

***Labellicula*, a new diatom genus (Bacillariophyta) from Ile de la Possession (Crozet Archipelago, Subantarctica)**

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Abstract – A new diatom genus, *Labellicula*, is described from soil samples taken from the subantarctic island Ile de la Possession (Crozet Archipelago). While this naviculoid genus shows some affinities with *Brachysira*, *Diadsmis*, *Fistulifera*, *Neidium* and *Luticola*, it presents a combination of characters that is unique: i.e. the presence of a stigma, large, elongated open alveoli and a relatively simple raphe structure. Thus far only one species, *Labellicula subantarctica* sp. nov., is placed in the genus. The ecology of this species is described and its valve structure compared to that of similar genera.

Bacillariophyceae / Diatoms / *Labellicula* gen. nov. / Soil algae / Subantarctica / Crozet Archipelago

Résumé – *Labellicula*, un nouveau genre de diatomées (Bacillariophyta) de l'île de la Possession (archipel Crozet, Subantarctique). Un nouveau genre de diatomées, *Labellicula*, est décrit à partir de quelques échantillons de sol provenant de l'île de la Possession (archipel Crozet, Subantarctique). Ce genre naviculoïde présente certaines affinités avec *Brachysira*, *Diadsmis*, *Fistulifera*, *Neidium* et *Luticola* mais présente aussi une combinaison de caractères unique comme la présence d'un stigma, de grandes alvéoles ouvertes et allongées, ainsi qu'une structure de raphé relativement simple. Jusqu'à présent, une seule espèce, *Labellicula subantarctica* sp. nov., est placée dans ce genre. L'écologie de cette espèce est décrite et sa morphologie est comparée avec celle de genres similaires.

Algues des sols / archipel Crozet / Bacillariophyceae / diatomées / *Labellicula* gen. nov. / Subantarctica

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INTRODUCTION

The diatom flora of islands belonging to the Subantarctic Region has recently been the subject of several morphological and taxonomic studies (e.g. Oppenheim, 1994; Le Cohu, 1999; Van de Vijver *et al.*, 2002a). In particular, the Crozet Archipelago, just north of the Antarctic Convergence at 45°48'-46°26'S, 50°14'-52°52'E, has been thoroughly studied, resulting in the descriptions of a number of new species (Le Cohu & Van de Vijver, 2002; Van de Vijver, 2002; Van de Vijver & Beyens, 2002; Van de Vijver *et al.*, 2002a, 2002b). Sampling in this remote location, which has a large range of quite diverse habitats, has resulted in the discovery of a typical subantarctic diatom flora. Although many taxa on the island can be considered cosmopolitan, there are still a number of unusual forms that are seemingly typical of the island and/or the Subantarctic Region.

During a survey of soil samples taken from cliffs bordering the coastline, a small unknown diatom species was found. Valves never exceeded 11µm in length, making identification impossible in the light microscope. Examination using SEM showed that we were dealing not only with a new species, but also with a new diatom genus, which we are herein naming *Labellicula*. This paper describes this small diatom genus and provides detailed information on its morphology. Comparisons with similar genera, such as *Brachysira*, are given, as well as notes on the ecology of the only species presently attributed to the genus, *Labellicula subantarctica*.

MATERIAL AND METHODS

During the austral summer of 2002, more than 50 soil samples from cliffs bordering the ocean were collected on Ile de la Possession, the main island of the Crozet Archipelago, situated in the southern Indian Ocean (45°48'-46°26'S, 50°14'-52°15'E). Samples were fixed in the field with 3% formaldehyde. For microscopic analysis, samples were prepared following the methodology of Van der Werff (1955): samples were treated with 37% H₂O₂ and saturated KMnO₄ in order to remove all organic material. To speed up the reaction, samples were heated on a hot plate for a short period. Following digestion and centrifugation, slides for light microscopy (LM) were prepared by mounting the cleaned diatom valves in Naphrax®. For scanning electron microscopy (SEM), part of the suspension was filtered through polycarbonate membrane filters with a pore diameter of 3µm; portions of the filters were affixed to aluminium stubs after air-drying. The stubs were sputter-coated with 20-50 nm of gold, and studied with a Hitachi S-4500. Morphological descriptions follow Round *et al.* (1990).

DIAGNOSIS

Labellicula Van de Vijver et Lange-Bertalot, gen. nov.

Frustula naviculoidea id est isovalvata biraphidea, circum planitiem valvae medianam et planitiem transapicalem medianam et planitiem apicalem symmetrica. E facie cincturae angustissime rectangulata. Cingulum utraque valva paucas vittas apertas continet subtilissime perforatas una (vel duobus) serie punctorum.

Cellulae communiter solitariae, chromatophora (et alterae partes proto-plasti) incognita sunt. Singula species adhuc cognita comparate parva id est valvae sub vel circiter 11µm longae, circiter 2µm latae, ad instar lineares marginibus modice concavis in media apicibus protractis capitatis. Altera signa non aspectabilia microscopio photonico.

Structurae submicroscopicae externae (microscopio electronico): Aliquid similis generi Brachysira enim striae uniseriatae ad iuncturam frontis cum limbo crista externa prominenti interruptae vero tamen alveoli non separati areolis pluribus circularibus sed continentes ab raphosterno ad marginem valvae et in limbis. Etiam non in seriebus apicalibus ordinatae (ut communiter in genere Brachysira).

Raphosternum angustum ad nodulum centralem vix expansum. Fissura externa raphis fere recta extremis terminalibus in modo litterae T (ut Brachysira) sed extremis centralibus aliquid curvatis denique unilateraliter deflexis (nec rectis) in directionem stigmati (unam vel plerumque duas praesentes).

Structurae internae: extrema terminalia centraliaque recta non dilatata helictoglossis parum formati sed cum nodulo angusto crasse silicificato posito inter extrema centralia (ita ut in genere Neidium). Alveoli occlusi hymenibus omnino. Plerumque dua stigmata occlusa unilateraliter praesentes et ordinata apicaliter. Stigma interne similis apparens stigmatibus in genere Fistulifera sed differt ab stigmati speciosa in genere Luticola, item vacant stauros vel fascia. Ita genus novum satis differt omnino generibus Brachysira, Luticola, etiam alteris generibus separatis ab Navicula sensu lato.

Typus generis: *Labellicula subantarctica* sp. nov. (vide infra)

Frustule naviculoid, isovalvate, biraphid, symmetrical around the middle plane of the valve, around the middle transapical plain and the apical plain. The mantle face is very narrowly rectangular. The cingulum on each valve contains a few open longitudinal bands, very finely perforated by one (or two) series of puncta.

Cells mostly solitary, chromatophores (and other parts of the protoplast) unknown. The only species known so far is relatively small, which means that the valves are less or around 10µm long, about 2µm wide. Valves are linear with moderately concave margins in the middle and capitate protracted ends. Other features are not distinguishable in the light microscope.

SEM observations: Somewhat similar to the genus *Brachysira*, both possess uniseriate striae, interrupted at the junction of the valve face with the mantle by a prominent external crest. Nevertheless the alveoli are not separated forming several circular areolae but continue from the raphosternum to the valve margins and on the mantle. They are not arranged in apical series as is common in the genus *Brachysira*.

Raphosternum narrow, hardly constricted at the central nodule. External raphe fissures almost straight with T-shaped terminal endings (as in *Brachysira*) but with central endings slightly curved and finally unilaterally deflected (and not straight) in the direction of the stigma. Internal structure: terminal and central endings straight, not expanded and with an only weakly formed helictoglossa but with a small, heavily silicified nodule, placed between the central endings (as in *Neidium*). The alveoles are entirely covered with membranes. Quite frequently two stigmata, closed on one side, are present and apically arranged. The internal stigma looks similar to the stigma in the genus *Fistulifera* but differs from the stigma in the genus *Luticola*. Stauros or fascia lacking. Therefore, the new genus differs considerably from the genera *Brachysira* and *Luticola* and from other genera that have been separated from *Navicula* sensu lato.

Etymology: The genus name has been given *Labellicula* because the valve outlines resemble the form of small lips.

***Labellicula subantarctica* Van de Vijver et Lange-Bertalot, sp. nov. (Figs 1-20)**

Valvae ut descriptae (vide supra) 6-11µm longae, 2-2,5µm latae. Raphe filiformis recta apparens. Area axialis angustissima, area centralis non separata. Striae non discernendae microscopio photonico sed alveoli (striae in SEM) circiter 50 in 10µm, modice radiantes usque sub apices, ibi subparallelae vel minime convergentes. Costae transapicales tenerrime verruculosae externe. Stigmata communiter dua, irregulariter posita, transapicaliter elongata sed difficulter discernanda externe sed bene aspectabilia aspectu interno.

Holotype: BRM Zu5/74 (Friedrich Hustedt collection, Bremerhaven).

Isotype: PLP-054 (University of Antwerp, RUCA), BR4097 (National Botanical Garden, Meise), CAS221076 (Californian Academy of Science)

Type locality: Baie du Marin (Bollard), Ile de la Possession, Crozet Archipelago, Sample BA173 (coll. date 06/02/2002)

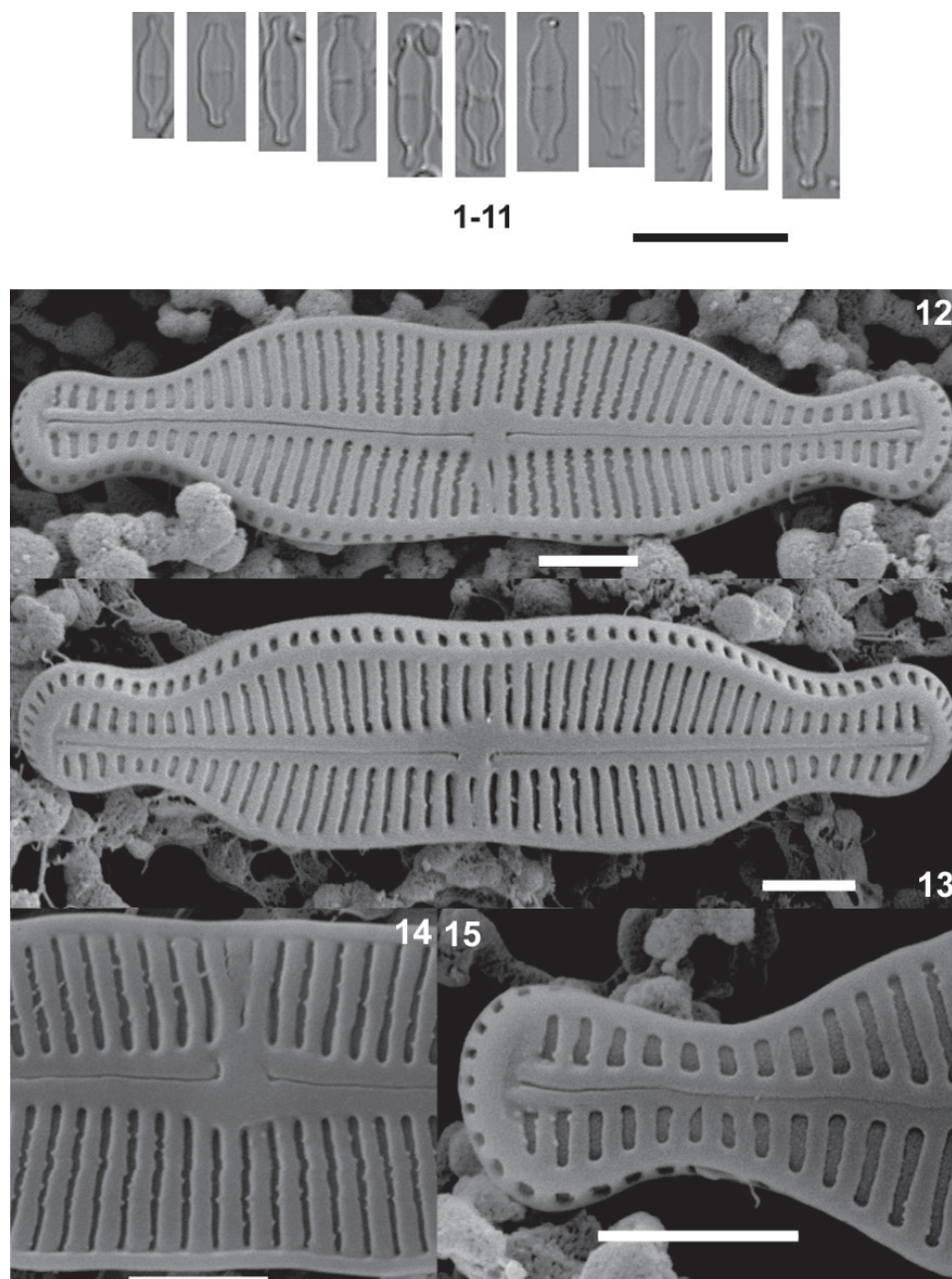
Valves as described in the genus diagnosis (see above), 6-11µm long, 2-2,5µm wide. Raphe filiform, apparently straight. Axial area very narrow, central area not separated. Striae not resolvable in LM but the alveoli (striae in SEM) around 50 in 10µm, moderately radiate towards to the ends, there subparallel or slightly convergent. Externally, the transapical costae are covered with very small wart-like outgrowths. Usually possesses two stigmata, irregularly placed, transapically elongated but externally difficult to find, quite visible in the interior view.

RESULTS AND DISCUSSION

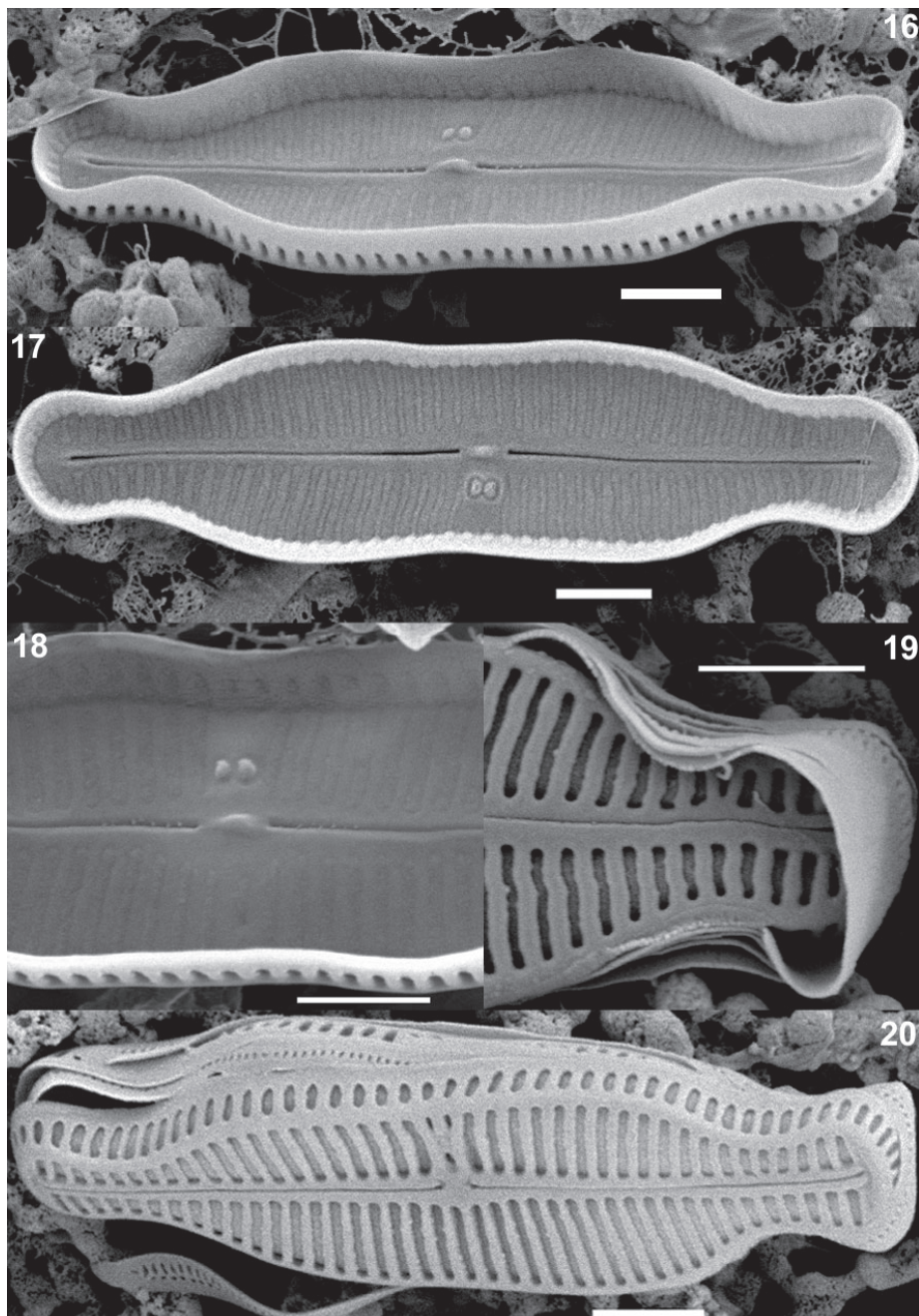
Valve morphology

Labellicula subantarctica is a very small-celled diatom species, with the maximum observed length not exceeding 11µm. Valves are typically linear with parallel, though concave, margins and capitate ends (Figs 1-13). In LM view, the fine structures of striae and raphe are hardly visible (Figs 1-11). The only resolvable feature is the internal central nodule, visible as an asymmetrical thickening. At the same place, an interruption in the striae is also weakly notable. In SEM view (Figs 12-20), striae appear uniseriate with alveoli that continue from the raphesternum up to the mantle (Figs 12-15). Striae are interrupted at the valve face/mantle junction (Fig. 13), sometimes by a thickened crest. The raphe is almost straight (Fig. 12), near the ends sometimes very weakly undulated (Fig. 15). The central endings are almost unmarked. Both are unilaterally deflected (Fig. 14). The alveoli are bordered by small transapical costae, whose margins often carry wart-like outgrowths (Fig. 14). The striae are parallel, but towards the apices they become subparallel (Figs 12 & 13).

Internally (Figs 16-18), the alveoli are covered with hymenes. The two raphe branches are separated in the centre by a heavily silicified central nodule. Both central and terminal endings are simple, not deflected or curved (Figs 16 & 17). Next to the central raphe endings, two stigmata can be observed (Fig. 18).



Figs 1-15. *Labellicula subantarctica* gen. et sp. nov. **1-11**. LM micrographs showing the range of variability within the species. Scale bar = 10µm. **12 & 13**. SEM external views of the entire valve face. On Fig. 13, the interruption of the striae at the junction mantle/valve face is quite obvious. **14**. SEM external view. Detail of the central area with special focus on the central raphe endings. **15**. SEM external view. Detail of the terminal raphe endings. Scale bar = 1µm.



Figs 16-20. *Labellicula subantarctica* gen. et sp. nov. **16 & 17.** SEM internal view of the entire valve. Note the presence of two stigmata. The raphe system is a simple, straight line, interrupted by a large, heavily silicified central nodule. **18.** SEM detail of the internal central area. **19-20.** SEM views of the girdle structure. Note the presence of at least one row of perforations. Scale bar = 1 μ m.

These are covered, only open to the valve outside. In some valves, only one stigma was found. The girdle structure consists of a few open bands (Figs 19 & 20). Some of these bands contain one, sometimes two rows of poroids. Due to fixation with formaldehyde that caused shrinking of the chloroplasts, it was not possible to resolve the structure of the plastids.

Comparison with similar genera

Several features distinguish *Labellicula* from similar naviculoid genera such as *Luticola*, *Brachysira*, *Neidium*, *Fistulifera* and *Diadesmis* (see Table 1). *Brachysira* seems to be the most similar genus to *Labellicula*, with both presenting a combination of T-shaped raphe endings and a small crest on the face/mantle junction. Nevertheless, they can be separated easily. The striae in *Brachysira* consist of one row of elongated poroids, whereas *Labellicula* has internally open alveoli extending from the raphesternum to the mantle. The presence of one or two stigmata is another feature that distinguishes *Labellicula* from *Brachysira*. *Labellicula* shares the presence of stigmata with *Luticola* and *Fistulifera*. However, the shape and structure of the stigmata in *Luticola* are quite different, showing internally a lipped slit whereas both stigmata in *Labellicula* are covered internally by some sort of occlusion, but are open to the valve outside. Externally, the stigmata are not always visible in *Labellicula* whereas externally the stigma of *Luticola* show, in all species so far known, an almost rounded or transapically elongated pore. The stigma, or 'fistula' as mentioned in the diagnosis of *Fistulifera* (Lange-Bertalot, 1997), in *Fistulifera* bear almost the same internal structure, but that genus is also based on other characters, such as the structure of the raphe and the absence of perforations on the girdle bands, which are important in separating the genera.

Neidium and *Diadesmis* also have several features in common, such as the weakly formed helictoglossa and the presence of a central nodule, but they lack stigmata and present a different striae structure.

At present, only one species is attributed to this new genus. Due to the small size of *L. subantarctica*, it is possible that other species belonging to *Labellicula* may have been overlooked up to now or incorrectly placed in other genera.

Ecology and associated diatom taxa

Labellicula subantarctica was found in several dry to semi-wet soil samples taken from small scratches in the cliffs bordering the coastline. Due to the very special character (very thin soil layer) of the sampling site, it was impossible to obtain reliable physicochemical measurements. Nevertheless, it is possible to propose some ecological hypotheses. The influence of sea-spray is likely. The samples are dominated by *Nitzschia pusilla* Grunow, *Nitzschia frustulum* (Kützing) Grunow var. *frustulum*, *Denticula sundayensis* Archibald, *Diatomella balfouriana* Greville, *Navicula ectoris* Van de Vijver and various species belonging to the genus *Diadesmis* (e.g. *D. faurei* Van de Vijver et Beyens and *D. subantarctica* Le Cohu et Van de Vijver). These species have been previously found on the island in various locations where both the chloride concentrations and the specific conductance values were enhanced (Van de Vijver *et al.*, 2002a).

The type locality is situated close to a large moulting place of the King penguin (*Aptenodytes patagonica*). The influence of decaying feathers and penguin

Table 1. Comparison of *Labellicula* with similar genera.

	<i>Labellicula</i>	<i>Brachysira</i>	<i>Neidium</i>	<i>Luticola</i>	<i>Diademesis</i>	<i>Fistulifera</i>
<i>striae</i>	uniseriate	uniseriate	uniseriate	uniseriate	uniseriate	uniseriate
<i>alveoli</i>	open and not separated by circular poroids	series of elongated poroids	series of elongated poroids	series of circular poroids	series of circular or elongated poroids	series of small areolae
<i>internal hymenes</i>	present	present	present	present	present	present
<i>junction valve face/mantle</i>	striae interrupted, crest	striae interrupted, crest	striae interrupted, no crest	striae interrupted, no crest, sometimes spines	often with crest	no crest
<i>external terminal endings</i>	T-shaped	T-shaped	commonly forked into two elongated fissures	curved	simple or T-shaped	very weakly curved
<i>external central raphe endings</i>	slightly curved, unilaterally deflected	simple, straight	curved or deflected into opposite directions	deflected, curved or bent away from the stigma	simple or T-shaped	simple, straight
<i>central nodule</i>	present, small, heavily silicified	absent	present	present, heavily silicified	weakly present	absent
<i>stigma</i>	1-2 present	absent	absent	1 present, open externally by pore, internally by lipped slit	absent	1 present, internally fistula-shaped, externally slit-like
<i>stauros/fascia</i>	absent	absent	absent	short stauros	sometimes present	absent
<i>helictoglossa</i>	weakly formed	absent	weakly formed	absent	weakly formed	
<i>perforation of bands</i>	1 (-2) rows	1 row	absent	1-2 rows	1-2 rows	absent

manure is quite evident, although not evaluated at the sampling location. The amount of animal debris is a likely factor determining the composition of several diatom assemblages on Ile de la Possession and Kerguelen (Van de Vijver & Beyens, 1999)

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