acta
geologica
polonica

Vol. 25, No. 3 Warszawa 1975

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On the nature of decapod burrows "*Spongia sudolica*" of Zaręczny (1878)

ABSTRACT: The specimens from transgressive Cenomanian deposits of the Cracow Upland, originally described by Zaręczny (1878) as *Spongia sudolica*, actually represent decapod crustacean burrows of the ichnospecies *Thalassinoides sudolicus* (Zaręczny, 1878). The occurrence of this ichnospecies is limited to some parts of the abrasion surface.

INTRODUCTION

At Sudół village near Cracow, Upper Jurassic limestones and marls displaying synsedimentary disturbances are truncated by the Cenomanian abrasion surface. Numerous trace fossils are confined to this surface, showing a distinct differentiation depending on the type of substrate: numerous highly diversified (pelecypod, polychaete, sponge and echinoid) borings are limited to limestones, whereas decapod crustacean burrows appear in marly deposits (*cf.* Głazek, Marcinowski & Wierzbowski 1971, Text-fig. 1*E*). The burrows from Sudół have been known for a long time and were originally described by Zaręczny (1878) as a new sponge species, *Spongia sudolica*.

Acknowledgements. Warm thanks are due to Docent A. Radwański for help in gathering the literature, discussions and critical reading the manuscript. Thanks are also due to Docent R. Gradziński and Z. Martini, M. Sc., for the lending the specimens from the original collection of S. Zaręczny, housed in the Geological Museum, Institute of Geological Sciences of the Polish Academy of Sciences, Cracow.

THE TRACE FOSSIL

Ichnogenus *THALASSINOIDES* Ehrenberg, 1944

Remarks. — According to Fürsich (1973, 1974), the ichnogeneric names *Ophiomorpha* Lundgren, 1891, and *Thalassinoides* Ehrenberg, 1944, are junior synonyms of *Spongeliomorpha* Saporta, 1887. Difficulties in separating these three ichnogenera were previously mentioned by several authors (*cf.* Kennedy 1967; Groetzner 1968; Martini & Mentzel 1971) and explained in terms of their possible close affinity. The ichnospecies *Spongeliomorpha iberica* Saporta (*cf.* Saporta 1887, Pl. 6, Figs 2—3), the type of the ichnogenus *Spongeliomorpha*, was based on highly incomplete material, insufficient for unequivocal paleontological interpretation. This material resembles some fragments of *Thalassinoides* system and, to some degree, *Rhizocorallium* Zenker (= *Taonurus* Saporta) system. It should be noted that *Spongeliomorpha iberica* and *Rhizocorallium* were found in the same layers of the Miocene of Alcoy in Spain (*cf.* Saporta 1887). Fürsich (1973), analysing the ichnogenera *Spongeliomorpha*, *Ophiomorpha* and *Thalassinoides*, emphasized the similarity between the two latter taxa and did not pay much attention to the ichnotaxon *Spongeliomorpha iberica* Saporta[1]. According to the present authors, the systematic status of the ichnogenus *Spongeliomorpha* will remain uncertain until more complete material of *Spongeliomorpha iberica* is described from its type locality. Therefore, the interpretation of so well-known ichnogenera as *Ophiomorpha* and *Thalassinoides* as synonyms of the former seems premature. Moreover, in order to avoid further complication of the systematics, it seems justified to regard *Ophiomorpha* and *Thalassinoides* as separate taxa as did Häntzschel (1962), Kennedy (1967), Wincierz (1973) and others. *

Thalassinoides sudolicus (Zaręczny, 1878)
(Text-figs 1—2 and Pls 1—2)

1878. *Spongia sudolica* n. sp.; Zaręczny, pp. 245—246, Pl. 4.
1890. *Spongeliomorpha* (related to *S. iberica*); Raciborski, p. 266.
1894. *Scyphia sudolica*; Zaręczny, p. 173.
[*non*] 1926. *Spongia sudolica* Zaręczny; Sujkowski, p. 397.
1971. "*Scyphia sudolica*" Zaręczny = *Thalassinoides*; Głazek, Marcinowski & Wierzbowski, p. 435.
1973. *Spongia sudolica* Zaręczny = *Spongeliomorpha* sp. indet.; Fürsich, p. 731.

Lectotype. — The most representative specimens originally illustrated by Zaręczny, and representing branching burrow system (Zaręczny, 1878, Pl. 4; reproduced here as Text-fig. 1) are lost. The only specimens preserved (Pl. 1, Figs 2—3) are of relatively small diagnostic value and thus one of the hitherto unfigured syntypes (Pl. 2, Fig. 1) is chosen here as the lectotype.

Material. — About 400 specimens preserved as sandstone moulds and mostly representing fragments of horizontal burrow systems; 266 of them represent original collection of Zaręczny.

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[1] Fürsich (1973, p. 729) accepted *Spongeliomorpha iberica* Saporta as the type ichnospecies of the ichnogenus *Spongeliomorpha* Saporta, 1887, stating thereafter that this ichnospecies is "unrecognizable" because of inadequate preservation of the material (*ibidem*, p. 731).

* *Note added in the proof:* Recently R. G. Bromley & R. W. Frey in "Redescription of the trace fossil *Gyrolithes* and taxonomic evaluation of *Thalassinoides*, *Ophiomorpha* and *Spongeliomorpha*" (*Bull. Geol. Soc. Denmark*, 23 (3/4), 311—335, 1974) presented a similar opinion on the taxonomic status of *Ophiomorpha* and *Thalassinoides*, and on the invalidity of the generic name *Spongeliomorpha*.

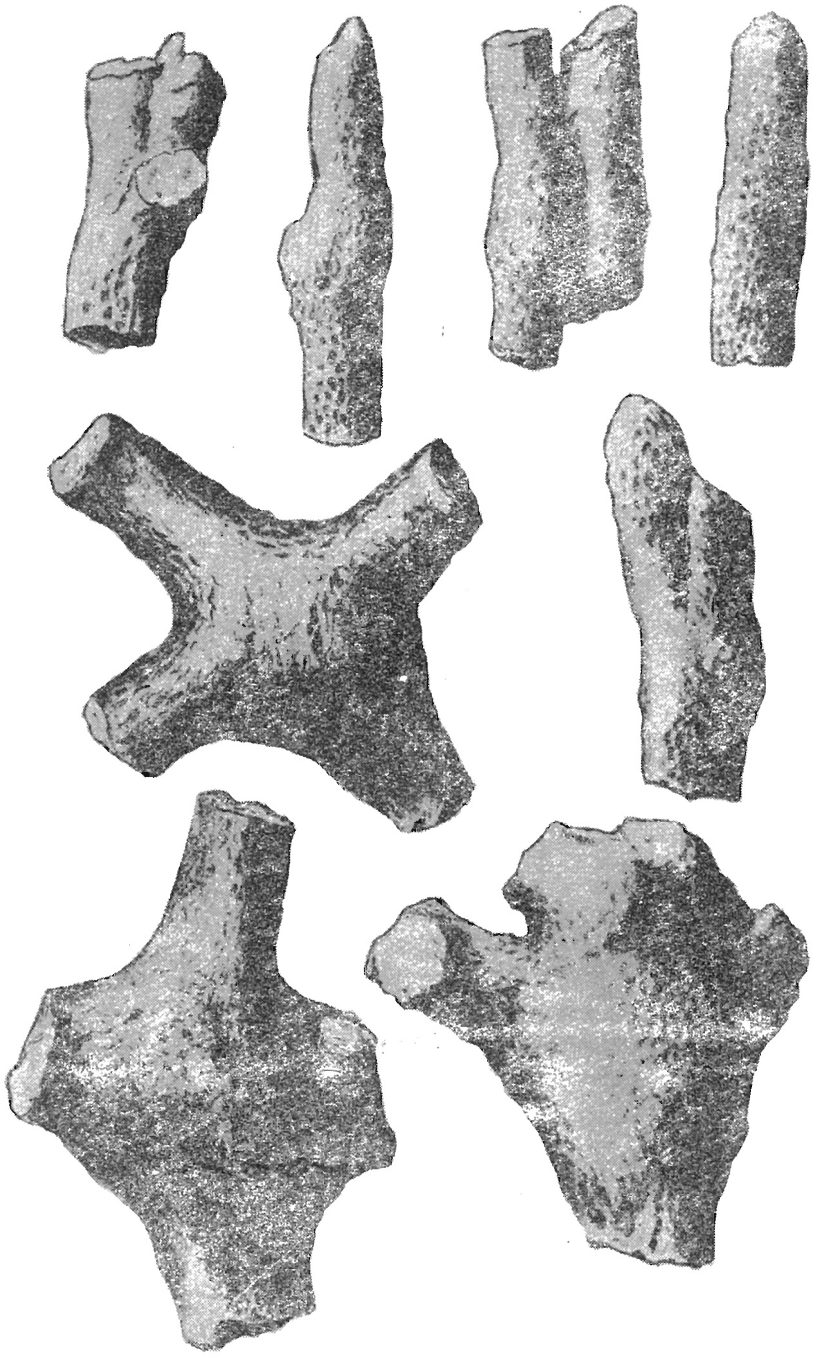


Fig. 1. "*Spongia sudolica*" as presented in the original description by Zaręczny (1878, Pl. 4); nat. size

Original description by Zaręczny (1878, pp. 245—246), somewhat modified and translated into English:

"Larger specimens developed in the form of thick, irregular bodies with closely spaced irregular branching. Thicker channels 2—4 cm in diameter, almost always somewhat flattened on one side...; channels rounded, forking or branching into fours; thickened at the place of subdivision ... Two channels sometimes cross one another ..., in places the channels are more numerous (3—6). Surface of the wider channels ornamented with irregular net-like pattern; meshes of that network ... are somewhat rhomboidal in outline and set in numerous oblique rows".

Description. — Irregular pattern of channels developed in separate horizons. Particular horizontal tunnels connected by oblique and vertical shafts. Channels densely spaced within a horizon; distance between neighbouring channels ranging from a few centimeters to zero (Pl. 1, Figs 3—4; *cf.* also Text-fig. 1, third drawing in upper row). The latter case may, however, result from overlapping of two independent systems of burrows. Channels varying from 0.6 to 4 cm in diameter, attaining 1—2 cm at the average; transverse section circular; however, compaction--deformed channels with elliptical section are fairly common. The channels are branching in various ways. Two types of branching predominate: one Y-shaped (Pl. 1, Figs 4—8), and another, with more complex division (Pl. 1, Figs 9—10 and Pl. 2; *cf.* also Text-fig. 1) and with higher number (4—6) of mutually connected channels. The place of division is emphasized by irregular chamber-like swelling. Channels extending from such place of division may vary in diameter (*cf.* Pl. 1, Figs 5—10 and Pl. 2). Incomplete, blind channels are also common (Pl. 1, Figs 1, 7, 9 and Pl. 2, Fig. 3a). The surface of burrow moulds is always ornamented with crossing scratch marks; on the surface of channels the scratch marks form a regular network pattern (*cf.* e.g. Pl. 1, Fig. 6) with meshes rhomboidal, about 1 to 5 mm in size. Angle between the scratch marks ranges from 30° to 60°, 30°—40° on the average (*cf.* Text-fig. 2).

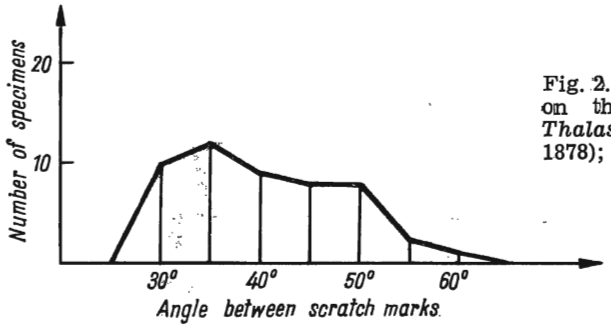
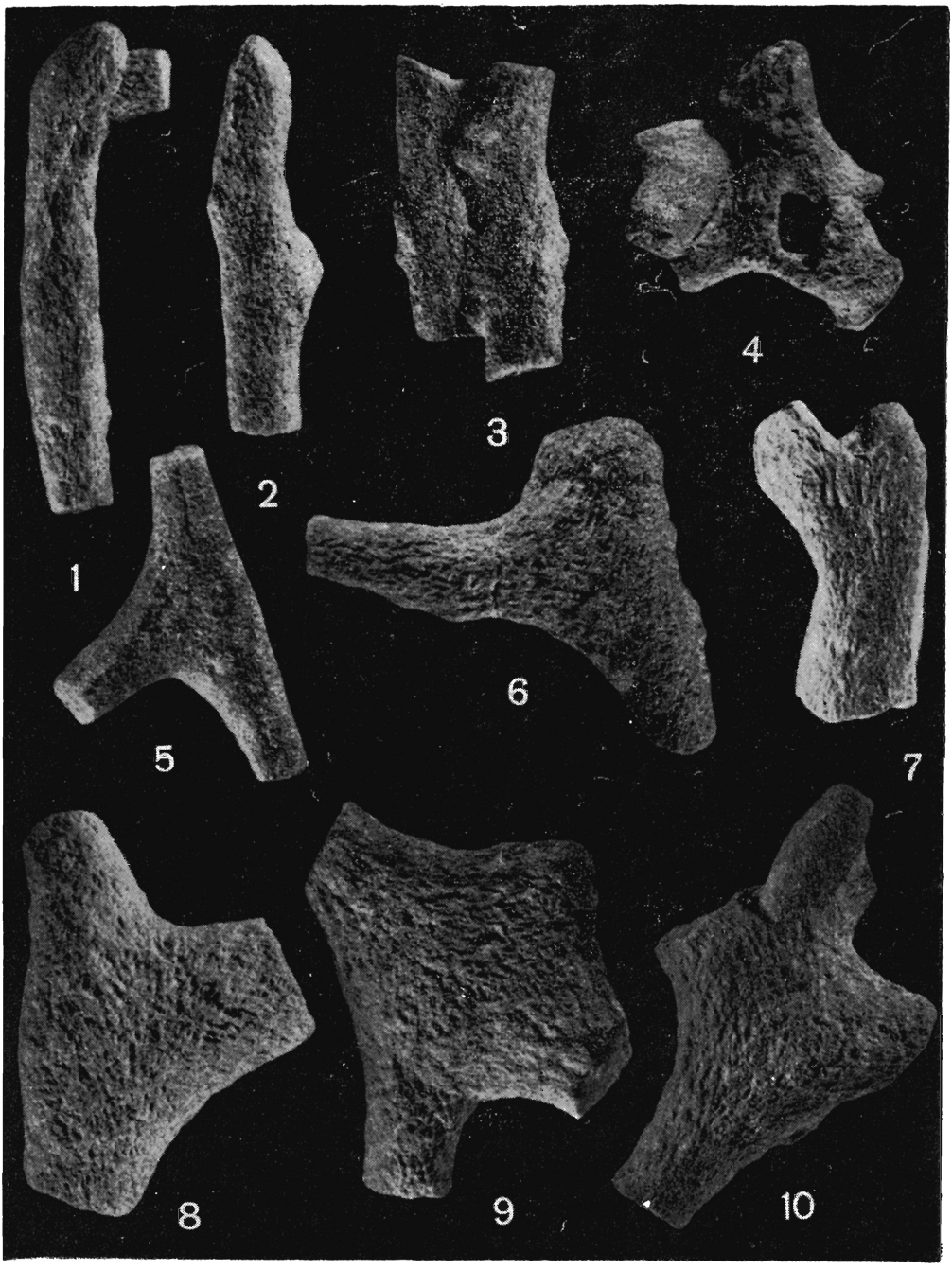


Fig. 2. Angles between scratch marks on the tunnel parts of burrows *Thalassinoides sudolicus* (Zaręczny, 1878); measured with accuracy to 5°

The scratch-mark pattern becomes less regular at the chamber-like swellings, where the angle between the scratch marks is highly variable, equalling sometimes even 90° (*cf.* Pl. 2).

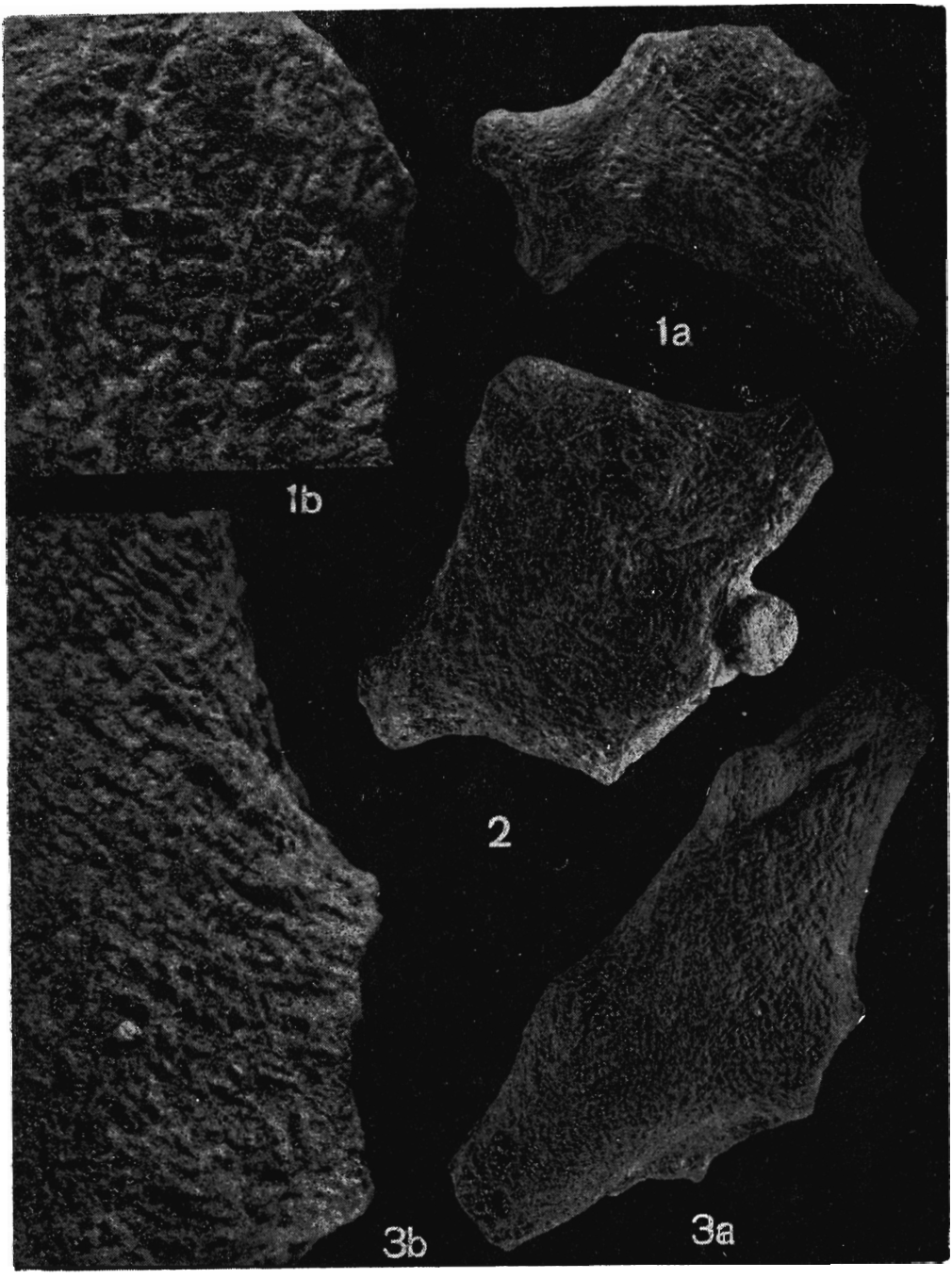
Remarks. — Zaręczny (1878, 1894) interpreted these specimens as a new species of sponge, *Spongia sudolica*. His interpretation was accepted by Raciborski (1890) and Siemiradzki (1909). Subsequently, Sujkowski (1926) assigned to the species *S. sudolica* an actual Albian sponge. The interpretation of Zaręczny was questioned for the first time by Kennedy (1967); who assigned this form to the ichnogenus *Thalassinoides* Ehrenberg, 1944, and noted its similarity to *T. paradoxica* (Woodward). According to Fürsich (1973, p. 731), the material described and figured by Zaręczny (1878) is insufficiently preserved for any reliable identification and recognition of its ichnospecific status.



Fragments of burrows *Thalassinoides sudolicus* (Zaręczny, 1878) from the Cenomanian at Sudół, Cracow Upland

1—6, 8 and *10* paralectotypes; *2—3* are the same specimens as those illustrated by Zaręczny (1878, Pl. 4 — uppermost row of figures; *cf.* reproduction in Text-fig. 1 of the present paper), but photographed from the opposite side not so obliterated as that taken by Zaręczny; nat. size

All photos taken by B. Drozd, M. Sc.



Fragments of burrows *Thalassinoides sudolicus* (Zaręczny, 1878) from the Cenomanian at Sudół, Cracow Upland

1a lectotype, and *2*, *3a* paralectotypes, all in nat. size; *1b* and *3b* magnified (× 3) fragments of the surface to show details of the scratch-mark pattern

All photos taken by B. Drozd, M. Sc.

The present authors consider *Thalassinoides sudolicus* (Zaręczny) as a separate ichnospecies. It differs from *T. paradoxica* (Woodward) in the pattern of scratch marks on channel surfaces (*cf.* Text-fig. 2), regularly crossing and not in the form of longitudinal ridges (*cf.* Kennedy 1967). The scratch mark pattern from channels is of remarkable diagnostic value as it may serve as a reliable hint for reconstruction the manner of burrowing; in such a case, position of the animal responsible for their formation was strictly set up. The pattern from chamber-like swellings appears irregular in the case of *T. sudolicus*; it is assumed that in these places the channel-maker could change its position when burrowing or penetrating already existing channel system.

ENVIRONMENTAL CONDITIONS

Much has been said about the relationship between particular types of burrows and the life activity of decapod crustaceans. The relationship is confirmed by observations made on both Recent (*cf.* Weigelt 1929; Reineck, Gutmann & Hertweck 1967; Shinn 1968; Braithwaite & Talbot 1972) and fossil (*cf.* Sellwood 1971; Bromley & Asgaard 1972) materials.

The occurrence of *Thalassinoides sudolicus* (Zaręczny) at Sudół is confined to the marly parts of the bottom which were softened during the inundation (*cf.* similar situation in Shujski 1966, Figs 1—2). The burrows, like the borings in limestone blocks truncated by the same abrasion surface, represent the first stage of activity of Cenomanian faunas from the time of transgression (*cf.* Głazek, Marcinowski & Wierzbowski 1971, Text-fig. 1*E*). The environment in which these trace-fossils originated was highly effected by hydrodynamic factors shaping the abrasion surface; they are also responsible for the truncation both of the channel systems and of the borings.

The walls of burrows display excellently preserved scratch marks. Such scratches in decapod-crustacean burrows are often encountered in both fossil and recent material and are indicative of the consistency of the sediments (*cf.* Weigelt 1929; Kennedy 1967, 1970; Shinn 1968; Kennedy & Macdougall 1969; Fürsich 1973).

The deposition of sands burying the abrasion surface and the ichnocoenose of burrows and borings, reflects an environmental change — smothering of the hydrodynamic activity that resulted from increase of the sea depth accompanying the Albian-Cenomanian transgression onto the whole area of the Polish Jura Chain (*cf.* Marcinowski 1974).

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NORY *THALASSINOIDES SUDOLICUS* (ZARĘCZNY, 1878) Z CENOMANU SUDOŁU KOŁO KRAKOWA

(Streszczenie)

Przedmiotem pracy jest rewizja skamieniałości śladowych (*trace fossils*) występujących w utworach cenomanu w Sudole pod Krakowem, a opisanych przez S. Zaręcznego (1878) jako gąbki *Spongia sudolica* Zaręczny. Formy te, wielokrotnie wspominane w literaturze, zostały ostatnio zinterpretowane przez W. J. Kennedy'ego (1967) jako nory utworzone przez raki lub kraby; ich pozycja ichnogatunkowa nie była jednakże dotąd wyjaśniona (por. Kennedy 1967; Fürsich 1973). Na podstawie analizy cech morfologicznych poszczególnych nor (*por.* fig. 1—2 oraz pl. 1—2), autorzy stwierdzają, iż reprezentują one osobny ichnogatunek w obrębie ichnorodzaju *Thalassinoides* Ehrenberg, 1944, i winny być określane jako *Thalassinoides sudolicus* (Zaręczny, 1878).
