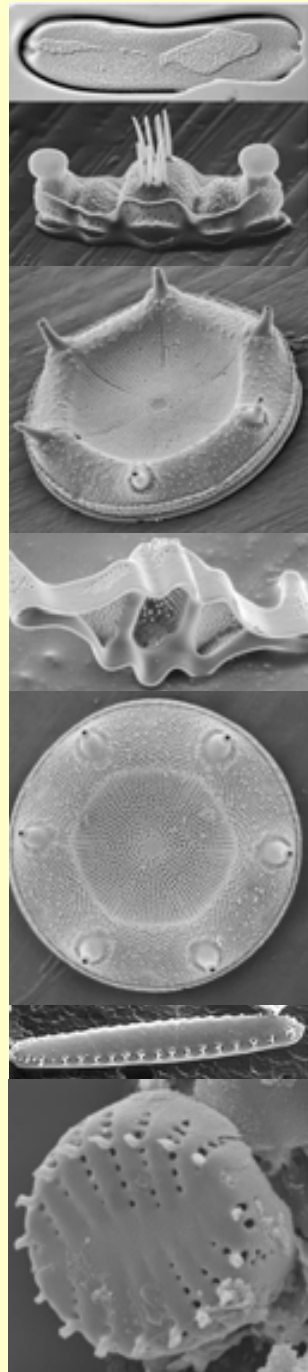


What are alien diatom species and how do we recognise them?

David M. Williams
Department of Life Science
Natural History Museum
Cromwell Road
London SW7 5 BD
UK





Meet the Invasive Species Challenge.

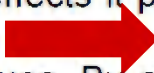
Know the NISC Plan, Manage the Problem.

PREPARE, PREVENT, PROTECT.

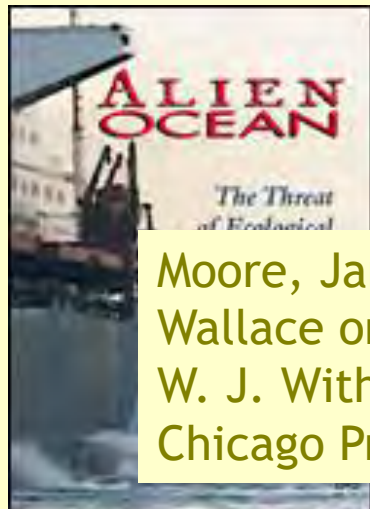
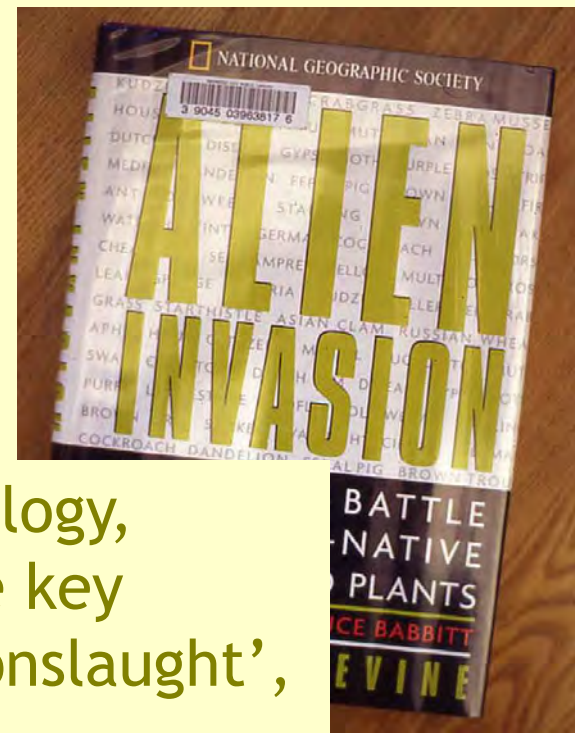
Invasive Species Definition Clarification and Guidance White Paper

Submitted by the Definitions Subcommittee of the
Invasive Species Advisory Committee (ISAC)

Invasive species are those that are not native to the ecosystem under consideration and that cause or are likely to cause economic or environmental harm or harm to human, animal, or plant health. Plant and animal species include domesticated and cultivated species and those that have become established in a region.

non-native species will be deemed to outweigh the beneficial effects it provides. Finally, a non-native species might be considered invasive in one region but not in  Whether or not a species is considered an *invasive species* depends largely on human values. By attempting to manage *invasive species*, we are affirming our economic and environmental values. Those non-native species judged to

In the sub-discipline of Invasion Ecology, 'Invasiveness', and 'Invasibility' are key concepts; 'aggression', 'assault', 'onslaught', and 'raid' are life's strategies; and 'colonization' and 'naturalisation' the results



Moore, James. 2005: Revolution of the Space-Invaders: Darwin and Wallace on the Geography of Life. In: David N. Livingstone and Charles W. J. Withers (eds) *Geography and Revolution*, Chicago: University of Chicago Press, pp. 106–32.



Meet the Invasive Species Challenge.

Know the NISC Plan, Manage the Problem.

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Invasive Species Definition Clarification and Guidance White Paper

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Invasive Species Advisory Committee (ISAC)

What We Do Not Mean, What We Do Mean, and the “Gray” Area

Native and Non-native Species

Feral Populations

A Biogeographical Context

The “Gray” Area

Environmental Harm





Meet the Invasive Species Challenge.

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Invasive Species Definition Clarification and Guidance White Paper

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A Biogeographical Context

The “Gray” Area

Environmental Harm



1. Biogeography

2. Diatoms

3. Floras

4. Can we tell what is or is not an alien?



1. Biogeography

“...a science that deals with the geographical distribution of animals and plants...”

From: Biogeography (2008) In *Merriam-Webster Online Dictionary*
<http://www.merriam-webster.com/dictionary/biogeography>



Aims of biogeography

- Describe & classify areas
- Discover relationships of areas
- Propose distributional histories of taxa
- Model for distributional mechanisms
- Model for ecological attributes (niches)
- Predict species distributions



Biogeography

Describe distribution: Distribution Maps

[Gila Woodpecker (*Melanerpes uropygialis*)]



Biogeography

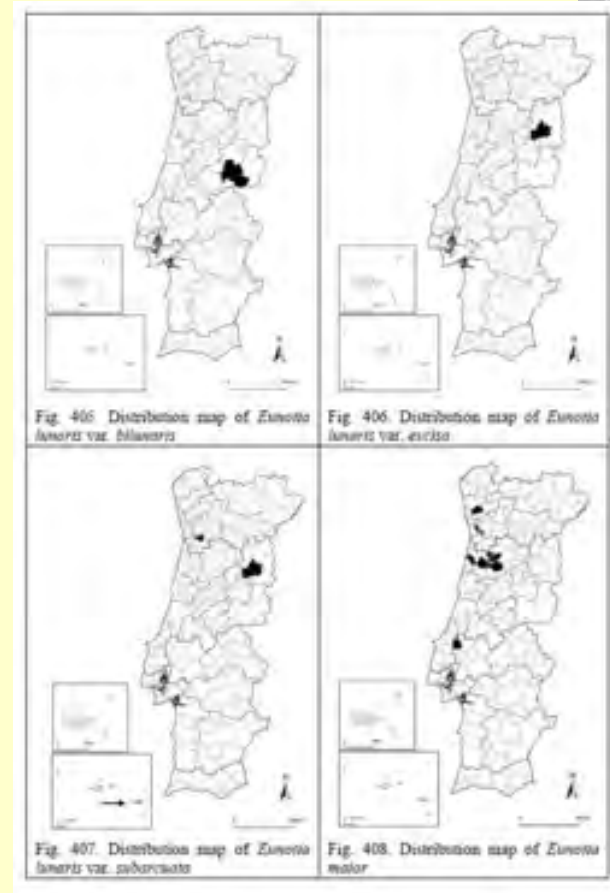
Catalogue of continental diatoms
from Portugal, including the Archipelagos of
Azores and Madeira: updated nomenclature,
distribution and bibliography

by

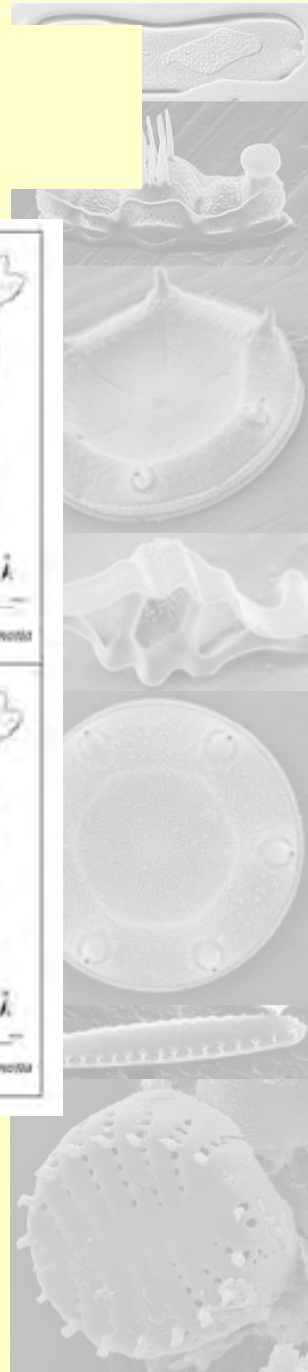
Maria Helena NOVAIS, Saúl BLANCO, Manuela
MORAIS, Lucien HOFFMANN & Luc ECTOR



Koeltz Scientific Books
2015

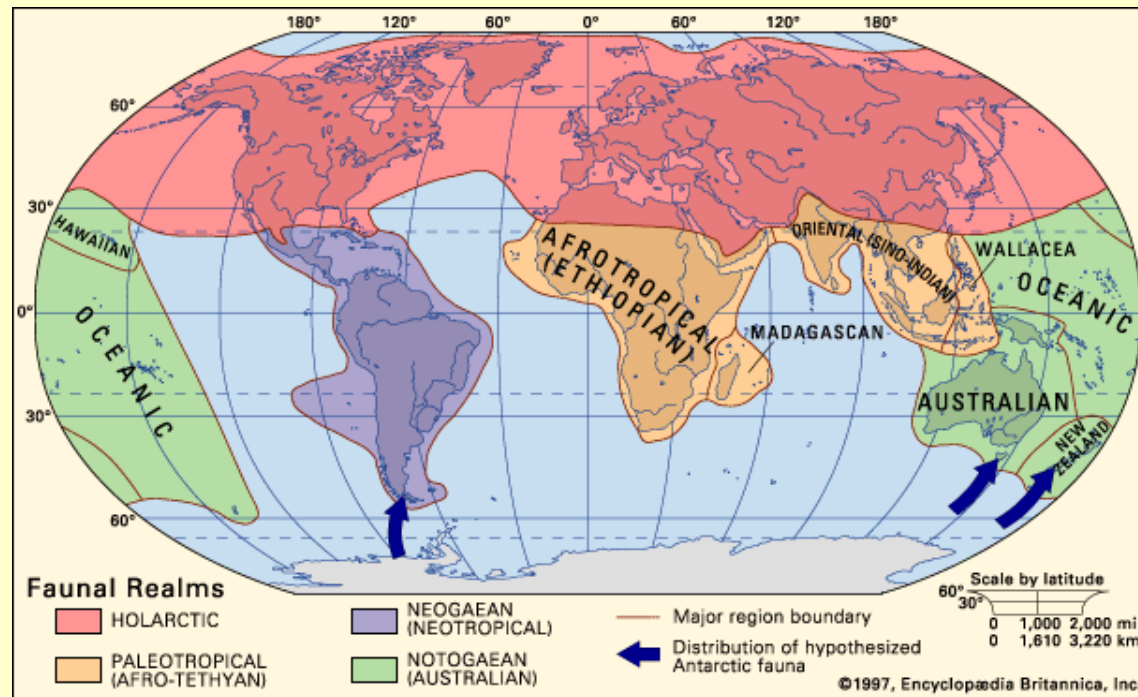


Eunotia Ehrenb. 1837: 44
Number of Species: 2300+



Biogeography

Discover biotic relationships



World biogeographical regions (after Sclater 1858)

Biogeography

Classification and description of areas

- Helps determine new area classifications
- Benefits ecological studies
- Aids conservation management (e.g., WWF)
- Reconstructs former boundaries and barriers
- Independent evidence for Earth Science studies

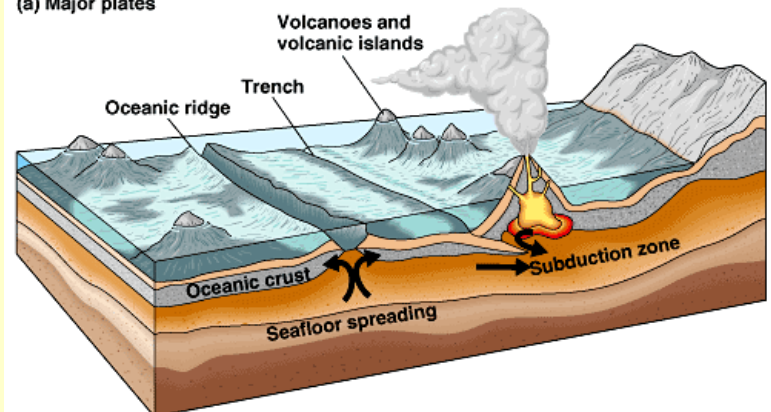


Biogeography

How do things get to where they are now?



(a) Major plates



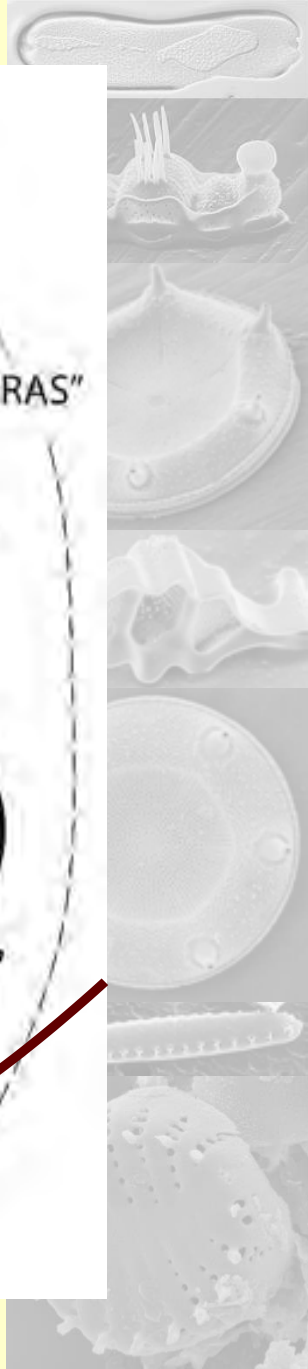
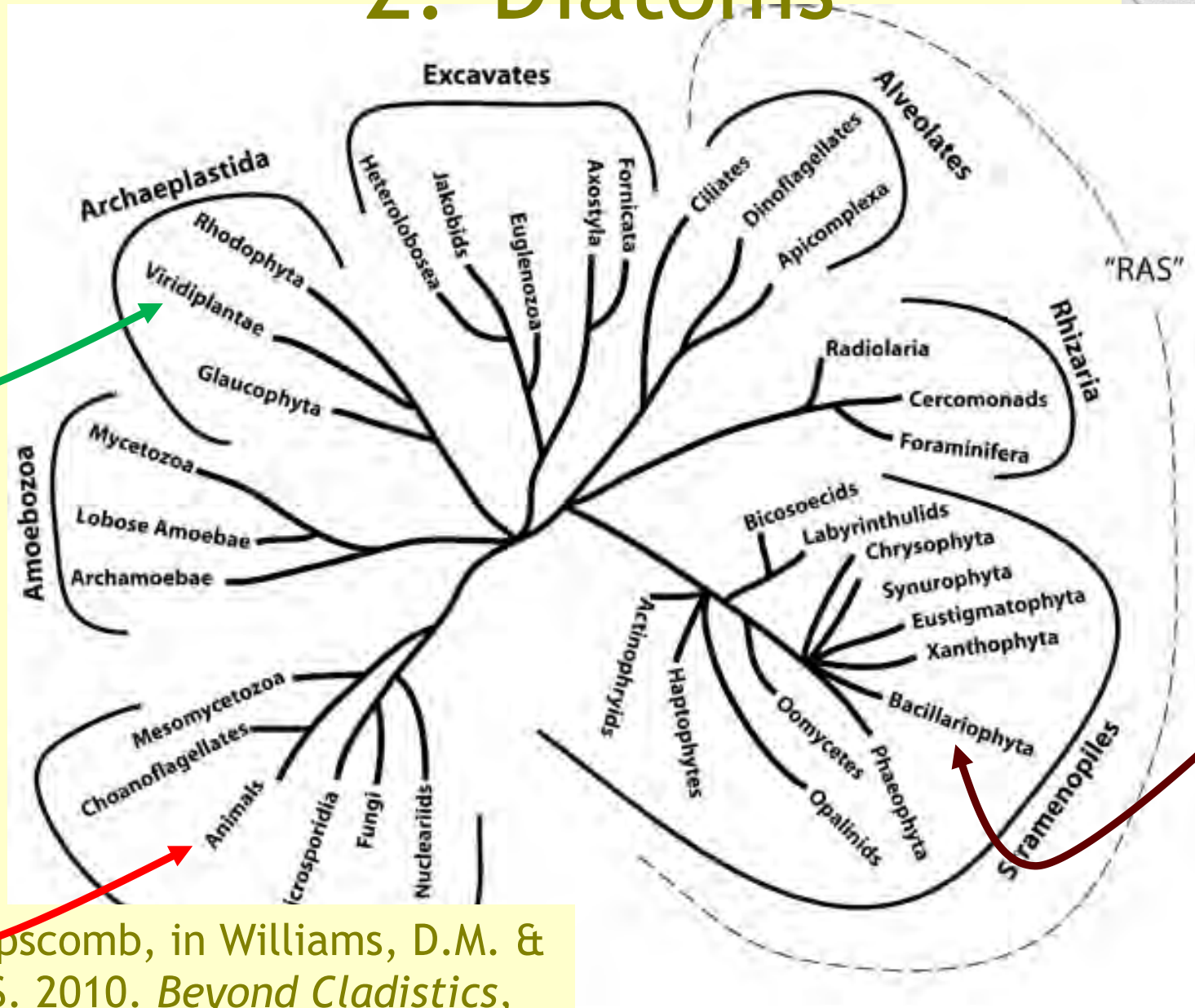
(b) Events at plate boundaries

Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.



1. Atkinson, K. M., 1970. Dispersal of phytoplankton by ducks. *Wildfowl* 21: 110-111.
2. Atkinson, K. M., 1972. Birds as transporters of algae. *Br. phycol. J.* 7: 319-321.
3. Luther, H., 1963. Botanical analysis of mute swan faeces. *Acta Vertebrat.* 2: 266-267.
4. Maguire, B., 1963. The passive dispersal of small aquatic organisms and their colonization of isolated bodies of water. *Ecol. Monogr.* 33: 161-185.
5. Milliger, L. E. & H. E. Schlichting, 1968. The passive dispersal of viable algae and protozoa by an aquatic beetle. *Trans. am. microsc. Soc.* 87: 443-448.
6. Proctor, V. W., 1959. Dispersal of freshwater algae by migratory waterbirds. *Science* 130: 623-624.
7. Schlichting, H. E., 1960. The role of waterfowl in the dispersal of algae. *Trans. am. Micr. Soc.* 79: 160-166.
8. Velasques, G. T., 1940. On the viability of algae obtained from the digestive tract of the Gizzard Shad, *Dorosoma cepedianum*. *Am. Midl. Nat.* 22: 376-412.

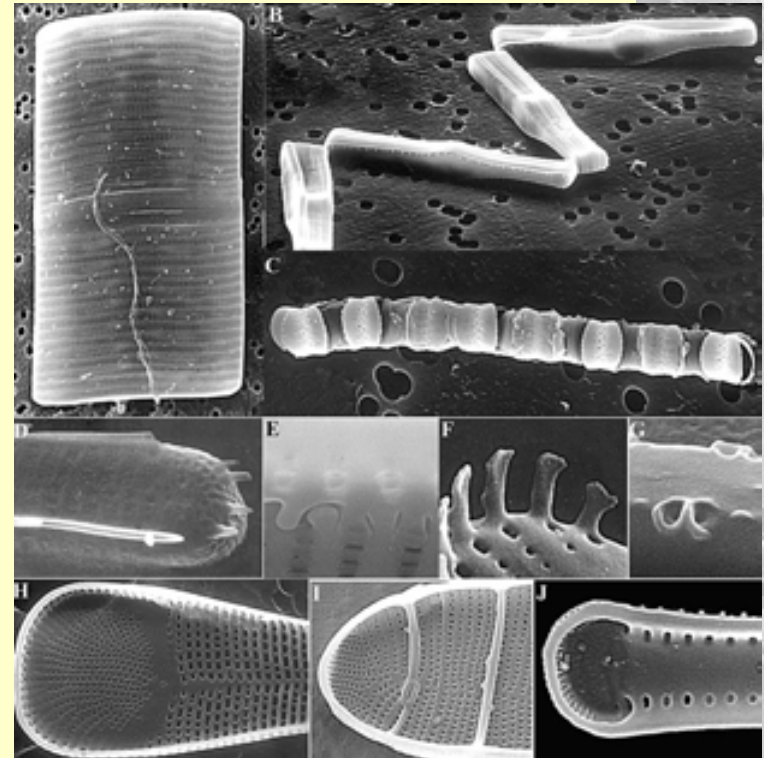
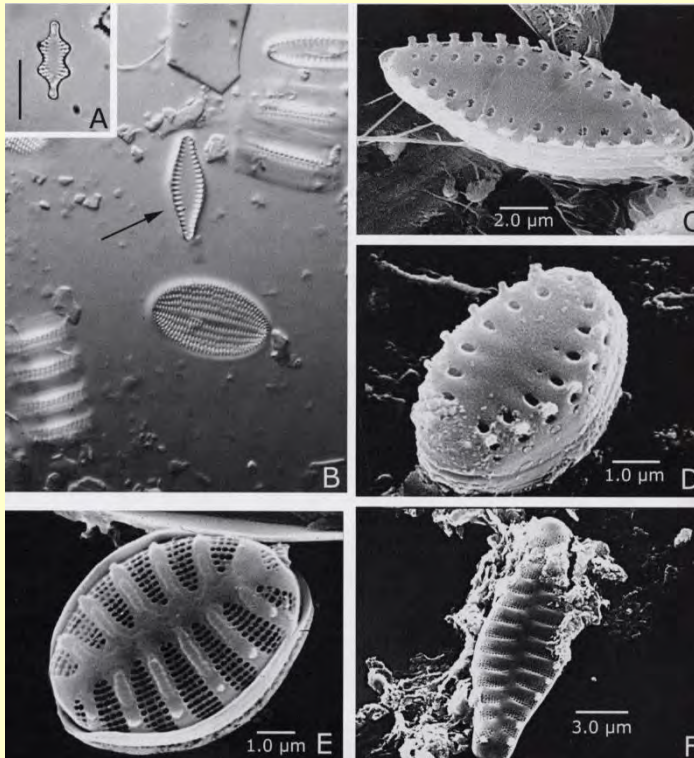
2. Diatoms



Diana Lipscomb, in Williams, D.M. & Knapp, S. 2010. *Beyond Cladistics*, University of California Press.

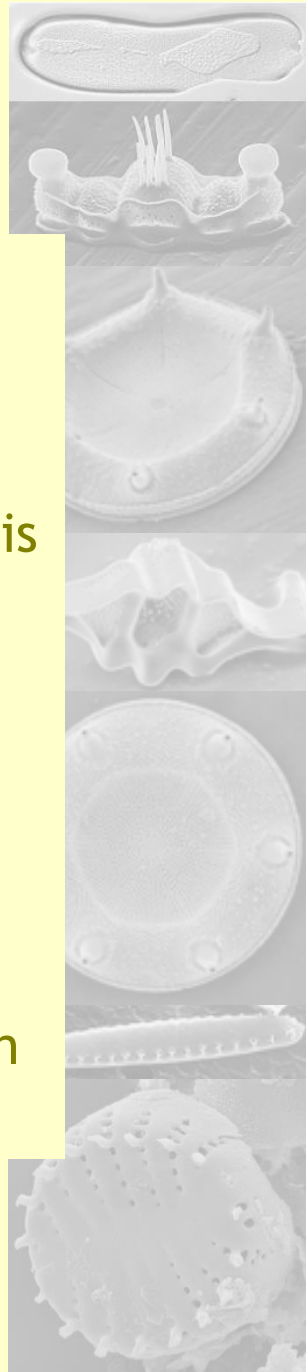
DIATOMS: SOME NUMBERS

	<i>Genera</i>	<i>Number of species</i>
Extant	450?	10,000–15,000 [250,000]
Extinct	150?	5,000??? [??]



3. Floras

1. The word “flora” refers to the plants occurring within a given region as well as to the publication of scientific descriptions of those plants.
2. In order to distinguish between the two, the word is often capitalized when a publication is meant.
3. A Flora may contain anything from a simple list of the plants occurring in an area to a very detailed account of those plants.
4. Floras are different from popular manuals in that they attempt to cover all of the plants, rather than only the most common or conspicuous ones.



Iconographia Diatomologica

Annotated Diatom Micrographs

Edited by Horst Lange-Bertalot

Volume 21

Diatoms of North America



*The Pliocene-Pleistocene freshwater flora of Bylot Is.
Nunavut, Canadian High Arctic*

by

Claudia Zimmermann, Michel Poulin & Reinhard P.

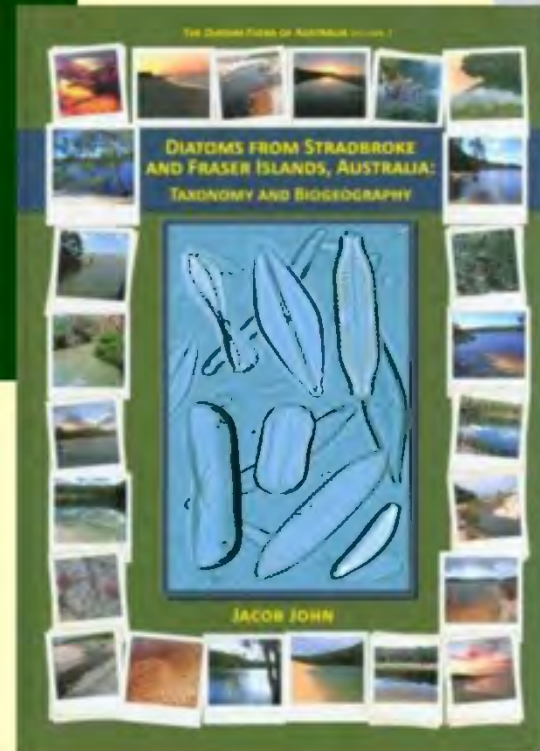
G

A.R.G. Gantner Verlag K.G.

Freshwater Benthic Diatoms of Central Europe



Koeltz Botanical Books



**DIATOMS FROM STRADBROKE
AND FRASER ISLANDS, AUSTRALIA:
TAXONOMY AND BIOGEOGRAPHY**

JACOB JOHN



Diatom identification guide & ecological resource

for water resource managers ecologists taxonomists analysts systematists students, and the public

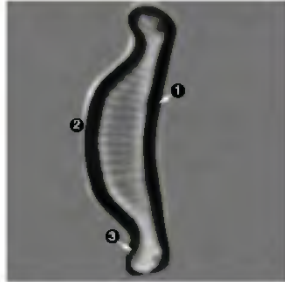
We aim to provide everyone with accurate information about diatoms of the United States

Expert contributors are submitting text and images for freshwater genera and North American species including taxonomic and ecological information

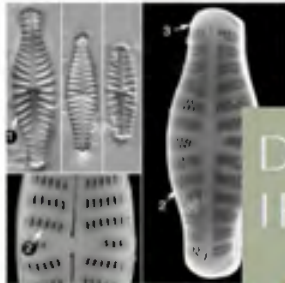
Diatom "visual guides" are included for all taxa. The guides illustrate key traits that distinguish a taxon (examples to the right). For many species, environmental response plots and geographic distribution maps are also included.

Our editorial review board is prioritizing taxa for treatment in species pages and ensuring the scientific merit of each submission.

See any issues with content or functionality? If so, please let us know.



Eunotia exigua



Hippodonta

Getting Started

- [ABOUT THIS WEBSITE](#)
- [WHAT ARE DIATOMS?](#)
- [IDENTIFY YOUR TAXA](#)

Special News

- 26 June, 2015
[Editorial Review Guidelines](#)
- 28 March, 2011
[Information for contributors](#)

News

- 01 February, 2017
[The Gomphonema Round Up Taxon Workshop](#)
- 20 January, 2017
[Citizen Scientists Lend a Hand](#)

DIATOM FLORA OF BRITAIN AND IRELAND



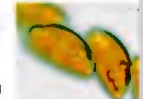
Home

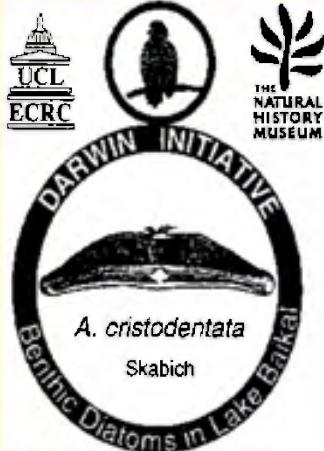
Introduction

Contributors & Acknowledgements

Introduction

Freshwater Diatom Flora of Britain and Ireland is a major project aiming to compile a web-based diatom flora and comprehensive taxonomic review of diatoms from freshwater, brackish and subaerial habitats in



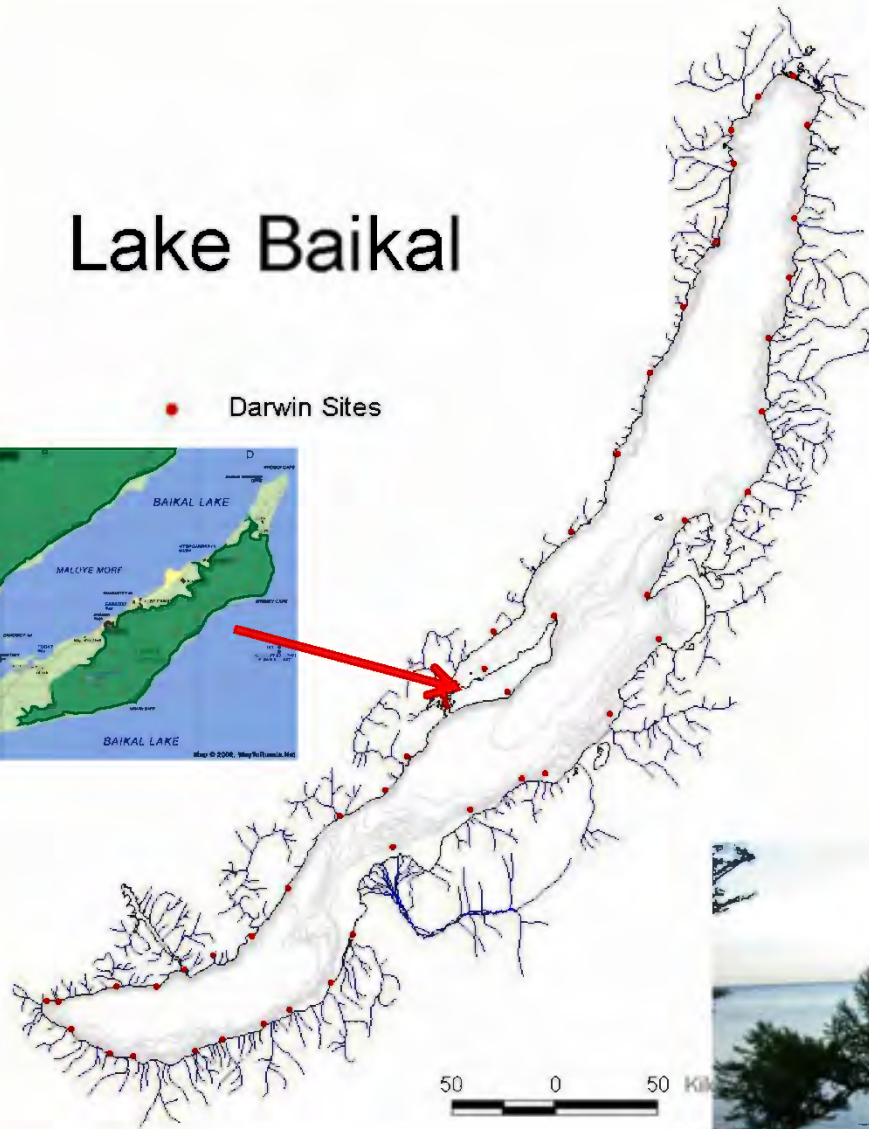


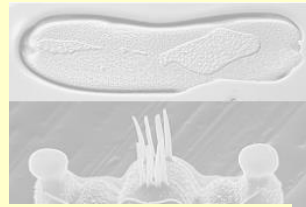
Дарвиновский проект
Лондон - Иркутск

Lake Baikal



● Darwin Sites



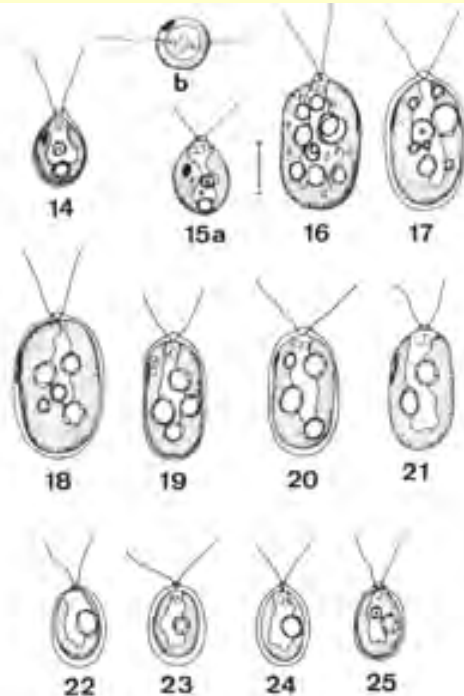
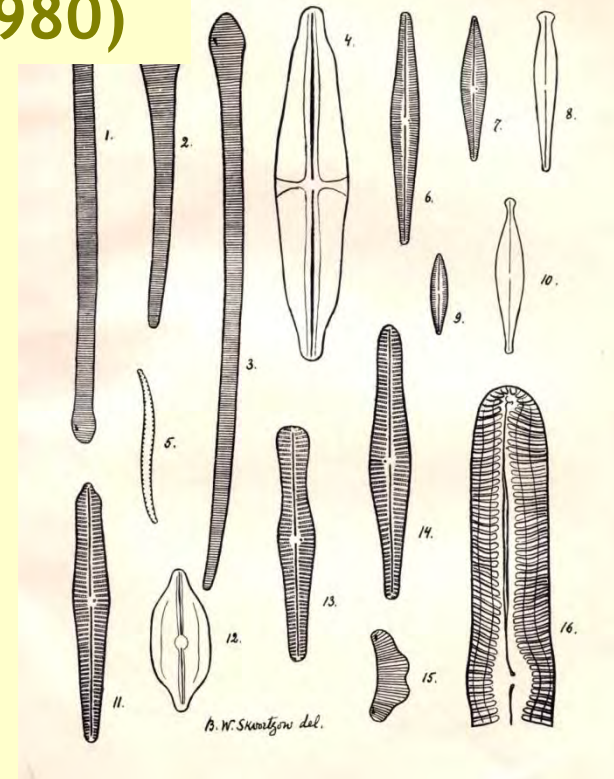


- Lake Baikal is in southern Siberia in Russia
- It is the deepest lake in the world (1,637m - 5,370ft)
- It is the largest freshwater lake in the world by volume
- It was formed in an ancient rift valley, so it is long and crescent-shaped with a surface area (12,160 sq miles)
- There are around 1,700 species of plants and animals; two thirds are endemic
- It is the oldest lake in the world (c. 25 million years old)

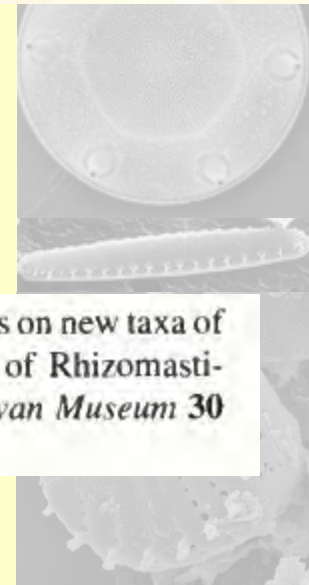


Boris Skvortzov (1896–1980)

1. Skvortzov, B.V. 1916. Les algues de la Mandjourie et recherches sur la végétation aquatique dans la vallée de Soungari. *Zhurnal Mikrobiologii* 3 (3–4): 443.



428. — 1977. The flagellates of clear and polluted waters on new taxa of genus *Cercobodo* Krasskil., A colourless flagellata of Rhizomastigaceae, Pantostomatineae. *Quarterly Journal of Taiwan Museum* 30 (1–2): 89–121 [June 1977].



ALGAL TAXONOMY: A ROAD TO NOWHERE?¹

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School of Botany, University of Melbourne, Melbourne, Victoria 3010 Australia

TABLE 1. A preliminary list, extracted from AlgaeBase, of algal taxonomists that have described more than 1,000 species.

Author	Nationality	Main group	No. species
Friedrich Traugott Kützing (1807–1893)	German	All	2,636
Christian Gottfried Ehrenberg (1795–1876)	German	Microalgae	2,055
Albert Grunow [Grunov] (1826–1914)	German	All	1,251
Friedrich Hustedt (1886–1968)	German	Diatoms	1,219
Horst Lange-Bertalot (1936–present)	German	Diatoms	1,145
Jacob Georg Agardh (1813–1901)	Swedish	Seaweeds	1,144
Boris Vassilievich Skvortsov [Скворцов] (1890–1980)	Russian	Microalgae	1,073
William Henry Harvey (1811–1866)	Irish	Seaweeds	1,061



- 3771. *Trachelomonas zorensis* var. *hispidula* B.V. Skvortzov image
- 3772. *Tropidoneis maxima* var. *sinensis* Skvortzov image
- 3773. *Tryblionella tryblionella* f. *hankensis* Skvortzov image
- 3774. *Tsumuraia numerosa* Skvortzov & Noda image
- 3775. *Tsumuraia numerosa* Skvortzov invalid image
- 3776. *Tsumuraia palmata* (Skvortzov) Skvortzov image
- 3777. *Tsumuraia palmata* (Skvortzov) Skvortzov invalid image
- 3778. *Tsumuraia punctatastriata* ('*punctata-striata*') Skvortzov & Noda image
- 3779. *Tsumuraia punctatostriata* ('*punctato-striata*') Skvortzov image
- 3780. *Ulothrix chengiana* Skvortzov image
- 3781. *Xanthidium manschuricum* B.V. Skvortzov image
- 3782. *Zygnema altaica* Skvortzov image
- 3783. *Zygnema altaica* Skvortzov & Noda image
- 3784. *Zygnema emersum* ('*emersa*') Skvortzov image
- 3785. *Zygnema emersum* ('*emersa*') Skvortzov & Noda image
- 3786. *Zygnema mucosa* Skvortzov image
- 3787. *Zygnema mucosa* Skvortzov & Noda image
- 3788. *Zygnema pulcherrimum* ('*pulcherrima*') Skvortzov image

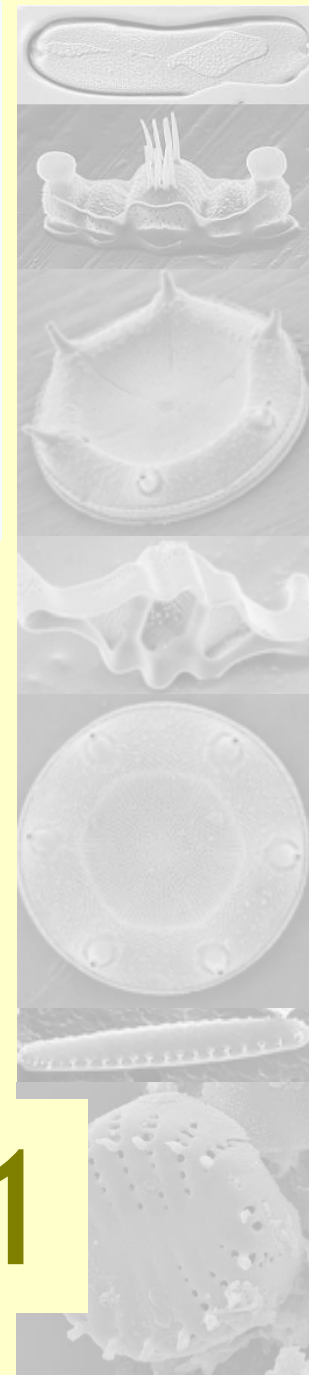
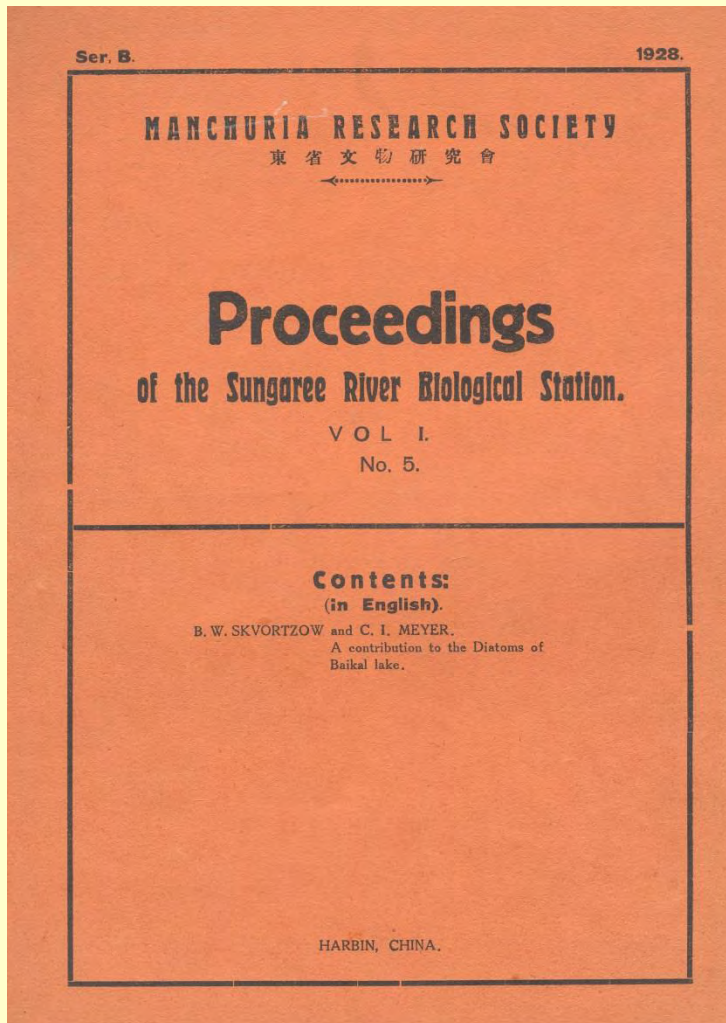


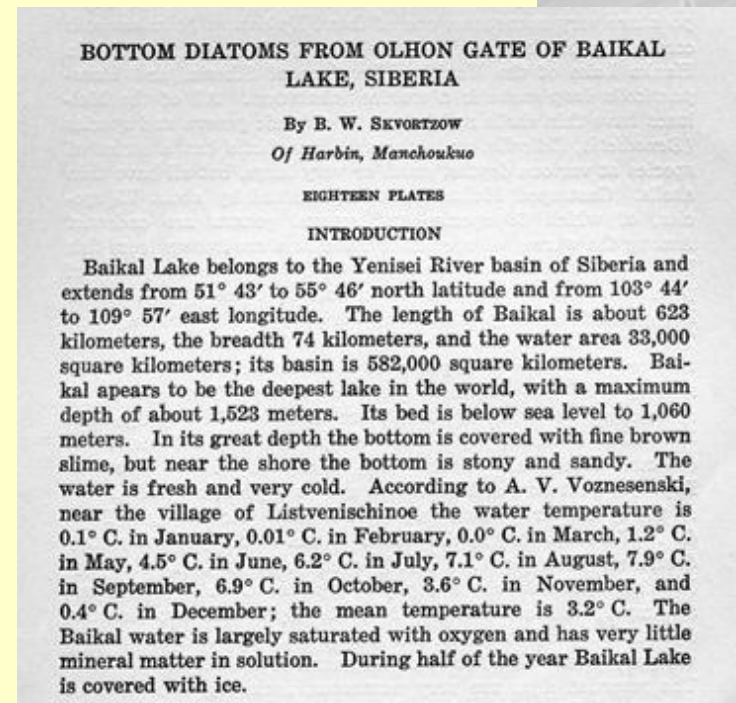
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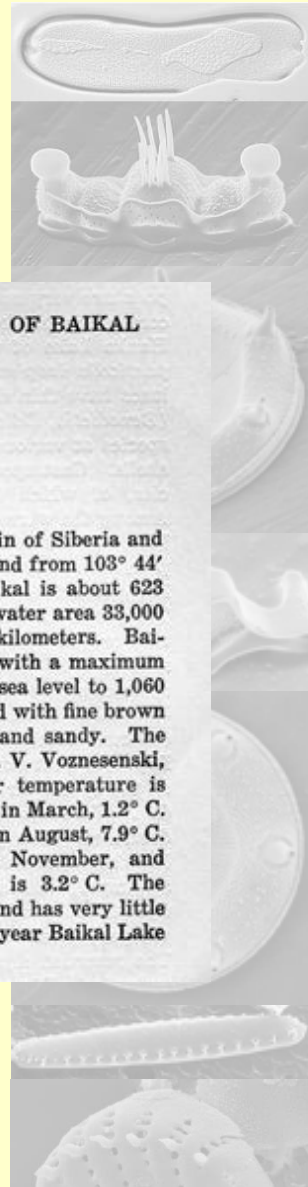
3791



1928: Total = 304
new species = 194



1937: Total = c. 500
New species = 148



Eunotia Ehrenb. 1837: 44

Number of Species: 2300+

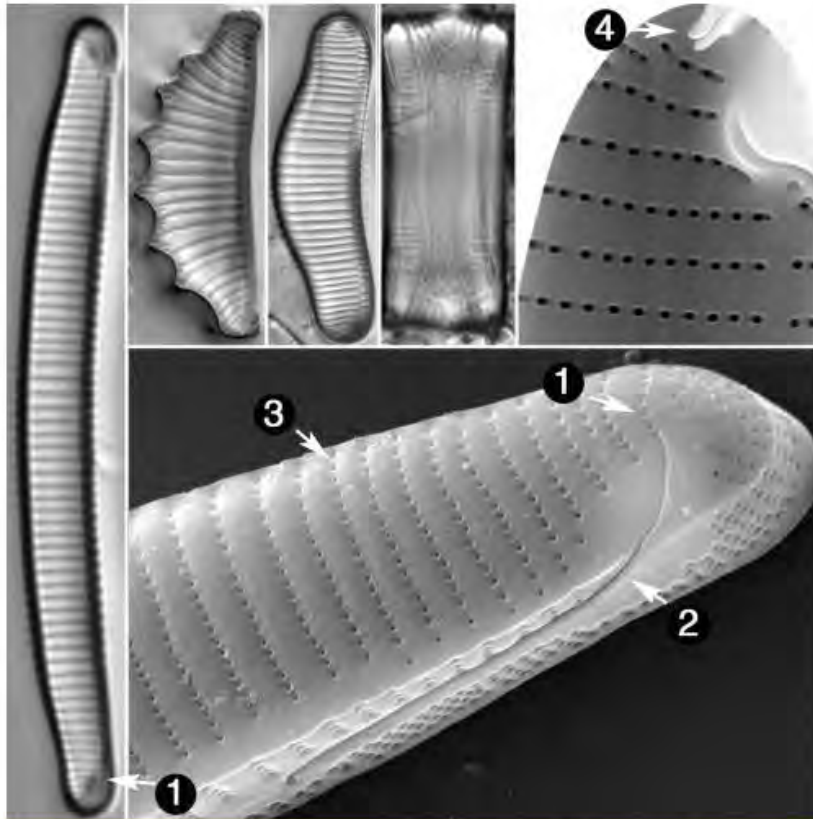
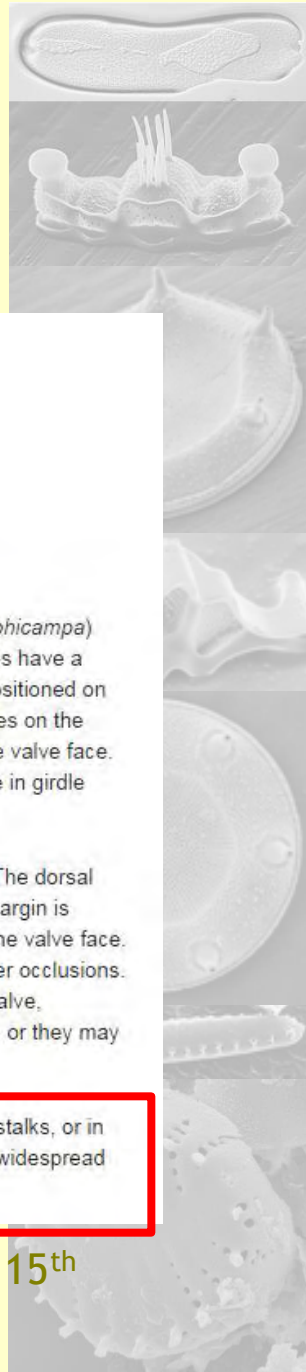


Image Credit: Paula Furey

CLASS: *Bacillariophyceae*
ORDER: *Eunotiales*
FAMILY: *Eunotiaceae*

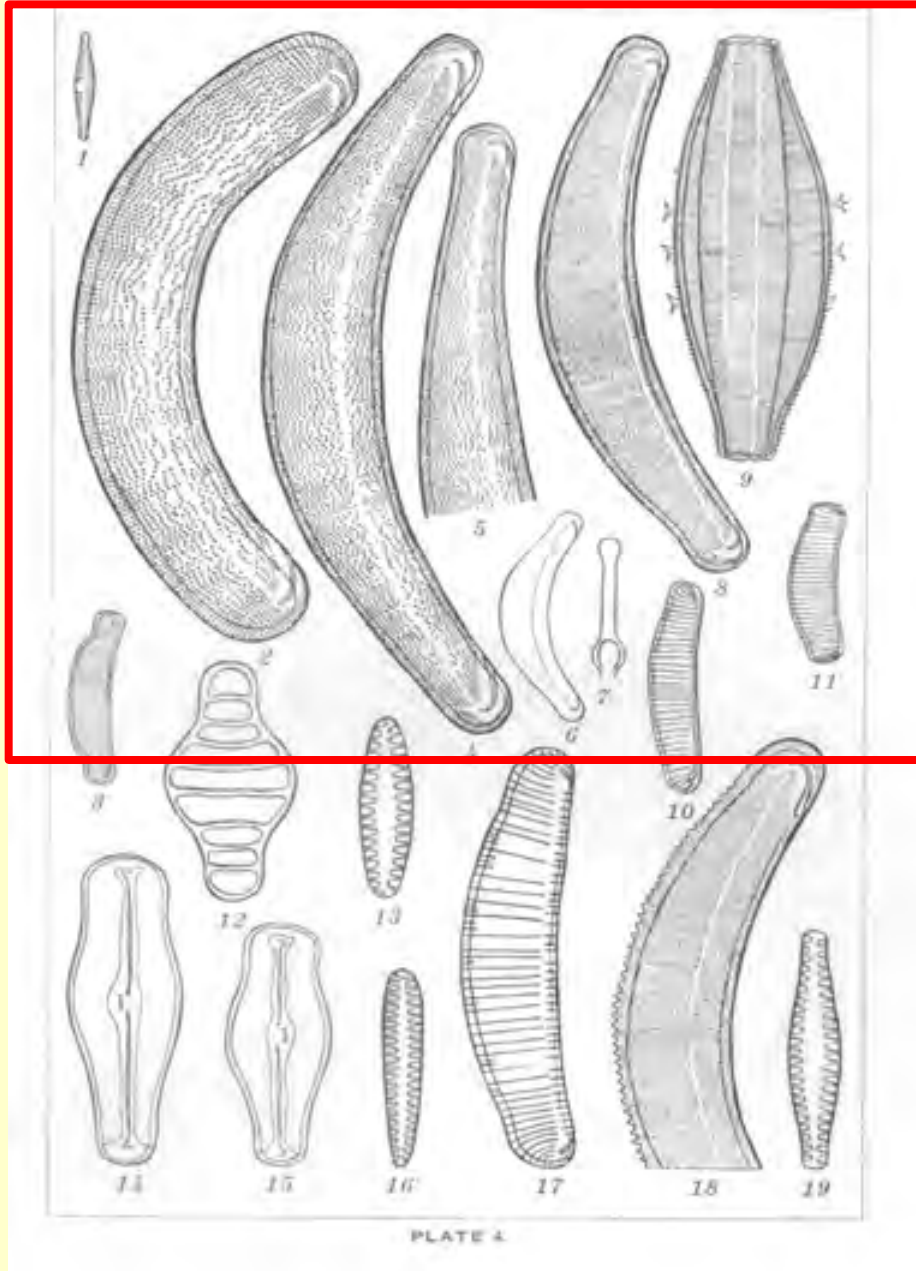
1. Valves with a short raphe
2. Raphe extends from valve mantle onto valve face
3. Striae uniseriate
4. One rimoportula usually present at valve apex

Members of the Eunotiaceae (*Eunotia*, *Actinella*, *Amphicampa*) are unusual among the raphid diatoms in that frustules have a very short raphe system. The terminal nodules are positioned on the mantle. From the terminal nodule, the raphe slit lies on the valve mantle then slightly, or strongly, curves onto the valve face. As a result of this morphology, raphe branches visible in girdle view.

Valves of *Eunotia* are asymmetric to the apical axis. The dorsal margin is convex, smooth, or undulate. The ventral margin is straight or concave. Uniseriate striae extend across the valve face. Areolae of the striae generally lack hymenes and other occlusions. Usually one rimoportula present at an apex of each valve, although occasionally there may be two rimoportulae, or they may be absent.

Cells occur singly, free, or attached by mucilaginous stalks, or in long ribbon-like colonies. Species within *Eunotia* are widespread and diverse in acidic and dystrophic habitats.

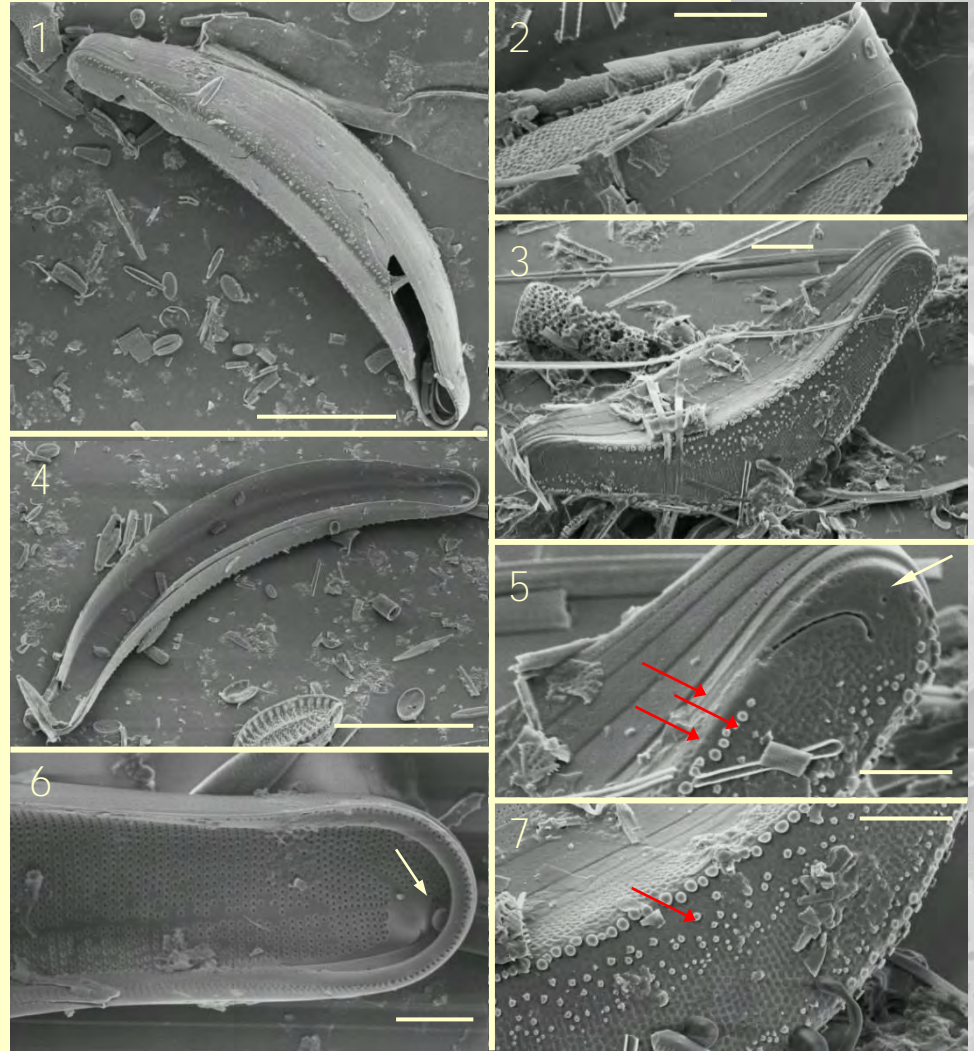
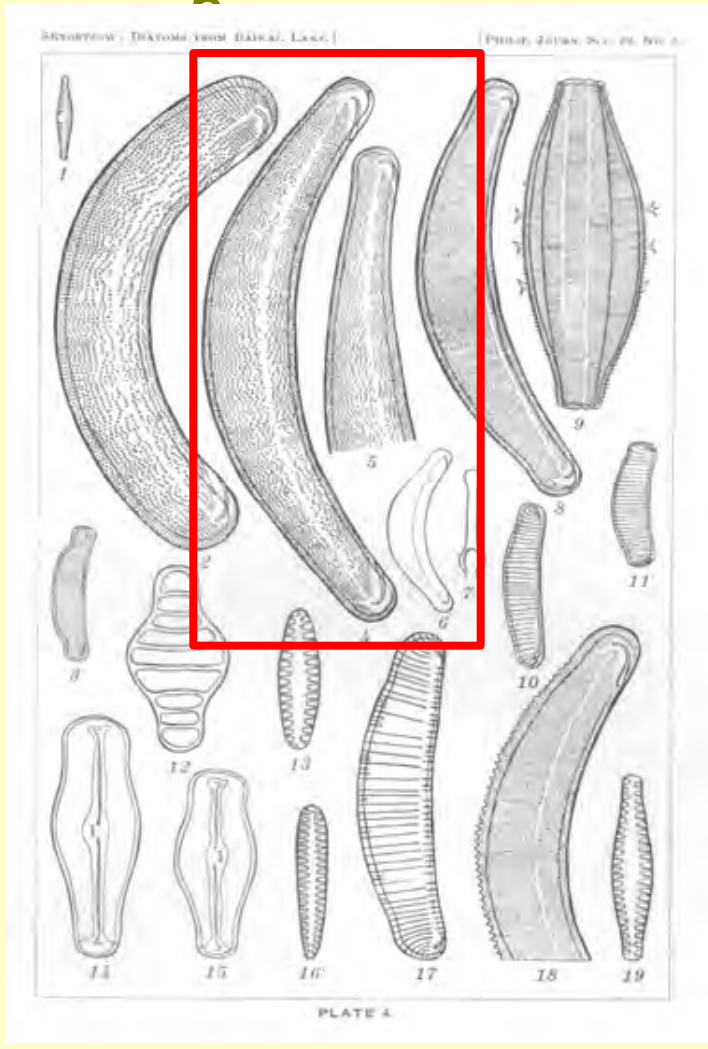
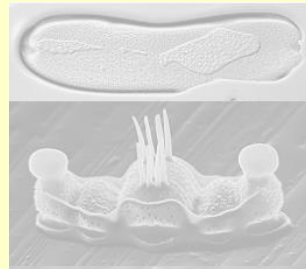
Furey, P. (2010). *Eunotia*. In *Diatoms of the United States*. Retrieved March 15th 2016, from <http://westerndiatoms.colorado.edu/taxa/genus/eunotia>



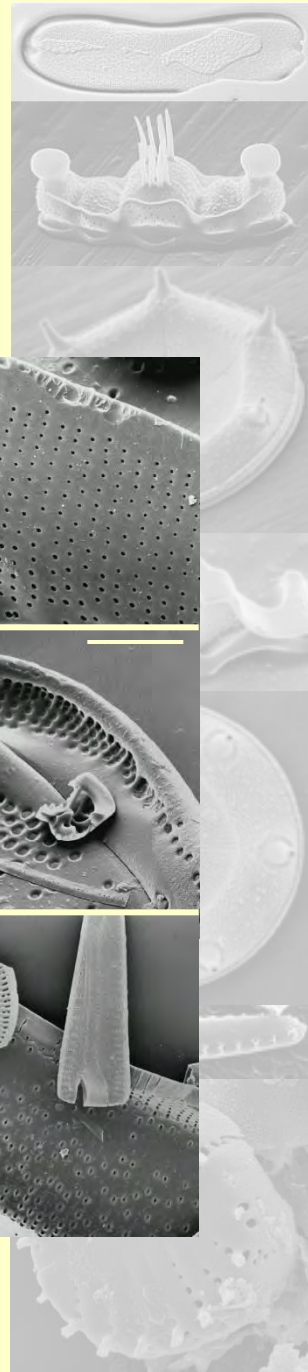
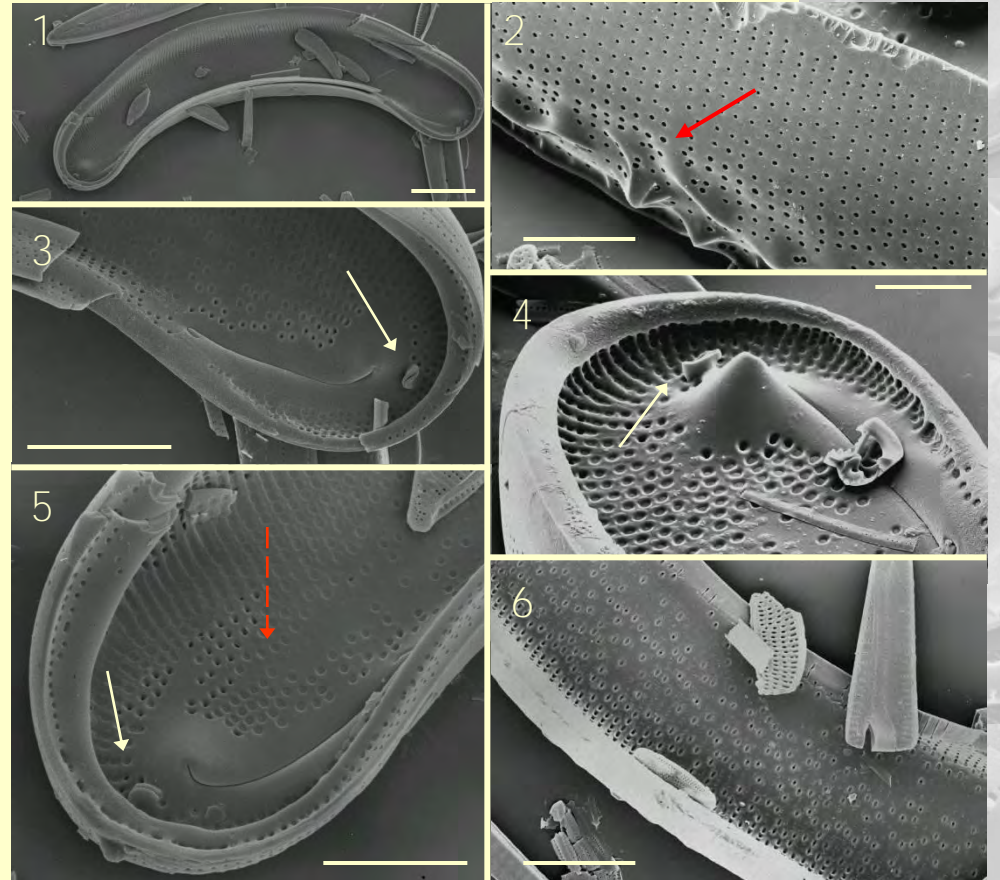
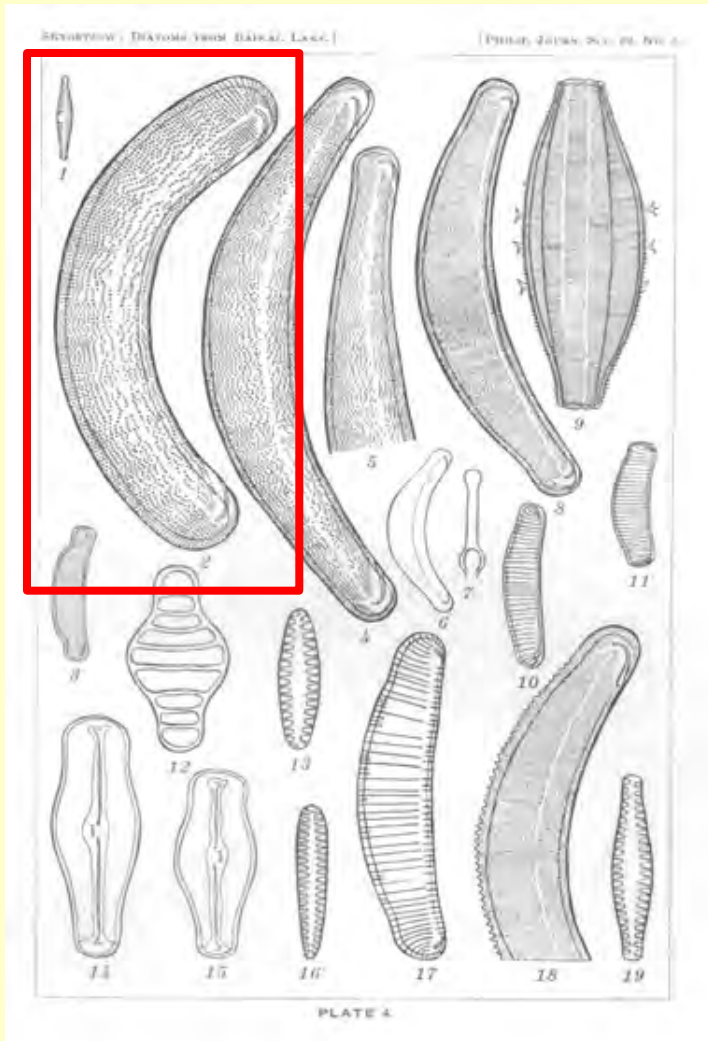
Eunotia clevei var. *hispida*
 Skvortzov
 1937: 310, pl. 4, figs 9, 18
Eunotia clevei var.
baikalensis Skvortzov 1937:
 310, pl. 4, figs 4-6
Eunotia lacusbaikali
 Skvortzov 1937: 310, pl. 4,
 fig. 2



Amphorotia baicalensis (Skvortzov) Williams
& Reid 2006: 52 = *Eunotia clevei* var.
baicalensis Skvortzov 1937: 310, pl. 4, figs 4-
6



Amphorotia lacusbaikali (Skvortzow)
Williams & Reid 2006: 58 = *Eunotia*
lacusbaikali Skvortzow 1937: 310, pl. 4, fig. 2



Amphorotia: Endemic species (Lake Baikal)
Cold-water species

Amphorotia baicalensis



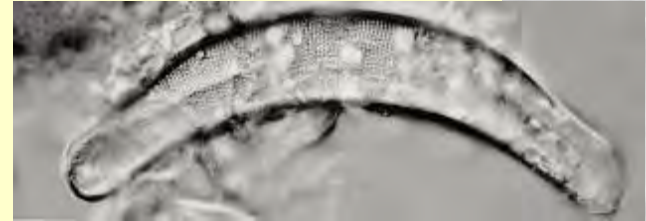
Amphorotia hispida



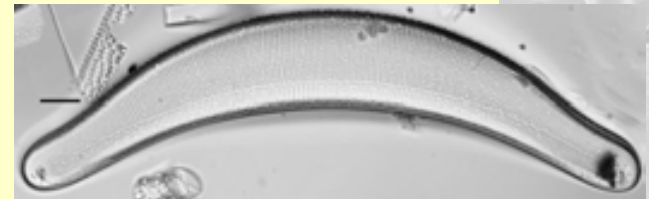
Amphorotia lacusbaikali



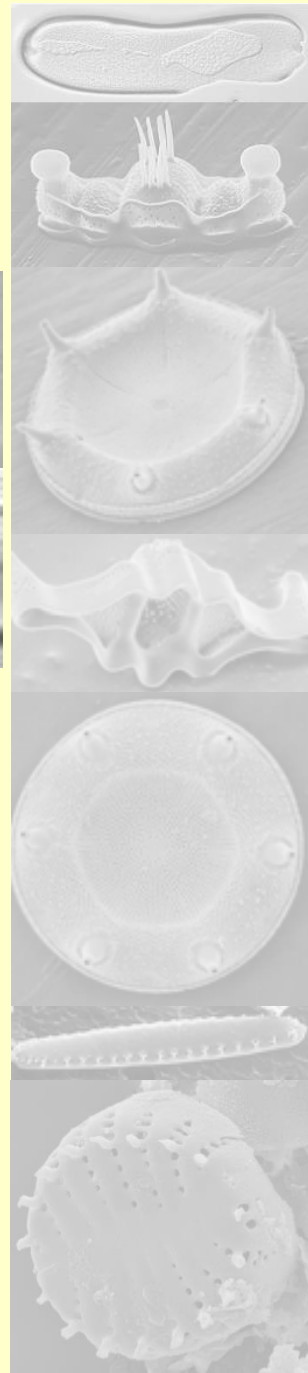
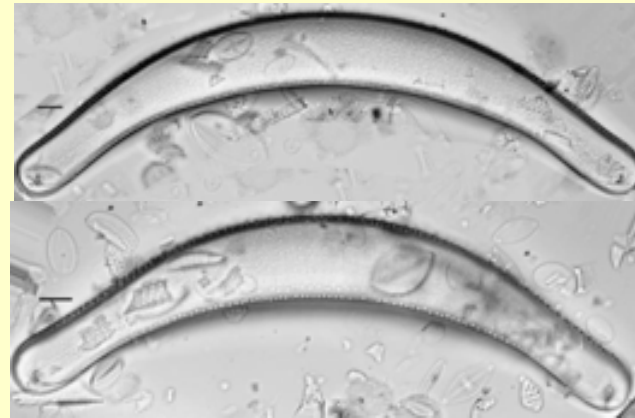
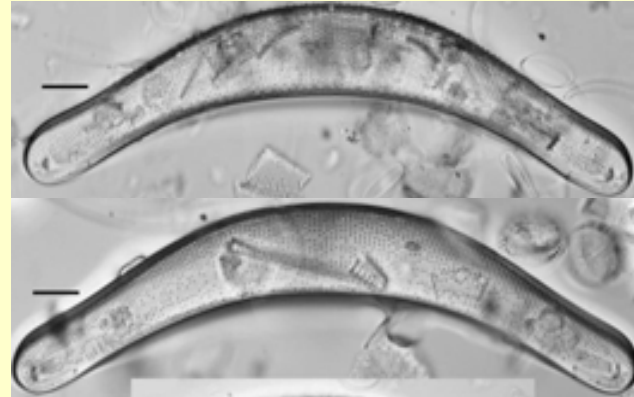
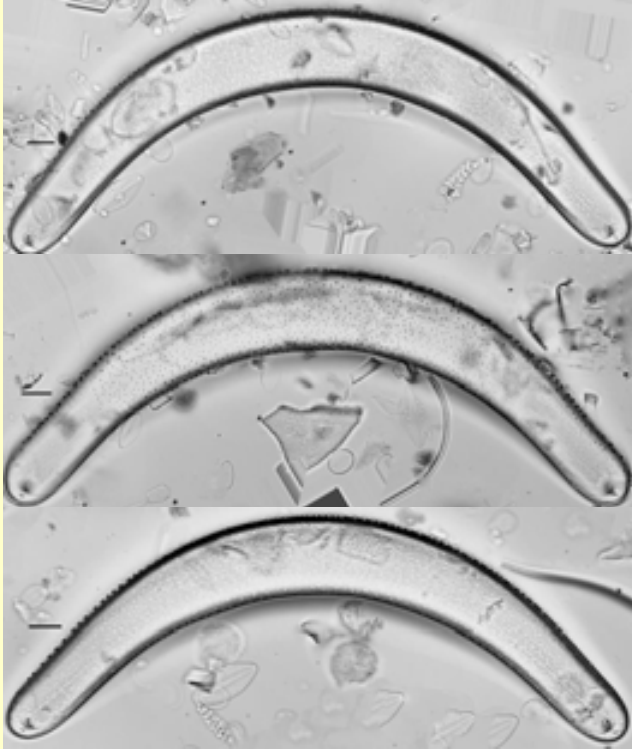
Amphorotia lunata



Amphorotia lineare



Amphorotia: Endemic species (Lake Baikal)
3 + still to be described



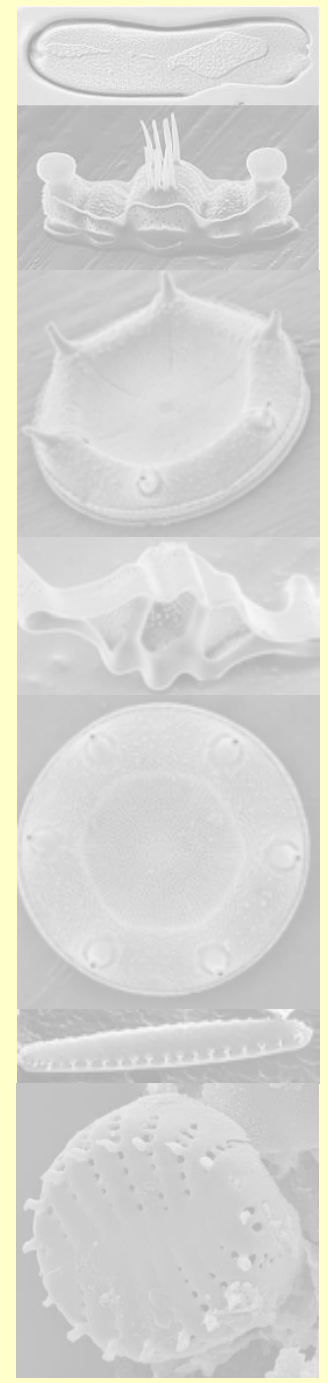
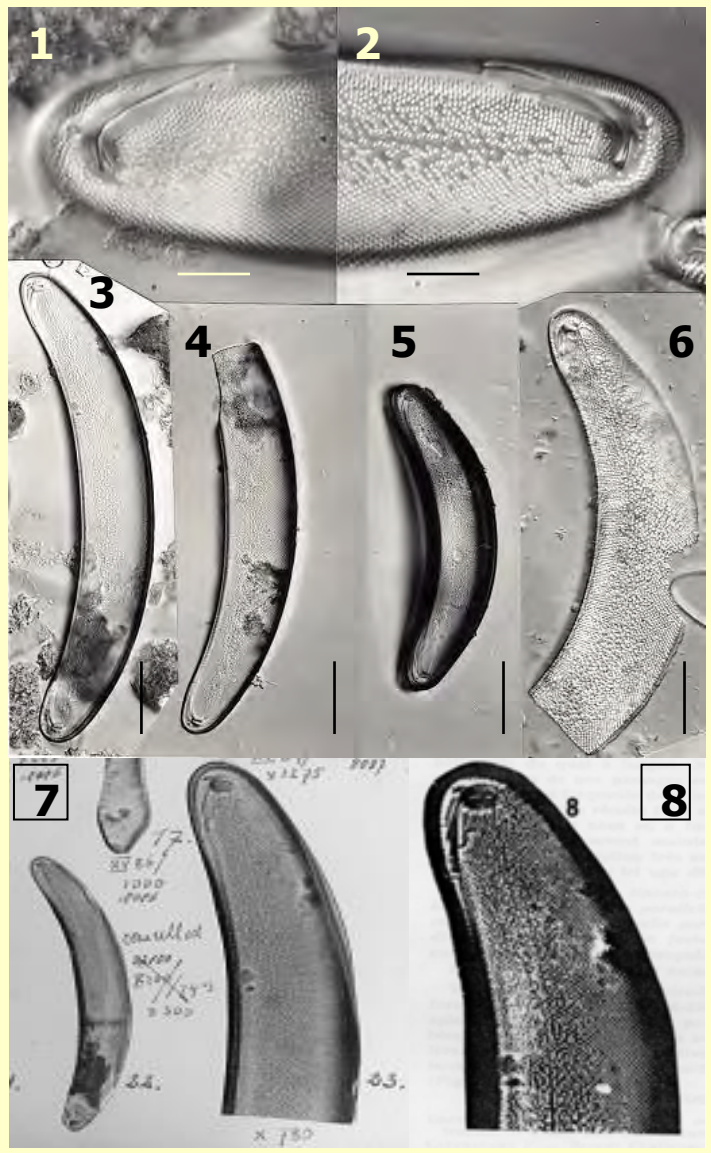


Adapted from *Cheyakounds of the Sea: The Story of the American Copper Ship*
Carl C. Cutler (New York: G.P. Putnam's Sons, 1930)



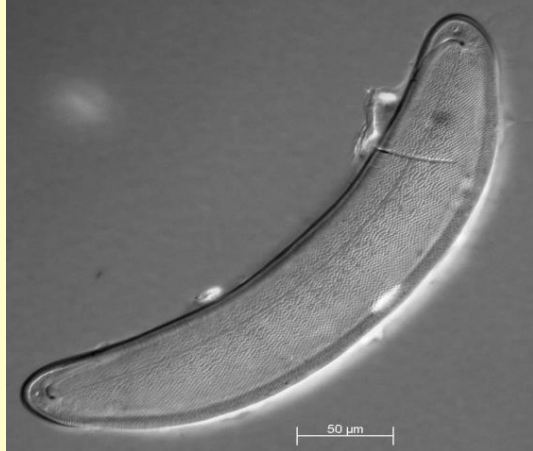
Amphorotia asiatica (M. Voigt) Williams & Reid 2006:
70 = *Eunotia americana* var. *asiatica* Voigt 1969, p.
292; fig. 7, 8

Mekong Delta



Amphorotia:

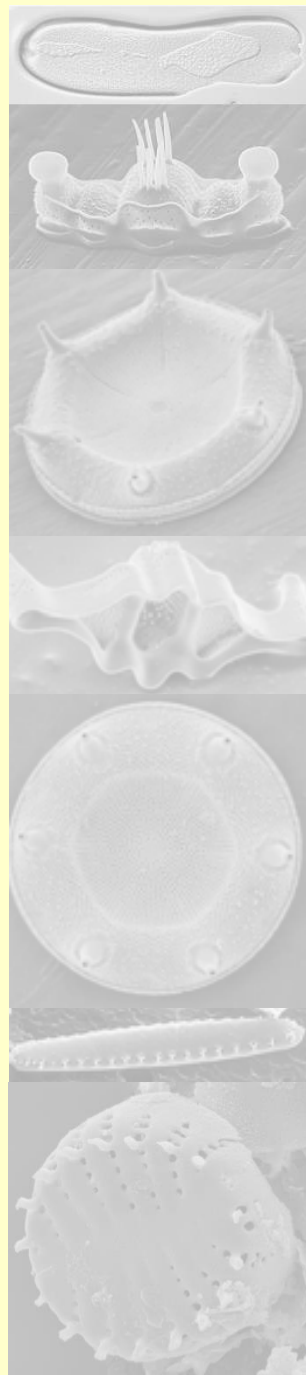
China and South East Asia



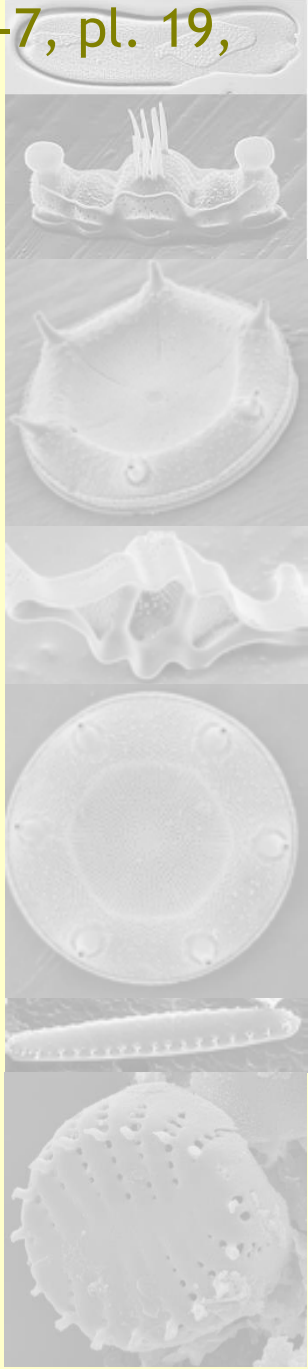
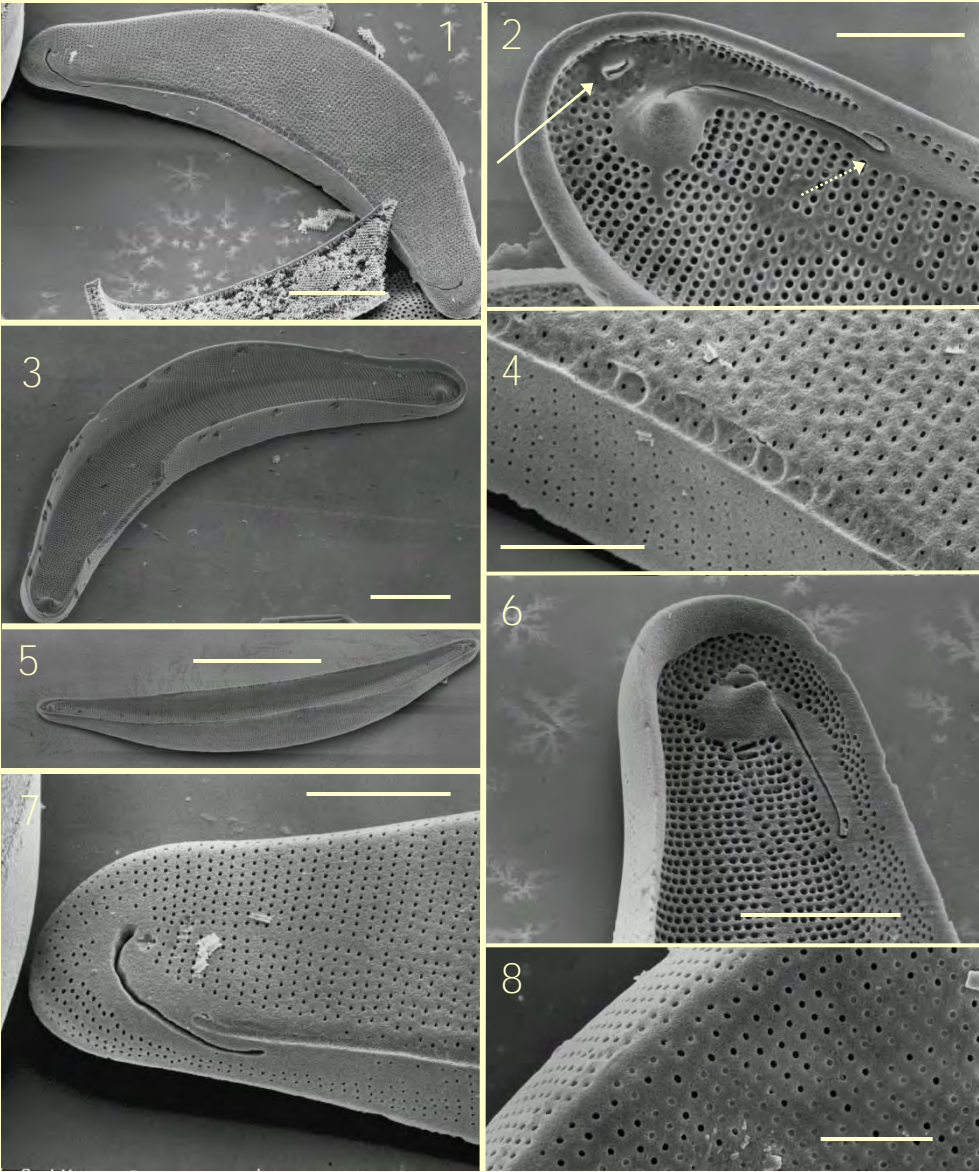
#1 *Amphorotia mekonesis*

#2 *Amphorotia asiatica*

#3 *Amphorotia sinica*

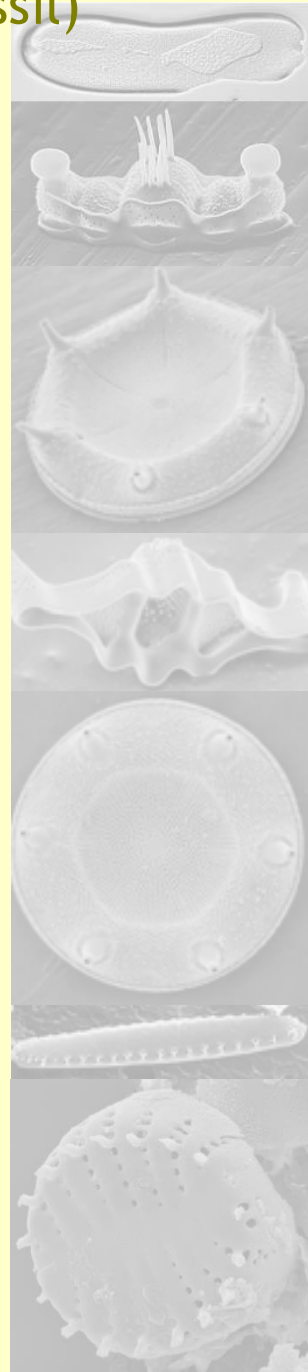
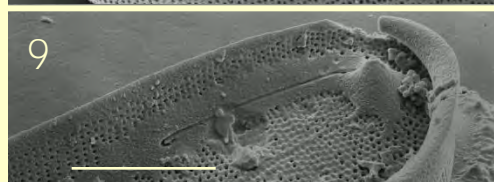
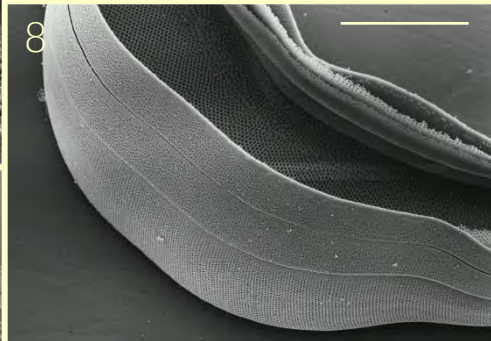
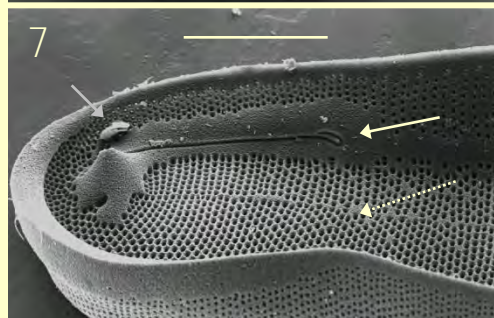
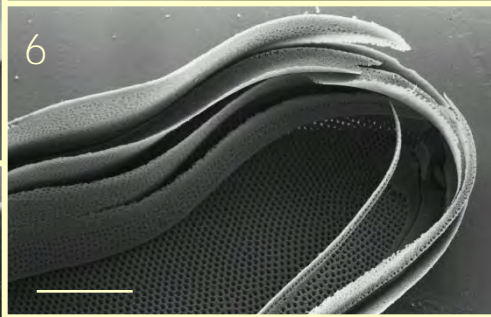
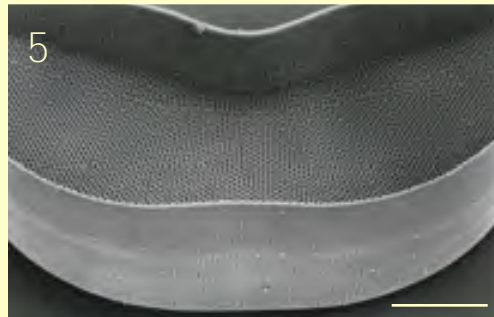
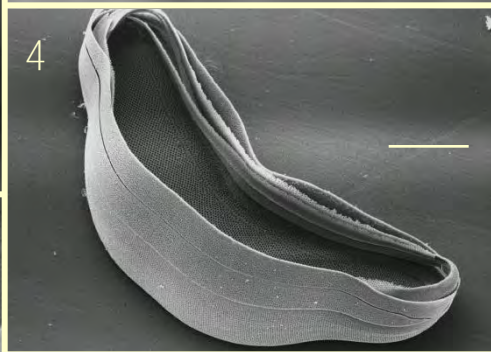
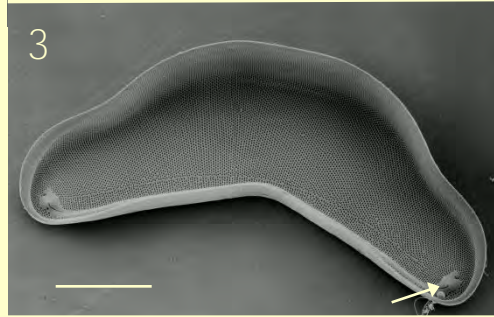
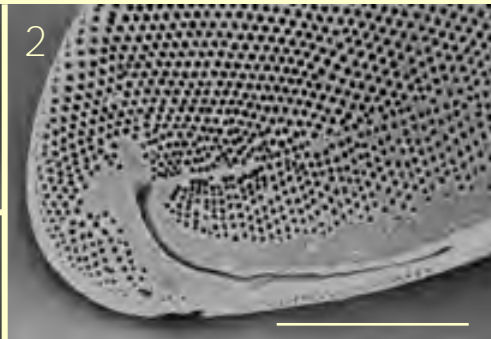
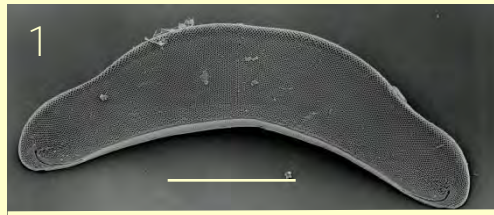


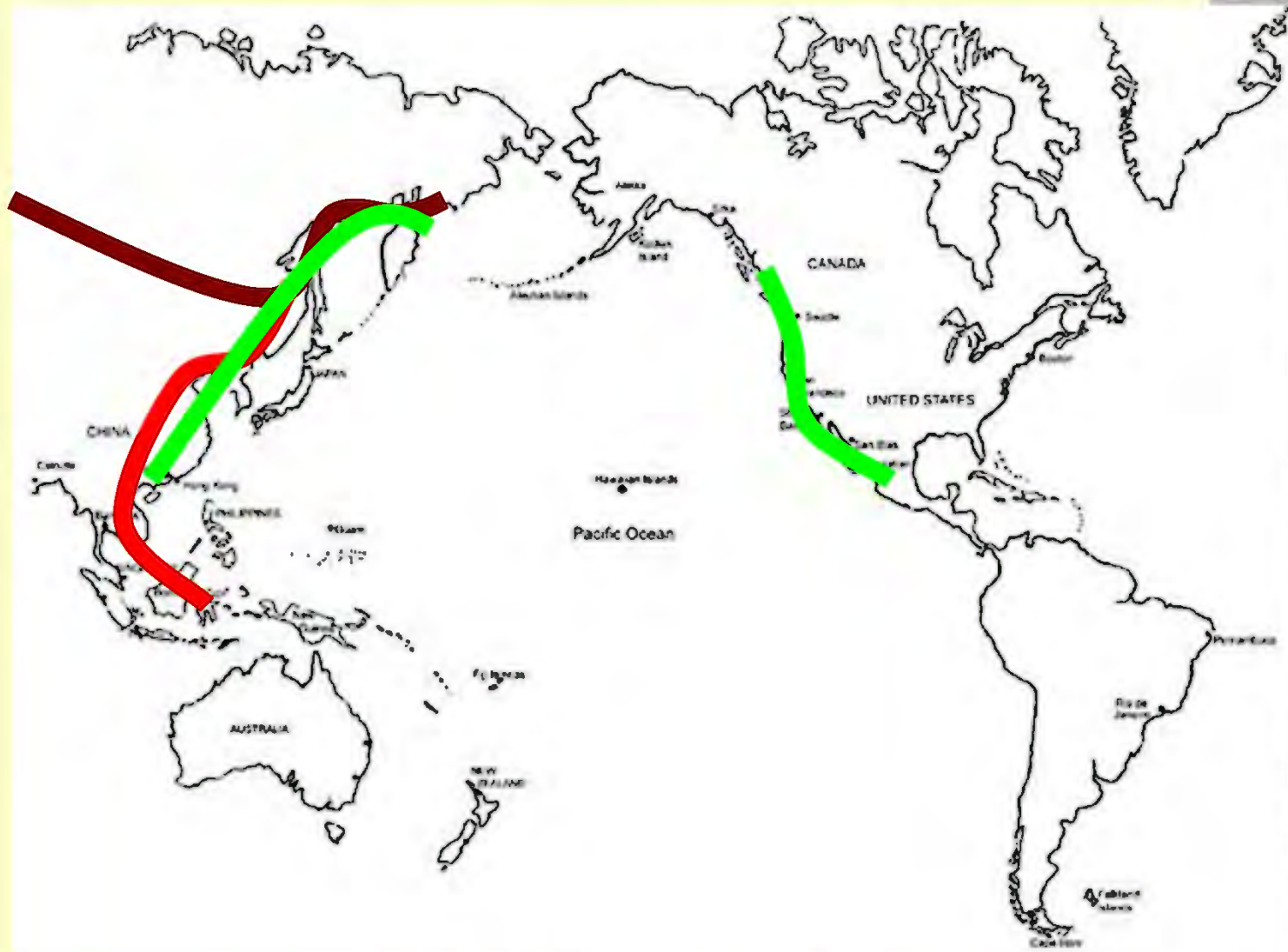
Amphorotia spinusnullosi Williams & Reid 2006: 79, pl. 18, figs 4-7, pl. 19, figs 1-8 Kittitas, Washington, USA (fossil)



Amphorotia: Fossils: USA, China, Japan

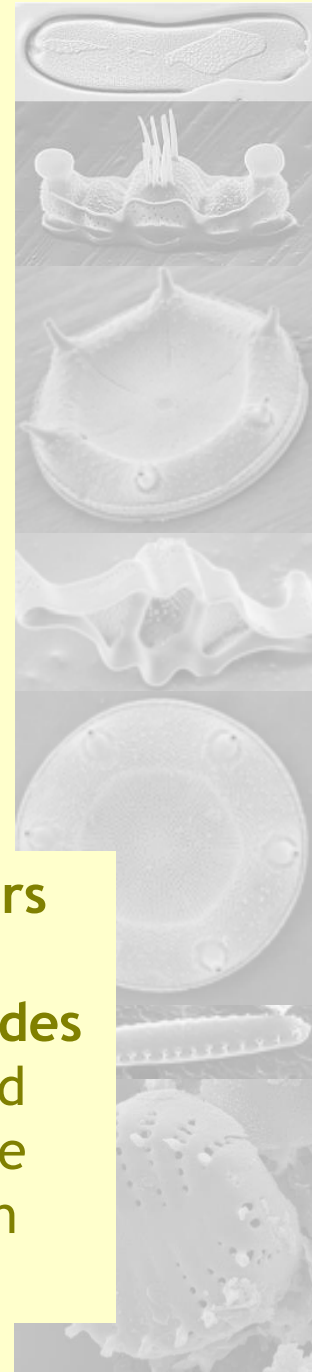
Amphorotia americana Williams & Reid 2006: 85 USA - Japan (fossil)



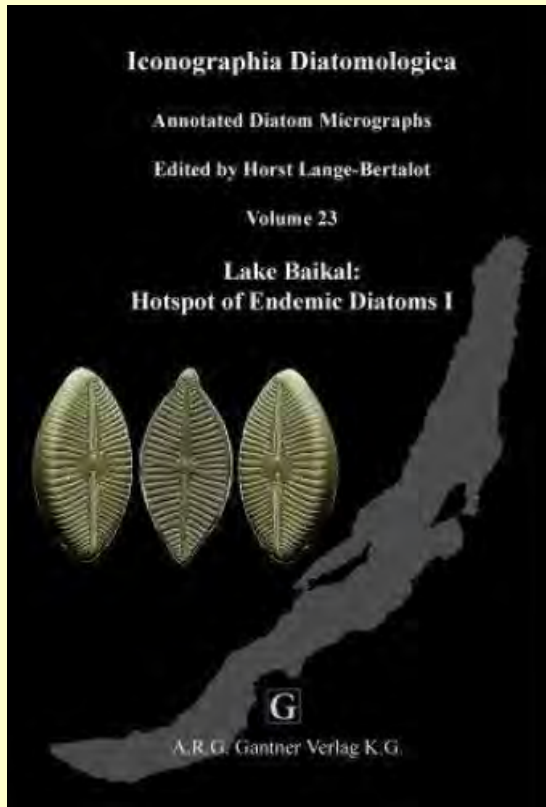


Adapted from *Cape of Storms: The Story of the American Copper Ship*
Carl C. Cutler (New York: G.P. Putnam's Sons, 1930)

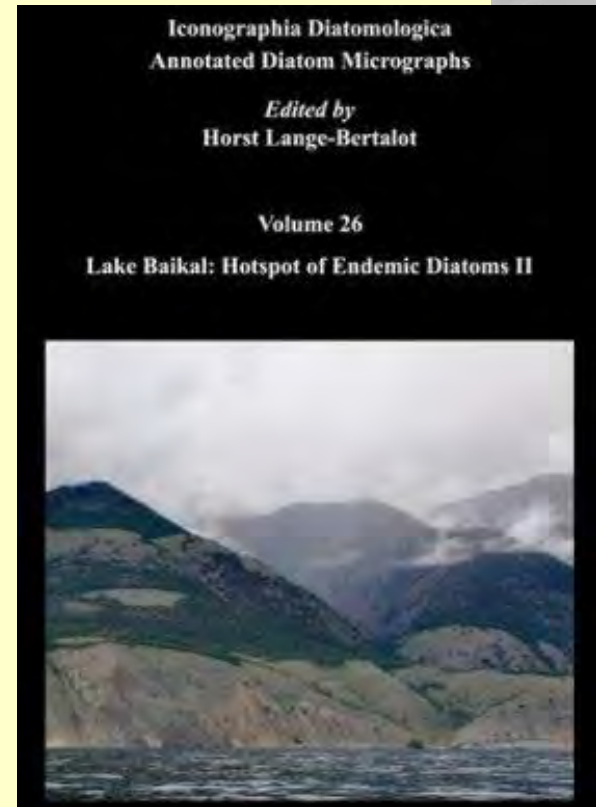




“... a small bottom sample ... from the depth of **33 meters** taken near the Olkhon Gate of Baikal Lake on July 29th 1916. I have examined about a **hundred microscopic slides** from this place and have taken great care to identify and illustrate the forms... **The result was unexpected**; I have identified 304 species, varieties and forms, among which 148 are new” (Skvortzov 1937)

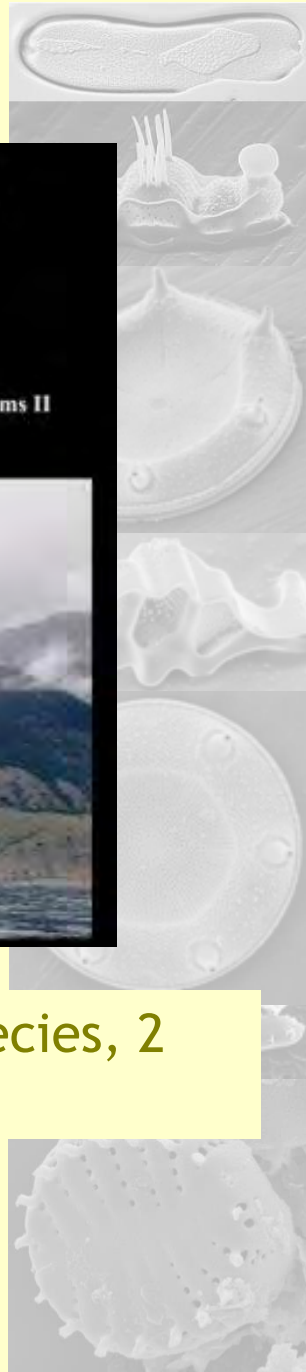


28 samples; 220 new species, 10 new genera...

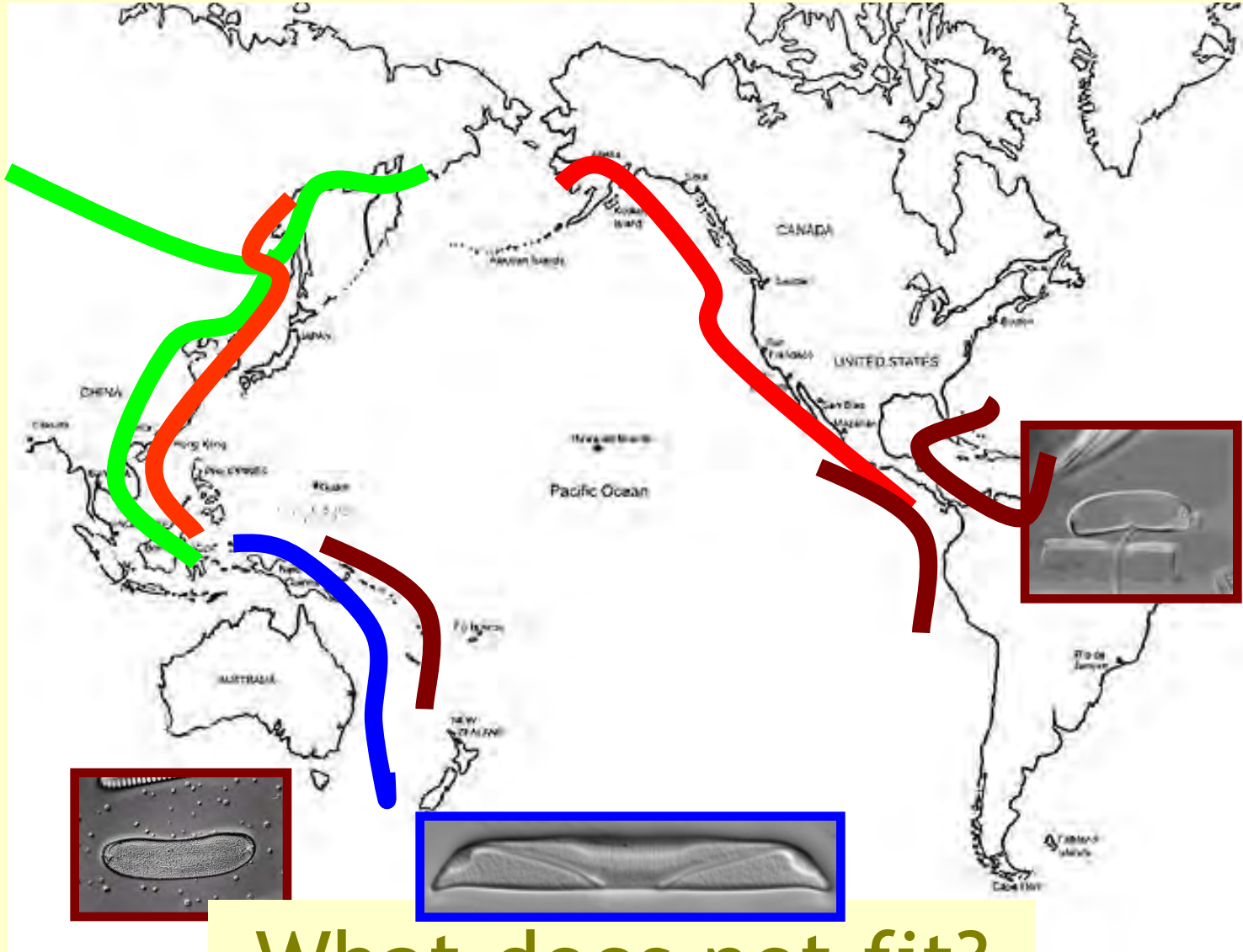


28 samples; 160 new species, 2 new genera...

28 samples; 380 new species, 12 new genera...

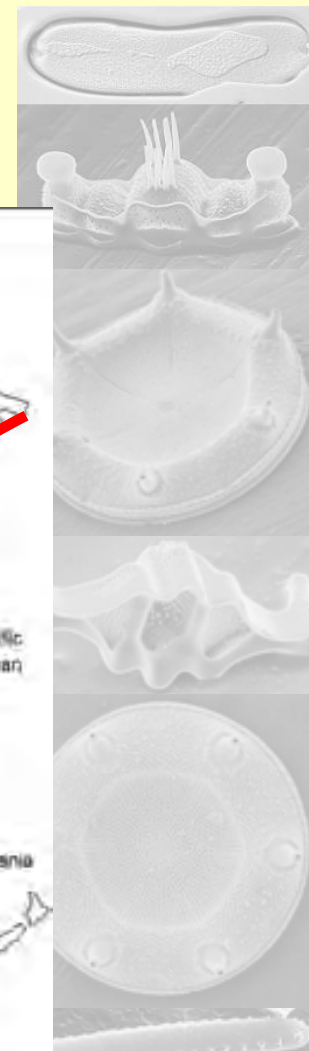
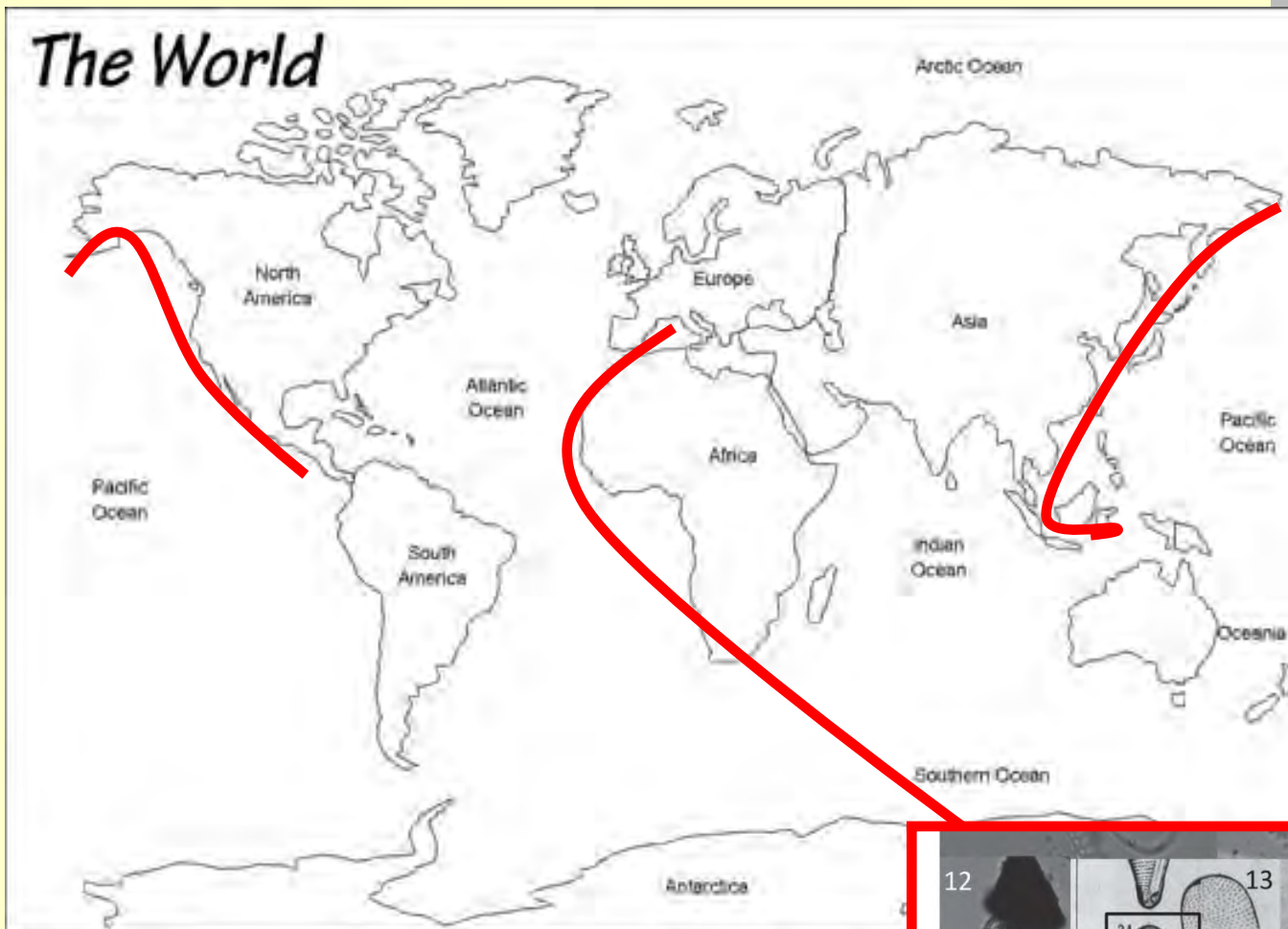


4. Can we tell what is or is not an alien?



What does not fit?

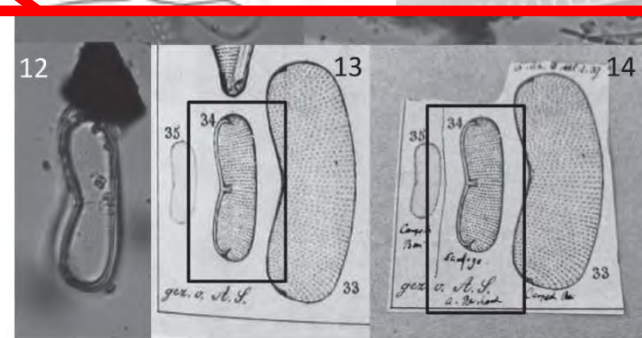
Does this fit?



Examination of type specimens for *Colliculoamphora reichardtiana* (Grunow) Williams and Reid, with a description of a new species, *Colliculoamphora johnwrightii* nov. sp.

DAVID M. WILLIAMS*

Department of Life Sciences, Natural History Museum, Cromwell Road, London SW7 5 BD, UK

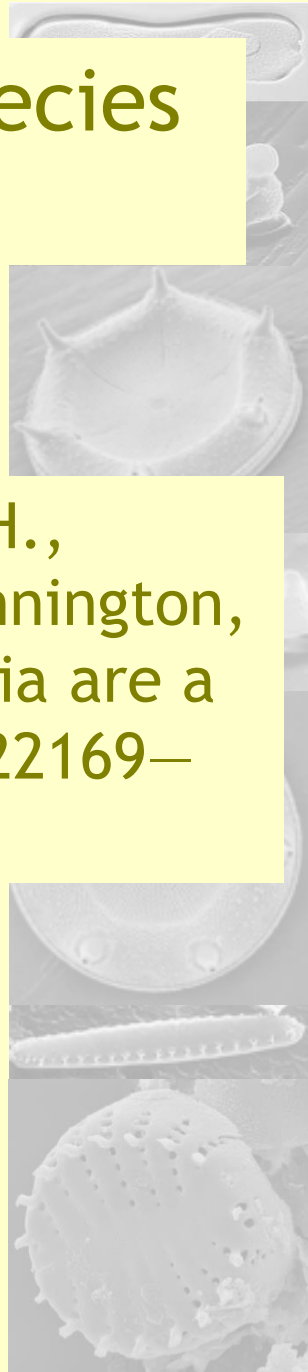


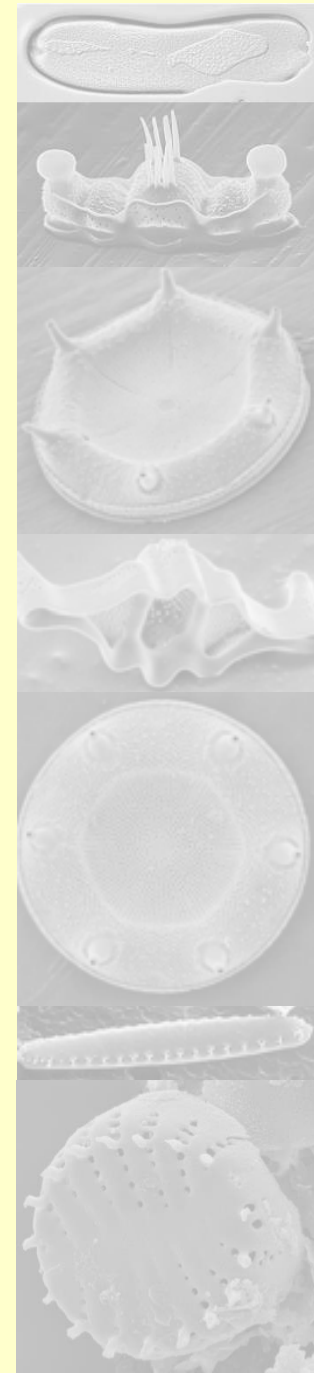
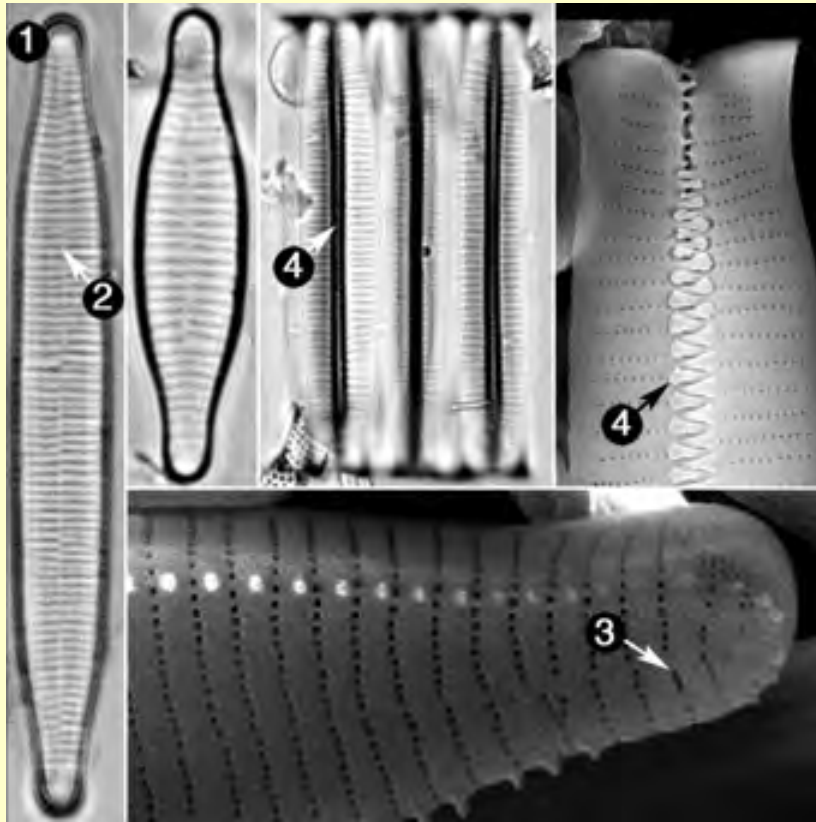
What is the major source of species discovery?



Herbaria are a major frontier for species discovery

Bebber, D.P., Carine, M.A., Wood, J.R.I., Wortley, A.H., Harris, D.J., Prance, G.T., Davidse, G., Paige, J., Pennington, T.D., Robson, N.K.B. and Scotland, R.W 2010. Herbaria are a major frontier for species discovery. *PNAS* 107 (51): 22169–22171.





Morales, E., and Spaulding, S. (2011). *Fragilariforma virescens*. In *Diatoms of the United States*. Retrieved October 21, 2015, from http://westerndiatoms.colorado.edu/taxa/species/fragilariforma_virescens

Californian Academy of Science, Catalogue of Diatom Names: 83

Institute for Biodiversity Science and Sustainability



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SCIENCES

CAS » IBSS (Research) » Invertebrate Zoology & Geology » Search Collection Database

Catalogue of Diatom Names, On-Line Version, Updated 19 Sep 2011

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Filter: Genus=%fragilaria%;Species=virescens%;

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1 of 5 Pages

Sort by: **Taxon** Author Year

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WebNameShort	
<i>Fragilaria virescens</i> DeNotaris ex Cuboni 1887	Details
<i>Fragilaria virescens</i> Ralfs 1843	Details
<i>Fragilaria virescens</i> var. <i>acicularis</i> Skvortzow 1976	Details
<i>Fragilaria virescens</i> var. <i>acuminata</i> Mayer 1917	Details
<i>Fragilaria virescens</i> var. <i>acuta</i> Istvánffi 1897	Details
<i>Fragilaria virescens</i> f. <i>angustata</i> Manguin 1964	Details
<i>Fragilaria virescens</i> var. <i>balatonis</i> Istvánffi 1897	Details
<i>Fragilaria virescens</i> var. <i>beta</i> W. Smith 1856	Details
<i>Fragilaria virescens</i> var. <i>birostrata</i> Mayer 1917	Details
<i>Fragilaria virescens</i> var. <i>birostrata</i> Mayer emend Cleve-Euler 1953	Details
<i>Fragilaria virescens</i> f. <i>capitata</i> (Østrup) Skabichevskii 1960	Details
<i>Fragilaria virescens</i> var. <i>capitata</i> Krasske 1923	Details
<i>Fragilaria virescens</i> var. <i>capitata</i> Østrup 1910	Details
<i>Fragilaria virescens</i> f. <i>clavata</i> (Grunow in Van Heurck) Schulz 1926	Details
<i>Fragilaria virescens</i> f. <i>clavata</i> Grunow in Van Heurck 1881	Details
<i>Fragilaria virescens</i> f. <i>clavata</i> Grunow in Van Heurck 1881	Details
<i>Fragilaria virescens</i> var. <i>constricta</i> Mayer 1917	Details
<i>Fragilaria virescens</i> f. <i>curta</i> Cleve-Euler 1948	Details
<i>Fragilaria virescens</i> f. <i>curta</i> Mayer 1937	Details
<i>Fragilaria virescens</i> f. <i>curta</i> Mayer 1937	Details

1 - 20 of 83 Records

1 of 5 Pages

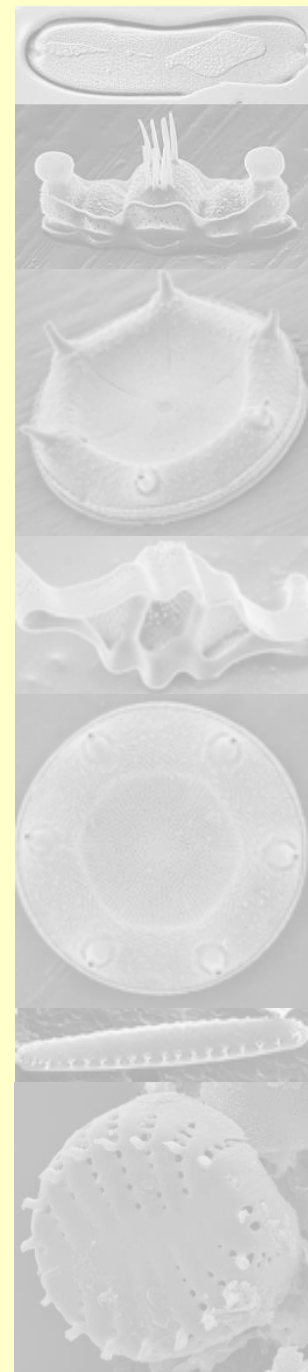
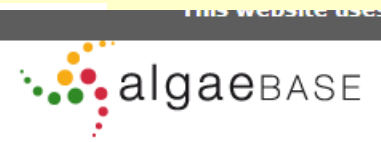
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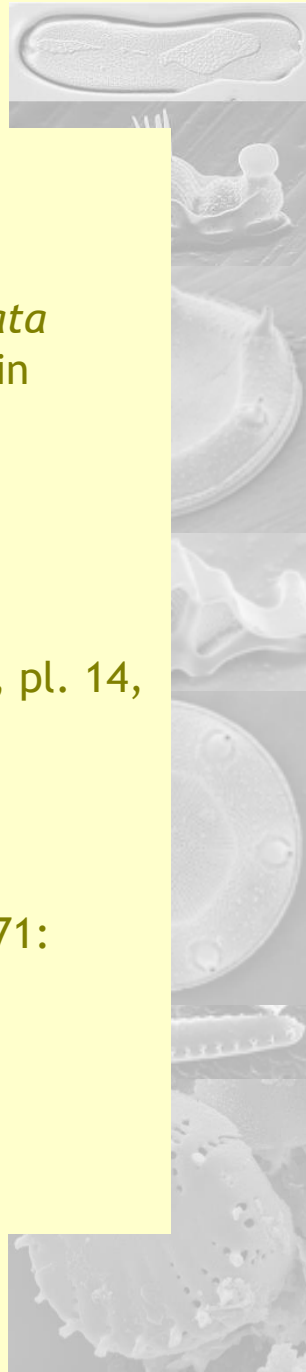
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Algaebase: 43

[Fragilaria virescens var. oblongella Grunow](#) **S**
[Fragilaria virescens var. mesolepta \(Rabenhorst\) Schönfelt](#) **S**
[Fragilaria virescens var. capitata Østrup](#) **S**
[Fragilaria virescens var. quebecensis M.Poulin, C.Hudon & A.Cardinal](#) **U**
[Fragilaria virescens Ralfs](#) **S**
[Fragilaria virescens var. subsalina Grunow](#) **S**
[Fragilaria virescens var. exigua Grunow](#) **C**
[Fragilaria virescens var. elliptica Hustedt](#) **S**
[Fragilaria virescens var. lata O.Müller](#) **C**
[Fragilaria virescens var. producta \(Lagerstedt\) De Toni](#) **S**
[Fragilaria virescens var. diatomacea](#) **C**
[Fragilaria virescens var. undulata Okuno](#) **C**
[Fragilaria virescens var. fuegiana J.Frenguelli](#) **P**
[Fragilaria virescens var. genuina Ant.Mayer](#) **P**
[Fragilaria virescens var. fuegiana f. major J.Frenguelli](#) **P**
[Fragilaria virescens var. obesa A.Lauby](#) **P**
[Fragilaria virescens subsp. subsalina \(Grunow\) Skabichevskii](#) **S**
[Fragilaria virescens f. clavata Grunow](#) **P**
[Fragilaria virescens var. ventricosa M.Peragallo & Héribaud-Joseph](#) **P**
[Fragilaria virescens var. undata \(W.Smith\) Grunow](#) **S**
[Fragilaria virescens var. torus M.H.Hohn & J.Hellerman](#) **S**
[Fragilaria virescens var. subsalina f. curta Cleve-Euler](#) **P**
[Fragilaria virescens var. restratus Skvortzov](#) **P**
[Fragilaria virescens f. parva Kützing](#) **P**
[Fragilaria virescens var. obtusa Skvortzov](#) **P**
[Fragilaria virescens var. nipponica \(Skvortzov\) Skvortzov & M.Noda](#) **P**
[Fragilaria virescens var. nipha M.H.Hohn & J.Hellerman](#) **C**
[Fragilaria virescens var. linearis Skvortzov](#) **P**
[Fragilaria virescens var. halophila E.Liebetanz](#) **P**
[Fragilaria virescens var. exigua f. sphaerophora Cleve-Euler](#) **P**
[Fragilaria virescens var. diophthalma \(Ehrenberg\) Schumann](#) **P**
[Fragilaria virescens f. elongata M.Peragallo & Héribaud-Joseph](#) **P**
[Fragilaria virescens var. elliptica f. nipponica Skvortzov](#) **P**
[Fragilaria virescens f. clavata Grunow](#) **P**
[Fragilaria virescens var. birostrata f. paucicostata Thomas & E.A.Gonzalves](#) **P**
[Fragilaria virescens var. balatonis G.Istvanfy de Csik Madéfalva](#) **P**
[Fragilaria virescens f. angustata Manguin](#) **C**
[Fragilaria virescens var. elongata](#) **P**
[Fragilaria virescens var. acuta G.Istvanfy de Csik Madéfalva](#) **P**
[Fragilaria virescens var. acicularis Skvortzov](#) **P**





***Fragilaria virescens* Ralfs 1843**

Fragilaria virescens f. *angustata* Manguin 1964

Fragilaria virescens f. *clavata* (Grunow in Van Heurck) Schulz

1926: 186, fig. 20 [= *Fragilaria virescens* var. *oblongella* f. *clavata* Grunow in Van Heurck = *Fragilaria virescens* f. *clavata* Grunow in Van Heurck 1881]

Fragilaria virescens f. *curta* Mayer 1937: 52, pl. 1, figs 8-9

Fragilaria virescens f. *curta* Cleve-Euler 1948: 9, pl. 1, fig. 6

Fragilaria virescens f. *elongata* M. Peragallo & Heribaud 1893: 148

Fragilaria virescens f. *genuina* (Mayer) Mayer 1937: pl. 1, figs 1-7 [= *Fragilaria virescens* var. *genuina* Mayer 1913: 38, pl. 14, fig. 26, pl. 14, figs 17, 17a]

Fragilaria virescens f. *major* Frenguelli 1924: 19

Fragilaria virescens f. *minor* Cleve-Euler 1953: 49

Fragilaria virescens f. *nipponica* Skvortzow 1936: 17, pl. 12, fig. 20

[= *Fragilaria virescens* var. *nipponica* (Skvortzow) Skvortzow 1971: 13, pl. 2, fig. 2]

Fragilaria virescens f. *oviformis* Cleve-Euler 1953: 50, fig. 361 u

Fragilaria virescens f. *paucicostata* Thomas & Gonzalves 1965: 341, fig. 1

Fragilaria virescens f. *typica* Cleve-Euler 1953: 50, fig. 361 r, s, u, y

...

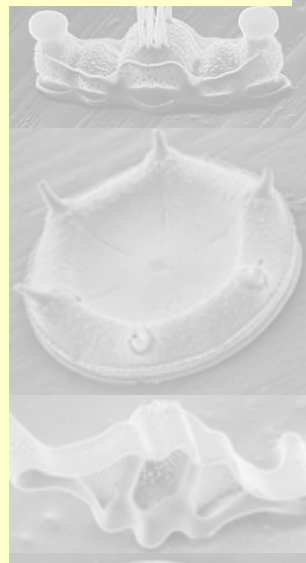


<i>Fragilaria virescens</i> Ralfs 1843	(9060)
<i>Fragilaria virescens</i> f. <i>angustata</i> Manguin 1964	(0)
<i>Fragilaria virescens</i> f. <i>clavata</i> (Grunow in Van Heurck) Schulz 1926: 186, fig. 20 [= <i>Fragilaria virescens</i> var. <i>oblongella</i> f. <i>clavata</i> Grunow in Van Heurck = <i>Fragilaria virescens</i> f. <i>clavata</i> Grunow in Van Heurck 1881]	(0)
<i>Fragilaria virescens</i> f. <i>curta</i> Mayer 1937: 52, pl. 1, figs 8-9	(0)
<i>Fragilaria virescens</i> f. <i>curta</i> Cleve-Euler 1948: 9, pl. 1, fig. 6	(0)
<i>Fragilaria virescens</i> f. <i>elongata</i> M. Peragallo & Heribaud 1893: 148	(0)
<i>Fragilaria virescens</i> f. <i>genuina</i> (Mayer) Mayer 1937: pl. 1, figs 1-7 [= <i>Fragilaria virescens</i> var. <i>genuina</i> Mayer 1913: 38, pl. 14, fig. 26, pl. 14, figs 17, 17a]	(0)
<i>Fragilaria virescens</i> f. <i>major</i> Frenguelli 1924: 19	(0)
<i>Fragilaria virescens</i> f. <i>minor</i> Cleve-Euler 1953: 49	(0)
<i>Fragilaria virescens</i> f. <i>nipponica</i> Skvortzow 1936: 17, pl. 12, fig. 20 [= <i>Fragilaria virescens</i> var. <i>nipponica</i> (Skvortzow) Skvortzow 1971: 13, pl. 2, fig. 2]	(0)
<i>Fragilaria virescens</i> f. <i>oviformis</i> Cleve-Euler 1953: 50, fig. 361 u	(0)
<i>Fragilaria virescens</i> f. <i>paucicostata</i> Thomas & Gonzalves 1965: 341, fig. 1	(0)
<i>Fragilaria virescens</i> f. <i>typica</i> Cleve-Euler 1953: 50, fig. 361 r, s, u, y	(0)...

Fragilaria virescens Ralps.

550+ slides with *F. virescens*

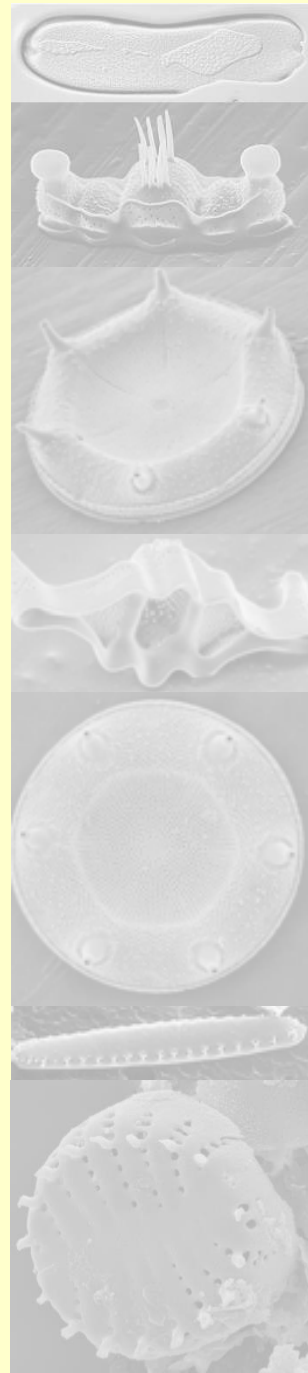
B.M. 261. 457. 511. 533. 536. 592. 831. 1611. 924 var.
2214. 4722. 4933. 6550. 6557. 6552. 1191. 11475. 11476.
11571. 11576. 13207. 12834. 12949. 13076. 13077. 13021. 14307.
14486. 14532. 14561. 14562. 14563. 14581. 14730. 14731. 14737 var.
14764. 14839 var *renhiosa*. 14840 et var. 14865. 15736. 16211.
17919. 17920. 17921. 17922. 17923. 17924. 17925. 17926.
19446. 20614. 20852. var. 21112. 22309. 22624. 22652.



Fragilaria virescens - Ralps.

B.M. 22653. 22654. 22655. var. 22656. 22657.
22658. 22659. var. 22660. 22661. 22662. 22663.
22664. 22983. Type 4. 1. 2. (filamentary connected.) 24044. 24045.
24046. 24047. 24048. 24049. β . 24050. β . 24057. 24052. 24053.
24605. 24840. 24949. 25012. 25737. 25746. 25281.
25420. 25425. 25731. 26620. 27702. 27703. 28180.

Fragilariforma virescens is a cosmopolitan species

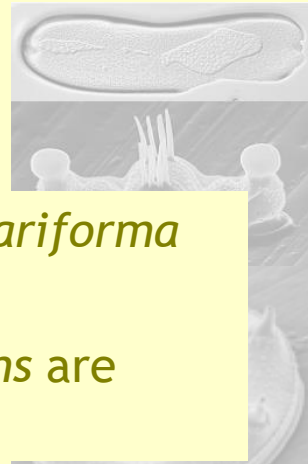


~~*Fragilariforma virescens* is a cosmopolitan species~~

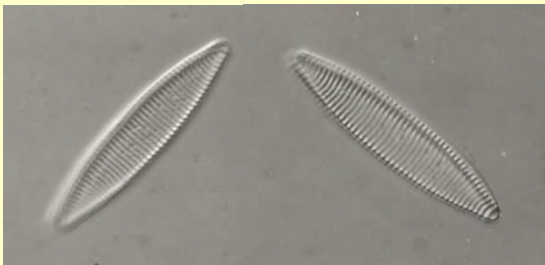
Fragilariforma virescens is a European species

The NHM's collection misidentifies 70% of the species named *Fragilariforma virescens*

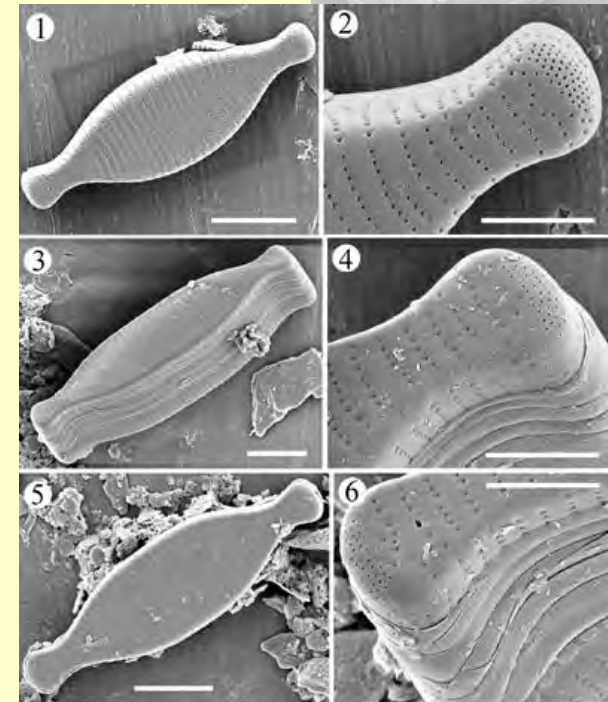
The NHM's collection with species named as *Fragilariforma virescens* are either just wrong or are new



BM 32217, 8 Lake George, Florida, USA



GC44450 Canada, La Vase River, holotype (?) of *Fragilaria virescens* var. *nipha* Hohn & Hellerman 1963: 282, pl. 1, fig. 10



Fragilariforma marylandicus = *Fragilaria virescens* var. *torus* Hohn & Hellerman 1966: 124, pl. 1, fig. 5

What is and what is not an alien?

1. Biogeography

2. Diatoms

3. Floras

4. Can we tell what is or is not an alien?



