

Synedra phantasma* M.H.Hohn (*Bacillariophyta*, *Fragilariaceae*) from the Amazon river (South America): its typification and transfer to the genus *Fragilaria

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In the mid-1950s, the Catherwood Foundation of Bryn Mawr, Pennsylvania, USA, provided a research grant to study the fauna and flora of the Peruvian headwaters of the Amazon (Patrick & al. 1966). Two expeditions were made in 1955: the first in June, the second in October. It was the latter expedition that undertook the scientific collecting (Patrick & al. 1966: 2). Matthew Hohn analysed and identified the diatoms (Hohn 1966). As Hohn (1966: 459) noted, “The field collections were obtained by sampling the many ecological habitats within each study area [...]”; the samples were cleaned and examined for diatoms (Hohn 1966). Of the 247 diatom taxa recorded, 27 were considered new by Hohn (>10%). This number included eight new species of the genus *Synedra* Ehrenberg (1830: 60), one of which was considered to be new to science and named *Synedra phantasma* Hohn (1966: 464). Of the seven other species noted, four would be now referable to *Ulnaria* (Kützing) Compère (2001: 100), one to *Tabularia* (Kützing) Williams & Round (1986: 320) and the remaining two (probably) to *Fragilaria* Lyngbye (1819:182). Hohn’s account is relatively brief, noting the valve’s shape (“linear, triundulate, ends sub-capitate to capitate”), dimensions (“length 43.1 µm; width 5.7 µm”), the structure and number of striae (“striae marginal, costate, parallel 10/10 µm”) and the broad and triundulate axial area (= sternum) (Hohn 1966: 464). Also noted was the “indistinct ‘ghost’ striae at the valve’s centre” (Hohn 1966: 464). Hohn provided just one line-drawing (Hohn 1966, pl. 1: fig. 2, reproduced here as Fig. 5).

Hohn (1966) compared his specimens of *Synedra phantasma* to *Synedra rumpens* Kützing [= *Fragilaria rumpens* (Kützing) G.W.F. Carlson] and noted that *Synedra phantasma* differed by “the broad pseudo raphe [=axial area, = sternum], coarser striae and the presence of ‘ghost striae’ in the central undulation” (Hohn 1966: 464). Interestingly, Hohn (1966: 464) noted that *Synedra phantasma* is “Of common occurrence”, yet no further records of it have been made since its description apart from appearing in compiled lists of species names for Peru (e.g. Tapia 1998: 138).

Although appearing a distinct entity, the question of the current generic placement of *Synedra phantasma* presents a problem: it is clearly not a species of *Synedra* as that genus is presently conceived (see Williams & Karthick 2021). The discovery of more specimens, found in roughly the same area (i.e. the Amazon basin) that Hohn explored in 1955, has made possible its examination and re-description using light and electron microscopy, and allows the question of its genus to be addressed using these new data.

Hohn’s sampling sites were located near Iquitos, Peru (Fig. 1). Since then, very few taxonomic studies have been carried out in the Amazon basin of ‘fragilarioid’ diatoms, either in the Andean part, which is characterized by the presence of ‘cosmopolitan’ elements (Rumrich & al. 2000), or the lowlands rich in oligotrophic species (Metzeltin & Lange-Bertalot 1998, 2007, Wetzel & al. 2012, Almeida & al. 2017) from the very diversified habitats and types of waters (see Sioli 1984).

The holotype slide GC25861a designated by Hohn and deposited at the Academy of Natural Sciences of Philadelphia (ANSP; Hohn 1966: 264), was thoroughly scanned to locate specimens that correspond to *S. phantasma*. However, not a single specimen belonging to *Fragilaria* could be found. The closest specimen is an unidentified *Ulnaria* the dimensions of which do not match those given for *S. phantasma* (the specimens of *Ulnaria* are twice as big as *S. phantasma*). The slide label indicates that it is a composite sample, meaning that several samples were pooled together. We suspect that Hohn saw representatives of the other four new taxa in some individual samples but did not check to see if they were indeed present on this slide.

Additional slides were checked that presumably contain types designated by Hohn in the same publication, but they too do not have *S. phantasma*, and they were made from samples from other rivers than the Amazon.

While sampling the Amazon basin in March 2005, samples gathered from the lower reaches of the Solimões River before its confluence with the Rio Negro near the city of Manaus, Northern Brazil (Fig. 1), were collected. The periphytic sample was scraped from stalks and leaves of a species of *Cymbopogon*, *Poaceae*). The raw material was oxidized using standard techniques for diatom observation and analysed using light and scanning electron microscopy.

Since its measurements and general description fits those of Hohn and considering the missing specimens in its original gatherings and holotype slide, we hereby designate an epitype based on a sample collected at the same river. The sampling site of the epitype is located at the same river basin, hundreds of kilometres downstream, near the city of Manaus (Fig. 1). An epitype is a specimen or illustration selected to serve as an interpretative type when the holotype, lectotype, or previously designated neotype, or all original material associated with a validly published name, is demonstrably ambiguous and cannot be critically identified for purposes of the precise application of the name to a taxon (ICN Art. 9.9; Turland & al. 2018).

Fragilaria phantasma (M.H.Hohn) C.E.Wetzel, Potapova & D.M.Williams, *comb. nov.* (Figs 6–44).

Basionym: *Synedra phantasma* M.H.Hohn (in Patrick & al.) *Monographs of the Academy of Natural Sciences of Philadelphia*, vol. 14: 464, pl. 1: fig. 2, 1966.

Holotype: Rio Amazonas, Peru, South America, GC25861a, holotype (ANSP!).

Epitype (here designated for the above holotype): Slide SP-400224 deposited at the Herbário Científico do Estado Maria Eneyda P. Kauffmann Fidalgo, São Paulo (SP). The epitype is represented by Fig. 9.

Epitype locality: Rio Solimões, near Manaus, Brazil. Periphytic material collected from submerged leaves of a species of *Cymbopogon* by C.E. Wetzel and L. Ector, sample No. 07, on 23/02/2005 (3°08'19.7"S 59°54'00.1"W).

Registration (new combination): <http://phycobank.org/103301>

Registration (epitype): <http://phycobank.org/103303>

Description: Valves with parallel sides, tapering towards each pole from $\frac{1}{3}$ of valve length; poles capitate to subcapitate, valves with slightly swollen centre harbouring 'ghost' striae. Valve length 26–50 μm , width 5–6.5 μm . Frustule rectangular in girdle view, valve with narrow mantle, bands perforate. Striae broad in width, parallel, more or less opposite either side of indistinct but broad sternum. Striae composed of wide virgae, c. 1 μm , and thin but extensive vimines, 9–11 per striae, equidistant and parallel, same on mantle with c. 5 per striae prior to meeting valve edge. Vimines with fragmented closing plate. Central area solid. Poles taper towards simple pore-field, distinguished by even row of porelli entirely on valve mantle. Mantle/face junction harbouring short but broad spines (with specimens also completely lacking this feature), as broad as each vimines, appear as modified vimines in places. The apex of each

spine variable. Rimoportulae at one pole, as internally paired lips orientated horizontally, appearing aligned with sternum; externally as simple opening. Spines observed (when present) from girdle view taper towards nearest pole. Mantle with distinct plaques, each separate plaque extending towards final vimen. Cingulum composed of open bands, at least 6, all identical, with single row of poroids barely visible; valvocopula somewhat wider than copulae; open end tapers towards valve. Valvocopula with fimbriate edge to allow attachment to valve interior.

Notes: *Ulnaria ulna* (Nitzsch) Compère [= *Bacillaria ulna* Nitzsch, ≡ *Synedra ulna* (Nitzsch) Ehrenberg] is the type of the genus *Ulnaria* (Compère 2001). For *Ulnaria*, closed girdle bands are of significance as they are hypothesized to be a synapomorphy for that group (see Williams 2011). The presence of two rimoportulae is a second character usually observed in *Ulnaria*, but not exclusive to this genus, since also present in *Fragilaria* (e.g. *F. capucina* Desmazières). *Synedra phantasma* has open girdle bands and one rimoportula per valve, which allows placement in the genus *Fragilaria*. Perhaps the most ‘intriguing’ characters observed in this species are the wide vimines forming the areolae/striae that are elongated and its fimbriate valvocopula are also similar to the ones found in *Staurosirella* species (Morales & al. 2019). Despite these similarities, *F. phantasma* has rimoportulae and areolae occlusion like those found in most *Fragilaria sensu stricto* species and does not belong the small araphid group of *Staurosirella* either. Moreover, fimbriate valvocopula is also a shared character also found in some varieties of *Ulnaria ulna* and in *Synedra gouldarii* as well (Morales & al. 2007, figs 35-41, 42-47).

Additionally, and provided that the specimens observed in Hohn’s slides (Figs 2-5) are currently identified as *Synedra gouldarii* [= *Fragilaria ulna* var. *gouldarii* (Brébisson) Lange-Bertalot] in many publications from South America (e.g. Patrick 1940, Rumrich & al. 2000, Brassac & Ludwig 2003, Metzeltin & Lange-Bertalot 1998, Metzeltin & al. 2005) and North America (e.g. Bellinger & al. 2013, Bishop 2015) and knowing that this species has two rimoportula (one at each apex) and open valvocopulae (Schwarzwaldner & Postek 1981, Sala & al. 2008, and pers. obs.), we propose its transfer to the genus *Ulnaria* Compère (2001) as follows.

Ulnaria gouldarii (Brébisson ex Cleve & Grunow) D.M.Williams, Potapova & C.E.Wetzel, *comb. nov.*

Basionym : *Synedra gouldarii* Brébisson ex Cleve & Grunow, Kongliga Svenska Vetenskaps-Akademiens Handlingar Vol. 17(2): 107, pl. 6: fig. 119, 1880 (‘*gouldarii*’).

Syntype localities: “Buenos Ayres, Portorico, Kamtschatka, Jenissey [...] Taf. 6, Fig. 119 [...]”

Registration: <http://phycobank.org/103304>

Notes: When *Synedra gouldarii* was first described by Cleve & Grunow, the name was attributed to ‘Brébisson in litteris’ (Cleve & Grunow 1880: 107). The description, giving only details of the valve shape and size (“*Schaalen in der Mitte etwas verengt, an den Enden zugespitzt, 0,057 — 0,080 mm. lang, 0,009 mm. breit, in der Mitte 0,008 mm., Querstreifen 10 1/2 in 0,01mm., an den Enden schwach radial in der Mitte auf einem fast quadratischen Raume sehr matt (bei schwacher Vergrößerung fehlend)*”), was accompanied by a single illustration (Cleve & Grunow 1880: pl. 6: fig. 119). Several different localities were noted in the protologue: Buenos Aires, Argentina (“Buenos Ayres”), Puerto Rico (“Portorico”), Kamtschatka (Russia) and Yenisi River (“Jenissey”, source in Mongolia, mostly in Russia) (Cleve & Grunow 1880: 107). The original drawing of the figure is annotated with “*Synedra gouldarii* Brébisson in litt’ (in **W**). Further inspection of material for *Synedra gouldarii* at **W** yielded several items relevant to the given type localities, including material from Buenos Aires, Argentina (“Buenos Ayres”, W1331, Brébisson’s material; probably the same material that was used by H.L. Smith for *Diatomacearum species typicae* no. 558 (**BM** 26119, isotype), as well as Yenisi River (“Jenissey”, **W** 2030a, 2030b), Kamtschatka (“Diat. Erde”, **W** 1109, a Möller slide) and Puerto

Rico (“Portorico”, W 1504). Lange-Bertalot illustrated specimens from a “Coll Grunow no. 1504 Syntypen aus Portorico” (= “Portorico, Grunow no. 1504”, a Möller slide) (Lange-Bertalot 1980: 768, figs 180-182). It is most likely that the “Buenos Ayres, W 1331” material was the source of the drawing in Cleve & Grunow (1880, pl. 6, fig. 119) but until revision of all the syntypes has been completed, a lectotype should not be assigned. The combination can be made here as the specimens examined so far as all species of *Ulnaria*.

This article is dedicated to the memory of our colleague and friend Luc Ector (1962–2022) who passed away while this paper was being prepared.

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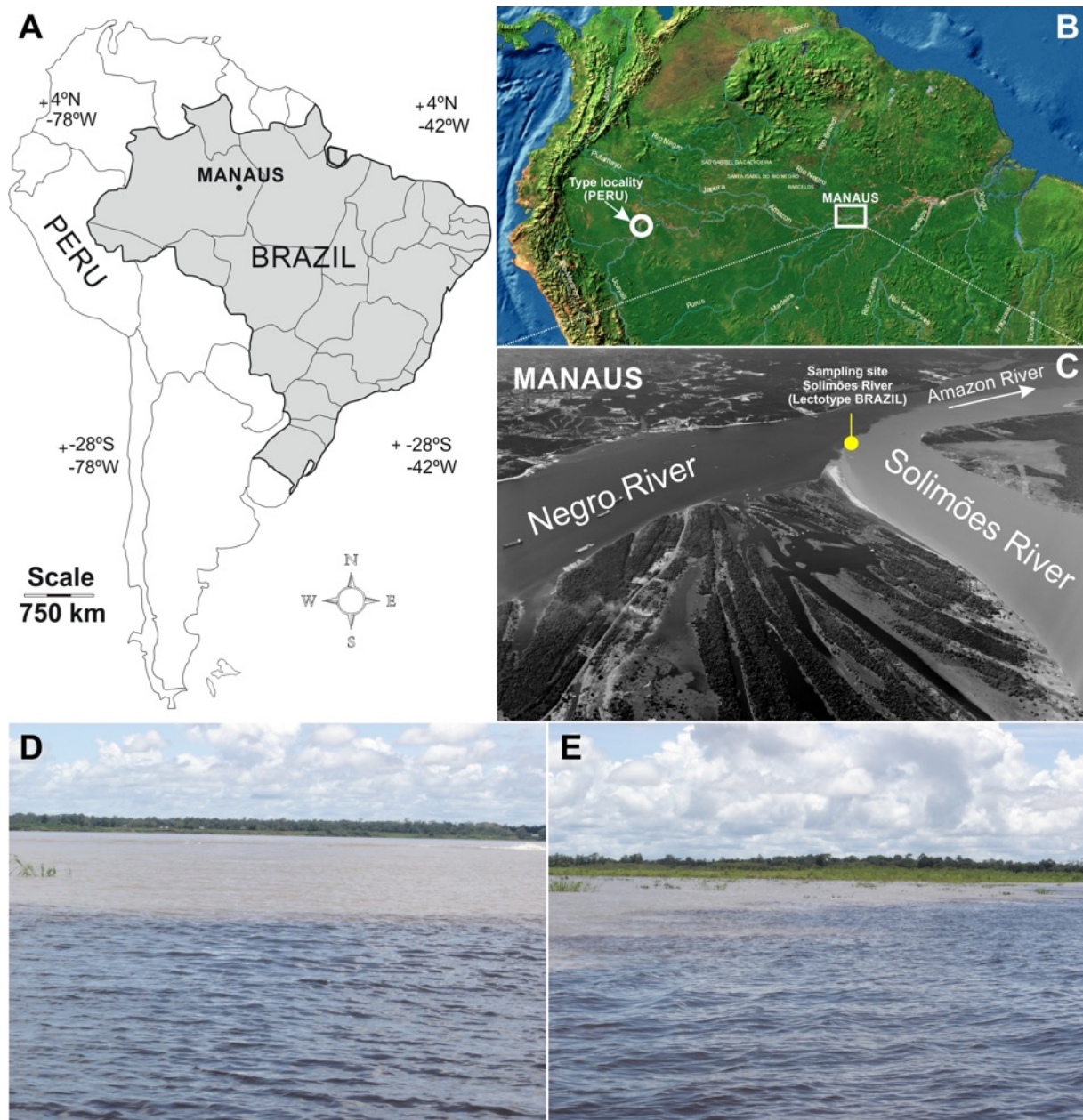
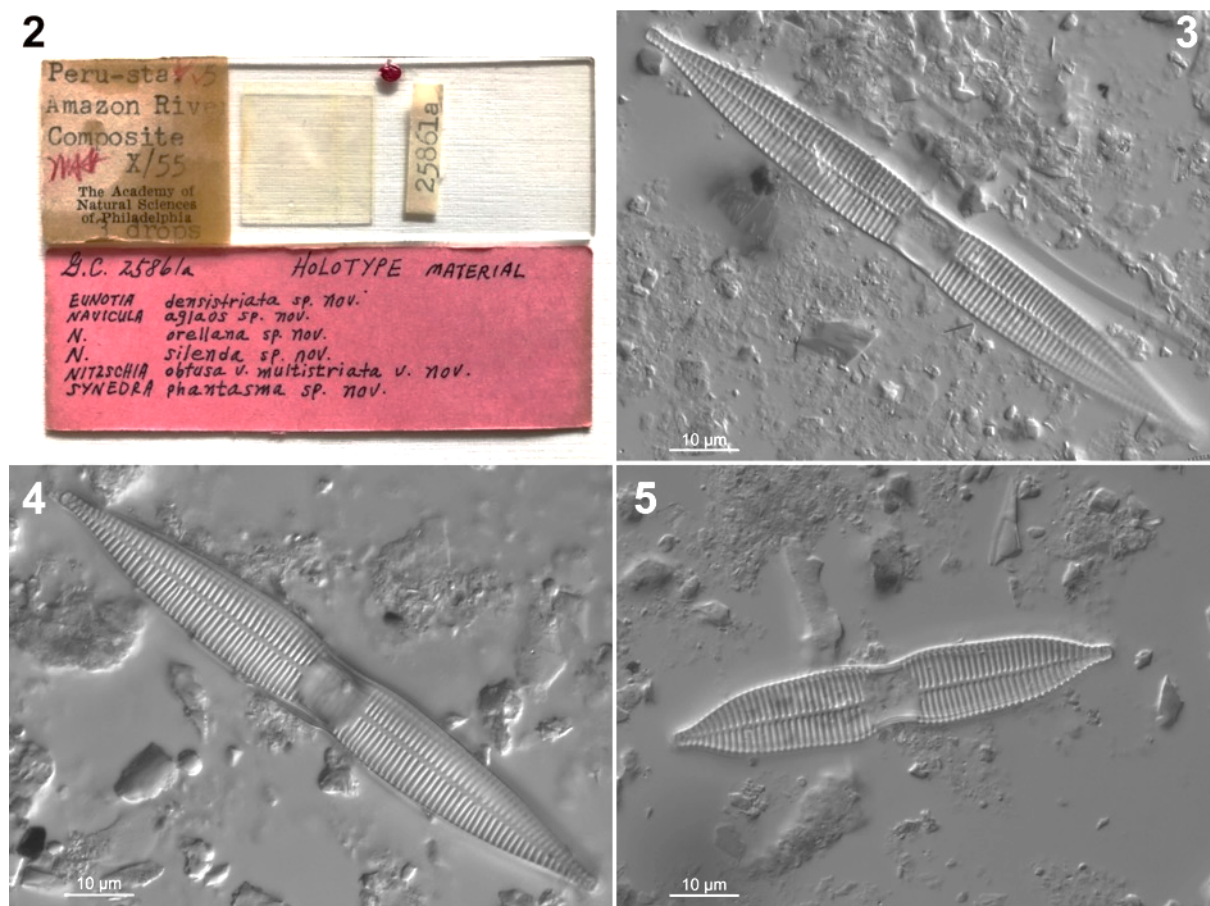
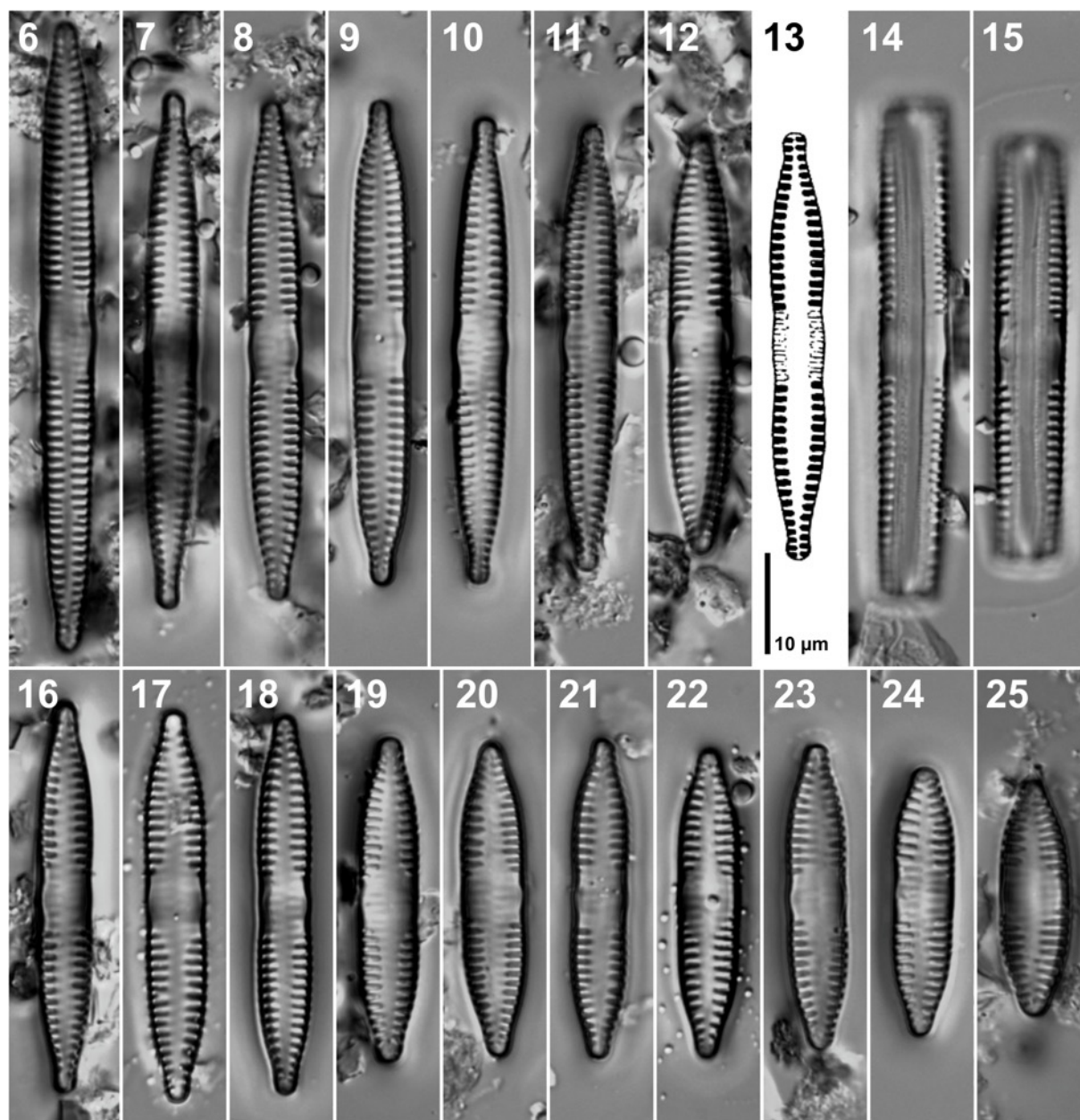


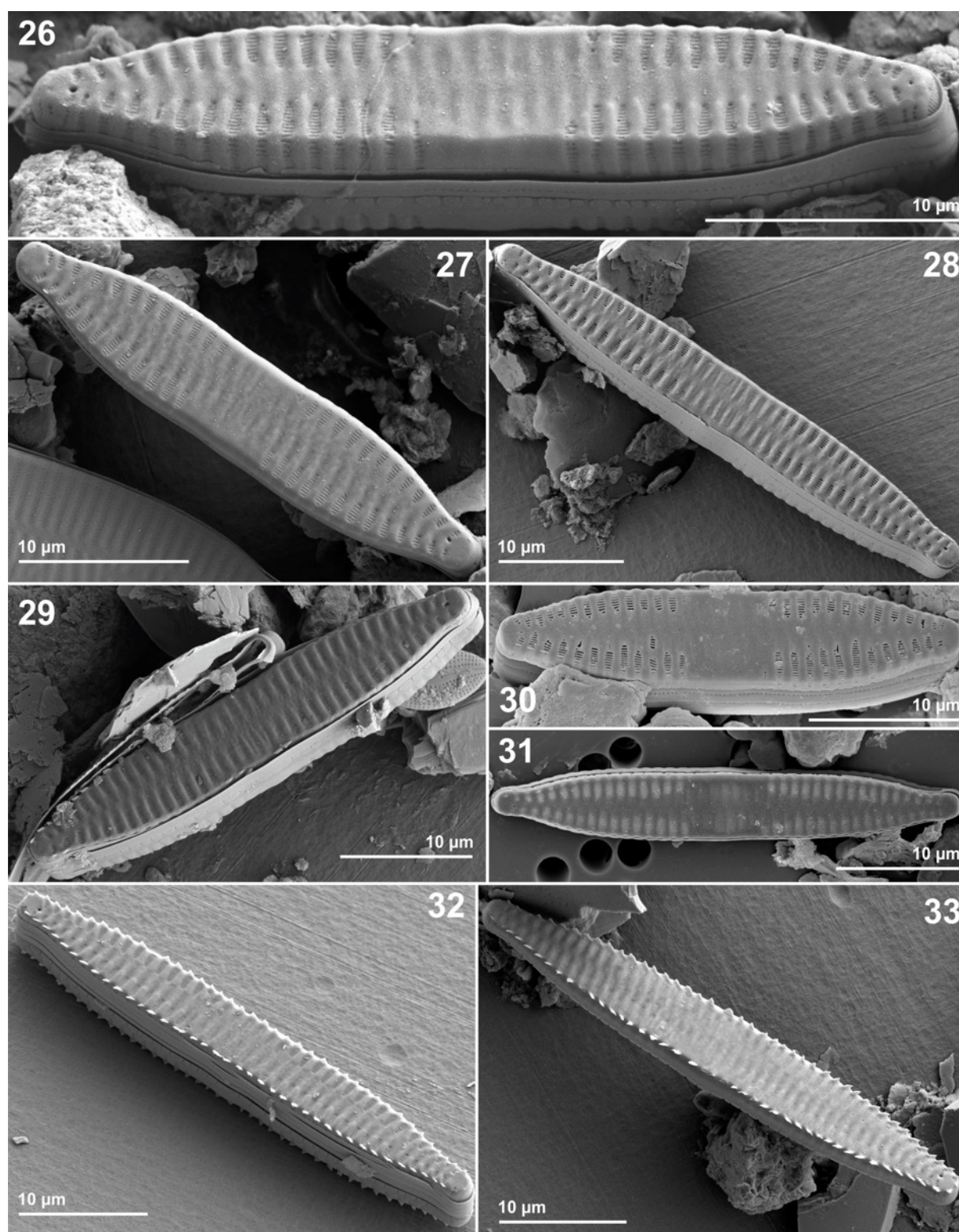
Fig 1. Location map of South America (A) showing the original type locality in Peru (B, white circle) and the sampling site of the here designated epitype (C) near the city of Manaus (Brazil), at the confluence of the Solimões river, clear water shown here in figures D and E (note the black water from the Negro River). Samples were scrapped from submerged leaves of *Cymbopogon* sp. seen here on figures D and E.



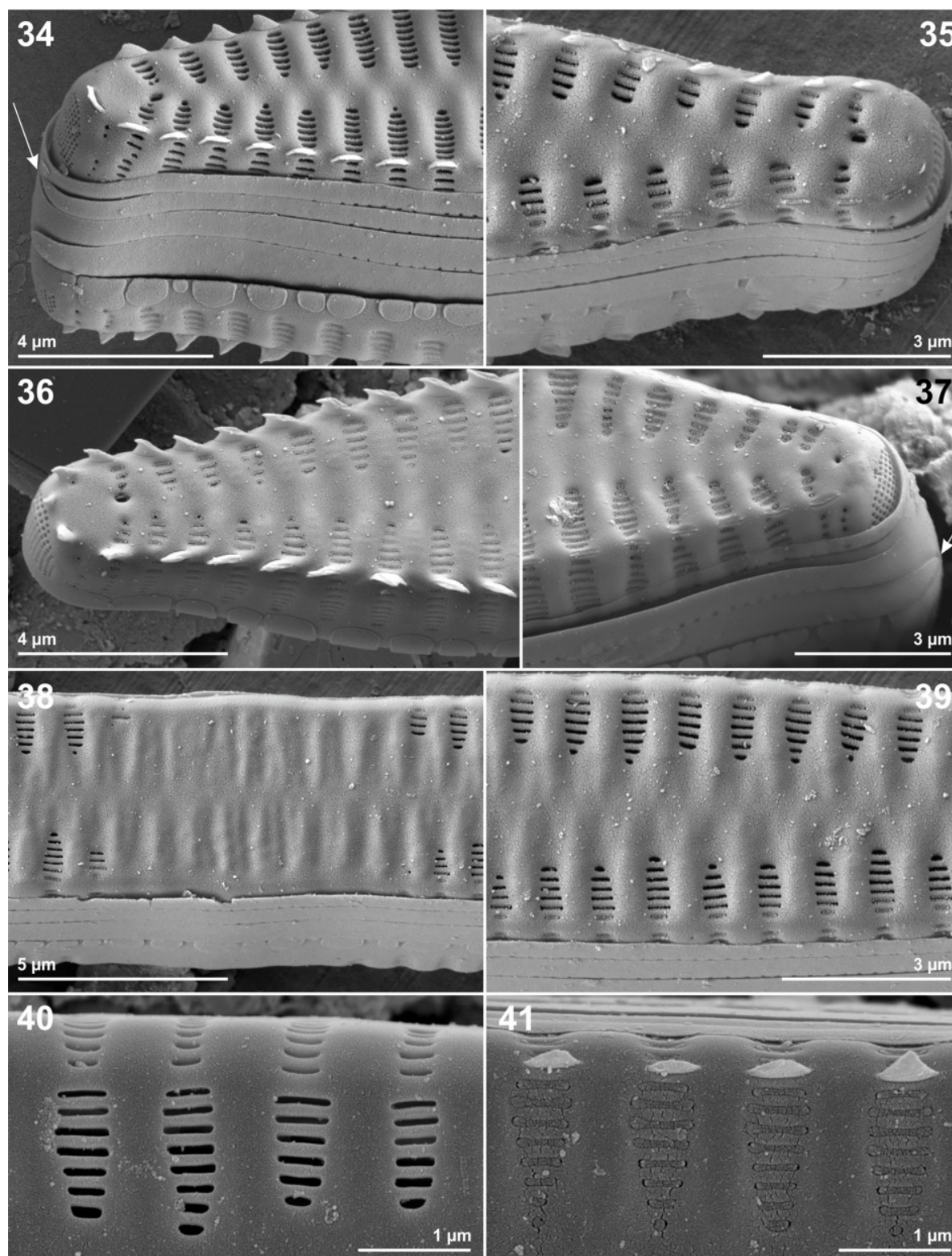
Figs 2–5. Slide GC25861a (ANSP) supposedly having the specimens of *Synedra phantasma* as indicated. However, the only “synedroid” specimens found are those related with *Ulnaria gouldarii* (Brébisson ex Cleve & Grunow) D.M.Williams, Potapova & C.E.Wetzel, *comb. nov.*; $\equiv$ *Synedra gouldarii* Brébisson ex Cleve & Grunow 1880; $\equiv$ *Fragilaria ulna* var. *gouldarii* (Brébisson) Lange-Bertalot 1980].



Figs 6–25. Cell cycle of *Fragilaria phantasma*. **Figs 6–12, 14–25.** Population from the epitype material, slide SP-400224, Solimões River near Manaus (Amazonas state, Brazil). **Fig. 13.** Original published draw of *Synedra phantasma* M.H.Hohn in Patrick & al. (1966: 464, pl. 1: fig. 2) from Peru. Figs 14 and 15 show frustules in girdle view. Fig. 9 represents the epitype specimen.



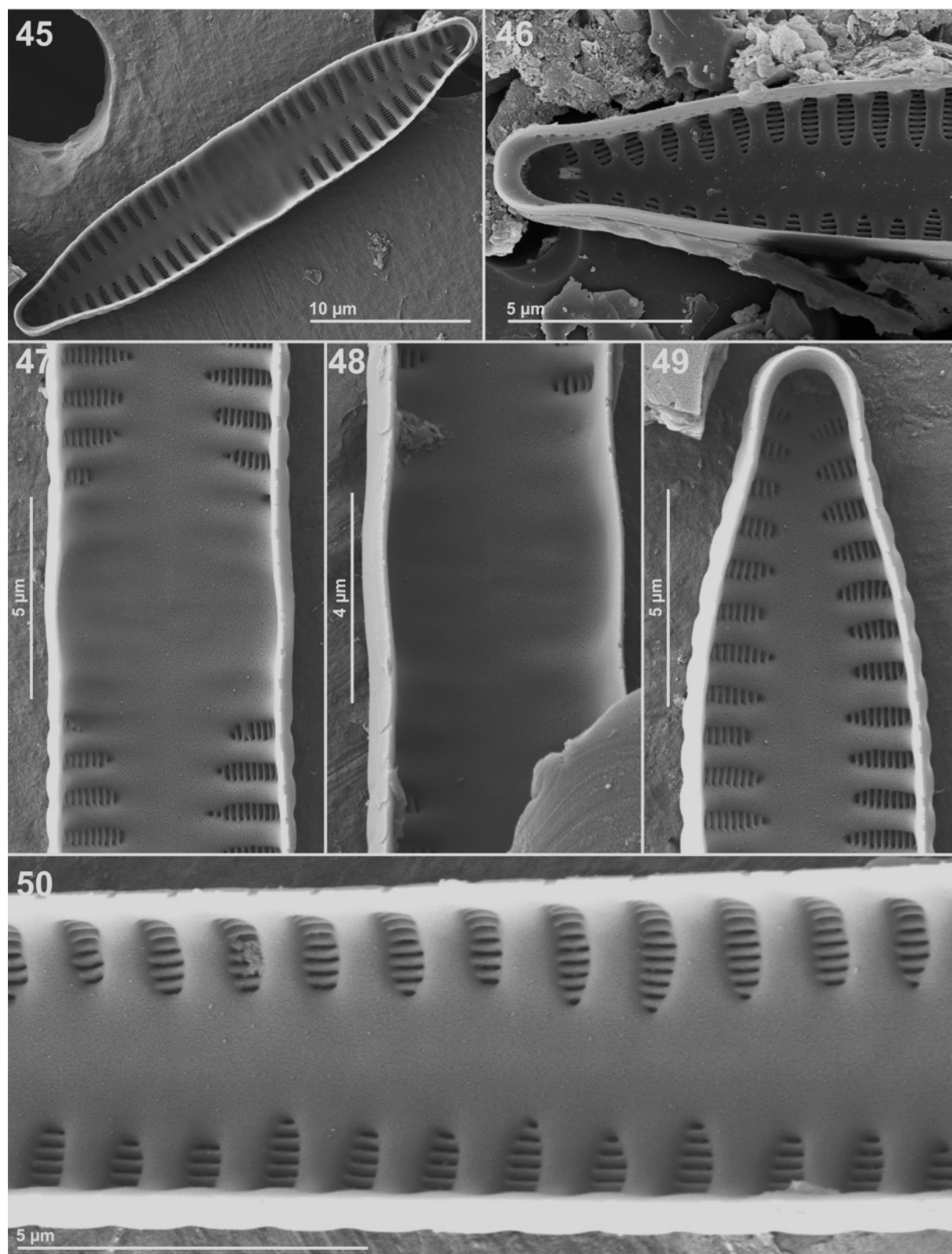
Figs 26–33. *Fragilaria phantasma*. SEM micrographs of the epitype material (Amazon River near Manaus, Brazil). Images showing external oblique view of entire frustules with regularly placed marginal spines. Sometimes these spines are already eroded and are not conspicuous anymore (**Figs 26–31**), while in more intact specimens the spines are clearly present (**Figs 32–33**). Note the change of direction of the spines (inclination) towards the apices.



Figs 34–41. *Fragilaria phantasma*. SEM micrographs of the epitype material. **Figs 34–37.** SEM external detail of apices showing external rimoportula aperture, occluded areolae, silica plates on the valve mantle, and apical pore fields; only one rimoportula per valve was observed in SEM. Note on figs 34 and 37 the open girdle bands. **Fig. 38.** Detail of the central area showing the lack of striae and slightly inflated central region. **Fig. 39.** Detail showing the slit like areolae and wide external sternum **Figs 40–41.** Details of striae and valve margins with and without triangular spines. Note the long vimines forming the areolae near the margins.



Figs 42–44. *Fragilaria phantasma*. Fig. 40. Frustule in girdle view showing numerous girdle bands with one row of perforated areolae, small irregular silica plates near the abvalvar margins, the interrupted striation pattern near the centre and the long striae extended onto the valve mantle. **Fig. 43.** Broken valve showing the fimbriate valvocopulae. **Fig. 44.** Details of the middle portion of the closed frustule with a slight inflation on the margins.



Figs 45–50. *Fragilaria phantasma*. SEM internal view. Fig. 45. General aspect of the internal valve. **Fig. 46.** Internal detail of the pole with one rimoportula aligned with the apical axis (seen also in figure 45). **Figs 47–49.** Detail of the central area showing the “ghost-striae” like depressions. **Fig. 49.** Details of the pole without rimoportulae. Note the broad sternum and the wide vimines forming the areolae/striae structure. **Fig. 50.** Detail of the wide sternum in internal view.