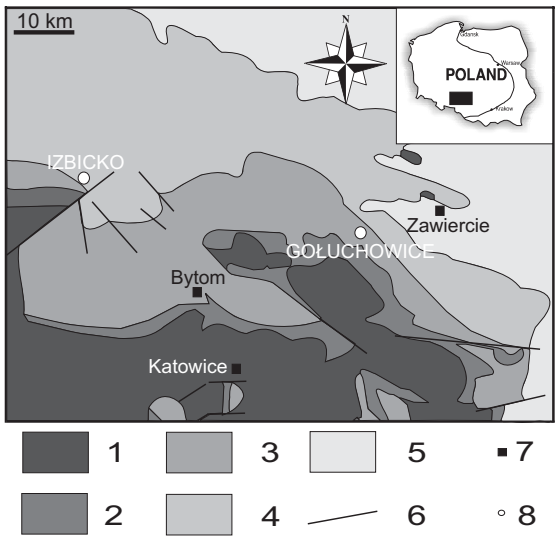

Fig. 2. Schematic geological map of Silesia (after Senkowiczowa 1973 & Salamon *et al*. 2003, compiled and modified): 1 – Palaeozoic, 2 – Buntsandstein, 3 – Muschelkalk, 4 – Keuper, 5 – Jurassic, 6 – faults, 7 – larger towns, 8 – outcrops with *Encrinus* cf. *liliiformis*

Fig. 2. Schematyczna mapa geologiczna Śląska (za Senkowiczowa 1973 & Salamon *et al*. 2003, skompilowane i zmodyfikowane): 1 – paleozoik, 2 – pstry piaskowiec, 3 – wapień muszlowy, 4 – kajper, 5 – jura, 6 – uskoki, 7 – większe miasta, 8 – odsłonięcia z *Encrinus* cf. *liliiformi*s

MATERIALS

All crinoid columnals collected were disarticulated, usually occurring as abraded, single columnals. Three rock samples contained many embedded columnals devoid of articular facets. Tertibrachials also collected were strongly abraded. Echinoid elements from the *Ceratites* Beds of the Holy Cross Mountains area (Nietulisko; Fig. 1) were represented by broken radioles (Salamon & Niedźwiedzki 2003), and an ophiuroid specimen from the same beds had distal arm portions missing (Salamon & Boczarowski 2003).

SYSTEMATIC PALEONTOLOGY

Class: Crinoidea Miller, 1821.

Infraclass: Articulata Miller, 1821.

Order: Encrinida Matsumoto, 1929.

Family: Encrinidae Dujardin & Hupe, 1862.

Encrinus Lamarck, 1801.

Type species: *Encrinus liliiformis* Lamarck, 1801.

Diagnosis: Encrinids with ten arms and pinnules that are smooth or pectinate.

Encrinus cf. *liliiformis* Lamarck, 1801 (Figs 3–4)

Material: Holy Cross Mountains: *E. discites* Beds and *Ceratites* Beds of Nietulisko (GIUS – 7 – 2225/54 a – j); *Ceratites* Beds of Bukowie (GIUS – 7 – 2225/54 m – v); *Ceratites* Beds of Jarugi (GIUS – 7 – 2225/55 l – t). Silesia: Wilkowice Beds – Tarnowice Beds (?) of Gołuchowice and Izbicko (GIUS – 7 – 2225/55 u – z).

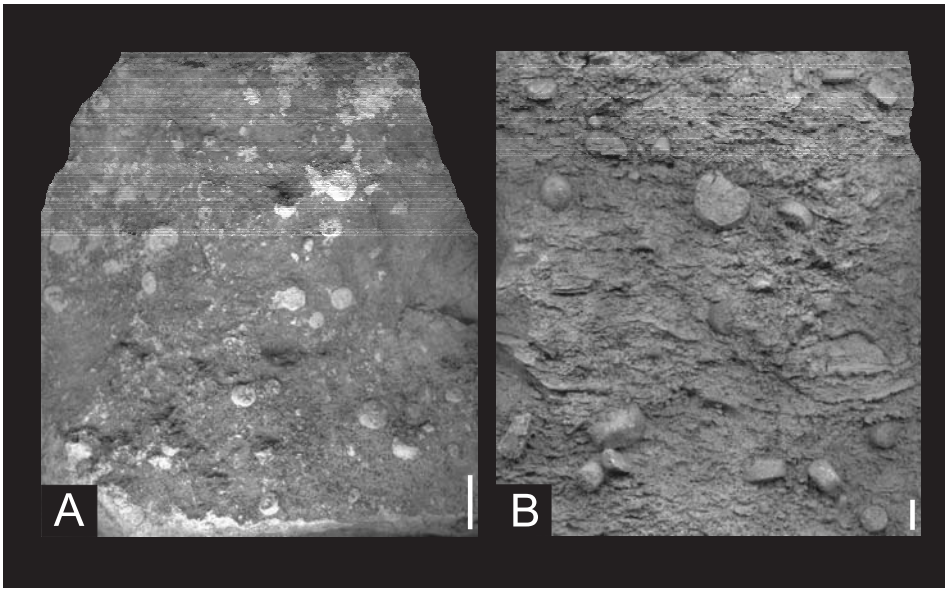

Fig. 3. *Encrinus* cf. *liliiformis* Lamarck, 1801. Upper Muschelkalk. Scale bar 10 mm: A) Rock surface with strongly abraded columnals; Gołuchowice: Upper Tarnowice Beds – Wilkowice Beds (?). GIUS – 7 – 2225/55 u1. B) Rock surface with distal columnals mainly; Bukowie: *Ceratites* Beds. GIUS – 7 – 2225/54 v

Fig. 3. *Encrinus* cf. *liliiformis* Lamarck, 1801. Górny wapień muszlowy. Skala 10 mm: A) Powierzchnia z silnie zabradowanymi kolumnaliami; Gołuchowice: warstwy tarnowickie górne – warstwy wilkowickie (?). GIUS – 7 – 2225/55 u1. B) Powierzchnia skalna z widocznymi kolumnaliami dystalnymi; Bukowie: warstwy ceratytowe. GIUS – 7 – 2225/54 v

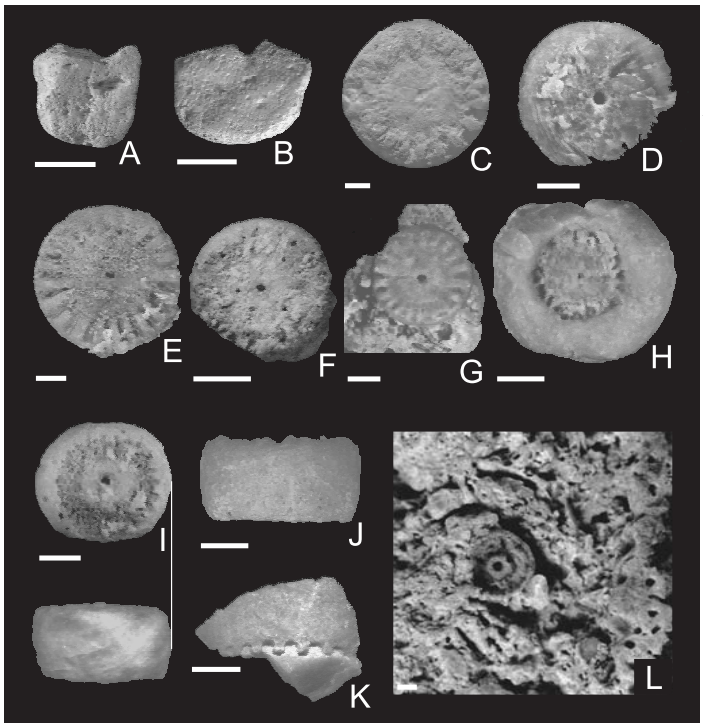

Fig. 4. *Encrinus* cf. *liliiformis* Lamarck, 1801. Upper Muschelkalk. Scale bar for A–C 1 mm, and for D – L 3 mm. A)–B) Tertibrachials (?); Gołuchowice: Upper Tarnowice Beds – Wilkowice Beds (?). GIUS – 7 – 2225/55 u2-3. C) Distal columnal; Nietulisko: *Ceratites* Beds. GIUS – 7 – 2225/54 a. D) Distal columnal; Izbicko: Upper Tarnowice Beds. GIUS – 7 – 2225/55 z1. E) Distal columnal; Izbicko: Upper Tarnowice Beds. GIUS – 7 – 2225/55 z2. F) Distal (?) columnal; Gołuchowice: Upper Tarnowice Beds – Wilkowice Beds (?). GIUS – 7 – 2225/55 u4. G) Distal columnal; Jarugi: *Ceratites* Beds. GIUS – 7 – 2225/55 r. H) Proximal columnal; Jarugi: *Ceratites* Beds. GIUS – 7 – 2225/55 s. I) Proximal and lateral view of columnal; Nietulisko: *Ceratites* Beds. GIUS – 7 – 2225/54 b. J) Lateral view of columnal; Nietulisko: *Ceratites* Beds. GIUS – 7 – 2225/54 c. K) Symplexy suture; Nietulisko: Ceratites Beds. GIUS – 7 – 2225/54 d. L) Columnal within coquina; Nietulisko: *Ceratites* Beds. GIUS – 7 – 2225/54 e. Photos A)–C) made by Philips XL30 TMP ESEM

Fig. 4. *Encrinus* cf. *liliiformis* Lamarck, 1801. Górny wapień muszlowy. Skala 1 mm dla fotografii A–C, dla D–L 3 mm. A)–B) Płytki tertibrachialne (?); Gołuchowice: warstwy tarnowickie górne – warstwy wilkowickie (?). GIUS – 7 – 2225/55 u2-3. C) Kolumnalium dystalne; Nietulisko: warstwy ceratytowe. GIUS – 7 – 2225/54 a. D) Kolumnalium dystalne; Izbicko: warstwy tarnowickie górne. GIUS – 7 – 2225/55 z1. E) Kolumnalium dystalne; Izbicko: warstwy tarnowickie górne. GIUS – 7 – 2225/55 z2. F) Kolumnalium dystalne (?); Gołuchowice: warstwy tarnowickie górne – warstwy wilkowickie (?). GIUS – 7 – 2225/55 u4. G) Kolumnalium dystalne; Jarugi: warstwy ceratytowe. GIUS – 7 – 2225/55 r. H) Kolumnalium proksymalne; Jarugi: warstwy ceratytowe. GIUS – 7 – 2225/55 s. I). Widok proksymalny i lateralny kolumnalium; Nietulisko: warstwy ceratytowe. GIUS – 7 – 2225/54 b. J) Widok lateralny kolumnalium; Nietulisko: warstwy ceratytowe. GIUS – 7 – 2225/54 c. K) Połączenie typu sympleksjalnego; Nietulisko: warstwy ceratytowe. GIUS – 7 – 2225/54 d. L) Kolumnalium w rumoszu mięczakowym; Nietulisko: warstwy ceratytowe. GIUS – 7 – 2225/54 e. Fotografie A)–C) wykonano na mikroskopie Philips XL30 TMP ESEM

Description: Circular to poorly subcircular, large columnals with diameters of 4.1–13.0 mm. Latera usually cylindrical, concave or convex. Crenulation pattern with short and thin culmina. Perilumen sometimes distinct, poorly granulated and petaloidal. Lumen wide and circular. KHi (columnal height index) < 120. Brachial plates almost as high as wide with distinct muscular facet and synostosial distal facet. Dorsal side without ornamentation or its lack as a preservational artefact. Proximal with low, usually rectangular dorsal outline; facets straight muscular and one zygosynostosial. The dorsal side of the brachial is wedge-shaped and the dorsal outline rounded.

Occurrence: Poland: Holy Cross Mountains – Illyrian – Longobardian (Upper Muschelkalk; Nietulisko, Bukowie, Jarugi), Upper Silesia – Illyrian (Upper Muschelkalk; Gołuchowice), Lower (Opole) Silesia – Illyrian (Upper Muschelkalk; Izbicko), Fore-Sudetic Monocline – Illyrian (Upper Muschelkalk). Germany: Illyrian – Longobardian – Trochitenkalk Formation – Hohenloche Formation (for details see Hagdorn 1985a; Salamon 2003). Tethys: Tatra Mountains – Anisian – Ladinian (?); Northern Alps – Anisian (for details see Linck 1965, Kristan-Tollmann & Tollmann 1967, Hess 1975).

DISCUSSION

Despite the lack of complete specimens of *E. liliiformis* in the Polish part of the Triassic epicontinental basin, and because disarticulated columnal morphology and articula are the same as that of *E. liliiformis*, it is assumed that the isolated columnals presented in this paper belong to that form. The ten-armed encrinid *Encrinus greppini* Loriol, and the twenty-armed encrinid *Chelocrinus schlotheimi* (Quenstedt) are also known from the Upper Muschelkalk of the western part of the Germanic Basin. *Encrinus greppini* is only known from a small area in southern Germany, where according to Hagdorn (1985b) it came from the southwest. Moreover, *Ch. schlotheimi*, a typical species occurring in the Upper Muschelkalk, and *Ch.* aff. *carnalli* Beyrich, a typical species occurring in sediments of the Lower Muschelkalk, appear not to have reached Poland. Both *Ch. schlotheimi* and *Ch.* aff. *carnalli* possessed cirrinodals. Neither in the literature nor during current field research have columnals with cirri scars have been recorded, and it is assumed that the genus did not reach the western part of the Germanic Basin. Hagdorn's observations (1985a) seem to confirm this opinion since (according to him) Ch. schlotheimi was common only in the central part of Germany in the late Anisian (within the *atavus* (ammonite) Zone).

Encrinus liliiformis is a marker fossil of the *liliiformis* biozone distinguished by Hagdorn & Głuchowski (1993). The zone was distinguished for the first time in Upper Silesia and is characteristic of the Upper Muschelkalk sediments (Upper Tarnowice Beds – Boruszowice Beds). However, a lack of marker fossil skeletal elements in mentioned strata meant that the *liliiformis* biozone was hypothetical. In fact, crinoid elements had been noted earlier in the Upper Muschelkalk of Silesia by Śliwiński (1964), Senkowiczowa (1973) and Kotlicki (1973), but published records were too vague to indicate clearly the occurrence of E. liliiformis in the area, and lacked detailed descriptions or illustrations of that taxa. The recent collection of *E.* sp. *liliiformis* columnals from Gołuchowice confirms their occur-

rence in the Upper Muschelkalk of Poland. The *liliiformis* biozone occurring in the Holy Cross Mountains is characteristic of sediments pertaining to the upper section of the *E. discites* Beds and the Ceratites Beds, but have been documented only in the north-eastern part of the area. Geochemical research indicates that the lowest part of the E. discites Beds in the Holy Cross Mountains was formed, like the sediments of the Middle Muschelkalk, in hypersalinary conditions (Marynowski *et al*. 2002). The first occurrence of *E*. cf. *liliiformis* from Gołuchowice was recorded as being 2.5 m above the basal section of this lithostratigraphical unit. Apart from the preceding two areas mentioned, marker fossil levels at other places where attempts have been made to apply crinoids for biostratigraphic purposes have not been documented (North-Sudetic Basin – Chrząstek 2002; Mecsek and Villany Mountains – Hagdorn *et al*. 1997), due to a lack of Upper Muschelkalk exposure. It is likely however, that skeletal elements of *E. liliiformis* also occur in other parts of the Holy Cross Mountains, and further field research may prove this. Kowalczewski (1926) mentioned large columnals of crinoids accompanying Ceratites in the western part of the area, and it is possible that the taxon observed was *E. liliiformis* (cf. Salamon 2003).

Research documented herein proves that *E*. cf. *liliiformis* existed in the Polish part of the Triassic epicontinental basin in sediments of the late Illyrian – Longobardian age (according to Trammer 1975, and Illyrian – Fassanian according to Szulc 2000), whilst in Germany it had already occurred in late Anisian (Hagdorn 1985a). The presence of *E*. cf. *liliiformis* in Poland at this time could indicate that the species colonised the eastern part of the Germanic Basin, immigrating from the west. However, Hagdorn & Głuchowski (1993) doubt this postulation, suggesting instead that immigration of the species may have occurred via the reactivated East-Carpathian Gate. Available literature also indicates that a significant part of the stenohalinic fauna that is characteristic for the Upper Muschelkalk (including crinoids), may have immigrated to Poland not through the open Western Gate (*sensu* Szulc 2000), but from the east, also through the reactivated East-Carpathian Gate. The East-Carpathian Gate immigration theory may be proved by the occurrence of Tethyan ammonites (known from Germany), which do not occur in the eastern part of the Middle-European Basin; their occurrence appears limited to the closest vicinity of the Western Gate (Niedźwiedzki & Salamon 2002). Complimentary to this, the conodont, *Paragondolella trammeri* (Kozur) and nautiloid *Pleuronautilus* sp. (Trammer 1975) have not been recorded from Germany nor from Upper Silesia, whilst they are common taxa in the Holy Cross Mountains area. Other Tethyan conodonts (e.g. *Neogeondolella cornuta* Budurov & Stefanov and *N. constricta* Mosher & Clark) appear earlier in Poland than in Germany.

Abbreviations of cited repositories: GIUS – Geological Institute of the University of Silesia, Sosnowiec, Poland.

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Streszczenie

Występowanie *Encrinus liliiformis* wzmiankowane było wielokrotnie z górnego wapienia muszlowego Polski. W obszarze świętokrzyskim (Fig. 1) dokumentowali go m.in.: Zeuschner (1868), Michalski (1884), Czarnocki (1958a, b, c), Senkowiczowa & Kotański (1979) oraz Salamon (2002, 2003). Natomiast Noetling (1880), Leśniak (1978), Senkowiczowa (1998), Niedźwiedzki (2002) i Salamon (2002, 2003) wspominali go ze Śląska (Fig. 2). Należy jednak wątpić, czy osobniki dokumentowane w osadach dolnego czy środkowego wapienia muszlowego rzeczywiście reprezentują ten gatunek. Chodzi raczej o trudne do jednoznacznej identyfikacji rodzajowej enkrynidy (*Encrinus* i/lub *Chelocrinus*) lub nawet o elementy dadokrynidów, powszechne w utworach dolnego wapienia muszlowego. Ostatnio jednak znaleziono kolumnalia o dużych średnicach w Górach Świętokrzyskich (warstwy z *Entolium discites* i ceratytowe; Fig. 3–4) oraz Śląska (warstwy tarnowickie – wilkowickie?; Fig. 3–4). Jednoznacznie dowodzi to obecności opisywanego gatunku we wschodniej części zbiornika germańskiego, tym bardziej że występowanie innych taksonów znanych z górnego wapienia muszlowego Niemiec ograniczone jest do niewielkich obszarów zachodniej części środkowotriasowego morza epikontynentalnego (*Encrinus greppini*, *Chelocrinus schlotheimi*). Również przesłanki paleogeograficzne potwierdzają występowanie *E*. cf. *liliiformis* w osadach górnego wapienia muszlowego Polski. Ponieważ jednak w niemieckiej części zbiornika germańskiego opisywana forma pojawiła się u schyłku illyru, zatem zakładając zgodnie z Szulcem (2000), że to brama zachodnia stanowiła w tym czasie główne połączenie z Tetydą, gatunek ten musiał migrować z zachodu na wschód. Z drugiej strony, już Hagdorn & Głuchowski (1993) wskazywali na możliwość migracji faun poprzez reaktywowaną bramę wschodniokarpacką, czyli ze wschodu ku zachodowi, i taki model przyjęto również obecnie. Taki kierunek napływu faun, zdają się potwierdzać i inne grupy bezkręgowców, przede wszystkim amonitowatych (porównaj: Niedźwiedzki & Salamon 2002). Ponadto, prezentowane fakty ostatecznie potwierdzają przypuszczenia Hagdorna & Głuchowskiego (1993) o możliwości istnienia biozony *liliiformis* w polskiej części zbiornika germańskiego. Już wtedy wspomnieni badacze nie wykluczali możliwości występowania *E*. *liliiformis* na Górnym Śląsku, wskazując na sprzyjające dla rozwoju liliowców warunki środowiskowe.