ANDRZEJ GAŻDZICKI, HEINZ KOZUR, RUDOLF MOCK AND JERZY TRAMMER

TRIASSIC MICROFOSSILS FROM THE KORYTNICA LIMESTONES AT LIPTOVSKÁ OSADA (SLOVAKIA, ČSSR) AND THEIR STRATIGRAPHIC SIGNIFICANCE

Abstract.—Foraminifers, sponge spicules, conodonts, and holothurian sclerites are recognized in the Korytnica Limestones at Liptovská Osada (West Carpathians, Slovakia). Five new holothurian sclerite species are erected, namely Eocaudina liptovskaensis sp.n., Kuehnites slovakensis sp.n., Praecaudina mostleri sp.n., Theelia liptovskaensis sp.n., and Theelia trammeri sp.n. The Korytnica Limestones are assigned to the Lower Carnian (Cordevolian), basing upon the entire microfossil assemblage. The Korytnica Limestones are also demonstrated to be time equivalent to the Upper Cassian Beds of the Dolomites.

INTRODUCTION

The Korytnica Limestones make a new lithostratigraphic unit established recently by Bujnovský et al. (1975) in the Triassic of the West Carpathians. The name is after the geographic locality (Korytnická valley) near Liptovská Osada, Slovakia (fig. 1). The unit is homogeneous

Fig. 1. Locality map of the Korytnica Limestones at Liptovská Osada (Slovakia).
in lithology and distinct from the underlying Reifling and/or Raming Limestones as well as the overlying Lunz Member (Jablonsky 1973 b: fig. 21; Bujnovský et al. 1975: fig. 5; see also fig. 2 herein).

The present paper is aimed to describe the foraminifers, sponge spicules, conodonts, and holothurian sclerites occurring abundantly in the investigated Korytnica Limestones, and to evaluate their stratigraphic significance. The samples were taken by A. Gądzicki in 1976 from the type section of the Korytnica Limestones (see fig. 2). Totally, 15 samples approximating jointly 65 kg in weight were analysed. They were macerated with acetate acid; furthermore, they supplied 40 thin sections for microfacies study. Aside of the microfossils studied in the present paper, the samples contain also fairly abundant ostracodes, scolecodonts, cephalopod arm hooks, crinoid and echinoid fragments, and fish debris.

A. Gądzicki is responsible for microfacies analysis and foraminifer identification, H. Kozur and R. Mock for holothurian sclerite study, and J. Trammer for sponge spicule and conodont identifications.

The SEM micrographs were taken in the Laboratory of Electron Microscopy of the Nencki Institute of Experimental Biology, Warsaw, and in the Geological Institute of the Dionýz Štúr, Bratislava. The foraminifers, sponge spicule, and conodont collections are housed at the Institute of Paleobiology of the Polish Academy of Sciences, Warsaw (abbreviated as ZPAL); the holothurian sclerite collection is housed at the Department of Geology and Paleontology of the Faculty of Natural Sciences of the Comenius University, Bratislava (abbreviated as PFUK).

This work is a contribution to the IGCP Project "Triassic of the Tethys Realm".

**MICROFACIES ANALYSIS**

The Korytnica Limestones are dark-grey to black regularly bedded limestones with thin intercalations of calcareous shales. In the investigated section (fig. 2, see also Bujnovský et al. 1975) they overlie the Raming Limestones represented by grey to light-grey biohermic limestones. Their microfacies characteristics is based upon 40 thin sections, the localization of which in the depositional sequence is shown in fig. 2.

The uppermost Raming Limestones (sample R₁) comprise crinoid-algal (Tubiphitès) biosparites (pl. 41: 6) with fragments of calcareous sponges, brachiopods, sessile foraminifers, and intraclasts (see also Jablonský 1971, 1973a, b, 1975; Mišík 1972; Bujnovský et al. 1975). In contrast, the Korytnica Limestones (samples R₂—R₆ and L₁—L₅) are dominated by brownish, mostly laminated biomicrites (pl. 41: 1—4) interlayered sometimes with crinoid biopelsparenites (pl. 41: 5).

The Korytnica Limestones are fairly homogeneous in microfacies. The most common components of the laminated biomicrites are sponge spicules
Fig. 2. Type locality and key beds of the Korytnica Limestones (first quarry in the cut of the major road south of Liptovská Osada; photo taken by A. Gazdzicki in May 1976). \(L\) — left side of the quarry, \(R\) — right side of the quarry; sampling: \(L_1-L_9\) and \(R_1-R_9\).
TRIASSIC MICROFOSSILS FROM THE KORYTNICA LIMESTONES

(plt. 41: 1—2), minute crinoid fragments (plt. 41: 3), and brachiopod debris (plt. 41: 4); there are also thin-walled shells of juvenile bivalves (*Halobia*?), abundant nodosariids, ostracodes, and spores *Globochaete alpina* Lombard. The biomicritic mass includes small amounts of a brownish, opaque matter (organic matter?).

The biopelsparenites (plt. 41: 5) are composed of crinoid, brachiopod, bivalve, and gastropod debris as well as of ostracodes, solenopores, and pellets. They comprise fairly abundant foraminifers of the genera *Ophthalmidium*, *Involutina*, *Tolypammina* (sample R₄), *Earlandia*, and *Galeanella*? (samples R₅—R₆), algae *Tubiphites obscurus* Maslov (sample R₇), and microproblematic *Ladinella porata* Ott (sample R₆) (see also Jablonský 1973a, Bujnovský et al. 1975).

**FORAMINIFERS**

(plt. 42—45)

Thirty nine foraminifer taxa have been found in the investigated section of the Korytnica Limestones (fig. 2). Their frequency distributions among the samples are given in table 1.

Most species recorded are well known from other areas of the Tethys Realm (see Zaninetti 1976) and hence, they are not systematically described in this paper. Nevertheless, the majority of the investigated foraminifers are here illustrated (plt. 42—45) to show their variability and facilitate future discussions.

When classifying the foraminifers, the system of Loeblich and Tappan (1964) has been used. The list of the foraminifer species recorded in the Korytnica Limestones comprises:

- *Ammodiscus* sp. — plt. 45: 7
- *Glomospira* sp.
- *Turritella sp.*
- *?Turritella sp.* — plt. 43: 9—10
- *Tolypammina* sp.
- *Lituotuba* sp. — plt. 45: 6
- *?Ammobaculites* sp. — plt. 43: 12
- *Placopsilina*? *hyerensis* Brönnimann and Zaninetti, 1972
- *?Placopsilina* sp.
- *Gaudryinella* sp. — plt. 43: 8
- *Earlandia amplituralis* (Pantić, 1972)
- *Earlandia tintinniformis* (Mišik, 1971)
- *Earlandinita* sp. — plt. 43: 11
- *?Endothyra* sp. — plt. 42: 5
- *Endothyranella* sp.
- *Agathammina* *austroalpina* Kristan-Tollmann and Tollmann — plt. 43: 5—6
- *Agathammina* sp.
- *Ophthalmidium exiguum* Koehn-Zaninetti, 1969 — plt. 43: 4
- *Ophthalmidium* sp. — plt. 43: 1—3
- *Galeanella*? *infundibuliforme* (Jablonský, 1973) — plt. 42: 1—4
- *Nodosaria* sp. — plt. 45: 3
- *Astacolus* sp. — plt. 45: 4
- *Darbyella* sp.
- *Dentalina* sp.
- *?Frondinodosaria* sp. — plt. 45: 1
- *Lenticulina* sp. — plt. 45: 2
- *Pachyphloides klebelsbergi* (Oberhauser, 1960) — plt. 44: 8
- *Pachyphloides oberhauseri* Sellier de Civrieux and Dessauvagie, 1965
- *Pachyphloides* sp. — plt. 44: 7, 9
The families Ammodiscidae and Nodosariidae predominate in number of both species and individuals in the foraminifer assemblage, being represented by 8 and 9 species, respectively. There are 6 species of the family Involutinidae but they are represented only by singular individuals. The families Lituolidae (3 species), Ataxophragmiidae (2 species), Mocavaminidae (3 species), Endothyridae (2 species), Fischerinidae (2 species), Nubeculariidae (2 species), Milioliporidae (1 species), and Variostomatidae (1 species) occur in subordinate numbers of individuals.

The genera Placopsis, Gaudryinella, and Pachyphloides are for the first time recorded in the Triassic of Slovakia.

The microproblematic Cucurbita infundibuliforme reported by Jablonsky (1973a) is attributed to the foraminifers, namely Galeanella? infundibuliforme (see also Zaninetti 1977).

Stratigraphic significance of the foraminifer assemblage. — Only some foraminifers recorded in the Korytnica Limestones appear significant stratigraphically. These are mostly involutinids (I. eomesozoica eomeso­zoica, I. gaschei praegaschei, and I. planidiscoides), as well as Pachyphloides klebelsbergi, P. oberhauseri, Placopsis? hyerensis, Gaudryinella aff. kotlensis, and Ophthalmidium exiguum.

Generally, the above mentioned foraminifer species permit attribution of the investigated strata to the Ladinian — Carnian (see Zaninetti 1976). Actually, P. klebelsbergi and G. aff. kotlensis indicate Lower Carnian age (Oberhauser 1960, Trifonova 1967), whereas P. oberhauseri and Placopsis? hyerensis indicate Carnian in general (Oberhauser 1960, Sellier de Civrieux and Dessauvagie 1965, Zaninetti 1976). One may note that in the type section of the Cassian Beds at St. Cassian, Dolomites, the species P. klebelsbergi occurs in the Upper Cassian Beds, i.e., Lower Carnian, Cordevolian (Oberhauser 1960, see also Urlichs 1974, 1977); it occurs also in the similar stratigraphic position in the Caucasus (Efimova 1974).

A characteristic involutinid assemblage is for the first time recorded in the Korytnica Limestones (sample R4), including I. eomesozoica eomesozoica, I. gaschei praegaschei, I. sinuosa cf. pragooides, and I. planidiscoides. Such assemblages are, indeed, typical of the Upper Ladinian to Lower Carnian strata of the Tethys Realm (Zaninetti 1976).

The investigated foraminifer assemblage appears somewhat impoverished but nevertheless, it resembles the time equivalent faunas reported from other Tethyan areas, e.g. the Alps (Oberhauser 1960, 1964; Zaninetti 1976), Hungary (Resch 1972), Bulgaria (Trifonova 1967, 1972),
Table 1

Frequency distributions of foraminifers in the Korytnica Limestones at Liptovska Osada

| Foraminifer                      | L1 | L2 | L3 | L4 | L5 | L6 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 |
|----------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Ammodiscus cf. planus            | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ammodiscus sp.                   |    | 4  | 9  | 10 | 1  | 1  | 2  | 8  | 43 | 9  | 5  | 2  |    |    |    |
| Glomospira sp.                   |    | 1  |    |    |    |    | 2  |    |    |    |    |    |    |    |    |
| Turritella sp.                   |    | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Turritella sp.                   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Polyammina gregorina             |    |    |    |    |    |    |    |    |    |    |    |    | 27 |    |    |
| Polyammina sp.                   |    | 1  | 2  | 2  |    |    | 12 | 2  |    |    |    |    |    |    |    |
| Lituituba sp.                    |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| ?Ammobaculites sp.               |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Placopilina? hyetensis           |    |    |    |    |    |    |    | 2  |    |    |    |    |    |    |    |
| ?Placopilina sp.                 |    |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |
| Gaudryinella aff. kotioniensis   |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 2  |
| Gaudryinella sp.                 |    |    |    |    |    |    |    | 2  | 2  | 1  | 1  |    |    |    |    |
| Earlandia angilimuralis          |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Earlandia tintinniformis         |    | 2  | 3  |    | 3  | 1  | 3  |    |    |    |    |    |    |    |    |
| Earlandinita sp.                 |    |    |    | 1  |    |    |    |    |    |    |    |    |    |    |    |
| ?Endothyra sp.                   |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Endothyranella sp.               |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Agathammina austroalpina         |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    | 3  |
| Agathammina sp.                  |    |    |    |    | 4  |    |    |    |    |    |    |    |    |    |    |
| Ophthamidium exiguum             |    |    |    |    | 1  |    | 1  |    | 1  |    |    |    |    |    |    |
| Ophthamidium sp.                 |    |    |    |    |    |    | 6  | 2  | 3  | 10 | 24 | 2  | 2  | 1  | 2  |
| Galeanella? infundibuliforme     |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 5  |
| Nodosaria sp.                    |    | 2  | 1  | 6  | 2  | 4  | 6  | 4  | 4  |    |    |    |    |    | 1  |
| Ascoacolus sp.                   |    |    |    |    |    |    | 2  | 1  |    |    |    |    |    |    |    |
| Darbyella sp.                    |    | 1  | 1  |    |    |    |    |    |    |    |    |    |    |    |    |
| Dentalina sp.                    |    |    |    |    | 2  |    |    | 4  |    |    |    |    |    |    |    |
| ?Trendrolodosaria sp.            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Lenticulina sp.                  |    |    | 3  | 2  | 1  | 2  | 3  |    |    |    |    |    |    |    |    |
| Pachyphloides klebsiizerti       |    | 2  |    | 1  | 8  | 2  | 1  | 2  |    |    |    |    |    |    |    |
| Pachyphloides oberhauseri        |    | 1  |    |    | 4  | 3  |    |    |    |    |    |    |    |    |    |
| Pachyphloides sp.                |    | 1  | 1  | 8  | 11 | 1  |    |    |    |    |    |    |    |    |    |
| Duostomina sp.                   |    | 1  | 1  | 4  | 2  | 1  |    |    |    |    |    |    |    |    |    |
| Involutina eocenozoica eocenozoica|    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Involutina geschei praegaschei   |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Involutina sinuosa cf. praegaschei|    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Involutina planidiscoides        |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |
| Involutina sp.                   |    |    |    |    |    |    | 1  | 2  |    |    |    |    |    |    |    |
| ?Involutina sp.                  |    |    |    |    |    |    | 5  |    |    |    |    |    |    |    |    |
Caucasus (Efimova 1974), Espahk Formation of Iran (Brönnimann et al. 1974), or Samana Suk section of Pakistan (Zaninetti and Brönnimann 1975).

**Sponge Spicules**

(pls 46, 47)

Ten morphologic types of sponge spicules have been found in the investigated section. Their frequency distributions among the samples are given in table 2. The terminology used follows Rauff (1893—1894), Lau-

**Table 2**

Frequency distributions of sponge spicules in the Korytnica Limestones at Liptovská Osada

<table>
<thead>
<tr>
<th></th>
<th>L 1</th>
<th>L 2</th>
<th>L 3</th>
<th>L 4</th>
<th>L 5</th>
<th>L 6</th>
<th>R 1</th>
<th>R 2</th>
<th>R 3</th>
<th>R 4</th>
<th>R 5</th>
<th>R 6</th>
<th>R 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>oxytriactine</td>
<td>20</td>
<td>5</td>
<td>15</td>
<td>2</td>
<td>6</td>
<td>13</td>
<td>16</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycalthrop</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>protriaene</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>prodichotriaene</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>orthodichotriaene</td>
<td>12</td>
<td>55</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td>11</td>
<td>38</td>
<td>115</td>
<td>104</td>
<td>100</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>oxyhexactine</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sphaeraster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxyaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>amphister</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rhizoclone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

benfels (1955), Reif (1967), and Mostler (1971b). The following sponge spicules occur in the Korytnica Limestones:

1 Triactines:
    - oxytriactine — pl. 47: 4
2 Tetractines:
    - oxycalthrop — pl. 47: 3
3 Triaenes:
    - protriaene,
    - prodichotriaene,
    - orthodichotriaene — pl. 46: 1—4, 6
4 Hexactines:
    - oxyhexactine — pl. 46: 5
5 Polyactines:
    - sphaeraster — pl. 47: 2,
    - oxyaster — pl. 47: 1
    - amphister — pl. 47: 5
6 Desmas:
    - rhizoclone.

The investigated spicules are mostly megascleres, with microscleres represented only by the polyactines. As demonstrated by table 2, only the orthodichotriaenes and oxytriactines occur fairly abundantly, while all other spicules play subordinate roles. One may notice a structural variability among the orthodichotriaenes; in fact, there are even forms transitional to the orthotrichotriaenes (pl. 46: 3).
Sponge spicules and the natural classification. — The spicules recorded in the Korytnica Limestones can be assigned to the following natural taxa (cf. Laubenhansels 1955; Reif 1967; Mostler 1971b): protriaene, prodichotriaene, orthodichotriaene, sphaeaster, oxyaster, amphiaster — class Demospongea, order Choristida; oxycthalthrop — class Demospongea, order Carnosida (?); rhizoclone — class Demospongea, order Lithistida, suborder Rhizomorina; oxyhexactin — class Hyalospongea; oxytriactine — class Calcispongea, order Pharetronida.

Only the choristid and pharetronid sponges occurred in any considerable amounts in the Korytnica Limestones. However, a single sponge contains usually more spicules than there are in the investigated samples altogether and hence, one may conclude that the sponges played but a subordinate role in the benthos of the Korytnica Limestones.

Stratigraphic significance of the sponge spicules. — Mostler (1972a) recognized the guide associations of sponge spicules in the Triassic of the Alps. The investigated assemblage from the Korytnica Limestones resembles most closely the association II of Mostler (1972a), that is the association indicative of the Lower Carnian (Cordevolian). It differs from the association I in that it lacks anadiene spicules; while from the association III it differs in the absence of megaclone and promesotriaene spicules. The stratigraphic value of the sponge spicule associations of Mostler (1972a) cannot be ultimately accepted as yet; nevertheless, it is to be noted that the age attribution of the Korytnica Limestones based upon the spicule association is entirely consistent with those after the conodonts, foraminifers, and holothurian sclerites.

CONODONT FAUNA AND ITS AGE (pls 47, 48)

The following conodonts have been found in the investigated section (their frequency distributions among the samples are given in table 3):

*Gondolella navicula* Huckriede, 1958 — pl. 48: 7

*Gondolella polygnathiformis* Budurov and Stefanov, 1965, pl. 48: 1.


Multielement *Gladigondolella tethydis* (Huckriede, 1958) _sensu_ Kozur and Mostler, 1971a; there are only fragments of the ramiform elements, mostly PA₁ and PC₁ elements _sensu_ Kozur and Mostler (1971b).

*Enantiognathus jungi* (Mosher, 1968) — pl. 48: 8

*Neospathodus* sp. — pl. 48: 6.

The species *G. malayensis* and *E. jungi* co-occurring in the sample R₉ indicate the uppermost Langobardian and Cordevolian (cf. Mosher 1968,
Table 3

Frequency distributions of conodonts in the Korytnica Limestones at Liptovská Osada

<table>
<thead>
<tr>
<th></th>
<th>L 1</th>
<th>L 3</th>
<th>L 5</th>
<th>R 2</th>
<th>R 3</th>
<th>R 4</th>
<th>R 6</th>
<th>R 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gondolella navicula</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>5</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Gondolella polygnathiformis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gladigondolella malayensis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gladigondolella tethydis ME (fragments)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Enantiognathus jungi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Neospathodus sp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Kozur and Mostler 1972, Krystyn 1973). G. polygnathiformis recorded in the sample R7 ranges since the Cordevolian up through the Tuvalian (Kozur and Mostler 1972). However, the investigated specimen appears morphologically close to its ascendant G. excelsa, while the separation of both the forms is known to have taken place at the Langobardian/Cordevolian boundary. Hence, the sample R7 can be assigned to the Cordevolian. The occurrence of multielement G. tethydis in the samples R2, R4, and L3 does not contradict the above age attribution, as G. tethydis ranges in the Austro-Alpine Province since the Fassanian up through the Julian (Kozur and Mostler 1972).

In summary, the Korytnica Limestones are to be assigned to the Lower Carnian (Cordevolian), basing upon the conodonts; the lowermost part of the unit may, however, represent the uppermost Ladinian (Langobardian) as well.

HOLOTHURIAN SCLERITES
(pls 49—53)

The sequence of the Korytnica Limestones at Liptovská Osada contains a lot of excellently preserved holothurian sclerites. This fauna of holothurian sclerites is dominated by Theelia koeveskalensis Kozur and Mostler, 1971 and Eocaudina cassianensis Frizzell and Exline, 1955. Less frequent, but also common are Achistrum triassicum Frizzell and Exline, 1955 and Theelia immisorbicula Mostler, 1968. All other species are very rare.

The frequency distribution among the samples are given in table 4.

Stratigraphic significance of the holothurian sclerites. — The holothurian fauna is typical for the Theelia koeveskalensis Zone (Cordevolian) in
Table 4

Frequency distributions of holothurian sclerites in the Korytnica Limestones at Liptovská Osada

<table>
<thead>
<tr>
<th>Genus</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
<th>L6</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acanthotheelia aff. ladinica</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acanthotheelia spinosa</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achistrium triassicum</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calclamna germanica</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calclamna nuda</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eocaudina cassianensis</td>
<td>22</td>
<td>37</td>
<td>24</td>
<td>16</td>
<td>12</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>53</td>
</tr>
<tr>
<td>Eocaudina liptovskakensis n.sp.</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eocaudina ramosa</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kuehnites slovakensis n.sp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Praecaudina mostleri n.sp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priscopedatus triassicus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theelia guembeli</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theelia immisorbicula</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>16</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theelia koeveskalensis</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>11</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>15</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theelia aff. lata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theelia liptovskakensis n.sp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theelia trimmeri n.sp.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theelia undata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

the sense of Mostler (1972b). The Cordevolian guide forms are Theelia koeveskalensis Kozur and Mostler (1971) and probably also Theelia guembeli Kristan-Tollman (1963). The dominance of Eocaudina cassianensis Frizzell and Exline (1955) and the occurrence of highly developed typical exemplars of Acanthotheelia spinosa Frizzell and Exline (1955) are also characteristic of the Cordevolian holothurian faunas.

DESCRIPTIONS

Genus Acanthotheelia Frizzell and Exline, 1955

Acanthotheelia aff. ladinica Kozur and Mostler, 1971
(pl. 49: 1)

Remarks.—Only one broken specimen is present. It differs from A. ladinica Kozur and Mostler, 1971 in having no typical spines at the outer margin of the rim opposite to the interspoke spaces. Moreover the diameter of the hub is considerably wider than in A. ladinica Kozur and Mostler and the lower surface of the hub is somewhat concave, the upper surface somewhat convex.

Occurrence.—A similar form was observed in the Ballabona-Cucharón complex of the Sierra de Carrascoy, southeastern Spain, in the Cordevolian.
**Acanthotheelia spinosa** Frizzell and Exline, 1955

(Pl. 49: 2–3)


**Remarks.**—Typical specimens with well developed denticulation at the inner margin of the rim are characteristic for the Cordevolian. The specimens from the Korytnica Limestones at Liptovská Osada belong to these forms.

**Occurrence.**—Illyrian to Cordevolian (Alps, Hungary, West Carpathians, Dinarids, and Turkey).

**Genus Achistrum** Etheridge, 1881


(Pl. 49: 4–6)


**Remarks.**—Frequent in the Cordevolian of Slovakia, Hungary, and the Alps. The exact taxonomic separation of this species against other species of the genus *Achistrum* is difficult so that the exact stratigraphic range of *A. triassicum* Frizzell and Exline cannot be given. In the Upper Norian, this species is still present.

**Genus Calclamna** Frizzell and Exline, 1955

*Calclamna germanica* Frizzell and Exline, 1955

(Pl. 49: 7–9)


**Occurrence.**—Anisian to Liassic.

*Calclamna nuda* (Mostler, 1971)

(Pl. 50: 1–2)

1972. *Calclamna nuda* (Mostler); Kozur and Mock: 7 (discussion to *Calclamna misiki*), pl. 3: 4–5.

**Occurrence.**—Middle Anisian—Norian.

**Genus Eocaudina** Martin, 1952

*Eocaudina cassianensis* Frizzell and Exline, 1955

(Pl. 51: 1–4)


Eocaudina liptovskaensis Kozur and Mock, sp.n.
(pl. 50: 5—6)

**Derivatio nominis:** After the occurrence at Liptovská Osada.

**Holotypus:** Specimen No. 77-III7, pl. 50: 5.

**Locus typicus:** Liptovská Osada.

**Stratum typicum:** Cordevolian, Korytnica Limestones, sample R2.

**Material.** — Two specimens.

**Diagnosis.** — Plane sieve plates. A central solid axis without pores is surrounded by 8 strongly radially elongated pores. In direction to the outer margin somewhat lesser radially elongated great pores follow. Near the margin the pores are sub-circular. The outer margin is subcircular, suboval or subrectangular and bears long spines that are in all cases situated opposite to the pores.

**Comparison.** — *Eocaudina spinosa* Mostler, 1968 has outside of the radially elongated central pores only very small pores. *Eocaudina spinosa* Mostler, 1968 and *Eocaudina liptovskaensis* sp.n. may represent a new genus.

**Occurrence.** — Known from the type locality only.

Eocaudina ramosa Kozur and Mostler, 1971
(pl. 50: 3)


**Occurrence.** — Langobardian (very frequent), Cordevolian (rare): Hungary, Austria, Slovakia.

Genus Kuehnites Mostler, 1969

*Kuehnites slovakensis* Kozur and Mock, sp.n.
(pl. 50: 4)

**Derivatio nominis:** After the occurrence in Slovakia.

**Holotypus:** Specimen No. 76-X/20, pl. 50: 4.

**Locus typicus:** Liptovská Osada.

**Stratum typicum:** Cordevolian, Korytnica Limestones, sample L2.

**Material.** — One specimen.

**Diagnosis.** — Outline subcircular. Rim moderately broad and rather well elevated with spines at the outer margin opposite to the pores. The 4 main “spokes” are primarily andsecondarily forked so that at least 10 pores and therefore 10 spines at the outer margin are present. Up to 12 pores are observed.

**Comparisons.** — Mostler, 1969, 1972b has shown the development from the genus *Canisia* (*Canisia zankli* group with 4 unforked spokes joint in central part by a spoke-like narrow bridge) to forms in which a part of the spokes (mostly 2) is forked (*Kuehnites inaequalis* Mostler, 1969). Mostler, 1972b has established the new species *Kuehnites turgidus* for form with broad rim and *K. dumosus* for forms with narrow to moderately broad rims in which the 4 “spokes” are all forked. Kozur and Mock, 1972 have emended *Kuehnites inaequalis* Mostler, 1969 to include all forms of the *Canisia* — *Kuehnites inaequalis* line with branched “spokes” to *Kuehnites inaequalis* Mostler, 1969. After the creation of *Kuehnites dumosus* Mostler, 1972 and *K. turgidus* Mostler, 1972 it seems to be better to make the following separation of species in the above mentioned transitional line:
1. All “spokes” unbranched: Canisia Mostler, 1972 pro Ludwigia Mostler, 1969 (Canisia zankli group).
3. All 4 “spokes” primarily branched, no secondary forking: Kuehnites dumosus Mostler, 1972.
4. All 4 “spokes” branched, at least one branch secondarily forked: Kuehnites slovakensis sp.n.

It seems that all these form species occur in one natural species (Kuehnites inaequalis Mostler, 1969), because all transitions occur. But in spite of this fact in the form taxonomy it seems better to make the above mentioned separation.

Occurrence. — Cordevolian — Norian (Slovakia, Austria).

Genus Praecaudina Mostler, 1970 emend.


A new species of Praecaudina described below, P. mostleri sp.n., has all characteristics of Praecaudina, but a subcircular outline. The outer rim is elevated, but not inward-bent. This new species shows clear transitional character to the concavo-convex “Eocaudina” species of the “Eocaudina” subhexagona group. In agreement with the proposals by Kozur and Mock, 1972 all these forms will be included in the emended genus Praecaudina Mostler, 1970. A new diagnosis of this genus is therefore necessary.

Emended diagnosis. — Concavo-convex sieve plates of subcircular to hexagonal, sometimes also octagonal outline. In the central part 4 great pores are situated surrounded by 1—2 concentric rows of mostly smaller pores. At the outer margin a rim or a somewhat thickened zone is present. Sometimes the inner margin of the rim is inward-bent.

The following species belong to Praecaudina Mostler, 1970 in the emended scope:

Protocaudina hexagonaria Martin, 1952
Eocaudina subhexagona Gutschick, Canis and Brill, 1967
Praecaudina hexagona Mostler, 1970
Praecaudina mostleri Kozur and Mock, sp.n.

Comparisons. — Eocaudina Martin, 1952 can be distinguished by a different arrangement of the pores and by the plane sieve plates. No thickened margin or rim is present in Eocaudina Martin, 1952.

Protocaudina Croneis, 1932 comprises circular wheel-like sclerites.


Praecaudina mostleri Kozur and Mock, sp.n. (pl. 51: 5—6)

Derivatio nominis: In honour of Prof. Dr. H. Mostler, Innsbruck.
Holotypus: Specimen No. 77-II/l, pl. 51: 5.
Locus typicus: Liptovska Osada.
Stratum typicum: Cordevolian, Korytnica Limestones, sample R4.
Material. — Two specimens.

Diagnosis. — Strongly concavo-convex sieve plates with subcircular to suboval or subrectangular outline. Opposite to the pores the outer margin is mostly clearly outward-bent (but not always at all pores). Outer margin somewhat to clearly thickened or elevated, but inner margin of the rim is never inward-bent. The 4 central pores are great, circular to subcircular. The concentric row of outer pores has 12 circular to subcircular pores of strongly different size.

Comparisons. — Praecaudina hexagona Mostler, 1970 has a hexagonal to octogonal outline and irregularly or rectangularly shaped pores.

At Praecaudina subhexagona (Gutschick, Canis and Brill, 1967) the outer margin is not outward-bent opposite the pores. Moreover two rows of pores are present in this species.

Praecaudina hexagonaria (Martin, 1952) has a roughly hexagonal outline without outward-bending of the outer margin opposite to the pores. Moreover the outer pores are semicircular to triangular in this species.

Occurrence. — Known from the type locality only.

Genus Priscopedatus Schlumberger, 1890 emend. Frizzell and Exline, 1955
Priscopedatus triassicus Mostler, 1968
(pl. 51: 7)


Occurrence. — Anisian to Norian.

Genus Theelia Schlumberger, 1890
Theelia guembeli Kristan-Tollmann, 1963
(pl. 50: 9)


Occurrence. — Cordevolian (Southern Alps, Hungary, Spain, West Carpathians).

Theelia immisorbicula Mostler, 1968 emend. Kozur and Mock, 1972
(pl. 53: 8—9)

1968. Theelia immisorbicula n.sp.; Mostler: 26—27, pl. 5: 1.
1972. Theelia immisorbicula Mostler; Kozur and Mock: 16—17, pl. 7: 5—12.

Occurrence. — Anisian to Norian.

Theelia koeveskalensis Kozur and Mostler, 1971
(pl. 52: 2—9)


Remarks. — The excellently preserved material of Theelia koeveskalensis Kozur and Mostler, 1971 from the Korytnica Limestones at Liptovská Osada shows in almost all specimens 2-4 marginal teeth at the inner margin of the rim above the spokes. Kozur and Mostler, 1971b could observe this denticulation only at very few specimens.

Occurrence. — Frequent in the Cordevolian of Hungary and Slovakia. Very rare (most probably homeomorph forms, see Kozur and Mock, 1972) in the Lower Norian of Silická Brezová (Slovakia).
**Theelia aff. lata** Kozur and Mostler, 1971  
(pl. 50: 7—8)

*Remarks.* — Only 3 broken specimens of this *Theelia* species are present. The wide, entirely plane hub corresponds to *Theelia lata* Kozur and Mostler, 1971, but the number of spokes is lesser (10) than in this species (13—18). The denticulation of the inner margin is considerably lesser than in *Theelia lata* Kozur and Mostler, 1971.

*Theelia planata* Mostler, 1968 has a smaller hub with central pit at the lower surface and an undenticulated inner margin of the rim.

*Occurrence.* — *Theelia lata* is known from the Cordevonian of Hungary and Slovakia.

**Theelia liptovskaensis** Kozur and Mock, sp.n.  
(pl. 53: 1—3)

*Derivatio nominis:* After the occurrence at Liptovská Osada.

*Holotypus:* Specimen No. 77-III/22 figured in pl. 53: 1.

*Locus typicus:* Liptovská Osada.

*Stratum typicum:* Cordevonian, Korytnica Limestones, sample R₄.

*Material.* — Four specimens.

*Diagnosis.* — Circular small wheels with 12—14 spokes. The width of the spokes is the same throughout length or the spokes are only a little broader in the middle part of its length. Rim low, slightly inward-bent. Inner margin of the rim finely denticulated. Hub moderately wide, somewhat lower than the upper surface of the rim. Lower surface of the hub slightly concave, upper surface very slightly convex.

*Comparisons.* — *Theelia simoni* Kozur and Mock, 1972 and *Theelia patinaformis* Mostler, 1970 are similar, but both have a smooth inner margin of the rim.

*Occurrence.* — Known from the type locality only.

**Theelia trammeri** Kozur and Mock, sp.n.  
(pl. 53: 4—7)

*Derivatio nominis:* In honour of Dr. J. Trammer, Warsaw.

*Holotypus:* Specimen No. 76-X/7 figured in pl. 53: 4.

*Locus typicus:* Liptovská Osada.

*Stratum typicum:* Cordevonian, Korytnica Limestones, sample L₂.

*Material.* — Five specimens.

*Diagnosis.* — Great wheels with subcircular outline. Rim narrow, inner margin almost not inward-bent, coarsely denticulated. Outer margin of the rim outward-bent opposite the interspoke spaces, but without spines. Hub small to moderate wide with plane lower and upper surface. Spokes (10—12) narrow, width equal throughout.

*Comparisons.* — *Theelia trammeri* Kozur and Mock sp.n. seems to derive from *Acanthotheelia spinosa* Frizzell and Exline, 1955 by lost of spines at the outer margin of the rim. A derivation of a hitherto undescribed *Theelia* from the Ladinian is also possible.

*Occurrence.* — Known from the type locality only.

**Theelia undata** Mostler, 1968  
(pl. 51: 8—9; pl. 52: 1)

1968. *Theelia undata* n.sp.; Mostler: 30, pl. 5: 5.
Remarks. — *Theelia serta* Speckmann, 1968 is most probably a younger synonym of *Theelia undata* Mostler, 1968.

Occurrence. — Anisian to Cordevolian (West Carpathians and Alps).

**FINAL REMARKS**

When recognizing the Korytnica Limestones for a new lithostratigraphic unit in the West Carpathians, Bujnovský *et al.* (1975) assigned the investigated strata to the Middle Carnian (Julian) on the basis of the brachiopod and bivalve fauna. Jablonský (1973b) claimed previously those strata to represent either the Cordevolian, or Julian.

The present study of the microfauna of the Korytnica Limestones permits their unequivocal attribution to the Lower Carnian (Cordevolian). Indeed, all the investigated microfossil groups indicate the latter substage.

The Korytnica Limestones were suggest (Jablonský 1973b, Bujnovský *et al.* 1975) to resemble generally the Cassian Beds of the Dolomites. However, according to Urlichs (1974, 1977) and Fürsich and Wendt (1977) the Lower Cassian Beds represent the Upper Ladinian (Langobardian), and the Upper Cassian Beds the Lower Carnian (Cordevolian). Then, the Korytnica Limestones are equivalent only to the Upper Cassian Beds. When the Lower Cassian Beds were deposited in the Dolomites, quite different facies of the Reifling and/or Raming Limestones prevailed in the area of Liptovská Osada (Hronic — Choč nappe).

Zakład Paleobiologii
Polska Akademia Nauk
Al. Żwirki i Wigury 93
02-089 Warszawa, Poland
(A. Gaździcki)

Staatliche Museen Meiningen
Schloß Elisabethenburg
DDR — 61 Meiningen
(H. Kozur)

Katedra Geologie a Paleontológie
Prirodovedeckej Fakulty Univerzity
Komenského
Gottwaldovo nám. 19
886-02 Bratislava, ČSSR
(R. Mock)

Instytut Geologii Podstawowej
Uniwersytet Warszawski
Al. Żwirki i Wigury 93
02-089 Warszawa, Poland
(J. Trammer)

December 1977
REFERENCES


TRIASOWE MIKROSKAMENIAŁOŚCI Z WAPIENI KORYTNICKICH REJONU LIPTOWSKIEJ OSady (SŁOWACJA) I ICH ZNACZENIE STRATYGRAFICZNE

Streszczenie

Przedmiotem niniejszej pracy jest analiza zespołów mikroskamieniałości z wapieni korytnickich odsłaniających się w Zachodnich Karpatach w rejonie Liptowskiej Osady na Słowacji (figs 1—2). Wzmiankowane wapienie zawiera liczbę mikroskamieniałości, z których szczegółowo opracowano otwornice, igły gąbek, sklerety holoturii i konodonty (pis 41—53; tab. 1—4). Nowe gatunki rozpoznano jedynie w obrębie sklerytów holoturii. Są to: Eocaudina liptovskaensis sp.n., Kuehnites slovakensis sp.n., Praecaudina mosteri sp.n., Theelia liptovskaensis sp.n. i Theelia trammeri sp.n. Na podstawie wszystkich zbadanych mikroskamieniałości określono wiek wapieni korytnickich na dolny karnik (kordewol). Należy podkreślić, że także i igły gąbek, którym nie przypisuje się zazwyczaj znaczenia stratygraficznego mogą być przewodnie w zespole. Stwierdzono, że wapienie korytnickie z Karpat zawierają tę samą asocjację igieł gąbek co równowiekowe utworzy Alp (por. Mostler 1972a).

W nawiązaniu do sugestii Jablonský'ego (1973b) i Bujnovský'ego i innych (1975) o ogólnym podobieństwie wapieni korytnickich do warstw z St. Cassian w Dolomitach przeprowadzono dokładniejszą korelację tych dwóch kompleksów. W wyniku ustalono, że wapieniom korytnickim odpowiada jedynie górna część warstw z St. Cassian.

Ninnejsza praca została wykonana w ramach problemu międzyresortowego PAN MR II/3.
TRIASSIC MICROFOSSILS FROM THE KORYTNICA LIMESTONES

EXPLANATION OF THE PLATES 41—53

Plate 41

Microfacies from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada

1. Laminated biomicrite with sponge spicules and thin-walled shells of juvenile bivalves, ×10; sample L5.
2. Biomicrite with sponge spicules, ×60; sample L2.
3. Crinoid biomicrite, ×60; sample R3.
5. Biopelsparrudite composed of crinoid, brachiopod and algal (Solenopora) debris with onkolitic crusts, overlaid with crinoid biomicrite, ×7; sample R4.
6. Crinoid biopelsparenite, ×7; sample R2.

Plate 42

Foraminifers from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada

1—4. Galeanella? infundibuliforme (Jablonský), ×130; 1—3 from sample R7, 4 from sample R8, ZPAL F. XXII/R7, R8.
6—8. Duostomina sp., 6 ×80, 7, 8 ×65; 6 from sample R4, 7 from sample R6, 8 from sample R2, ZPAL F. XXII R2.
9—11. Tolypammina gregaria Wendt, 9 ×110, 10—11 ×40; sample R4, ZPAL F. XXII/R4.

ниферы, спиккулы губок, склериты голотурий и конодонты (пл. 41—53; табл. 1—4). Новые виды обнаружены только в группе склеритов гологруи: Eocaudina liptovskaensis sp. n., Kuehnites slovakensis sp. n., Praecaudina mostleri sp. n., Theelia liptovskaensis sp. n. и Theelia trammeri sp. n. На основе всех изученных микроокаменелостей возраст корытничковых известняков соответствует карнийскому ярусу (кордеволь). Следует подчеркнуть, что спиккулы губок, хотя не считаются руководящими ископаемыми, могут иметь стратиграфическое значение в ассоциации. Обнаружено, что корытничковые известняки из Карат содержат ту же ассоциацию спиккул губок, что и синхронные отложения Альп (Мостлер 1972).

Что касается предположения Яблонски (1973б) и Буйновски и др. (1975) об общем сходстве корытничковых известняков с кассийскими слоями Доломитовых Альп проведена детальная корреляция этих комплексов, в результате которой установлено, что корытничковым известнякам соответствует только верхняя часть кассийских слоёв.
Plate 43

Foraminifers from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada

1—3. *Ophthalmidium* sp., 1, 2 × 80, 3 × 110; 1 from sample R₉, 2 from sample R₄, 3 from sample R₃, ZPAL F. XXII/R₄, R₉.


9—10. ?*Turritellella* sp., 9 × 80, 10 × 110; sample R₈, ZPAL F. XXII/R₈.


12. ?*Ammobaculites* sp., × 40; sample R₄, ZPAL F. XXII/R₄.

Plate 44

Foraminifers from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada

1. *Involutina eomesozoica eomesozoica* (Oberhauser), × 110; sample R₄, ZPAL F. XXII/R₄.

2. *Involutina planidiscoides* (Oberhauser), × 110; sample R₄, ZPAL F. XXII/R₄.

3. *Involutina* sp., × 110; sample R₄, ZPAL F. XXII/R₄.


5. *Involutina gachieri praegaschei* Koehn-Zaninetti, × 60; sample R₂, ZPAL F. XXII/R₂.

6. ?*Involutina* sp., × 110; sample L₅, ZPAL F. XXII/L₅.

7. 9. *Pachyphloides* sp., 7 × 60, 9 × 110; sample R₃, ZPAL F. XXII/R₃.

8. *Pachyphloides klebelsbergi* (Oberhauser), × 40; sample R₃, ZPAL F. XXII/R₃.

Plate 45

Foraminifers from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada

All figures are SEM photographs

1. ?*Frondinodosaria* sp., × 100; sample R₄, ZPAL F. XXII/1.

2. *Lenticulina* sp., × 60; sample R₄, ZPAL F. XXII/2.

3. *Nodosaria* sp., × 75; sample R₄, ZPAL F. XXII/3.

4. *Astacolus* sp., × 60; sample R₂, ZPAL F. XXII/4.

5. *Pachyphloides* sp., × 75; sample R₂, ZPAL F. XXII/5.


7. *Ammodiscus* sp., × 200; sample R₅, ZPAL F. XXII/7.

Plate 46

Sponge spicules from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada

All figures are SEM photographs × 100

1. Orthodichotriaene; sample R₄, ZPAL Pf. II/1.

2. Orthodichotriaene; sample R₅, ZPAL Pf. II/2.
3. Orthodichotriaene, a form transitional to orthotrachotriaene; sample L², ZPAL Pf. II/3.
5. Oxyhexactine; sample L³, ZPAL Pf. II/5.
6. Orthodichotriaene; sample R₅, ZPAL Pf. II/6.

Plate 47

Sponge spicules and a conodont from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada
All figures are SEM photographs

1. Oxyaster, × 200; sample R₅, ZPAL Pf. II/7.
3. Oxycalthrop, × 100; sample L₂, ZPAL Pf. II/9.
4. Ocytriactine, × 100; sample L₂, ZPAL Pf. II/10.
5. Amphiasster, × 250; sample L₂, ZPAL Pf. II/11.

Plate 48

Conodonts from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada
All figures are SEM photographs × 100 (only figure 8 × 200)

1. Gondolella polygonatiformis Budurov and Stefanov; sample R₇, ZPAL C. IX/1.
2. Gladigondolella malayensis Nogami, a juvenile form in side view; sample R₅, ZPAL C. IX/2.
3. Gladigondolella malayensis Nogami; sample R⁵, ZPAL C. IX/3.
5. Gladigondolella malayensis Nogami, bottom view; sample R₂, ZPAL C. IX/5.
7. Gondolella navicula Huckriede; sample R₄, ZPAL C. IX/7.
8. Enantiognathus jungi (Mosher); sample R₃, ZPAL C. IX/8.

Plate 49

Holothurian sclerites from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada
All figures are SEM photographs.

1. Acanthotheeia aff. ladinica Kozur and Mostler: upper view, × 120; sample R₂, PFUK 372.
2—3. Acanthotheeia spinosa Frizzell and Exline, 2 × 120, 3 × 100; 2 from sample R₄, 3 from sample L₂, PFUK 359, 6660.
4—6. Achistrum triassicum Frizzell and Exline, 4—5 × 60, 6 × 60 and × 250; 4 from sample L₂, 5 from sample R₄, 6 from sample L₅, PFUK 6658, 368, 392.
7—8. Calclamna germanica Frizzell and Exline, 7 × 110, 8 × 100; 7 from sample R₄, 8 from sample R₂, PFUK 350, 371.
9. Calclamna germanica Frizzell and Exline, a transition form to Calclamna nuda (Mostler), × 110; sample R₄, PFUK 351.
Plate 50

Holothurian sclerites from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada
All figures are SEM photographs

1—2. *Caldamna nuda* (Mostler), 1 × 120, 2 × 170; 1 from sample R₄, 2 from sample L₄, PFUK 352, 340.
3. *Eocaudina ramosa* Kozur and Mostler, × 50; sample L₁, PFUK 6655.
4. *Kuehnites slovakensis* Kozur and Mock sp.n., holotype, × 150; sample L₄, PFUK 6667.
5. *Eocaudina liptovskaensis* Kozur and Mock sp.n., holotype, × 110; sample R₂, PFUK 369.
7—8. *Theelia aff. lata* Kozur and Mostler, upper views, 7 × 150, 8 × 130; 7 from sample R₃, 8 from sample R₆, PFUK 339, 396.

Plate 51

Holothurian sclerites from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada
All figures are SEM photographs

1—4. *Eocaudina cassianensis* Frizzell and Exline, 1, 3—4 × 70, 2 × 60; 1, 3 from sample L₃, 2 from sample L₁, 4 from sample L₅, PFUK 387, 6657, 384, 391.
5. *Praecaudina mostleri* Kozur and Mock sp.n., holotype, × 100; sample R₄, PFUK 364.

Plate 52

Holothurian sclerites from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada
All figures are SEM photographs

1. *Theelia undata* Mostler, a transition form to *Th. koeveskalensis* Kozur and Mostler, upper view, × 140; sample R₄, PFUK 357.
2—9. *Theelia koeveskalensis* Kozur and Mostler, 8—9 lower views, 2, 4—7 × 150, 3 × 140, 8 × 175; 2, 6—7 from sample L₃, 3 from sample L₁, 4 from sample L₄, 5 from sample L₅, 8 from sample R₃, PFUK 6662, 6653, 333, 389, 6666, 343.

Plate 53

Holothurian sclerites from the Korytnica Limestones (Lower Carnian, Cordevolian) at Liptovská Osada
All figures are SEM photographs

1. *Theelia liptovskaensis* Kozur and Mock sp.n., holotype, × 200; sample R₄, PFUK 354.
2. *Theelia liptovskaensis* Kozur and Mock sp.n., × 200; sample R₆, PRUK 398.
3. *Theelia teplovskensis* Kozur and Mock sp.n., ×225; sample L2, PFUK 383.

4. *Theelia trammeri* Kozur and Mock sp.n., holotype, upper view, ×90; sample L4, PFUK 6651.

5—7. *Theelia trammeri* Kozur and Mock sp.n., 5—6 upper views, 7—lower view, ×100; 5 from sample R4, 6 from sample R4, 7 from sample L2, PFUK 397, 353, 6661.

8—9. *Theelia immisoricula* Mostler, 8 lower view, 9 side view, 8 ×150, 9 ×120; sample L4, PFUK 356, 337.