

A new atrypid genus (Brachiopoda) from the Frasnian of Poland

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A new atrypid *Waiotrypa sulcicarina* gen. et sp. n. from the late Frasnian of the Holy Cross Mountains is proposed. The new genus is close to *Iowatrypa* Copper, 1973 from which it differs mainly in having a keeled pedicle valve and sulcate brachial valve. *Waiotrypa* is one of the latest atrypids prior to extinction of the order at the end of the Frasnian.

Key words: Atrypida, Brachiopoda, Late Devonian, Poland.

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Introduction

The Frasnian–Famennian mass extinction resulted in one of the most extensive ecosystem deteriorations of the Phanerozoic (e.g., Algeo *et al.* 1995; McGhee 1989, 1996; Narkiewicz & Hoffman 1989; Sepkoski 1986). The temporal duration and geological scenario of the Late Devonian event have been the subject of considerable debate. In the past decade a substantial amount of palaeontological data has been collected from this important interval. There is no doubt, however, that many detailed questions concerning the F–F mass extinction remain unresolved.

One of the most severely affected groups of marine invertebrates during the F–F extinction were the spire-bearing brachiopods. Especially dramatic was the disappearance of the entire order Atrypida near the end of the Frasnian. It is crucial to analyze detailed atrypid diversity at generic and species levels and its temporal changes. This problem, among others, has been studied by an international team in 1994–1996, stimulated and supervised by Dr. Grzegorz Racki (results in preparation). This paper is a preliminary step to a more comprehensive review of the atrypid fauna from the Frasnian of the Holy Cross Mountains (in preparation).

Geologic and stratigraphic setting

The studied collection comes from two localities in the southern part of the Holy Cross Mountains (central Poland) on the southern limb of the Głęczycze Syncline (Fig. 1). One of these localities is known as Łgawa Hill, where a nearly complete Middle to Late Devonian carbonate succession is exposed (Racki 1981; Miklas 1993). A rich brachiopod fauna was found in the coquinite partings in the bedded-nodular marly complex R of Racki (1981). This part of the section (Fig. 1) is correlated with the *Palmatolepis rhenana* Zone (late Frasnian).

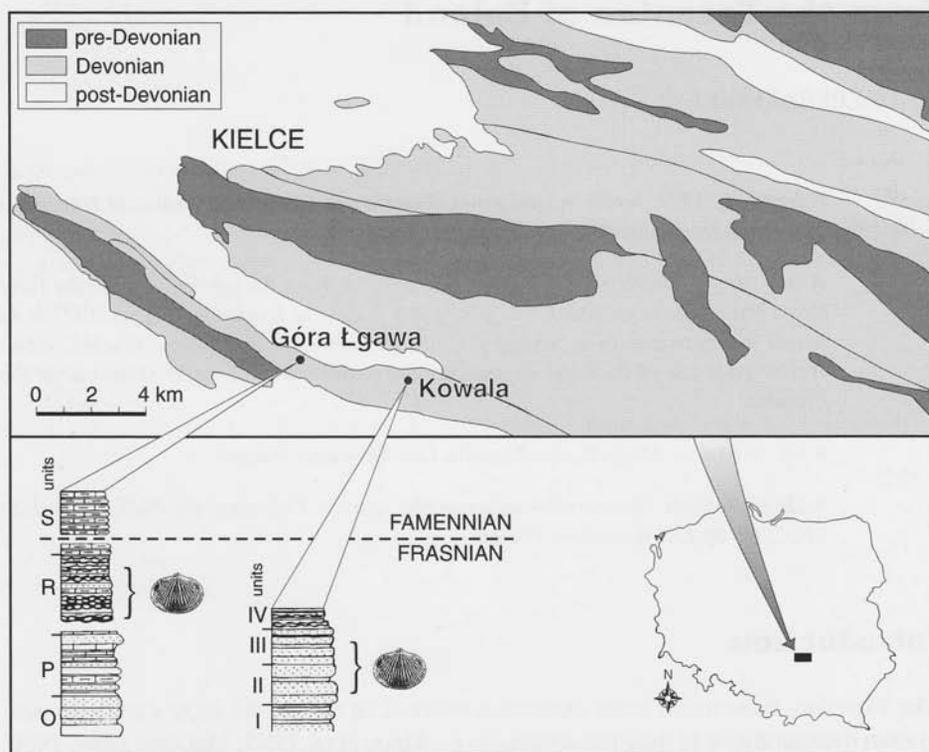


Fig. 1. Location of two sections with *Waiotrypa sulcicarina* gen. et sp. n. bearing strata in the geologic sketch map of the Holy Cross Mountains (after Racki 1993: fig. 2).

The Kowala road-cut (the second locality) is about 3 km east from Łgawa Hill and 300 m west of the railroad cut at Kowala (Fig. 1; Szulczewski 1971). Four lithologic units (I–IV) have been established in the section according to their petrographic character and fossil content (Miklas 1993). *Waiotrypa sulcicarina* gen. et sp. n. was found in the topmost unit IV, that consists of various detrital limestones with micritic intercalations. This part of the section corresponds probably to the upper part of the *P. rhenana* Zone (Szulczewski 1990).

The studied material is deposited in the Geological Institute University of Silesia, Sosnowiec, Poland (abbreviated GIUS).

Systematic paleontology

Order Atrypida Rzhonsnitskaya, 1960

Family Atrypidae Gill, 1871

Subfamily Invertininae Copper, 1995

Genus *Waiotrypa* gen. n.

Type species: *Waiotrypa sulcicarina* sp. n.

Derivation of the name: An anagram of the name of closely related genus *Iowatrypa* Copper.

Diagnosis. — An atrypid closely related to *Iowatrypa* Copper, 1973 from which it differs mainly by a keeled pedicle valve, a sulcate brachial valve, a higher ventral interareas, and sometimes well developed dental cavities. From *Anatrypa* the new genus differs mainly by the rib structure which is *Desquamatia*-like tubular in the former, and tubular-imbricate in the latter.

Remarks. — *Waiotrypa* gen. n. most closely resembles the Frasnian genus *Iowatrypa* Copper from Eurasia and North America (from which the new genus probably evolved) in its small size, character of the shell ornamentation and reversed biconvexity. The new genus is distinguished from all known species of *Iowatrypa* by the higher ventral interarea, a less convex pedicle valve, and the occurrence of dorsal median sulcus and ventral median fold which is angular in anterior profile. Although high ventral interareas occur in *Iowatrypa* (e.g., Cooper & Dutro 1982: pl. 24: 13–14; Copper *et al.* 1995: fig. 4) the feature is rather uncommon for that genus. The internal structure of the pedicle valve of *Iowatrypa* shows that the dental cavities are not present in representatives of the genus (e.g., Baliński 1979: p. 58, fig. 20; Copper 1995: p. 256, fig. 3; Godefroid 1994: figs 3–4). To the contrary, in *Waiotrypa* the dental cavities are sometimes well developed (Fig. 4B).

The presence of median dorsal sulcus and ventral fold is characteristic of the described shells. Although a short dorsal sulcus can be observed in some species of *Iowatrypa* (e.g., Alekseeva 1962: p. 147; Lyashenko 1973: p. 79, pl. 23: 8–9; Baliński 1979: p. 58; Godefroid 1994: figs 3–4) it is never as well developed.

There are some similarities between *Waiotrypa* gen. n. and *Anatrypa* Nalivkin, 1941 such as inverted shell convexity (pedicle valve more convex than brachial), the presence of a high, well delineated ventral interarea and in shell ornamentation where the density of ribs increases towards anterior margin. The new genus differs from *Anatrypa* mainly in its rib structure; the latter has *Desquamatia*-like tubular ribs.

The general form of the shell, especially the keeled pedicle valve and sulcate brachial valve suggests a striking homeomorphy with some Ordovician–Silurian atrypids (*Tuvaella* Chernyshev, 1937 and *Dihelicteria* Copper, 1995) and the Late Devonian enteletacean *Cariniferella* Schuchert & Cooper, 1931. These morphological features were probably connected with some functional adaptations and might facilitated a disposition of the inhalant and exhalant water currents.

Occurrence. — The type species occurs in Poland (the Holy Cross Mountains) in the *Palmatolepis rhenana* Zone (Late Devonian, Frasnian).

Species assigned. — Thus far the genus is monospecific but there are a few records of atrypids, which generic assignment needs to be carefully considered. It is possible that specimens described as *Anatrypa kadzielniae* (Gürich, 1896) (*nomen nudum*) by

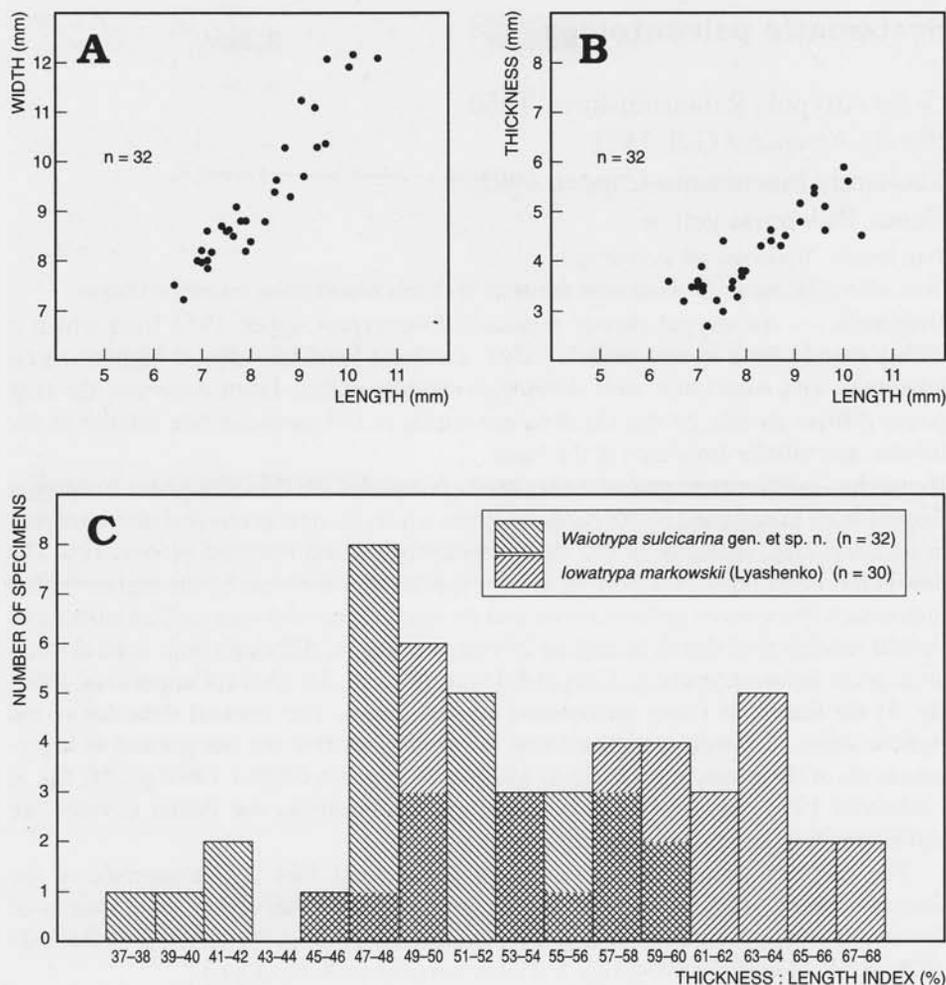


Fig. 2. **A–B.** A scatter diagram of length against maximum width (**A**) and thickness (**B**) of shell in *Waiotrypa sulcicarina* gen. et sp. n. from Góra Łgawa, Holy Cross Mountains. **C.** Comparison of the frequency distribution of the thickness to length shell index in *Waiotrypa sulcicarina* gen. et sp. n. from Góra Łgawa, Holy Cross Mountains, and *Iowatrypa markowskii* (Lyashenko) from the Dębnik anticline, southern Poland; n – number of specimens.

Nalivkin (1930, 1947, 1951) and Alekseeva (1962) from the Frasnian of Kazakhstan and Russia should be referred to *Waiotrypa*.

Godefroid & Helsen (in preparation) have recovered a new atrypid species from the Grands Breux and Neuville formations (Frasnian) in Belgium. They regarded the new species as a possible representative of the newly proposed *Waiotrypa*.

Waiotrypa sulcicarina sp. n.

Figs 2–4.

Holotype: GIUS 284/117; complete, well preserved shell, illustrated in Fig. 3A–E.

Type locality: Góra Łgawa (= Łgawa Hill).

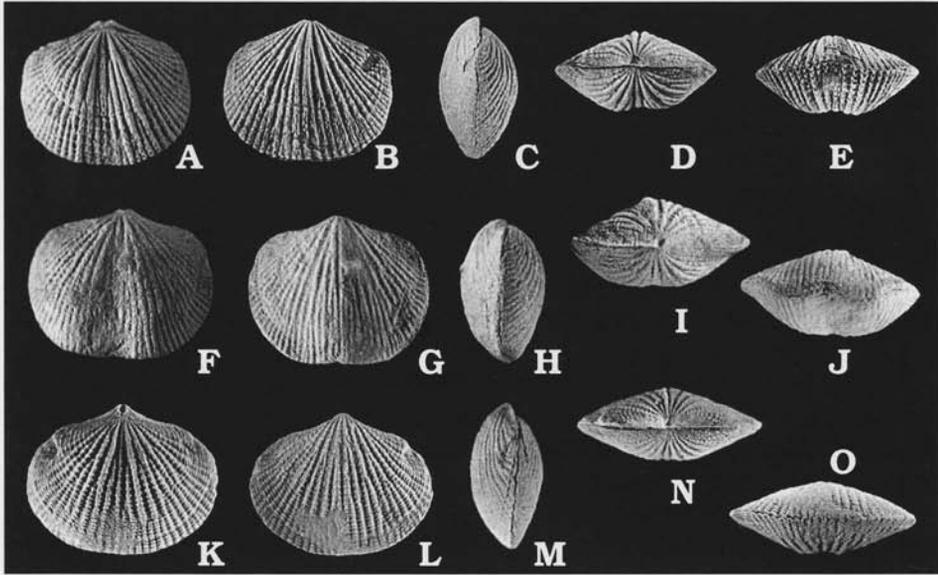


Fig. 3. *Waiotrypa sulcicarina* gen. et sp. n. from Góra Łgawa, Holy Cross Mountains, *Palmatolepis rhenana* Zone. A–E. Holotype GIUS 284/117 in dorsal, ventral, lateral, posterior, and anterior views; $\times 2$. F–J. Paratype GIUS 284/122 in dorsal, ventral, lateral, posterior, and anterior views; note well developed dorsal sulcus and paraplicate anterior commissure; $\times 2$. K–O. Wide and flat paratype GIUS 284/121 in dorsal, ventral, lateral, posterior, and anterior views; $\times 2$. All coated with ammonium chloride.

Type horizon: Bedded-nodular marly complex R (after Racki 1981); *Palmatolepis rhenana* conodont Zone.

Derivation of the name: *Sulcicarina* – from the presence of sulcus on brachial valve and an acute fold on the pedicle valve.

Diagnosis. — Shell up to 11 mm in length, subequally biconvex to ventribiconvex, subelliptical in outline, wider than long, with about 9 to 11 tubular-imbricate ribs per 5 mm at the commissure of mature specimens. Pedicle valve with high, apsacline to orthocline interarea; foramen small, apical, bordered by deltidial plates; median fold is low, better marked in posterior half of the valve. Brachial valve with median sulcus, which starts from umbo and continues to anterior margin.

Material. — 30 complete and 19 damaged shells and 21 fragments of isolated and silicified valves preserving details of internal shell structure.

Description. — Shell is small, up to 11 mm in length, wider than long (Fig. 2), lenticular, subequally biconvex, the pedicle valve having more often a slightly deeper profile. Outline is subelliptical with rounded antero-lateral extremities and broadly rounded to slightly truncate anterior margin. Cardinal margin is long and nearly straight; cardinal extremities rounded. Anterior commissure is sulcate to paraplicate.

Pedicle valve is gently convex in lateral profile and angular in anterior profile; low median fold is sharp, especially in posterior half of the valve where the top of the fold is marked by a pair of higher ribs. Interarea is high, apsacline to orthocline, clearly delineated laterally; foramen is small, apical, bordered by conjunct deltidial plates (Fig 4G).

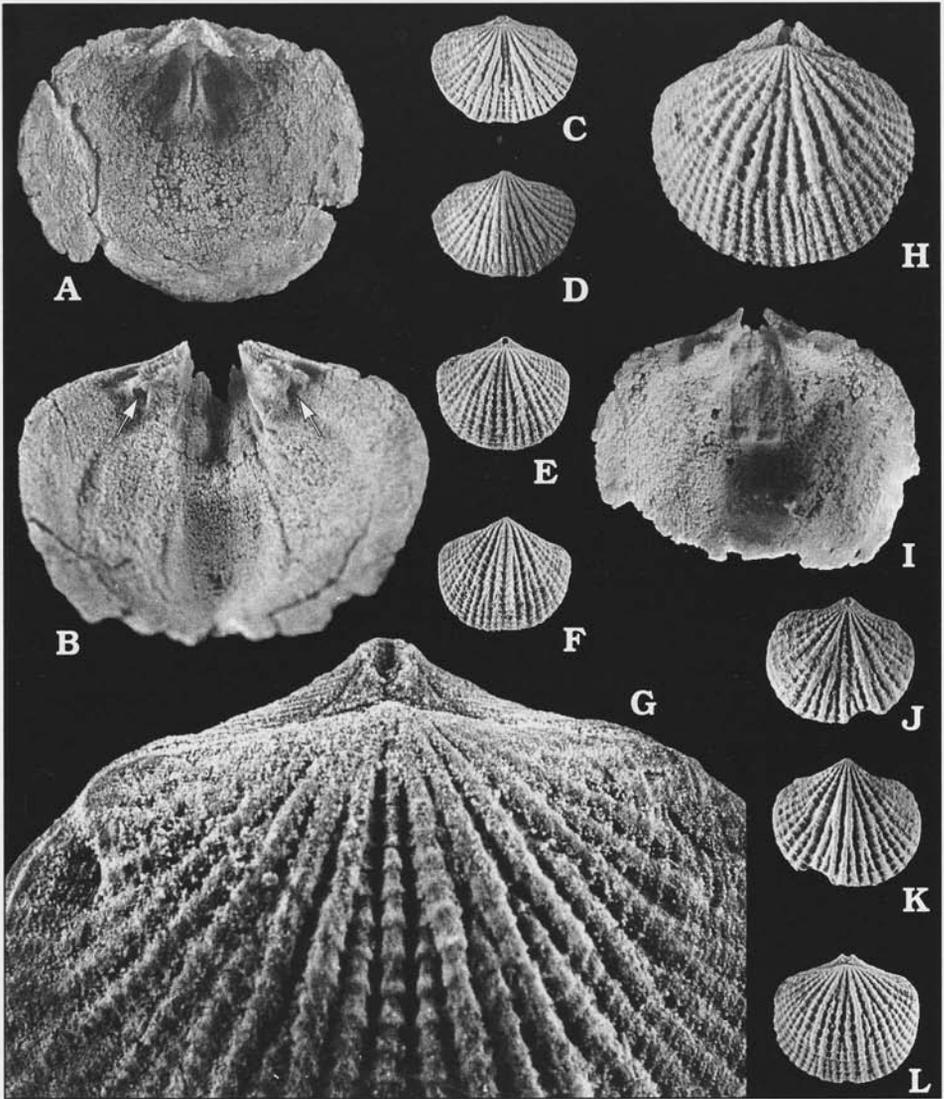


Fig. 4. *Waiotrypa sulcicarina* gen. et sp. n. from Góra Łgawa, Holy Cross Mountains, *Palmatolepis rhenana* Zone. **A.** Interior of the brachial valve GIUS 284/77; $\times 4$. **B, I.** Interior of two pedicle valves GIUS 284/78, 80; note the dental cavities in **B** (arrowed); $\times 4$. **C–D, E–F, J–K.** Three juvenile shells GIUS 284/126, 118, and 81 in dorsal and ventral views; $\times 2$. **G.** Enlargement of the shell from Fig. 3K in dorsal view showing details of delthyrial structure and shell ornamentation; $\times 8$. **H.** A juvenile shell GIUS 284/79 showing characteristic transition in ribbing density; $\times 4$. **L.** Dorsal view of a paratype GIUS 284/120; $\times 2$. All coated with ammonium chloride.

Brachial valve is regularly convex in lateral profile and sulcate with flattened flanks in anterior profile. Sulcus appears at umbo where it is deep and narrow, becomes wide and broadly concave anteriorly.

Pedicle valve interior shows strong teeth supported by short dental plates (Fig. 4B), obsolescent in large shells because of filling of lateral cavities by shell material (Fig. 4I). Muscle scars are only easily recognizable in adult shells, deeply impressed posteriorly and elevated anteriorly (Fig. 4B, I). Brachial valve possesses short and wide median ridge (Fig. A). The specimens are usually silicified and their internal structure cannot be corroborated by serial sections.

Shell covered by tubular-imbricate ribs (Fig. 4G), coarser in posterior part of the shell, becoming lower and narrower anteriorly (Fig. 4H). The number of ribs increases by bifurcation on pedicle valve and by intercalation on brachial valve. Growth lines are numerous, spaced at about 1 mm interval posteriorly, and crowded near front up to 3 lines per 1 mm.

Discussion. — *W. sulcicarina* sp. n. is distinguished from all known species of *Iowatrypa* by a high ventral interarea, a less convex pedicle valve, a lower shell thickness index (Fig. 2C), and the occurrence of a dorsal median sulcus and ventral median fold which is angular in anterior profile.

The new species corresponds in external appearance to specimens described as *Atrypa kadzielniae* or *Anatrypa kadzielniae* (Gürich) by Nalivkin (1930: p. 101, pl. 7: 6, 8; 1947: p. 103, pl. 23: 11–12; 1951: p. 19, pl. 4: 6–7) and Alekseeva (1962: pp. 144–145, pl. 8: 6) from the Frasnian of Kazakhstan and Russia. *W. sulcicarina* sp. n. differs from them mainly in having better developed ventral fold and dorsal sulcus which extend to the anterior valve margins, and in the rib densities which increase anteriorly, whereas in forms from Kazakhstan and Russia the density increases posteriorward. Originally *Atrypa desquamata* var. *kadzielniae* was described by Gürich (1898) from the Late Devonian of Kadzielnia (Holy Cross Mountains) but the original specimens have never been illustrated; thus at present the name should be regarded as a *nomen nudum*.

Godefroid & Helsen (in preparation) recorded a new atrypid species from the Frasnian of Belgium and believed that it was congeneric with *W. sulcicarina* sp. n. Indeed, both forms are very close externally, but they differ mainly in the absence of a clearly developed ventral fold and dorsal sulcus in the Belgian specimens.

Occurrence. — The main part of the collection is from the bedded-nodular marly limestones (complex R of Racki 1981) of Łgawa Hill. The strata are correlated with *Palmatolepis rhenana* Zone (Racki 1981; Miklas 1993: p. 69). A few additional fragmentary specimens are from limestones that crop out at the Kowala road cut (*Palmatolepis rhenana* Zone).

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Nowy rodzaj atrypy (Brachiopoda) z franu Polski

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Streszczenie

Jedną z grup najbardziej dotkniętych wielkim wymieraniem na granicy fran–famen były ramienionogi z rzędu Atrypida. W późnym franie wykazują one wyraźne ubożenie zróżnicowania taksonomicznego by wymrzeć całkowicie z końcem franu.

Badania szczegółowej dynamiki zmian zróżnicowania taksonomicznego atrypidów mają zatem kluczowe znaczenie dla zrozumienia procesów wymierania. Niniejsza praca jest wstępnym opracowaniem – bardziej kompleksowe zespołowe opracowanie zróżnicowania faun ramienionogów w obliczu wielkiego wymierania na granicy fran–famen znajduje się w przygotowaniu. Opisany tu nowy rodzaj i gatunek atrypida *Waiotrypa sulcicarina* należy do ostatnich przedstawicieli tej grupy. Gatunek ten występuje w górnofrańskich wapieniach odsłoniętych w kamieniołomie na Górze Łgawej i w przekopie drogi koło Kowali (Góry Świętokrzyskie) reprezentujących poziom *Palmatolepis rhenana*. Nowy atrypid wykazuje duże podobieństwo do frańskiej *Iowatrypa* Copper, od której jednak różni się przede wszystkim występowaniem środkowej zatoki na skorupce grzbietowej i kilowatego siedła na nóżkowej. Do *Waiotrypa* należy zapewne zaliczyć niektóre atrypidy opisane jako *Anatrypa kadzielniae* (Gürich) z franu Rosji (Nalivkin 1930, 1947, 1951) i Kazachstanu (Alekseeva 1962).