

Dolichospermum a příbuzné planktonní nostokální rody

Genotypová a morfologická diverzita
a taxonomické novinky

Eliška Zapomělová

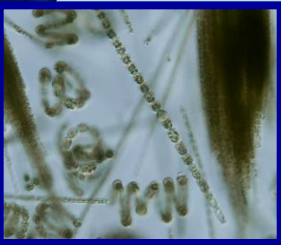
Problémy současné sinicové taxonomie

- prokaryotické organismy
- pouze nepohlavní rozmnožování

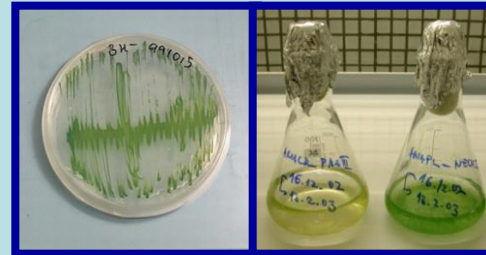
⇒ **POLYFÁZICKÝ PŘÍSTUP**

Co to je
DRUH
???

Tradiční morfologie

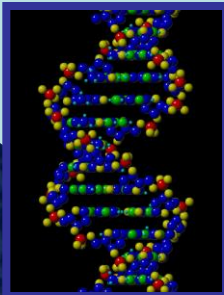


- kmeny ze sbírek
- přírodní populace



Molekulární metody

- většinou kmeny ze sbírek
 - **16S rRNA (+ ITS)**
- vysoké % podobnosti na úrovni druhů

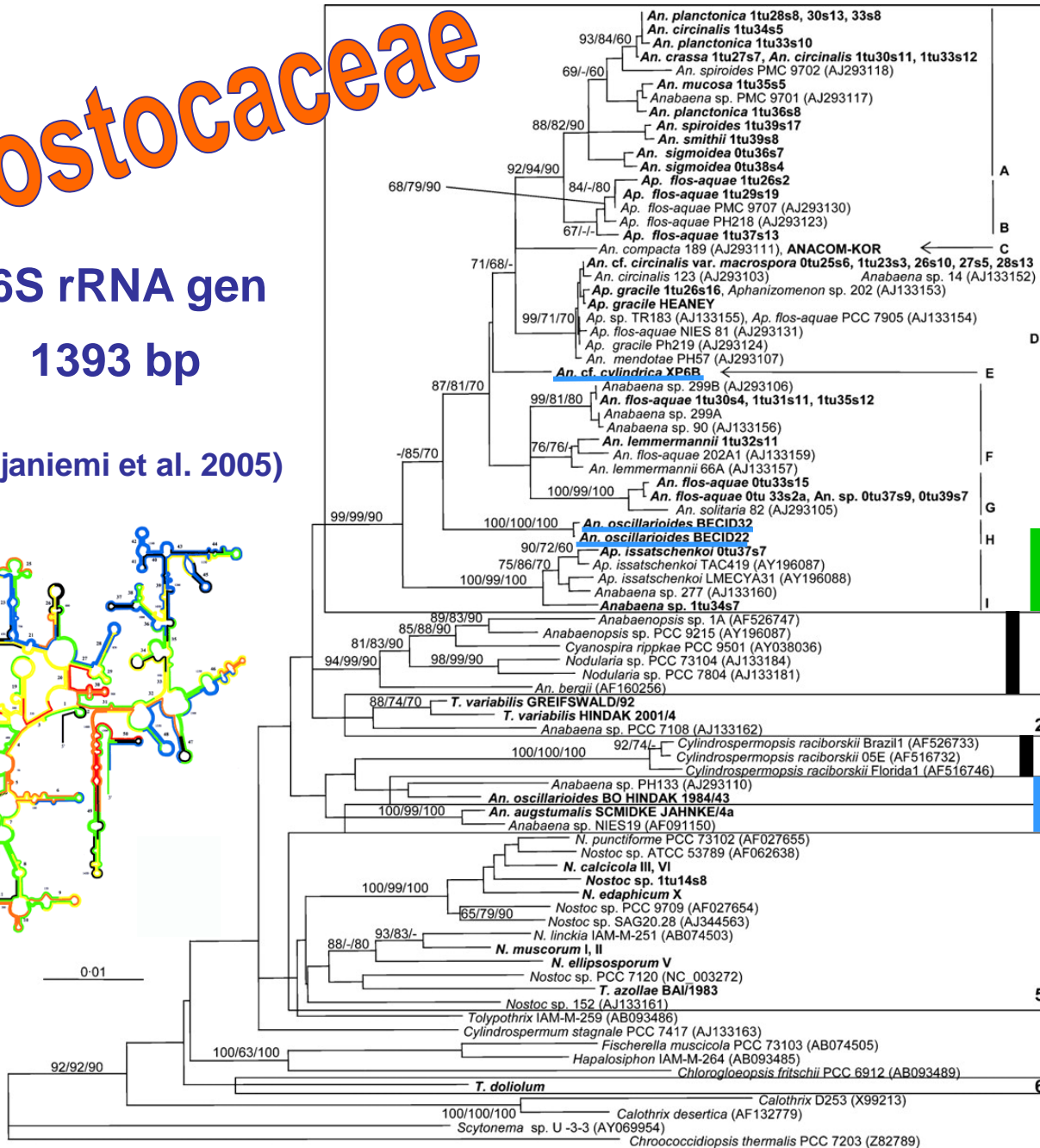
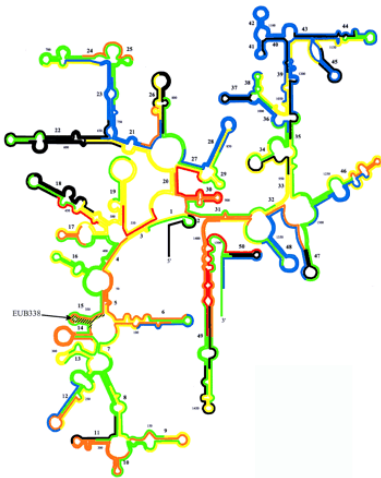


Nostocaceae

16S rRNA gen

1393 bp

(Rajaniemi et al. 2005)



Planktonní
Anabaena
Aphanizomenon

**Cuspidothrix
issatschenkoii**

Anabaenopsis,
Nodularia, *An. bergii*
Trichormus

Cylandrospermopsis
Anabaena - bentické

Nostoc

6

5

2

Taxonomická novinka - I.

Nomenklatorická validizace rodu Dolichospermum

= většina planktonních „morphospecies“ původního rodu *Anabaena*;
metamerická vlákna (⇒ morphospecies rodu Ahanizomenon
do *Dolichospermum* nepatří)

Fottea 9(1): 59-64, 2009

<http://fottea.czechphycology.cz/contents>

Fottea, 9(1): 59–64, 2009

59

Nomenclatural validation of the genetically revised cyanobacterial genus *Dolichospermum* (RALFS ex BORNET et FLAHAULT) comb. nova

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Abstract: The traditional cyanobacterial genus *Anabaena* is heterogeneous, as follows from the modern molecular evaluation. The cluster of planktic *Anabaena*-morphotypes with gas vesicles in cells must be separated as a unique generic entity from the typical benthic mat-forming species. In the present articles all planktic morphospecies

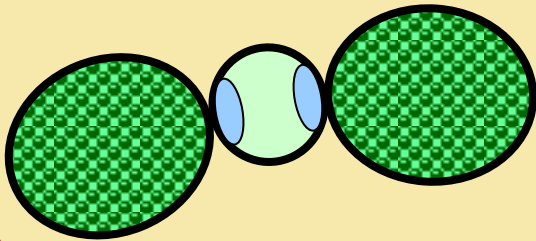
Taxonomická novinka - II.

Zřízení nového rodu Sphaerospermopsis

= S. reniformis (*Anabaena reniformis*), S. kisseleviana (*Anabaena kisseleviana*), S. aphanizomenoides (*Aphaniz. aphanizomenoides*)

+ corrigendum 2010

Journal of Phycology 45: 1363-1373, 2009



J. Phycol. 45, ***-*** (2009)

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DOI: 10.1111/j.1529-8817.2009.00758.x

POLYPHASIC CHARACTERIZATION OF THREE STRAINS OF *ANABAENA RENIFORMIS* AND *APHANIZOMENON APHANIZOMENOIDES* (CYANOBACTERIA) AND THEIR RECLASSIFICATION TO ~~*SPHAEROSPERMUM*~~ GEN. NOV. (INCL. *ANABAENA*

KISSELEVIANA)¹
Sphaerospermopsis

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Jitka Jezberová

Biology Centre of AS CR, Institute of Hydrobiology, Na Sádkách 7, CZ-37005 České Budějovice, Czech Republic

Pavel Hrouzek, Daniel Hisem

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Microbiology, AS CR, Department of Autotrophic Microorganisms, Opatovický mlýn, CZ-379 81 Třeboň, Czech Republic and
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Biology Centre of AS CR, Institute of Hydrobiology, Na Sádkách 7, CZ-37005 České Budějovice, Czech Republic and Institute of
Botany, ASCR, Dukelská 135, CZ-37982 Třeboň, Czech Republic

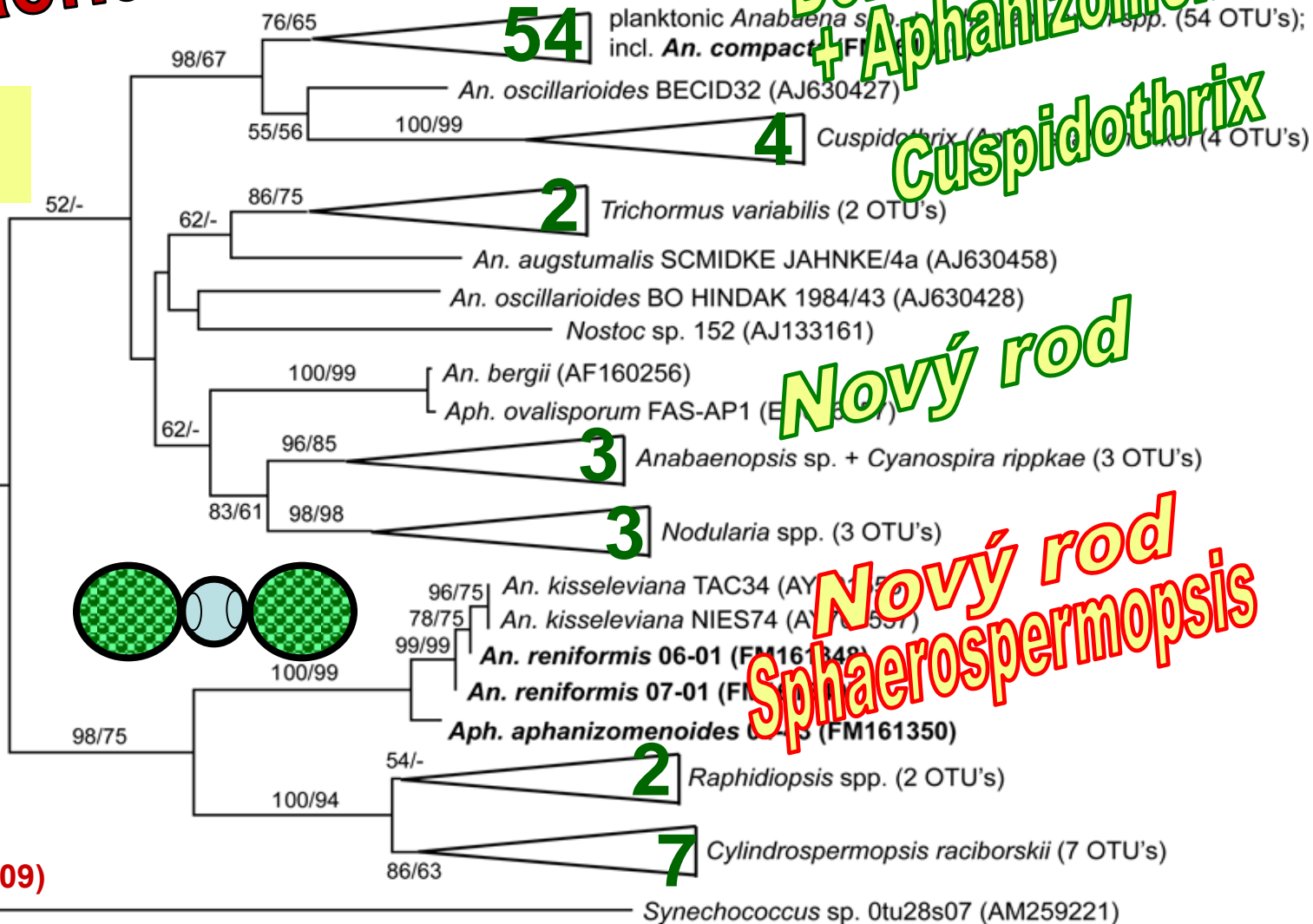
and *Jaroslava Komárková*

University of South Bohemia, Faculty of Science, Branišovská 31, CZ-37005 České Budějovice, Czech Republic; Biology Centre of AS
CR, Institute of Hydrobiology, Na Sádkách 7, CZ-37005 České Budějovice, Czech Republic and Institute of Botany, ASCR, Dukelská
135, CZ-37982 Třeboň, Czech Republic

Fylogeneze tradičních rodů Anabaena a Aphanizomenon

16S rRNA gen
1318 bp

0.01



(Zapomělová et al. 2009)

Taxonomická novinka – III.

Zřízení nového rodu Chryso sporum

= C. bergii (*Anabaena bergii*),

C. ovalisporum (*Aphanizomenon ovalisporum*)

Hydrobiologia 698: 353-365, 2012

Hydrobiologia (2012) 698:353–365
DOI 10.1007/s10750-012-1034-z

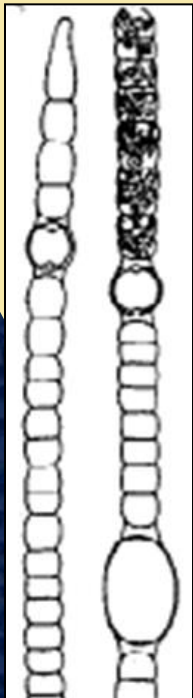
PHYTOPLANKTON

Biogeographically interesting planktonic Nostocales (Cyanobacteria) in the Czech Republic and their polyphasic evaluation resulting in taxonomic revisions of *Anabaena bergii* Ostenfeld 1908 (*Chryso sporum* gen. nov.) and *A. tenericaulis* Nygaard 1949 (*Dolichospermum tenericaule* comb. nova)

Eliška Zapomělová · Olga Skácelová ·
Petr Pumann · Radovan Kopp · Emil Janeček

Received: 16 November 2011 / Accepted: 12 February 2012 / Published online: 2 March 2012

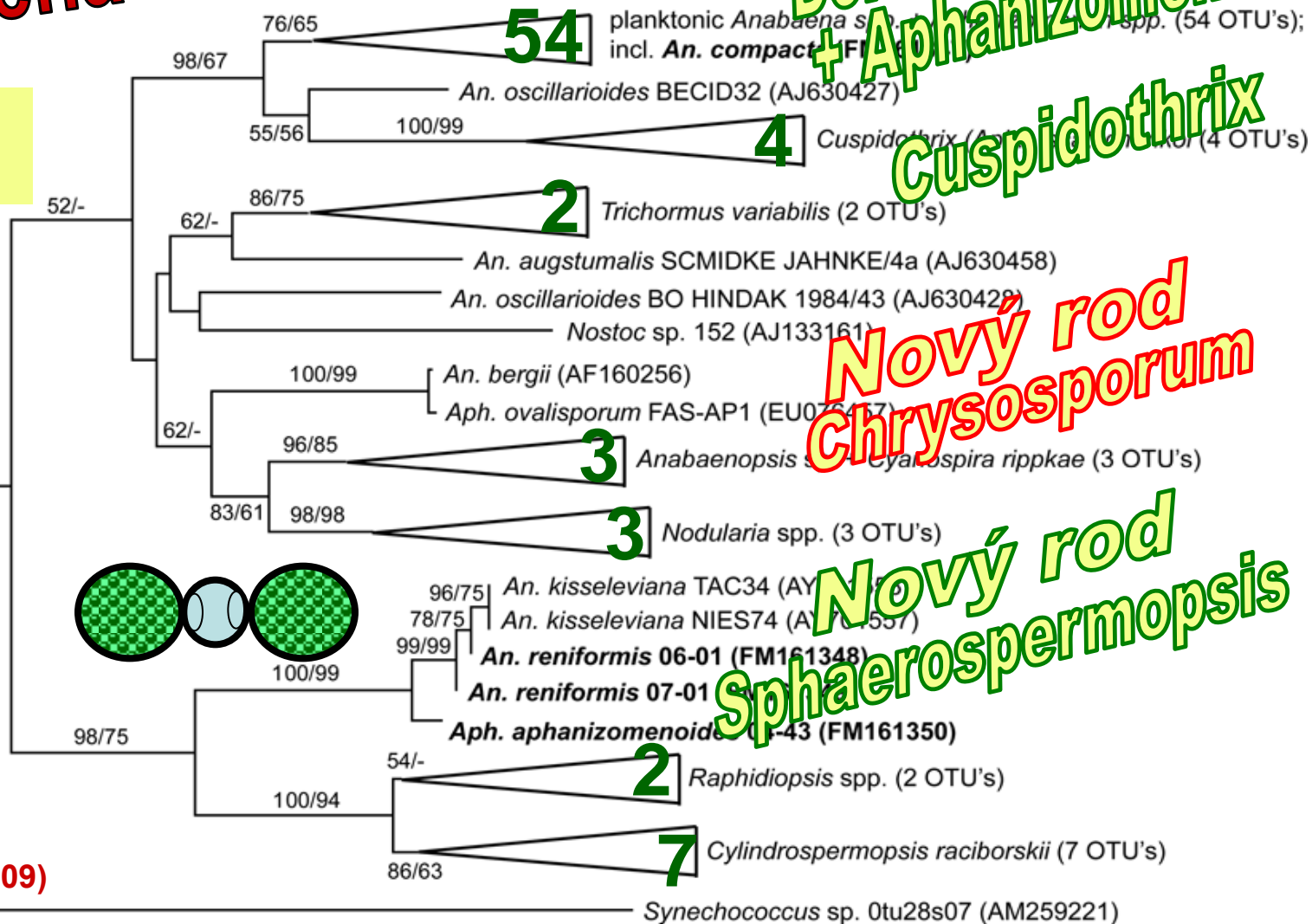
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Fylogeneze tradičních rodů Anabaena and Aphanizomenon

16S rRNA gen
1318 bp

0.01



Dolichospermum
+ Aphanizomenon

Cuspidothrix

Nový rod
Chryso sporum

Nový rod
Sphaerospermopsis

(Zapomělová et al. 2009)

Přehled současných revizí

ANABAENA

Dolichospermum

– cca 46 planktonních druhů

Sphaerospermopsis

– cca 3-6 planktonních druhů

Anabaena

– cca 56 bentických druhů

Chrysochloris

– 2 planktonní druhy

Nerevidované *Anabaena*-like taxony

– cca 20 planktonních dr

– cca 19 bentických/perifyt. druhů

APHANIZOMENON

Aphanizomenon

– cca 9 planktonních druhů

Cuspidothrix

– 5 planktonních druhů

Unrevised *Aphanizomenon*-like taxa

– cca 1-2 planktonní druhy

Aphanizomenon - „pravý“



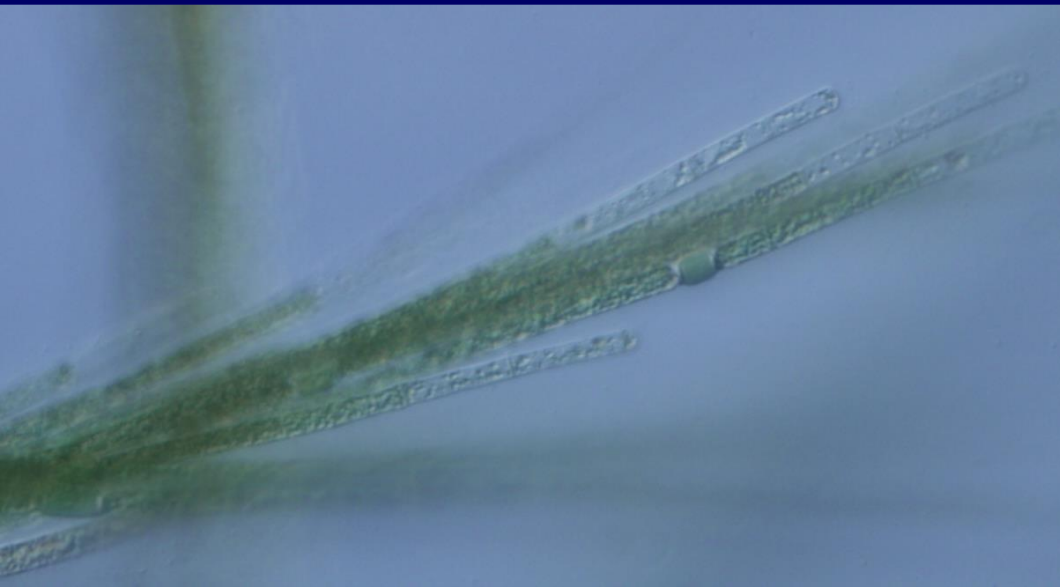
- svazky vláken

- diferencované koncové buňky:

- prodloužené

- hyalinní

- někdy zúžené

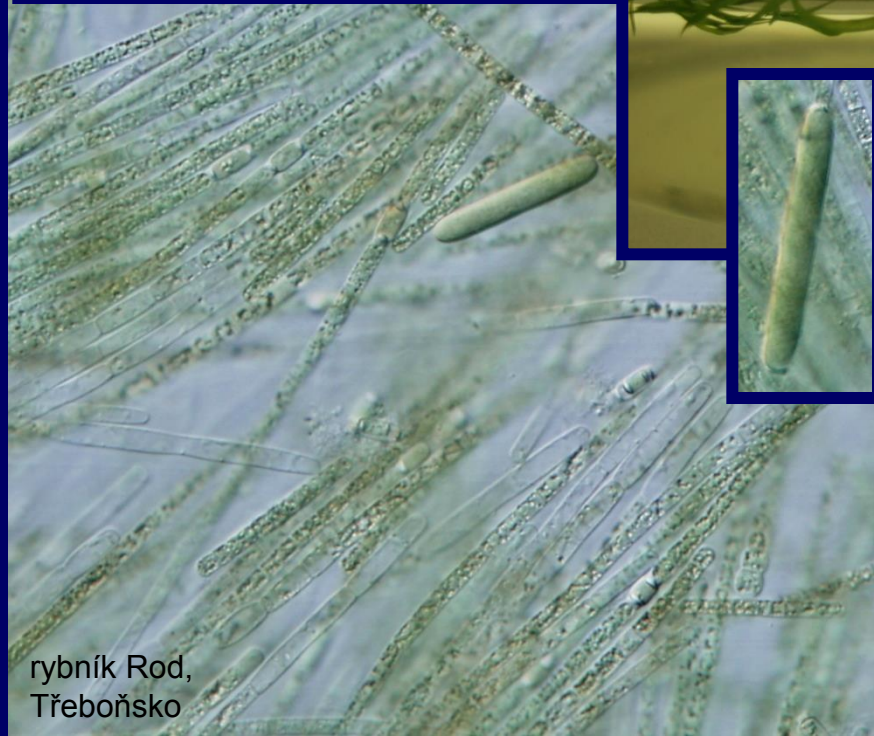
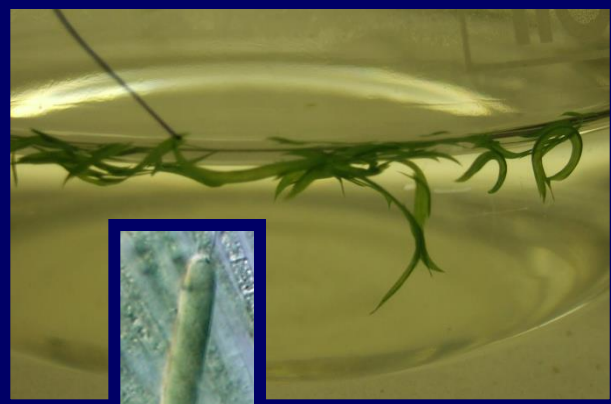


Aphanizomenon flos-aquae Ralfs ex Bornet et Flahault 1888

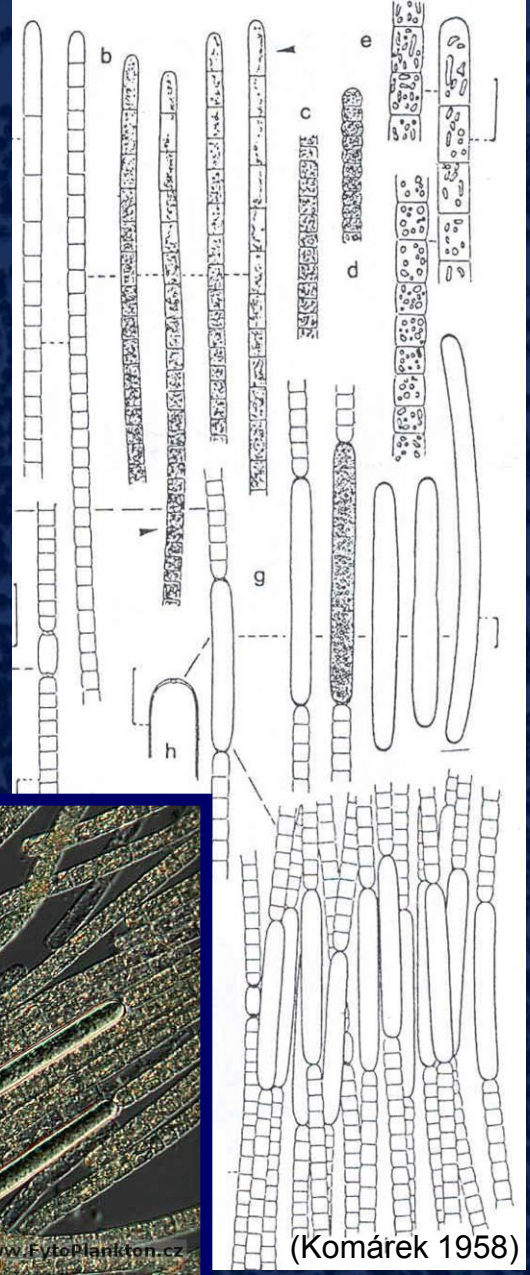


Šířka vlákna
4.4-8.0 μm

Akinety
40-220
x 6.0-10.8 μm



Novohradské hory,
foto P. Znachor



(Komárek 1958)

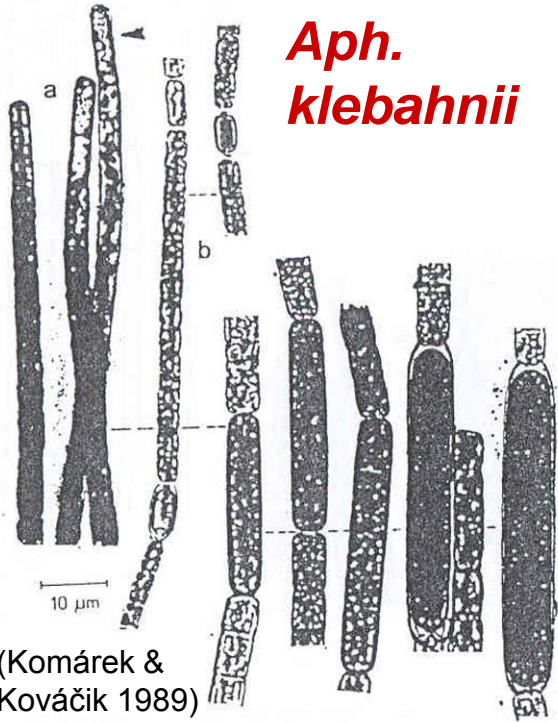
rybník Rod,
Třeboňsko

www.FytoPlankton.cz

Aphanizomenon flos-aquae Ralfs ex Bornet et Flahault 1888

Aphanizomenon klebahnii Elenkin ex Pechar 2008

Aph. klebahnii


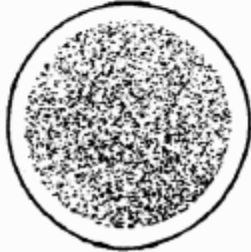

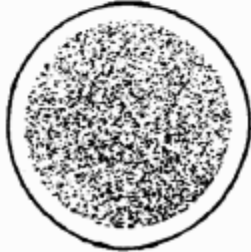


(Komárek & Kováčik 1989)

Šířka vlákna
3.2-5.2 μm

Akinety

20-54 (113) x 5.4-9.3 μm

<i>Aphanizomenon</i>	<i>flos-aquae</i>	<i>klebahnii</i>
length of colonies	(2)5-10(20) mm	0.1-2.0 mm
trichome width	4.5-6.5(8) μm	3.2-4.5(5.2) μm
chlorophyll-a/DW absorbance ratio 480/664 nm (pigment extract)	6-8 μg.mg ⁻¹ >1.2	8-12 μg.mg ⁻¹ 1.0-1.2
DW/biomass (average)	0.231 mg.mm ⁻³	0.291 mg.mm ⁻³
transparency	> 1 m	< 0.5 m - small species
zooplankton	large <i>Daphnia</i> -species	<i>Copepoda</i> , <i>Rotatoria</i> , <i>Cladocera</i>
terminal cells		
size and shape of colonies		

Pechar & Kalina (in prep.) in Komárek & Komárková 2006

Aphanizomenon klebahnii Elenkin ex Pechar 2008

Aphanizomenon yezoense M. Watanabe 1991

Šířka vlákna 2-4 μm
 Akinety 31.2-48.9 x 4.7-7.3 μm

Šířka vlákna 3.2-5.2 μm
 Akinety 20-54 (113) x 5.4-9.3 μm

**Aph.
yezoense**

Lipno reservoir,
 Czech Republic
 Photo by P. Znachor

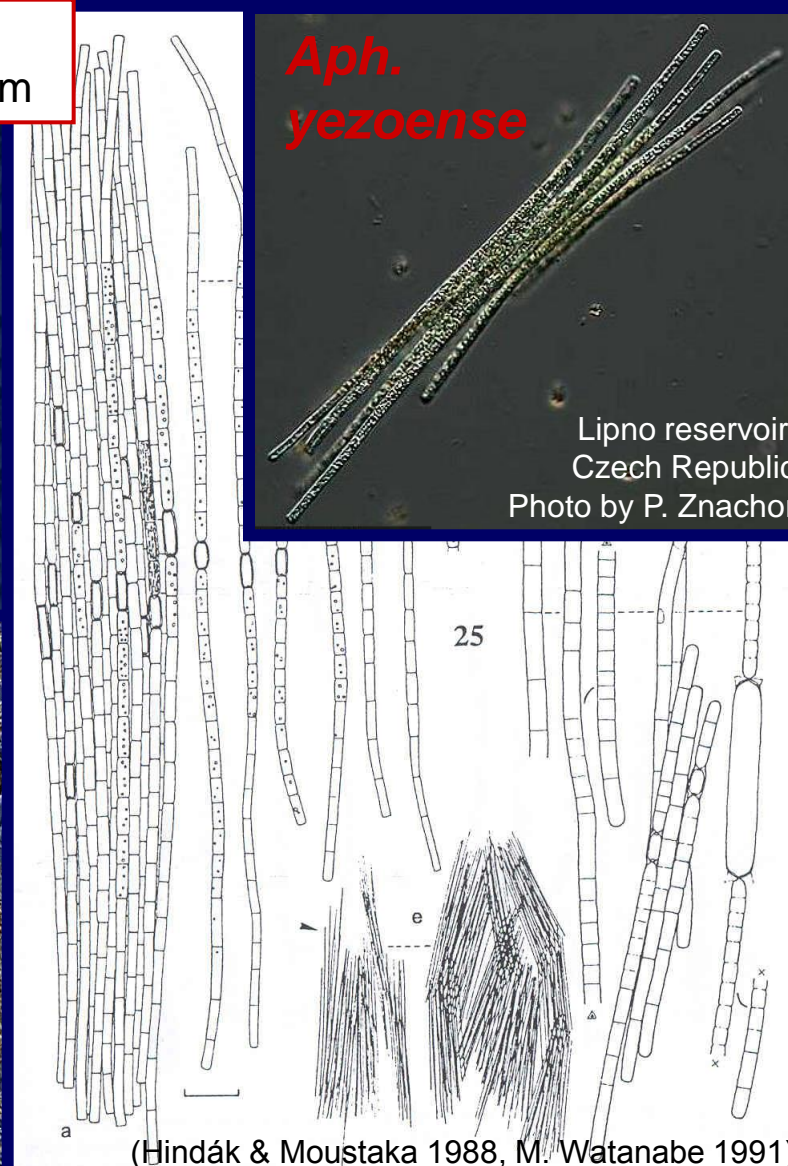
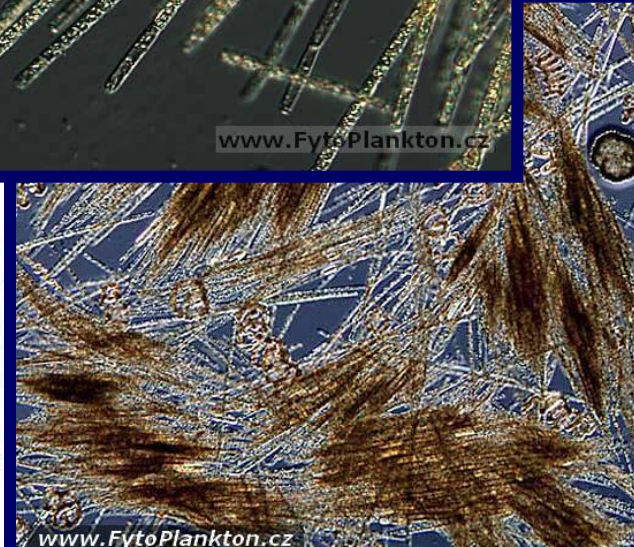
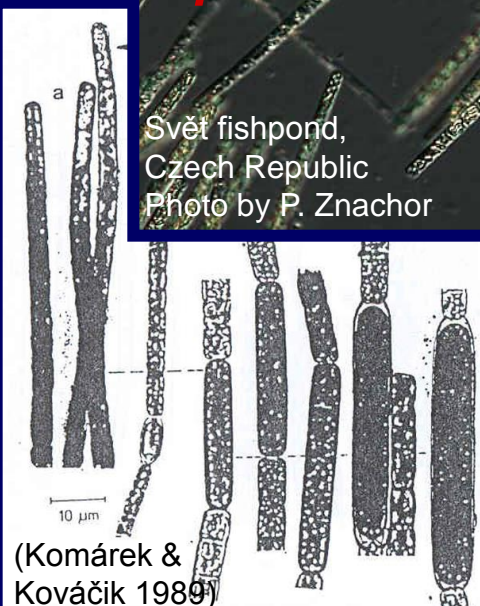
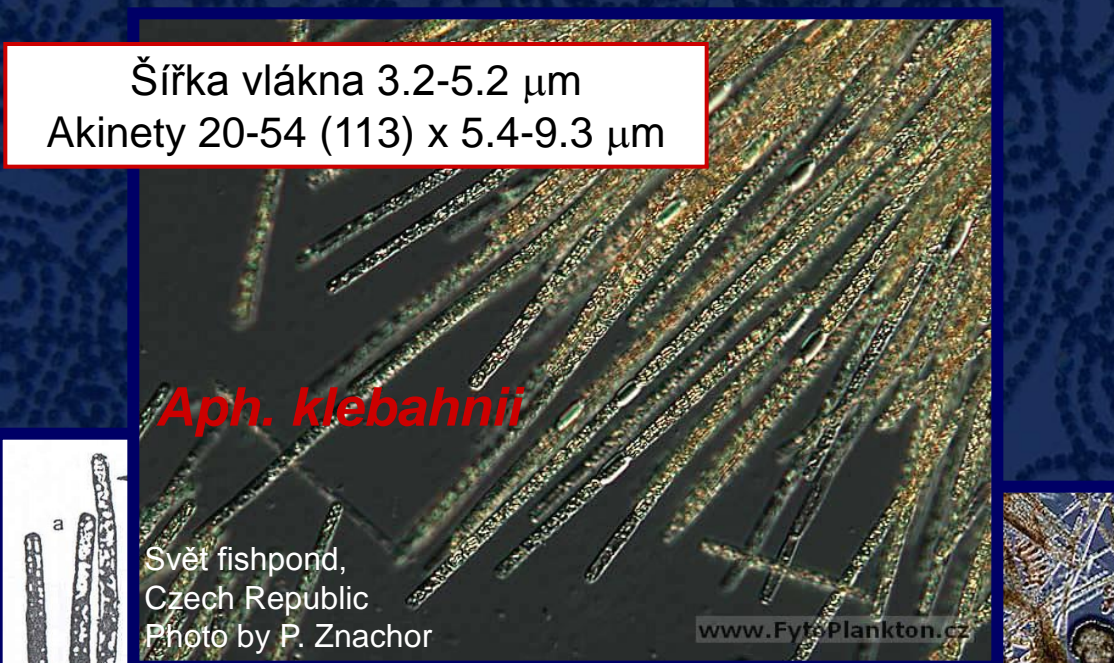
Aph. klebahnii

Svět fishpond,
 Czech Republic
 Photo by P. Znachor

www.FytoPlankton.cz

www.FytoPlankton.cz

(Hindák & Moustaka 1988, M. Watanabe 1991)



(Komárek & Kováčik 1989)

Aphanizomenon flexuosum

Komárek et Kováčik 1989

Aphanizomenon hungaricum

Komárková-Legnerová & Mátyás 1995

(Komárek &
Kováčik 1989)

Aph. flexuosum

Šířka vlákna
2-4 μm

Akinety
20-47 (56) x
x 3.5-5.7 μm

?

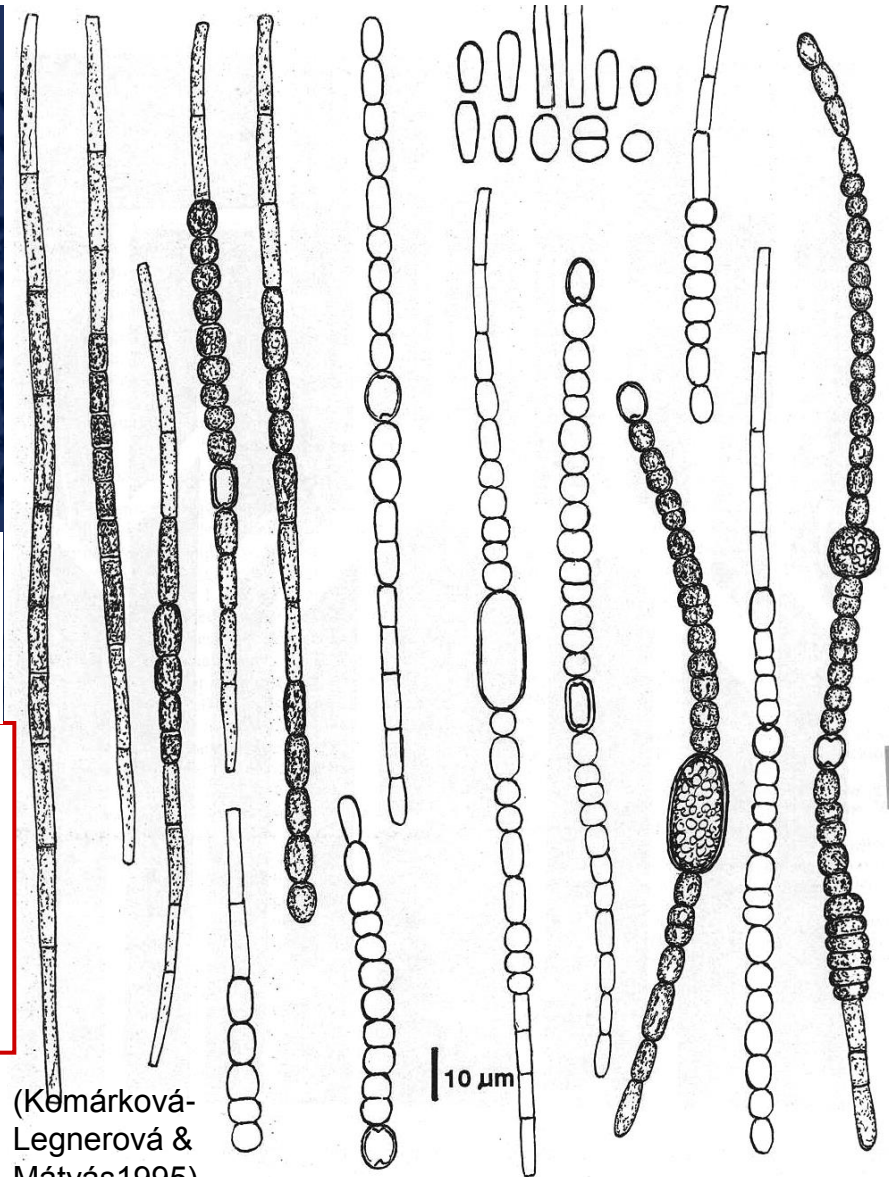
?

Šířka vlákna
(3.2) 6.5-7.2 μm

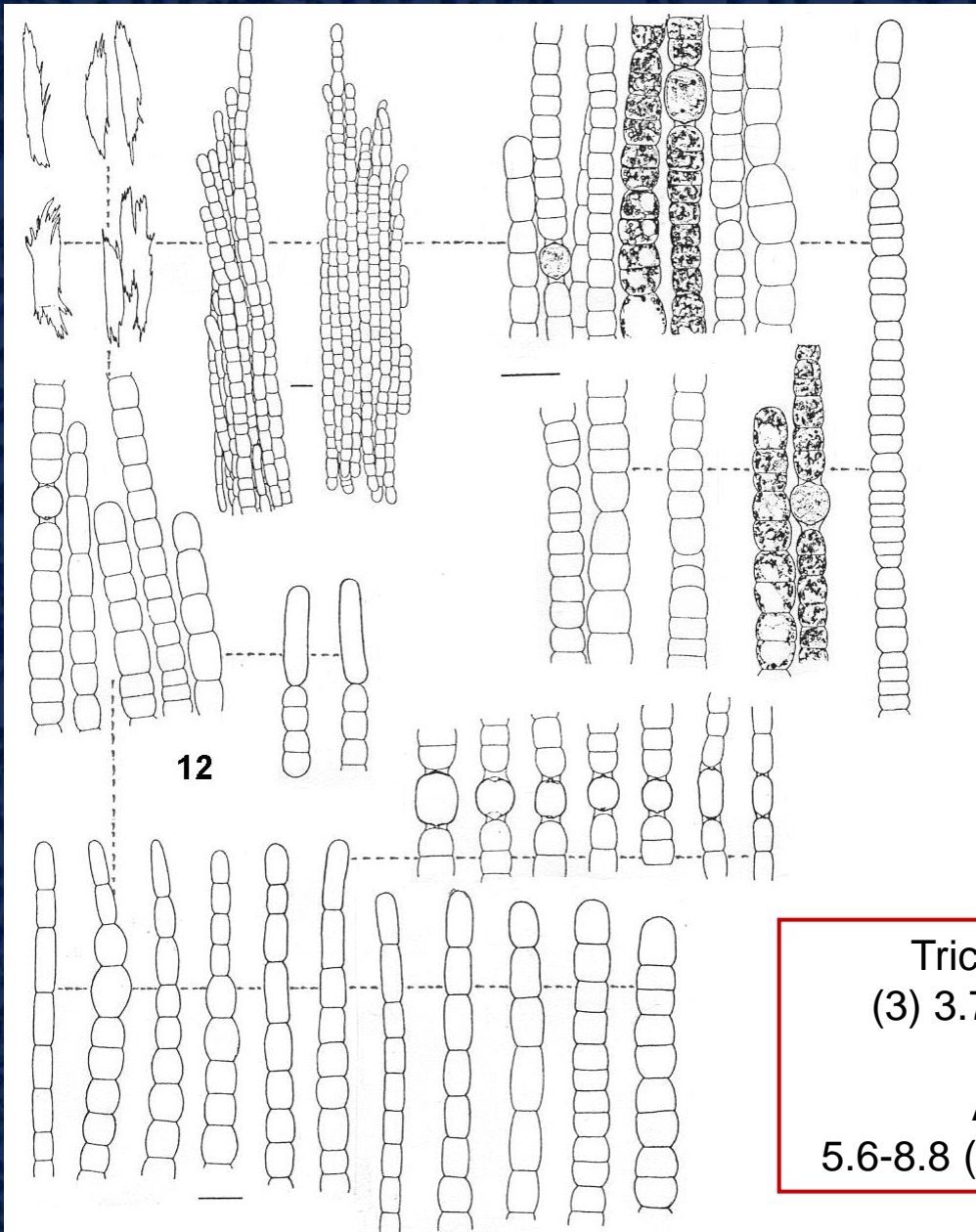
Akinety
15-24.5 x
x 4.5-10 μm

Aph. hungaricum

(Komárková-
Legnerová &
Mátyás 1995)



Aphanizomenon slovenicum Rekar & Hindák 2002



?

Trichome width
(3) 3.7-5.7 (7.3) μm

Akinetes
5.6-8.8 (22) x 3.3-5.2 μm

„velké druhy“ Dolichospermum

-/50
17/13
-/81
15/13

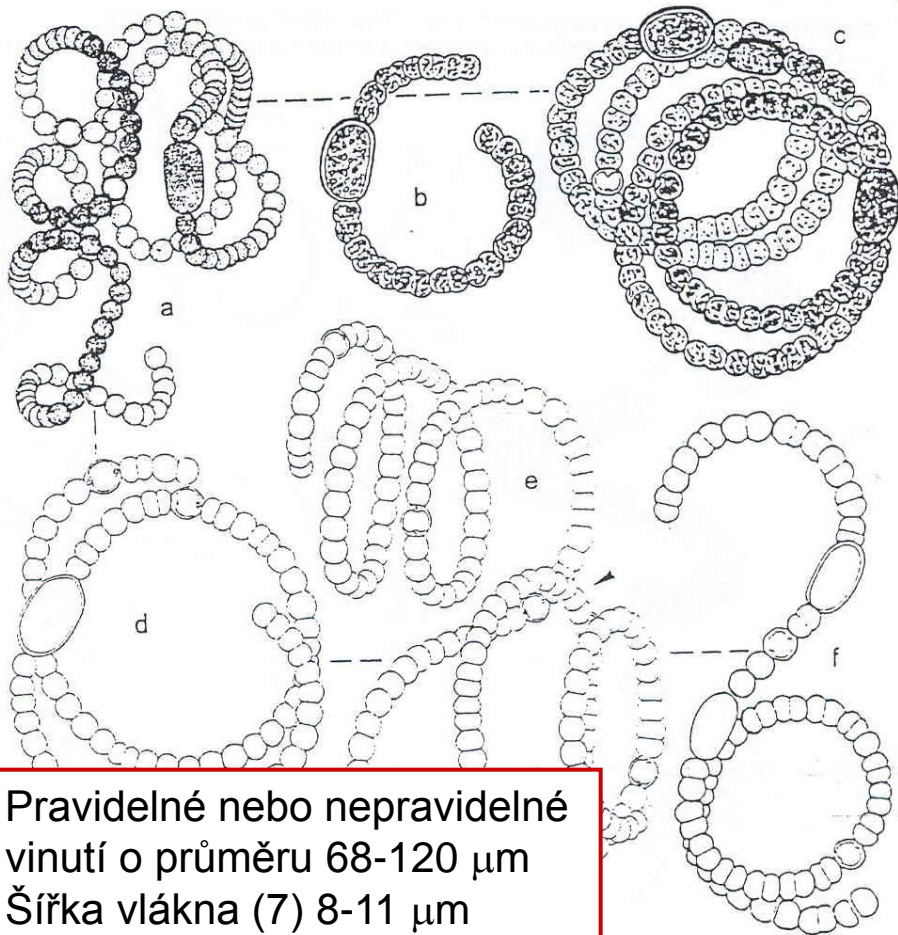
D. planctonicum 00-05, 05-10, 08-06, 08-08, 1tu28s8, 1tu33s10;
D. circinale / *D. crassum* 04-22, 04-26, 04-28, 04-29, 04-46, 04-59, 05-09, 1tu27s7, 1tu34s5;
D. cf. viguieri 05-06; *D. mucosum* 09-05
D. smithii 05-05, 08-02; *D. mucosum* 06-04, 06-05, 08-03, 08-09, 1tu35s5;
D. circinale / *D. crassum* 04-21, 04-28, 04-56; *D. planctonicum* 08-07, 1tu36s8;
D. viguieri 05-07, 08-04; *D. spiroides* 04-51



Dolichospermum circinale (Rabenh. ex Born. et Flah.) Wacklin et al. 2009
D. crassum (Lemm.) Wacklin et al. 2009

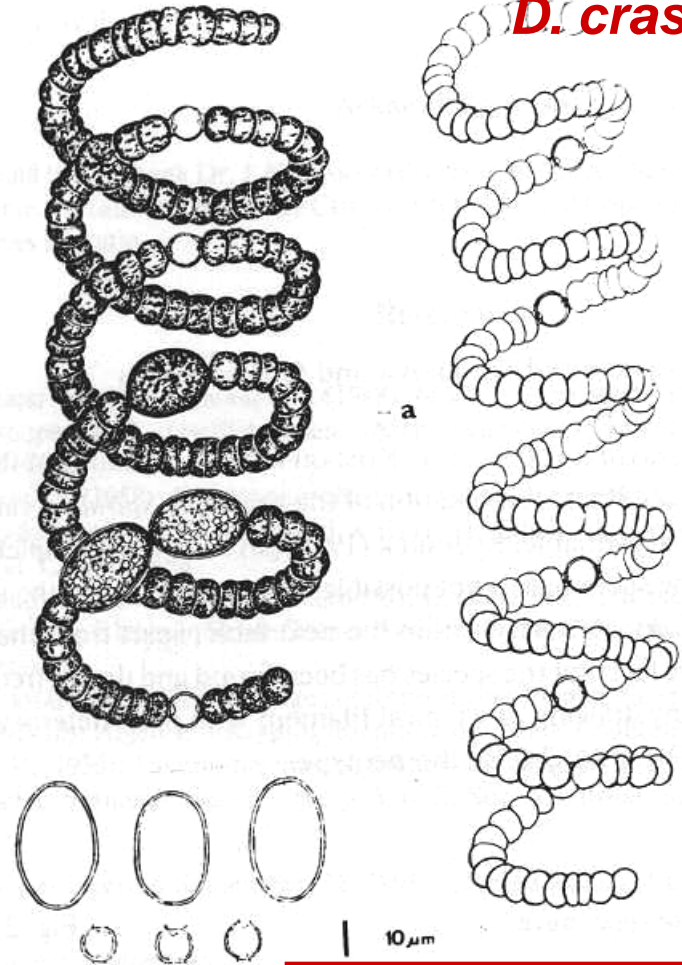
D. circinale

(G.M. Smith 1920, Komárek 1958,
Kondrateva 1968)



Pravidelné nebo nepravidelné
vinutí o průměru 68-120 μm
Šířka vlákna (7) 8-11 μm

D. crassum

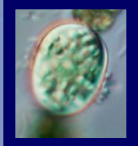


(Cronberg &
Komárková 1988)

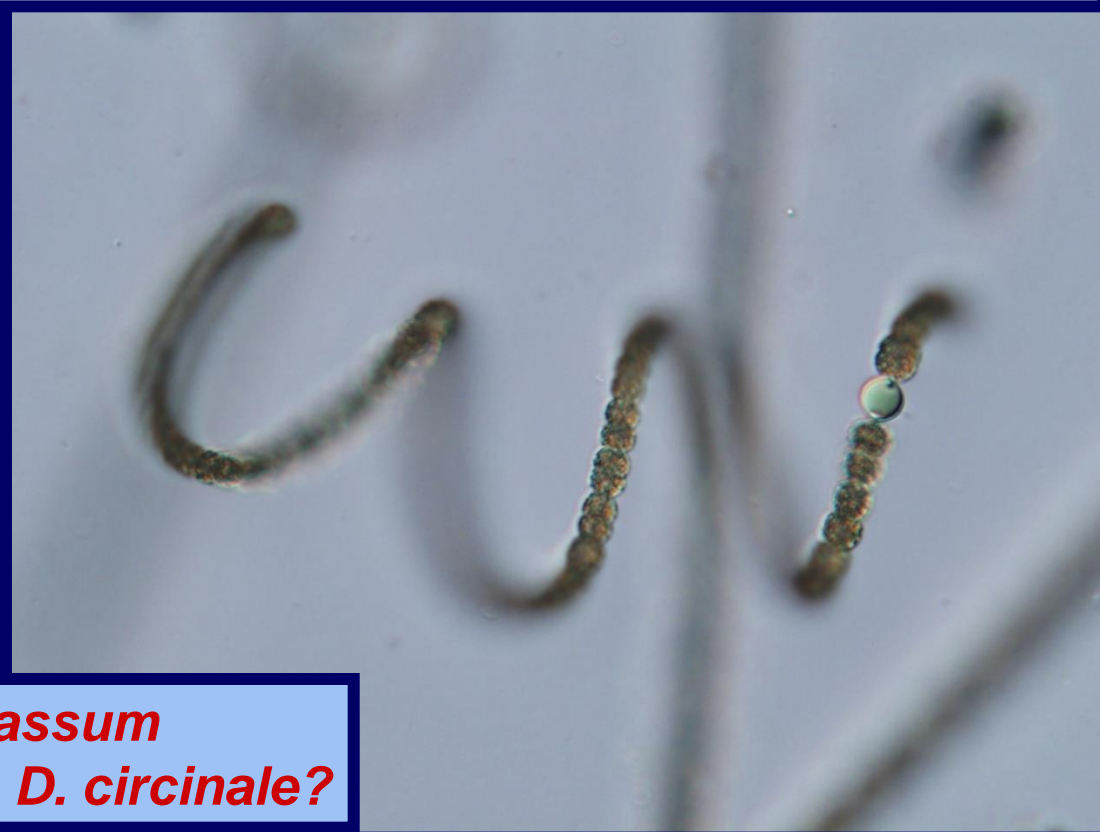
Pravidelné vinutí
o průměru 40-70 (80) μm
Šířka vlákna (8) 10-15 μm

Dolichospermum circinale (Rabenh. ex Born. et Flah.) Wacklin et al. 2009

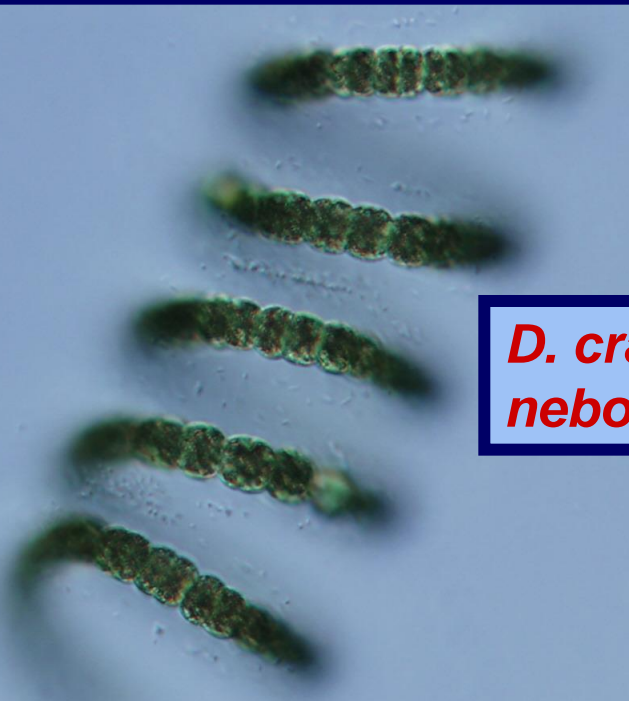
D. crassum (Lemm.) Wacklin et al. 2009



D. circinale



D. crassum
nebo *D. circinale*?



20.0 μm



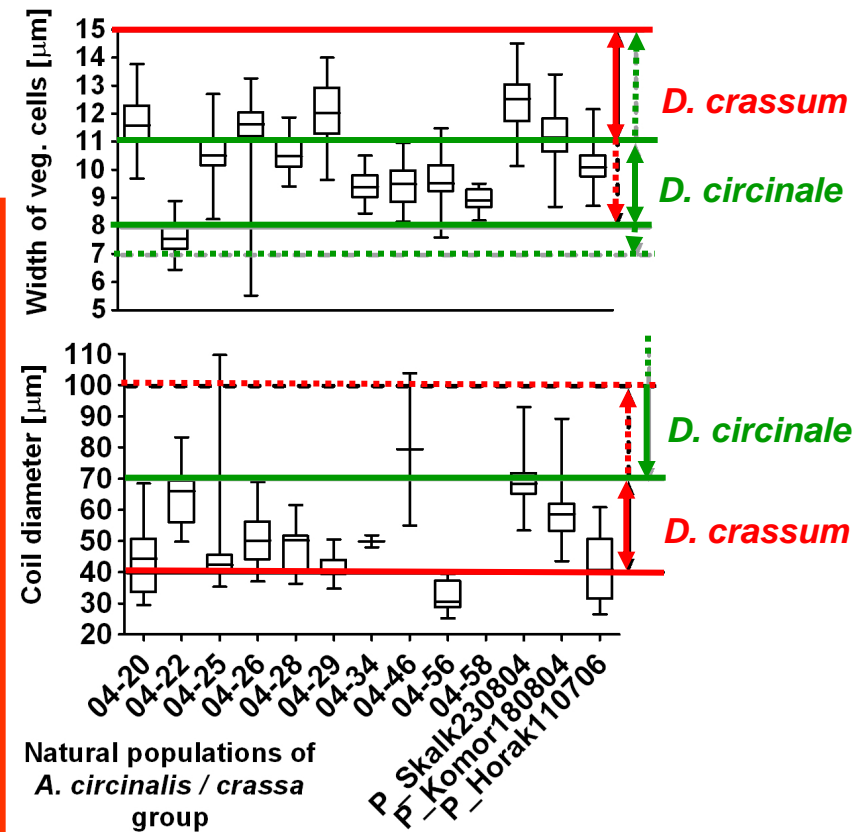
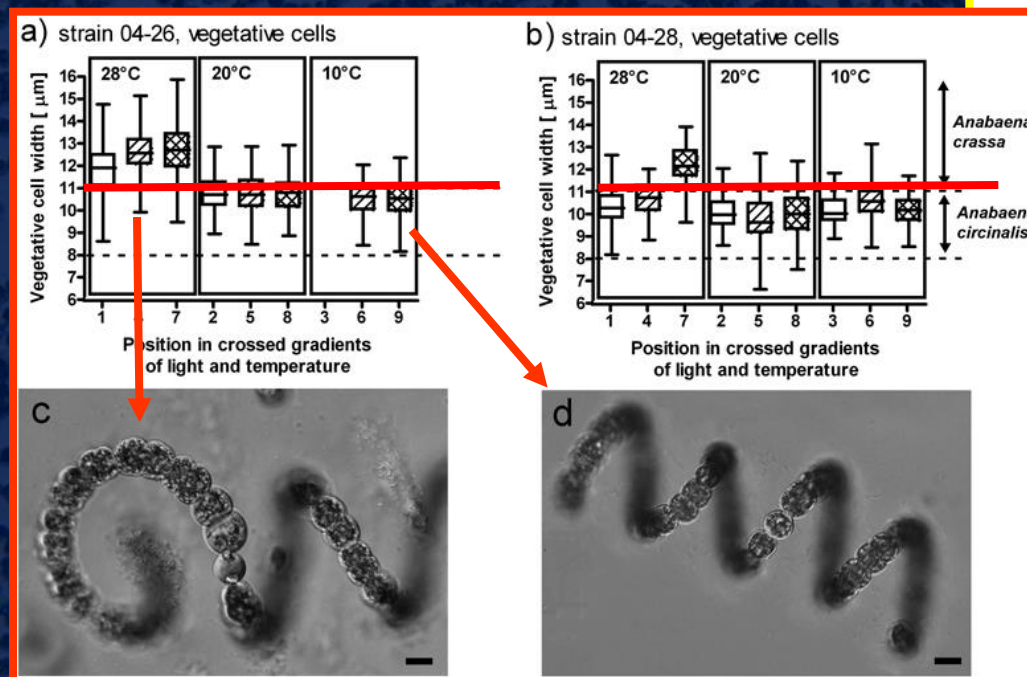
D. crassum

Dolichospermum circinale (Rabenh. ex Born. et Flah.) Wacklin et al. 2009

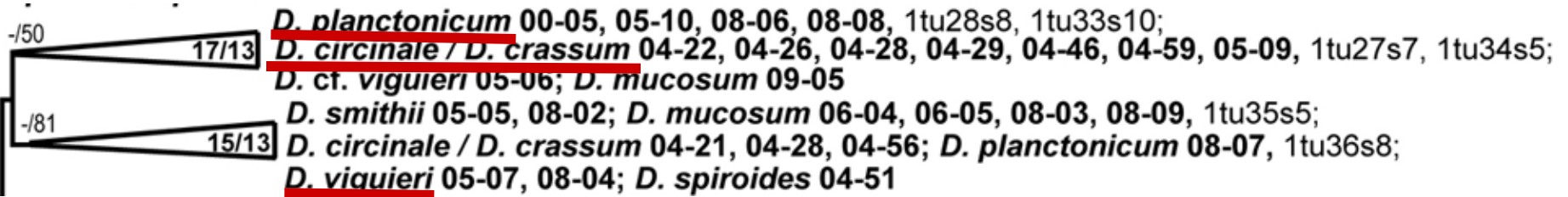
D. crassum (Lemm.) Wacklin et al. 2009

Morfologie přírodních populací (měřeno v přírodních vzorcích):

Vliv teploty na šířku vlákna v řízených laboratorních podmínkách:

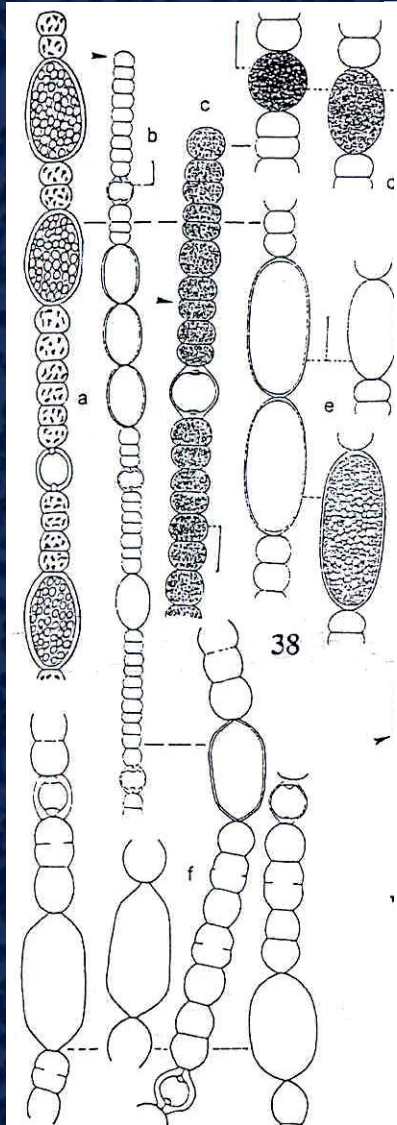


"Big" Dolichospermum morphospecies



Dolichospermum planctonicum (Brunnthal) Wacklin et al. 2009

D. viguieri (Denis & Frémy) Wacklin et al. 2009

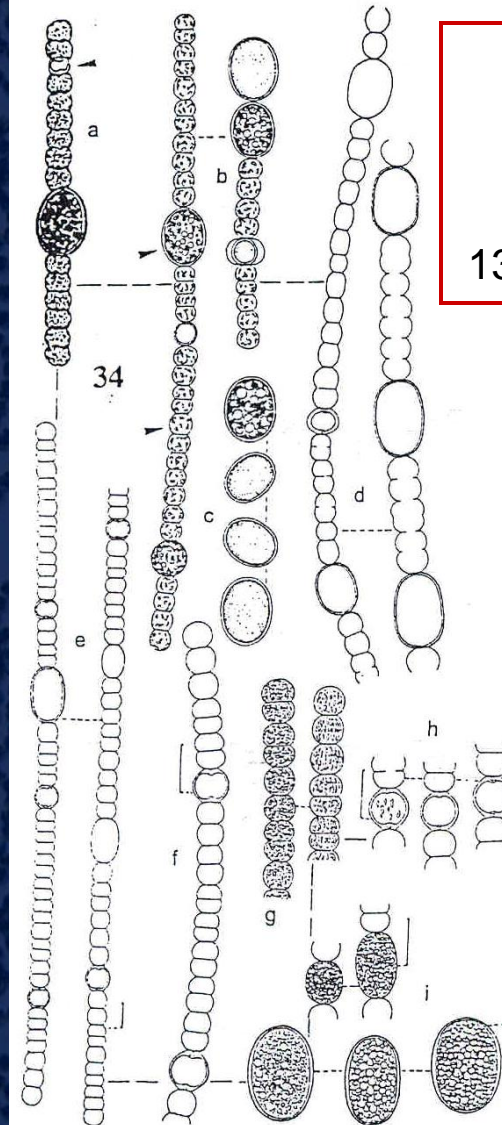


Šířka vlákna
(7.7) 8-15 μm

Akinety
15-37 x 9-21 μm

D. planctonicum

(Komárek 1958, Kiselev
in Kondratěva 1968,
M. Watanabe 1992)



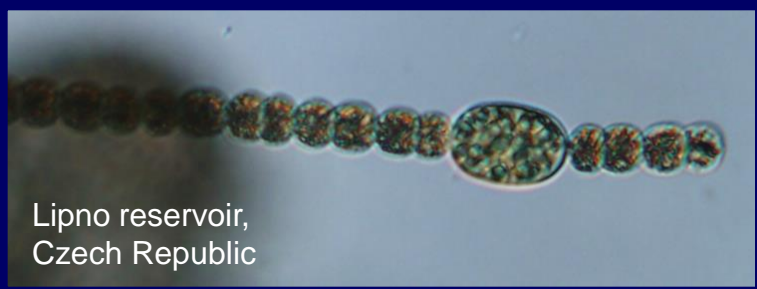
Šířka vlákna
(4.6) 5-7 (9) μm

Akinety
13.5-30 x 11-16 μm

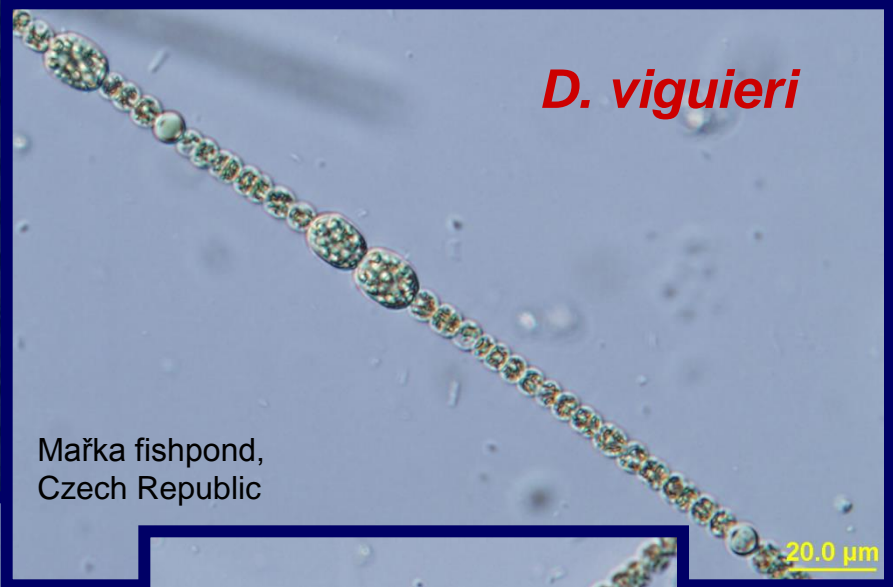
D. viguieri

(Denis, Frémy in Geitler
1932, Nygaard 1949,
Komárek 1958,
M. Watanabe 1992)

Dolichospermum planctonicum (Brunnthaler) Wacklin et al. 2009
D. viguieri (Denis et Frémy) Wacklin et al. 2009

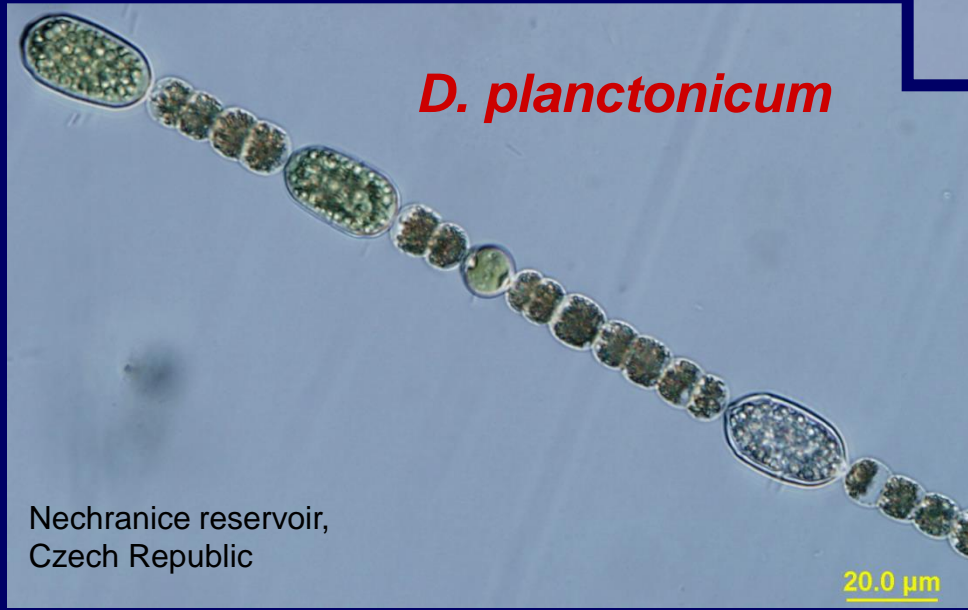


Lipno reservoir,
Czech Republic



D. viguieri

Mařka fishpond,
Czech Republic



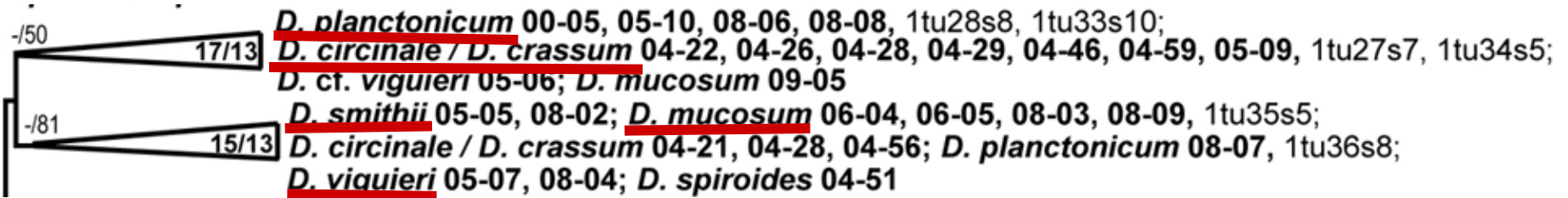
D. planctonicum

Nechranice reservoir,
Czech Republic



Mařka fishpond,
Czech Republic

"Big" Dolichospermum morphospecies

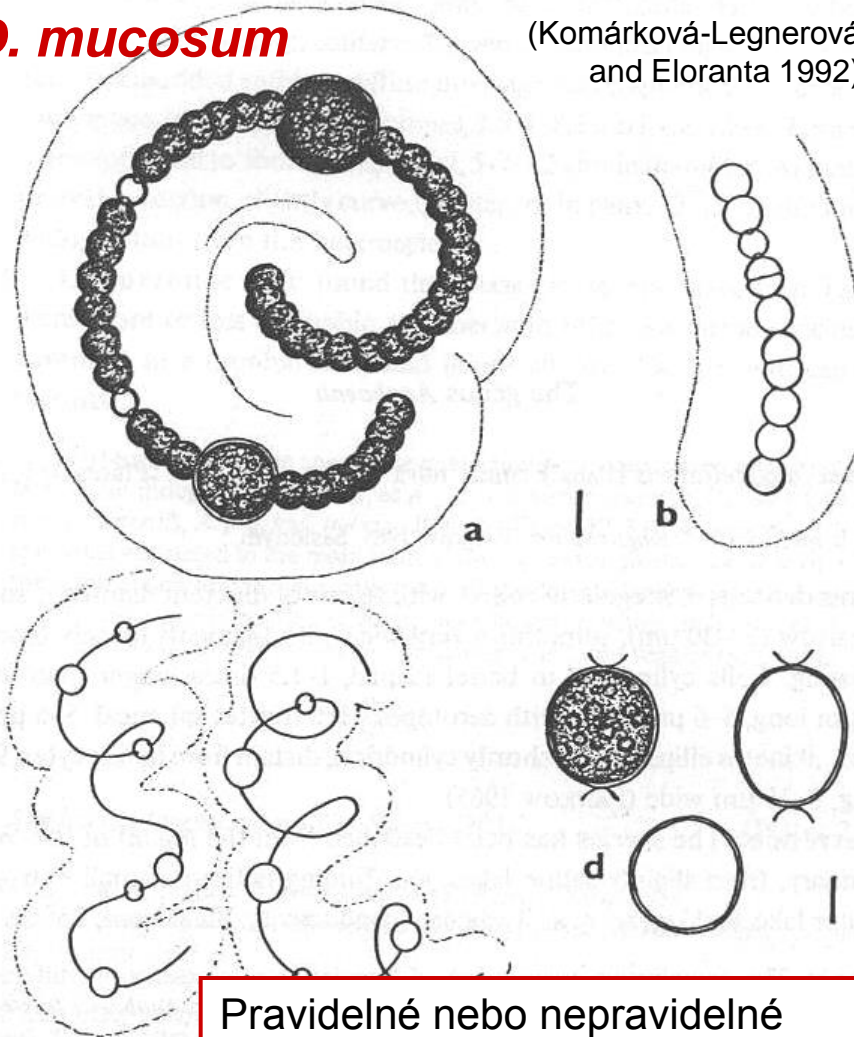


Dolichospermum mucosum (Kom.-Legn. et Eloranta) Wacklin et al. 2009

D. smithii (Komárek) Wacklin et al. 2009

D. mucosum

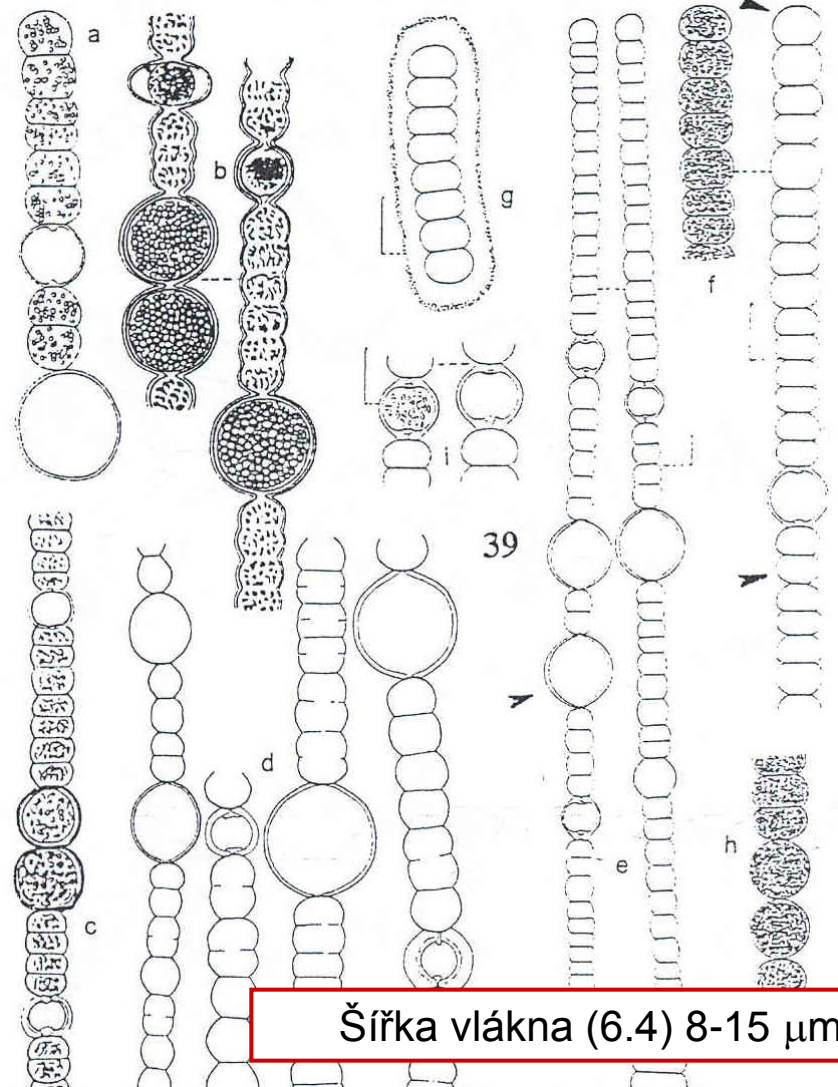
(Komárková-Legnerová
and Eloranta 1992)



Pravidelné nebo nepravidelné
vinutí o průměru 80-200 μm
Šířka vlákna (7) 7.5-9 μm

D. smithii

(G.M. Smith 1920, Komárek 1958, Elenkin
in Starmach 1966, Kondrat'eva 1968)



Šířka vlákna (6.4) 8-15 μm

Dolichospermum mucosum (Kom.-Legn. et Eloranta) Wacklin et al. 2009

D. smithii (Komárek) Wacklin et al. 2009

Mšeno reservoir,
Czech Republic

D. mucosum



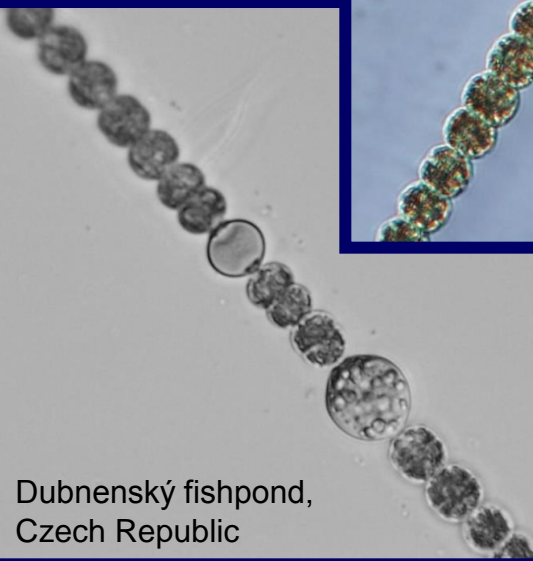
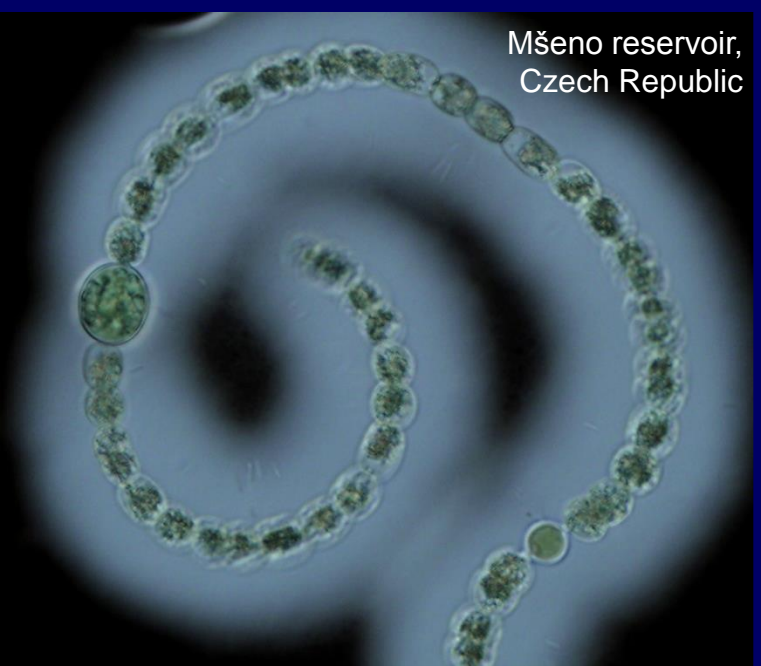
Mařka fishpond,
Czech Republic

D. smithii



Mařka fishpond,
Czech Republic

Mšeno reservoir,
Czech Republic



Dubnenský fishpond,
Czech Republic

Dolichospermum mucosum (Kom.-Legn. et Eloranta) Wacklin et al. 2009 *var. ucraianicum* (Schkorb.) M. Watanabe 196

Mšeno reservoir,
Czech Republic

D. mucosum



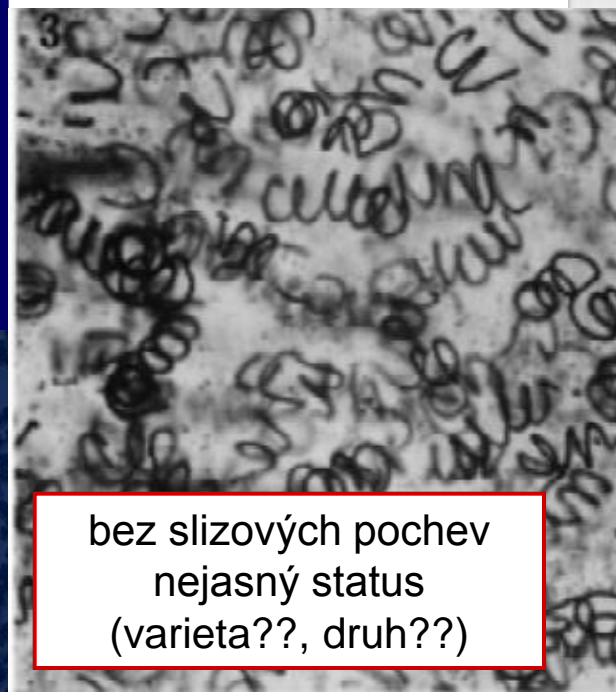
Pravidelné nebo nepravidelné
vinutí o průměru 80-200 μm
Šířka vlákna (7) 7.5-9 μm



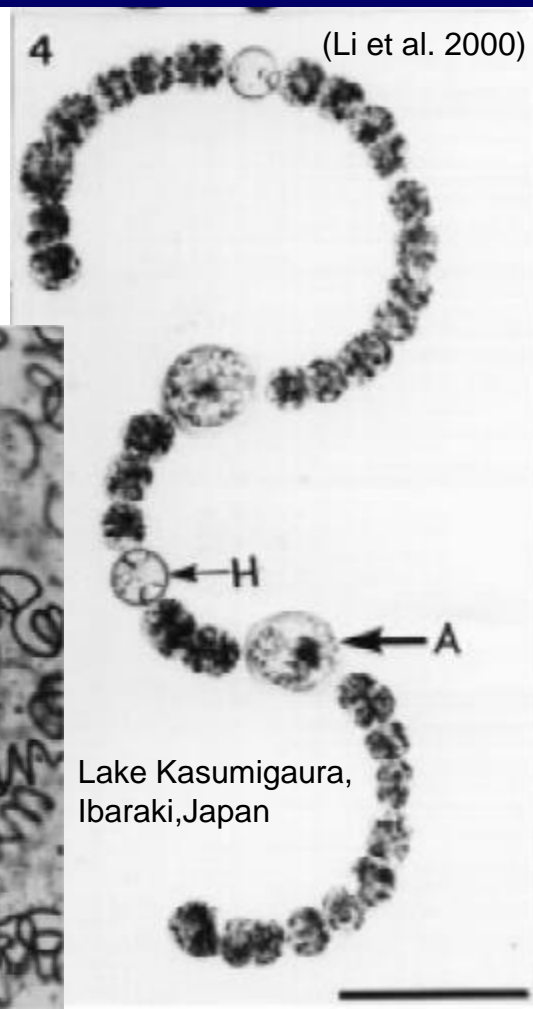
Mšeno reservoir,
Czech Republic

var. ucraianicum

bez slizu



bez slizových pochev
nejasný status
(varietá??, druh??)

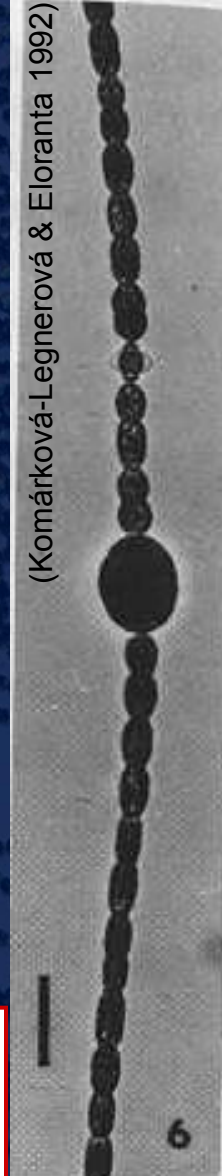
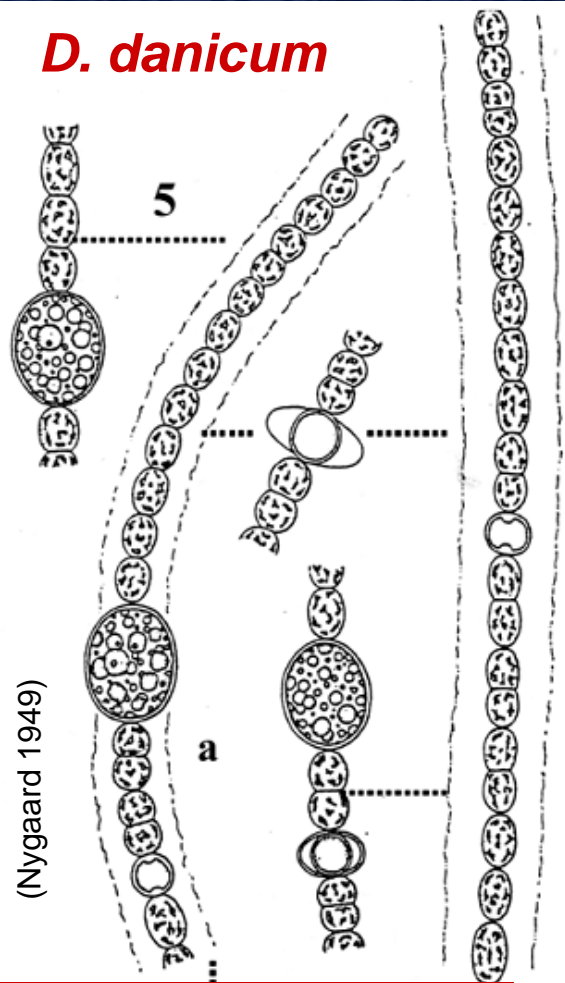


Lake Kasumigaura,
Ibaraki, Japan

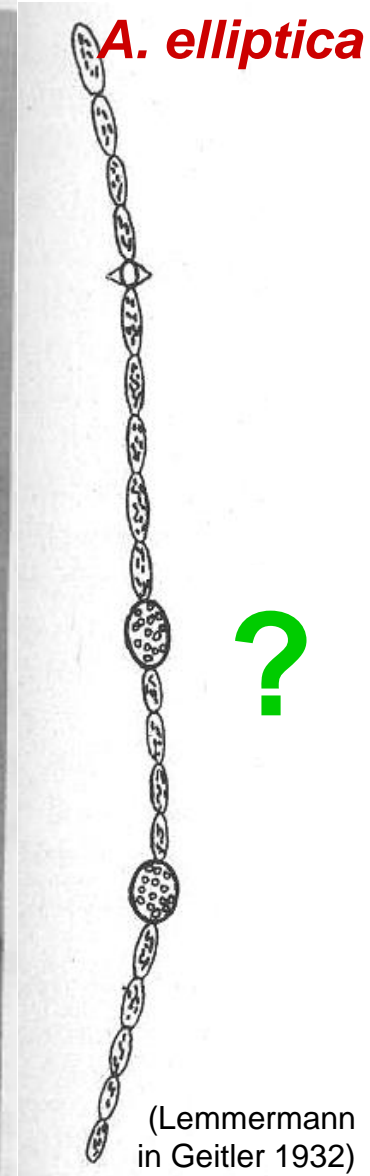
Dolichospermum danicum (Nygaard) Wacklin et al. 2009

Anabaena elliptica Lemmermann 1898

D. danicum



A. elliptica



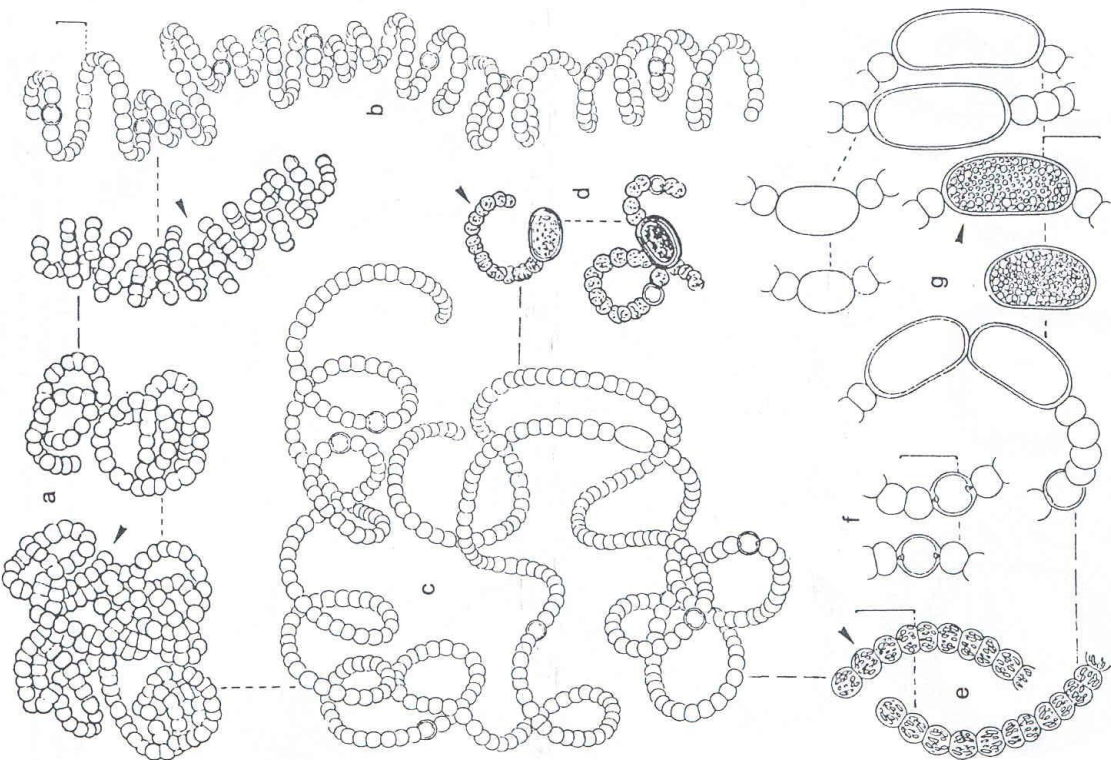
Šířka vlákna 5-7 μm
 Akinety 18-19 (23.3) x
 x13-17.5 μm

Vegetativní buňky
 ~14 x 7 μm
 Akinety až 25 x 15-16 μm

Dolichospermum flos-aquae (Bréb ex Born. et Flah.) Wacklin et al. 2009
D. spiroides (Klebahn) Wacklin et al. 2009

D. flos-aquae

(Komárek 1958, Kondratěva 1968)



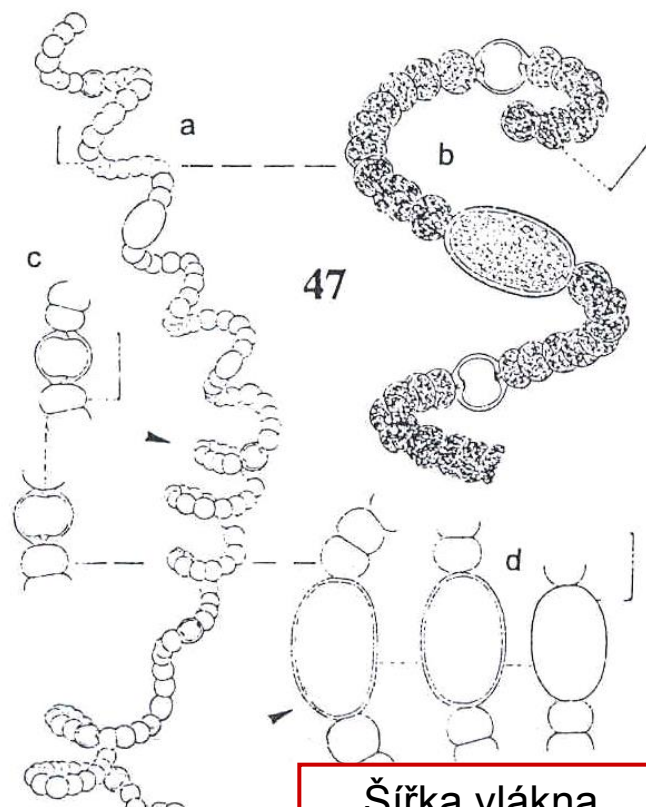
Šířka vlákna 4-7 (8.3) μm

Akinety

(12)15-24 (35) x x (5) 7- 12.8 (14) μm

D. spiroides

(Komárek 1958)



Šířka vlákna
6-8 (9) μm

Akinety

15-22 x 9-14 μm

Dolichospermum flos-aquae (Bréb ex Born. et Flah.) Wacklin et al. 2009

D. spiroides (Klebahn) Wacklin et al. 2009

D. flos-aquae

Byňov fishpond,
Czech Republic

Vajgar fishpond,
Czech Republic

Opatovický fishpond,
Czech Republic

D. spiroides

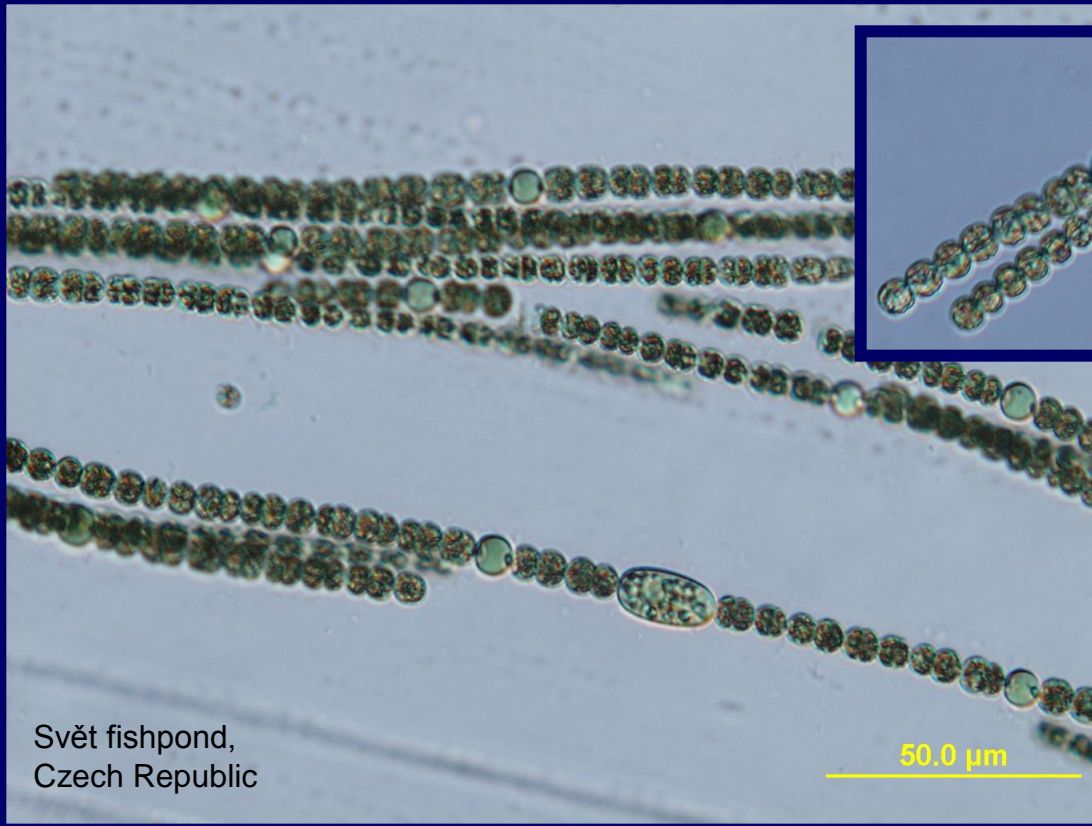
Svět fishpond,
Czech Republic

Dehtář fishpond,
Czech Republic

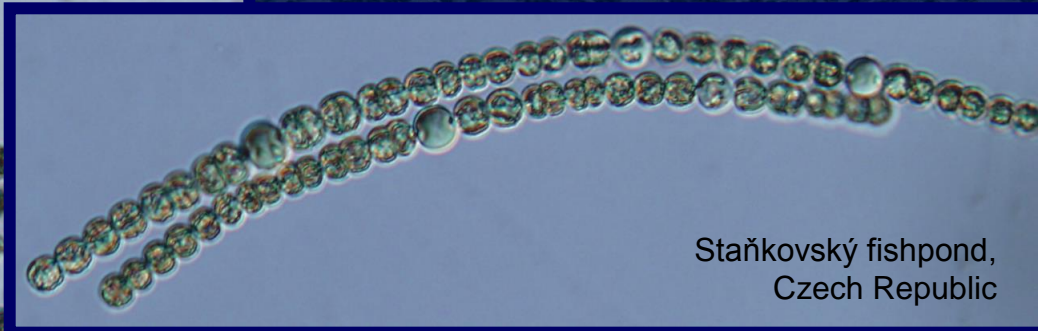
Švarcenberk
fishpond,
Czech Republic

Římov
reservoir,
Czech Republic

Dolichospermum affine (Brunnthaler) Wacklin et al. 2009

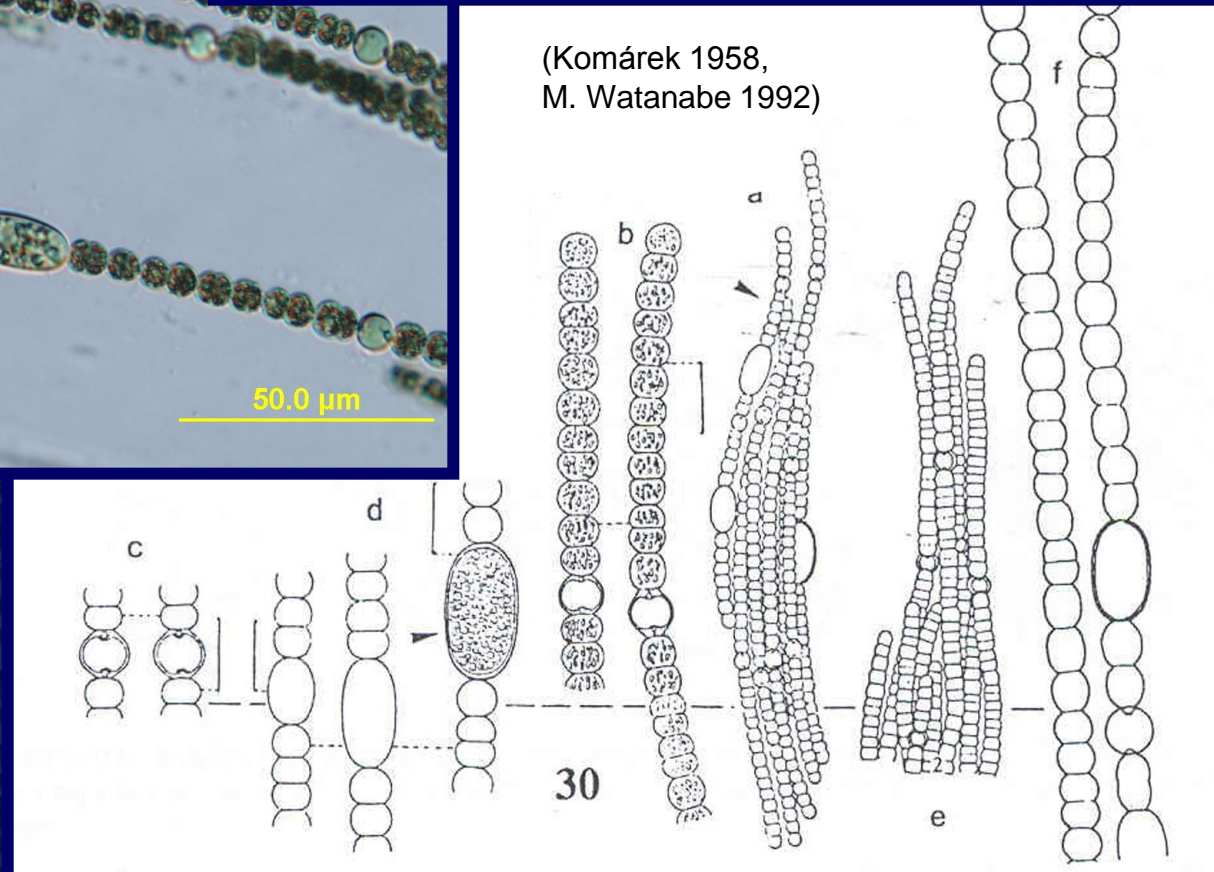


Svět fishpond,
Czech Republic



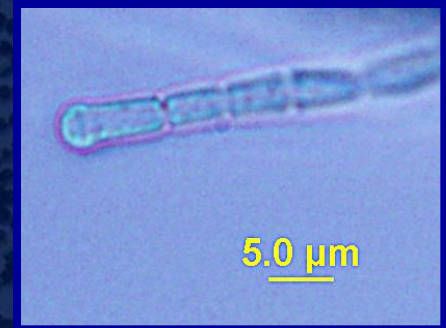
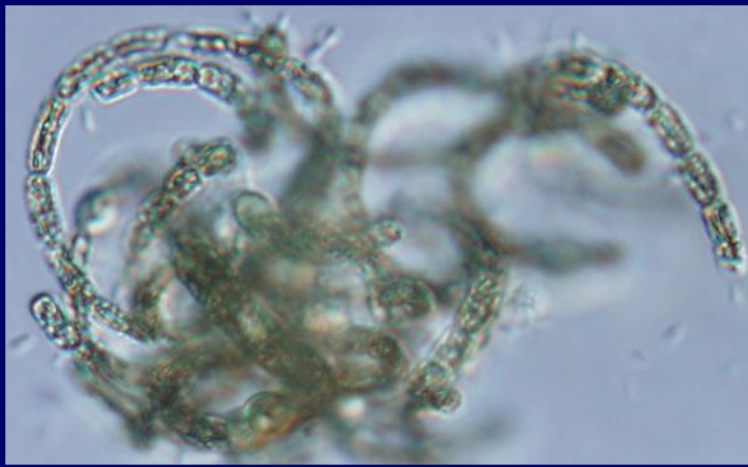
Staňkovský fishpond,
Czech Republic

(Komárek 1958,
M. Watanabe 1992)

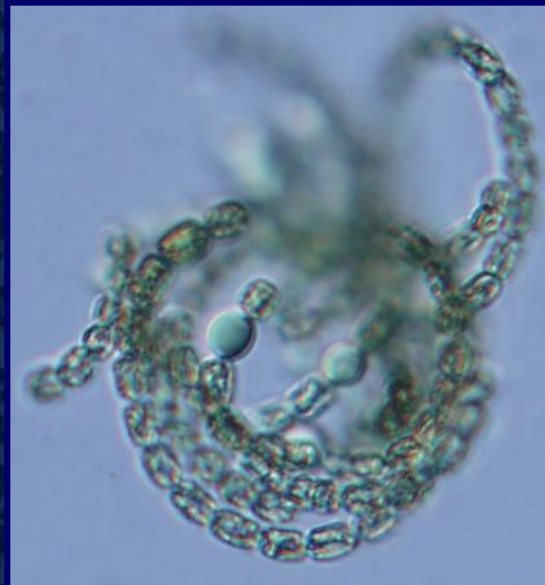
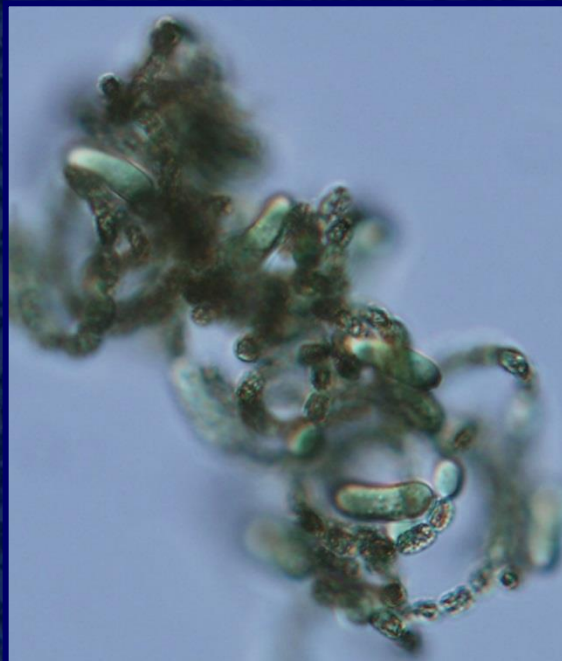


Šířka vlákna
(3) 4.5-7 (8) μm

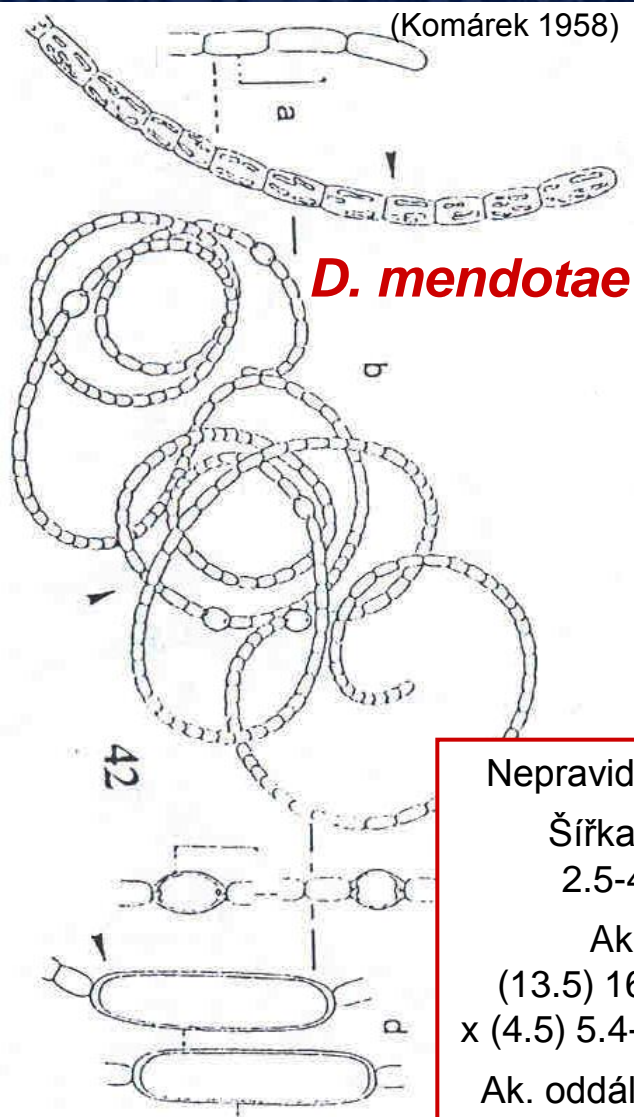
Akinety
11-30 x 9.2-13 μm



-/90 15/12 *Aph. gracile* 00-06, 1tu26s16; *D. tenericaulis* 08-10, 08-11;
D. mendotae / *D. sigmoideum* 04-05, 04-06, 04-11, 04-14, 04-33, 04-45, 04-61, 04-63, 05-01;
D. circinale var. *macrosporum* 0tu25s6, 1tu26s10



Dolichospermum mendotae (Trelease) Wacklin et al. 2009
Dolichospermum sigmoideum (Nygaard) Wacklin et al. 2009



D. mendotae

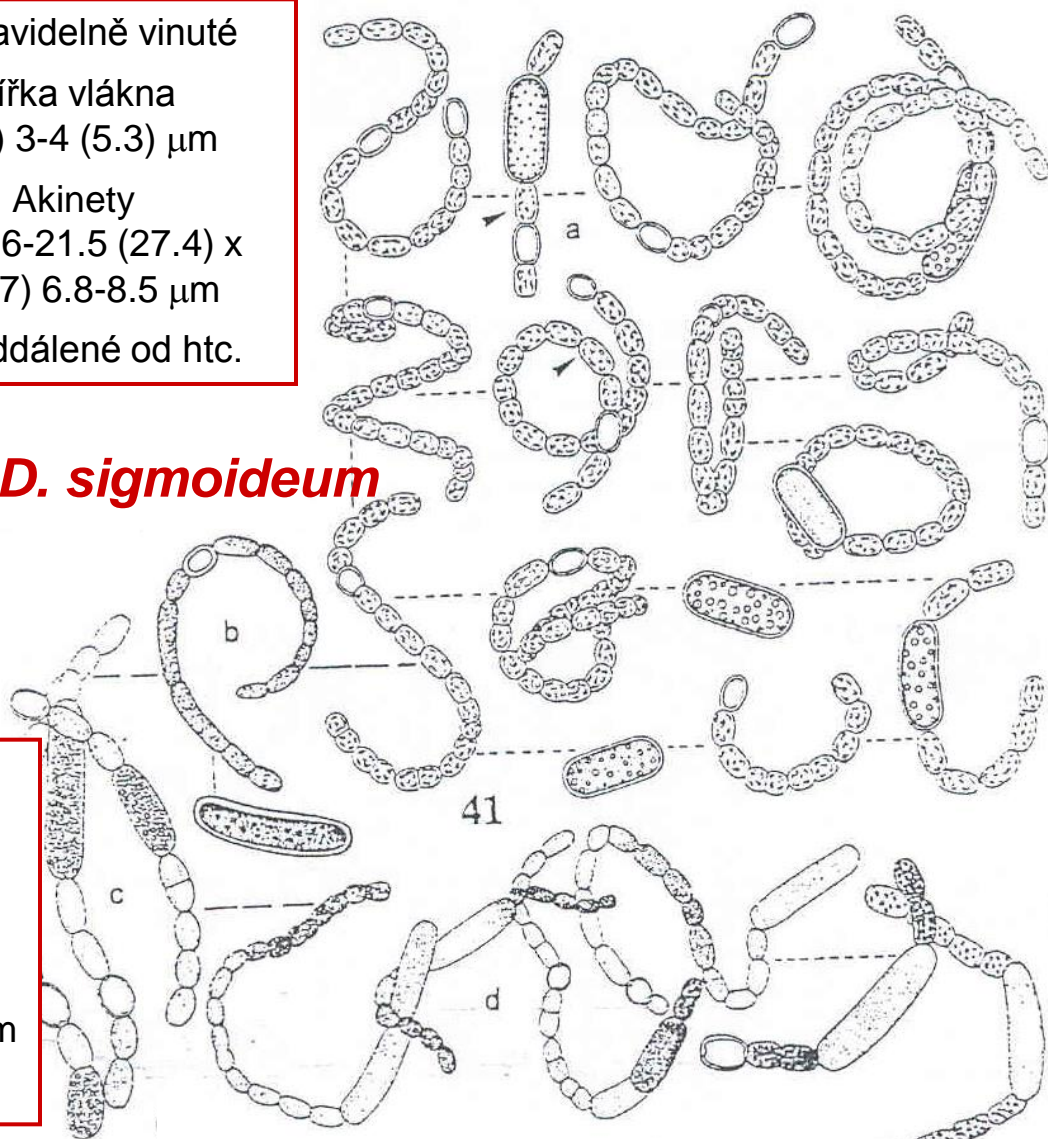
Nepravidelně vinuté

Šířka vlákna
(2.5) 3-4 (5.3) μm

Akinety
(12) 16-21.5 (27.4) x
x (5.7) 6.8-8.5 μm

Ak. oddálené od htc.

D. sigmoideum



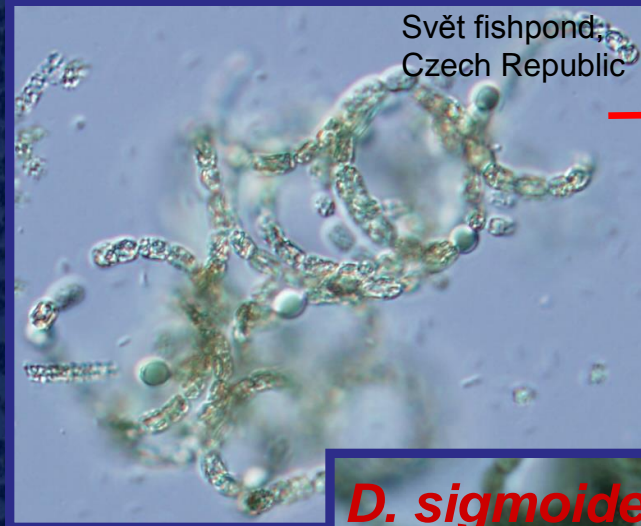
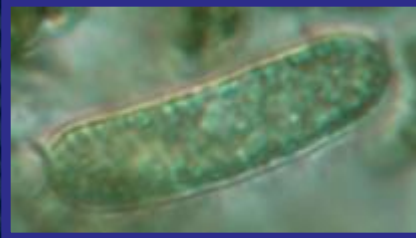
Nepravidelně vinuté

Šířka vlákna
2.5-4.5 μm

Akinety
(13.5) 16-30 (45) x
x (4.5) 5.4-7.8 (8.4) μm

Ak. oddálené od htc.

Dolichospermum mendotae (Trelease) Wacklin et al. 2009
Dolichospermum sigmoideum (Nygaard) Wacklin et al. 2009



Svět fishpond,
Czech Republic



Strain 04-45, culture conditions
Svět fishpond, Czech Republic

D. sigmoideum



Stanovice,
reservoir,
Czech Republic

20.0 μm



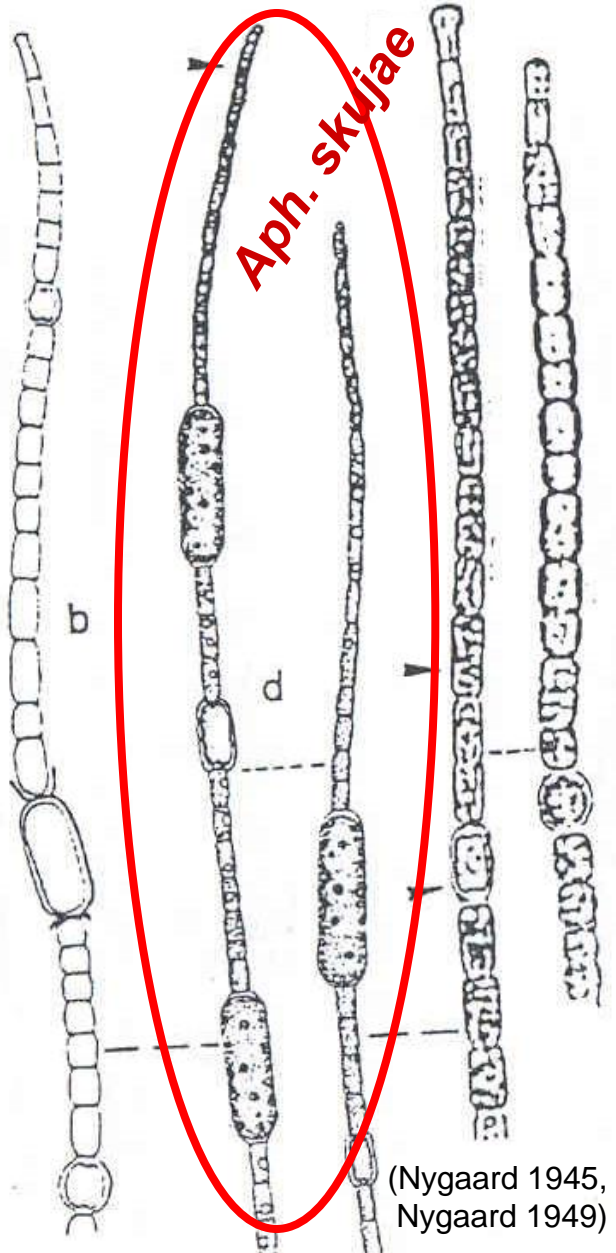
D. mendotae

Černiš fishpond,
Czech Republic

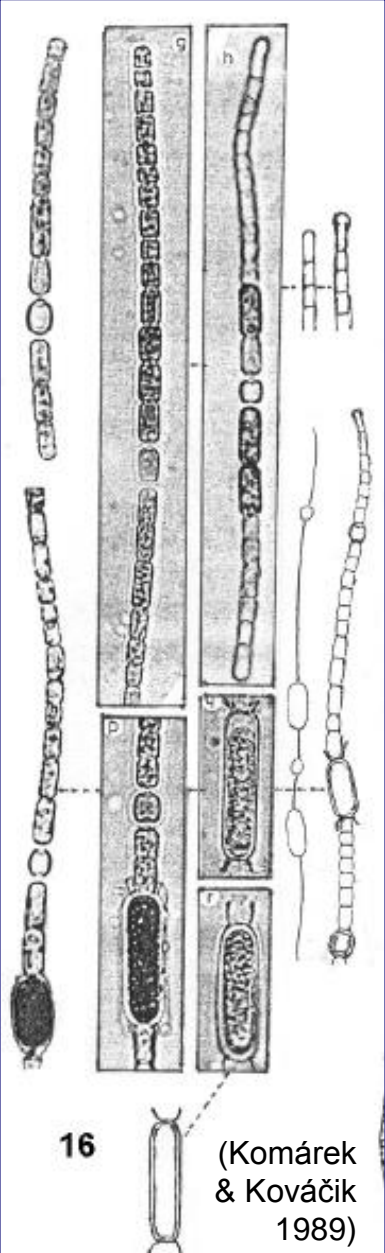
20.0 μm

Aphanizomenon gracile (Lemmermann) Lemmermann 1907

Aph. skujajae



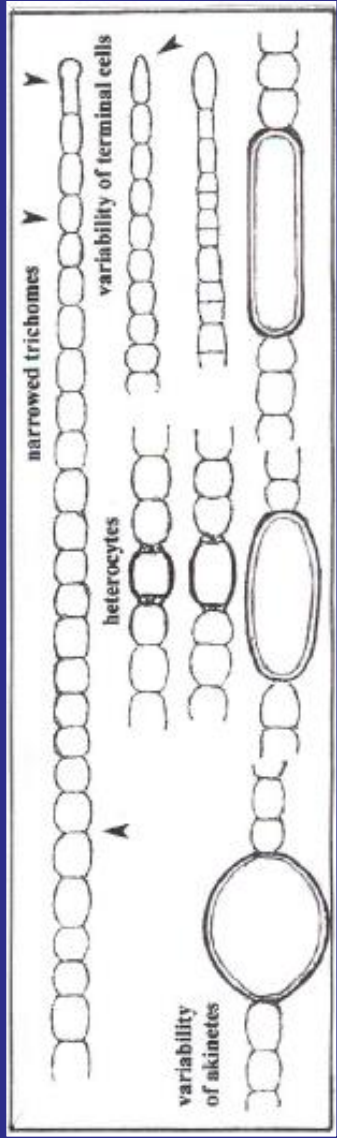
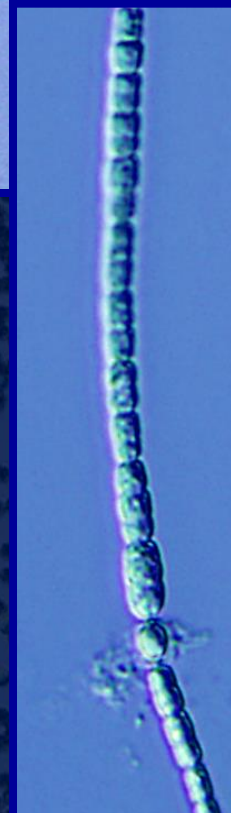
(Nygaard 1945, Nygaard 1949)



(Komárek & Kováčik 1989)

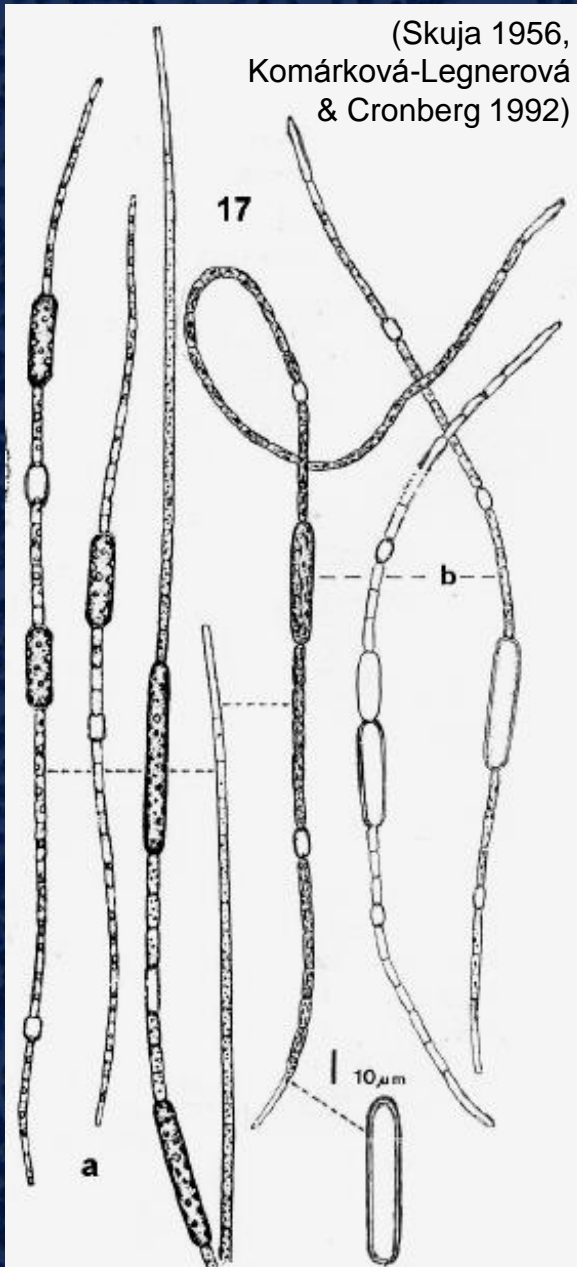
Šířka vlákna
(3.8) 4-5 (5.9) μm

Akinety
(8) 8.9-12.5 x
X (7) 7.6-11 μm



After Rajaniemi et al. 2005

Aphanizomenon skujae Komárková-Legnerová & Cronberg 1992



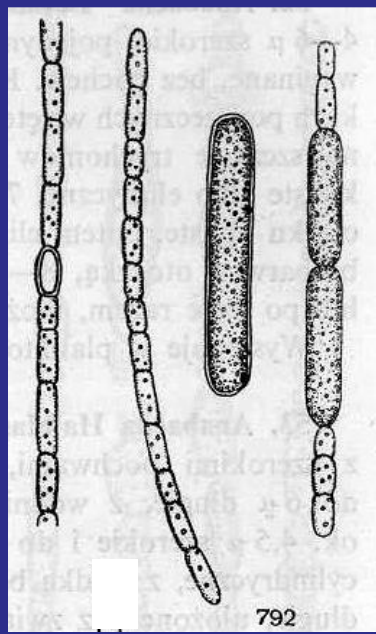
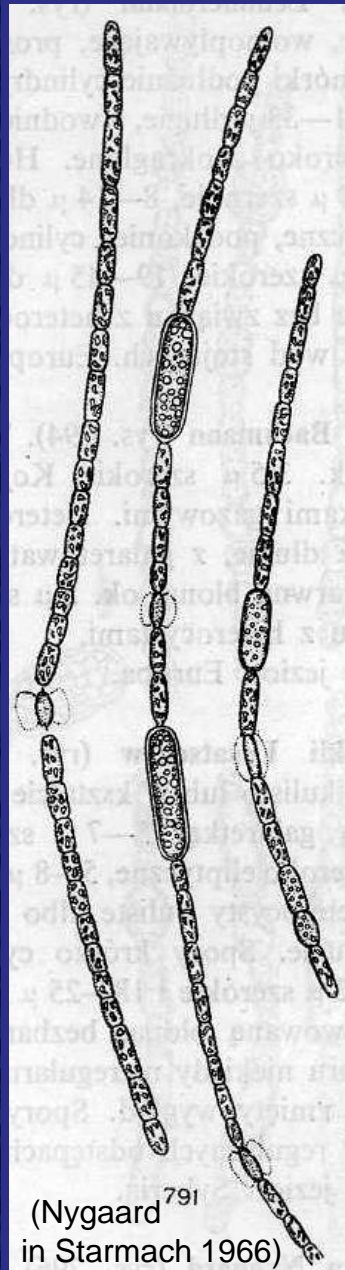
Šířka vlákna 1.7-2.6 μm

Akinety
20-34 (40) x 2.7-4.7 μm

Popsán ze Švédska.

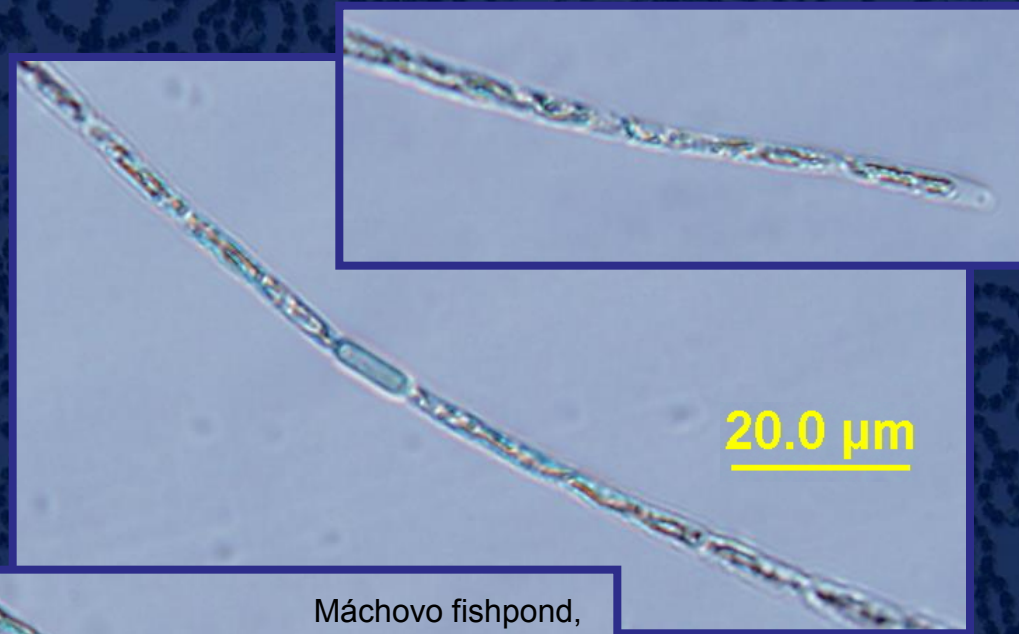
?

Dolichospermum tenericaule Nygaard 1949



Šířka vlákna
2-3 μm
Akinety
13-40 x 5-6.7 μm

(Nygaard⁷⁹¹
in Starmach 1966)



Máchovo fishpond,
Czech Republic



Hydrobiologia (2012) 698:353–365
DOI 10.1007/s10750-012-1034-z

PHYTOPLANKTON

Biogeographically interesting planktonic Nostocales (Cyanobacteria) in the Czech Republic and their polyphasic evaluation resulting in taxonomic revisions of *Anabaena bergii* Ostenfeld 1908 (*Chrysochloris* gen. nov.) and *A. tenericaulis* Nygaard 1949 (*Dolichospermum tenericaule* comb. nova)

Eliška Zapomělová · Olga Skácelová ·
Petr Pumann · Radovan Kopp · Emil Janeček

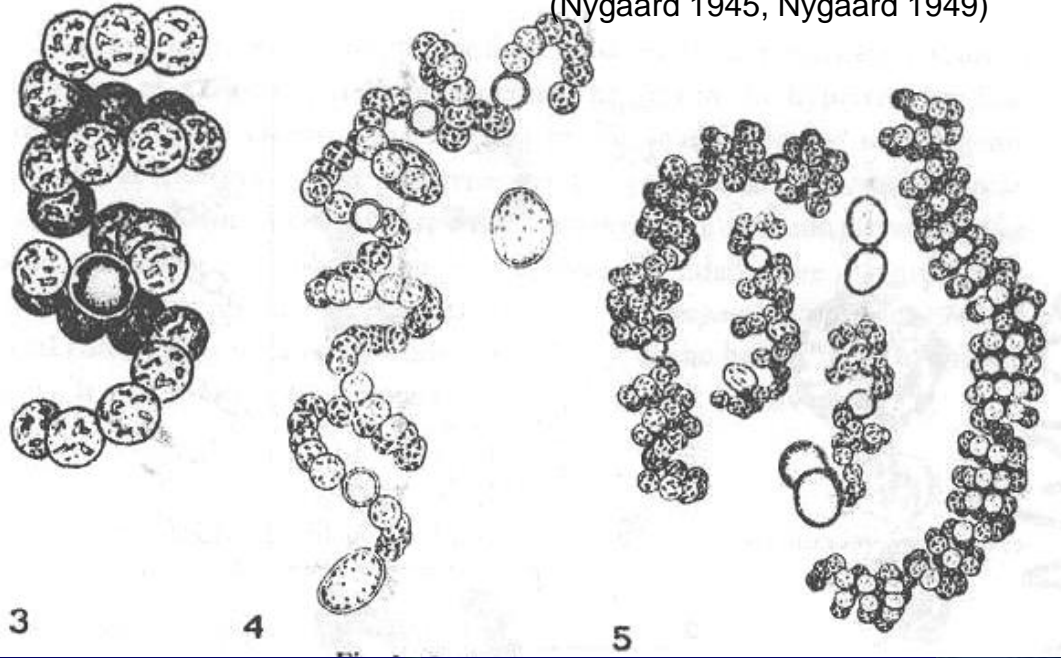
Received: 16 November 2011 / Accepted: 12 February 2012 / Published online: 2 March 2012
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Abstract Questions of biogeography of freshwater cyanobacteria and their ability to colonize new areas have been recently discussed in connection with increasing occurrence of some formerly rare morpho-species in temperate zones. Nevertheless, the general

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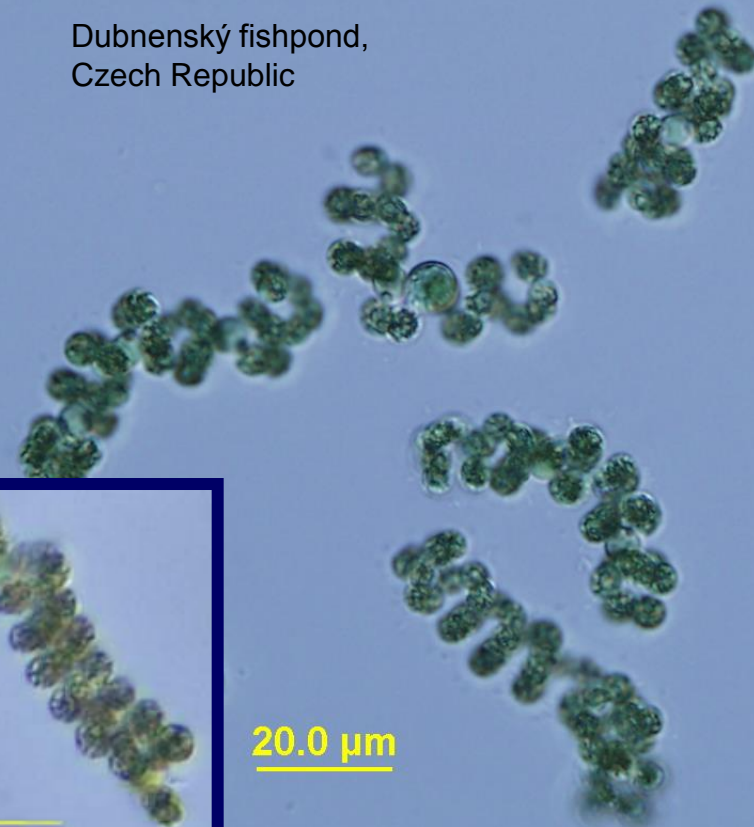
Dolichospermum compactum (Nygaard) Wacklin et al. 2009

(Nygaard 1945, Nygaard 1949)

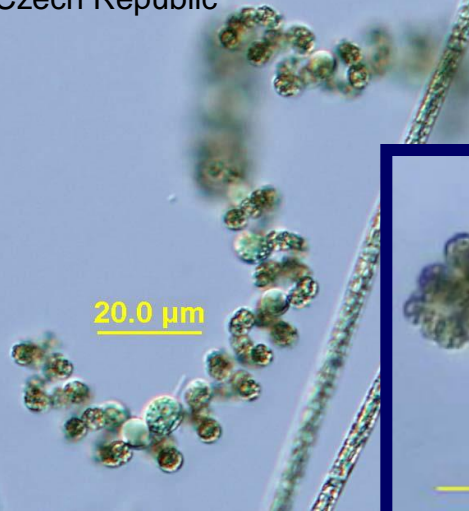


Striktně pravidelná spiralizace
Velmi kompaktní vinutí
Průměr otáček 11-16 μm
Šířka vlákna (3.8) 4-5 (5.9) μm
Akinety (8) 8.9-12.5 x (7) 7.6-11 μm
Akinety oddálené od heterocytů

Dubnenský fishpond,
Czech Republic



Svět fishpond,
Czech Republic



Pěšák fishpond,
Czech Republic

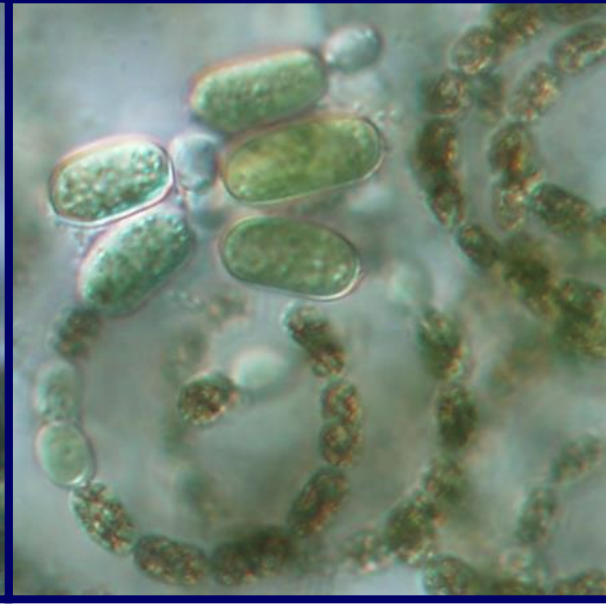
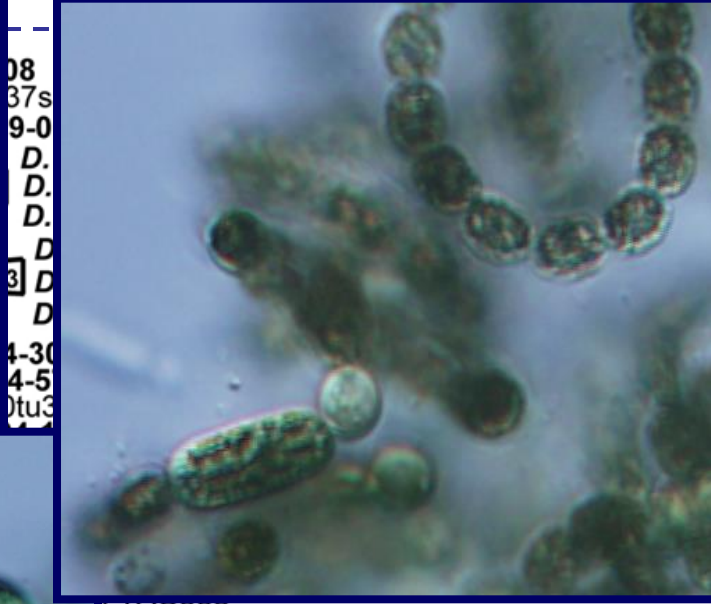
20.0 μm

20.0 μm

50.0 μm

20.0 μm

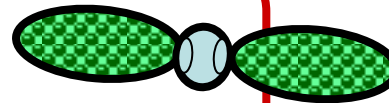
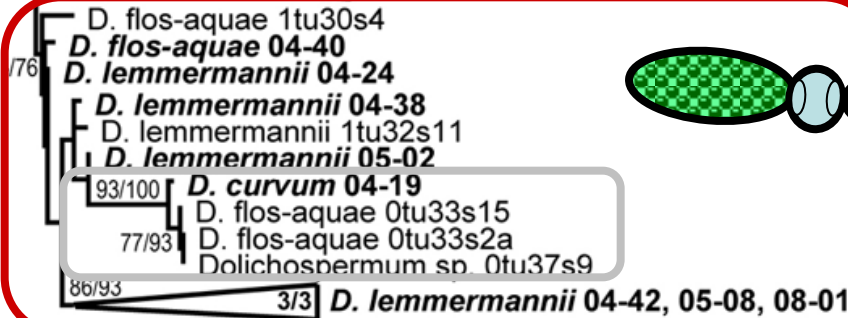
Dolichospermum + Aphanizomenon



Dolichospermum lemmermannii

Dolichospermum cf. *curvum*

00-06, 1tu26s16; *D. tenericaulis* 08-10, 08-11;
D. sigmoideum 04-05, 04-06, 04-11, 04-14, 04-33, 04-45, 04-61, 04-63, 05-01;
D. macrosporum 0tu25s6, 1tu26s10
D. compactum 04-17, 06-02, 06-03, ANACOM-KOR



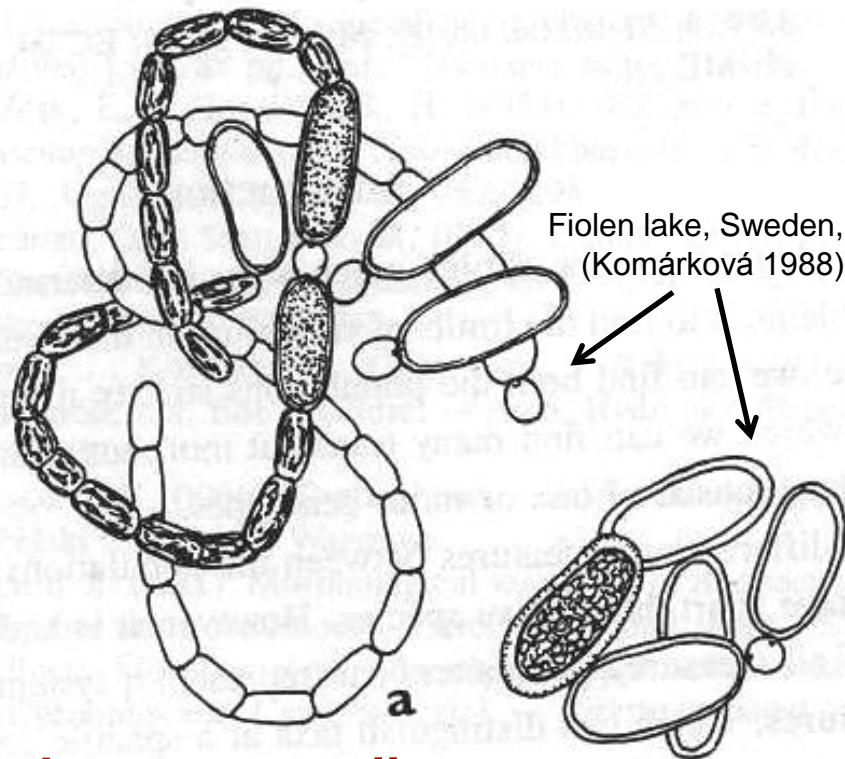
ML tree
16S rRNA gene
1414 bp
ML/NJ bootstraps

(Zapomělová et al. in prep.)

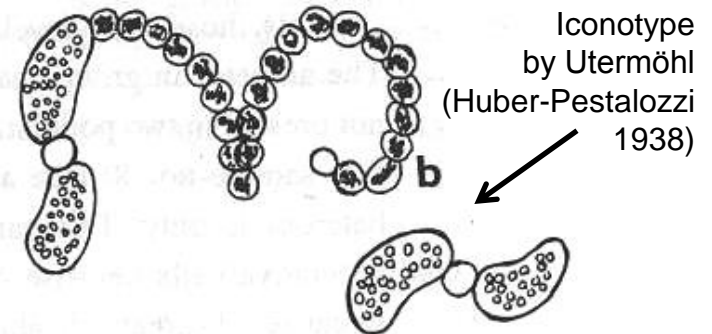
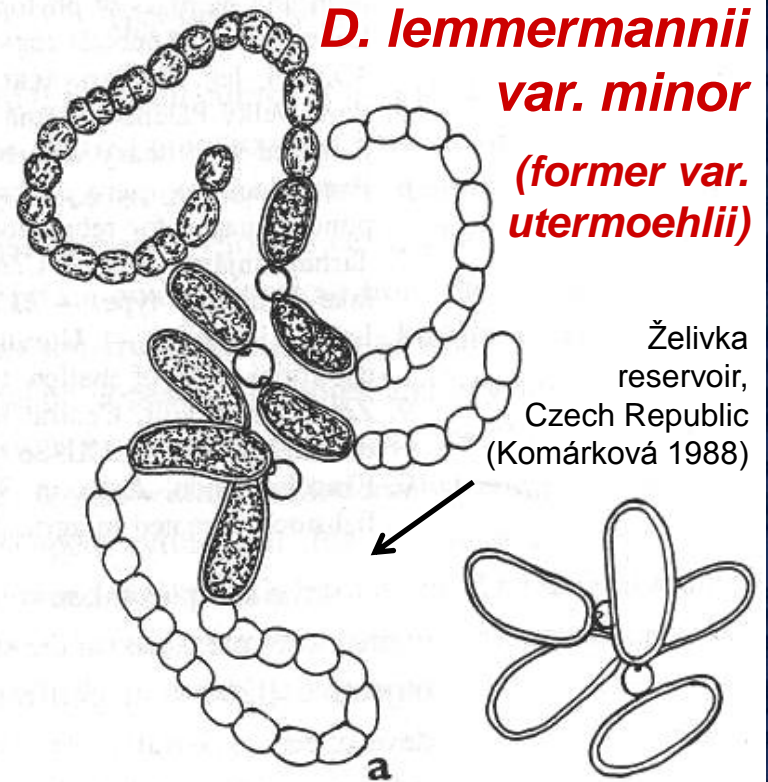
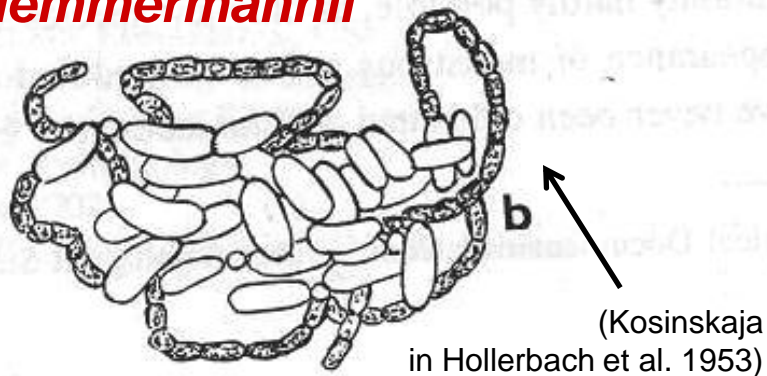
An. oscillarioides BECID32
 An. oscillarioides BECID22

Dolichospermum lemmermannii

(Richter in Lemmermann) Wacklin et al. 2009



D. lemmermannii
var. lemmermannii



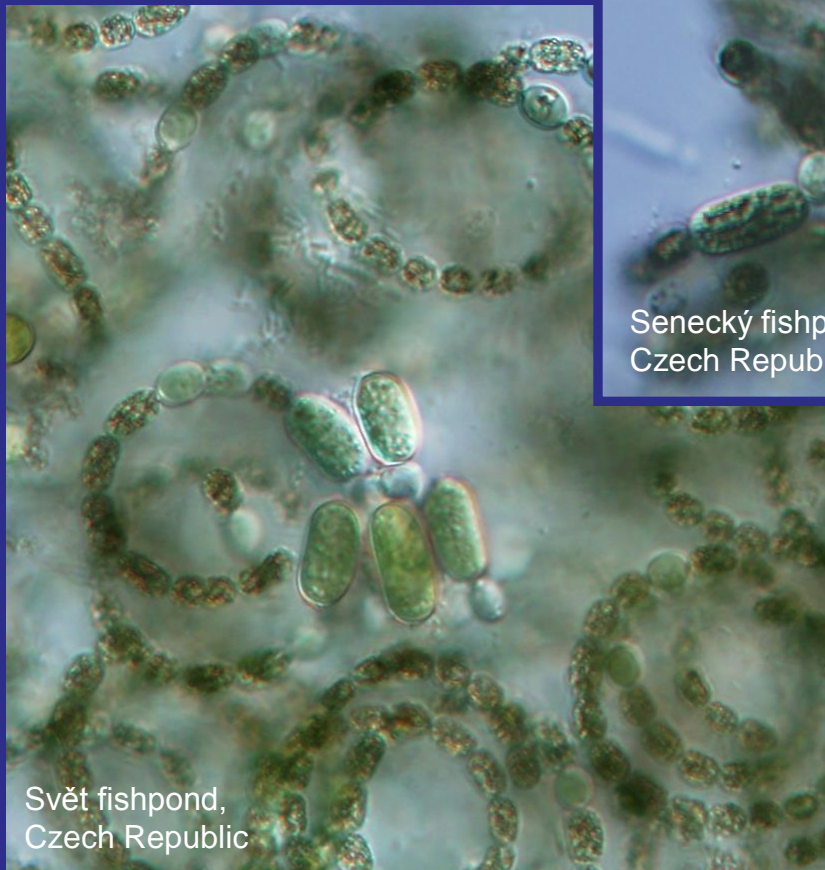
Dolichospermum lemmermannii

(Richter in Lemmermann) Wacklin et al. 2009

D. lemmermannii
var. *minor*



Senecký fishpond,
Czech Republic



Svět fishpond,
Czech Republic



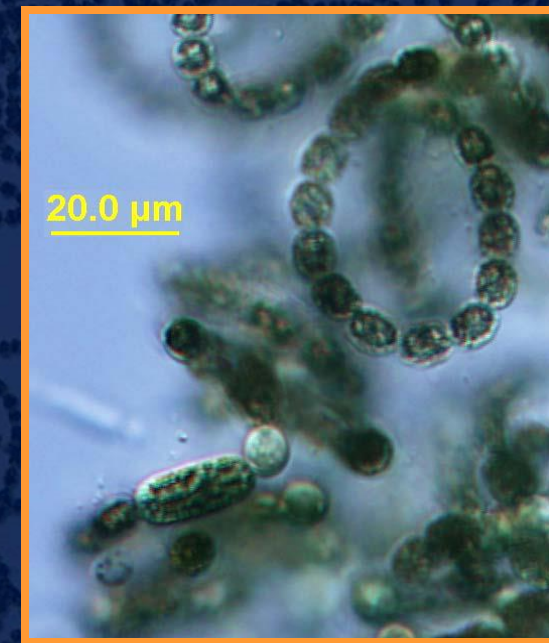
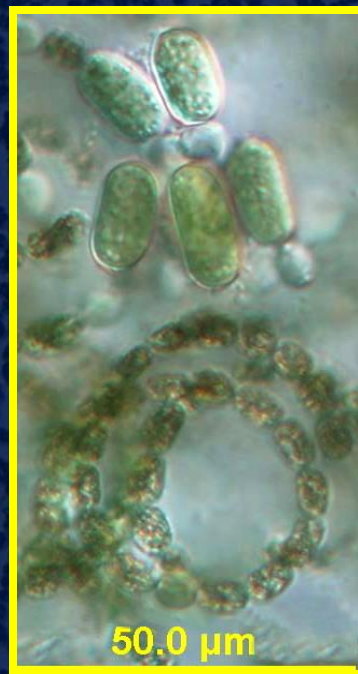
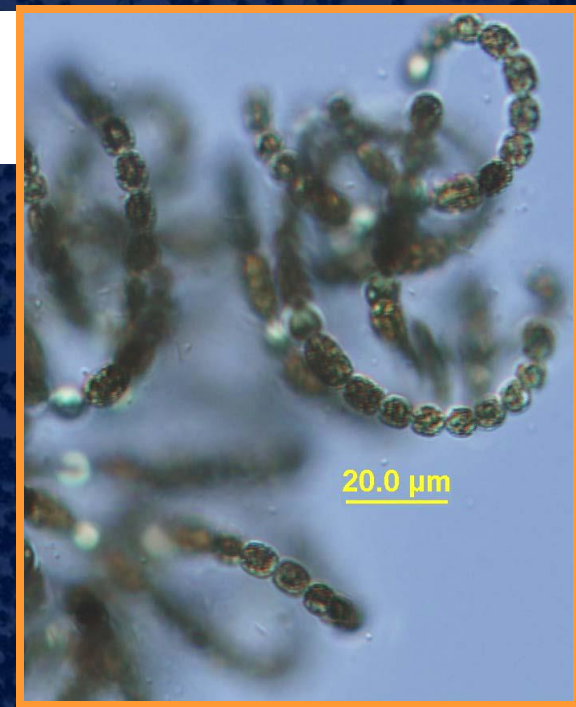
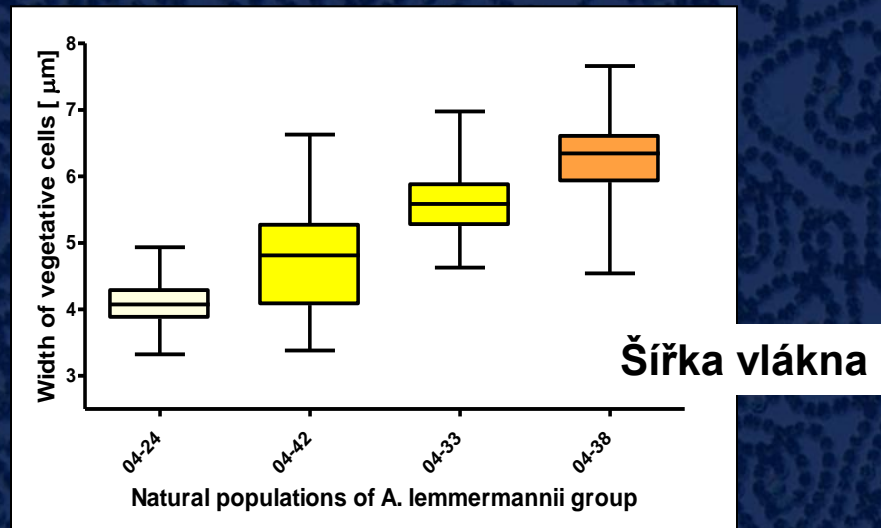
Husinec reservoir,
Czech Republic

D. lemmermannii
var. *lemmermannii*

20.0 μm

Dolichospermum lemmermannii

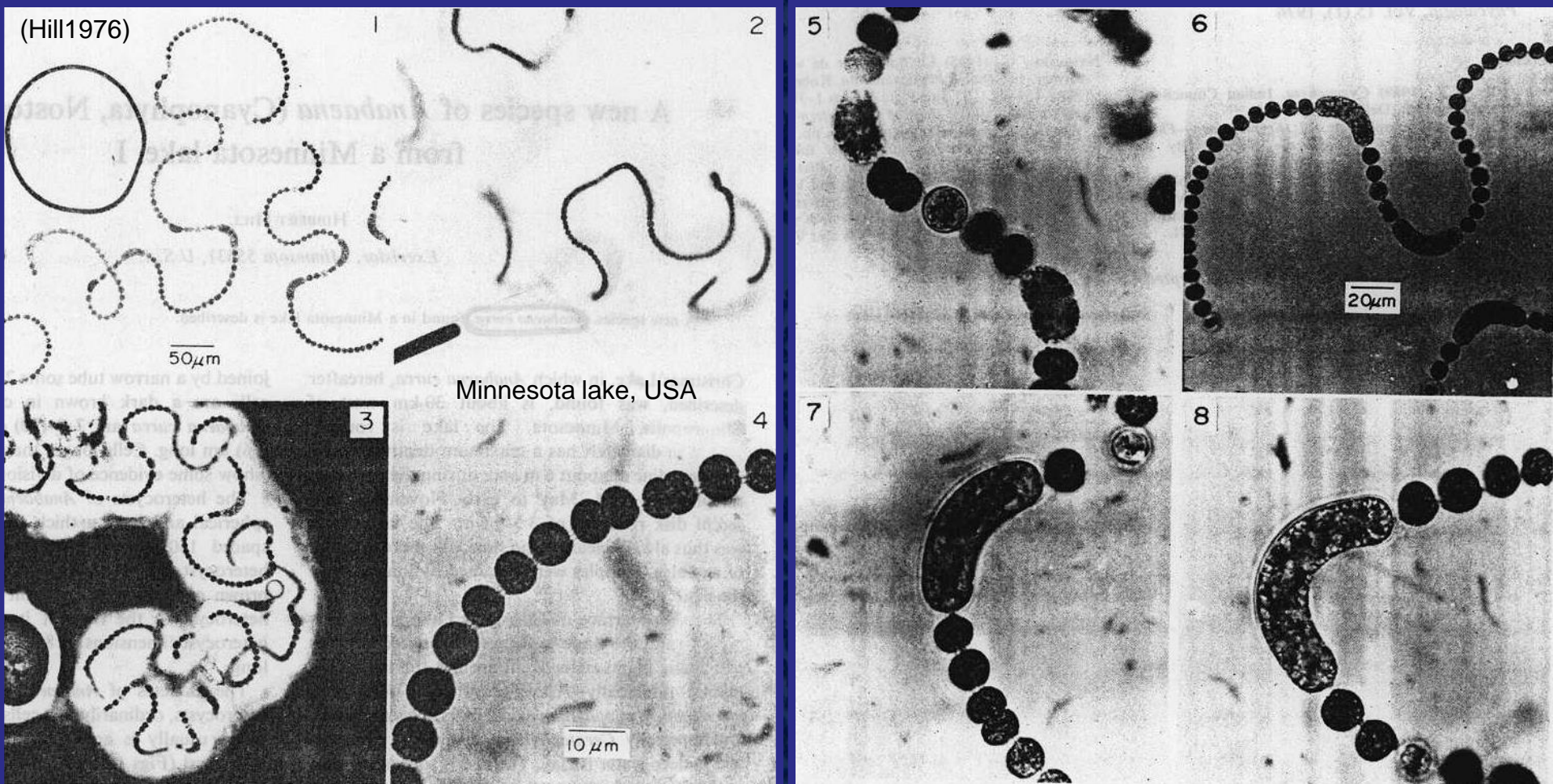
(Richter in Lemmermann) Wacklin et al. 2009



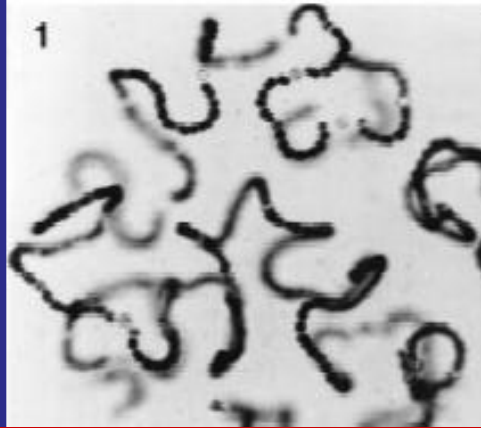
Dolichospermum curvum (Hill) Wacklin et al. 2009

Šířka vlákna
7-9 (10) μm

Akinety
26-47 x 9.5-11.0 (12.0) μm

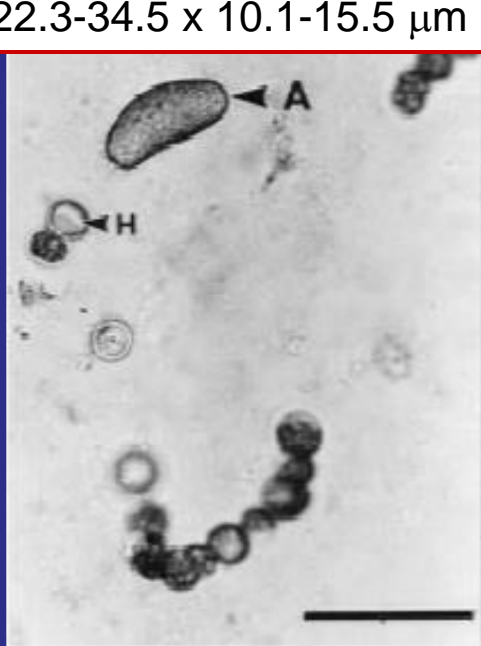
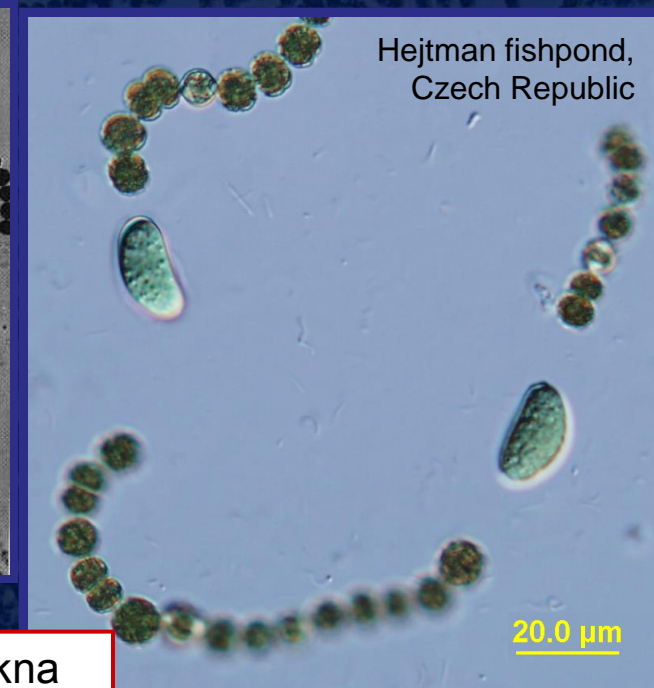
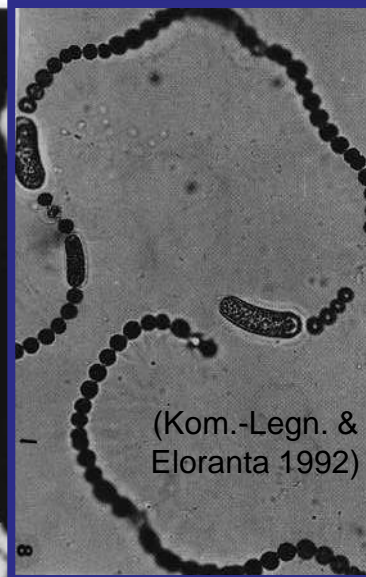


Dolichospermum curvum (Hill) Wacklin et al. 2009



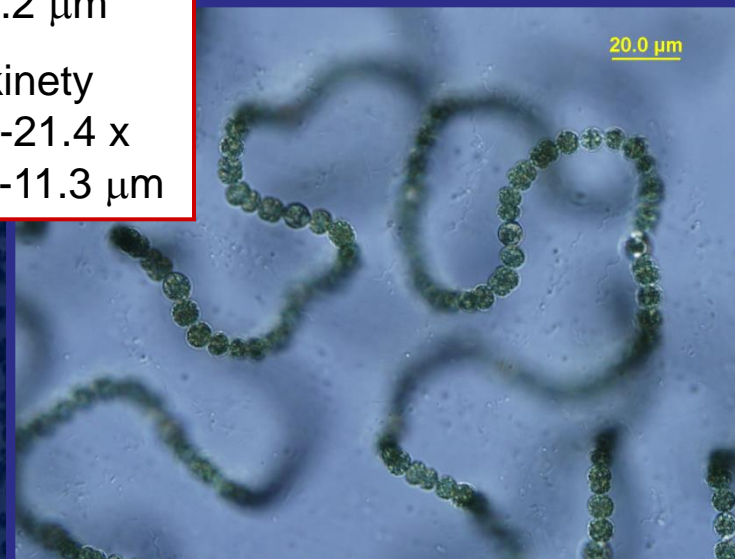
Šířka vlákna
8.3-13 μm

Akinety
22.3-34.5 x 10.1-15.5 μm

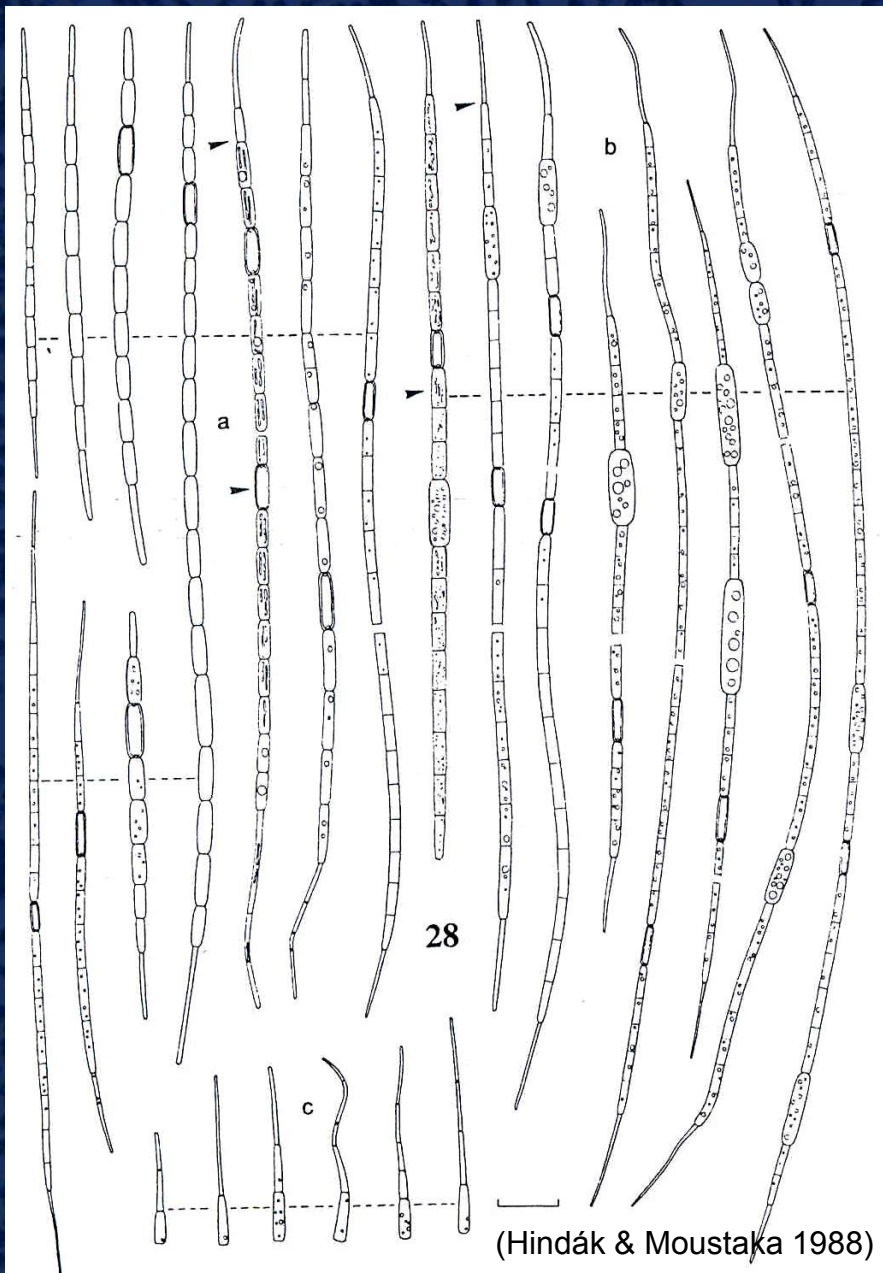


Šířka vlákna
6-8.2 μm

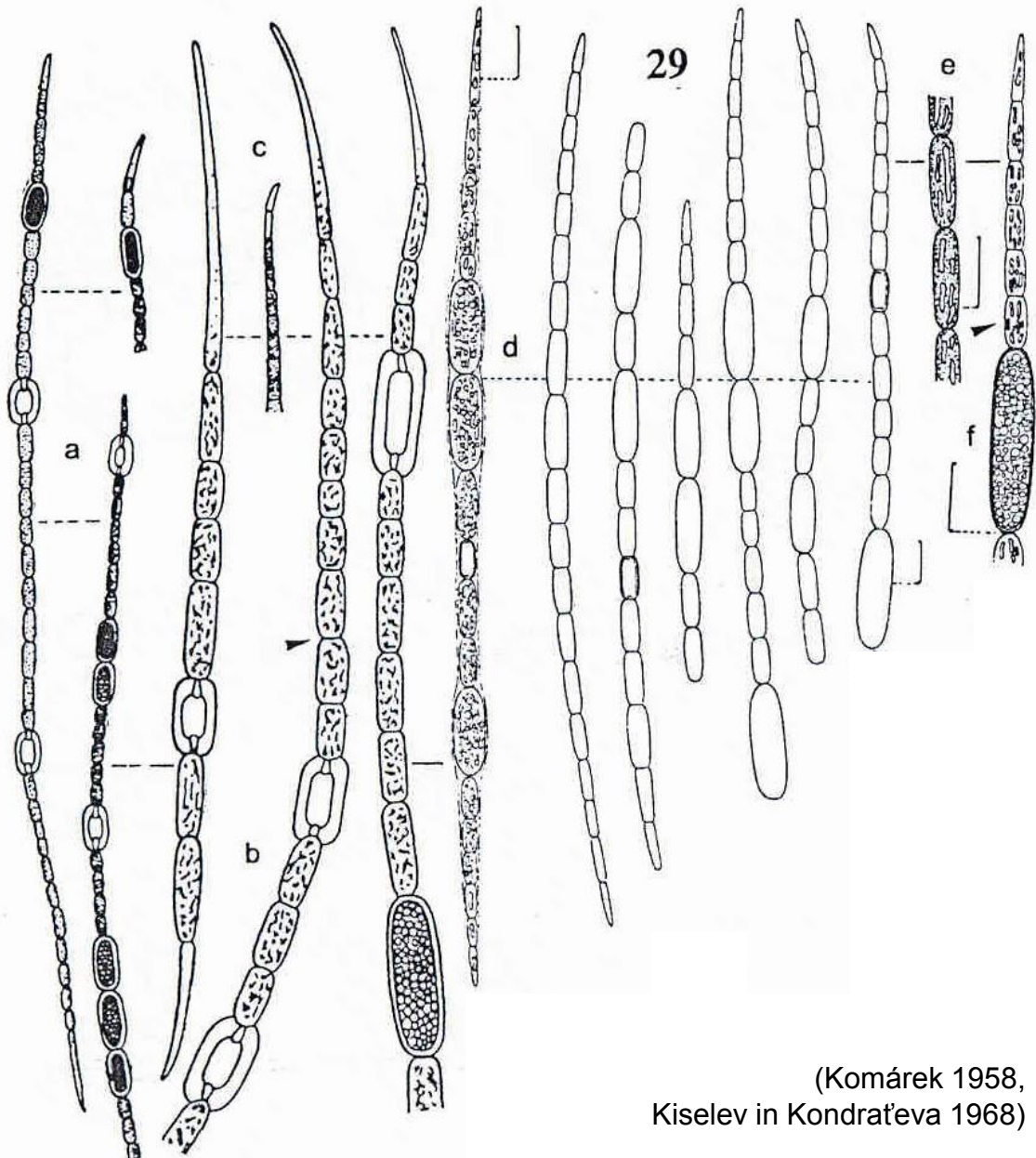
Akinety
20.6-21.4 x
10.1-11.3 μm



Cuspidothrix issatschenkoi (Usačev) Rajaniemi et al. 2005



Cuspidothrix elenkinii (Kiselev) Rajaniemi et al. 2005



Trichome width
(2) 2.5-6 μm
Akinetes
11-28.5 x 4-7 μm



(Komárek 1958,
Kiselev in Kondrat'eva 1968)

Anabaena bergii Ostenfeld 1908
Aphanizomenon ovalisporum Forti 1911

Hydrobiologia (2012) 698:353–365
DOI 10.1007/s10750-012-1034-z

Hydrobiologia 698: 353-365, 2012

PHYTOPLANKTON

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Eliška Zapomělová · Olga Skácelová ·
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Anabaena bergii Ostenfeld 1908
Aphanizomenon ovalisporum Forti 1911

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Stüken et al. (2009) – J. Plank. Res. 31 (5): 465-480.

Genetic and morphologic
characterization of four putative
cylindrospermopsin producing species of
the cyanobacterial genera *Anabaena* and
Aphanizomenon

Chrysochloris ~~*Anabaena bergii*~~ ?
~~*Aphanizomenon ovalisporum*~~
Sphaerospermopsis ~~*Aphanizomenon aphanizomenoides*~~

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AND CLAUDIA WIEDNER¹

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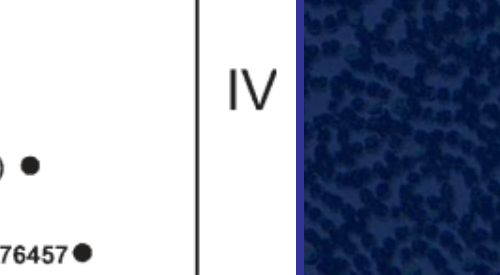
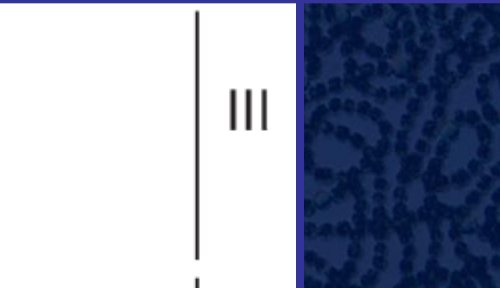
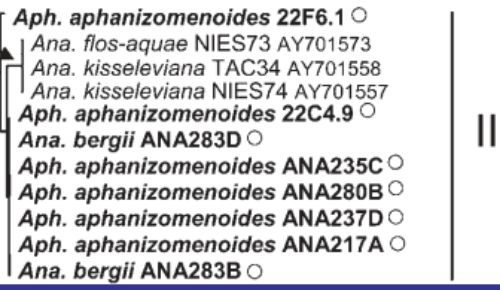
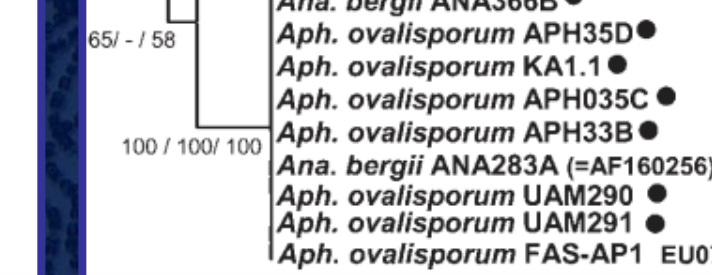
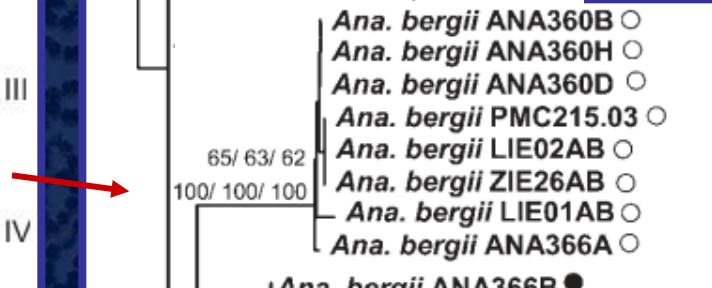
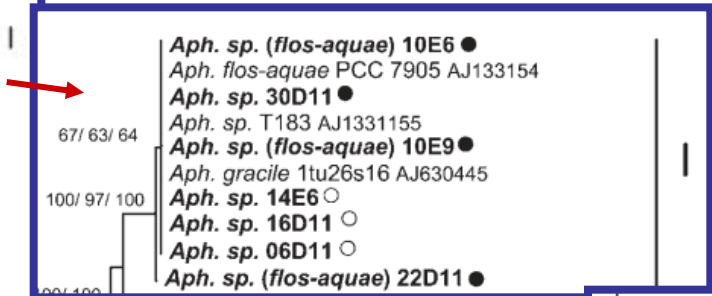
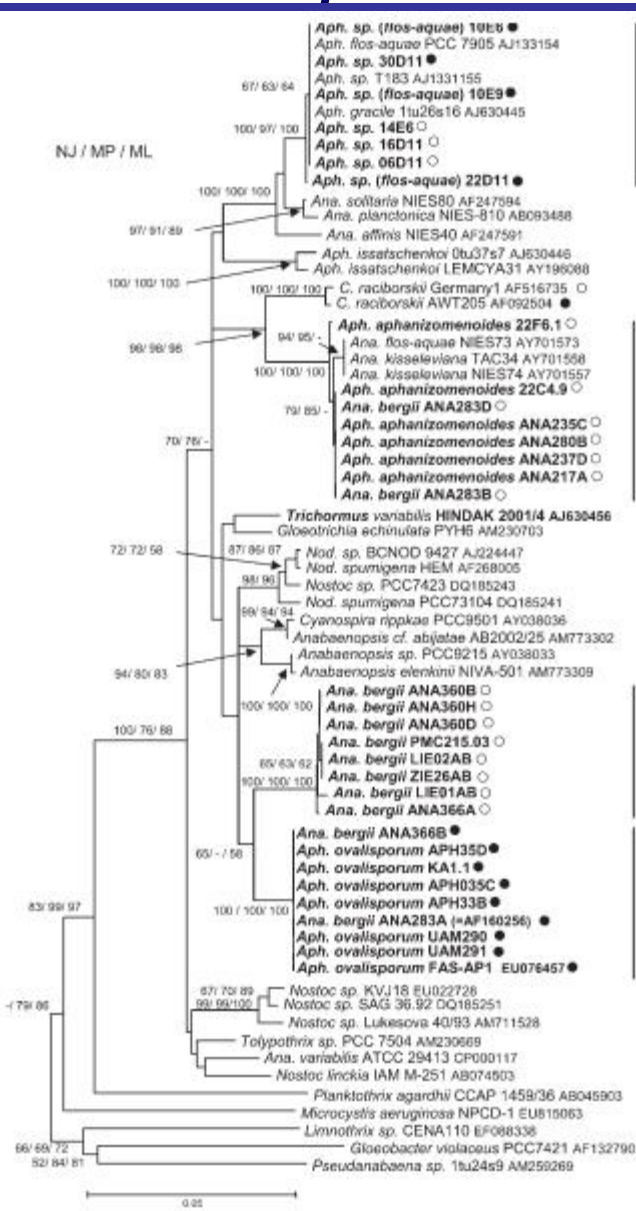
Anabaena bergii Ostenfeld 1908

Aphanizomenon ovalisporum Forti 1911

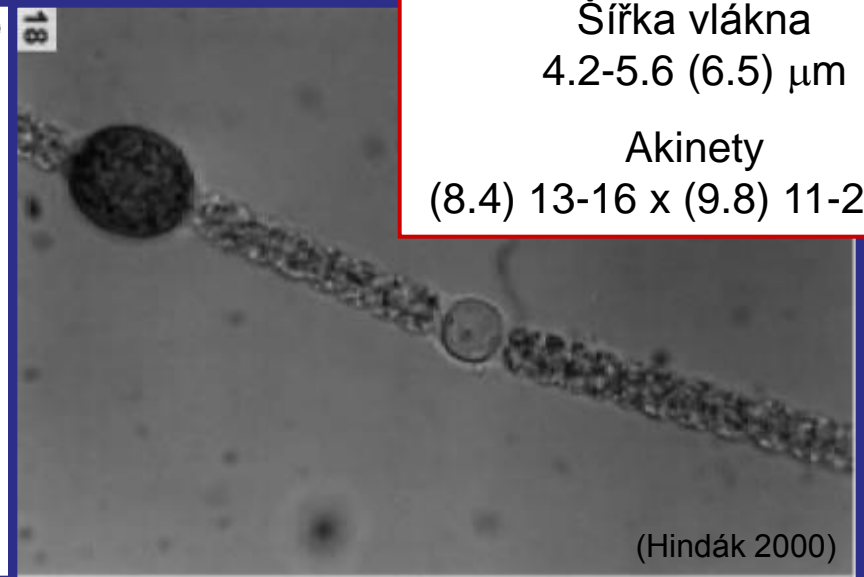
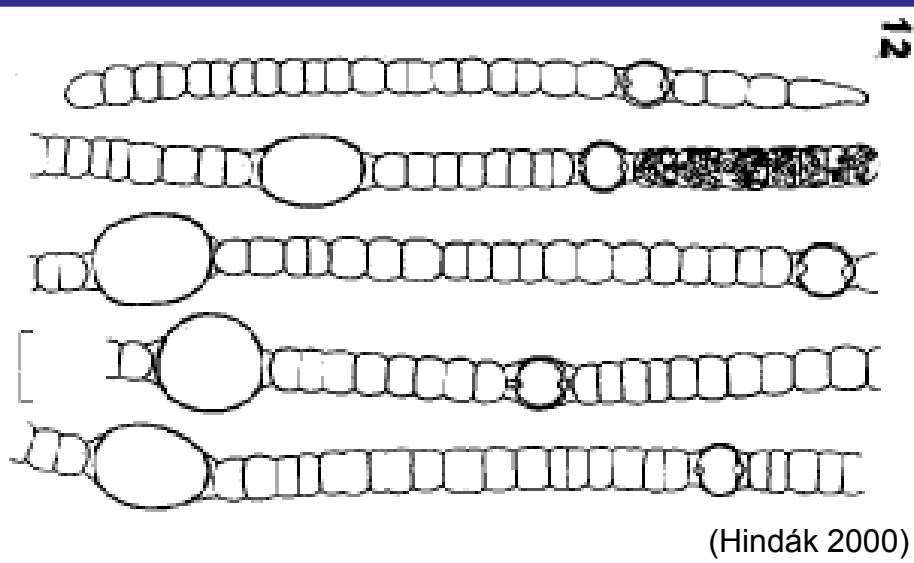
Stüken et al. (2009) – J. Plank. Res. 31 (5): 465-480.

16S rRNA gene
1059 bp

● CYN producer
○ CYN not detected



Anabaena bergii Ostenfeld 1908



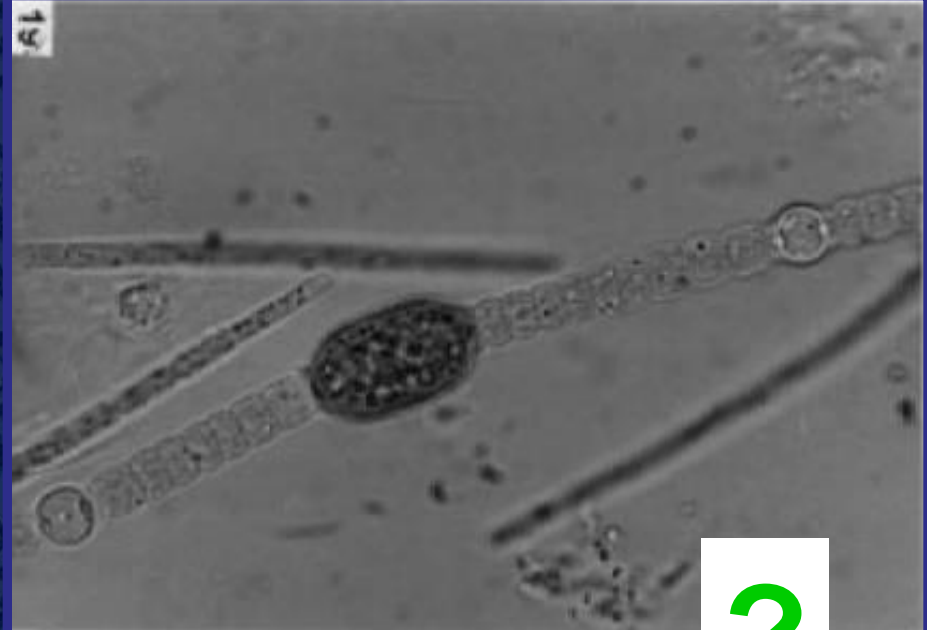
Šířka vlákna
4.2-5.6 (6.5) μm
Akinety
(8.4) 13-16 x (9.8) 11-23 μm



Anabaena minderi Huber-Pestalozzi 1938



(Hindák 2000)

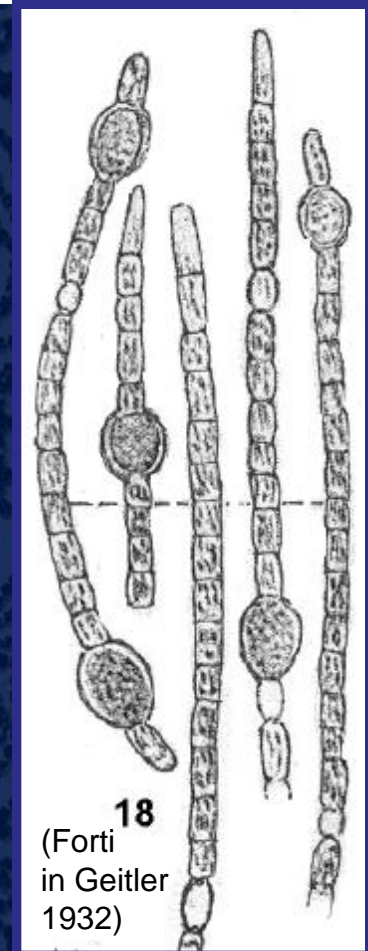
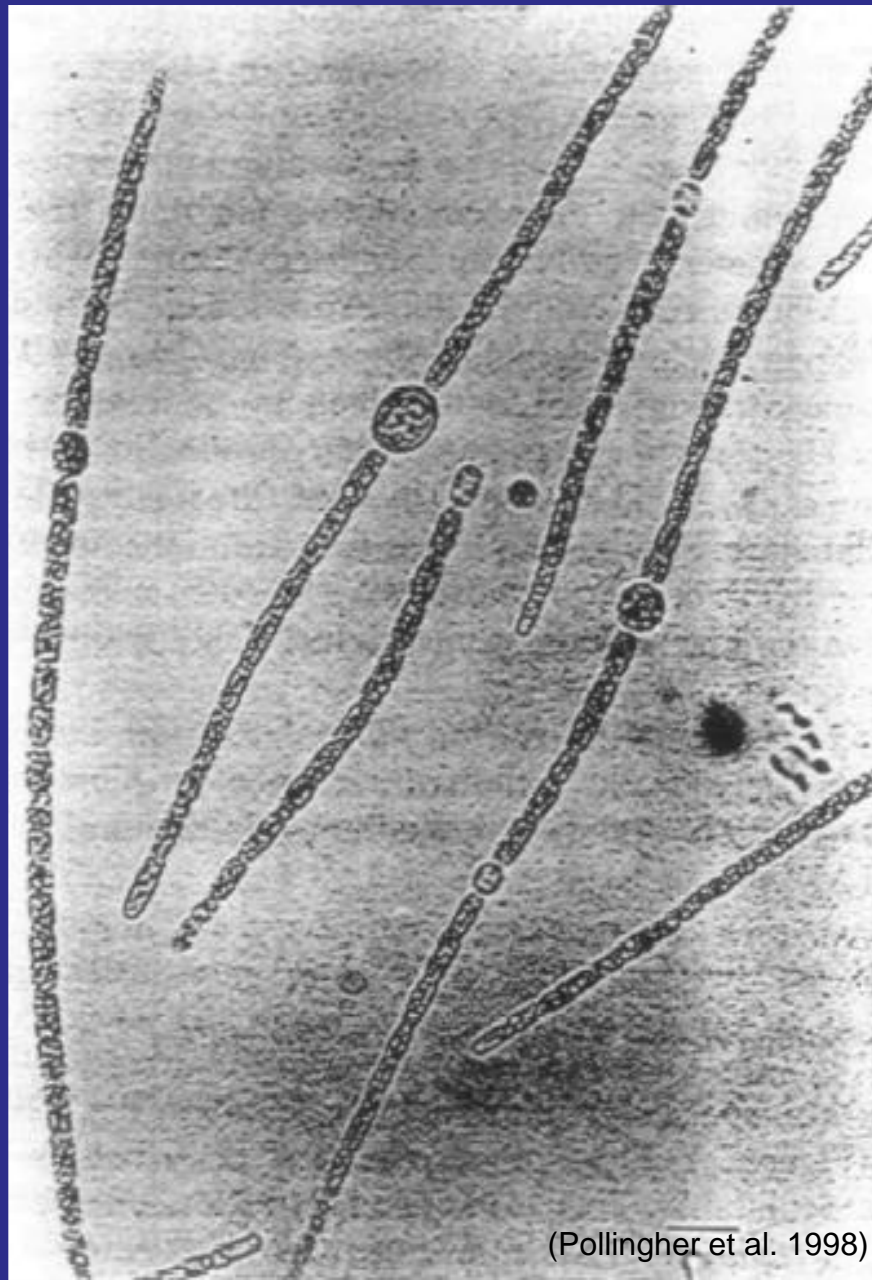
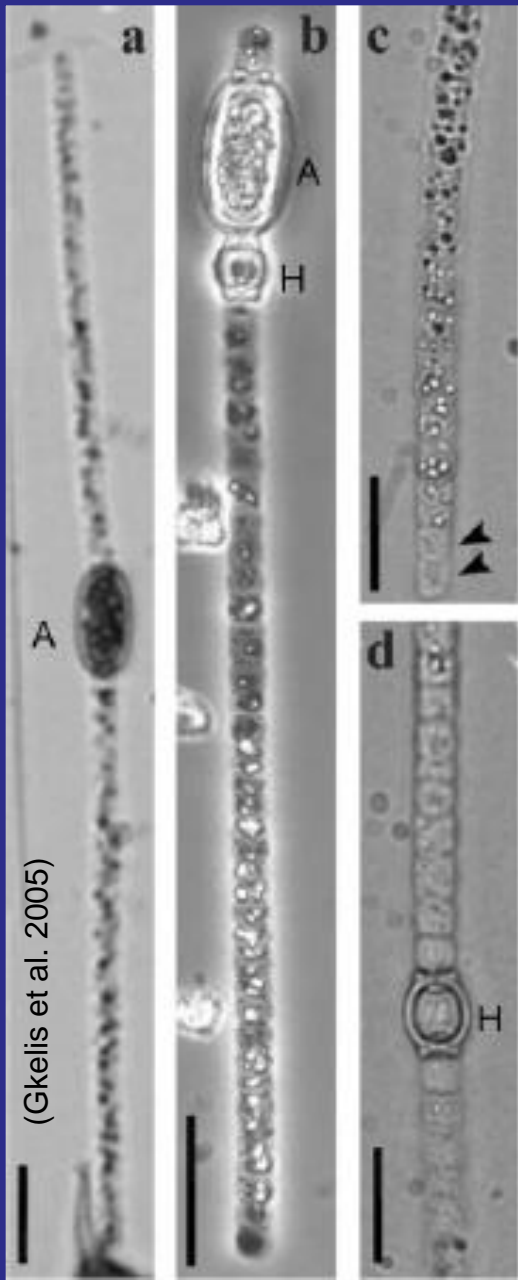


?

Šířka vlákna
3.5-5.5 (7) μm
Akinety
21-24 x 10-20 μm

(Hindák 2000)

Aphanizomenon ovalisporum Forti 1911



Šířka vlákna
4-5.8 μm

Akinety
(13.6) 18-20.4 x
x 10.8-15.1 μm

Anabaena recta Geitler & Ruttner 1935



20µm

(Cronberg & Komárek 2004)

Šířka vlákna

5-6 µm

Akinety

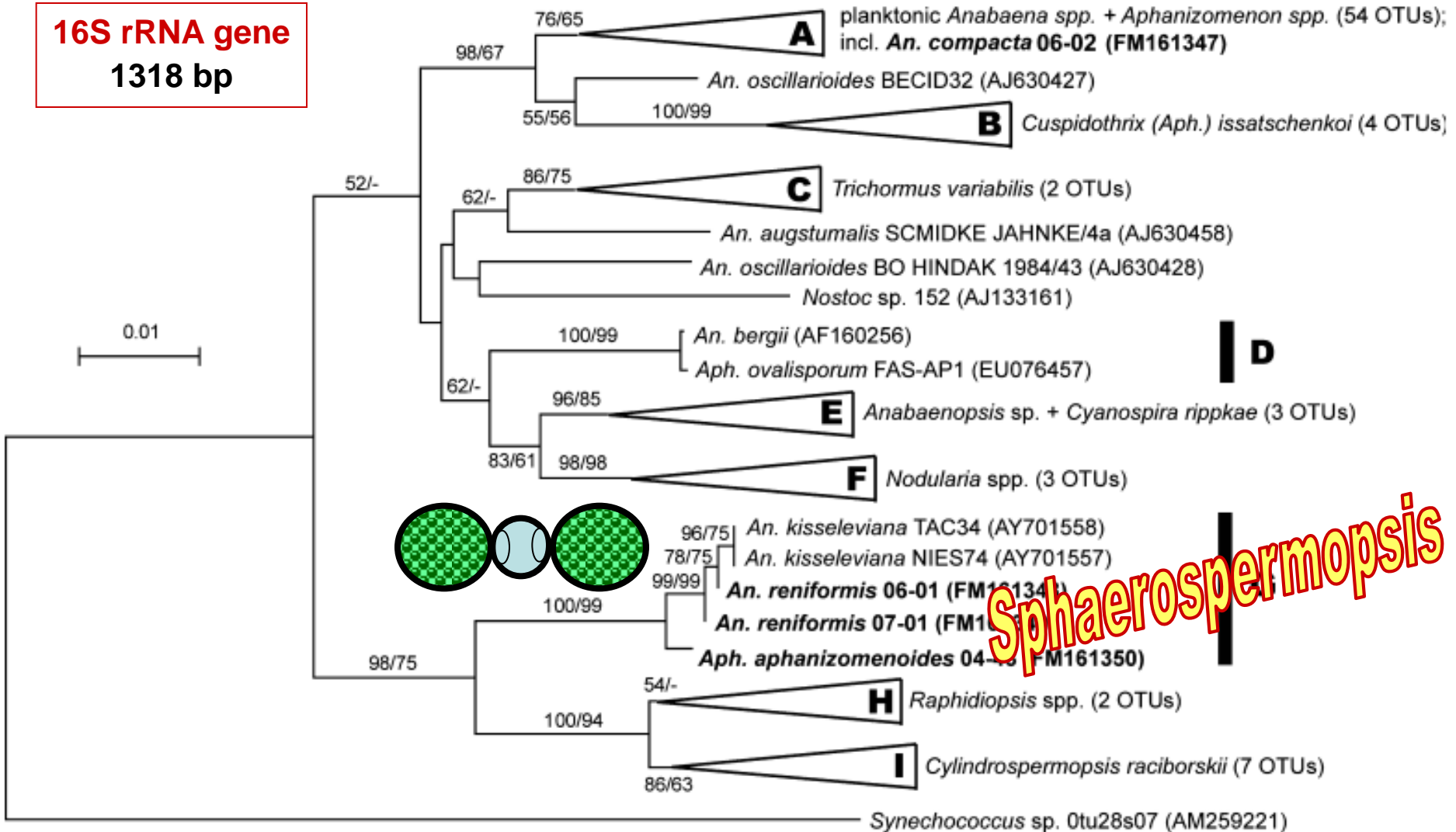
19-24 x 12-14 µm



Sphaerospermopsis Zapomělová et al. 2010

Zapomělová et al. (2009) – J. Phycol. 45: 1363-1373.

16S rRNA gene
1318 bp



Sphaerospermopsis reniformis (Lemm.) Zapomělová et al. 2010

Anabaena reniformis

→ *Sphaerospermopsis reniformis*

(Zapomělová et al. 2009)

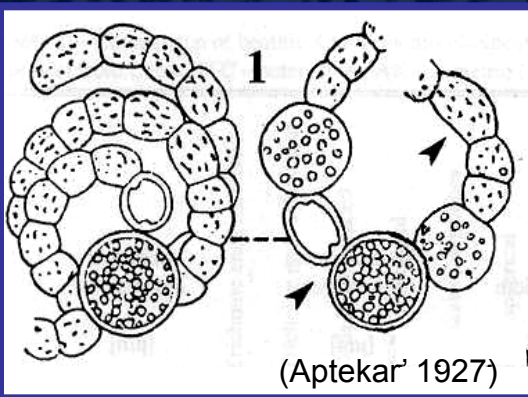
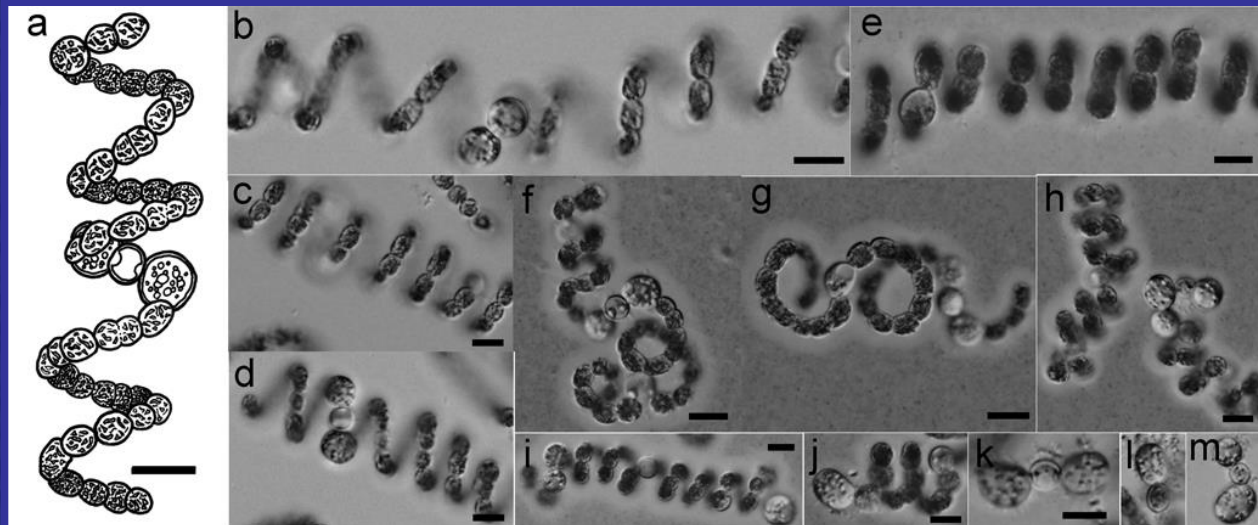
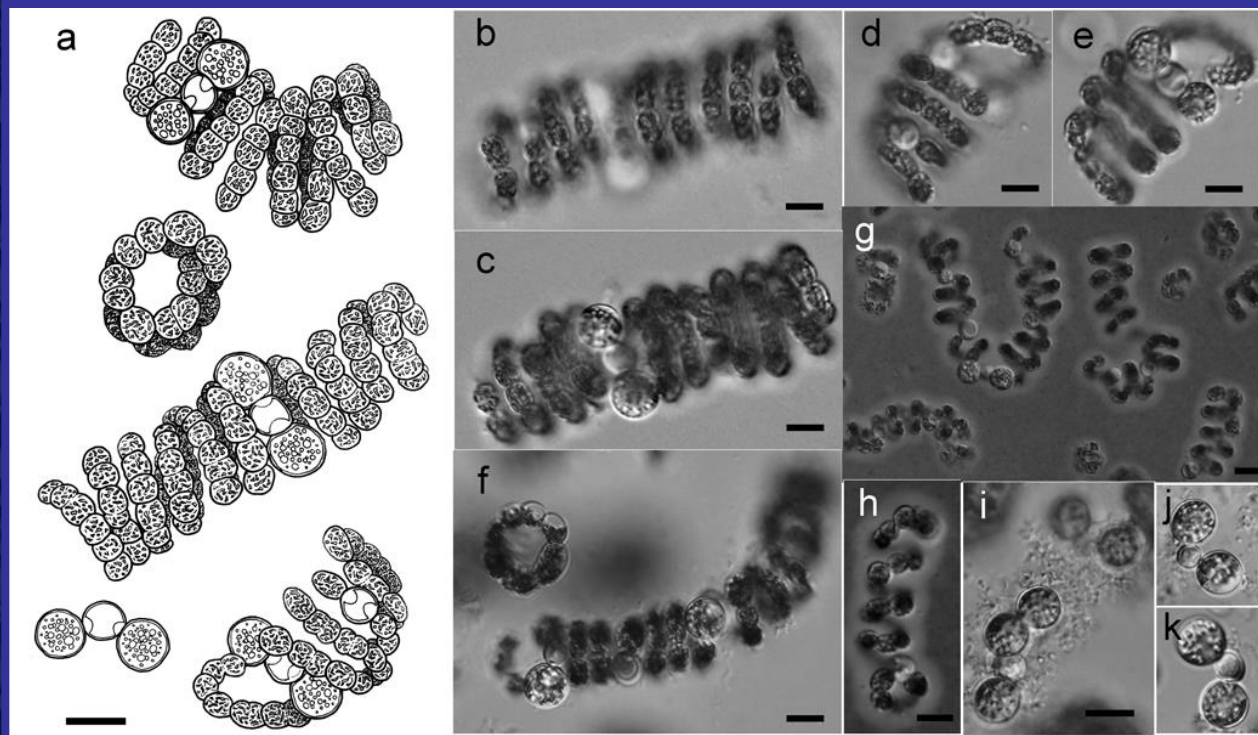
Průměr otáček
12-23 μm

Šířka vlákna
(3.2) 3.5-5.5 μm

Akinety
8.5-11.2 x
x 8.5-11.2 μm

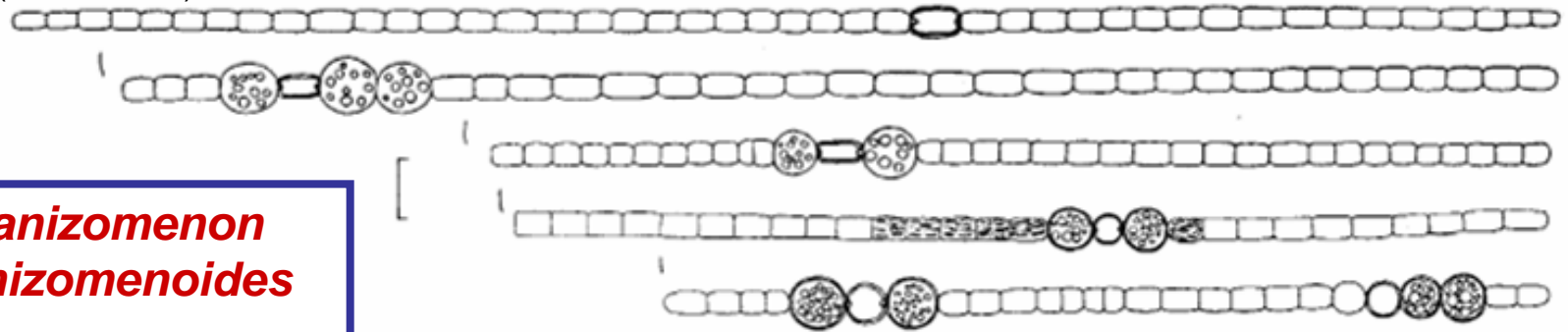
Pěšák fishpond
Czech Republic

Vyšehrad fishpond
Czech Republic



Sphaerospermopsis aphanizomenoides (Forti) Zapomělová et al. 2010

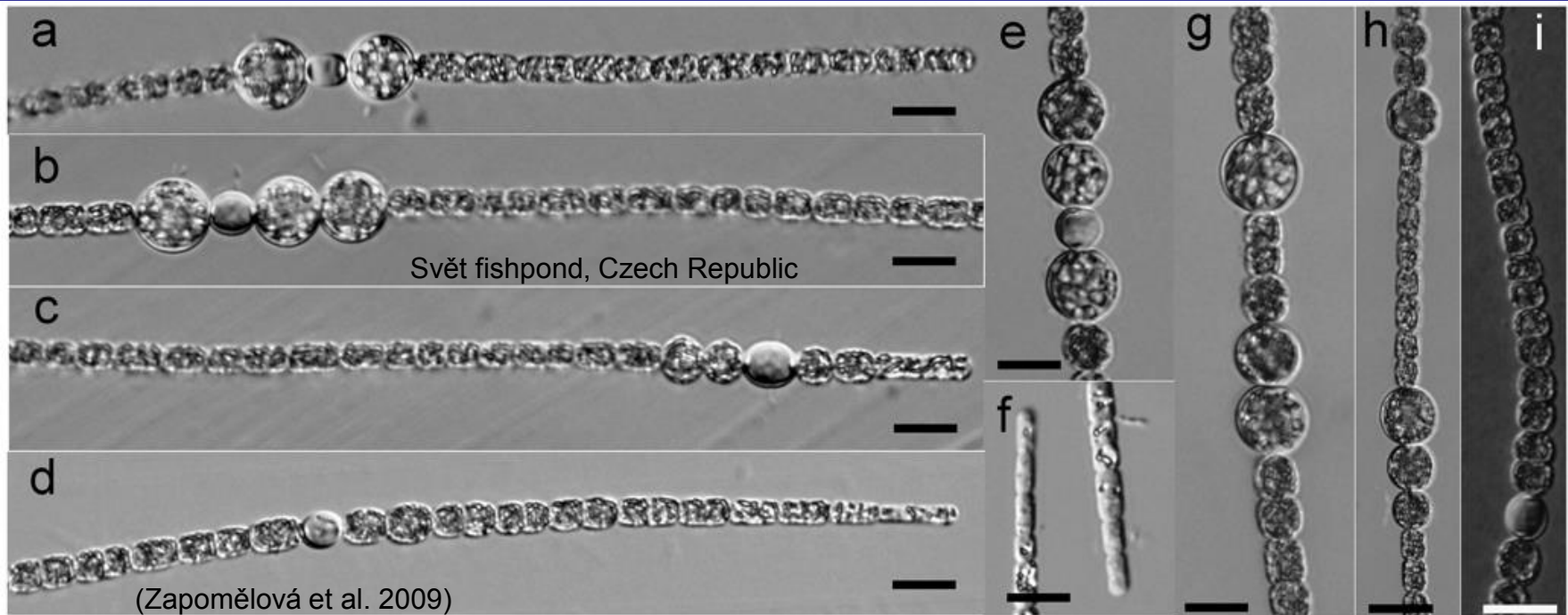
(Hindák 2000)



***Aphanizomenon
aphanizomenoides***

**→ *Sphaerospermopsis
aphanizomenoides***

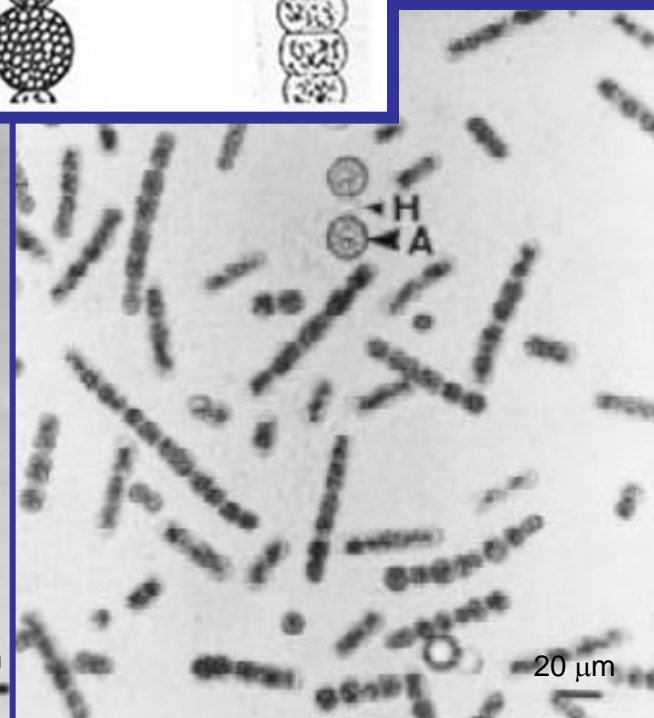
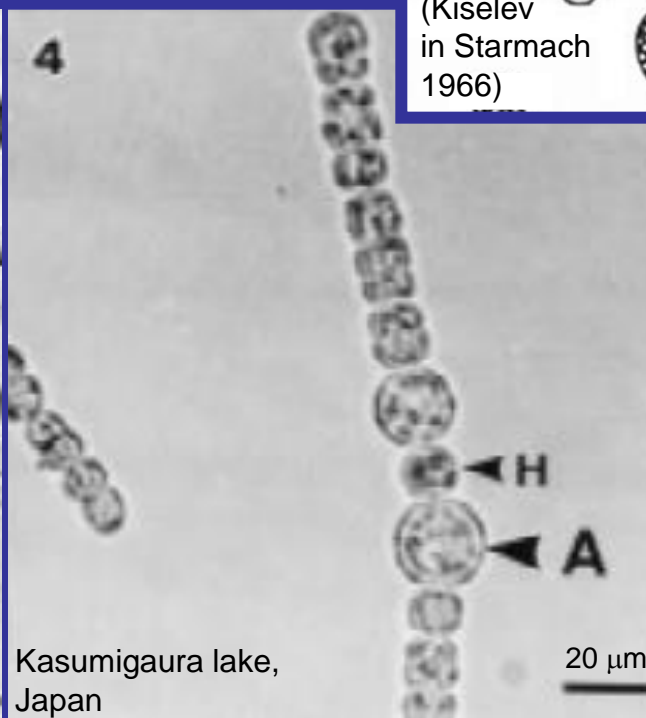
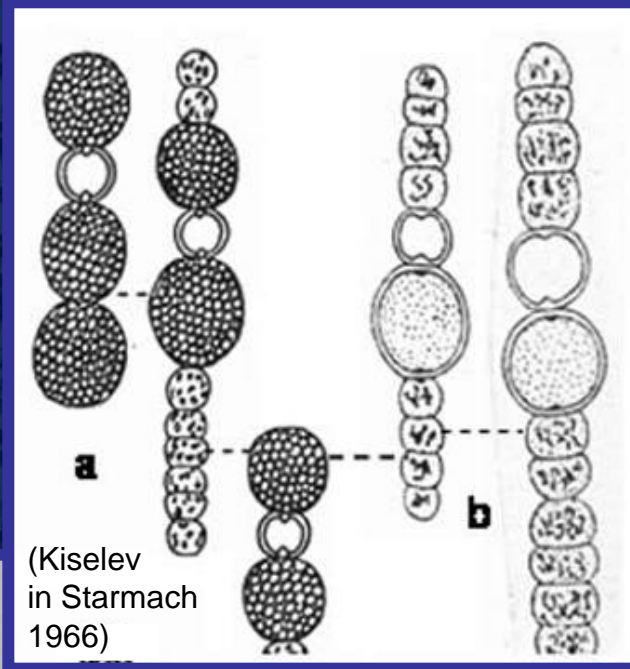
Šířka vlákna (1.5) 3-5.5 (7.2) μm
Akinety (4) 6.6-14.6 x (4) 6.6-14 μm



Sphaerospermopsis kisseleviana (Elenkin) Zapomělová et al. 2010

***Anabaena*
*kisseleviana***
→ ***Sphaerospermopsis*
*kisseleviana***

Šířka vlákna 6-8 μm
Akinety 15-21 x 14-18 μm

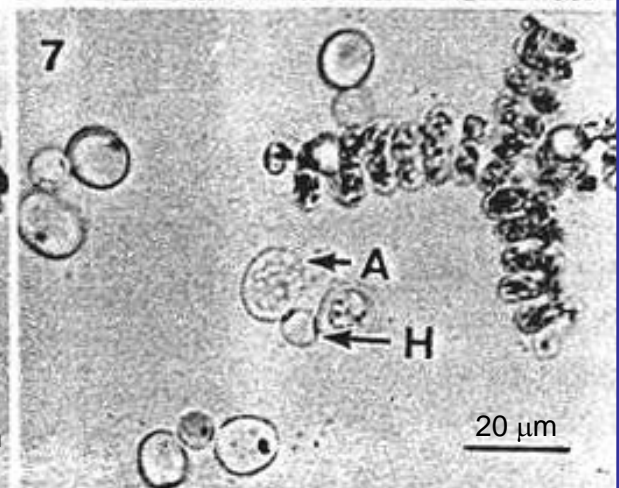
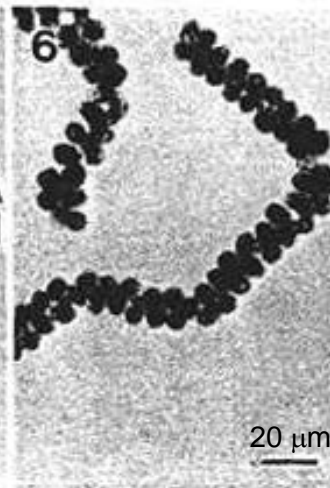
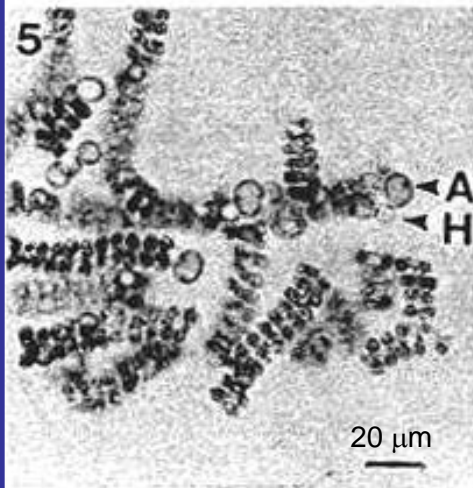
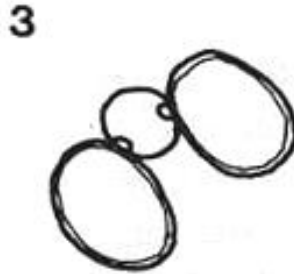
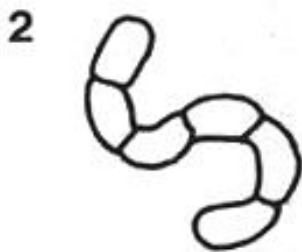
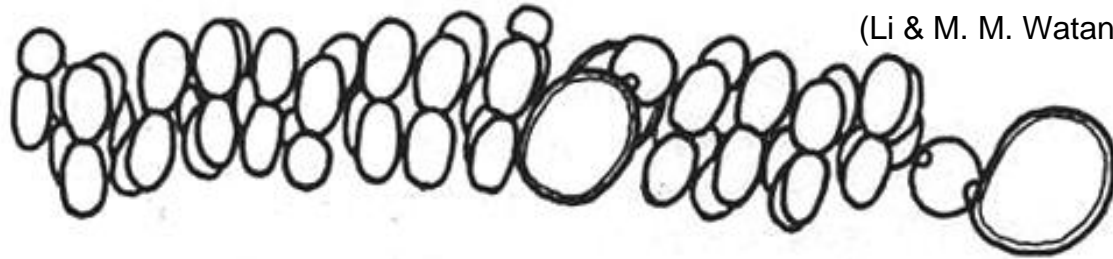


Anabaena eucompacta Li & M. M. Watanabe 1999

Šířka vlákna
3-5.6 μm

Akinety
6.6-12 x 6.3-9.6 μm

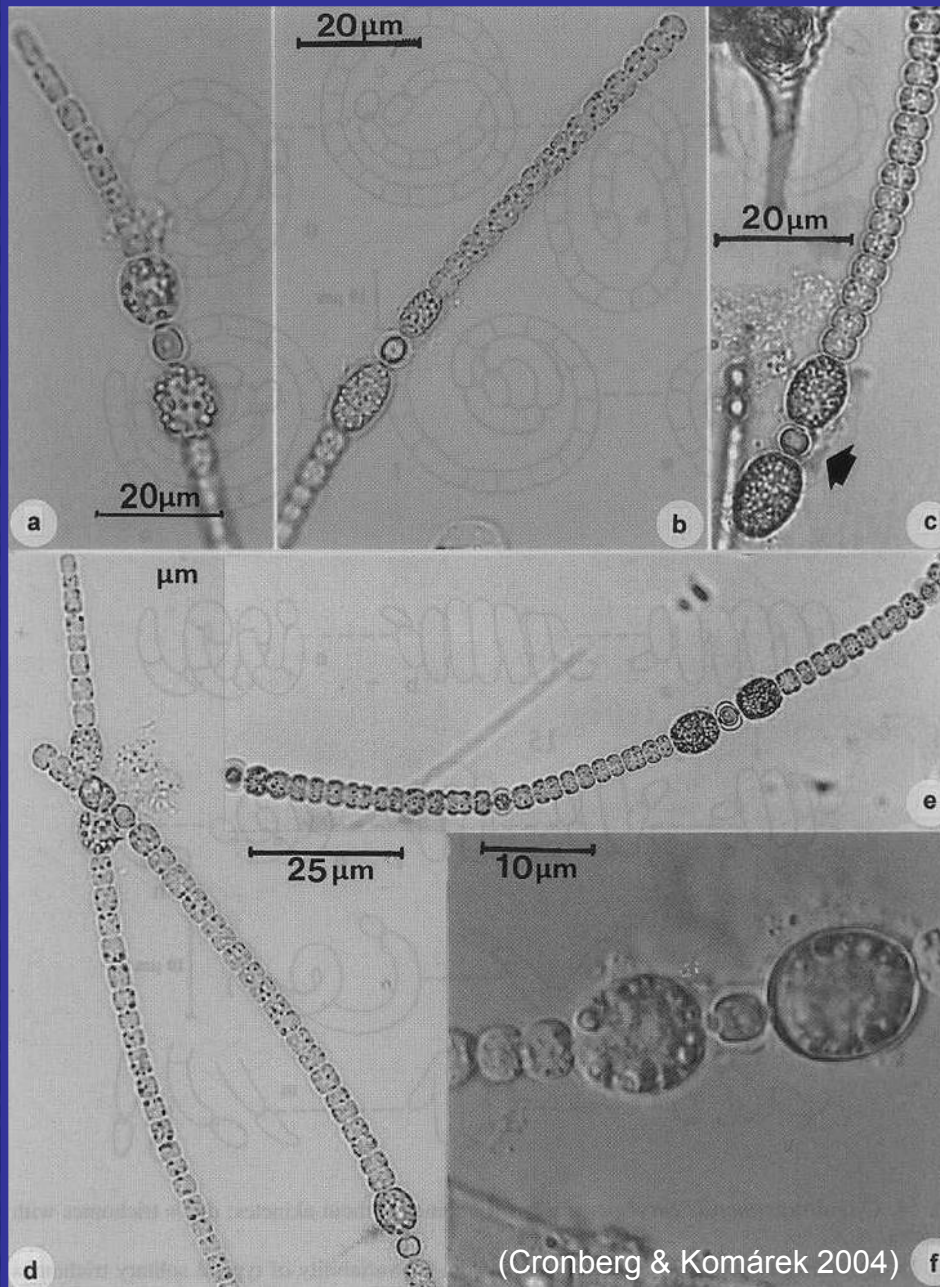
(Li & M. M. Watanabe 1999)



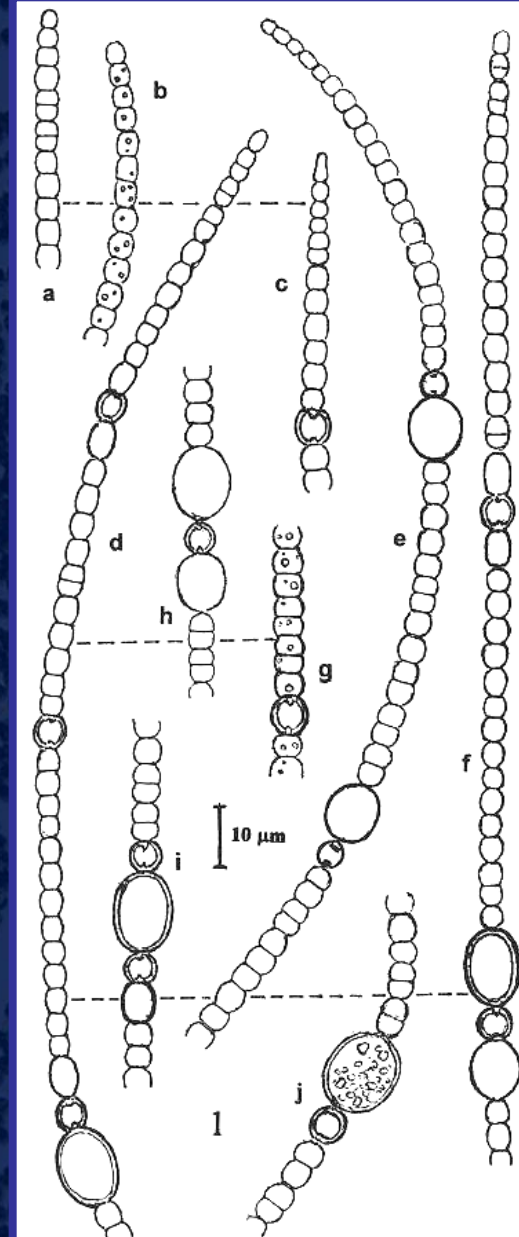
Anabaena austro-africana Cronberg & Komárek 2004

Šířka vlákna
3.8-6.1 μm

Akinety
10.6-14.8 x
x 9.2-11.2 μm

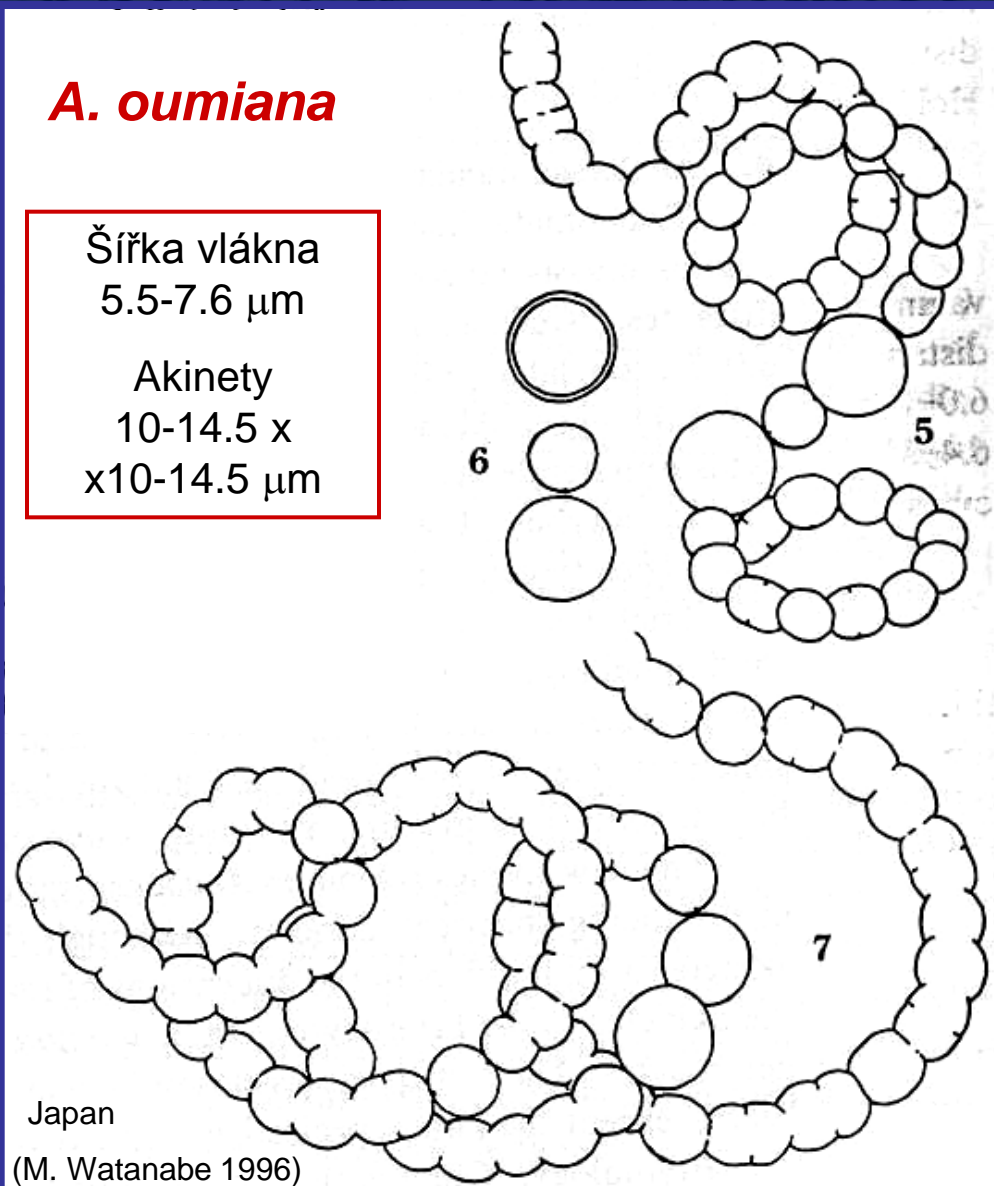
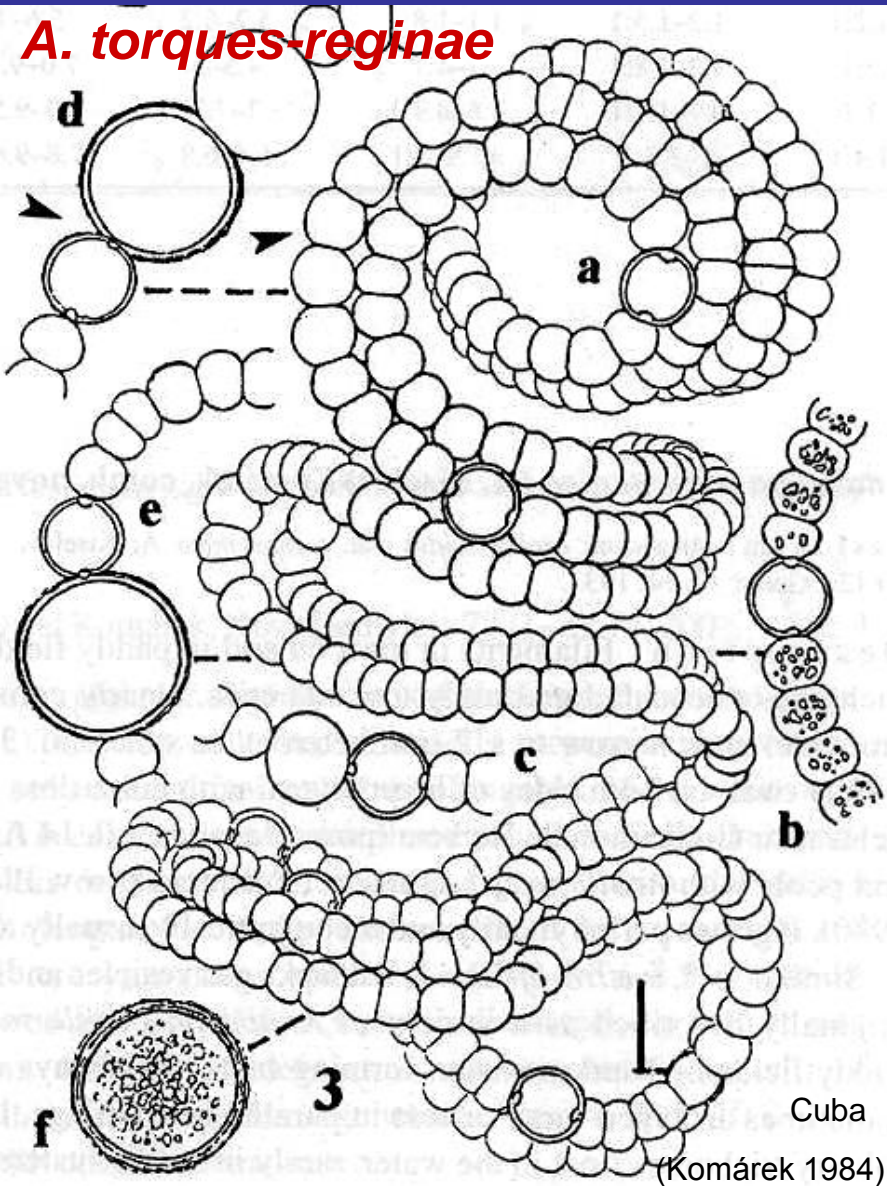


(Cronberg & Komárek 2004)



(Cronberg & Komárek 2004)

Anabaena torques-reginae Komárek 1984 syn. *Anabaena oumiana* M. Watanabe 1996



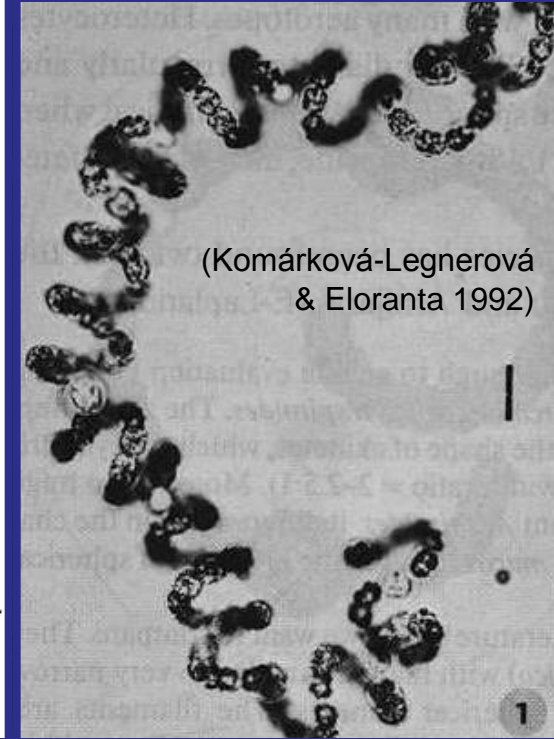
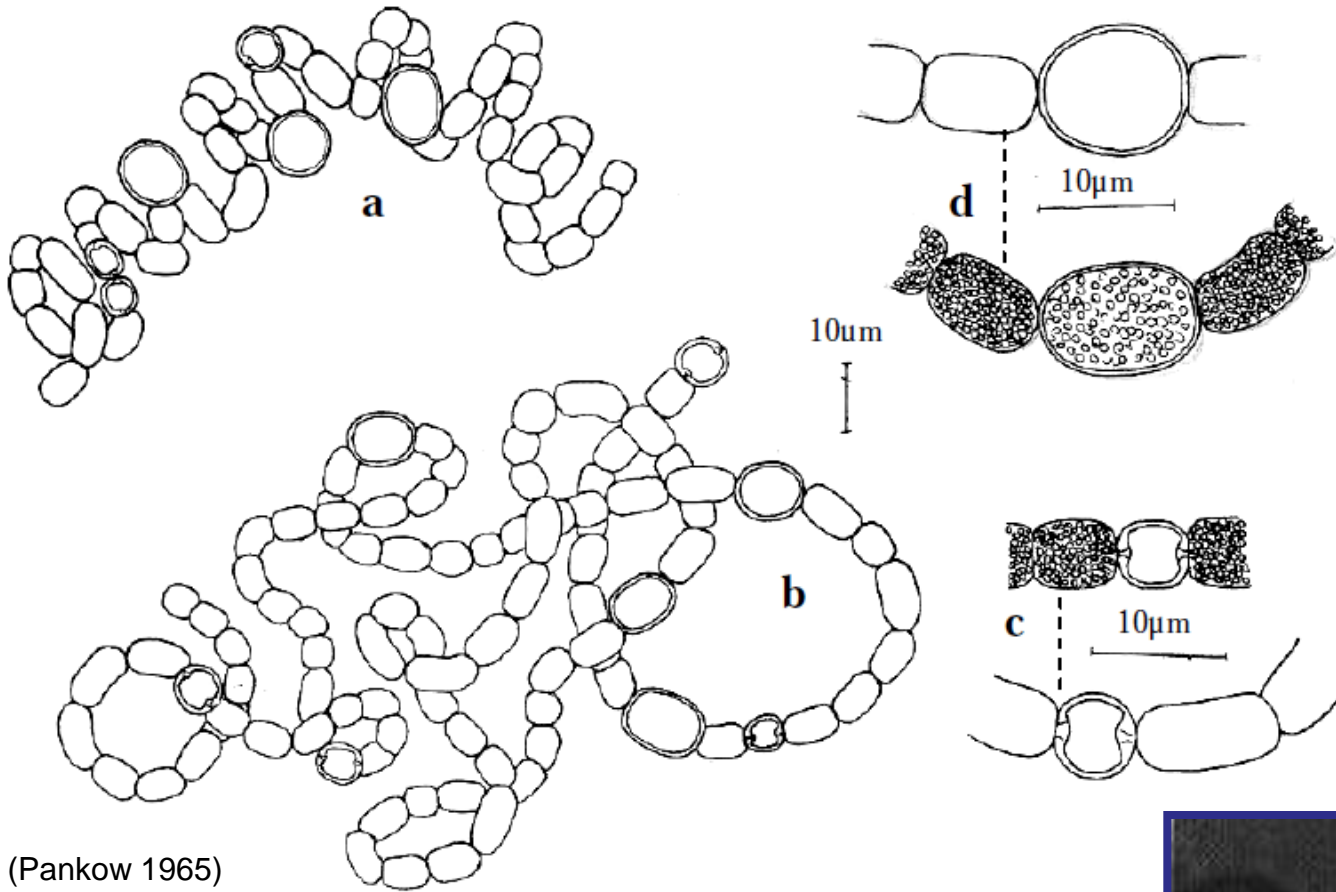
Další „*Dolichospermum*-like“ a „*Anabaena*-like“ morphospecies bez objasněné fylogeneze

Evropské morphospecies:

- D. berezowskii* (Usačev) Wacklin et al. 2009
 - D. delicatulum* (Lemmermann) Wacklin et al. 2009
 - D. ellipsoides* (Bolochoincev) Wacklin et al. 2009
 - D. farcimiforme* (Cronberg & Komárková-Legnerová) Wacklin et al. 2009
 - D. halbfassii* (Bachmann) Wacklin et al. 2009
 - D. heterosporum* (Nygaard) Wacklin et al. 2009
 - D. longicellulare* (Pankow) Wacklin et al. 2009
 - D. macrosporum* (Klebahn) Wacklin et al. 2009
 - D. perturbatum* (Hill) Wacklin et al. 2009
 - D. skujae-laxum* (Komárek & Zapomělová) Wacklin et al. 2009
 - D. solitarium* (Klebahn) Wacklin et al. 2009
 - D. zinserlingii* (Kosinskaja) Wacklin et al. 2009
-
- A. salina* Liebetanz 1925
 - A. elliptica* Lemmermann 1898
 - A. levanderi* Lemmermann 1906
 - A. miniata* Skuja 1956



Dolichospermum longicellulare (Pankow) Wacklin et al. 2009



Šířka vlákna

5-6 μm

Akinety

9-12 x 8-11 μm

?

(Komárková-Legnerová & Eloranta 1992)

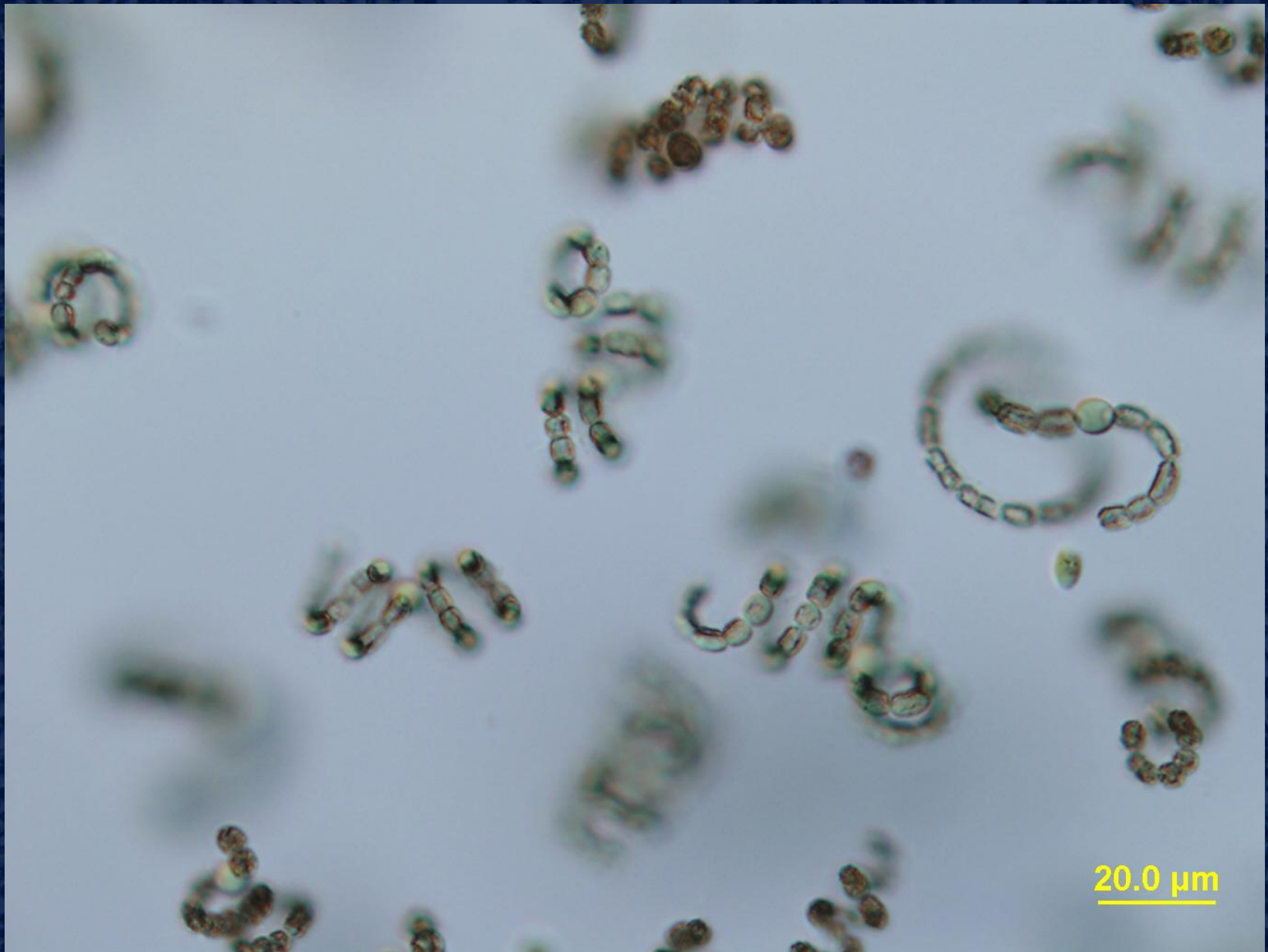
Dolichospermum longicellulare (Pankow) Wacklin et al. 2009



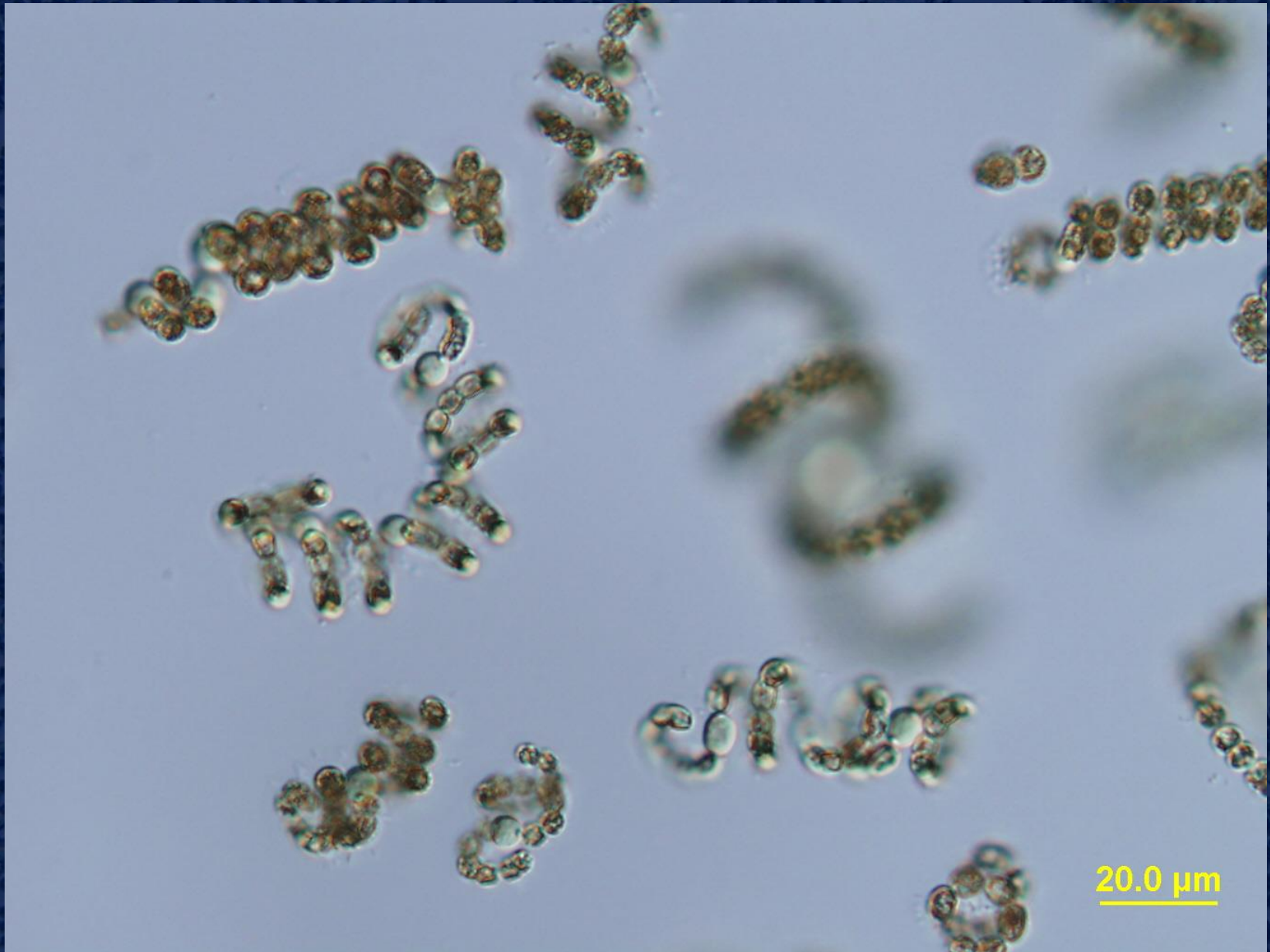
rybník Studna
u Františkových Lázní

20.0 μm

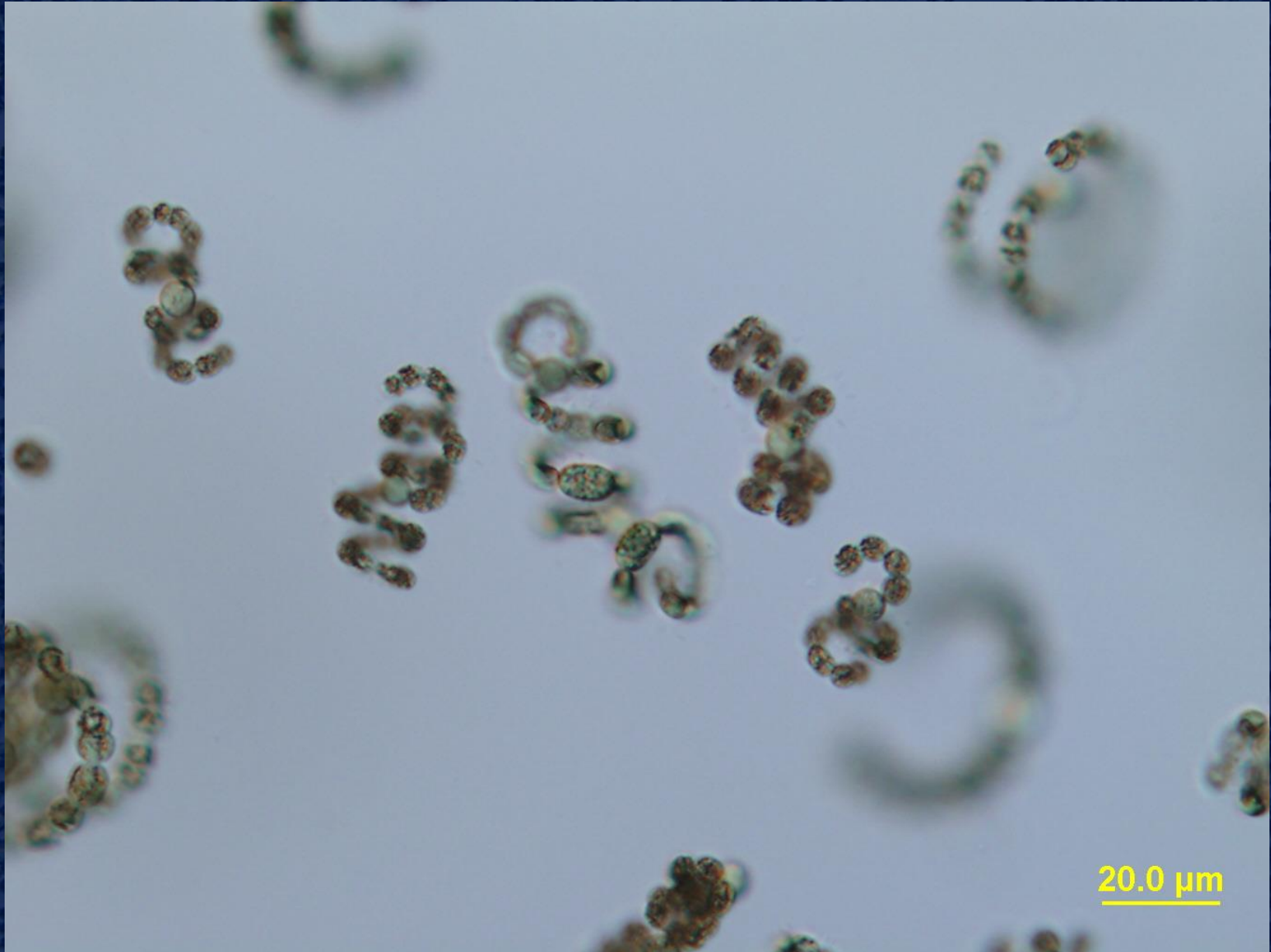
Dolichospermum longicellulare (Pankow) Wacklin et al. 2009



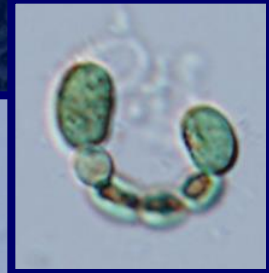
Dolichospermum longicellulare (Pankow) Wacklin et al. 2009



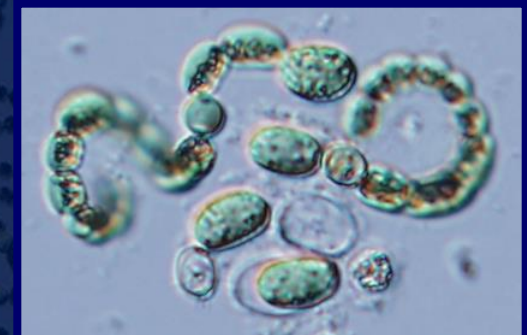
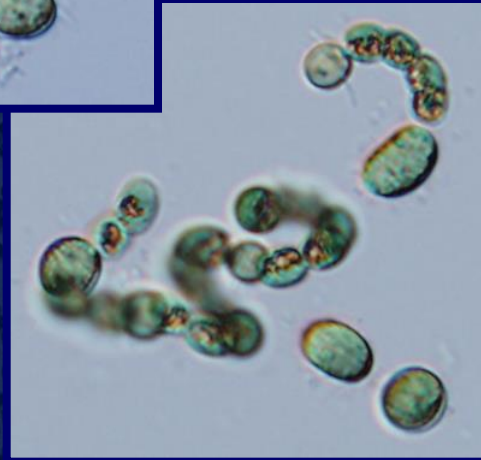
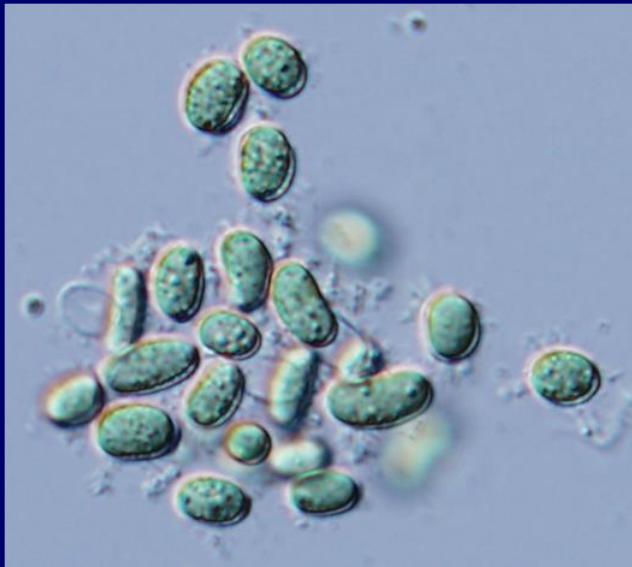
Dolichospermum longicellulare (Pankow) Wacklin et al. 2009



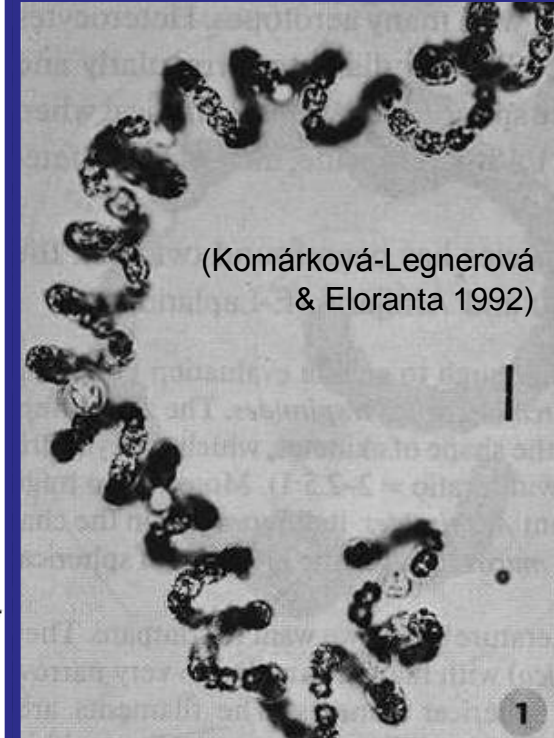
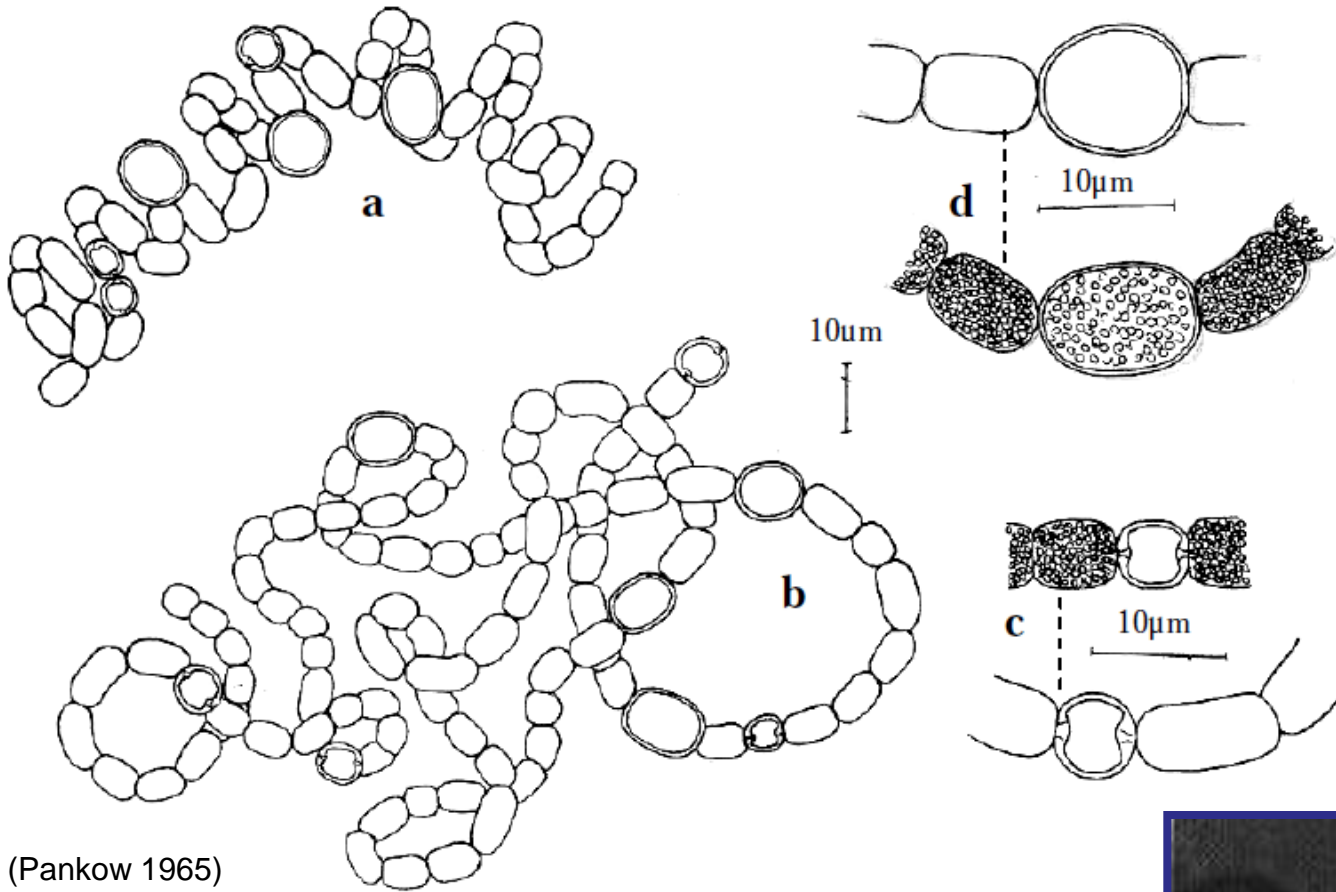
Dolichospermum longicellulare (Pankow) Wacklin et al. 2009



v kultuře...



Dolichospermum longicellulare (Pankow) Wacklin et al. 2009



Šířka vlákna

5-6 µm

Akinety

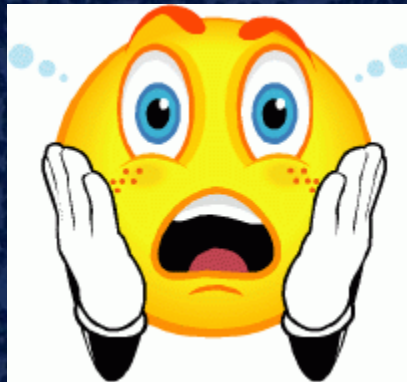
9-12 x 8-11 µm

?

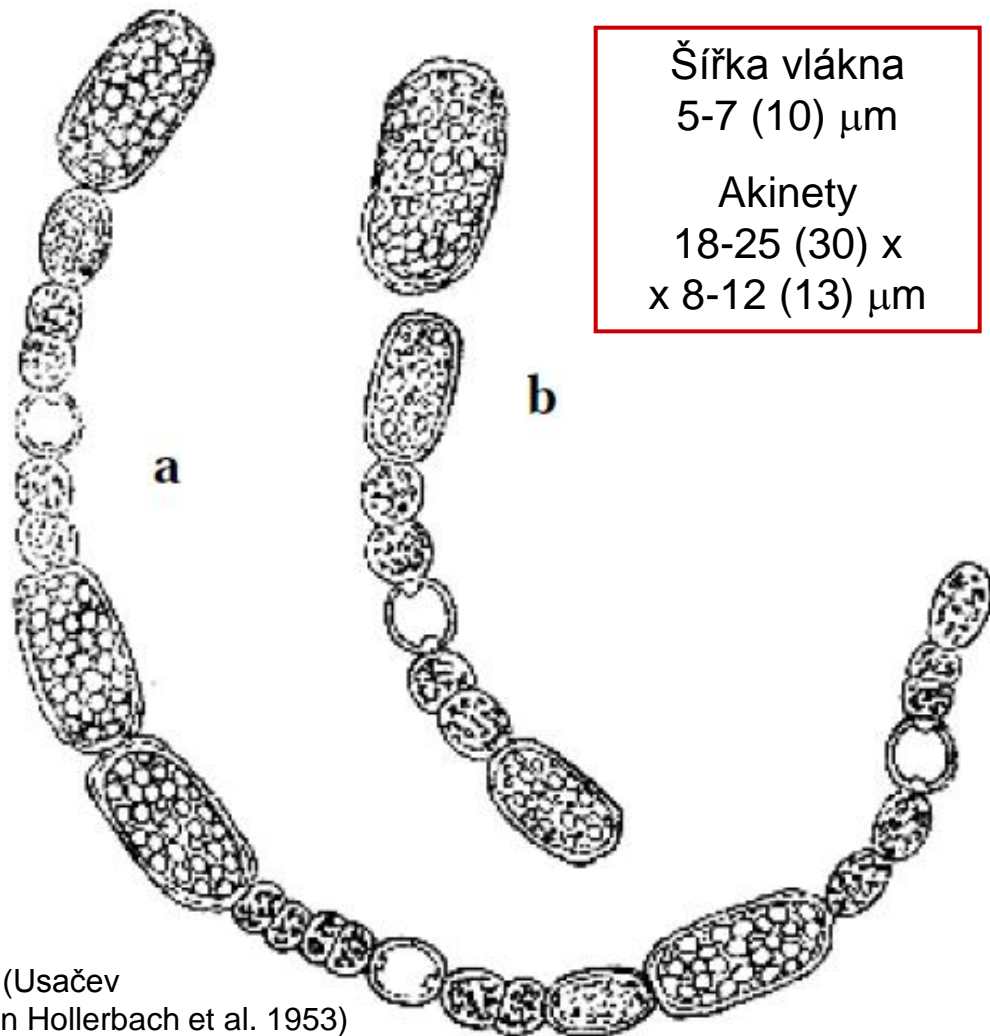
(Komárková-Legnerová & Eloranta 1992)

Dolichospermum longicellulare (Pankow) Wacklin et al. 2009

- úspěšně sekvenován 16S rRNA gen 4 kmenů
- na základě podobnosti sekvencí (megaBLAST) se zdá, že bude spadat do příbuzenství *Cuspidothrix issatschenkoi*



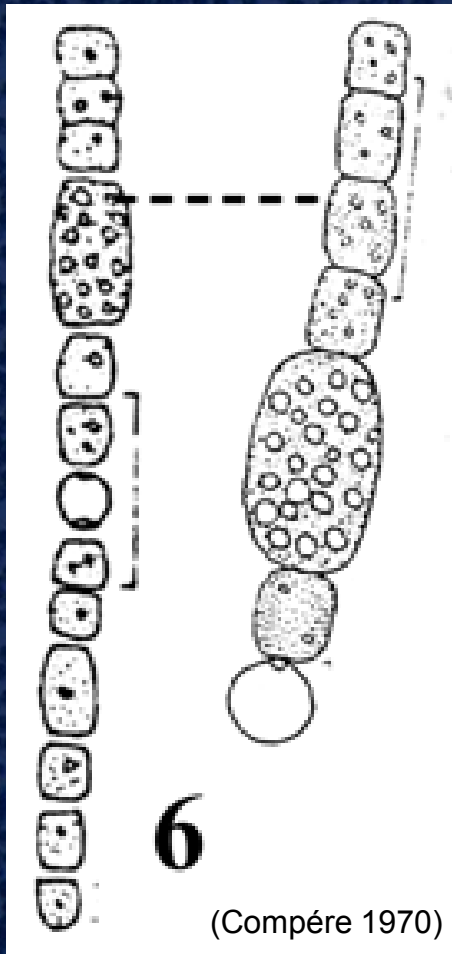
Dolichospermum berezowskii (Usačev) Wacklin et al. 2009



(Usačev
in Hollerbach et al. 1953)



Dolichospermum delicatulum (Lemmermann) Wacklin et al. 2009



Šířka vlákna

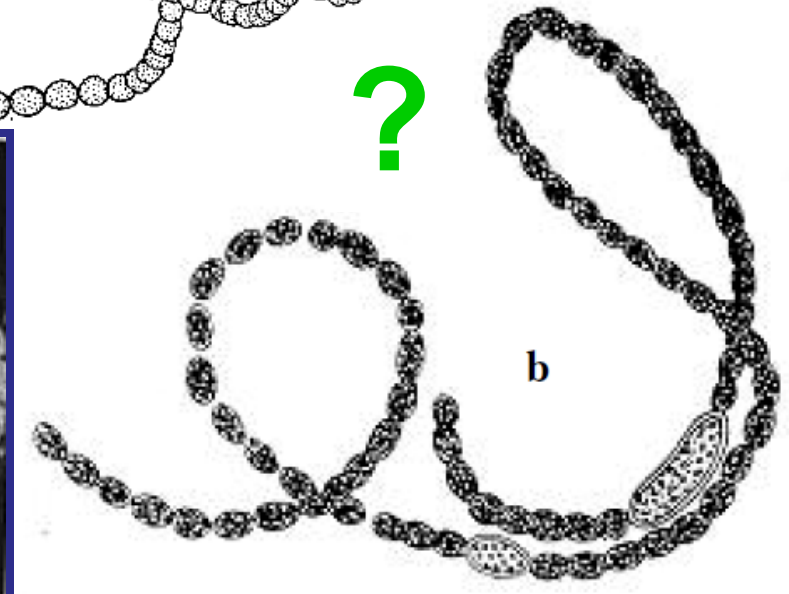
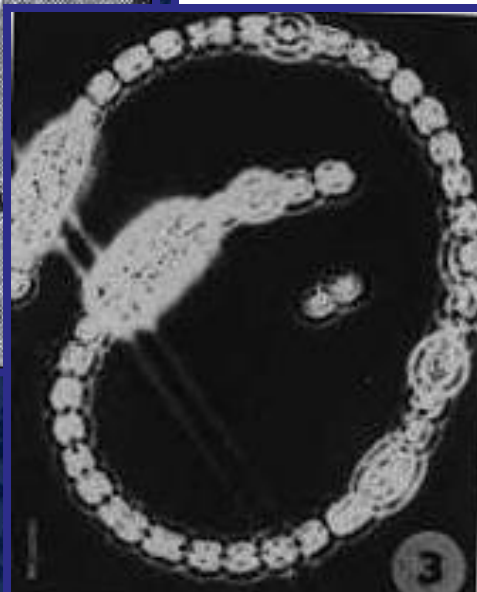
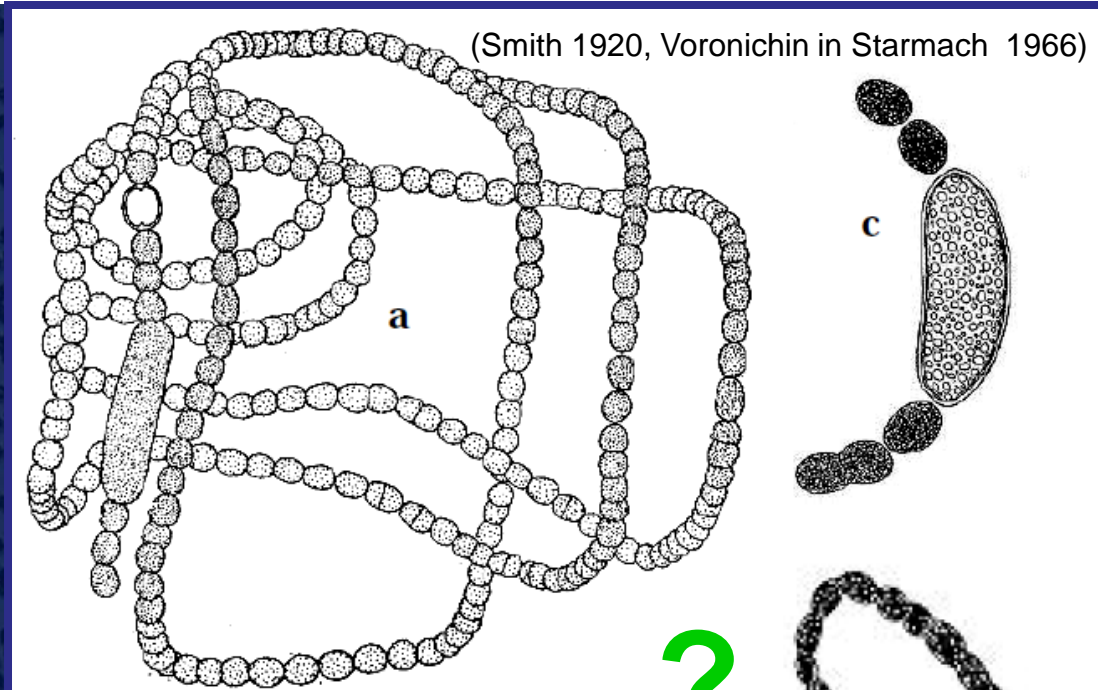
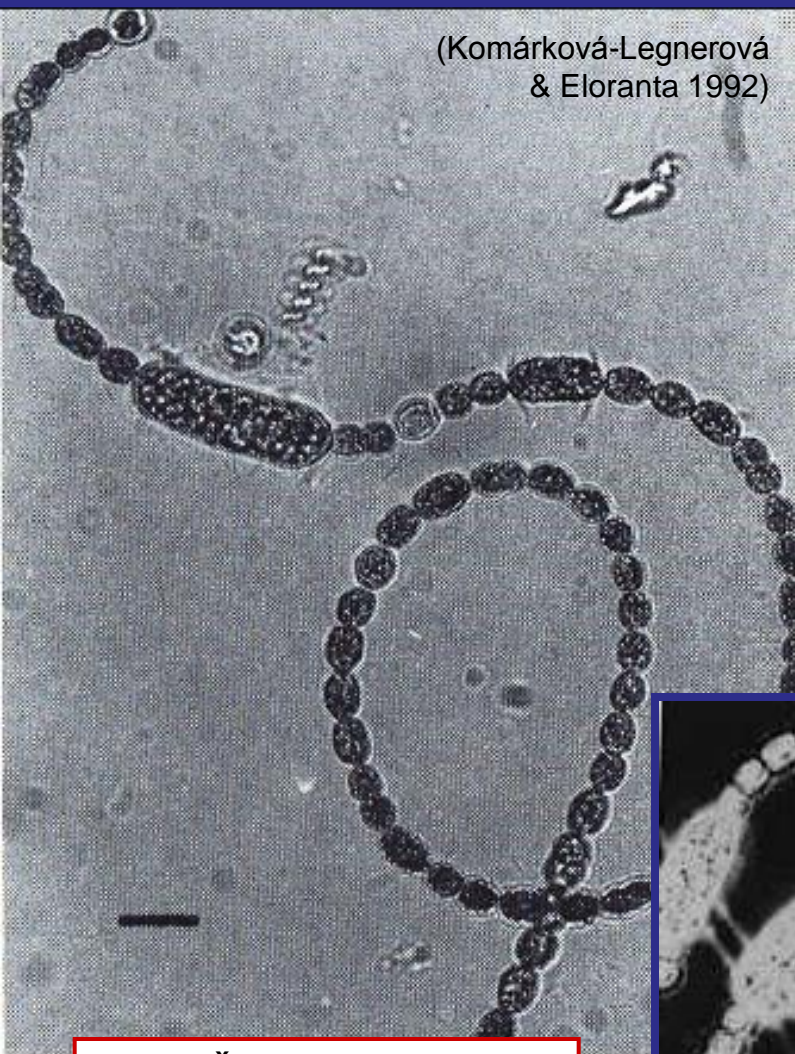
3-4.5 μm

Akinety

7-19 x 5-8 μm



Dolichospermum ellipsoides (Bolochoincev) Wacklin et al. 2009

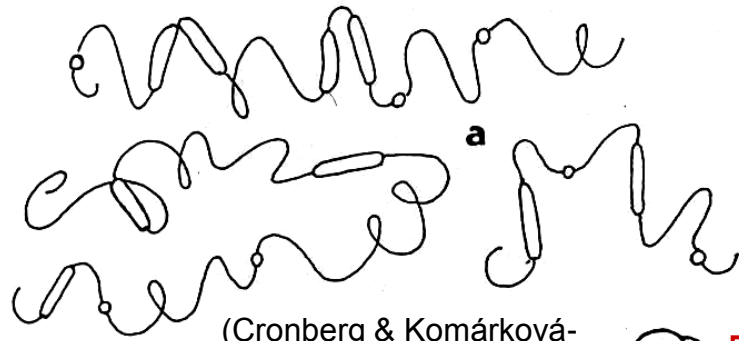


Šířka vlákna
(5) 6.4-8 μm

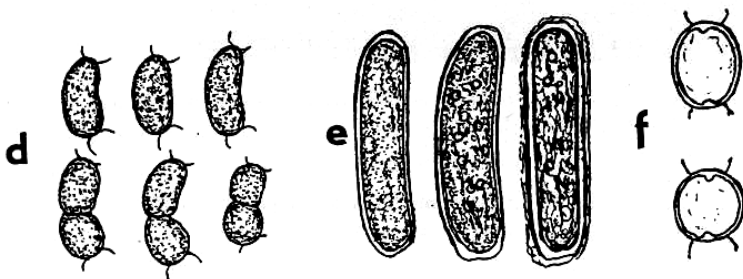
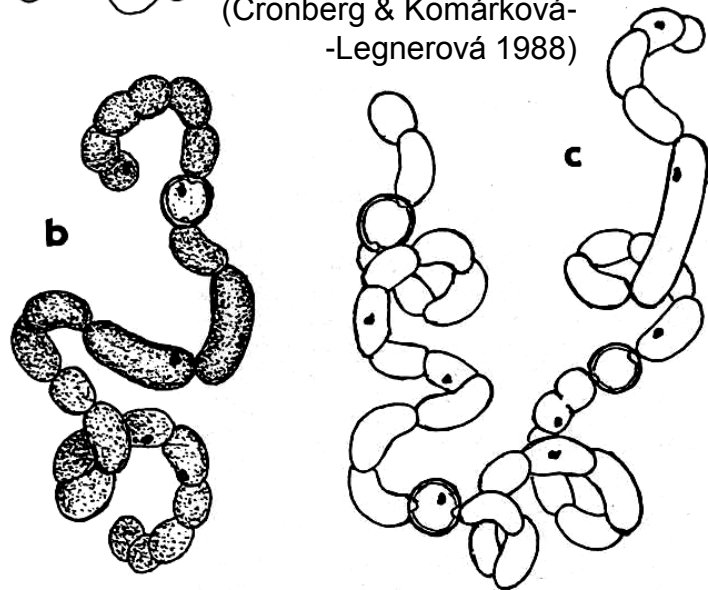
Akinety
20-42 x (8) 9-10.5 μm

Dolichospermum farcimiforme

(Cronberg & Komárková-Legnerová) Wacklin et al. 2009

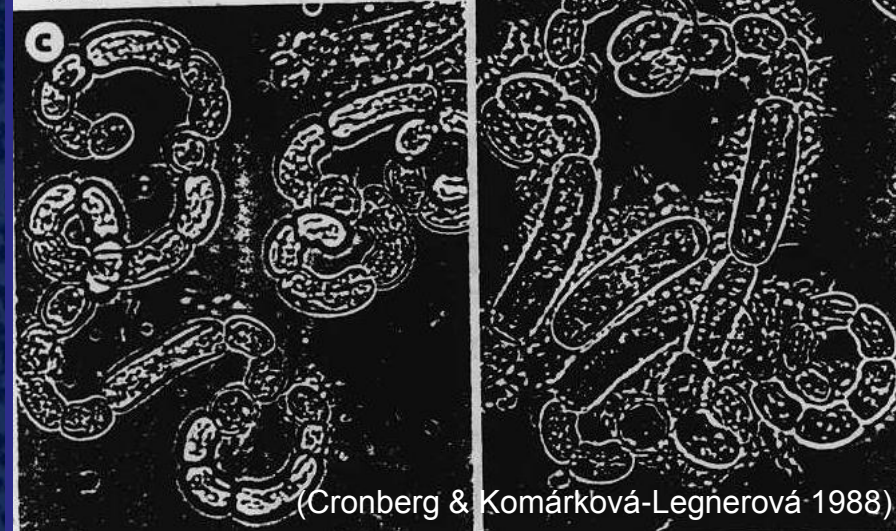
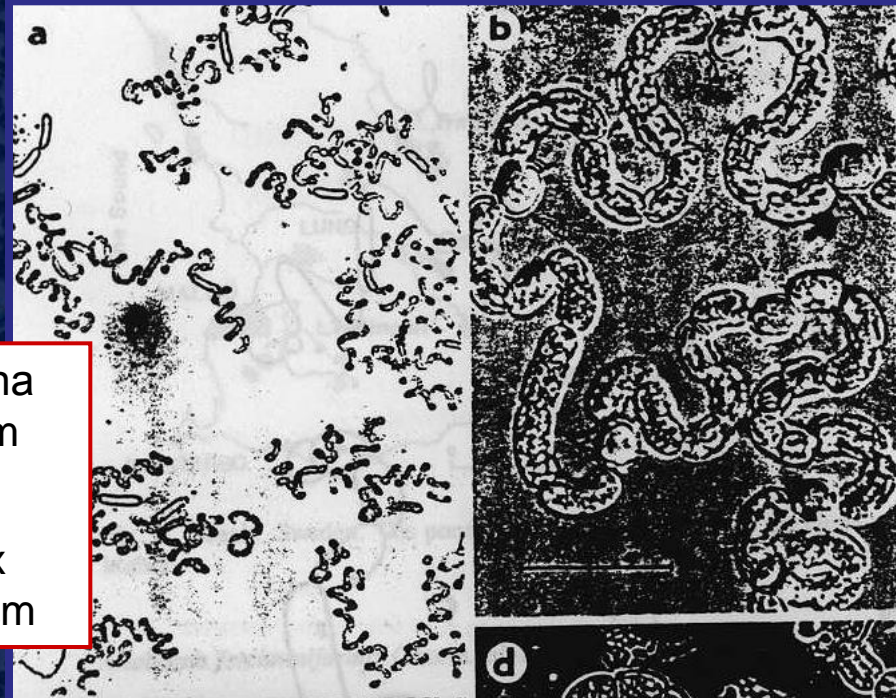


(Cronberg & Komárková-Legnerová 1988)



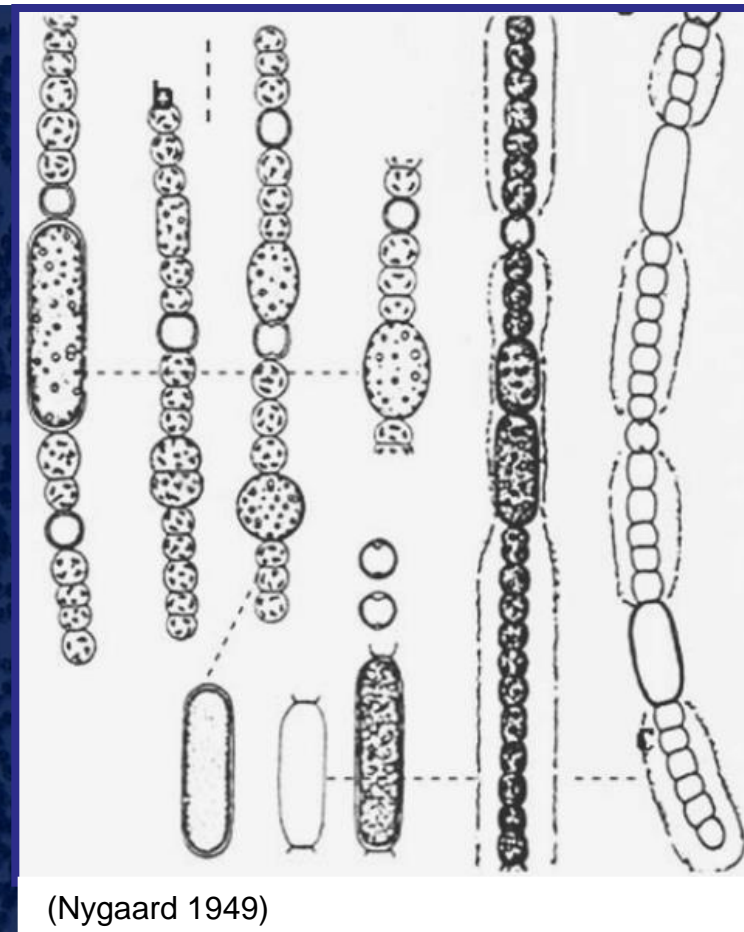
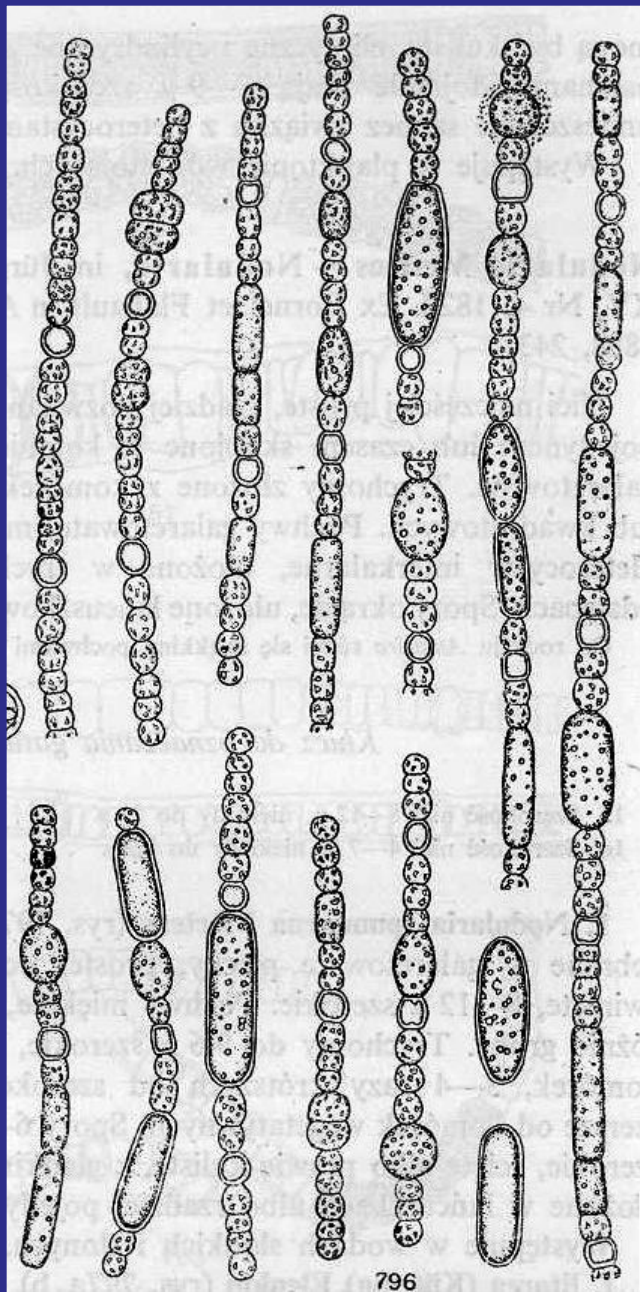
Šířka vlákna
4.3-5.7 μm

Akinety
22.8-30 x
x 7.1-8.6 μm



(Cronberg & Komárková-Legnerová 1988)

Dolichospermum heterosporum (Nygaard) Wacklin et al. 2009



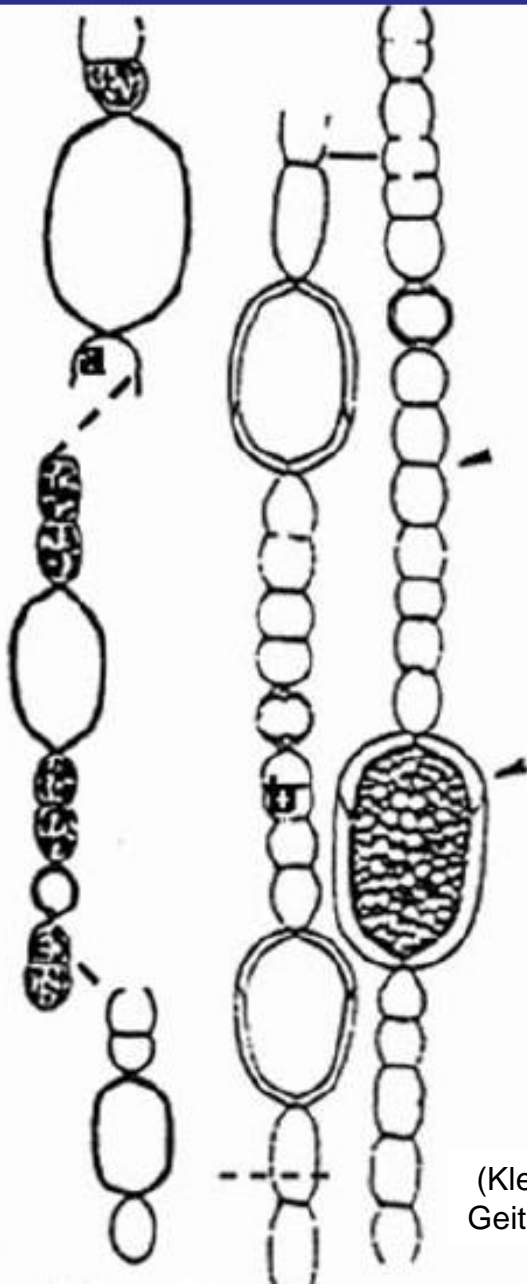
(Nygaard 1949)

(Nygaard in Starmach 1966)

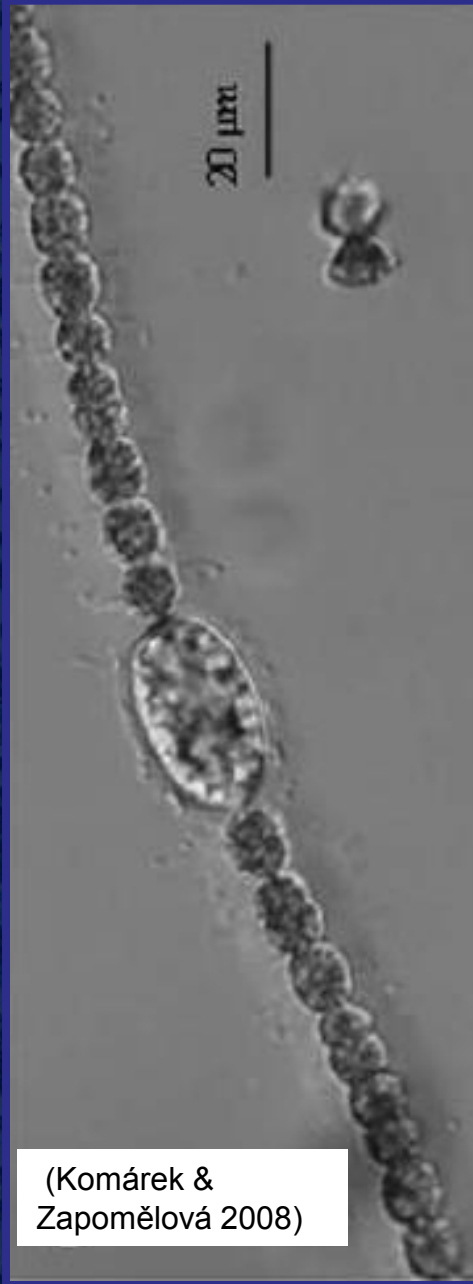


Šířka vlákna
(4.5) 5-6 μ m
Akinety
25-36 x (5.6) 8-9 (10) μ m

Dolichospermum macrosporum (Klebahn) Wacklin et al. 2009



(Klebahn in
Geitler 1932)



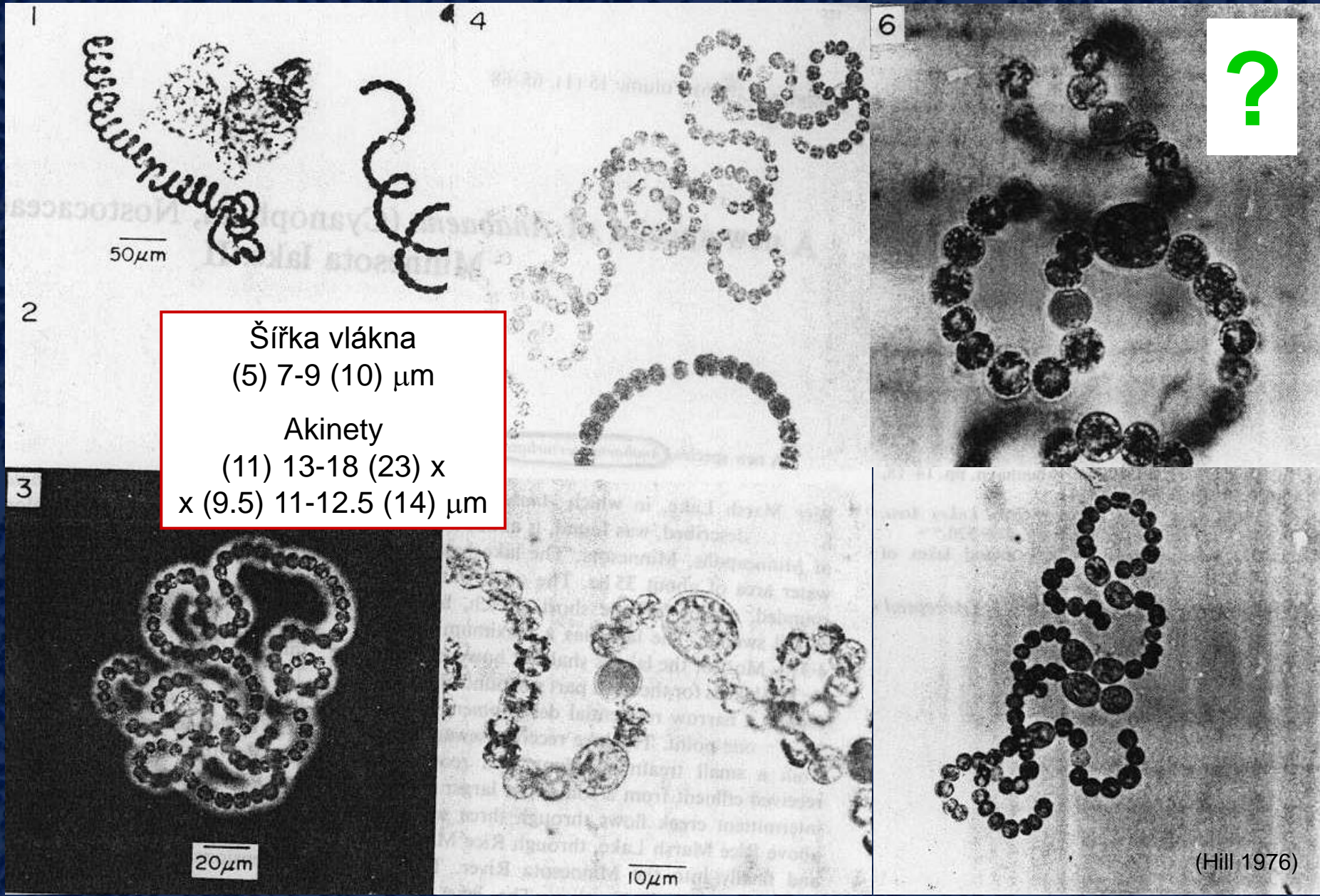
(Komárek &
Zapomělová 2008)



Šírka vlákna
5-6.5 (8-10?) μm

Akinety
17-35 x 11-21 μm

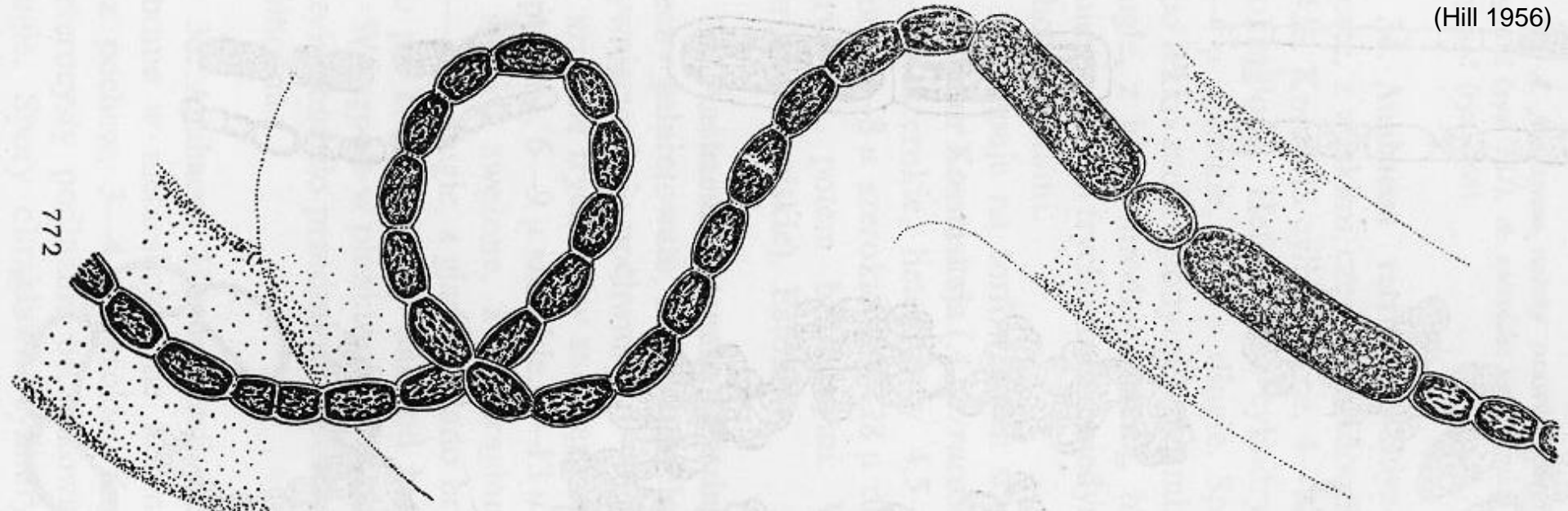
Dolichospermum perturbatum (Hill) Wacklin et al. 2009



Dolichospermum skujae-laxum

(Komárek & Zapomělová) Wacklin et al. 2009

(Hill 1956)



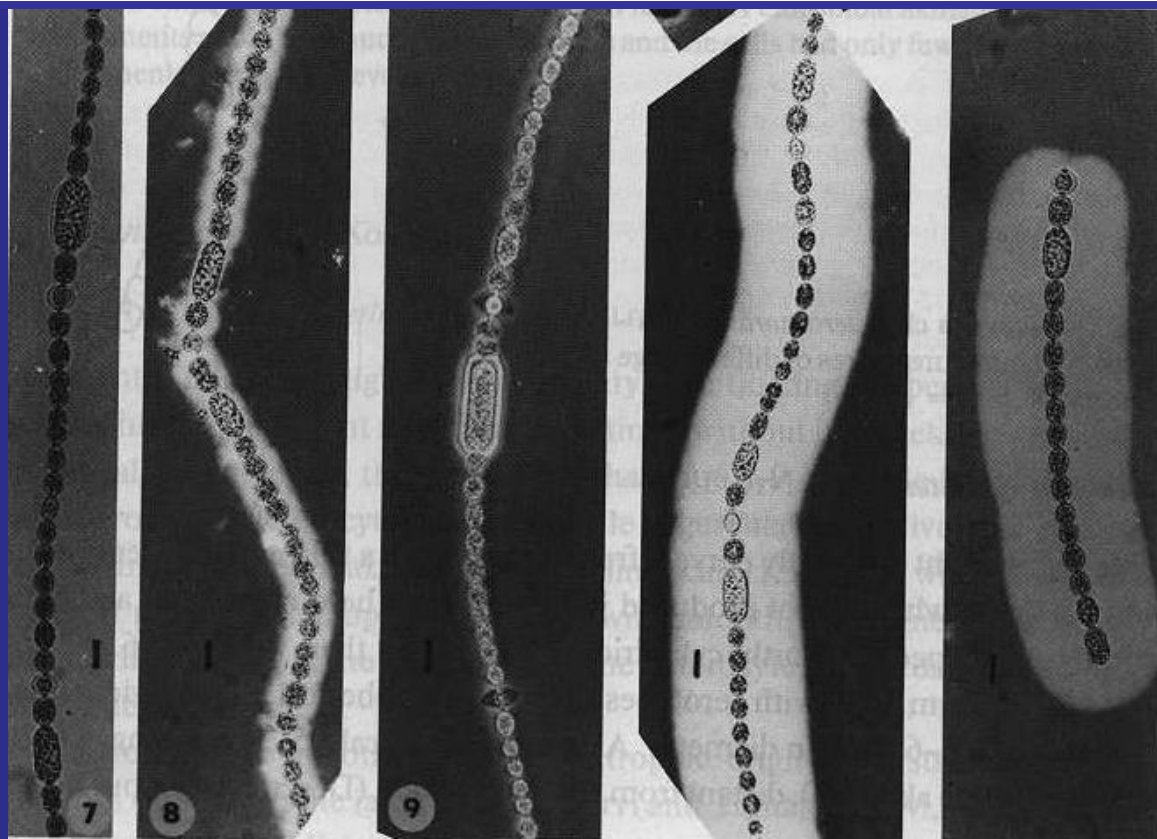
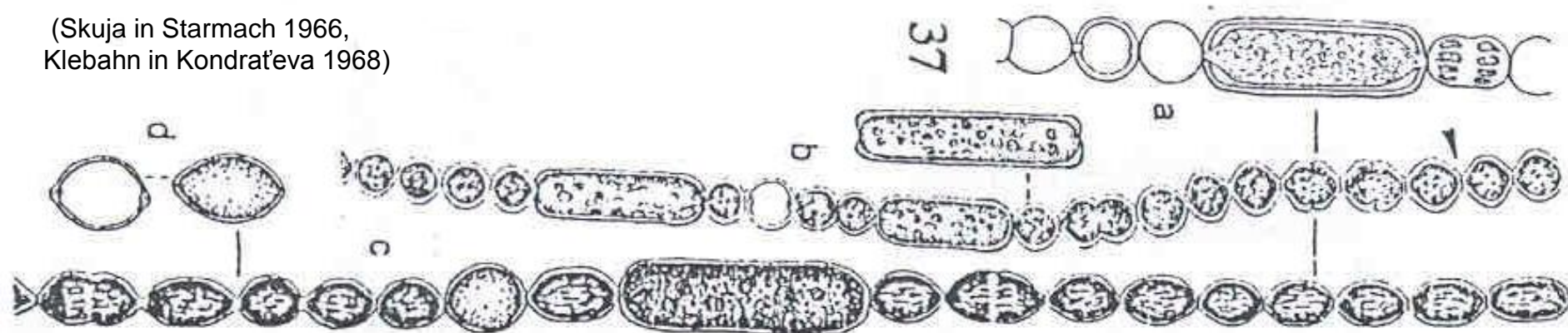
Šířka vlákna
5-6 μm

Akinety
7-10 x 5-6 μm



Dolichospermum solitarium (Klebahn) Wacklin et al. 2009

(Skuja in Starmach 1966,
Klebahn in Kondratěva 1968)



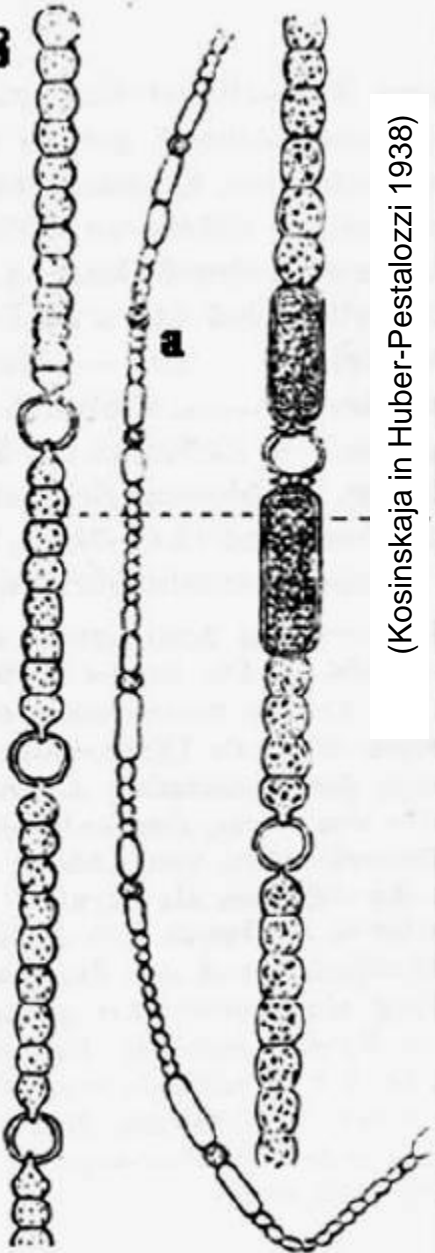
Šírka vlákna
6.5-10 (12) μm
Akinety
20-45 x 10-16 μm



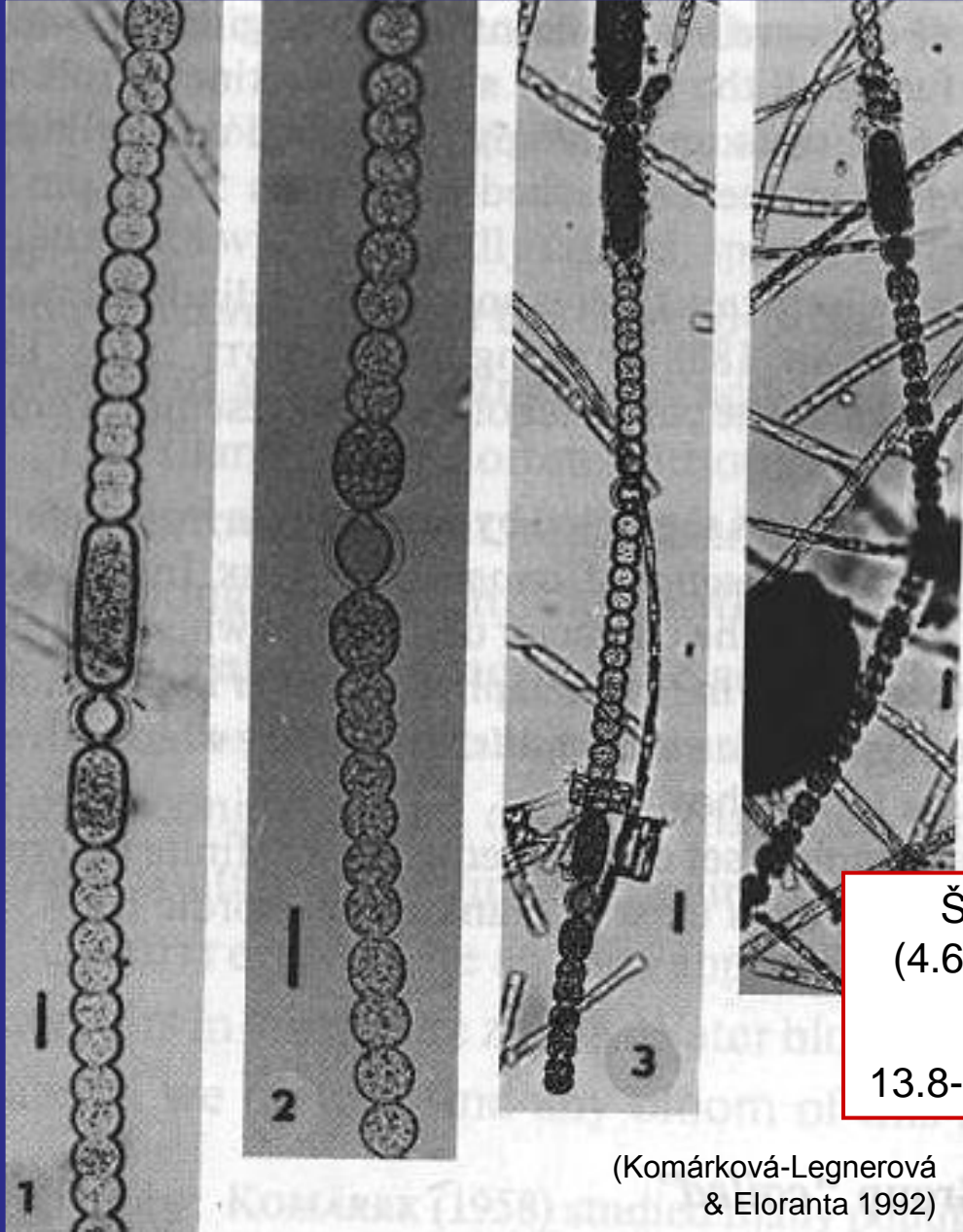
(Komárková-Legnerová & Eloranta 1992)

Dolichospermum zinsenlingii (Kosinskaja) Wacklin et al. 2009

18



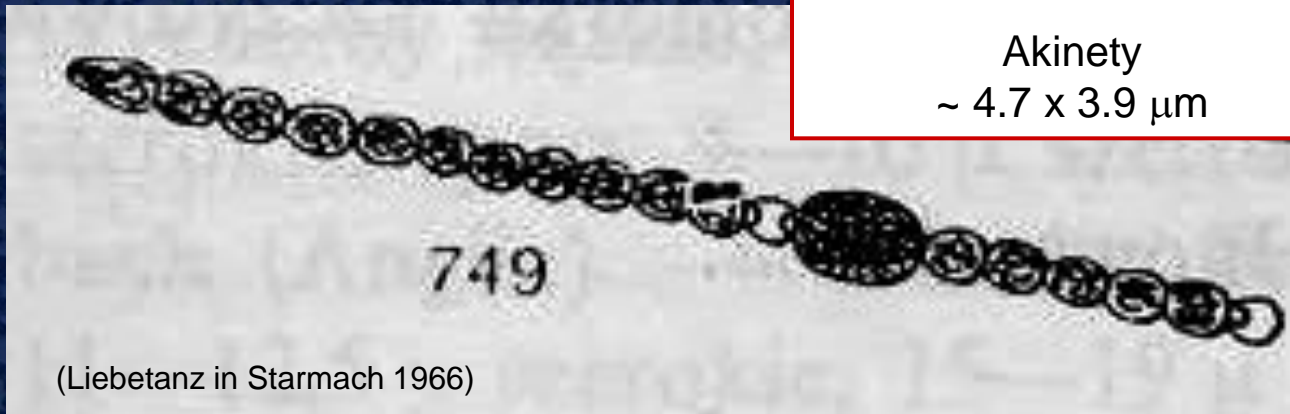
(Kosinskaja in Huber-Pestalozzi 1938)



Šírka vlákna
(4.6) 5.7-7 (9) μm
Akinety
13.8-34.5 x 8-13 μm

(Komárková-Legnerová & Eloranta 1992)

Anabaena salina Liebetanz 1925



(Liebetanz in Starmach 1966)

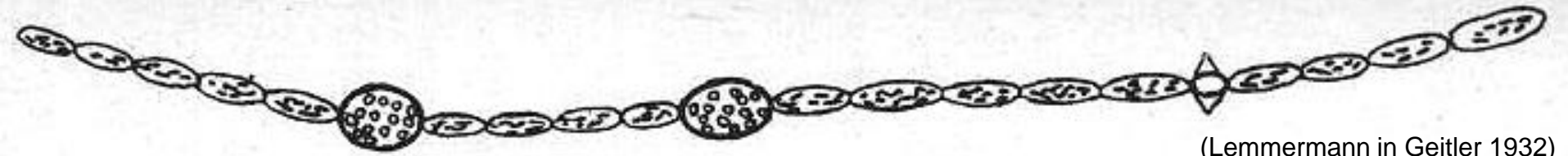
Šířka vlákna
~2.5 μm

Akinety
~ 4.7 x 3.9 μm

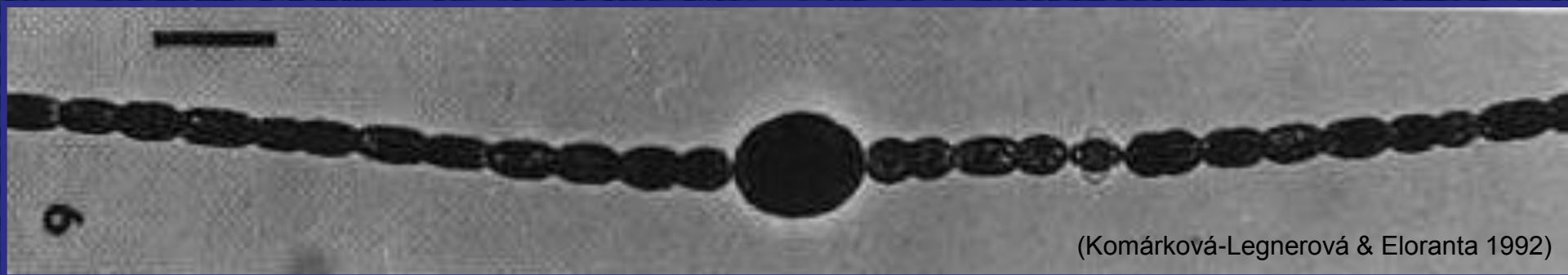
Cluster of *Anabaena bergii*,
Aphanizomenon ovalisporum etc.

???

Anabaena elliptica Lemmermann 1898



(Lemmermann in Geitler 1932)

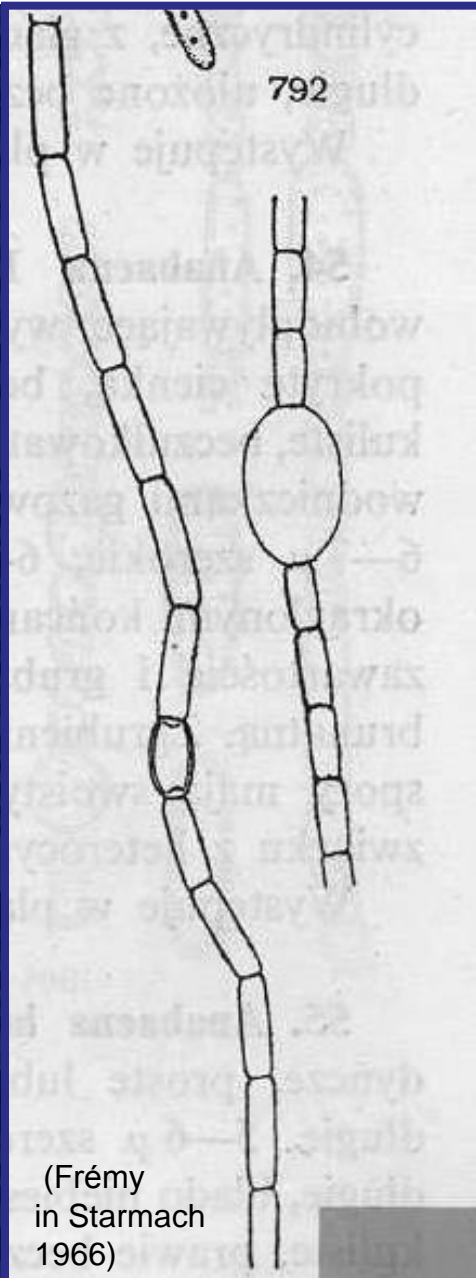


(Komárková-Legnerová & Eloranta 1992)

Šířka vlákna
~7 μm

Akinety
7-8 x 6-7 μm

Anabaena levanderi Lemmermann 1906



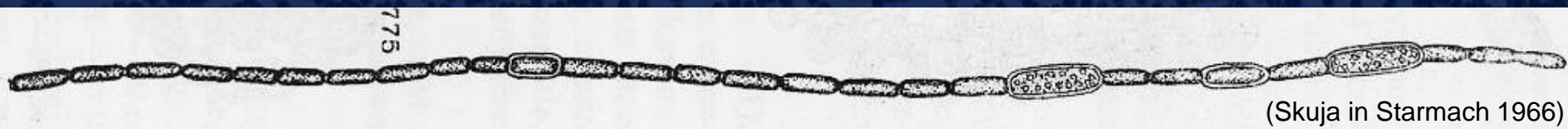
Šířka vlákna

4-6 μm

Akinety

19-45 x 8-15 μm

Anabaena miniata Skuja 1956



(Skuja in Starmach 1966)

Šířka vlákna
1.5-1.7 μm

Akinety
9-13 x 2-3 μm

Přehled současných revizí

ANABAENA

Dolichospermum

– cca 46 planktonních druhů

Sphaerospermopsis

– cca 3-6 planktonních druhů

Anabaena

– cca 56 bentických druhů

Chrysochloris

– 2 planktonní druhy

Nerevidované *Anabaena*-like taxony

– cca 20 planktonních dr

– cca 19 bentických/perifyt. druhů

APHANIZOMENON

Aphanizomenon

– cca 9 planktonních druhů

Cuspidothrix

– 5 planktonních druhů

Unrevised *Aphanizomenon*-like taxa

– cca 1-2 planktonní druhy

Děkuji Vám
za pozornost!

