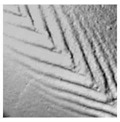
Silurian *Tetinka* Barrande, 1881 (Bivalvia, Spanilidae) from Bohemia (Prague Basin) and Germany (Elbersreuth, Frankenwald)

Jiří Kříž



Silurian *Tetinka* Barrande, 1881 (Nepiomorphia Kříž, 2007) containing seven species *Tetinka accedens* Barrande, 1881, *Tetinka caesarea* (Barrande, 1881), *Tetinka costulifera* Kříž, 2008, *Tetinka elongata* Barrande, 1881, *Tetinka tiro* sp. nov., *Tetinka trigona* (Münster *in* Goldfuss, 1837), and *Tetinka sagitta* Barrande, 1881 is characteristic of the Gorstian, Ludfordian and earliest Přídolí of the Prague Basin, Bohemia, Perunica and *Tetinka trigona* of the middle Ludfordian of Elbersreuth, Frankenwald, Germany, Saxothuringian–Lugian Zone. *Tetinka costulifera* Kříž, 2008 occurs in the Gorstian coral-crinoid biofacies and the other species occur in the cephalopod limestone biofacies of the Ludlow (Gorstian and Ludfordian) and the earliest Přídolí. Ancestors of *Tetinka* were most probably related to the reclining *Kenzieana* Liljedahl, 1989 in the late Wenlock of Bohemia. It is concluded that *Tetinka* was a suspension filterer with byssate semi-infaunal to infaunal mode of life living with the lanceolate frontal face down and parallel with narrow spaces between the crowded current-oriented cylindrical cephalopod shells on the bottom. This conclusion is supported by the relatively abundant preservation of the shells with conjoined valves in the cephalopod limestones. In the paper is defined especially modified anterior part of the shell – the frontal face – developed in enantiomorphous Stolidotidae Starobogatov, 1977 and Spanilidae Kříž, 2008 adapted to the semi-infaunal or shallow infaunal mode of life. • Key words: Bivalvia, Nepiomorphia, Silurian, morphology, systematics, evolution, palaeoecology, European peri-Gondwana.

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Joachim Barrande in his *Systême silurien du centre de la Bohême* (1852–1881) created several thousands of new specific and generic names, mostly derived from Latin. It became increasingly more and more difficult for him to find new names and he had to use the same specific name several times. In his last volume on bivalves (1881) he described no fewer than 1264 new species and 29 new genera. The 2nd session of the International Geological Congress held 1881 in Bologna accepted the nomenclatorial rule requirement concerning the availability of names, excluding all languages except Latin or latinized names to be used as the scientific names. Barrande (1881) immediately strongly protested against this decision on pages XXIII and XXIV ("*Protestation, au sujet de la nomenclature*") of the introductory part and expressed his freedom by derivation of 20 new generic names of bivalves from the Bohemian national language – Czech. His protest was accepted by the majority of scientists except some German-speaking workers in the late 19th and early 20th century who used only Latin translation of Barrande's Czech names or even proposed new generic names for them (Neumayr 1891, Frech 1891, Heller 1925, Heritsch 1929 *etc*.). The genus *Tetinka* Barrande, 1881 with name derived from the Czech diminutive of *teta* (aunt) is a good example. It was used as *Amita* Barrande, 1881 or as *Goniophorella* Frech, 1891. Thanks to progress started by Barrande it is today possible to use names derived from all languages using the Latin alphabet, or be formed from such a word, whether the ending of the name is one used in Latin or not [Article 11b(ii) of ICZN]. A name may be even formed from a language that uses a non-Latin alphabet, or that has no alphabet, or to represent a natural sound, or as an arbitrary combination of letters, if it is written in Latin and so constructed that it can be used as a word and deemed to be Latin [Article 11b(iii) of ICZN].

Tetinka is a characteristic bivalve of the Ludlow and early Přídolí (Silurian) epochs adapted to a specialized semi-infaunal or infaunal byssate mode of life especially in

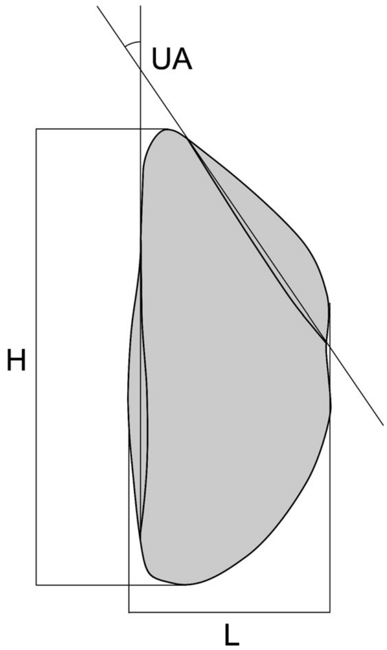

Figure 1. Schematic representation of basic morphology of the genus *Tetinka*. H – height, L – length, UA – umbonal angle.

the cephalopod limestone biofacies. Barrande's original (1881) concept of *Tetinka* was somehow not consistent. He mixed together species of *Tetinka* [*T. accedens* Barrande, 1881, *T. elongata* Barrande, 1881, *T. sagitta* Barrande, 1881, and *T. securiformis* Barrande, 1881 (= *"Cardium" trigonum* Münster *in* Goldfuss, 1837)], *Kenzieana* [*K. bellula* (Barrande, 1881)], and *Spanila* [*Tetinka caesarea* (Barrande, 1881) and *Tetinka serva* (Barrande, 1881)].

Systematic palaeontology

Abbreviations. – V = valve, L = length of the shell, H = height of the shell, W = width of the shell, W/2 = width of one valve (Kříž 1969). Descriptions are based on the author's collection (JK) of Lower Palaeozoic bivalves (1953–2010), deposited in the Czech Geological Survey, Prague, Barrande's types (NM) deposited in the National Museum, Prague and on the cast of the type loaned to me by the Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany (BSPG). (NC) = new collections with detailed stratigraphic data. All measurements are in millimetres.

Class Bivalvia Linné, 1758
Superorder Nepiomorphia Kříž, 2007
Order Antipleurida Kříž, 2007
Superfamily Dualinoidea Conrath, 1887
Family Spanilidae Kříž, 2007

Genus *Tetinka* Barrande, 1881

1881 *Tetinka* Barrande, pp. 164, 165.
1881 *Amita* Barrande, p. 164.
1891 *Goniophorella* Frech, p. 249.

Type species. – *Tetinka sagitta* Barrande, 1881 (type species designated by Newell & LaRocque 1969, p. 297), Perunica, Bohemia, Prague Basin, Silurian, Ludlow and earliest Přídolí. These authors did not accept the designation of *Tetinka bellula* Barrande, 1881 [= *Kenzieana bellula* (Barrande, 1881) (Kříž 2010a)] by Růžička & Prantl (1960) who designated many "genotypes" collectively without revision of Barrande's genera.

Diagnosis. – Spanilidae with small, dorso-ventrally elongated, inequivalve, inequilateral, narrowly obtrulate, subtriangular or narrowly ovate, obese shells. Enantiomorphous (Kříž 2001), distinctly inclined to the right. Prominent blunt umbos are in anterior terminal position, beaks prosogyrate. Umbonal angle in upper left valve is 18–58°. In the postero-dorsal part of the shell an elongated posterior wing is developed separated from the central part by shallow sulcus. Wing ends on the posterior margin in the level of maximum shell length. Ventral part of posterior margin and ventral margin are rounded. Frontal face well developed, lanceolate. The upper left valve overhanging; the almost flat frontal face is separated from the posterior part of the shell by narrow blunt edge, straight and only rarely curved anteriorly. The angle between the frontal face and the posterior part of the right lower shell is right or obtuse angle and the umbonal edge is thus more rounded. Outer surface smoother than inner surface, radial ribs (11–26) are especially prominent on the inner surface of frontal face. Central part of the shell is formed by 19–42 radial ribs or it is smooth, posteriorly of sulcus are developed 3–11 radial ribs. Opisthodetic ligament is external. Posterior adductor muscle scar is situated close to the sulcus and the posterior wing.

Description. – Small shell (length maximally 13.9 mm, height maximally 30 mm and width maximally 10 mm), dorso-ventrally elongated, inequivalve, inequilateral, narrowly obtrulate, subtrangular or narrowly ovate in outline, and obese. Enantiomorphous, inclined to the right. Blunt umbos formed by subovate mesoconch are in anterior terminal position, beaks prosogyrate. Umbonal angle in upper left valve is 18–58°. In the postero-dorsal part of the shell elongated posterior wing is separated from the central part of the shell by a sulcus. Wing terminates on the posterior margin in the level of maximum shell length. The angle between ventral end of frontal face and ventral part of the shell is a right or obtuse angle and ventral margin is rounded. Well developed, a little inflated, lanceolate frontal face is very steep, in upper valve even overhanging. It is separated from the

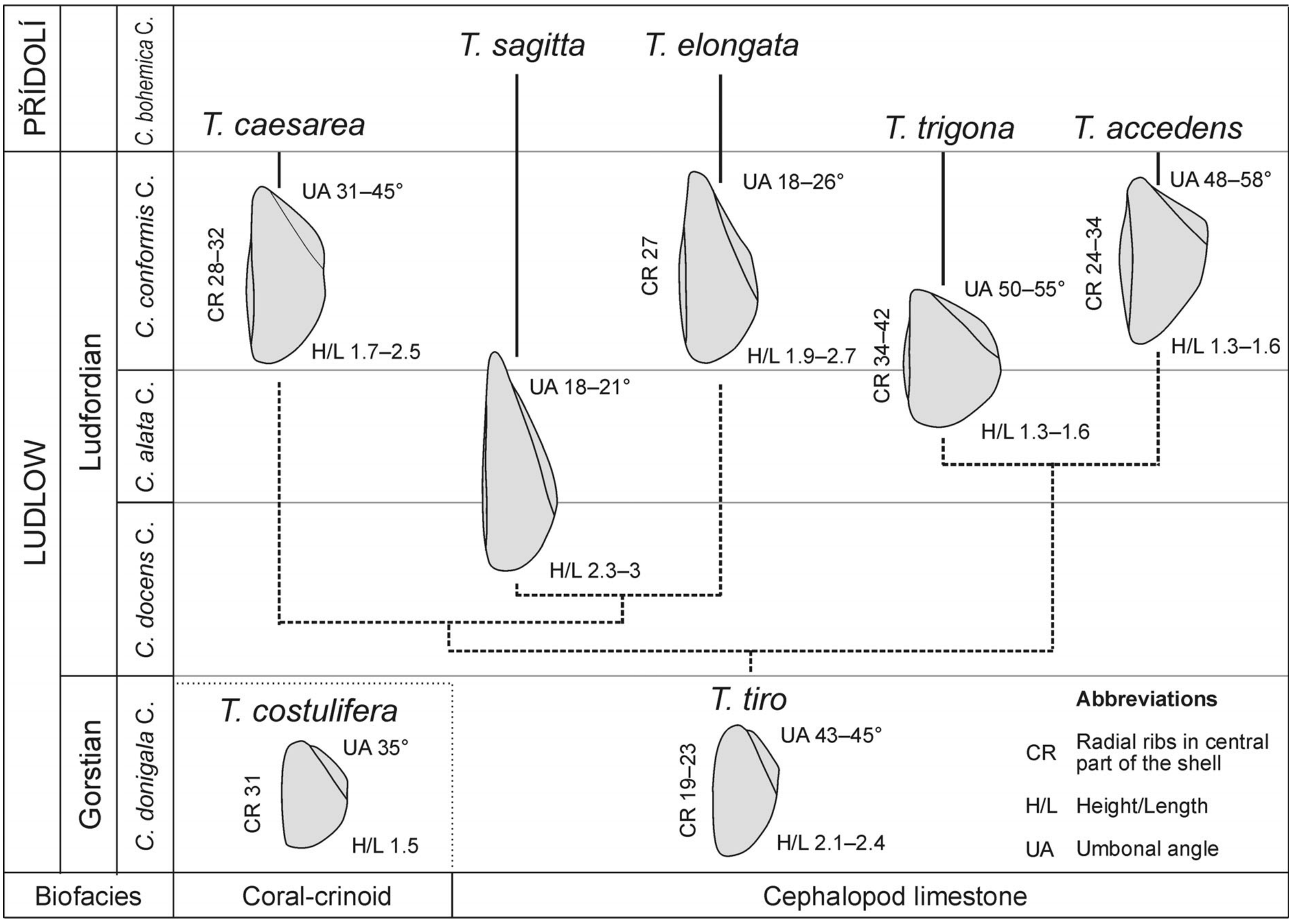

Figure 2. Phylogeny of *Tetinka*. Detailed stratigraphy is based on Bivalvia dominated communities of the *Cardiola* Community Group (Kříž 1999a, c).

central part of the shell by blunt edge, straight and only rarely curved anteriorly. The angle between the frontal face and central part of the right lower shell is a right or obtuse angle and the umbonal edge is more rounded. Outer surface smoother than inner surface, formed by growth wrinkles and weak regular narrow, or irregular wide growth bands and furrows sometime in combination with numerous radial striae and numerous radial ribs and gutters. In some species inner surface radial sculpture is reduced only to the crenulations along the shell margin. Radial ribs (11–26) are especially prominent on the inner surface of the frontal face. Central part of the shell is formed by 19–42 radial ribs or it is smooth. Posteriorly of sulcus are developed 3–11 radial ribs. External opisthodetic ligament situated in short longitudinal groove. Elliptic posterior adductor muscle scar is close to the sulcus and the posterior wing. Shell thickness is 0.11–0.5 mm. Other features are not known.

Remarks. – *Tetinka* is a characteristic member of the Silurian recurring communities of the *Cardiola* Community Group (Kříž 1999a) and evolved in the environment of the cephalopod limestone biofacies originated below wave base, and influenced by surface currents (*e.g.* Kříž 1979a, b, 1999a; Ferretti & Kříž 1995). The genus *Tetinka* may be derived from the shallow burrowing Wenlock (Homerian) ancestors of the genus *Kenzieana* Liljedahl, 1989. The number of radial ribs is reduced and frontal face became distinctly dorsoventrally elongated during adaptation to the endobyssate and semi-infaunal mode of life in the cephalopod limestone biofacies. In contrary to *Kenzieana* the enantiomorphous *Tetinka* is inclined to the right and this results in the inequivalved shells having the left upper valve frontal face overhanging. The angle between the frontal face and the posterior part of the right lower shell is a right or obtuse angle and the umbonal edge is blunt. In contrast to *Kenzieana* and *Spanila* Barrande, 1881 the outer surface is mostly almost smooth and radial ribs are developed on the inner surface, especially on the frontal face. *Tetinka costulifera* Kříž, 2008 occurs in the coral-crinoid shallow water facies. Almost contemporaneous *Tetinka tiro* sp. nov., and other later species of *Tetinka* occur in the cephalopod limestone biofacies of the Prague Basin, Bohemia and *Tetinka trigona* in Elbersreuth, Frankenwald, Germany. The enantiomorphous shells of *Tetinka* inclined to the right were most probably shallow burrowing or semi-infaunal, byssally attached, with well developed frontal face parallel with the bottom. This conclusion is supported by their common occurrence as shells with conjoined valves in the early Ludlow shallow water coral-crinoid (Kříž 2008b) and in the early Ludlow to earliest Přídolí recurring cephalopod limestone biofacies (Kříž 1998a). The genus *Spanila* was most probably derived from the ancestors of *Tetinka accedens* Barrande, 1881 in the late Gorstian or in the early Ludfordian. *Spanila* differs from *Tetinka* mainly in its pointed umbos, enantiomorphous shells inclined slightly to the left, presence of carina between the frontal face and the central part of the shell, more developed radial ribs on outer surface and more distinct posterior wing.

The early Ludfordian species of *Tetinka* evolved most probably from the Gorstian dorsoventrally elongated *Tetinka tiro* sp. nov. (H/L 2.1–2.3), and occur in the Ludfordian *Cardiola docens* Community (Kříž 1999a, c). Two trends of evolution may be seen (Fig. 2). On one side the species *Tetinka caesarea* (Barrande, 1881), *Tetinka sagitta* Barrande, 1881 and *Tetinka elongata* Barrande, 1881 show the development of dorsoventrally more elongated shells (H/L 1.7–3.3) with low umbonal angle (18–45°) and most probably adapted to the semi-infaunal to infaunal life in the narrow spaces between the crowded cephalopods in the cephalopod limestone biofacies. The species *Tetinka trigona* (Münster *in* Goldfuss, 1837) and *Tetinka accedens* Barrande, 1881 show the development of longer shells (H/L 1.3–1.6) having larger umbonal angle (48–58°) and the posterior margin elevated more above the sediment water interface. They were most probably adapted more to the semi-infaunal than to the infaunal mode of life in the cephalopod limestone biofacies between scattered cephalopod shells.

Remarks on the functional morphology. – Enantiomorphous Stolidotidae Starobogatov, 1977 and Spanilidae Kříž, 2008, that were adapted to the semi-infaunal or shallow infaunal mode of life, developed an especially modified anterior part of the shell, the frontal face. It is lanceolate, dorso-ventrally elongated, flattened or slightly inflated anterior part separated from the central parts of the shell by carina or blunt edge. On the frontal face, or at least on its inner shell surface prominent radial ribs are developed forming a characteristic zigzag deflected anterior margin. Presumably, the frontal face was parallel with the bottom and served for the firm byssal attachment of the shell to the substrate. During opening the shell edges with mantle between them, the frontal face being in close contact with substrate, the animal had to improve a protective system against approaching sediment or food particles. The function of brachiopod costae in the serial zigzag deflections of the commissure was interpreted in brachiopods Schmidt (1937), Rudwick (1964) and Westbroek (1967) as the straining and warning protective system protecting against small harmful particles. It is supposed that the function of the zigzag commissure in frontal face of Stolidotidae and Spanilidae bivalves was similar. A functionally identical frontal face is also developed in the Recent *Hippopus* Lamarck, 1799 living in its juvenile and early adult stages with the sagittal plane vertical, attached firmly to substratum by byssal threads through the widely lanceolate gapeless frontal face parallel to the substratum (Fankboner 1971). Numerous radial ribs are developed on the frontal face and form the zigzag shell edges similar to Stolidotidae and Spanilidae. In adult *Hippopus* the byssal glands atrophy and massive clams rest on the coral rubble or sand with sagittal plane vertical and shell open, able to self-right itself to this position by spreading its valves widely apart after being rolled during a storm (Fankboner 1971).

The majority of Stolidotidae and Spanilidae were fixed to the substrate with the sagittal plane inclined. Shells and sagittal plane of the Stolidotidae were inclined in most of genera to the left and also to the right. In contrary the shells of the Spanilidae show almost no inclination and with the sagittal plane almost vertical (*Kenzieana* Liljedahl, 1989) or inclined to the left (*Algerina* Kříž, 2008 and *Spanila* Barrande, 1881) or to the right (*Tetinka* Barrande, 1881). In the Stolidotidae the upper valve is twisted sinistrally along the radial sinus in the shells inclined to the right (right valve is lower one) and dextrally in the shells inclined to the left (left valve is lower one). The posterior of the shell thus become oriented subvertical. In the Spanilidae the shell is not twisted.

The shells of the Stolidotidae are mostly subcircular or broadly subtriangular and the majority of the Spanilidae is dorso-ventrally elongated, subtriangular to narrowly subtriangular, *Tetinka sagitta* Barrande, 1881 being one of the best examples. The general shape of this species is very similar to the shape of the Recent Mediterranean *Pinna nobilis* Linné, 1758. *Pinna nobilis* is dorso-ventrally elongated, may grow more than 1,000 mm in height, it is semi-infaunal, attached to the substratum by byssal threads, and in a vertical position. Its umbos are at the anterior terminal position, have very low umbonal angle and large posterior adductor muscle in the posterior part of the shell. *Tetinka sagitta* is much smaller, also dorso-ventrally elongated, it was most probably also attached to the substratum by byssal threads, but with frontal face parallel to the bottom. It has umbos also in the anterior terminal position, very low umbonal angle and posterior adductor muscle scar developed close to the posterior wing serving to direct exhalant current away from the shell. In *Pinna* the anterior adductor is very close to the umbo, in *Tetinka* the anterior adductor muscle scar is not preserved, but it is possible that the position of the anterior adductor was similar to *Pinna*, close to the umbo. *Tetinka* was most probably able to move horizontally in the narrow spaces between cephalopod shells using contraction of the foot with byssus when necessary in similar way to Recent *Pinna* Linné, 1758 is facilitating downward movements deeper into the sediment (Stanley 1970).

Shell pathology. – Aberrations in shell growth in *Tetinka* resulting from pathological or near-pathological functions accompanying physiological repairs (Boshoff 1968) are very rare. The pathological form of posterior margin in the left valve of *Tetinka caesarea* (Barrande, 1881) lectotype, NM L 21 761, Fig. 4L,N may be interpreted as repair of the shell margin. The mantle tissue was probably not injured permanently because the normal shell form was restored soon after the repair was completed.

Species and distribution. – *Tetinka tiro* sp. nov. occurs in the cephalopod limestone facies of the early Gorstian (*Saetograptus chimaeara* Biozone), Ludlow, the *Cardiola donigala-Slava cubicula* Community (Kříž 1999a–c), Prague Basin, Bohemia; *Tetinka costulifera* Kříž, 2008, the coral-crinoid facies of the early Gorstian, Ludlow, the *Janicula potens* Community (Kříž 2008b), Prague Basin, Bohemia; *Tetinka caesarea* (Barrande, 1881), the cephalopod limestones of the upper Ludfordian, Ludlow, the *Cardiola conformis* Community (Kříž 1999a, c), Prague Basin, Bohemia; *Tetinka trigona* (Münster *in* Goldfuss, 1837), middle Ludfordian, the *Cardiola alata* Community (Kříž 1999a, c), Ludlow (Greiling 1962, Heller 1925, Münster *in* Goldfuss 1837, Münster 1840), Elbersreuth, Frankenwald, Germany, and late Ludfordian, the *Cardiola conformis* Community (Kříž 1999a, c), Prague Basin, Bohemia; *Tetinka accedens* Barrande, 1881, late Ludfordian, the *Cardiola conformis* Community (Kříž 1999a, c), Prague Basin, Bohemia; *Tetinka elongata* Barrande, 1881, middle Ludfordian, late Ludfordian, the *Cardiola conformis* Community, and earliest Přídolí, the *Cardiolinka bohemica* Community (Kříž 1999a, c); *Tetinka sagitta* Barrande, 1881, early Ludfordian, the *Cardiola docens* Community (Kříž 1999a, c), late Ludfordian, the *Cardiola conformis* Community (Kříž 1999a, c), and earliest Přídolí, the *Cardiolinka bohemica* Community (Kříž 1999a, c). *T. sagitta* and *T. elongata* occur in the eastern part of the Central Segment and in the Pankrác Segment of the Prague Basin (Kříž 1991, 1992, 1998b) localities where the cephalopod limestone biofacies was developed above the Ludlow–Přídolí boundary and is occupied by the *Cardiola bohemica* Community (Kříž 1999a, c).

***Tetinka tiro* sp. nov.**
Figure 3A–L

Holotype. – Internal mould of shell with conjoined valves and the counterpart of the left valve, figured herein on Fig. 3A–G, JK 4985a, b.

Paratypes. – Shell with conjoined valves, JK 4983, figured herein on Fig. 3H–L and non-figured right valve JK 4982 and left valve JK 4984.

Derivation of name. – Derived from Latin *tiro* – beginner, recruit; masculine.

Type locality. – Bohemia, Prague Basin, Sedlec locality near Beroun (Kříž 1970).

Type horizon. – Silurian, Ludlow, early Gorstian, *Saetograptus chimaera* Biozone, Kopanina Formation (Kříž 1970, 1999b).

Material. – 1 left, 1 right valve, and 2 shells with conjoined valves.

Diagnosis. – Small *Tetinka* with dorso-ventrally elongated, inequivalve, inequilateral, narrowly obovate, and inflated shells. Enantiomorphous, inclined to the right. Umbonal angle in upper left valve is 43–45°. Almost flat and lanceolate frontal face with 12–15 radial ribs is separated from the posterior part of the shell by blunt edge curved anteriorly. Posteriorly of edge the shell is formed by 19–23 radial ribs and posteriorly of sulcus by more than 3 radial ribs.

Description. – Shell very small (length maximally 6.1 mm, height maximally 12.8 mm, and width maximally 5.5 mm), dorso-ventrally elongated (H/L = 2.1–2.4), narrowly ovate and inflated (L/W = 0.8–1.2). The left valve is prosocline and the right valve is opisthocline. Enantiomorphous, distinctly inclined to the right. Prominent blunt umbos formed by subcircular mesoconch are in anterior terminal position, beaks prosogyrate. Umbonal angle in the left upper valve is 43–45°. In the left valve overhanging, the almost flat and lanceolate frontal face is separated from the central part of the shell by narrow blunt edge, curved anteriorly. The angle between the ventral end of the frontal face and ventral part of the shell is a right or obtuse angle and ventral margin is rounded. In the dorsal part of the shell posterior a small, but distinct wing is developed and separated from the central part of the shell by shallow sulcus. Outer surface generally smoother than inner surface, radial ribs most prominent on the frontal face, in other part of the shell interior are radial ribs present only as crenulations on the margin. On the inner surface are visible inexpressive irregular growth bands. Interior of the shell formed by numerous radial ribs (12–15 on the frontal face, 19–23 posteriorly of blunt edge, and >3 posteriorly of sulcus). Both, the radial ribs and radial gutters broaden ventrally. Posterior adductor muscle scar is developed on the posterior wing. External ligament is opisthodetic.

Shell thickness is 0.13–0.27 mm. Other features unknown.

Ontogeny. – Prodissoconch subcircular, height of known shell (JK 4985a, left) is 1.3 mm, inflated (H/W = 2.2), umbo in central position, beaks prosogyrate. Inner surface is smooth. The mesoconch is equivalve, subcircular (H/L = 1), inflated (H/W = 1.2), prosogyrate, inequilateral. The height of known shell (JK 4985a, left) is 1.7 mm. Posterior part of the shell much steeper than anterior face. Outer surface sculpture formed by several regularly spaced, wide growth bands. During further growth the shell becomes dorso-ventrally elongated (H/L up to 2.4) with length and width almost equal (L/W = 0.8–1.2). H/W ratio varies (2.0–2.3). The umbonal angle varies in upper left valves from 43° to 45°. The maximum known height is 12.8 mm.

Dimensions. –

specimen	V	L	H	W/2	L/W	H/W	H/L
JK 4985a	L	1.3	1.3	0.3	2.2	2.2	1.0
JK 4985a	L	1.7	1.7	0.7	1.2	1.2	1.0
JK 4985a	R	4.5	10.1	2.3	1.0	2.2	2.2
JK 4985a	L	5.2	10.0	2.2	1.2	2.2	2.2
JK 4982	R	5.3	12.6	3.2	0.8	2.0	2.4
JK 4983	R	5.5	12.8	2.7	1.0	2.3	2.3
JK 4983	L	6.1	12.8	2.8	1.1	2.3	2.1

Remarks. – *Tetinka tiro* occurs rarely in the cephalopod limestone biofacies, *Saetograptus chimaera* Biozone, early Gorstian at the Loděnice-Sedlec locality in the Prague Basin. Contemporary *Tetinka costulifera* occurs in the shallow water *Janicula potens* Community (Kříž 2008b), Coral-Crinoid Community Group (Havlíček & Štorch 1990, 1999) in the early Gorstian, Karlštejn, Liščí Quarry near Amerika gamekeeper's lodge locality in the Prague Basin. The deeper environment of the current influenced cephalopod limestones represented temporary ventilated environment characterized by the occurrence of the *Cardiola donigala-Slava cubicula* Community (Kříž 1999a–c). *Tetinka costulifera* differs from *Tetinka tiro* by more numerous radial ribs and by less dorso-ventrally elongated shells.

Occurrence. – Type locality only.

***Tetinka costulifera* Kříž, 2008**
Figure 3M–S

2008b *Tetinka costulifera* sp. nov.; Kříž, pp. 245, 246, fig. 3Z–ZE.

Holotype. – Shell with conjoined valves figured by Kříž (2008b) on fig. 3Z–ZE as *Tetinka costulifera* Kříž, 2008b, and refigured herein on Fig. 3M–S, JK 11 571.

Type locality. – Bohemia, Karlštejn, Liščí Quarry near Amerika gamekeeper's lodge (Kříž 2008b).

Type horizon. – Silurian, Ludlow, early Gorstian, Kopanina Formation, section No. 942/2.

Material. – Holotype only.

Diagnosis. – Small *Tetinka* with dorso-ventrally elongated, inequivalve, inequilateral, narrowly obovate, strongly inflated shells. Enantiomorphous, inclined to the right. Umbonal angle of the left upper valve is 35°. Flat and lanceolate frontal face with 26 radial ribs, separated from the posterior part of the shell by blunt edge, curved anteriorly. Posteriorly of edge 31 ribs and posteriorly of sulcus 6 ribs are developed.

Description. – Shell very small (length 6.1 mm, height 9.3 mm, and width 4.9 mm), dorso-ventrally elongated (H/L = 1.5), narrowly obovate, and inflated (L/W = 1.2). The left valve is prosocline and the right valve is opisthocline. Enantiomorphous, inclined to the right. Prominent blunt umbos are in anterior terminal position, beaks prosogyrate. Umbonal angle in upper left valve is 35°. A little developed posterior wing is separated by very shallow sulcus. In the left valve overhanging, almost flat, and lanceolate frontal face is separated from the posterior part of the shell by blunt edge, slightly curved anteriorly. The frontal face in the right valve is wider and less steep than in the left valve, almost flat. The angle between the ventral end of frontal face and ventral part of the shell is a right or obtuse angle, ventral margin rounded. Outer shell surface is formed by numerous radial ribs (26 on the frontal face,

Figure 3. A–L – *Tetinka tiro* sp. nov. • A–G – shell with conjoined valves, internal mould with fragments of recrystallized shell, JK 4985a, holotype; A – left lateral view, × 6.3; B – right lateral view, × 6.2; C – anterior view, frontal face, × 6.2; D – posterior view, × 6.2; E – ventral view, × 7.8; F – detail of the umbo with mesoconch, left lateral view, × 9.3; G – dorsal view, × 7.8. • H–L – shell with conjoined valves, internal mould, JK 4983, paratype; H – left lateral view, × 4.9; I – right lateral view, × 4.9; J – anterior view, frontal face, × 4.9; K – posterior view, × 4.9; L – ventral view, × 6.8. • M–S – *Tetinka costulifera* Kříž, 2008, shell with conjoined valves, weathered outer surface, JK 11 571, holotype; M – ventral view, × 7.8; N – dorsal view, × 7.1; O – left lateral view, × 6.5; P – right lateral view, × 6.5; R – anterior view, frontal face, × 6.5; S – posterior view, × 6.5. • A–L – Prague Basin, Bohemia, Loděnice-Sedlec locality, *Saetograptus chimaera* Biozone, *Cardiola donigala-Slava cubicula* Community (Kříž 1999a–c), lower Gorstian, Ludlow. • M–S – Prague Basin, Bohemia, Karlštejn – Liščí Quarry near Amerika gamekeeper's lodge, *Janicula potens* Community (Kříž 2008b), lower Gorstian, Ludlow.


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31 posteriorly of edge, and 6 posteriorly of sulcus), and in combination with irregular growth wrinkles and inexpressive growth bands. Both, the radial ribs and radial gutters broaden ventrally. External opisthodetic ligament developed in short longitudinal groove. Other features unknown.

Dimensions. –

specimen	L	H	W	L/W	H/W	H/L
JK 11 141a	6.1	9.3	4.9	1.2	1.9	1.5

Remarks. – *Tetinka costulifera* from the shallow water *Janicula potens* Community (Kříž 2008b), Coral-Crinoid Community Group (Havlíček & Štorch 1990, 1999), the early Gorstian, Karlštejn, Liščí Quarry near Amerika gamekeeper's lodge locality, Prague Basin was almost contemporaneous with *Tetinka tiro* sp. nov. from the deeper cephalopod limestone biofacies with the *Cardiola donigala-Slava cubicula* Community (Kříž 1999a, b), the early Gorstian, *Saetograptus chimaera* Biozone, Loděnice-Sedlec locality, Prague Basin. Both species are similar. *Tetinka costulifera* differs by less dorso-ventrally elongated shells (H/L = 1.5), more numerous radial ribs (on the frontal face 26 radial ribs, on the posterior part of the shell 31 ribs and posteriorly of sulcus <6 ribs) and smaller umbonal angle in the upper left valve (35°). *Tetinka tiro* sp. nov. has H/L up to 2.4, only 12–15 ribs on the frontal face, on the posterior part of the shell 19–23 ribs and posteriorly of sulcus >3 ribs. The umbonal angle in the upper left valve is larger (43–45°) than in *Tetinka costulifera* (35°).

Occurrence. – Type locality only.

Tetinka caesarea **(Barrande, 1881)**

Figure 4A–R

1881 *Spanila caesarea* Barr.; Barrande, pl. 214, figs III/1–8.

Lectotype. – (SD, herein), shell with conjoined valves with well-preserved recrystallized shell wall figured by Barrande (1881) on pl. 214, figs III/1–6, and herein on Fig. 4K–R, NM L 21 761.

Paralectotype. – Internal mould of the shell with conjoined valves figured by Barrande (1881) on pl. 214, figs III/7–8, NM L 21760.

Type locality. – Bohemia, Prague Basin, Praha-Lochkov, Barrande's test pits.

Type horizon. – Silurian, Ludlow, late Ludfordian, *Cardiola conformis* Community (Kříž 1999a, c), Kopanina Formation.

Material. – 11 left, 9 right valves, and 24 shells with conjoined valves.

Diagnosis. – *Tetinka* with dorso-ventrally elongated, inequivalve, inequilateral, narrowly ovate, and inflated shells. Enantiomorphous, distinctly inclined to the right. Umbonal angle in the left upper valve is 31–45°. Posterior wing is relatively large, separated from the central part of the shell by shallow and relatively wide radial sulcus which ends in the central part of the posterior margin, parallel with frontal face. Posterior margin is here slightly concave. Outer surface sculpture formed by growth wrinkles and regular narrow growth bands in combination with weak radial ribs. When the uppermost layer of the shell is etched or eroded fine, numerous radial striae are visible. Inner surface radial ribs are most prominent on frontal face (24) and posteriorly of posterior wing (6–9). In the central part of the shell are numerous radial ribs (28–32) less prominent, best preserved on the ventral margin as crenulations.

Description. – Shell small (length maximally 10.5 mm, height maximally 23.7 mm and width maximally 9.8 mm), dorso-ventrally elongated (H/L = 1.7–2.5), inequivalve, inequilateral, narrowly ovate, and inflated (L/W = 1.1–1.6). Enantiomorphous, distinctly inclined to the right. Prominent blunt umbos formed by subcircular mesoconch are in anterior terminal position, beaks prosogyrate. Umbonal angle in the left upper valve is 31–45°. In the left valve overhanging, almost flat and lanceolate frontal face is separated from the central part of the shell by narrow blunt edge, curved anteriorly. The angle between the ventral end of frontal face and

Figure 4. A–R – *Tetinka caesarea* (Barrande, 1881). • A–D – shell with conjoined valves, internal mould, JK 8783; A – left lateral view, × 4.5; B – right lateral view, × 4.5; C – anterior view, frontal face, × 4.5; D – posterior view, × 4.5. • E – left valve, outer surface, JK 8990, × 4.5. • F–I – shell with conjoined valves, internal mould, JK 8756; F – left lateral view, × 4.3; G – ventral view, × 3.3; H – right lateral view, × 4.3; I – dorsal view, × 4.3. • J – shell with conjoined valves, internal mould with most of recrystallised shell preserved, left lateral view, × 3.4. • K–R – shell with conjoined valves, outer surface, original of Barrande (1881, pl. 214, figs III/1–8), lectotype, NM L 21 761; K – detail of radial striae on the umbonal part of the right valve, × 22.9; L – detail of ventral margin of the left valve with the shell repair pathology, × 9.4; M – ventral view, × 2.6; N – left lateral view, 3.4. O – right lateral view, × 3.4; P – anterior view, frontal face, × 3.4; R – posterior view, × 3.4. • A–D, F–I, K–R – Prague Basin, Bohemia, Praha-Lochkov, Barrande's test pits, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow. • E – Prague Basin, Bohemia, Praha-Lochkov, Cephalopod Quarry locality, uppermost *Cardiola conformis* Community (Kříž 1999a, c), uppermost Ludfordian, Ludlow. • J – Prague Basin, Bohemia, Praha-Dvorce quarry, uppermost *Cardiola conformis* Community (Kříž 1999a, c), uppermost Ludfordian, Ludlow.


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ventral part of the shell is a right or obtuse angle, and ventral margin is rounded. Posterior wing is relatively large, separated from the central part of the shell by shallow and wide radial sulcus which ends in the central part of the posterior margin, parallel with frontal face. Posterior margin is here slightly concave. Outer surface sculpture formed by growth wrinkles and regular narrow growth bands in combination with weak radial ribs. When the uppermost layer of the shell is etched, fine, numerous radial striae are visible (Fig. 4K). Inner surface radial ribs are most prominent on frontal face (24) and posteriorly of posterior wing (6–9). In the central part of the shell are numerous radial ribs (28–32) less prominent, best preserved on the ventral margin as crenulations. Outer ligament is opisthodetic. Shell thickness is 0.11–0.31 mm. Other features unknown.

Ontogeny. – Prodissoconch not preserved. The mesoconch is equivalve, subcircular (H/L = 1.1), inflated (H/W = 1.7), prosogyrate, inequilateral (length maximally 2.1 mm, height maximally 2.4 mm and width maximally 1.4 mm). Outer surface sculpture formed by several regularly spaced, wide growth bands. During further growth the shell becomes dorso-ventrally elongated (H/L up to 2.5).

Dimensions. –

specimen	V	L	H	W/2	L/W	H/W	H/L
JK 11 243	L	5.7	9.4	2.6	1.1	1.8	1.6
NM L 21 760	L	5.9	13.4	2.5	1.2	2.7	2.3
JK 8783	R	6.2	13.7	2.7	1.1	2.5	2.2
JK 8895	L	6.3	11.8	2.8	1.1	2.1	1.9
JK 8783	L	6.3	13.7	2.5	1.3	2.7	2.2
JK 8785	R	6.4	12.5	2.6	1.2	2.4	2.0
JK 8793	L	6.7	13.8	3.0	1.1	2.3	2.1
JK 8785	L	6.9	11.8	3.0	1.2	2.0	1.7
JK 8749	R	6.9	16.0	3.0	1.2	2.7	2.3
JK 4867	R	7.0	13.7	2.7	1.3	2.5	2.0
JK 8756	R	7.1	13.9	2.2	1.6	3.2	2.0
JK 8756	L	7.1	14.0	3.1	1.1	2.3	2.0
JK 8775	L	7.1	15.2	3.0	1.2	2.5	2.1
JK 8788	R	7.4	15.0	2.8	1.3	2.7	2.0
JK 8788	L	7.4	15.0	3.2	1.2	2.4	2.0
JK 8990	L	7.9	15.0	3.2	1.2	2.3	1.9
JK 8754	L	7.9	19.0	3.2	1.2	3.0	2.4
JK 4998	L	8.3	15.7	3.3	1.3	2.4	1.9
JK 8764	R	9.1	17.8	2.6	1.8	3.4	2.0
JK 8967	L	9.3	22.8	3.9	1.2	2.9	2.5
JK 8771	R	9.6	22.8	3.4	1.4	3.4	2.4
JK 4874	R	10.0	20.3	3.8	1.3	2.7	2.0
JK 2958	L	10.2	>22.2	4.7	1.1	2.4	2.2
NM L 21 761	R	10.5	23.7	4.9	1.1	2.4	2.3

Remarks. – Ancestors of *Tetinka caesarea* were probably derived from the early Ludfordian descendants of *Tetinka tiro* sp. nov. *Tetinka caesarea* differs from *Tetinka tiro* especially by its relatively large posterior wing separated from the central part of the shell by shallow and wide radial sulcus which ends in the central part of the posterior margin, parallel with frontal face. Posterior margin is here slightly concave. *Tetinka caesarea* has more numerous radial ribs than *Tetinka tiro*.

Occurrence. – Bohemia, Prague Basin, late Ludfordian, base of the *Cardiola conformis* Community: Praha-Pankrác, temporary outcrop for the TV Studio and Sdružení Street locality (NC), Praha-Lochkov, Marble Quarry (NC); latest Ludfordian, the *Cardiola conformis* Community: Praha-Lochkov – Barrande's test-pits, Radotín Valley, small quarries 400 NNW of Lochkov cement work (NC), Kosoř, Praha-Butovice, Praha-Velká Chuchle, Praha-Slivenec; latest Ludfordian, the *Cardiola conformis* Community: Praha-Pankrác, temporary outcrop for the TV Studio and Sdružení Street locality (NC), Praha-Lochkov – Cephalopod Quarry, Praha-Dvorce, Kosov near Beroun, old quarry, southern face (NC).

***Tetinka trigona* (Münster *in* Goldfuss, 1837)**
Figure 5A–L

1837 *Cardium trigonum* Münster; Goldfuss, p. 215, pl. 142, figs 8 a–c.
1840 *Cardium trigonum* – Münster, p. 61.
1881 *Tetinka securiformis* Barr. – Barrande, pl. 214, figs IV/1–8.
1925 *Amita trigona* Mstr. sp. – Heller, pp. 225, 226, pl. 2, figs 6a, b.

Holotype. – Shell with conjoined valves figured by Münster *in* Goldfuss (1837) on pl. 142, figs 8a–c, figured herein on Fig. 5B, BSPG AS VII 1752.

Figure 5. A–L – *Tetinka trigona* (Münster *in* Goldfuss, 1837). • A – right valve, outer surface, JK 4873, lateral view, × 7.6. • B – shell with conjoined valves, outer surface, original Münster *in* Goldfuss (1837), pl. 142, figs 8a–c, holotype, BSPG AS VII 1752, left lateral view, × 3.8. • C – right valve, internal mould, JK 4995, lateral view, × 3.3. • D – left valve, internal mould, JK 8921, lateral view, × 3. • E–G – shell with conjoined valves, internal mould with parts of recrystallized shell preserved, JK 8782; E – detail of radial striae on the posterior part of the left valve, × 25.6; F – left lateral view, × 3.9; G – ventral view, × 4.2. • H – right valve, internal mould, JK 4849, lateral view, × 3.8. • I–K – shell with conjoined valves, internal mould with parts of recrystallized shell preserved, original of Barrande (1881, pl. 214, figs IV/1–6), NM L 21 762; I – anterior view, frontal face, × 2.7; J – left lateral view, × 3.9; K – right lateral view, × 3.9. • L – right valve, internal mould with part of recrystallized shell preserved, JK 4872, × 4.9. • A, C – Prague Basin, Bohemia, Praha-Pankrác, TV Studio locality, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow (NC). • B – Germany, Frankenwald,

Elbersreuth (Greiling 1962, Heller 1925, Münster *in* Goldfuss 1837, Münster 1840), middle Ludfordian, Ludlow, *Cardiola alata* Community (Kříž 1999a) (= *Neocucullograptus kozlowskii* Biozone). • D – Prague Basin, Bohemia, Praha-Lochkov, Cephalopod Quarry locality, uppermost *Cardiola conformis* Community (Kříž 1999a, c), uppermost Ludfordian, Ludlow (NC). • E–G, I–K – Prague Basin, Bohemia, Praha-Lochkov, Barrande's test pits, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow. • H – Prague Basin, Bohemia, Praha-Pankrác, Sdružení Street locality, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow (NC). • L – Prague Basin, Bohemia, Radotín Valley, small quarries 400 NNW of Lochkov cement work upper Ludfordian, Ludlow (NC).

Type locality. – Germany, Frankenwald, Elbersreuth.

Type horizon. – Silurian, Ludlow, most probably middle Ludfordian, the *Cardiola alata* Community (Kříž 1999a) (= *Neocucullograptus kozlowskii* Biozone), Orthocerenkalk.

Material. – 24 left, 20 right valves, and 10 shells with conjoined valves.

Diagnosis. – Postero-ventrally elongated (H/L = 1.3–1.6), broadly subtriangular *Tetinka* with slightly inflated shell (L/W = 1.5–2.4), the greatest length is at mid-height. Enantiomorphous, inclined to the right. Umbonal angle 50–55°. Blunt edge separates lanceolate frontal face from the rest of shell. Postero-ventral margin rounded. The angle between the ventral end of frontal face and ventral margin is a right or obtuse angle. Poorly developed posterior wing separated by very shallow sulcus. On inner surface prominent radial ribs are developed on the frontal face (11–17) and posteriorly of posterior wing (7–8). On the central part of the shell the radial ribs are developed only as the bifurcated crenulations on the ventral margin (34–42).

Description. – Shell small (length maximally 13.9 mm, height maximally 20.7 mm, and width maximally 7.4 mm), inequivalve, inequilateral, dorso-ventrally elongated (H/L = 1.3–1.6), broadly subtriangular, slightly inflated (L/W = 1.5–2.4), the greatest length is at mid-height. Enantiomorphous, inclined to the right. Blunt umbos formed by subcircular mesoconch are in anterior terminal position, beaks prosogyrate. Umbonal angle 50–55°. Almost flat, narrow, and lanceolate frontal face separated from the central part of the shell by blunt, almost straight edge. The angle between the ventral end of frontal face and ventral part of the shell is a right or obtuse angle. Not well-distinguished, relatively long posterior wing ends in longest part of the shell and is separated from the central part of the shell by very shallow sulcus. Outer surface almost smooth with growth wrinkles and growth rugae, and regularly spaced narrow growth bands; radial ribs developed on inner surface are only a little visible. When uppermost layer of shell is etched off or eroded the numerous radial striae may be seen (Fig. 5E). On inner surface prominent radial ribs are developed on frontal face (11–17) and posteriorly of wing (7–8). On the almost smooth central part of the shell the radial ribs are ventrally bifurcated and developed only as the crenulations on the ventral margin (34–42). Radial sculptures are in combination with almost regularly spaced narrow growth bounds. Outer ligament is opisthodetic. Shell thickness is 0.14–0.26 mm. Other features unknown.

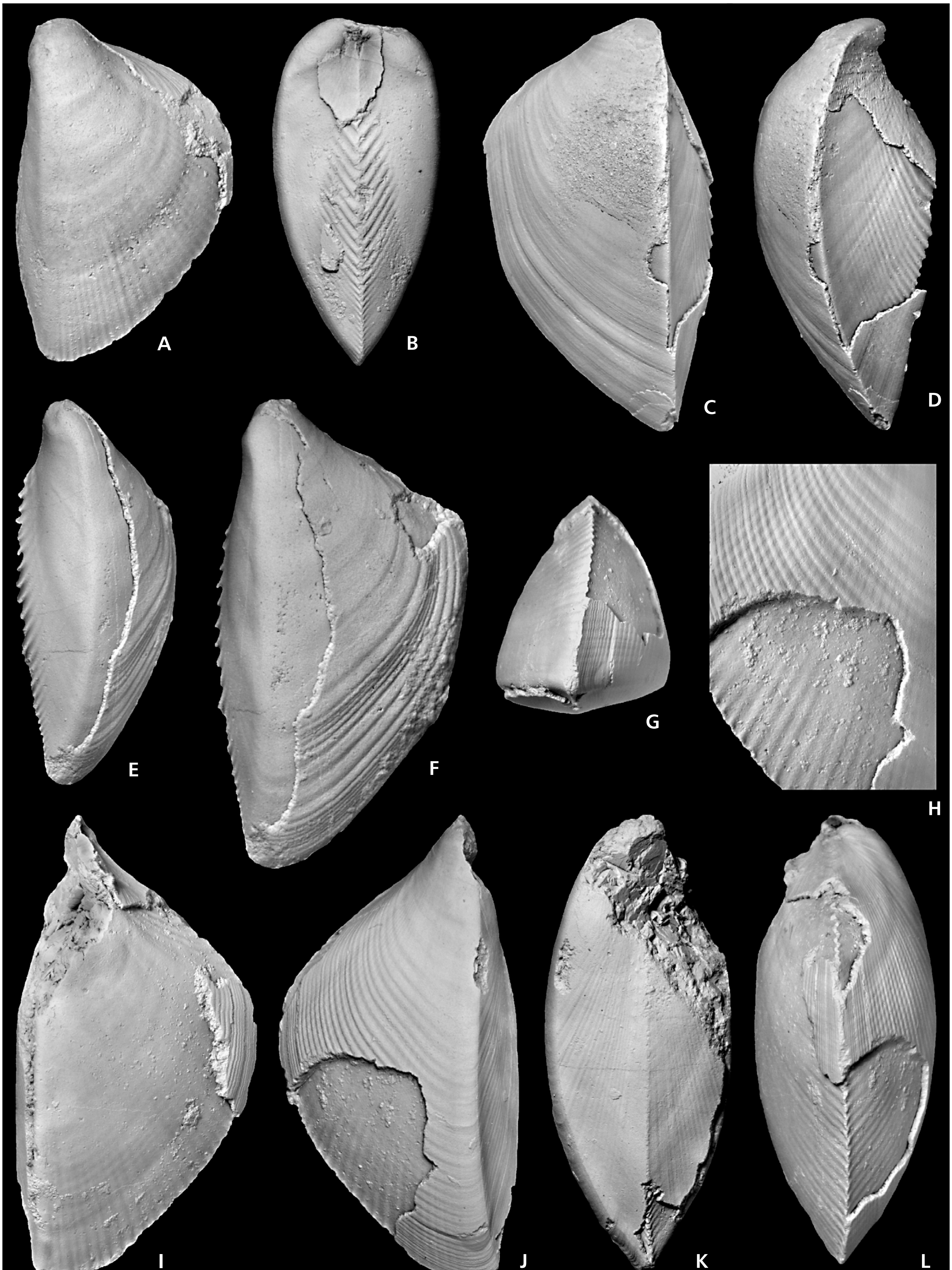
Dimensions. –

specimen	V	L	H	W/2	L/W	H/W	H/L
JK 4873	R	5.5	7.2	1.8	1.5	2.0	1.3
NM L 21 763	L	5.4	8.6	2.0	1.4	2.2	1.6
JK 11 097	L	6.6	9.5	2.0	1.7	2.4	1.4
JK 8976	R	8.7	12.9	2.2	2.0	2.9	1.5
JK 4830	R	10.3	14.9	2.5	2.1	3.0	1.4
JK 4840	L	10.5	17.0	3.1	1.7	2.7	1.6
JK 8780	L	10.6	14.9	3.0	1.8	2.5	1.4
JK 8971	R	10.7	16.3	2.6	2.1	3.1	1.5
JK 8782	L	11.1	15.9	3.1	1.8	2.6	1.4
JK 4849	R	11.3	15.8	2.4	2.3	3.3	1.3
JK 4963	L	11.8	15.9	2.7	2.2	2.9	1.3
JK 4845	R	12.2	18.8	3.1	2.0	3.0	1.5
JK 8921	L	12.8	19.0	3.3	1.9	2.9	1.5
NM L 21 762	L	12.8	20.7	3.7	1.7	2.8	1.6
JK 4995	R	12.9	17.8	2.7	2.4	3.3	1.4
JK 4841	L	13.2	17.8	3.1	2.1	2.9	1.3
JK 4842	L	13.9	18.8	3.0	2.3	3.1	1.4

Remarks. – *Tetinka trigona* is characterized by its broadly subtriangular and slightly inflated shells, which are longest in the half height and have higher umbonal angle than most of other species of *Tetinka* except *Tetinka accedens*. It is possible that *Tetinka sagitta, Tetinka elongata* and *Tetinka trigona* evolved from the closely related ancestors in the early Ludfordian.

Occurrence. – Germany, Frankenwald, Elbersreuth [Greiling (1962), Heller (1925), Münster *in* Goldfuss (1837), Münster (1840)], middle Ludfordian, Ludlow, most

Figure 6. A–L – *Tetinka accedens* Barrande, 1881. • A, B – shell with conjoined valves, internal mould, JK 8781; A – left lateral view, × 4.9; B – anterior view, frontal face, × 4.9. • C, D – right valve, internal mould with most of recrystallized shell preserved, JK 4917; C – lateral view, × 4.8; D – antero-lateral view, × 4.8. • E, F – left valve, internal mould with part of recrystallized shell preserved, JK 4875; E – antero-lateral view, × 4.3; F – lateral view, × 5.3. • G–L – shell with conjoined valves, internal mould with parts of recrystallized shell preserved, original of Barrande (1881, pl. 204, figs I/1–5), holotype, NM L 23 488; G – ventral view, × 3.3; H – detail of the outer and inner surface sculpture, right valve, × 4.6; I – left lateral view, × 3.7; J – right lateral view, × 3.7; K – anterior view, frontal face, × 3.7; L – posterior view, × 3.7. • A, B – Prague Basin, Bohemia, Praha-Butovice, upper Ludfordian, Ludlow (NC). • C, D – Prague Basin, Bohemia, Praha-Pankrác, TV Studio locality, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow (NC). • E, F – Prague Basin, Bohemia, Praha-Lochkov, Cephalopod Quarry locality, uppermost *Cardiola conformis* Community (Kříž 1999a, c), uppermost Ludfordian, Ludlow (NC). • G–L – Prague Basin, Bohemia, Praha-Lochkov, Barrande's test pits, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow.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probably the *Cardiola alata* Community (Kříž 1999a) (= *Neocucullograptus kozlowskii* Biozone). Bohemia, Prague Basin, late Ludfordian: Praha-Lochkov – Barrande's test-pits, Radotín Valley, small quarries 400 NNW of Lochkov cement work (NC), Praha-Pankrác, temporary outcrop for the TV Studio and Sdružení Street locality (NC); latest Ludfordian, the *Cardiola conformis* Community: Praha-Lochkov – Cephalopod Quarry (NC), Kosov near Beroun, old quarry southern face (NC).

***Tetinka accedens* Barrande, 1881**
Figure 6A–L

1881 *Tetinka accedens* Barr.; Barrande, pl. 204, figs I/1–5.

Holotype. – Shell with conjoined valves with well-preserved recrystallized shell wall figured by Barrande (1881) on pl. 204, figs I/1–5, and herein on Fig. 6G–L, NM L 23 488.

Type locality. – Bohemia, Prague Basin, Praha-Lochkov, Barrande's test-pits.

Type horizon. – Silurian, Ludlow, late Ludfordian.

Material. – 6 left, 3 right valves, and 4 shells with conjoined valves.

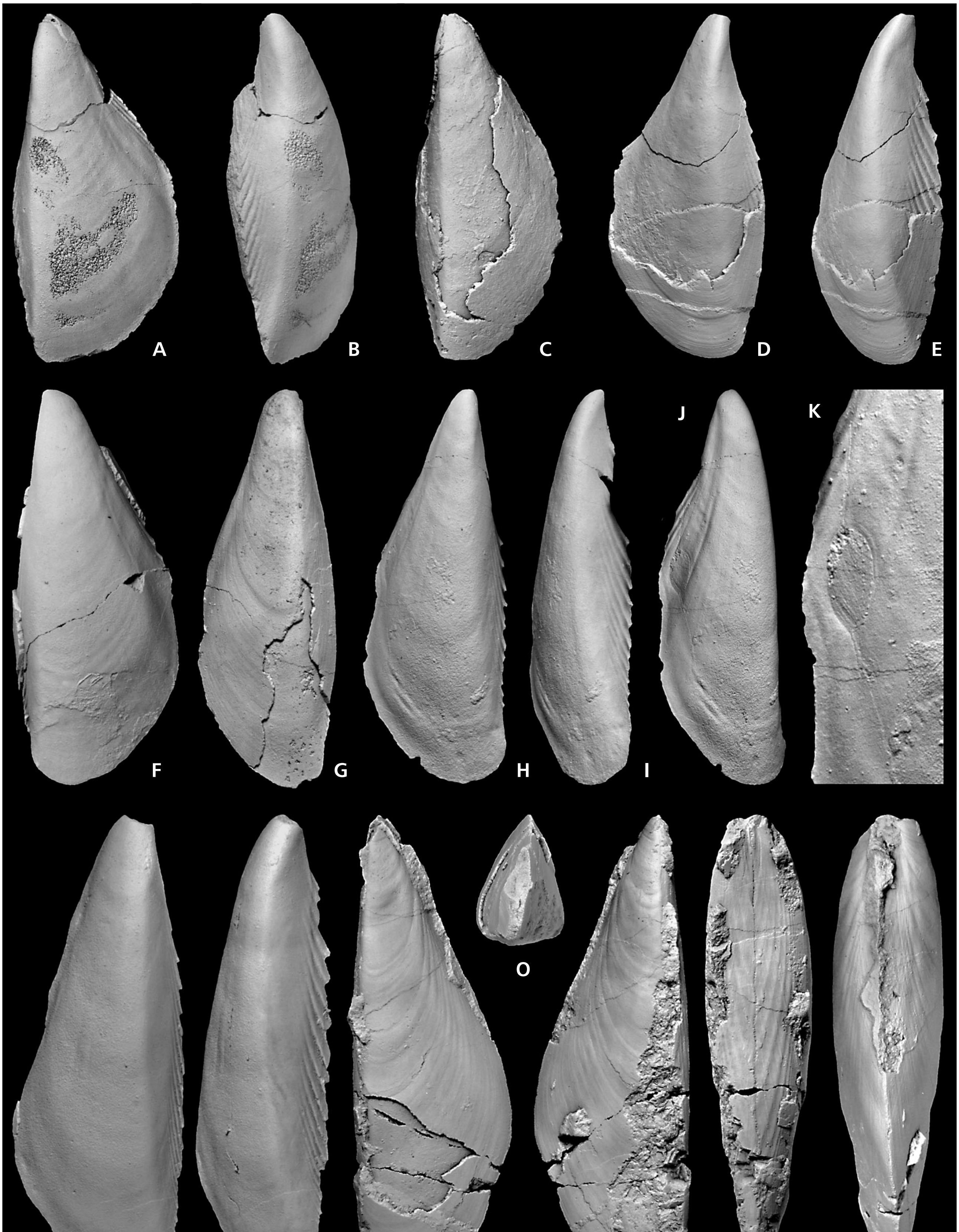
Diagnosis. – Postero-ventrally elongated (H/L = 1.3–1.6), broadly subtriangular *Tetinka*, with obese shell (L/W = 1–1.5), longest in the upper half of the shell height. Enantiomorphous, inclined to the right. Umbonal angle 48–58°. Blunt edge separates the frontal face and the rest of shell. Dorso-ventral margin rounded. The angle between ventral end of frontal face and ventral margin of the shell is almost sharp. Posterior wing separated by very shallow and wide sulcus. Outer surface almost smooth with fine growth wrinkles or with narrow regular growth bands combined with numerous radial ribs. On the inner surface prominent radial ribs are developed on frontal face (24) and posteriorly of posterior wing (7–11). On the central part of the shell the radial ribs (24–34) are less developed.

Description. – Shell small (length maximally 13 mm, height maximally 23 mm, and width maximally 8.6 mm), inequivalve, inequilateral, dorso-ventrally elongated (H/L = 1.3–1.6), broadly subtriangular, and obese (L/W = 1–1.5), the greatest length is longest at upper shell height. Enantiomorphous, inclined to the right. Blunt umbos formed by subcircular mesoconch are in anterior terminal position, beaks prosogyrate. Umbonal angle 48–58°. Almost flat, narrow, and lanceolate frontal face separated from the central part of the shell by narrow, blunt edge, slightly curved anteriorly. The angle between the ventral end of frontal face and ventral part of the shell is mostly sharp angle. Posterior wing ends in longest part of the shell and is separated from the central part of the shell by wide and very shallow sulcus. Outer surface almost smooth with fine growth wrinkles or with narrow regular growth bands combined with numerous radial ribs. On inner surface prominent radial ribs are developed on frontal face (24) and posteriorly of posterior wing (7–11). On the central part of the shell the radial ribs (24–34) are less prominent. Outer ligament is opisthodetic. Inter-umbonal pallial muscle scars. Shell thickness is 0.2–0.5 mm. Other features unknown.

Dimensions. –

specimen	V	L	H	W/2	L/W	H/W	H/L
JK 11 122	L	5.5	9.6	2.5	1.1	1.9	1.7
JK 8794	R	7.0	10.7	2.6	1.3	2.1	1.5
JK 8781	R	7.7	12.5	2.6	1.5	2.4	1.6
JK 11 019	L	8.0	15.0	2.8	1.4	2.7	1.9
JK 11 031	L	8.5	17.0	3.6	1.2	2.4	2.0
JK 4917	L	8.6	15.5	3.5	1.2	2.2	1.8
JK 4875	R	9.3	16.1	4.5	1.0	1.8	1.7
JK 4844	R	9.8	17.8	3.7	1.3	2.4	1.8
JK 4893	L	11.0	20.1	–	–	–	1.8
NM L 23 488	R	12.0	23.0	4.2	1.4	2.7	1.9
JK 4898	R	13.0	23.0	4.3	1.5	2.7	1.8

Figure 7. A–F – *Tetinka elongata* Barrande, 1881. • A, B – shell with conjoined valves, internal mould, JK 8768; A – left lateral view, × 3.1; B – antero-lateral view, × 3.1. • C – left valve, internal mould with part of recrystallized shell preserved, JK 4939, lateral view, × 3.5. • D, E – right valve, internal mould with part of recrystallized shell preserved, original of Barrande (1881, pl. 213, figs II/1–6), lectotype, NM L 26 518; D – lateral view, × 2.9; E – antero-lateral view, × 2.9. • F – left valve, internal mould, JK 4949, lateral view, × 4.1. • G–S – *Tetinka sagitta* Barrande, 1881. • G – right valve, internal mould with fragments of recrystallized shell preserved, JK 4920, lateral view, × 4.2. • H–K – right valve, internal mould, JK 4855; H – lateral view, × 3.1; I – antero-lateral view, × 3.1; J – postero-lateral view, × 3.1; detail of the posterior adductor muscle scar, × 7.2. • L, M – right valve, internal mould, JK 4919; L – lateral view, × 4.4; M – antero-lateral view, × 4.4. • N–S – shell with conjoined valves, internal mould with parts of recrystallized shell preserved, original of Barrande (1881, pl. 213, figs I/1–6), holotype, NM L 26 517; N – left lateral view, × 2.8; O – ventral view, × 2.1; P – right lateral view, × 2.8; R – anterior view, frontal face, × 2.8; S – posterior view, × 2.8. • A, B – Prague Basin, Bohemia, Praha-Lochkov, Barrande's test pits, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow. • C, F – Prague Basin, Bohemia, Praha-Pankrác, Sdružení Street locality, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow (NC). • D, E – Prague Basin, Bohemia, Kosoř, *Cardiola conformis* Community (Kříž 1999a, c), upper Ludfordian, Ludlow. • G–M – Prague Basin, Bohemia, Praha-Lochkov, Cephalopod Quarry locality, uppermost *Cardiola conformis* Community (Kříž 1999a, c), uppermost Ludfordian, Ludlow (NC). • N–S – Prague Basin, Bohemia, Praha-Velká Chuchle, upper Ludfordian, Ludlow.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Remarks. – *Tetinka accedens* differs from all other species of *Tetinka* by the largest umbonal angle and by the greatest lenght at upper half of the shell height. From its mid Ludfordian ancestors was probably derived also *Spanila* Barrande, 1881.

Occurrence. – Bohemia, Prague Basin, late Ludfordian, the early *Cardiola conformis* Community: Praha-Lochkov – Barrande's test-pits, Praha-Butovice; latest Ludfordian, the *Cardiola conformis* Community: Praha-Pankrác, temporary outcrop for the TV Studio and Sdružení Street locality (NC), Praha-Lochkov – Cephalopod Quarry (NC).

***Tetinka elongata* Barrande, 1881**
Figure 7A–F

1881 *Tetinka elongata* Barr.; Barrande, pl. 213, figs II/1–9.

Lectotype. – (SD, herein), shell with conjoined valves with well-preserved recrystallized shell wall figured by Barrande (1881) on pl. 213, figs II/1–6, and herein on Fig. 7D, E, NM L 26 518.

Paralectotypes. – Internal mould of the left valve with the fragments of recrystallized shell wall figured by Barrande (1881) on pl. 213, fig. II/7, NM L 21 754, and internal mould of the left valve with the fragments of recrystallized shell wall figured by Barrande (1881) on pl. 213, figs II/8–9, NM L 21 755.

Type locality. – Bohemia, Prague Basin, Kosoř, Barrande's test-pits.

Type horizon. – Silurian, Ludlow, late Ludfordian, Kopanina Formation.

Material. – 15 left, 12 right valves, and 3 shells with conjoined valves.

Diagnosis. – *Tetinka* with dorso-ventrally elongated, inequivalve, inequilateral, narrowly subtrigonal, and inflated shells. Enantiomorphous, inclined to the right. Umbonal angle in the left upper valve is 18–26°. Posterior wing is long, ends in the longest part of the shell mostly below the half of the shell height and is separated from the central part of the shell by shallow and relatively wide radial sulcus. Inflated frontal face separated from the central part of the shell by blunt edge, straight or slightly curved anteriorly. Posterior margin rounded. Outer surface sculpture formed by growth wrinkles. When the uppermost layer of the shell is etched, fine, numerous radial striae are visible. Inner surface radial ribs are most prominent on frontal face (11–24) and posteriorly of posterior wing (6–7). The central part of the shell is mostly smooth, but also with a little visible radial ribs (27), mostly reduced on the ventral margin to crenulations.

Description. – Shell small (length maximally 10 mm, height maximally 21.5 mm and width maximally 7.8 mm), dorso-ventrally elongated (H/L = 1.9–2.7), inequivalve, inequilateral, narrowly subtriangular, and inflated (L/W = 1.1–1.9). Enantiomorphous, distinctly inclined to the right. Long and blunt umbos formed by subovate mesoconch are in anterior terminal position, beaks prosogyrate. Umbonal angle in the left upper valve is 18–26°. In the left valve overhanging, inflated and lanceolate frontal face is separated from the central part of the shell by blunt edge, straight or a little curved anteriorly. Posterior and ventral margin rounded. Posterior wing is long, ends at the greatest length mostly below the half of the shell height, and is separated from the central part of the shell by shallow and relatively wide radial sulcus. Outer surface sculpture formed by growth wrinkles. When the uppermost layer of the shell is etched, fine, numerous radial striae are visible. Inner surface radial ribs are most prominent on frontal face (11–24) and posteriorly of posterior wing (6–7). The central part of the shell is mostly smooth, but also with a little developed radial ribs (27), best preserved on the ventral margin as crenulations. Outer ligament is opisthodetic. Shell thickness is 0.14–0.24 mm. Other features unknown.

Dimensions. –

specimen	V	L	H	W/2	L/W	H/W	H/L
JK 11 028	L	5.0	13.6	2.2	1.1	3.1	2.7
JK 4946	L	5.6	14.7	2.0	1.4	3.7	2.6
JK 4880	L	6.3	15.8	2.5	1.3	3.2	2.6
JK 4961	R	6.9	15.7	2.4	1.4	3.3	2.3
JK 4928	R	7.0	13.8	2.8	1.3	2.5	2.0
NM L 21 754	L	7.0	17.9	2.5	1.4	3.6	2.6
JK 4929	R	7.3	14.1	2.5	1.5	2.8	1.9
JK 4939	L	7.3	17.5	3.0	1.2	2.9	2.4
JK 4949a	L	7.4	17.4	2.5	1.5	3.5	2.4
JK 4869	R	7.5	17.9	2.9	1.3	3.1	2.4
JK 4881	R	7.9	19.8	2.8	1.4	3.5	2.5
JK 11 008	R	8.0	18.8	3.2	1.3	2.9	2.4
JK 8987	L	8.3	18.6	2.8	1.5	3.3	2.2
JK 8940	R	8.7	16.7	3.2	1.4	2.6	2.6
JK 4950	R	9.5	21.1	2.5	1.9	4.2	2.2
JK 8768	L	9.6	20.0	3.4	1.4	2.9	2.1
NM L 26 518	R	10.0	21.5	3.9	1.3	2.8	2.2

Remarks. – *Tetinka elongata* and *Tetinka sagitta* differ from other species of *Tetinka* by generally very low umbonal angle and by more dorso-ventrally elongated shells. *Tetinka elongata* is also closely related to *Tetinka caesarea* by similar number of radial ribs, smooth outer surface and by the similar height to length ratio. Probably all these species had the closely related ancestors in the mid Ludfordian.

Occurrence. – Bohemia, Prague Basin, late Ludfordian, the early *Cardiola conformis* Community: Praha-Pankrác – temporary outcrop for the TV Studio and Sdružení Street locality (NC), Praha-Lochkov – Marble Quarry (NC), Praha-Zadní Kopanina, mill-race (NC), Karlštejn – Liščí Quarry, section No. 942 (NC); latest Ludfordian, the *Cardiola conformis* Community: Praha-Lochkov – Barrande's test-pits, Radotín Valley – small quarries 400 NNW of Lochkov cement work (NC), Kosoř, Praha-Butovice, Praha-Velká Chuchle, Praha-Slivenec; latest Ludfordian, the *Cardiola conformis* Community: Praha-Pankrác – temporary outcrop for the TV Studio and Sdružení Street locality (NC), Praha-Lochkov – Cephalopod Quarry (NC), Praha-Dvorce, Dlouhá Hora near Beroun; earliest Přídolí, the *Cardiola conformis* Community, Praha-Radotín Valley – U topolů Section.

***Tetinka sagitta* Barrande, 1881**
Figure 7G–S

1881 *Tetinka sagitta* Barr.; Barrande, pl. 213, figs I/1–6.
1881 *Spanila serva* Barr.; Barrande, pl. 213, figs I/7–9.

Holotype. – Shell with conjoined valves with preserved fragments of recrystallized shell wall figured by Barrande (1881) on pl. 213, figs I/1–6, and herein on Fig. 7N–S, NM L 26 517.

Type locality. – Bohemia, Prague Basin, Praha-Velká Chuchle.

Type horizon. – Silurian, Ludlow, Ludfordian, Kopanina Formation.

Material. – 4 left, 7 right valves, and 2 shells with conjoined valves.

Diagnosis. – *Tetinka* with dorso-ventrally elongated (H/L = 2.3–3), inequivalve, inequilateral, narrowly subtriangular, and inflated shells (L/W = 1–1.6). Enantiomorphous, distinctly inclined to the right. Umbonal angle in the left upper valve is 18–21°. In the left valve slightly overhanging, inflated and lanceolate frontal face is separated from the central part of the shell by blunt edge, mostly straight. Posterior wing is very long, separated from the central part of the shell by shallow and relatively wide radial sulcus ending in the longest part of the shell far ventrally below the half of the shell height. Outer and inner surface sculpture with irregularly spaced relatively wide prominent growth bands and furrows. Inner surface radial ribs are prominent on frontal face (13–18) and posteriorly of posterior wing (6). The central part of the shell is smooth. Relatively large, elliptic posterior adductor muscle scar is developed close to the wing in the place of sulcus.

Description. – Shell small (length maximally 10.1 mm, height maximally 30 mm and width maximally 8.8 mm), dorso-ventrally elongated (H/L = 2.3–3), inequivalve, inequilateral, narrowly subtriangular, and inflated (L/W = 1–1.6). Enantiomorphous, distinctly inclined to the right. Long and blunt umbos formed by subovate mesoconch are in terminal position, beaks prosogyrate. Umbonal angle in the left upper valve is 18–21°. In the left valve slightly overhanging, inflated and lanceolate frontal face is separated from the central part of the shell by blunt edge, mostly straight. Ventral margin rounded. Posterior wing very long, separated from the central part of the shell by shallow and relatively wide radial sulcus ending in the longest part of the shell far ventrally below the half of the shell height. Posterior margin rounded. Outer surface sculpture formed by growth wrinkles and irregularly spaced flat and relatively wide growth bands and furrows. Slightly visible are radial ribs on the anterior face. Inner surface radial ribs are prominent on frontal face (13–18) and posteriorly of posterior wing (6). The central part of the shell is smooth. Outer ligament is opisthodetic. Relatively large, elliptic posterior adductor muscle scar is developed close to the wing in the place of sulcus. Shell thickness is 0.14–0.31 mm. Other features unknown.

Dimensions. –

specimen	V	L	H	W/2	L/W	H/W	H/L
JK 11 145	R	5.7	17.0	3.0	1.0	2.8	3.0
JK 4856	R	6.3	17.1	2.6	1.2	3.3	2.7
JK 4920	R	6.4	17.0	2.9	1.1	2.9	2.7
JK 8772	L	6.6	17.7	2.5	1.3	3.5	2.7
JK 4919	R	6.9	19.0	3.0	1.2	3.7	2.8
JK 4941	R	7.6	>18.4	3.1	1.2	>2.7	>2.4
NM L 21 664	L	8.5	22.2	3.5	1.2	3.2	2.6
JK 4855	R	8.5	23.5	3.4	1.3	3.5	2.8
JK 4930	R	8.6	20.0	4.4	1.0	2.3	2.3
NM L 26 517	R	10.1	30.0	3.2	1.6	4.7	3.0

Remarks. – *Tetinka sagitta* occurs in the lower early *Cardiola docens* Community (Kříž 1999a, c) and represents thus the earliest Ludfordian *Tetinka.* It differs from other species of *Tetinka* by lowest umbonal angle, relatively highest shells, and by the presence of flat wide growth bands and furrows.

Occurrence. – Bohemia, Prague Basin, early Ludfordian, the *Cardiola docens* Community: Praha-Řeporyje – Mušlovka Quarry (NC); late Ludfordian, the *Cardiola* *conformis* Community: Praha-Velká Chuchle, Praha-Lochkov – Cephalopod Quarry (NC), Praha-Pankrác – temporary outcrop for the TV Studio and Sdružení Street locality (NC); earliest Přídolí, Praha-Radotín Valley – U topolů section, and Nad ubikacemi locality (NC).

Conclusions

1. Upper Silurian, Gorstian, Ludfordian and early Přídolí *Tetinka* Barrande, 1881 evolved most probably from the Wenlock ancestors of *Kenzieana* Liljedahl, 1989.

2. *Tetinka* is represented by seven species, *Tetinka costulifera* Kříž, 2008, *Tetinka tiro* sp. nov., *Tetinka sagitta* Barrande, 1881, *Tetinka trigona* (Münster *in* Goldfuss, 1837), *Tetinka caesarea* (Barrande, 1881), *Tetinka elongata* Barrande, 1881 and by *Tetinka accedens* Barrande, 1881. The Ludfordian species may be derived from the early Gorstian *Tetinka tiro.* Occurrence of *Tetinka* is almost restricted to the Gorstian, Ludfordian and earliest Přídolí cephalopod limestone biofaces in the Prague Basin, Bohemia. *Tetinka trigona* also occurs in the middle Ludfordian of Elbersreuth, Frankenwald, Germany. *Tetinka costulifera* occurs in the early Gorstian coral-crinoid biofacies in the Prague Basin and was probably contemporary with *Tetinka tiro.*

3. *Tetinka* was most probably a byssate semi-infaunal to infaunal bivalve living with the frontal face down and parallel with the bottom among crowded cephalopod shells in the cephalopod limestone biofacies of Perunica and European peri-Gondwana. Its infaunal mode of life is supported by the relatively abundant preservation of the shells with conjoined valves.

4. An especially modified anterior part of the shell, the frontal face, is developed in enantiomorphous Stolidotidae Starobogatov, 1977 and Spanilidae Kříž, 2008 adapted to a semi-infaunal or shallow infaunal mode of life. It is lanceolate, dorso-ventrally elongated, flattened or slightly inflated anterior part separated from the central parts of the shell by a carina or blunt edge. The frontal face, or at least its inner shell surface, is built of the prominent radial ribs forming characteristic zigzag deflections of anterior margin representing the straining and warning protective system against approaching small harmful particles. Presumably, the frontal face was parallel with the bottom and served for the firm byssal attachment of the shell to the substrate.

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