

A gladius-bearing coleoid cephalopod from the Aptian of Central Russia

LARISA A. DOGUZHAeva, Moscow *)

With one figure

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Abstract

Remains of an unknown Early Cretaceous squid-like coleoid comprising a delicate slender small-sized gladius and an ink sac are studied. The specimen comes from the Lower Aptian beds of Middle Volga area, Uljanovsk region, Central Russia. The preserved fragment of the gladius is 26 mm in length and 6 mm in its maximum width and lacks posterior and anterior parts nevertheless it represents a significant part of its real length. An ink sac rests under the gladius starting in 13 mm from its distal edge and continues forward. The gladius shows a slowly expanding rachis with an acute-angled triangle slightly convex central field and flattened narrow lateral fields. Median and lateral keels are distinct. The available portion of the gladius shows equal lengths of the median and lateral keels but their real length ratio is unknown. Fine growth lines follow the pointed shape of the anterior edge of the central field and show a slightly pointed anterior tip. This characteristic differs this form from *Plesioteuthis* WAGNER, 1860 but put it closer to living oegopsid squids. On the basis of the Aptian specimen a new genus and species *Nesisoteuthis simbirskensis* gen. et sp. n. are described. The genus falls in the family Plesioteuthidae.

*) Author's address: Dr. LARISA A. DOGUZHAeva, Palaeontological Institute, Russian Academy of Sciences, St. Profsoyuznaya, 123, Moscow, Russia 117867; ldoguzhaeva@rambler.ru

Zusammenfassung

Das Fragment eines bisher unbekanntes, unterkretazischen Tintenfisch-ähnlichen Coleoiden mit einem relativ kleinen, zierlichen, schmalen Gladius und einem Tintenbeutel werden beschrieben. Das Fundstück entstammt den Schichten des Unter-Aptiums von Uljanovsk, (Mittlere Wolga Region, Zentral Russland). Der hintere und vordere Teil des Gladius fehlen. Seine erhaltene Länge beträgt 26 mm, seine maximale Breite 6 mm. Unterhalb des Gladius liegen Reste eines Tintenbeutels, die ca. 13 mm vor seiner distalen Kante beginnen und sich nach vorne fortsetzen. Der Gladius hat eine sich langsam verbreiternde Rachis mit einem spitzwinklig dreieckigen, schwach gewölbten Zentralfeld und flache, schmale Lateralfelder. Median- und Lateralkiel sind deutlich ausgebildet. Der erhaltene Teil des Gladius zeigt identische Längen des medianen und des lateralen Kiels, ihre wahren Längenverhältnisse sind jedoch nicht ermittelbar. Feine Anwachstreifen folgen der zugespitzten Form der vorderen Kante des Zentralfeldes und zeigen ein leicht zugespitztes vorderes Ende. Darin unterscheidet sich die hier beschriebene Form von der Gattung *Plesiotheuthis* WAGNER und rückt sie den rezenten oegopsiden Tintenfischen näher. Basierend auf diesem Fundstück werden eine neue Art und Gattung *Nesisoteuthis simbirskensis* gen et sp. n beschrieben. Die Gattung wird der Familie Plesiotheuthidae zugeordnet.

I. Introduction

The available record of Early Cretaceous gladius-bearing coleoids is short and comprises a few Barremian and Aptian finds from Germany and Central Russia, mainly. These coleoids fall in a small number of taxa: the late Barremian *Maioteuthis morroensis* from Isle of Maio (REITNER & ENGESER, 1982: Fig. 2a, b), the early Aptian ?*Plesiotheuthis* sp. from Central Russia (HECKER & HECKER, 1955; KRYMGOLC, 1958: Pl. LXXI, fig. 1) and *Plesiotheuthis* sp., *Maioteuthis damesi*, *Boreopeltis helgolandiae*, *Mastigophora stuebmeri* from North Germany (ENGESER & REITNER, 1985) and the herein described *Nesisoteuthis simbirskensis* gen. & sp. n. from Central Russia.

The paper deals with a beautiful delicate transparent small-sized slender gladius, covering an underlying ink sac. The specimen was found during the field trip to the Uljanovsk region in 1995 by the author. The expedition was financially supported by a grant of the International Science Foundation by G. SOROS. The description of the specimen has been delayed for a decade in the hope getting additional material. However, the lower Aptian concretions of the Shilovka fossil *Lagerstätte* where the specimen comes from yields numerous exceptionally well-preserved aragonitic shells of ammonites, sometimes with muscular scars, radula and jaws in the body chamber (DOGUZHAEVA & MUTVEL, 1991, 1992) but extremely rare gladii of teuthids. This is the fifth specimen that has been reported from this locality. The four other specimens (HECKER & HECKER, 1955) were found in the late 40th and 1950s by a famous collector of Jurassic and Cretaceous fossils of the Middle Volga region, the amateur naturalist, citizen of Uljanovsk K.A. KABANOV.

II. Material studied, status of preservation and method

The specimen is weakly deformed and fractured above the ink sac but shows gross morphology well. The gladius is secondarily phosphatized like the initially chitinous aptychi that occur abundantly in the concretions, connecting rings in ammonite shells with aragonitic preservation, coleoid ink (DOGUZHAEVA & al., 2004) or scales and gill coverings of pelagic fish from the same locality. The gladius preservation shows that it consists of several lamel-

lae. The initial composition of the gladius is beyond the scope of this paper and is analysed in a separate paper (DOGUZHAIEVA & MUTVEL, 2005, in press).

The images (figs. 1A-D) were scanned from the specimen that was coated by a gold.

The specimen no. 3871/391 is stored at the Palaeontological Institute of the Russian Academy of Sciences, Moscow.

III. Depositional environment

The gladius under examination belonged to a pelagic teuthid that dwelled in the epicontinental early Aptian Sea on the East-European Platform. The gladius was preserved in a dense dark-grey siderite concretion that provided its exceptional conservation. Such concretions commonly have rusty marks on dry surfaces, are large (0.2 - 0.5 m in larger diameter), usually flattened lens-like but sometimes swollen, elongated and laminated. The uniformity of the sediment outside and inside the concretion provides proof of their early diagenetic formation. Apart from the single gladii of teuthids (HECKER & HECKER, 1955; KRYMGOLIC, 1958; herein), they yield well preserved shells and aptychi of ammonites, abundant scales, vertebrae and gill covers of pelagic fishes, rare inoceramids, nuculids and gastropods, floating wood pieces of different sizes, sometimes large (up to 0.3 m in length), and rare wings of terrestrial insects.

The sediments of the basin, namely: dark bituminous claystone and shales rich in organic matter with numerous clusters of gypsum crystals, dispersed pyrite, concretions of marcasite, dark-grey siderite, and ankerite-siderite concretions provide evidence for the desoxygenated sedimentary environments. The lamination of the calcareous concretions and the claystone with interbeds of fine-grinded glauconite sandstone, laminated aleurite limestone and marl indicates the changing of depth of generally shallow sea. This conclusion fits with the preservation of the weakly diagenetically recrystallized ammonite shell matter. It contains much organic matter that could be preserved in the conditions of shortage of oxygen. Finds of the buccal apparatus within the body chamber also provide evidence for the fact that the ammonite shells were sunk into the silt before their soft tissues had disintegrated. This could be possible if the sea floor was soft and covered by silt, and scavengers were absent or rare, the seawater contained less oxygen and the disintegration was slow (DOGUZHAIEVA, 2002).

IV. Systematic palaeontology

Subclass Coleoidea

Family Plesioteuthidae NAEF, 1921

Genus *Nesisoteuthis* n. gen.

Type-species: *Nesisoteuthis simbirskensis* n. sp

Derivation of name: In honor of Kir N. NESIS (Moscow, Russia, Institute of Oceanography, the Russian Academy of Sciences) for his valuable study on systematics and biogeography of recent teuthids.

Diagnosis: Gladius thin delicate slender small-sized, about 30 mm in length and 6 - 8 mm in maximum width, formed by a rachis; no vanes. Apical angle is about 15°-20°. Central

field is an acute-angled triangle, weakly convex, with thin longitudinal striation and convex growth lines. It has a pointed shape of the anterior edge with an angle of about 120°. Lateral fields are narrow, approximately 1/10 - 1/8 of its width, and flattened, with thin longitudinal ribs. Median and lateral keels are about the same length.

Notes: The genus is erected on the basis of a single specimen (figs. 1A-D) that lacks the posterior and anterior parts, nevertheless it represents a significant part of its real length. Moreover, the specimen shows delicate growth lines and thin longitudinal striation that were not observed so far in other Aptian forms referred to plesio-teuthids (see ENGESER & REITNER, 1985). The diagnosis is based on the description of a major part of the gladius preserved that seems to represent nearly its total length. At the posterior edge the width of the gladius is approximately 2 mm that makes it reasonable to consider that the gladius lacked vanes.

Discussion: Well preserved growth lines in *Nesisoteuthis* make it possible to compare the shape of the anterior margin in related genera, namely: *Plesio-teuthis*, *Paraplesio-teuthis* and Recent *Ommastrephes*. It differs from the first genus in having a slightly larger angle of expansion and pointed central field; from the second one in having a pointed tip of the central field and from the third genus in having a less pointed tip of the central field.

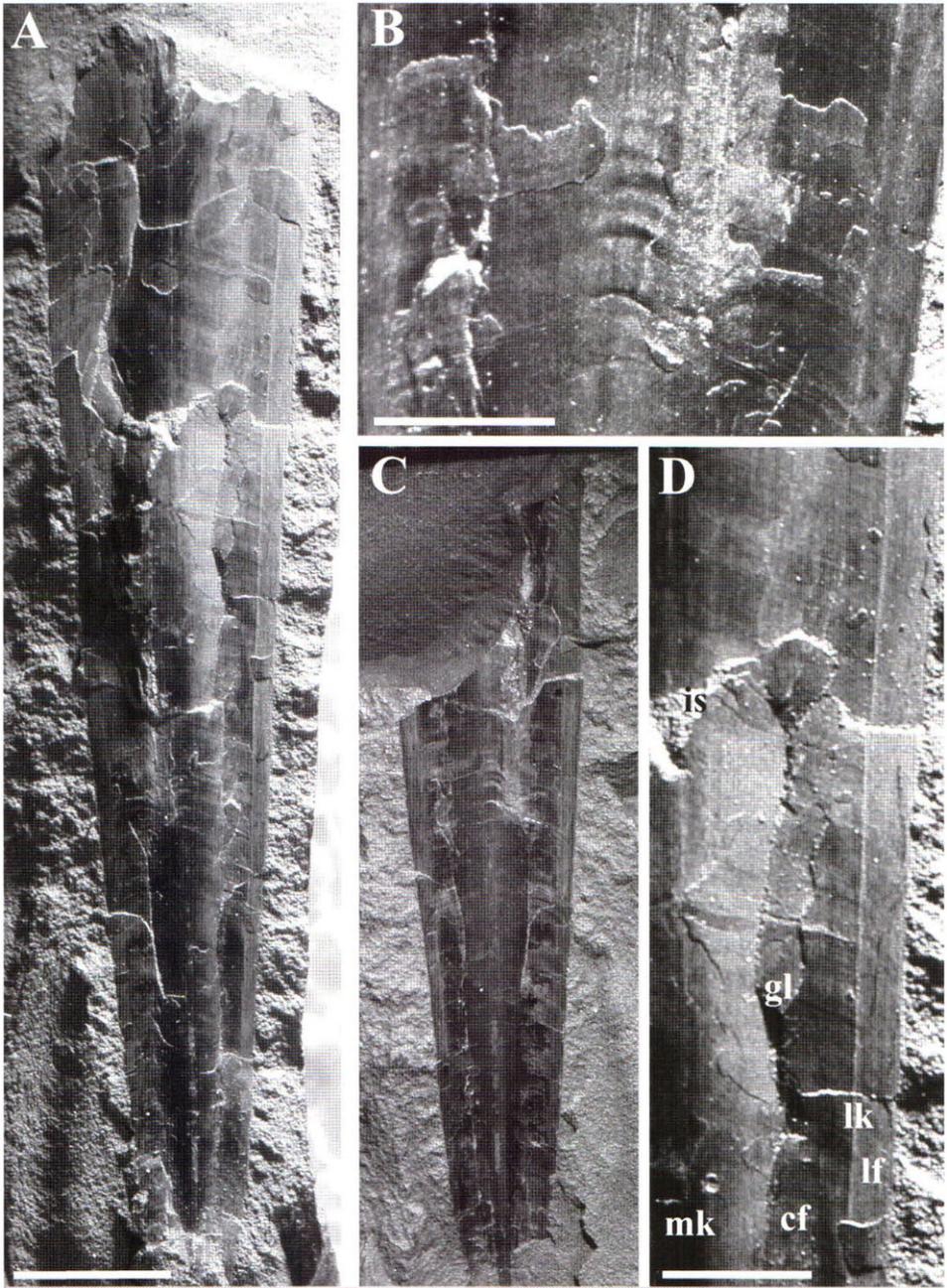
Nesisoteuthis comes from the same locality as the four specimens referred to ?*Plesio-teuthis* sp. by HECKER & HECKER and one of them, better preserved, was described and illustrated (1955: Text-fig. 1, Pl. I, Fig. 1). One should note that the authors emphasized that even the latter specimen that had a well preserved gladius lacked a feature that is characteristic not only of the genus *Plesio-teuthis* but also of the family Plesio-teuthidae, namely, a median keel. Based on a fact that in this specimen the central field bears delicate longitudinal striation one should expect that if the keel was developed in this form it would be preserved. Also, the HECKERS' form has distinct vanes which are absent in *Plesio-teuthis* but present in *Paraplesio-teuthis* NAEF, 1921. Therefore, while the gladius exhibits certain similarity to the latter genus the specimen is not a member of Plesio-teuthidae and should be reevaluated.

Nesisoteuthis differs from the lower Aptian specimen from Helgoland, North Germany described as *Plesio-teuthis* sp. by ENGESER & REITNER (1985). In the former genus the gladius has a lateral narrow flattened thickening provided by the lateral fields that are thickened. In the latter the gladius is preserved as an imprint showing deep lateral grooves (ENGESER & REITNER, 1985: Abb. 5). These grooves could be formed if the gladius had prominent, longitudinal, rounded thickenings. This is not a characteristic of *Plesio-teuthis* (NAEF, 1922: p. 113).

Nesisoteuthis differs from the lower Aptian *Boreopeltis* from Helgoland, North Germany (ENGESER & REITNER, 1985). In the former genus the lateral fields are narrow like in *Plesio-teuthis*. In the latter the lateral field consists of two parts (ENGESER & REITNER, 1985: Abb. 7, 8). This is not a characteristic of plesio-teuthids (NAEF, 1922: p. 111) as well.

Nesisoteuthis differs from the lower Aptian *Maioteuthis* from Helgoland, North Germany (ENGESER & REITNER, 1985). In the former genus the gladius has a lateral narrow flattened thickening, provided by the lateral fields that are thickened. In the latter the gladius is preserved as an imprint showing deep lateral grooves (ENGESER & REITNER, 1985: Abb. 9). These grooves could be formed if the gladius had prominent, longitudinal, rounded thickenings. This is not a characteristic of *Plesio-teuthis* (NAEF, 1922: p. 113).

One can assume that *Nesisoteuthis* is the only known Aptian member of the fam. Plesio-teuthidae so far.



Figs. 1A-D: *Nesisoteuthis simbirskensis* gen. et sp. n., holotype, no. PIN 3871/391; Lower Aptian; village Shilovka, Uljanovsk region, middle Volga area, Central Russia; **A:** General view of the gladius resting by its ventral side on the concretion matrix and is exposed along the splitting surface; scale bar is 3 mm; **B:** Close-up of fig. 1C to show that the central field has a pointed shape with an angle of about 120° ; the ink sac (not visible because of coating of the specimen while taking a photo) occupies the middle part of the gladius (about 1/3-1/4 of its length) where it is maximum deformed; scale bar is 1 mm; **C:** A counterpart of the gladius on fig. 1A, resting by its dorsal side on the concretion matrix; same magnification as on fig. 1A; **D:** Close-up of fig. 1A to show the central (cf) and lateral (lf) fields, the median (mk) and lateral (lk) keels, ink sac (is), and the growth lines (gl); scale bar is 1.5 mm.

Geographical range: Uljanovsk region, Middle Volga, Central Russia.

Stratigraphical range: Lower Aptian.

Nesisoteuthis simbirskensis n. sp

(figs. 1A - D)

Holotype: PIN 3871/391, is represented by two halves of a splitting (into two parts) one and same gladius. The gladius lacks the initial and distal portions. The available fragment is 26 mm long, 6 mm in maximum and 2 mm in minimum (near the posterior edge) width and possibly presents a significant part of its real length. Both halves show splitting surfaces. The ventral and dorsal sides of the gladius are not exposed as the ventral side of the main larger part (fig. 1A) faces the concretion matrix and the dorsal side of the counterpart (fig. 1C) matches it. The main bulk of an ink sac rests under the main part of the gladius (fig. 1A, D) but a small portion is attached to the counterpart. The main part of the gladius has the bulk of its thickness, while the counterpart is thin. Growth lines are well preserved and give an idea on the configuration of the anterior edge of a gladius that allow to compare it with several other genera characterized by a slender gladius.

Derivation of name: From Simbirsk that is a former name of the town of Uljanovsk in about 45 km from that the described specimen was found.

Type locality: Village Shilovka, Uljanovsk region, Middle Volga, Central Russia.

Stratum typicum: Lower Cretaceous, Lower Aptian.

Diagnosis: As for the genus.

Description: The total length of the gladius and the maximum width are estimated as 30-35 mm and 6-8 mm respectively (fig. 1A). The apical angle is about 15°-20°. The gladius is formed by a rachis; vanes are missing. The central field is weakly convex. The lateral fields are narrow and perfectly flattened. Along the anterior preserved edge the lateral fields are about 0.6 - 0.7 mm wide. This corresponds approximately to 1/10 of the total width of the gladius there. Close to the posterior limit of the gladius the width of the lateral field is 0.15 - 0.2 mm. This shows that the width ratio of the central and lateral fields is approximately constant throughout its ontogenetic growth. The central and lateral fields are separated with lateral keels. The central field bears a median keel, thin longitudinal striation, and prominent convex growth lines. The growth lines show a prominent weakly pointed anterior tip that means that the central field has a pointed shape with an angle of about 120°. The available portion of the gladius shows equal lengths of the median and lateral keels but their real length ratio is unknown. The lateral fields are sculptured with thin longitudinal ribs. The growth lines are of several orders. The first-order growth lines form regular thickenings along the median keel. The ink sac is recognized by its black colour and elongated shape. The posterior margin lies approximately 13 mm from the posterior edge of the gladius.

Geographical and stratigraphical range: As for the genus.

V. Discussion

The slender gladii of extinct (fam. Plesiotheuthidae; late Jurassic-early Cretaceous) and living (fam. Ommastrephidae) squids (see TOLL, 1988: Fig.4) exhibit remarkable similarity. This is considered as an indicator of their common origin - plesiotheuthids formed a root

stock of modern oegopsid squids (JETETZKY, 1966; DONOVAN & TOLL, 1988). The features that are common to extinct plesiotheuthids and living ommastrephids comprise (1) reduction/ or absence of vanes and development of (2) a narrow and long rachis, (3) distinct median and lateral keels, and (4) primary conus (although in some ommastrephids the latter is 2.5 times longer than that in *Plesiotheuthis*). The minor differences between them concern (1) the relative length of the keels (in *Plesiotheuthis* the lateral keel extends beyond the median one, while in ommastrephids: the median keel is longer than the lateral ones), and (2) the anterior margin of the central field (in *Plesiotheuthis* the central field is broadly rounded while in ommastrephids it has a pointed shape). The gladius of the Lower Aptian *N. simbirskensis* gen. et sp. n. here described has a central field with a pointed shape with an angle of about 120°. In the living squid *Gonatus*, for example, this angle is about 60° (NESIS, 1982: fig. 5a). The Early Cretaceous *Nesisoteuthis* can be considered as an intermediate between Late Jurassic *Plesiotheuthis* and Recent oegopsid squids and emphasizes their close relationship.

It has been thought that the only significant difference between them is that the fossil gladii appear to have been originally thicker and mineralized (NAFF, 1922) while modern ones are chitinous only. It has been recently shown that in some extinct squid-like coleoids the gladii were also originally organic (DOGUZHAeva & MUTVEI, 2002). Moreover, recent SEM examination of the gladius in *N. simbirskensis* gen. et sp. n. has confirmed this conclusion (DOGUZHAeva & MUTVEI, 2005, in press).

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