A new late Givetian rhynchonellid species from the Holy Cross Mountains, Poland, and its relevance to stratigraphical and ecological problems near the Givetian/Frasnian boundary

by Paul SARTENAER and Grzegorz RACKI

Abstract

A new rhynchonellid species, Hadrotatorhynchus laskowaensis, is described from the Klapperina disparilis Zone of the Holy Cross Mountains in Poland, and its stratigraphical and ecological meanings are stressed. The species is another example of the importance of the genus Hadrotatorhynchus Sartenaer, 1986 both as a tool for correlating late Givetian beds and as an element of the succession of the rhynchonellid genera Hadrotatorhynchus - Phlogoiderhynchus Sartenaer, 1970 across the Givetian/Frasnian boundary. In the Lysogóry facies region this boundary can consequently be placed near the top of the middle member of the Szydłowiek Beds composed of marly shales containing large-sized P. polonicus (Roemer, 1866), and succeeded by the upper member, which is characterized by a small-size variety of the same species, and is mostly composed of platy marly limestones passing laterally into detrital beds. Hadrotatorhynchus laskowaensis n.sp. thrived in shallower water than the succeeding Phlogoiderhynchus polonicus, and forms chiefly monospecific shell banks on the storm-disturbed, prograding carbonate slope bordering the Lysogóry intrashelf basin.

Key-words: Hadrotatorhynchus laskowaensis - rhynchonellids - late Givetian - early Frasnian - Holy Cross Mountains.

Résumé

Une nouvelle espèce, Hadrotatorhynchus laskowaensis, de la Zone à Klapperina disparilis des Monts Sainte-Croix de Pologne est décrite et sa signification stratigraphique et écologique est mise en évidence. L'espèce constitue un nouvel exemple de l'importance du genre Hadrotatorhynchus Sartenaer, 1986 pour la corrélation des couches d'âge givetien terminal et en tant qu'élément de la succession des genres Rynchonellides Hadrotatorhynchus - Phlogoiderhynchus Sartenaer, 1970 de part et d'autre de la limite Givetien/Frasnien. Dans la région du facies de Lysogóry, cette limite peut être placée en conséquence dans la partie supérieure du membre moyen des Couches de Szydłowiek, composé de schistes marneux contenant des spécimens de P. polonicus (Roemer, 1866) de grande taille, auquel succède le membre supérieur, caractérisé par une variété de petite taille de la même espèce et composé principalement de calcaires marneux en plaquettes passant latéralement à des bancs détritiques. Hadrotatorhynchus laskowaensis n.sp. vivait dans des eaux moins profondes que Phlogoiderhynchus polonicus qui lui succède et qui forme à elle seule des bancs coquilliers sur la pente calcaire en voie de progradation et soumise à l'action des tempêtes en bordure du bassin de Lysogóry creusé dans la plate-forme continentale.


Streszczenie

Nowy gatunek rynchonellida Hadrotatorhynchus laskowaensis został opisany z poziomu Klapperina disparilis Gór Świętokrzyskich w Polsce i jego znaczenie stratygraficzne oraz ekologiczne jest uwypuklone. Gatunek ten stanowi kolejny przykład znaczenia rodzaju Hadrotatorhynchus Sartenaer, 1986, zarówno jako narzędzia do korelacji utworów późnożyweckich jak i elementu w sekwencji rodzajów rynchonellidów Hadrotatorhynchus - Phlogoiderhynchus Sartenaer, 1970 po obu stronach granicy żywej/frasniany. W lysiogórskim regionie faładowym granica ta może być konsekwentnie umiejscowiona w wyższej części warstw szydłóweckich; środowiskowe ogniwo składa się z łupków marglistych zawierających duże odmiany P. polonicus (Roemer, 1866) i zastąpione jest w sekwencji przez górne ogniwo (głównie płaty wapienne marglisty) przechodzące obecnie w warstwy detrytyczne i charakteryzujące się występowaniem małej odmiany tego gatunku. Hadrotatorhynchus laskowaensis n.sp. rozwinął się w mniej głębokich wodach niż stratygraficznie młodszy, ekspansywny Phlogoiderhynchus polonicus i tworzył na ogół jednogatunkowe ławice morskie na podlegającym oddziaływaniom sztormów, progradującym sklonie włączającym ograniczającym lysiogórski basen śródszelfowy.

Key - words: Hadrotatorhynchus laskowaensis - rynchonellids - późny żywej - wczesny frasniany - Góry Świętokrzyskie.

Introduction

Brachiopods are among the most frequently reported fossils in the Devonian of the Holy Cross Mountains, but little work has been undertaken on their taxonomy and biostratigraphy. This is true particularly for the western part of the Lysogóry (northern) palaeogeographical region (Fig. 1A), where abundant Givetian and Frasnian faunas are known to occur (see RACKI, GLUCHOWSKI & MALEC, 1985, pp.165-167, 169).

This paper is a refinement of the one presented by RACKI (1986) on the distribution of the common species Phlogoiderhynchus polonicus (Roemer, 1866), which BIERNAT & SZULCZEWSKI (1975, p.212) considered of great significance for regional correlation of early Frasnian strata. Current study of the brachiopod succession across the Givetian/Frasnian boundary in the Lysogóry region indicates abundant occurrence of a new Givetian species of the genus Hadrotatorhynchus Sartenaer, 1986. Some problems related to the rhynchonellid suc-
The main collection examined comes from the basal part of the Szydłówek Beds exposed in the northeastern part of Laskowa Hill Quarry at Kostomloty, northwest of Kielce (set B, RACKI, GLUCHOWSKI & MALEC, 1985, pl.1, fig. 3, p. 163, fig.4, p. 164; and RACKI, 1985, fig.2, p.268, figs.3,4 between p.268 and p.269, pl. 1, fig.1). This marly lithostratigraphical unit, at least 50m thick, contains in its lower part some intercalations of detrital limestone (mostly calcarenites); one of them occurring at 6.2m above the base, is an up to 0.2m thick brachiopod coquina of Hadrotatorhynchus laskowaensis n. sp. The reader is reminded that the International Subcommission on Devonian Stratigraphy has decided, in Frankfurt/Main (1982), the base of the Frasnian (and the Middle/Upper Devonian Series Boundary) to be the lower boundary of the Lower Polygnathus asymmetricus Zone. This decision has been approved by the International Commission on Stratigraphy, and ratified by the International Geological Congress held in Moscow in 1984.
larly dolomitised crinoid-brachiopod calcarenites. These beds are also in the *Klapperina disparilis* Zone, but apparently in its lower part (viz. with *K. disparata*). Thus, *Hadrotatorhynchus laskowaensis* n. sp. is found at the base and at the top of a thickness of beds of about 7.4m.

**Systematic Description (P.S.)**

*Hadrotatorhynchus laskowaensis* n.sp.

(Plate 1, Figures 1a-e, 2a-e, 3a-e, 4a-e, 5a-e, 6a-e, 7a-e, 8a-e; Text-fig.3)

**SYNONYMY**

1985 *Platyterorhynchus* (?) sp.n. - SARTENAER (personal communication) in RACKI, GLUCHOWSKI & MALEC, p.166, pl.X, figs.1a-c;
1985 *Phlogoiderhynchus* sp.n. (? new genus) - SARTENAER in RACKI, GLUCHOWSKI & MALEC, p.167;
1986 species from the Holy Cross Mountains (Poland) - SARTENAER, p.137, p.138, p.141.

**DERIVATIO NOMINIS**

From Laskowa Hill, Holy Cross Mountains, Poland.

**TYPES**

GIUS: Geological Institute University of Sosnowiec; 4: Devonian; La: Laskowa Hill Quarry; 296 and 297: specimens from set A and set B respectively.

Holotype, GIUS4 - 297La/1 (Pl.1, Figs.2a-e); Paratypes A, GIUS4 - 297La/2 (Pl.1, Figs.1a-e), B, GIUS4 - 297La/3 (Pl.1, Figs.4a-e), C, GIUS4 - 297La/4 (Pl.1, Figs.5a-e), D, GIUS4 - 297La/5 (Pl.1, Figs.3a-e), E, GIUS4 - 297La/6 (Pl.1, Figs.7a-e), F, GIUS4 - 297La/7 (Pl.1, Figs.8a-e), G, GIUS4 - 297La/8 (Pl.1, Figs.6a-e), J, GIUS4 - 297La/9 (Fig.3). A 0.2m thick calcarenite located in the lower part (set B) of the Szydłówek Beds, at 6.2m above the base, Laskowa Hill Quarry, at Kosnół, north-west of Kielce, 297La. Collector: RACKI, 1984.

Paratypes H, GIUS4 - 296La/1, I, GIUS4 - 296La/2. Bed one metre below the top of the thick calcarenite beds located in the upper part of the Laskowa Hill Beds (=Fossiliferous Limestones and Marls = set A of RACKI, GLUCHOWSKI & MALEC, 1985, pl.I, fig.3, p.163, fig.4, p.164, and RACKI, 1985, fig.2, p.268, fig.3,4 between p.268 and p.269, pl.1, fig.1; Laskowa Hill Beds of NARKIEWICZ, RACKI & WRZOLEK, 1990, fig.2, p.439, p.452) about one metre below the top. Same locality as Holotype. Locality 296La. Collector: RACKI, 1984.

Plaster casts of these primary types have been made and are deposited in the Royal Institute of Natural Sciences of Belgium in Brussels under the number 27770. A plaster cast of paratype J was made before grinding and is joined to the remainder of the specimen.
LOCUS TYPICUS
Northeastern part of Laskowa Hill Quarry at Kos- tomloty, north-west of Kielce, Holy Cross Mountains, Poland.

STRATUM TYPICUM
A 0.2m thick brachiopod calcarenite located in the lower part (set B of Racki, Gluchowski & Malec, 1985, pl.1, fig.3, p.163, fig.4, p.164, and Racki, 1985, fig.2, p.268, figs.3,4 between p.268 and p.269, pl.1, fig.1) of the Szydlówek Beds of late Givetian - early Frasnian age, at 6.2m above the base. In terms of conodont chronology, this calcarenite is located in the higher part of the Klapperina disparilis Zone.

MATERIAL. STATE OF PRESERVATION
Seventy four specimens from locality 297La: thirty two specimens are in a good state, and thirteen in a satisfactory state of preservation; twenty five specimens are fragmental; five specimens are isolated valves.
Twenty five specimens from locality 296La: three specimens are in good state, and five in satisfactory state of preservation; five specimens are fragmental; twelve specimens are poorly preserved isolated valves.

DESCRIPTION

General external characters
Medium to large sized. Front margin uniplicate. Thick-set and bulging. Inequivalve, the thickness of the pedicle valve varying from 35 to 43 per cent of the thickness of the shell. Transversely subelliptical, sometimes tending to become subcircular, in ventral and dorsal views, subelliptical to suboval in frontal view. Commissure sharp, slightly or hardly (exceptionally not) undulated by the low costae. Cardinal line is more or less long, and slightly undulating. Postero-lateral margins concave near the commissure. Commissures are located high as seen in lateral profile.

Pedicle valve
Contour of pedicle valve is a low half-ellipse or half-oval in longitudinal median sections, and a flattened half-ellipse in transverse median sections. Flanks regularly convex sloping sometimes gently, sometimes steeply toward the lateral commissures, but becoming always steeper near the postero-lateral commissures. Well marked sulcus, wide at front, beginning well in front of the beak: 45-67 per cent of the length of the shell (most values between 55 and 62 per cent) or 34-50 per cent of the unrolled length of the valve (most values between 45 and 50 per cent). Sulcus is shallow to moderately deep; bottom of sulcus is flat to slightly convex; width of sulcus at point of origin varies from 27 to 48 per cent of its greatest width (60-70 per cent of the width of the shell at the junction of the frontal and lateral commissures). Tongue trapezoidal or slightly arched, moderately high to high with sharp borders, standing out clearly, vertical or almost vertical at its crest. The top of the tongue is the top of the shell for 45.85 per cent of the specimens, and in almost half of them the fold becomes slightly concave before reaching the front. Beak thick-set, erect to slightly incurved, overhanging the cardinal line, and often almost in contact with the dorsal umbonal region. Interarea ill-defined. No deltidial plates have been observed in transverse serial sections.

Brachial valve
Curve of the brachial valve is one quarter of an ellipse in longitudinal median sections. Flanks uniformly convex. Umbonal region tangential to a vertical plane. Well marked fold, moderately high to high, wide at front, beginning well in front of the beak. Top of the fold is flat or slightly convex. A slight, more or less median depression is rarely observed in the anterior third of the fold; it affects the frontal commissure.

Ornament
The general costal formula is: 5 to 7 ; 0; 7 to 11. The general costal formula gives a grouping of at least 75 per cent of the specimens in the categories: median, parietal, and lateral.

The median and lateral costae are distributed as follows:

<table>
<thead>
<tr>
<th>Median</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of costae</td>
<td>Number of specimens</td>
</tr>
<tr>
<td>4/3</td>
<td>1</td>
</tr>
<tr>
<td>5/4</td>
<td>12</td>
</tr>
<tr>
<td>6/5</td>
<td>14</td>
</tr>
<tr>
<td>7/6</td>
<td>7</td>
</tr>
<tr>
<td>8/7</td>
<td>3</td>
</tr>
<tr>
<td>37</td>
<td>100</td>
</tr>
<tr>
<td>11/12</td>
<td>4</td>
</tr>
<tr>
<td>12/13</td>
<td>1</td>
</tr>
<tr>
<td>28</td>
<td>100</td>
</tr>
</tbody>
</table>

Costae low, rounded. Median costae starting at a great distance from the beaks, almost where sulcus and fold start. Median costae are sometimes divided or intercalated, but even without these divisions and intercalations they are often irregular because they differ in width. Lateral costae begin on the border of the umbonal regions, but the most external ones are restricted to the margins of the flanks and are often evident only as mere undulation(s) of the commissure. Sometimes one (exceptionally two) internal lateral costa does not reach the commissure. Parietal costae are rarely present; when present, there is generally one parietal costa, exceptionally (in three specimens) two.
**Dimensions**

Measurements of ten specimens, of which eight are photographed:

<table>
<thead>
<tr>
<th></th>
<th>Paratype H</th>
<th>Paratype A</th>
<th>Holotype</th>
<th>Paratype I</th>
<th>Paratype B</th>
<th>Paratype C</th>
<th>Paratype D</th>
<th>Paratype E</th>
<th>Paratype F</th>
<th>Paratype G</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>l</strong></td>
<td>25.9</td>
<td>(23.2)</td>
<td>22.8</td>
<td>22.5</td>
<td>(22.1)</td>
<td>21.8</td>
<td>21.2</td>
<td>20.8</td>
<td>19.7</td>
<td>19.6</td>
</tr>
<tr>
<td><strong>w</strong></td>
<td>31.5</td>
<td>(31.4)</td>
<td>30.6</td>
<td>(28.3)</td>
<td>28.5</td>
<td>28.7</td>
<td>30</td>
<td>25.7</td>
<td>25.2</td>
<td>27.5</td>
</tr>
<tr>
<td><strong>lpv unrolled</strong></td>
<td>44.5</td>
<td>42</td>
<td>39</td>
<td>39.5</td>
<td>(40)</td>
<td>39</td>
<td>35.5</td>
<td>36</td>
<td>35</td>
<td>32.5</td>
</tr>
<tr>
<td><strong>t</strong></td>
<td>20.7</td>
<td>20</td>
<td>19.2</td>
<td>(18.6)</td>
<td>21.5</td>
<td>18.9</td>
<td>17.5</td>
<td>17.4</td>
<td>16.3</td>
<td>16.1</td>
</tr>
<tr>
<td><strong>tpv</strong></td>
<td>8.1</td>
<td>7.8</td>
<td>7.5</td>
<td>7.7</td>
<td>8.2</td>
<td>7.3</td>
<td>6.5</td>
<td>7.4</td>
<td>6.8</td>
<td>6.8</td>
</tr>
<tr>
<td><strong>tbv</strong></td>
<td>12.6</td>
<td>12.2</td>
<td>11.7</td>
<td>(10.9)</td>
<td>13.3</td>
<td>11.6</td>
<td>11</td>
<td>10</td>
<td>9.5</td>
<td>9.3</td>
</tr>
<tr>
<td><strong>l/w</strong></td>
<td>0.82</td>
<td>(0.74)</td>
<td>0.75</td>
<td>(0.80)</td>
<td>(0.78)</td>
<td>0.76</td>
<td>0.71</td>
<td>0.81</td>
<td>0.78</td>
<td>0.71</td>
</tr>
<tr>
<td><strong>t/w</strong></td>
<td>0.66</td>
<td>(0.64)</td>
<td>0.63</td>
<td>(0.66)</td>
<td>0.75</td>
<td>0.66</td>
<td>0.58</td>
<td>0.68</td>
<td>0.65</td>
<td>0.59</td>
</tr>
<tr>
<td><strong>t/l</strong></td>
<td>0.80</td>
<td>(0.86)</td>
<td>0.84</td>
<td>(0.83)</td>
<td>(0.97)</td>
<td>0.87</td>
<td>0.83</td>
<td>0.84</td>
<td>0.83</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>apical angle</strong></td>
<td>131°</td>
<td>134°</td>
<td>135°</td>
<td>(135°)</td>
<td>133°</td>
<td>133°</td>
<td>133°</td>
<td>129°</td>
<td>135°</td>
<td>137°</td>
</tr>
<tr>
<td><strong>angle of the cardinal commissure</strong></td>
<td>138°</td>
<td>140°</td>
<td>143°</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>(140°)</td>
<td>137°</td>
<td>139°</td>
<td>141°</td>
</tr>
</tbody>
</table>

The abbreviations used are: l = length; w = width; t = thickness; pv = pedicle valve; bv = brachial valve. Measurements shown in parentheses indicate a reasonable estimate on a damaged specimen.

Highest part of pedicle valve is located between 31 and 42 per cent of the length of the shell or between 24 and 36 per cent of the unrolled length of the valve. Greatest thickness of the shell is located, in 54.15 per cent of the specimens, at a variable point posterior to the frontal commissure; from this point the brachial valve either curves gently toward this commissure (37.5 per cent) or stays at this level (16.65 per cent). In the remaining 45.85 per cent of the specimens, the greatest thickness of the shell is reached at the frontal commissure, either directly (18.75 per cent) or as the result of the fold becoming concave before reaching this commissure (27.1 per cent). Width is always the largest dimension. Maximum width of shell occurs, with very few exceptions, at a point between 45 and 61 per cent (most values are between 50 and 61 per cent) of the length of the shell anterior to the ventral beak. Apical angle varies from 127° to 140° (most values are between 133° and 137°). Angle of the cardinal commissure varies from 135° to 145°.

**Internal characters**

The characteristic features of the genus can easily be recognized on figure 3, among others: no clear but only residual dental plates, stout and widely separated teeth, long and lamellar septum, no true outer hinge plates, crural trough, delicate crural bases, short crura curved at their distal ends.

**Comparisons**

*Hadrotatorhynchus laskowaensis* n. sp. may be distinguished from *H. halli* FLAMAND, 1911, the type species of the genus, by: sulcus, fold, and median costae starting generally farther away from the beaks; top of tongue never strongly arched; fold becoming slightly concave before reaching the front (this happens seldom in *H. halli*); the possibility of reaching higher numbers of costae, although the general costal formulae are similar; the greatest thickness of the shell reached at the frontal commissure in almost half the specimens (this is exceptional in *H. halli*).

**Biostratigraphical and ecological aspects (G.R.)**

The discovery of a species of the genus *Hadrotatorhynchus* in the Holy Cross Mountains supplies, in spite of its isolated nature, new data for stratigraphical and ecological refinement of the *Phlogoiderhynchus* group, believed to be of more than regional significance.

**Biostratigraphy**

As already emphasized by SARTENAER (1986, p.138, p.141), the range of the Polish species of *Hadrotatorhynchus* is restricted to the *Klapperina dispersilis* Zone, which corresponds to the age of the North African (Algeria and Morocco) representatives of the genus, and thus is useful for intercontinental correlation. Furthermore he underlined that the succession in time of the genera *Hadrotatorhynchus* and *Phlogoiderhynchus* is of basic importance for biostratigraphical evaluation of the Middle/Upper Devonian boundary. The age of the genus *Phlogoiderhynchus*, as presently known, is that of
the Mesotaxis falsiovalis to Palmatolepis punctata Zones (see SARTENAER, 1985, p.314) and straddles this boundary. The same succession is found in the Holy Cross Mountains, where the thickest sequence with rhynchonellids has been described by RACKI, GLUCHOWSKI & MALEC (1985, p.162, pp.166-167) in the Kostomolaty section. Hadrotatorhynchus laskowaensis n. sp. is found in rocks overlying older Givetian [Middle Polygnathus varcus Subzone to Schmidtiognathus hermanni-Polygnathus cristatus Zone (= S. hermanni Zone of KLAPPER & JOHNSON, 1990, p.934)] assemblages of the Laskowa Hill Beds (= Fossiliferous Limestones at Szydlówek, 1980, pp.30-31; in RACKI & al., 1991, in press). This morphological difference is probably not only related to environmental factors as pointed out by BIERNAT & SZULCZEWSKI (1975, p.214), because the small variety occurs in contrasting lithological settings and habitats comprising pelagic Styliolina shales as well as detrital beds with redeposited stromatoporoids and corals.

This conclusion is a first attempt to elucidate the wide intraspecific variability of P.polonicus advocated by BIERNAT & SZULCZEWSKI (1975, pp.206-208). The biostratigraphical significance of rhynchonellid data available can be summarized in the following tentative sequence (Fig.4):

1. Hadrotatorhynchus laskowaensis n. sp. is restricted to the upper part of the Laskowa Hill Beds and to the lower part of the Szydlówek Beds, i.e. to the Klapperina disparilis Zone;
2. The entry of Phlogoiderhynchus polonicus corresponds approximately to the boundary between the Klapperina disparilis and Mesotaxis falsiovalis Zones, according to the range of the genus given by SARTENAER (1980, p.19; 1985, p.314; 1986, p.137);
3. A small-sized morphotype of Phlogoiderhynchus polonicus is a conspicuous fossil of the upper member (early Frasnian) of the Szydlówek Beds and their detrital equivalents.

Data on the Ancyrodella succession in the Czarnów section (BULTYNCK & RACKI, 1991, in press) suggest that the Givetian/Frasnian boundary falls somewhere in the uppermost part, or even near the top, of the range of the large-sized Phlogoiderhynchus polonicus.

The following questions need further accurate palaeontological analysis: the reappearance of fairly large and evenly biconvex P.polonicus in the southern Kielce region (especially the Kowala site; BIERNAT & SZULCZEWSKI, 1975, p.207, p.214), and its southward expansion during early Frasnian transgressive pulses suggested by RACKI (1986, p.209). It could be a relict occurrence of the genus on account of its exceptionally high stratigraphical position (Palmatolepis punctata Zone).
ECOLOGY

BIERNAT & SZULCZEWSKI (1975, pp.213-215) stated that the widespread *Phlogoiderhynchus polonicus* thrived in a relatively deep water, calm and muddy habitat, below storm base. This species, of which adult specimens were probably free-lying, has been found in various marly (typically bituminous) and micritic deposits, and only sporadically (see above) in detrital limestones, which are considered to have formed in shallower water and in turbulent conditions.

*Hadrotatorhynchus laskowaensis* n. sp., which occurs only in the Laskowa Hill Quarry, behaves ecologically very differently. At its main occurrence it forms a typical monospecific high-density (up to 20 specimens per dm² square) coquina that varies laterally in thickness (Fig.5) and probably pinches out completely. Shells are mostly disarticulated, sometimes fragmented, and val-
ves have, in some places, perpendicular and stacking positions. Size sorting is obviously due to strong dominance of large shell remains, rarely with adhering or contained brownish pelitic sediment, distinctly different from black fine-grained interstitial deposits. The matrix consists chiefly of intrabionomic sparite, suggesting a primary packstone texture affected by progressive neomorphism. The most common skeletal constituents include fine echinoderm detritus (crinoid remains, echinoid spines), ostracods and gastropods. Moreover, high amounts of bioclasts (calcispheres and other parathuromminaloid “foraminifera”) as well as clotted (cryptagal) micrite or micritized grains derived from shallow water, partly restricted-marine environments (see Racki & Balinski, 1981, pp.188-189) indicate a platform debris supply from the adjacent Kiecie region. The shell bed considered is interpretable (see e.g. whole fossil packstone of Kreisa, 1981, pp.829-830) as a severely winnowed skeletal lag accumulation. However, it is important to note that this layer is embedded in fossil-poor (background) marly deposits (with Styliolina in places), and similar rhytonellid low-density occurrences are limited to underlying detrital beds. For such cases Brett, Speyer & Baird (1986, pp.137-139) and Kidwell, Fürsich & Aigner (1986, p.235) prefer a model of episodic low depositional rates, due either to regional sediment starvation or to locally altered current patterns. These shell beds probably represent both longer interval(s) of the skeletal concentration under sediment-starved conditions, and final storm reworking and rapid burial in resuspended fine-grained sediments. Indeed, skeletal cavities filled mostly with interstitial sediment (Fig.5) suggest, according to Brett & Baird (1986, p.221), slow net deposition. On the other hand, significance of down-slope transport, and consequently, strictly paraautochthonous status of the shelly material remain an open question for the Laskowa Hill coquina. Evidently, the reworking was more significant in the case of the lowest occurrence of Hadrotatorhynchus laskowaensis n. sp in the uppermost Laskowa Hill Beds. The calcarenites locally contain rich crinoid debris and intraclastic partings (see Racki, Gluchowski & Malec, 1985, pl.4, fig.4), and diversified, but more fragmented, brachiopods, such as Hypothyridina, Warrenella and atrypids. In conclusion, the storm-disturbed banks of Hadrotatorhynchus laskowaensis n. sp. flourished locally on a prograding carbonate slope forming the southern border of the Lysogory intrashelf basin. The succeeding species, Phlogoiderhynchus polonicus, expanded geographically as a result of progressive development of this basin, but its expansion was connected also with successful colonization of deeper, semi-stagnant and oxygen-deficient biotopes (Racki, 1989, p.148) as, for example, is the case for the “Leiorhynchus” fauna of the Middle and Upper Devonian of southwestern New York (see e.g. Thompson & Newton, 1987, pp.274-280), and generally speaking, for the widespread Rhythonellid Biofacies typical of basinal (off-reef) settings, as discussed by Racki & al. (1991, in press). According to Racki (1986, pp.209-210;
RACKI & al., 1991, in press), the expansion of similarly shaped large rhyynchonellids is a remarkable brachiopod event in many basins developing as a result of late Givetian through early Frasnian progressive onlaps. In this context differences in shell convexity within the Phlogoiderhynchus group, which are important from a taxonomic point of view, may be partly a functional reflection of evolutionary habitat shift linked to disparate bottom preferences: firmer and sandy for the genus Hadrotatorhynchus, unstable and muddy for the flatter genus Phlogoiderhynchus. This hypothesis could be checked by examination of other occurrences of these genera, e.g. in Morocco.

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References


THOMPSON, J.B. & NEWTON, C.R., 1987. Ecological reinter-
pretation of the dysaerobic Leiorhynchus fauna: Upper Devo-
274-281.

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Plate 1

_Hadrotarhynchos laskowaensis_ n. sp.

All figures are natural size

a = ventral view; b = dorsal view; c = frontal view; d = apical view; e = lateral view

Figs.1a-e. Paratype A, GIUS4 - 297La/2. Costal formula: $\frac{7}{6}$; $\frac{10}{1}$; $\frac{12}{13}$.

Figs.2a-e. Holotype, GIUS4 - 297La/1. Costal formula: $\frac{9}{6}$; $\frac{0}{10}$.

Figs.3a-e. Paratype D, GIUS4 - 297La/5. Costal formula: $\frac{5}{4}$; $\frac{0}{10}$.

Figs.4a-e. Paratype B, GIUS4 - 297La/3. Costal formula: $\frac{7}{6}$; $\frac{0}{12}$.

Figs.5a-e. Paratype C, GIUS4 - 297La/4. Costal formula: $\frac{4}{4}$; $\frac{0}{7}$.

Figs.6a-e. Paratype G, GIUS4 - 297La/8. Costal formula: $\frac{5}{4}$; $\frac{0}{9}$.

Figs.7a-e. Paratype E, GIUS4 - 297La/6. Costal formula: $\frac{6}{5}$; $\frac{0}{8}$.

Figs.8a-e. Paratype F, GIUS4 - 297La/7. Costal formula: $\frac{6}{5}$; $\frac{0}{8}$.