Cryptogamie, Algol., 2009, 30 (4): 295-310

Four new freshwater diatom species (Bacillariophyceae) from Antarctica

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(Received 16 July 2009, accepted 6 November 2009)

Abstract – Four new diatom species belonging to the genera *Achnanthidium, Placoneis, Geissleria* and *Stauroneis* were observed during a survey of the non-marine diatom flora of several islands in the Maritime Antarctica and South Georgia. Based on light- and scanning electron microscopical observations, the following species are described as new: *Achnanthidium lailae* Van de Vijver sp. nov., *Placoneis australis* Van de Vijver *et* Zidarova sp. nov., *Geissleria gabrielae* Van de Vijver *et* Zidarova sp. nov. and *Stauroneis nikolayi* Zidarova sp. nov. The new species are compared to other morphologically similar species from Europe, South America and the (sub-)Antarctic region. Data on their ecology and biogeography are also given.

Antarctica / diatoms / James Ross Island / new species / South Georgia / South Shetland Islands

Résumé – **Quatre espèces nouvelles de diatomées d'eau douce de la Région antarctique.** Quatre diatomées nouvelles appartenant aux genres *Achnanthidium*, *Placoneis*, *Geissleria* et *Stauroneis* ont été trouvées lors d'une analyse de la flore diatomique non-marine de plusieurs îles dans la Région antarctique-maritime et de la Géorgie du Sud. Sur base d'observations en microscopies optique et électronique à balayage, *Achnanthidium lailae* Van de Vijver sp. nov., *Geissleria gabrielae* Van de Vijver *et* Zidarova sp. nov., *Placoneis australis* Van de Vijver *et* Zidarova sp. nov. et *Stauroneis nikolayi* Zidarova sp. nov. sont

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Communicating editor: Diana Sarno

décrites. Les nouvelles espèces sont comparées avec des espèces morphologiquement similaires d'Europe, d'Amérique du Sud et de la Région sub-antarctique. Des données sur leur écologie et distribution géographique sont ajoutées.

Antarctique / diatomées / Île de James Ross / espèces nouvelles / Géorgie du Sud / Îles Shetland du Sud

INTRODUCTION

The terrestrial habitat in the southern Ocean between South America and the Antarctic Continent is restricted to a few islands and archipelagos on the Scotia Arch (e.g. South Georgia, South Sandwich Islands, South Shetland Islands) and the islands around the Antarctic Peninsula such as James Ross Island and Horseshoe Island. Apart from South Georgia, almost all of these islands and archipelagos belong to the Maritime Antarctic Province as defined by Stonehouse (1982).

The species diversity of the non-marine diatom flora of these islands and archipelagos is not very high when compared to more tropical and temperate islands such as New Caledonia (Moser *et al.*, 1998), the Seychelles (Coste & Ricard, 1982) or Tahiti (Coste & Ricard, 1990). Based on recent literature data, most species found in this region appear to be cosmopolitan and not exclusive from the region (e.g. Toro *et al.*, 2007). However, recent taxonomic research has shown that the concept of an almost cosmopolitan Antarctic diatom flora is not entirely correct (Sabbe *et al.*, 2003; Van de Vijver *et al.*, 2005). During a survey of the non-marine diatoms from some of these islands (South Georgia, Deception Island, Livingston Island, James Ross Island), a large number of new species have been found within the genera *Hantzschia*, *Luticola*, *Navicula*, *Pinnularia* and *Stauroneis*. Most of them have been described or are currently under description (Van de Vijver *et al.*, 2004, 2006; Esposito *et al.*, 2008; Van de Vijver, 2008; Van de Vijver & Mataloni, 2008; Kopalová *et al.*, 2009; Zidarova *et al.*, unpublished results). Several others still await description.

The present paper describes four new species belonging to the genera *Achnanthidium, Geissleria, Placoneis* and *Stauroneis*. Some of these species, e.g. *Placoneis australis* Van de Vijver & Zidarova sp. nov., have been reported numerous times from this region but force-fitting (Tyler, 1996) due to the use of European and North American identification books for the Antarctic species, caused them to be misidentified as other already known species. In this paper, these new species are described formally and the differences with European/ American morphologically similar species are discussed.

MATERIALS AND METHODS

During several austral summers, samples for diatom analysis were collected from various locations in the Maritime Antarctic Region (Livingston Island, Deception Island, King George Island and James Ross Island) and South Georgia.

Diatom samples were prepared following different methods. Part of each sample was treated following the method of Van der Werff (1955): small subsamples were cleaned by adding 37% H_2O_2 and heating to 80°C for about 1h followed by addition of $KMnO_4$. Following digestion and centrifugation (x3, 10 mins, 3700 *g*), the resulting clean material was diluted with distilled water to avoid excessive concentrations of diatom valves. Another part of the samples was prepared according to the method described in Hasle & Fryxell (1970): small subsamples were cleaned using concentrated H_2SO_4 followed by the addition of $KMnO_4$. The samples were then faded with $H_2C_2O_4$ and washed with distilled water (x8). In both cases, clean diatom valves were mounted in Naphrax.

Light microscopical (LM) observations were made using an Olympus BX51 microscope equipped with Nomarski differential interference contrast optics. For scanning electron microscopy (SEM), part of the suspension was filtered through polycarbonate membrane filters (pore diameter 1 µm), pieces of which were fixed on aluminium stubs after air-drying. Stubs were sputter-coated with a 50 nm layer of Au and examined with a JEOL-5800LV SEM at 20 kV. SEM micrographs of figures 42 & 43 were taken using a JEOL JSM-5510 by Dr. Nikola Dimitrov at the Faculty of Chemistry, University of Sofia, Bulgaria.

Comparisons are based mainly on information in Lange-Bertalot (2001), Cox (2003), Reichardt (2004), Van de Vijver *et al.* (2004), Metzeltin *et al.* (2005) and Ponader & Potapova (2007). Terminology follows Hendey (1964) and Round *et al.* (1990). The type slide of *Placoneis paraelginensis* Lange-Bert. (Van Heurck Types 43, National Botanic Garden of Belgium) was checked for a comparison with the new *Placoneis* species.

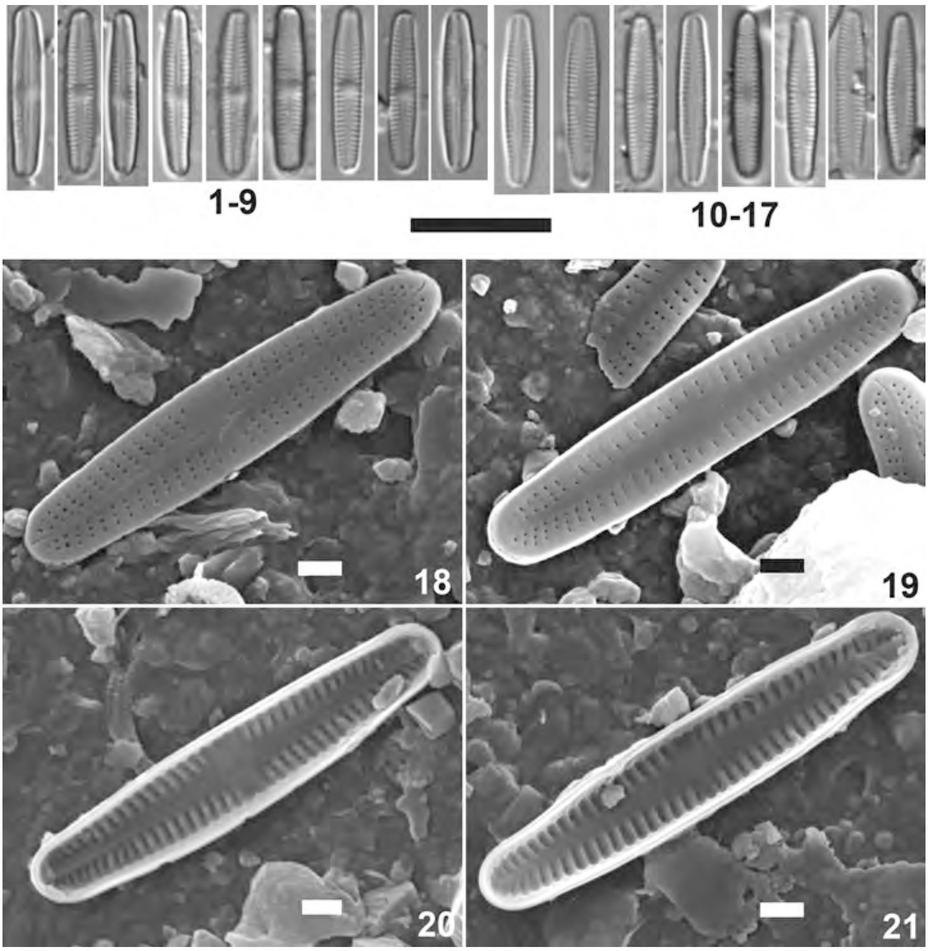
Samples and slides are stored at the National Botanic Garden of Belgium and the Central Laboratory of General Ecology in Sofia, Bulgaria.

RESULTS

Achnanthidium lailae Van de Vijver sp. nov. Figs 1-21

HOLOTYPUS: BR-4160 (National Botanic Garden, Meise, Belgium)
ISOTYPI: PLP-130 (UA, University of Antwerp, Belgium), BRM-ZU7/02 (Hustedt Collection, Bremerhaven, Germany)
TYPE LOCALITY: Katia Lake, James Ross Island, sample JRI2008-13 (Coll. *Nedbalová*, coll. date 01 February 2008)
ETYMOLOGY: This taxon is named after Mrs. Laila Willems to thank her and the entire crew of the TV-program ‘Canvascrack’ for the most enjoyable time Bart Van de Vijver could spend with them in May 2009.

DIAGNOSIS: *Valvae lineares ad lineares-lanceolatas marginibus parallellis apicibusque late rotundatis sed numquam protractis. Longitudo 9-13.5 µm, latitudo 2-2.25 µm. Area axialis in araphovalva moderate lata, claro lanceolataque. Area centralis formans apicaliter elongata, non formans fasciam. Striae transapicales, 28-30 in 10 µm, parallellae ad leviter radiatae in aream centralem, magis radiatae ad polos. Raphe in raphovalva recta, filiformis poris centralibus inconspicuis, fissures terminalibus unilateraliter deflexis, non visibilibus in microscopio photonico. Area axialis angusta, linearis ad linearis-lanceolata. Area centralis formans fasciam rectanularem. Striae 30-33 in 10 µm, leviter radiatae in media parte valvae, magis radiatae ad polos.*



Figs 1-21. *Achnanthidium lailae,* frustules from the type population. **1-9.** LM, external views of the raphe-bearing valve. **10-17.** LM, external views of the rapheless valve. **18.** SEM, external view of the raphe-bearing valve. **19.** SEM, external views of the rapheless valve. **20.** SEM, internal views of the raphe-bearing valve. **21.** SEM, internal views of the rapheless valve. Scale bars = 10 μm, except for Figs 18-21 where scale bar = 1 μm.

LM OBSERVATIONS: Valves are linear to (rarely) linear-lanceolate with almost parallel margins. Some valves are weakly dorsiventrally bent. Valve apices are broadly rounded but never protracted, rostrate or capitate. Valve length 10-12.5 μm, valve width 2-2.5 μm. Raphe-bearing valve (Figs 1-9): The axial area is rather narrow, linear to linear-lanceolate, widening towards the central area. The central area is a typical rectangular fascia reaching the valve margins. Shortened striae border the central area. The raphe appears straight to weakly undulating with inconspicuous straight central pores. Terminal raphe fissures are not discernible in LM. The striae are weakly radiate near the valve center, becoming more radiate towards the apices, 30-33 in 10 μm. Rapheless valve (Figs 10-17): The axial area is moderately broad, clearly lanceolate, widening near the valve center to form an apically elongated central area. Fascia absent due to the presence of several striae near the central area. The striae are parallel to weakly radiate near the valve centre, becoming more radiate towards the apices, 28-30 in 10 µm.

SEM OBSERVATIONS: The striae of the raphe-bearing valve (Fig. 18) are composed of 2-3 small, rounded areolae. At times the two outer areolae are fused, forming a transapically elongated slit. The raphe is slightly undulating with almost straight, inconspicuous central pores and deflected terminal raphe fissures. Internally (Fig. 20) the striae are sunken between raised, thickened rims, giving the impression of being one continuous slit obscuring the view of the individual areolae. The central raphe endings are deflected into opposite directions and each one terminates in a thickened central pore. The striae of the rapheless valve are composed of 2-3 rounded to slit-like external areola openings (Fig. 19). Internally, the striae are sunken between raised rims (Fig. 21).

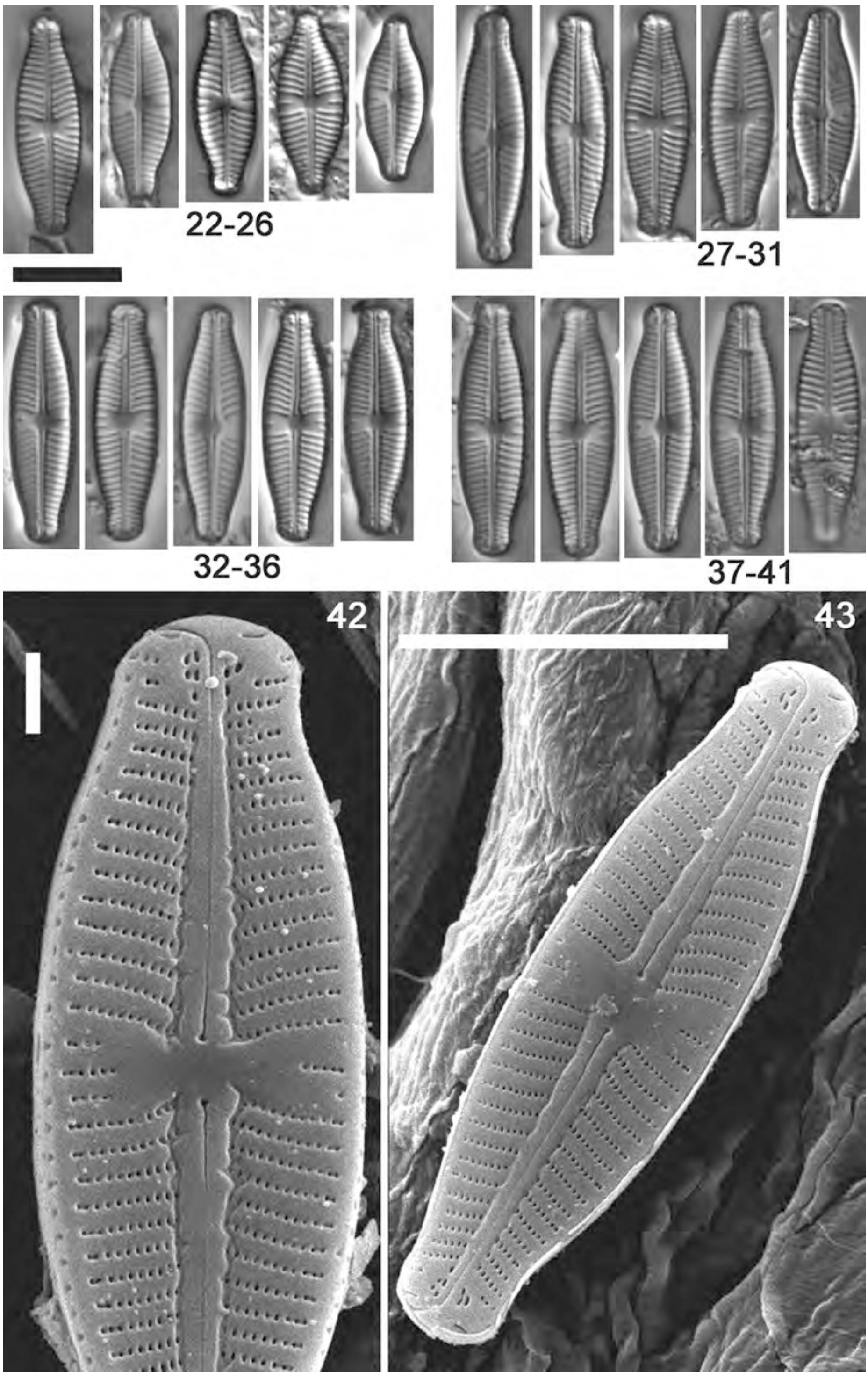
ECOLOGY AND ASSOCIATED DIATOM TAXA: *Achnanthidium lailae* was found living on the sediment of several lakes on James Ross Island. The largest population was observed in Katia Lake, a circumneutral (pH = 7.05), oligotrophic lake with a high specific conductance (660 µS/cm). Co-dominant species in this lake were *Diadesmis* sp., *Gomphonema* sp. and *Nitzschia perminuta* (Grun.) Peragallo. Another large population was found in Lake Katia II, dominated by *Diadesmis* sp., *Gomphonema* sp., *Nitzschia perminuta* and *N. homburgiensis* Lange-Bert. having similar physico-chemical characteristics,
CONFIRMED DISTRIBUTION RECORDS: So far only found on James Ross Island, although certain records of *Achnanthidium minutissimum* (Kütz.) Czarn. from the Antarctic Region may represent in fact *A. lailae*.

Geissleria gabrielae **Van de Vijver *et* Zidarova sp. nov.** **Figs 22-43**

HOLOTYPUS: BR-4161 (National Botanic Garden, Meise, Belgium)
ISOTYPI: PLP-131 (UA, University of Antwerp, Belgium), BRM-ZU7/03 (Hustedt Collection, Bremerhaven, Germany)
TYPE LOCALITY: South Shetland Islands, Deception Island. Sample CR, near Crater Lake (coll. *Mataloni*, coll. date 14 February 2002).
ETYMOLOGY: This taxon is named after our colleague and dear friend Dr. Gabriela Mataloni, University of Buenos Aires, Argentina.

DIAGNOSIS: *Valvae lineares-ellipticae ad ellipticas-lanceolatas apicibus leviter protractis, late rotundatis, rostratis in valves minoribus, subcapitatis in valvae maioribus. Longitudo 15.3-23.8 µm, latitudo 5.3-6.2 µm. Area axialis angusta, linearis. Area centralis lata, transversaliter expansa formans subfasciam rectangularem. Stigma abest in area centrale. Raphe filiformis, recta poris centralibus inconspicuis. Striae transapicales leviter curvatae, radiatae omnino, 14-16 in 10 µm. Puncta non distinguibilia in microscopio photonico, ca 50 in 10 µm.*

LM OBSERVATIONS: Valves are linear-elliptic to elliptic-lanceolate. Larger valves tend to have slightly convex to almost parallel margins, whereas in smaller valves the margins are clearly convex (Figs 24, 25, 26). The valve apices are weakly protracted and broadly rounded; rostrate in smaller valves to subcapitate in larger valves. Valve length ranges from 15.3 to 23.8 µm; the valve width is 5.3-6.2 µm, typically about 5.8 µm. The axial area is narrow and linear. The central area is large and transversally expanded, forming a rectangular subfascia bordered by 1-3 short


22-26
27-31
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37-41
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43

striae more widely spaced than the other striae. A stigma is absent in the central area. The raphe is filiform, straight, with almost indistinct central pores. The transapical striae are slightly curved, radiate throughout the entire valve, 14-16 in 10 µm. The puncta are not discernible in LM. The "annuloid" structure at the valve poles is more or less distinct in larger valves, but barely visible in smaller valves.

SEM OBSERVATIONS: The raphe is located on a typical raphe sternum, bordered by narrow, irregularly shaped shallow grooves (Fig. 42), in which the normal areolae structure of the striae continues. Near the central area, the grooves disappear connecting the raphe sternum with the central subfascia. The raphe itself is straight with slightly undulating central endings, terminating in weakly expanded central pores. The terminal raphe fissures are unilaterally deflected to the same side and do not seem to continue onto the valve mantle (Figs 42, 43). Striae are interrupted near the valve face/mantle margin by a hyaline zone, but continue after the interruption on the valve mantle where 2-3 rounded areolae are present. The areolae are almost circular to slightly transapically elongated, *ca* 50 in 10 µm. Near the valve apices, on both sides of the raphe, one transapically orientated slit can be seen, as is often the case in the genus *Geissleria*. The "annuloid" structure at the valve poles is composed mainly of one or two pairs of apical slits, although a third single slit may at times be present between the annuloid structure and the last striae. Other (usually two) transversally orientated slits are present at both sides of the raphe at the valve pole near the valve mantle (Figs 42, 43).

ECOLOGY AND ASSOCIATED DIATOM FLORA: The type population of *Geissleria gabrielae* was found in a a very diatom-rich sample containing dark, slightly acid (pH = 6.7) mineral soil collected on a steep slope, disturbed by volcanic eruptions ca. 150 years ago. Apart from several *Luticola* species, the sample was dominated by *Stauroneis latistauros* Van de Vijver *et* Lange-Bert., *Hantzschia hyperborea* (Grunow) Lange-Bert. and *Chamaepinnularia krookiiformis* (Krammer) Lange-Bert. *et* Krammer. In other samples, *G. gabrielae* was found in low abundance in wet soils and on very wet to moist mosses around small pools. The species was accompanied by *Achnanthes coarctata* (Bréb.) Grunow, *Pinnularia borealis* var. *scalaris* (Ehrenb.) Rabenh., *Luticola muticopsis* (Van Heurck) D.G. Mann, *Luticola higleri* Van de Vijver, Van Dam *et* Beyens, *Diadesmis* spp., *Muelleria* spp. and *Hantzschia* spp.

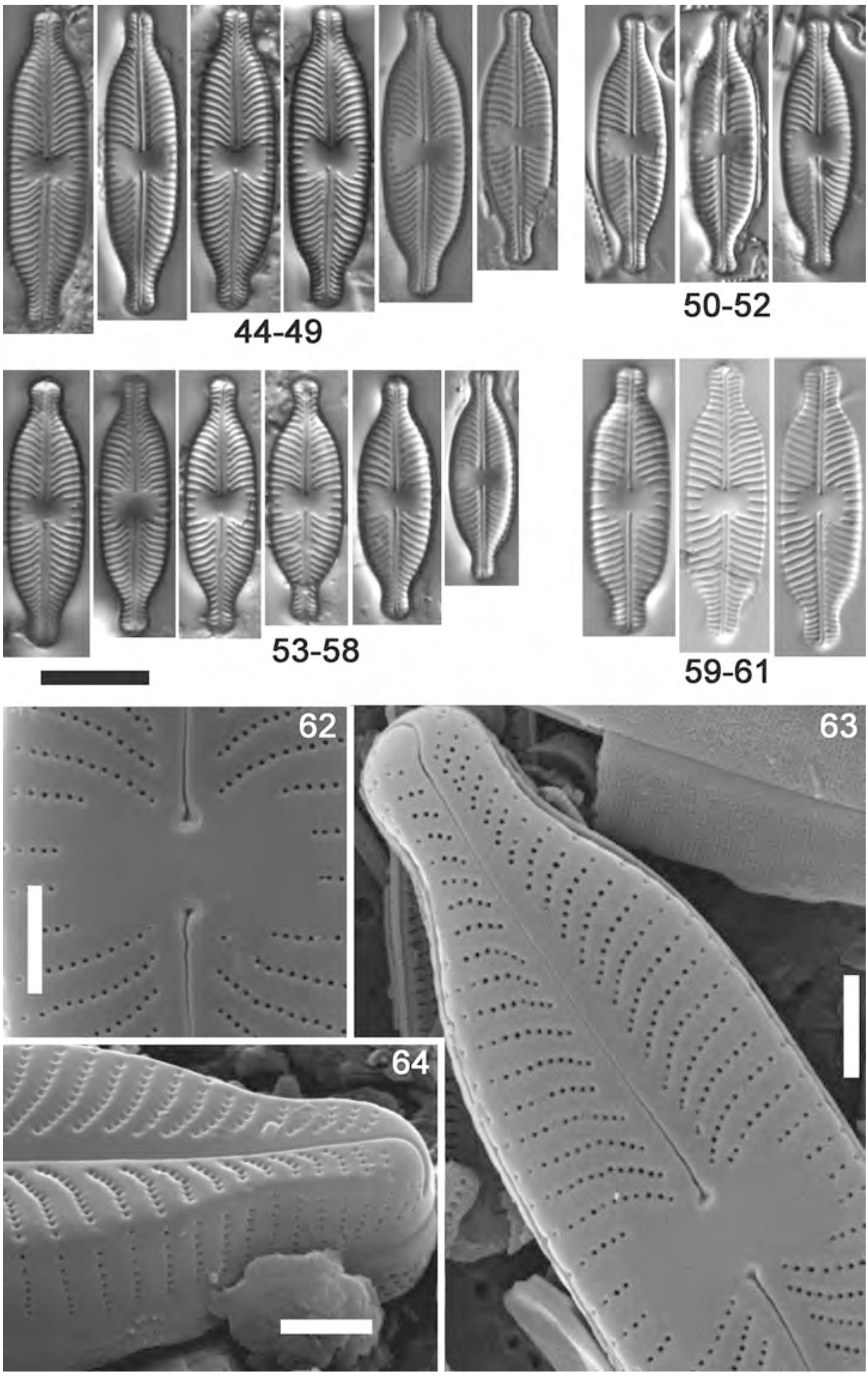
CONFIRMED DISTRIBUTION RECORDS: South Shetland Islands (Livingston Island, King George Island, Deception Island), James Ross Island, South Georgia.

***Placoneis australis* Van de Vijver *et* Zidarova sp. nov. Figs 44-58, 62-64**

HOLOTYPUS: BR-4162 (National Botanic Garden, Meise)

ISOTYPI: PLP-132 (UA, University of Antwerp), BRM-ZU7/04 (Hustedt Collection, Bremerhaven)

Figs 22-43. *Geissleria gabrielae,* frustules from several populations showing the variability of the species. **22-26.** LM, valves from the Byers Peninsula (Livingston Island) population. **27-31.** LM, valves from the Hurd Peninsula (Livingston Island) population. **32-36.** LM, valves from the type population, Deception Island. **37-41.** LM, valves from the South Georgia population. **42.** SEM, type population, external valve view showing the raphe sternum, the irregularly shaped grooves bordering the raphe, the areolae and the "annuloid" structure. **43.** SEM, type population, external view of an entire valve. Scale bar = 10 µm, except for Fig. 42 where scale bar = 2 µm.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50-52
53-58
59-61
62
63
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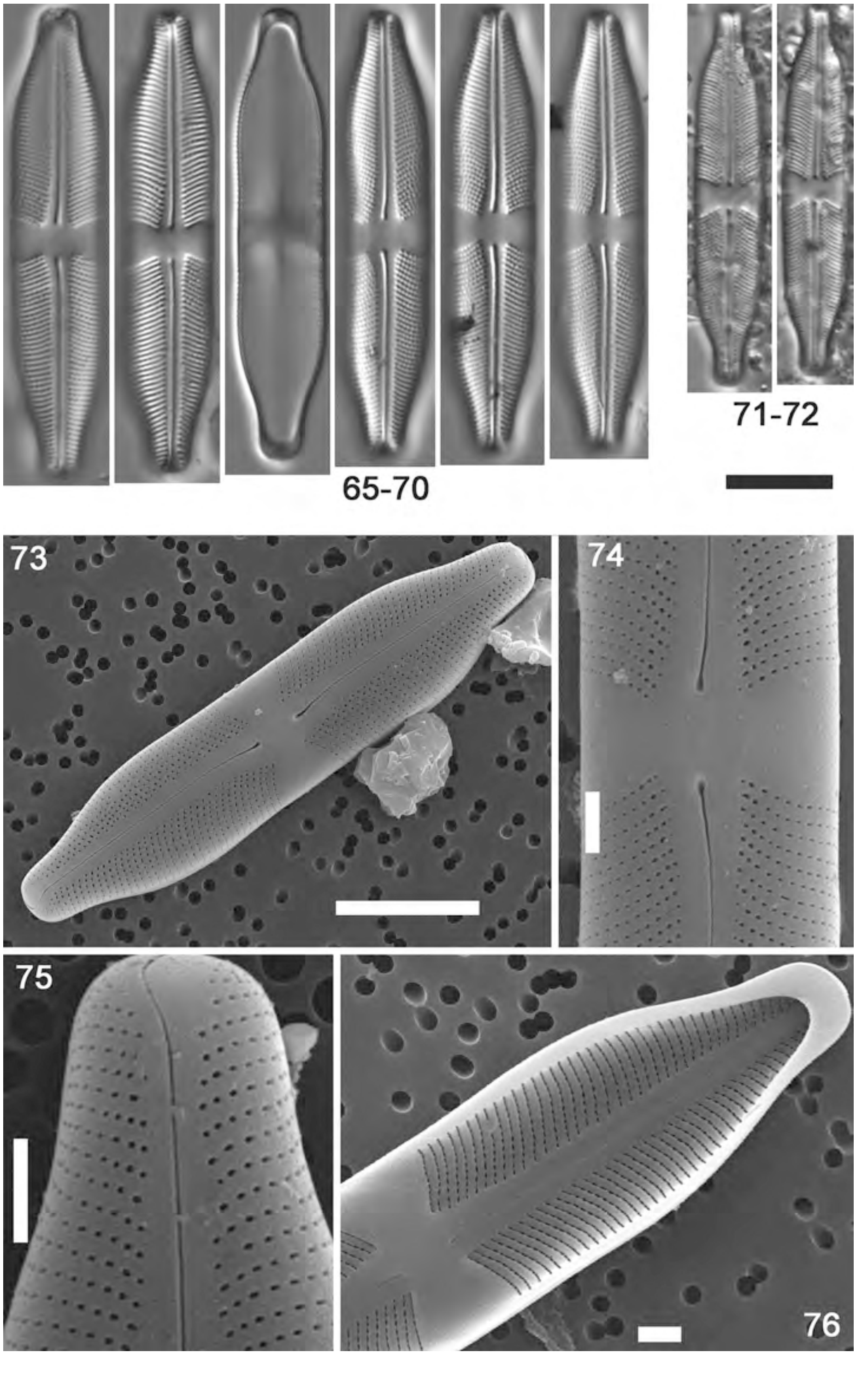
TYPE LOCALITY: Livingston Island (South Shetland Islands), sample 12-1/2008 (coll. *Natcheva*, collection date 22 February 2008)

DIAGNOSIS: *Valvae lineares ad lineares-ellipticas, marginibus parallellis ad leviter convexes, apicibusque subcapitatis, numquam rostratis vel subrostratis. Longitudo 20.4-30.0 µm, latitudo 6.1-7.9 µm. Area axialis angusta, linearis-lanceolata. Area centralis variabilis, rotunda ad rectangularem vel ad instar papilionaceam formans subfasciam acute angulatam. Raphe filiformis, leviter undulata ad paene rectam poris centralibus leviter expansis, 1.1-1.8 µm inter se distantes. Striae transapicales claro radiatae omnino, 15-18 in 10 µm. In media parte valvae, striae magis geniculatae sed ad apices, striae curvatae ad rectas. Areolae non distinguibiles in microscopio photonico, ca 40 in 10 µm.*

LM OBSERVATIONS: The valves are linear to linear-elliptical. Larger specimens tend to have more parallel margins, whereas smaller ones have slightly convex margins. The valve apices are always subcapitate, never rostrate or subrostrate, with a width varying between 2.4 and 3.1 µm. The valve length ranges from 20.4 to 30.0 µm, the valve width between 6.1 and 7.9 µm. The axial area is narrow and linear-lanceolate, only slightly and gradually widening from the valve apices towards the central area. The central area itself varies in shape from rounded (Fig. 54) in some specimens, to almost rectangular (Figs 44, 49, 51, 53, 58) and even butterfly-shaped (Figs 45-47, 52, 54, 55), forming an acute-angled sub-fascia, clearly widening towards the valve margins. A real fascia is never formed since three to five shortened striae always border the central area. The raphe is filiform, slightly undulating (Figs 44-48, 51-53, 57), although it can also be straight in some specimens (Figs 49, 51, 58). The central pores are almost straight and only weakly expanded, and set 1.1-1.8 µm apart from each other. The striae are 15-18 in 10 µm and clearly radiate throughout the entire valve. Near the valve middle, the striae tend to become more geniculate while near the apices, they are curved or even straight. The areolae are not discernible in LM. Plastid structure, an important taxonomic feature in the genus *Placoneis,* could not be studied because samples were fixed in formaldehyde.

SEM OBSERVATIONS: The ultrastructure of this species (Fig. 63) does not differ considerably from that typical of *Placoneis.* The proximal raphe endings are weakly deflected unilaterally to almost straight with weakly expanded, shallow central pores (Fig. 62). Typically, the terminal fissures are crescent-shaped (Fig. 63). The striae are interrupted near the valve face/mantle margin by a narrow hyaline zone (Fig. 64). The areolae are small, rounded poroids, *ca* 40 in 10 µm. The striae, composed of 6-8 small, rounded areolae, continue on the valve mantle (Fig. 64).

Figs 44-58. *Placoneis australis,* frustules from several populations. **44-49.** LM, valves from the Byers Peninsula (Livingston Island). **50-52.** LM, valves from the King George Island population. **53-58.** LM, valves from the type population, Hurd Peninsula, Livingston Island. Scale bar = 10 µm.
Figs 59-61. *Placoneis paraelginensis* Lange-Bertalot, LM views of three valves from the type population (Van Heurck Types 43, National Botanic Garden of Belgium). **60, 61.** Internal view. Scale bar = 10 µm. Figs 62-64. *Placoneis australis,* SEM, type population. **62.** External view showing the central area, raphe endings and central pores. **63.** External view showing the valve ultrastructure. **64.** Detail from the valve mantle and the apex. Scale bar = 2 µm.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ECOLOGY AND ASSOCIATED DIATOM FLORA: The type locality is a small pond situated north from the Bulgarian Antarctic Base, surrounded by *Sanionia georgico-uncinata* (Müll. Hal.) Ochyra *et* Hedenäs. The species is accompanied mainly by *Diadesmis* spp., *Muelleria* spp., *Luticola higleri* and *Pinnularia subantarctica* var. *elongata* (Manguin) Van de Vijver *et* Le Cohu. *Placoneis australis* is usually found in very low numbers in different aquatic habitats, such as streams, lakes and their outflows, ponds and, only occasionally, on wet soil and mosses in and around water basins.

CONFIRMED DISTRIBUTION RECORDS: This species has been reported frequently under the name of *Navicula elginensis* (W. Greg.) Ralfs or *Placoneis elginensis* (W. Greg.) Cox (see Kellogg & Kellogg 2002 for more distribution data on *P. elginensis*). We observed *P. australis* in samples taken on the South Shetland Islands (King George Island and Livingston Island) and James Ross Island, although in the latter location it was found only rarely.

***Stauroneis nikolayi* Zidarova sp. nov.** **Figs 65-70, 73-76**

HOLOTYPUS: BR-4163 (National Botanic Garden, Meise, Belgium)
ISOTYPI: PLP-133 (UA, University of Antwerp, Belgium), BRM-ZU7/05 (Hustedt Collection, Bremerhaven, Germany)
TYPE LOCALITY: Livingston Island (South Shetland Islands), close to the Bulgarian Antarctic Base, Hurd Peninsula, sample LIV-1a/2003 (coll. *Metcheva*, coll. date February 2003).
ETYMOLOGY: The species is named after my dear friend Dipl. eng. Nikolay Stanchev from the Bulgarian Antarctic Institute.

DIAGNOSIS: *Valvae stricte lineares marginibus parallellis, leviter constrictis in media parte valvae, apicibusque breviter protractis, rostratis, late rotundatis. Pseudosepta adsunt. Longitudo 42-45 µm, latitudo 7.5-8.3 µm. Area axialis angusta, dilatata deltoidea prope fasciam. Area centralis fasciam latam formans valde dilatata ad margines versus. Raphe leviter lateralis, terminationibus centralibus unilateriler deflexis, leviterque expansis poris centralibus guttiformibus. Fissurae terminales raphis fortiter uncinatae. Striae transapicales curvatae, fortiter radiatae omnino, 19-21 (22) in 10 µm. Areolae striarum vix visibiles in microscopio photonico, 30-35 in 10 µm.*

LM OBSERVATIONS: The valves are strictly linear with parallel to slightly undulated margins, somewhat constricted in the middle. The valve apices are shortly protracted, rostrate with bluntly rounded ends. Pseudosepta are always present (Fig. 67). The valve length varies between 42 and 45 µm, the valve width from 7.5 to 8.3 µm. The axial area is narrow, widened in a deltoid fashion near the

Figs 65-70. *Stauroneis nikolayi,* LM views of six valves from the type population; Fig. 67 shows the pseudosepta. Scale bar = 10 µm. Figs 71-72. *Stauroneis husvikensis,* LM views of two valves from the type population of South Georgia (sample M331). Scale bar = 10 µm. Figs 73-76. *Stauroneis nikolayi,* SEM, type population. **73.** External view of an entire valve. **74.** Detail from the central area showing the unilaterally deflected central raphe endings.**75.** Detail of the valve apex showing the terminal raphe fissure. **76.** Internal view showing the pseudosepta and the central raphe endings. Scale bar = 2 µm, except for Fig. 73 where scale bar = 10 µm.

central area. The central area forms a broad, wedge-shaped fascia, strongly expanding towards the valve margins. The raphe is slightly lateral with clearly unilaterally deflected central endings and only very weakly expanded, drop-like central pores. The terminal raphe fissures are strongly hooked unilaterally. The transapical striae are curved and strongly radiate throughout the entire valve, 19-21(22) in 10 µm. The areolae of the striae are virtually not discernible in LM.

SEM OBSERVATIONS: The valve face is slightly convex (Figs 73, 74). The raphe branches are curved with drop-like central pores. Both central pores terminate before the striae in the central area (Fig. 74). The central raphe endings are weakly deflected and rather inconspicuous. The terminal raphe fissures are typically comma-shaped (Fig. 75) towards the opposite side of the central endings (Fig. 73). The striae consist of very small, rounded to slightly transversally elongated areolae, about 30-35 in 10 µm. The areolae tend to become smaller towards the valve margins. Internally, large pseudosepta are present at each valve pole (Fig. 76).

ECOLOGY & ASSOCIATED DIATOM FLORA: The species is described from soil below a *Deschampsia antarctica* Desv. vegetation, on a rock close to the sea. The sample is mainly dominated by *Pinnularia borealis* Ehrenb. s*ensu lato.*
CONFIRMED DISTRIBUTION RECORDS: So far only known from Livingston Island (South Shetland Islands) and Signy Island (South Orkney Islands).

DISCUSSION

All four species described in this paper represent taxa that have probably been misidentified in the older literature. A detailed morphological analysis has now revealed a sufficient number of distinctive features to separate them from similar taxa.

Achnanthidium lailae is a typical species belonging to the group around *A. minutissimum*. The species is most similar to *Achnanthidium strictum* Reichardt, described from a spring in Austria (Reichardt, 2004), and can only be distinguished with absolute certainty based on the ultrastructure of the valves. Both species can be separated from the *A. minutissimum* group (*sensu* stricto) by the weakly deflected terminal raphe fissures (Ponader & Potapova, 2007). In *A. minutissimum* and related species such as *A. eutrophilum* (Lange-Bert.) Lange-Bert., the terminal raphe fissures are straight, whereas species such as *A. alpestre* (Lowe *et* Kociolek) Lowe *et* Kociolek and *A. gracillimum* (Meister) Lange-Bert. have longer, deflected terminal fissures (Ponader & Potapova, 2007). Moreover, both species present a characteristic valve outline with almost no protracted valve apices and almost straight valve margins. *A. strictum* has a very typical striae and areolae structure, which is absent in *A. lailae*. Each stria of the raphe valve in *A. strictum* is composed of one rounded areola and one slit-like areola. By contrast, the stria in *A. lailae* are composed of three small rounded areola without any slit-like areolae. Internally, both species can also be separated on the basis of the typical raised rims bordering the striae in *A. lailae*. These rims seem to be absent in *A. strictum*.

Geissleria gabrielae shares features with several other *Geissleria* species, such as *G. dolomitica* (Bock) Lange-Bert. *et* Metzeltin, *G. boreosiberica* Lange-

Bert., Genkal *et* Vekhov, *G. punctifera* (Hust.) Metzeltin, Lange-Bert. *et* García-Rodríguez and related taxa such as *G. aikenensis* (R.M. Patrick) Torgan & Oliveira and *G. schmidiae* Lange-Bert. *et* Rumrich. Morphologically, the most similar species to *G. gabrielae* is *G. dolomitica*, known only from the Italian Dolomites (Lange-Bertalot, 2001). Although type material for SEM analysis was not available, both the analysis of the iconographic material from the type slide (Bock, 1970) and pictures from the type slide, kindly provided by D. Metzeltin, showed that *G. dolomitica* has more linear-elliptic to elliptic-lanceolate valves with weakly protracted, bluntly to broadly rounded and almost never subcapitate ends (see also the description of the species in Lange-Bertalot, 2001, p. 124). The striae in *G. dolomitica* are almost straight, not curved, and more spaced than in *G. gabrielae*. *G. gabrielae* has 14-16 striae in 10 µm, while *G. dolomitica* has 16-19 striae in 10 µm according to Lange-Bertalot (2001). Striae counts on photomicrographs from the type slide showed 16-18 striae in 10 µm (Zidarova, unpublished observations). The central area is usually defined by only one very short stria at each side. The Siberian *G. boreosiberica* (Lange-Bertalot & Genkal, 1999) shows the same striae density (14-16) as *G. gabrielae,* but is larger (length 23-29 µm vs 15.3-23.8 µm, breadth 7.5-8.5 vs. 5.3-6.2 µm) with abruptly protracted and almost capitate ends, and slightly radiate to parallel striae (Lange-Bertalot, 2001). Other species that resemble *Geissleria gabrielae* are *G. punctifera*, *G. aikenensis* and *G. schmidiae*. According to Metzeltin *et al.* (2005) *G. aikenensis* should be considered as a synonym of *G. punctifera.* Those authors pointed out that *G. schmidiae,* known from Chile and Ecuador, might also be conspecific with *G. punctifera.* When comparing *G. aikenensis* to *G. schmidiae,* Torgan & Oliveira (2001) already concluded that the latter was a synonym of *G. aikenensis.* Although we were not able to investigate the type material of these three *Geissleria* species, according to the existing iconographic material and descriptions in the literature (e.g. Rumrich *et al.*, 2000; Torgan & Oliveira, 2001; Metzeltin *et al.*, 2005), it is clear that they all differ from *G. gabrielae* by having a small central area with at least one stigma and almost parallel to slightly radiate striae, as well as a different "annuloid" structure. In *G. gabrielae* the "annuloid" structure is similar to that in *G. ignota* (Krasske) Lange-Bert. & Metzeltin. However, with its linear valves with triundulated margins (Lange-Bertalot, 2001), the latter has a completely different outline and could not be confused with *G. gabrielae.*

Placoneis australis clearly belongs to the group around *P. elginensis* (Gregory) Cox. Table 1 compares the new species with similar members of this group such as *P. elginensis*, *P. paraelginensis*, *P. rostrata* (A. Mayer) Cox and *P. abiskoensis* (Hustedt) Lange-Bert. & Metzeltin. These four taxa can be distinguished by having a different striation pattern. *P. australis* has very radiate, curved to even geniculate striae, a feature never observed in any of the four species. The stria density is higher, 15-18 against the number generally reported in other species, for instance 10-11 in *P. abiskoensis,* around 11 in *P. elginensis* and 11-12 in *P. paraelginensis* and *P. rostrata* (Table 1). *P. abiskoensis*, *P. elginesis* and *P. rostrata* could also be differentiated because of their larger dimensions. According to Cox (2003) and Rumrich *et al.* (2000), these species have wider apices (5 vs 2.4-3.1 µm). The valve length of *P. abiskoensis* ranges from 37-46 µm (vs 20.4-30) and the width is 9-12 (vs 6.1-7.9). Based on Rumrich *et al.* (2000), *P. rostrata* is again larger and broader (valve length 37 µm and width ca. 9 µm), the valve apices are rostrate and never subcapitate. Apart from the striation pattern, *P. elginensis* differs owing to its larger width (9-10 vs 6.1-7.9), wider apices (4-4.5 vs 2.4-3.1) and a straight raphe. A straight raphe and wider apices (up to 3.5 µm) are also observed in *P. paraelginensis* (Figs 59-61 and Table 1).

Table 1. Comparison of several moprhological features of *Placoneis australis* and other similar *Placoneis* species [1 Based on Cox (2003), 2 Based on Rumrich *et al.* (2000)].

	P. australis	*P. elginensis*[1]	*P. paraelginensis*[1]	*P. abiskoensis*[1]	*P. rostrata*[2]
Valve outline	Linear to linear-elliptic	Linear	Linear	Linear to slightly undulate	Linear
Valve length (µm)	20-30	30-36	25-27	37-46	37
Valve width (µm)	6.1-7.9	9-10	ca. 7	9-10	ca. 9
Apex shape	Subcapitate	Subcapitate	Subcapitate	Subcapitate	Rostrate
Apex width (µm)	2.4-3.1	4-4.5	3-3.5	5	5
Raphe	Slightly curved, occasionally almost straight	Straight	Straight	Slightly curved	Slightly curved
Central endings separation	1.1-1.8	ca. 2	< 2	2.5	ca. 3
Central area shape	Rounded to almost rectangular – butterfly shaped	Bowtie shaped	From transverse-bowtie shaped to transverse-broadly elliptic	Transverse ellipse	Transverse
Central area width	> 1/2 valve	> 1/2 valve	> 1/2 valve	> 1/2 valve	ca. 1/2 valve
Number of striae in 10 µm	15-18	ca. 11	11-12	10-11	11-12
Puncta visible in LM?	No	No	No	Yes	No
Alternating longer/shorter striae	No	No	No	No	No

Stauroneis nikolayi could only be confused with *S. husvikensis* Van de Vijver & Lange-Bert., recently described from South Georgia (Van de Vijver *et al.*, 2004). The latter species, however, is shorter and narrower (length 33-36 µm, width 6.5-7.5) with straight margins and more protracted rostrate-subcapitate ends (Figs 71, 72). The central raphe endings in *S. husvikensis* are almost straight, whereas in *S. nikolayi* they are clearly deflected. Both species can also be separated based on different striae densities, *S. husvikensis* having a higher number of striae (24-27 vs 19-22 in 10 µm) composed of fewer puncta (25 vs 30-35 in 10 µm) that are clearly visible in LM. There are records in the Antarctic literature of unidentified *Stauroneis* species presenting very similar features. Broady (1979) reported *Stauroneis* cf. *lapponica* Cleve from samples of soil below *Deschampsia antarctica* on Signy Island (South Orkney Islands). Based on the description and illustration presented (Broady, 1979, p. 59, fig. 14c), it is clear that *Stauroneis* cf. *lapponica* from Signy Island represents in fact *Stauroneis nikolayi*. According to the original description of *S. lapponica* in Cleve (1895), the latter has a different valve outline with more rounded and less rostrate or capitate apices, smaller dimensions (length 20-35 µm versus 42-45 µm, width 4-7 µm versus 7.5-8.3 µm), a straight raphe and a higher striae density (24 versus 19-22 in 10 µm). Moreover, the striae in *S. lapponica* are clearly punctate.

Acknowledgements. We are grateful to Dr. Roumiana Metcheva (Institute of Zoology, BASc) who collected the sample containing *Stauroneis nikolayi,* and to Dr. Rayna Natcheva (Institute of Botany, BASc) for the collection of the sample with *Placoneis australis.* This study was made possible with the financial support of SYNTHESYS and partly the MSMT 0021620828 project.

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