Fig. 1-1. A comparison of the Kickxellales and its alleles (= kickxellids).

*1: The compositions of the orders are based on Kirk et al. (2001) except for that of the Kickxellales. The Kickxellales includes 1 genus and 2 species described through the present study.

*2: All species of the Dimargaritales are parasites of the species of the Mucorales (Zygomycetes), and more rarely on the ascomycete genus *Chaetomium* Kunze : Fr. (Benjamin 1979). The members of the Harpellales are regarded as parasites, commensals, or symbionts of aquatic insect larvae (Misra 2001).

*3: Diagrams are copied from Benjamin (1958) and Alexopoulos et al. (1996).

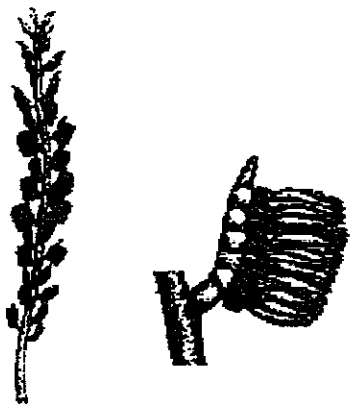
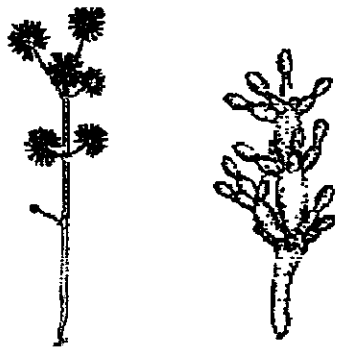
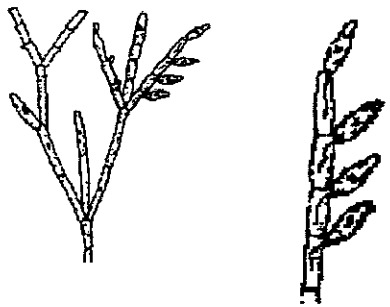
phylum	Zygomycota		
class	Zygomycetes		Trichomycetes
order	Kickxellales	Dimargaritales	Harpellales
composition of the order*1	1 fam., 10 gen., 28 spp.	1 fam., 4 gen., 14 spp.	2 fam., 33 gen., 142 spp.
nutritional mode*2	mainly saprobes, the rest are suspected to be mycoparasites	parasites of the Mucorales (Zygomycetes)	endoparasites (or endocommensals or symbiont) of aquatic insect larvae
diagrams of asexual sporogeneous structures*3 sporangiophores (left) and fertile branchlets (right)			

Fig. 1–1. A comparison of the Kickxellales and its alleles (= kickxellids).

Fig. 1-2. A comparison of the asexual sporogeneous morphology of the kickxellids. Diagrams of total asexual sporogeneous morphology, the component of the morphology, and a sporangiospore are shown. All kickxellids, especially the Kickxellales and the Harpellales share similar asexual sporogeneous morphology (emphasized with red frames). ■ : Fertile branchlets. Called as sporocladia in the Kickxellales, sporiferous branchlets in the Dimargaritales, and generative cells in the Harpellales. ■ : Pseudophialides (Kickxellales). These are absent in the Dimargaritales. Pseudophialides are homologous with collar regions of generative cells of the Harpellales (left). In the genus *Pteromaktron* (Harpellales), subsidiary cells exist (right). ■ : Sporangiospores. Sporangiospores are asexual spores formed endogenously in sporangiola. Sporangiola are monosporic in the Kickxellales and the Harpellales, and two-spored in the Dimargaritales. In the Dimargaritales, a pseudoseptum (arrow) separates the two spores in a sporangiole. In the Harpellales, sporangiola have appendage(s).

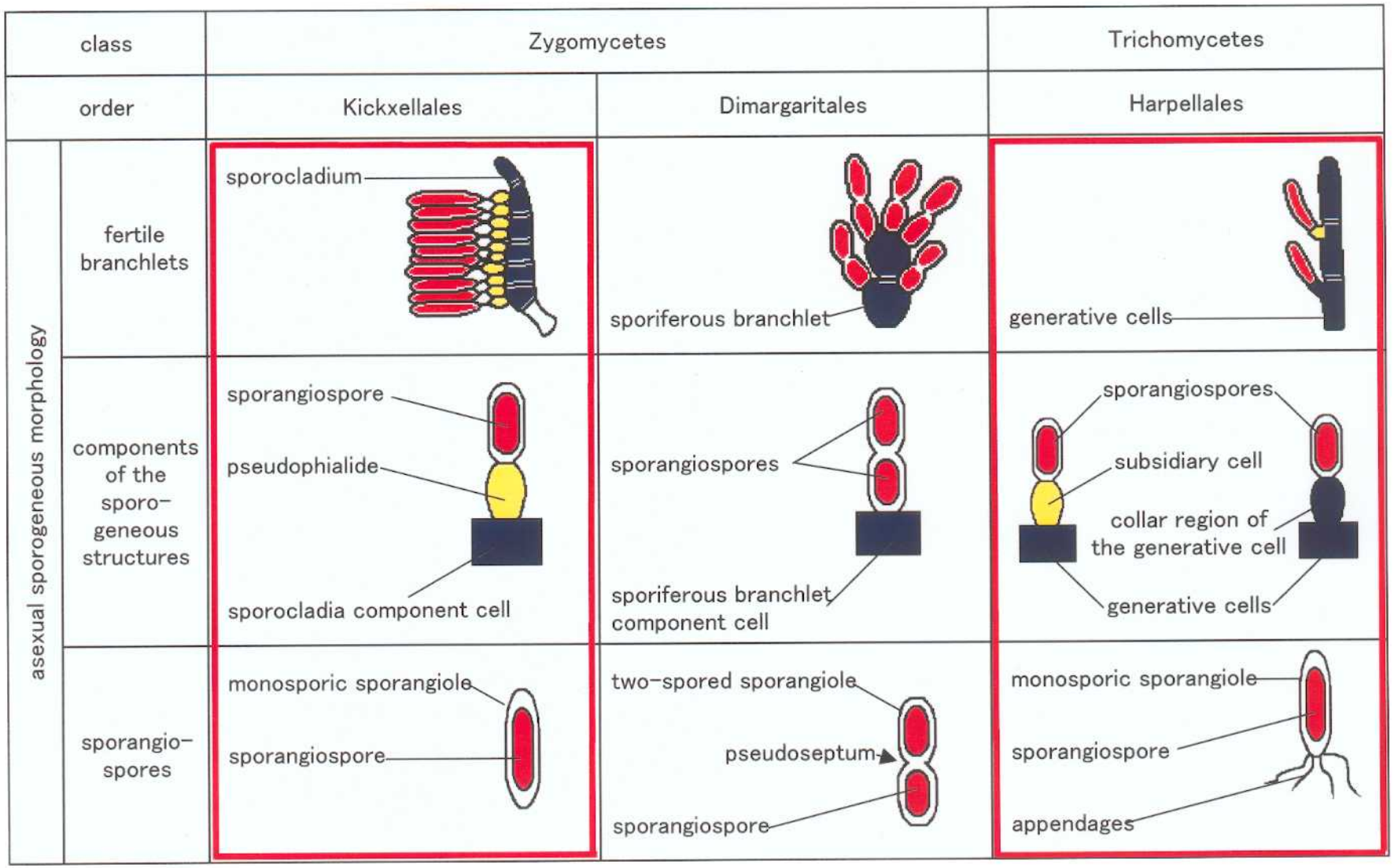


Fig. 1-2. A comparison of the asexual sporogeneous morphology of the kickxellids.

Fig. 1-3. A comparison of the sexual sporogeneous morphology of the kickxellids. Diagrams of total sexual sporogeneous morphology and each characteristics of the morphology are indicated. The Kickxellales and the Dimargaritales share similar sexual sporogeneous morphology (emphasized with red frames). Zygospores are formed endogenously in monosporic zygosporangia; as a result, mature zygospores are enveloped with the zygosporangia. Typically, zygospores are thick-walled, hyaline (Kickxellales, Harpellales, and a few dimargaritaleans) or lightly pigmented (most dimargaritaleans), and having (Kickxellales and Dimargaritales) or not having (Harpellales) globular contents. Zygospore surfaces are ornamented (Dimargaritales) or not (Kickxellales and Harpellales) in general.

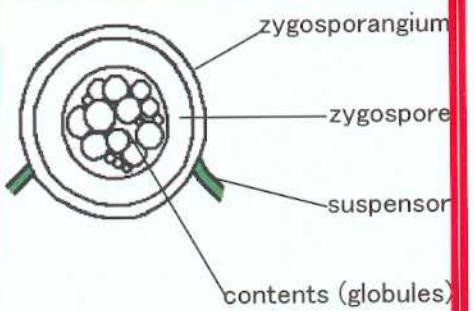
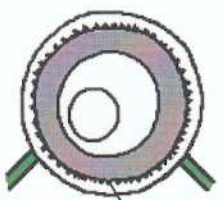
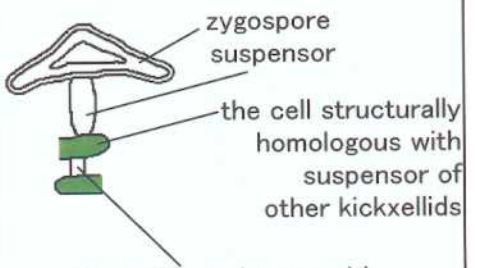
	class	Zygomycetes		Trichomycetes
	order	Kickxellales	Dimargaritales	Harpellales
sexual sporogeneous morphology	diagram of zygospores			
	the origin of zygosporangia	the conjugant cell of two progametangia	the conjugant cell of two progametangia	the short branch develops on or from near the conjugant cell
	surface ornamentation of zygospores	absent	present (sculptured or punctulate)	absent
	pigmentation of cell wall	absent (hyaline)	present (lightly pigmented)	absent (hyaline)
	contents of zygospore	many globules	a large single globule	not globular

Fig. 1-3. A comparison of the sexual sporogeneous morphology of the kickxellids.

Fig. 1-4. A comparison of the septal structures of the kickxellids. Diagrams of the whole septal structures and septal plugs (= median plugs) are indicated. All kickxellids, especially the Kickxellales and the Harpellales share almost the same structures (emphasized with red frames). The septal structure of the Dimargaritales is characterized by the plugs with protuberances.

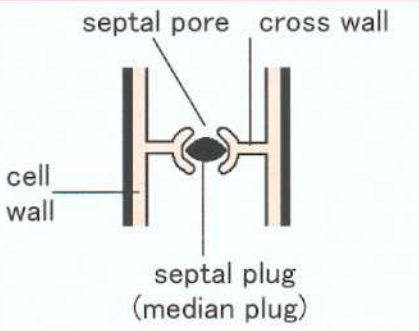
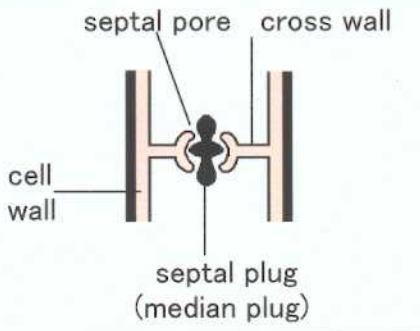
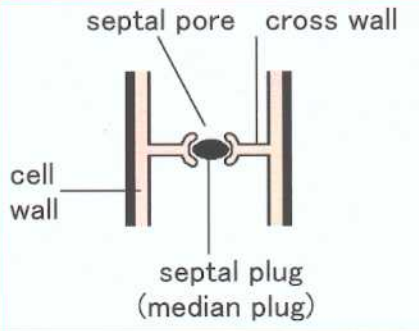
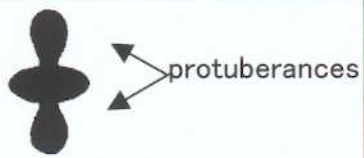
class		Zygomycetes		Trichomycetes
order		Kickxellales	Dimargaritales	Harpellales
septal structures	diagram of septal structures			
	diagram of septal plugs			
	protuberances of the plug	absent	present	absent
solubility of septal plugs		insoluble in 2–3% KOH and acidic stains	soluble in 2–3% KOH and acidic stains	not examined yet

Fig. 1–4. A comparison of the septal structures of the kickxellids.

Fig. 2-1. Morphological diagrams of kickxellalean species. A. Habit sketch showing sexual and asexual reproductive apparates. B. Asexual sporogeneous structures. C. Asexual spore (sporangiospore). D. Sexual spore (zygospore). E. Septal structures of sporangiophore. ac: Apical cell of a sporocladium. cw: Cell wall, consists of outer and inner layers. fp: Fertile part of a sporangiophore. gfs: Gangliform structure of vegetative hyphae. gl: Globule, contents of zygospores. il: Inner layer of the two-layered cell wall. mp: Median plug (= septal plug), a plug-like structure that occupies the septal pore. ol: Outer layer of the two-layered cell wall. pp: Pseudophialide, a sporogeneous cell. sc: Sporocladium, a fertile branchlet. sd: Spore droplet, a mass of sporangiospores enveloped with mucilage. se: Septum (= cross wall). sep: Septal pore, a large central pore of septa. sl: Sporangiole, a structure composed of cell wall and envelopes a sporangiospore. sp: Sporangiophore. ss: Sporangiospore, an asexual spore formed endogenously in a sporangiole. stl: Stolon. stp: Stipe (stalk) of a sporocladium. su: Suspensor of a zygospore. vh: Vegetative (= somatic) hypha. zg: Zygosporangium, a structure that originates from a conjugate cell of two gametangia, consists of cell wall, and envelopes a zygospore. zs: Zygospore, a sexual spore formed endogenously in a zygosporangium.

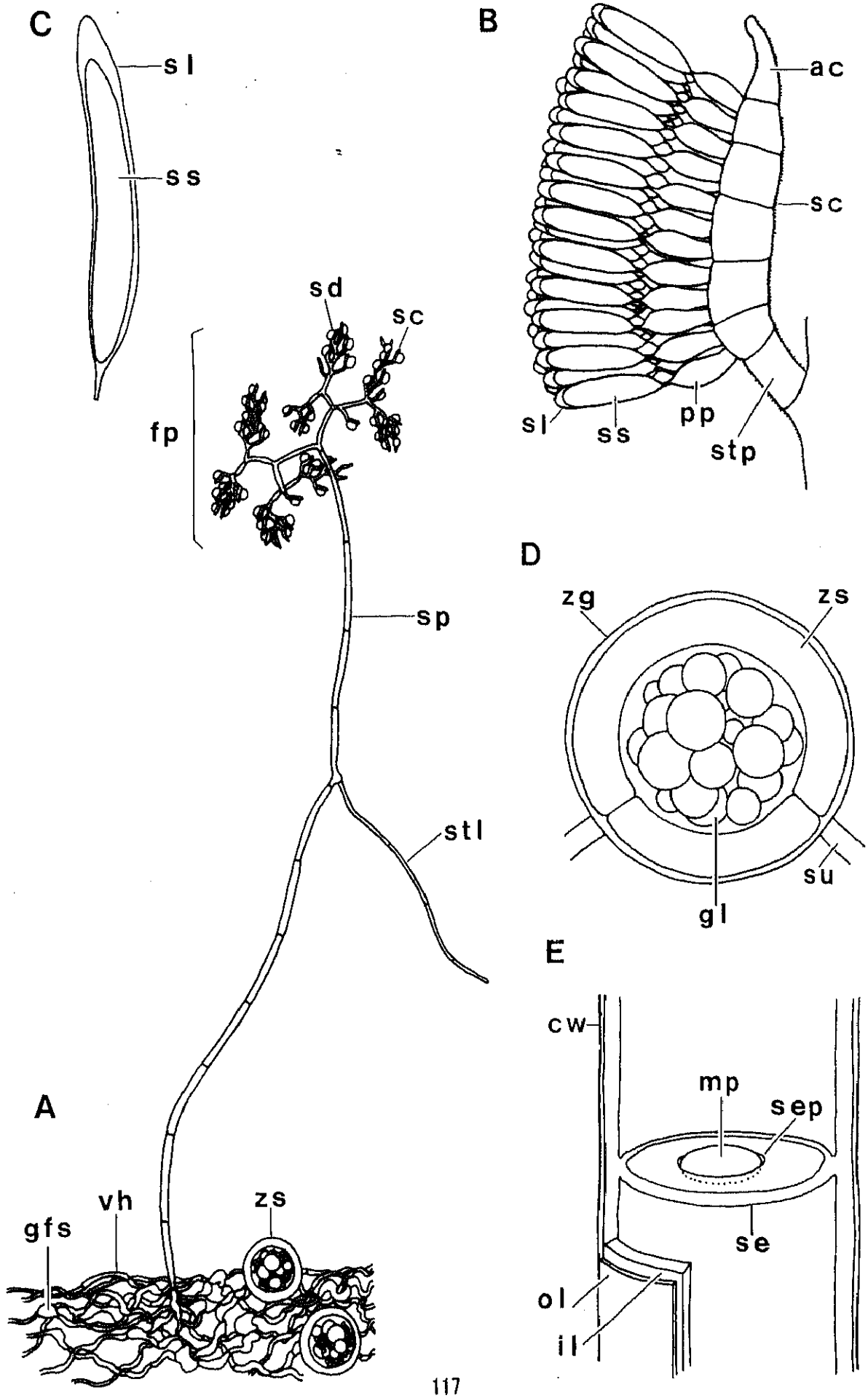

C
sl
ss
sd
sc
fp
sp
stl
A
gfs
vh
zs
B
ac
sc
sl
ss
pp
stp
D
zg
zs
su
gl
E
cw
mp
sep
se
ol
il

Fig. 2-2. *Coemansia furcata*. A. Upper portion of a sporangiophore. Bar = 50 μm. B. Fertile part of sporangiophore. Bar = 25 μm. C. Two sporocladia with nearly mature sporangiospores. Bar = 10 μm. D. Sporocladia after the separation of mature sporangiospores. Bar = 10 μm. E. Septum of a sporangiophore. Bar = 5 μm. F. Two sporangiola with sporangiospores in lactic acid-cotton blue; the sporangiospores are deformed. Bar = 5 μm. G. Young zygospore. Bar = 25 μm. H. Mature Zygospore. Bar = 25 μm.

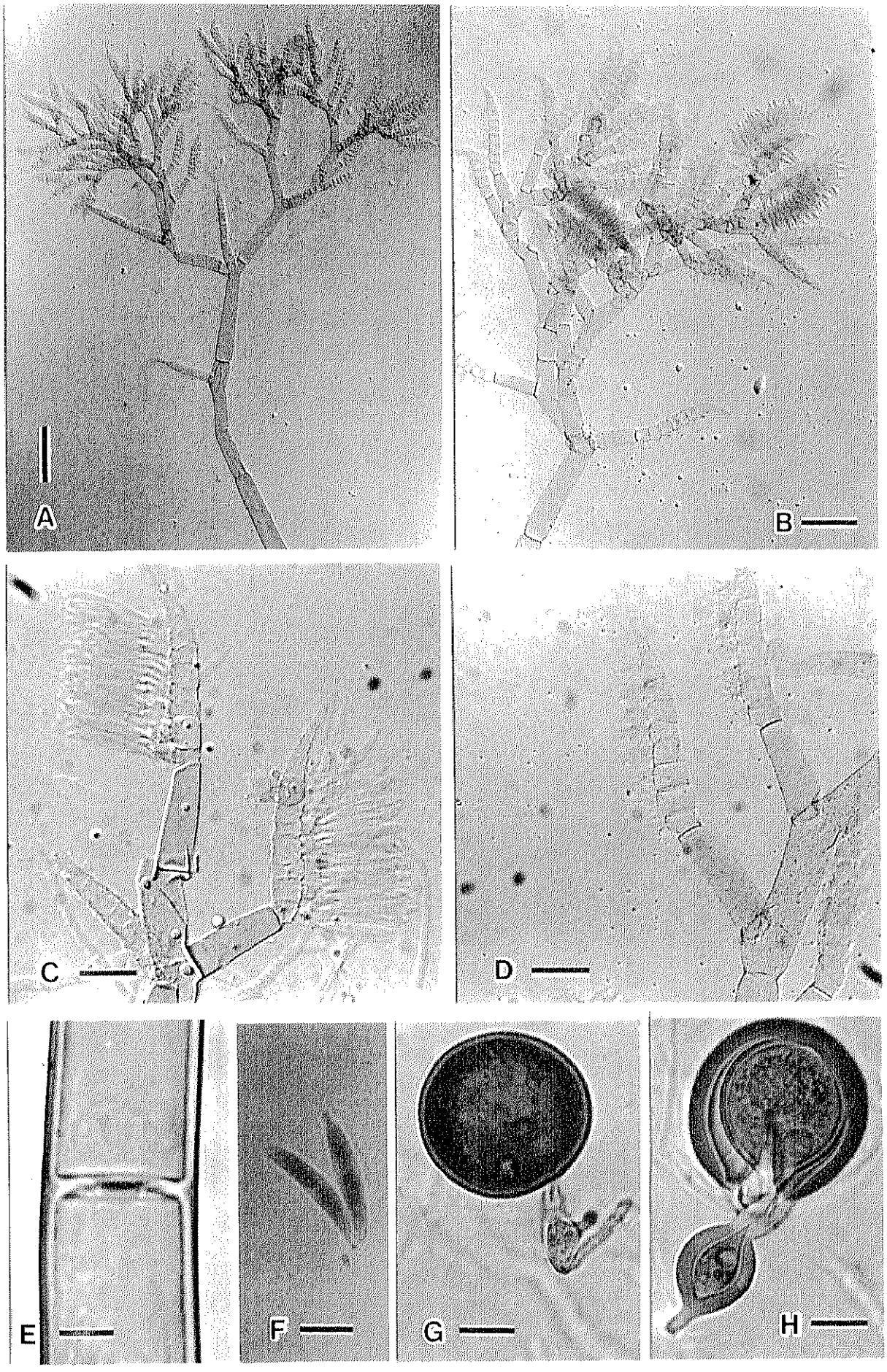

A
B
C
D
E
F
G
H

Fig. 2-3. *Coemansia furcata*. A. Habit sketch of sporangiophores. The left structure was often observed in old cultures. Bar = 150 μm. B. Upper part of sporangiophore. Bar = 30 μm. C. Five sporocladia showing successive stages in producing pseudophialides and sporangiola. Bar = 10 μm. D. Three sporangiola with sporangiospores in water. Bar = 5 μm. E. Two sporangiola with sporangiospores in lactic acid-cotton blue; the sporangiospores are deformed. Bar = 5 μm. F. Successive stages in germination of sporangiospore in water. Bar = 5 μm. G. Zygospores. Bar = 20 μm.

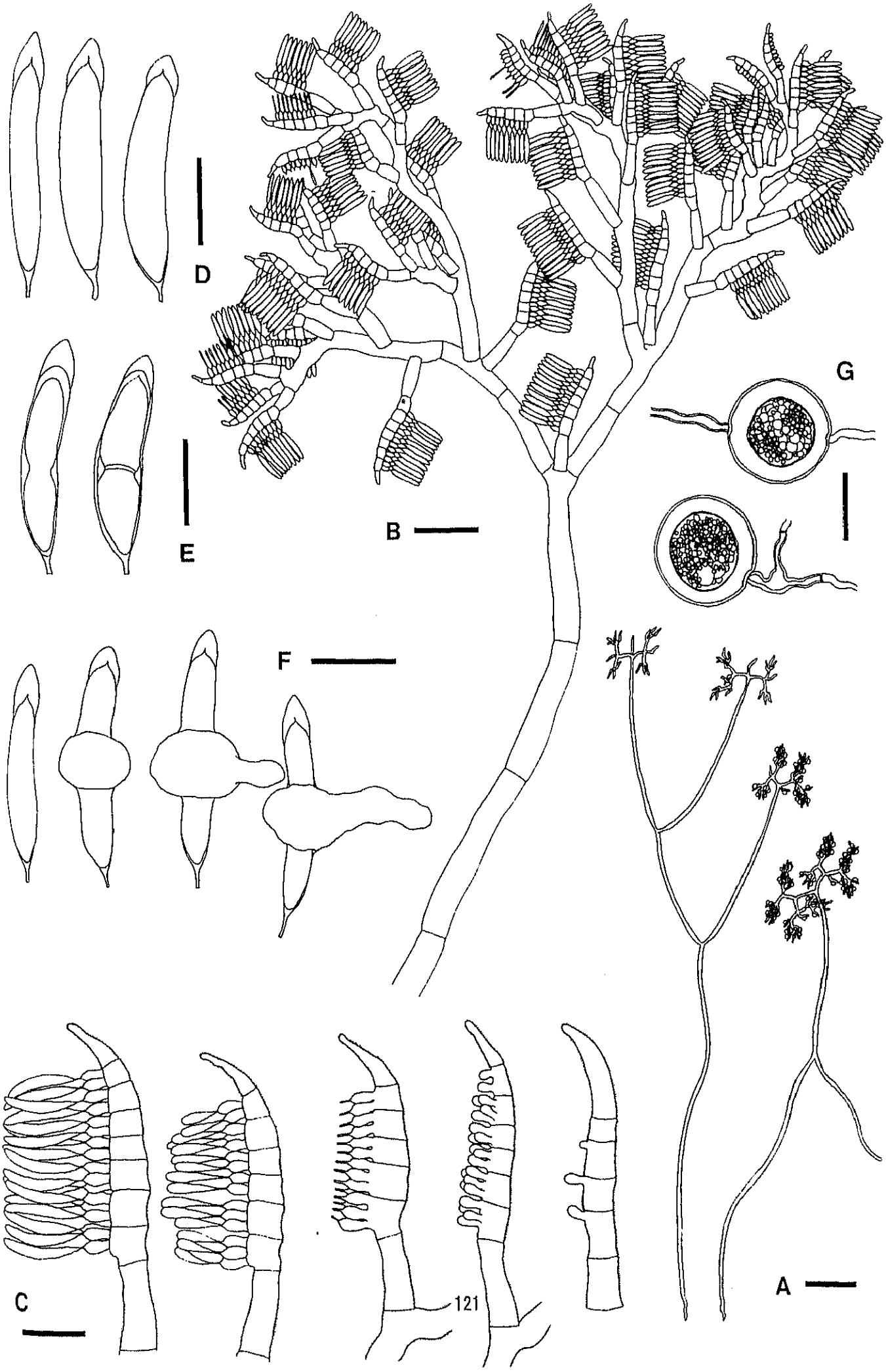

D
E
B
G
F
C
A
121

Fig. 2-4. *Coemansia* sp. 1. A. Upper portion of a sporangiophore with arcuate sporocladia. Bar = 20 μm. B. Mature sporangiola with sporangiospores. Bar = 5 μm.

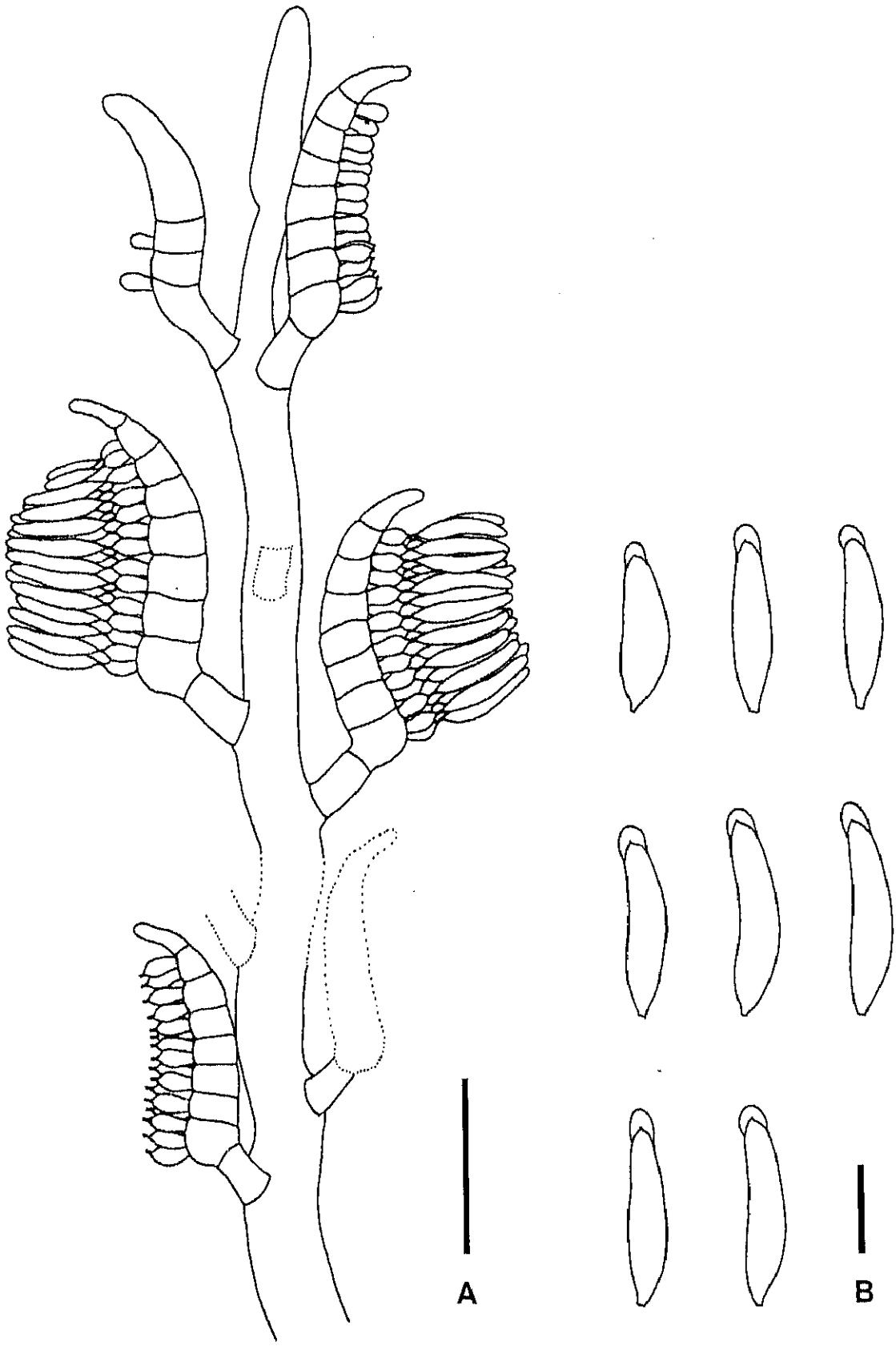

A
B

Fig. 2-5. *Myconymphaea yatsukahoi*. A. Sporangiophore. Bar = 50 μm. B. Fertile part of a sporangiophore. Bar = 20 μm. C. Fertile part of a sporangiophore after shedding of most sporangiola. Bar = 20 μm. D. Fertile part of a young sporangiophore in producing pseudophialides. Bar = 20 μm. E. Unicellular (left) and two-celled (right) sporocladia with developing sporangiospores. Bar = 10 μm. F. Sporangiophore septum. Bar = 20 μm. G. Sporangiophore septal plug separated from a septal pore. Bar = 5 μm. H. Upper half of a sporangiole including sporangiospore. Nucleus (n) of a uninucleate sporangiospore cell. Bar = 5 μm.

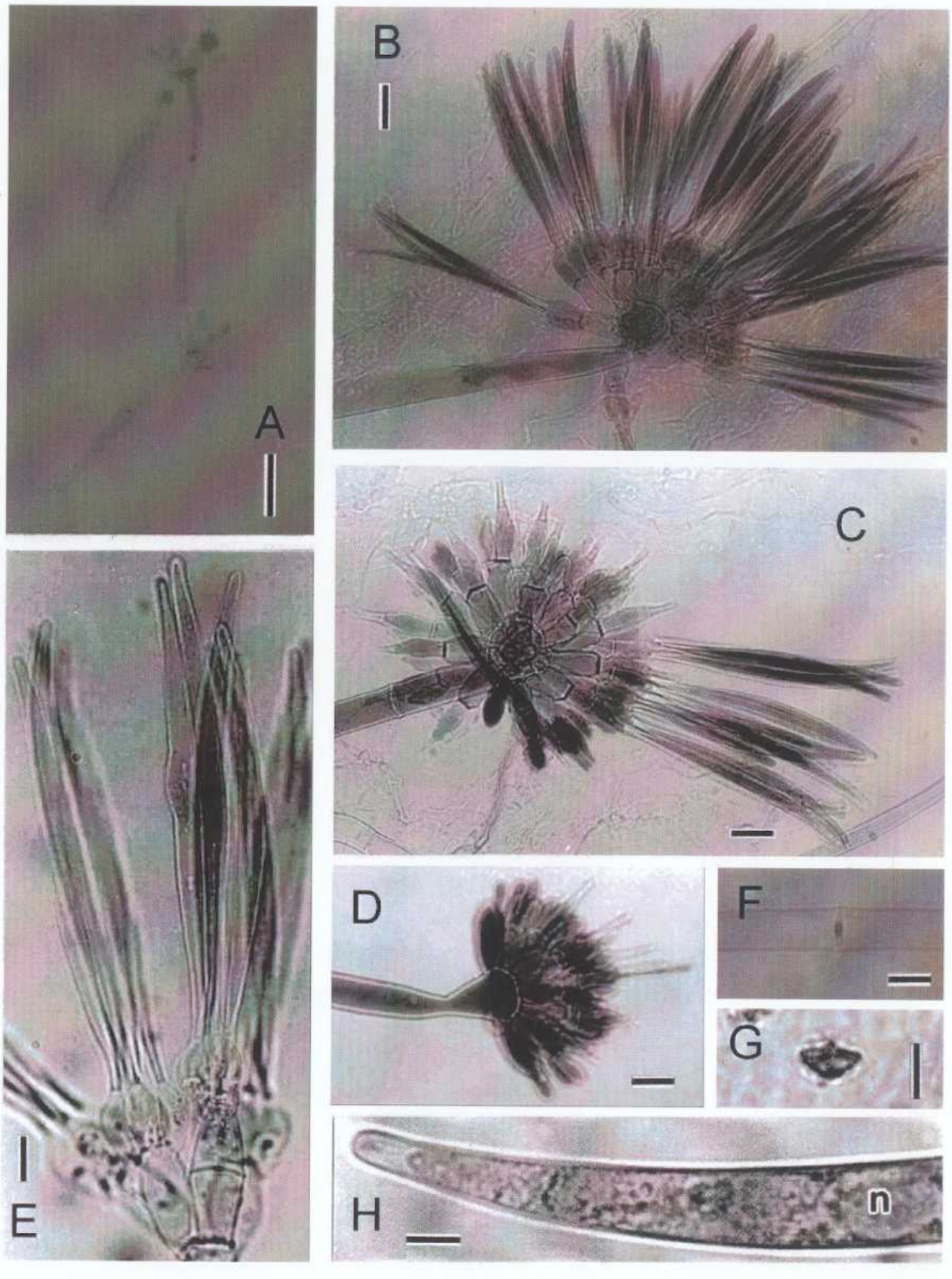

A
B
C
D
E
F
G
H
n

Fig. 2-6. *Myconymphaea yatsukahoi*. A. Habit sketch. WITHOUT SCALE. B, C. Habits of sporangiophores under wet (B) and dry (C) conditions. WITHOUT SCALES. D, E, F, G, H. Five fertile parts showing successive stages in development of sporocladia, pseudophialides, and sporangiola. Bars = 20 μm. D, E. Sporocladia arising from apical vesicles of sporangiophores. F. Young sporocladia bearing pseudophialides. G. Pseudophialides producing sporangiola. H. Sporocladia with young sporangiola (middle two), with mature and nearly mature sporangiospores (right), and after the separation of sporangiola (left). Pseudophialides often shrunk and disappeared after shedding of sporangiola except for the central one. I. Three mature sporangiola containing sporangiospores. Bar = 20 μm. J. Diagram of a sporangiophore septum. Two-layered cell wall, a septal pore, and a separated septal plug are shown. Bar = 5 μm. K, L. Sporangiophore septal plugs. Bars = 1 μm. K. Ordinary-shaped plug. Stained with 1% Phloxin. L. Deformed plug. Stained overnight with lactic acid-cotton blue.

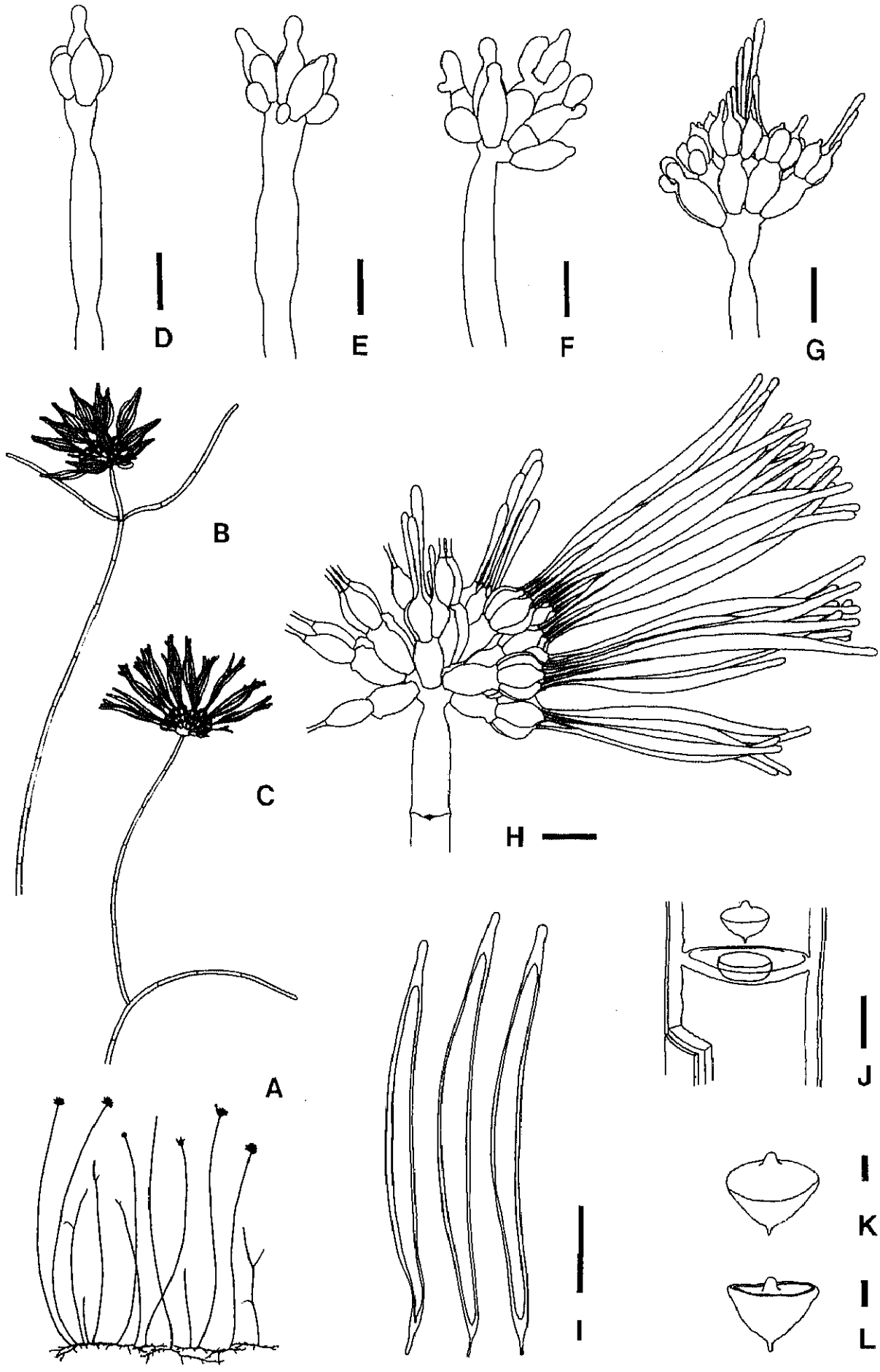

D
E
F
G
B
C
H
A
I
J
K
L

Fig. 2-7. *Myconymphaea yatsukahoi*. A. Four sporocladia showing successive stages in pseudophialides and sporangiola development. Bar = 20 μm. B. Successive stages in sporangiola development from pseudophialides. Bar = 20 μm. C. Successive stages in sporangiospore germination. Pseudoseptum (arrowhead). Bar = 20 μm.

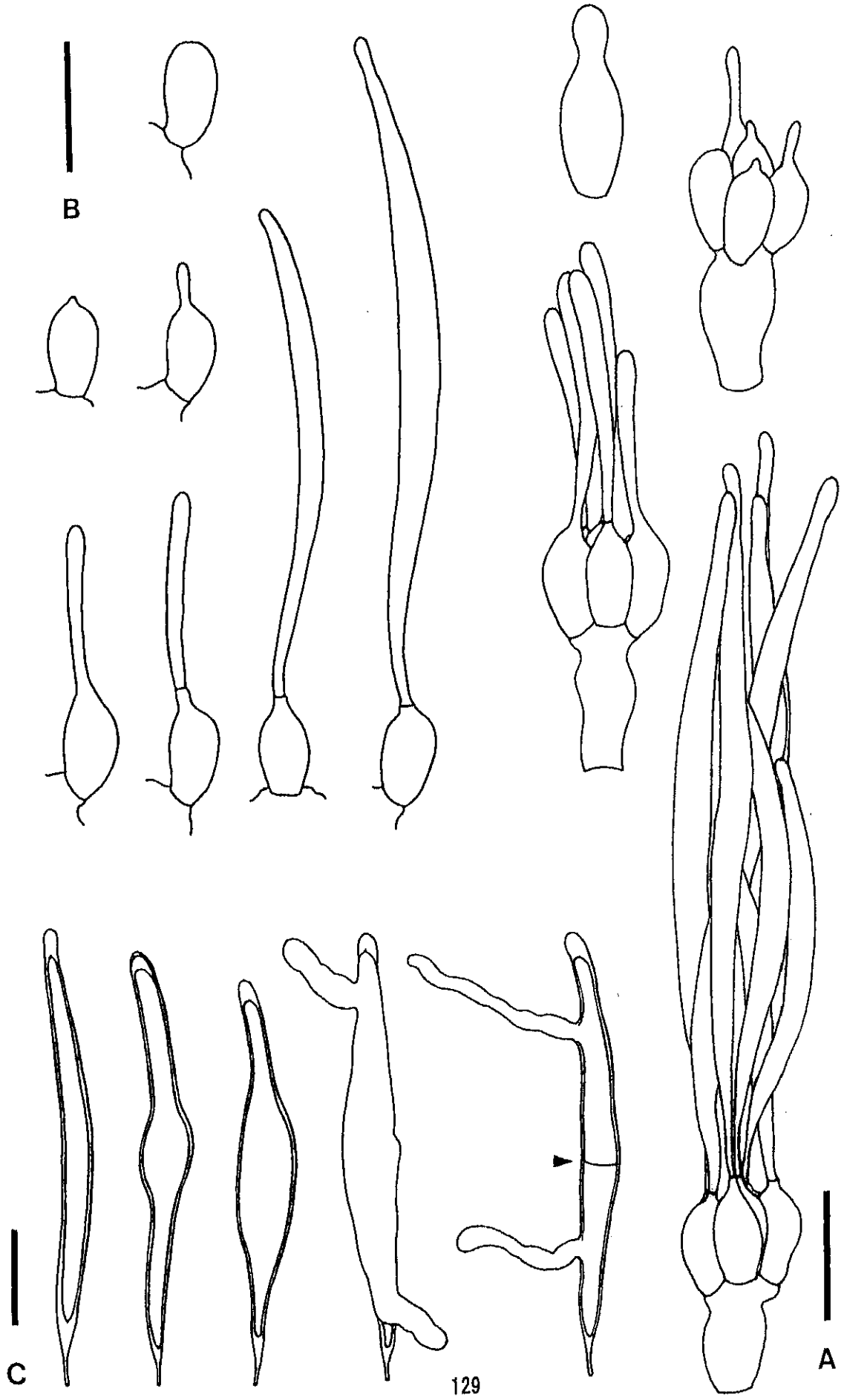

B
C
A

Fig. 2-8. *Mycoemilia scoparia* (tentative name). A. Upper part of a sporophore. Bar = 20 μm. B. Sporocladia bearing spores. Bar = 10 μm. C. Sporangiophore septum. Bar = 5 μm. D. Mature spore. Bar = 5 μm. E. Young sporocladium developing spores. Bar = 5 μm. F. Sporocladia after the separation of spores. Bar = 5 μm. G. Young zygospore. Bar = 5 μm. H, I. Surface (H) and sectional (I) figures of the same nearly mature zygospore. H. Minutely punctate surface of the zygospore. Bar = 5 μm. I. Globular contents of the zygospore. Bar = 5 μm.

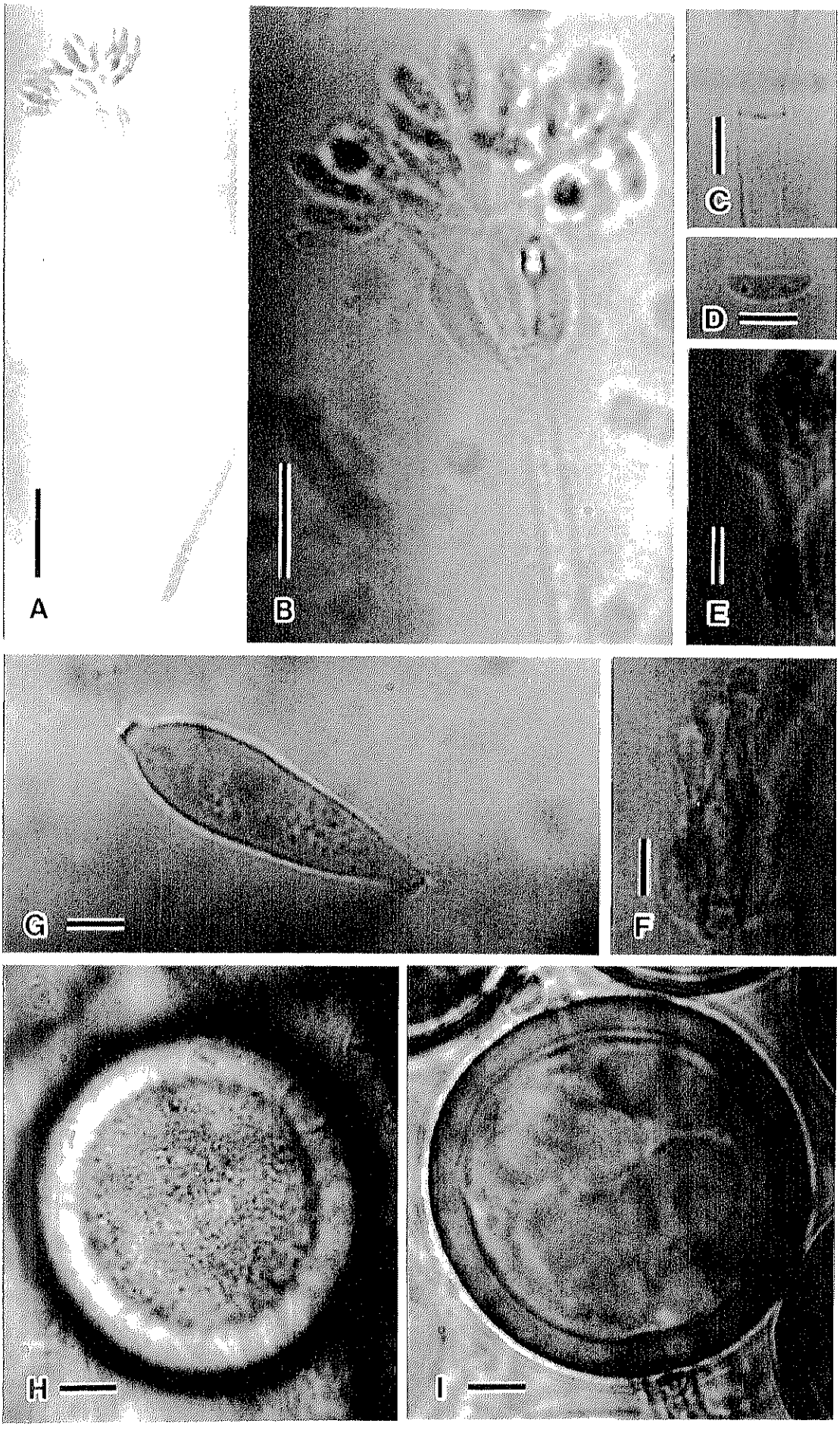

A
B
C
D
E
F
G
H
I

Fig. 2-9. *Mycoemilia scoparia* (tentative name). A. Habit sketch of sporophores. Arrows indicate monosporic sporogeneous cells produced laterally. WITHOUT SCALE. B. Upper part of a sporophore. Bar = 20 μm. C, D. Fertile parts of sporophores. C. Fertile part. Sporocladia bearing nearly mature asexual spores. Bar = 10 μm. D. A new fertile part produced laterally bellow the original fertile part. Spores have already shed off from the latter. Bar = 5 μm. E. Pleurogenous sporogeneous cell. Around the neck of the cell (arrowhead) was stainable with lactic acid-cotton blue. Septa have conspicuous median plugs. Bar = 5 μm.

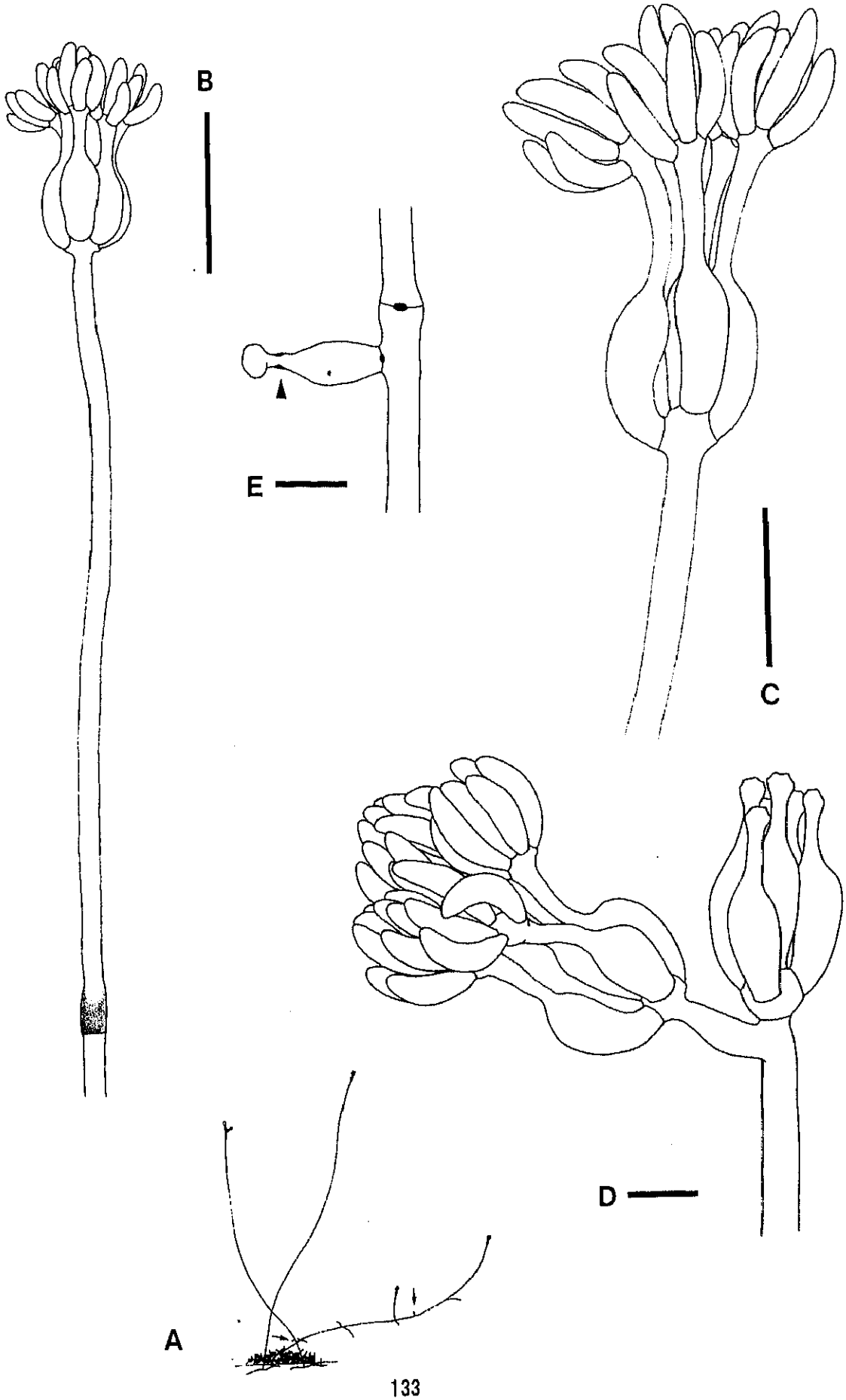

B
E
C
D
A

Fig. 2-10. *Mycoemilia scoparia* (tentative name). A. Five sporocladia showing successive stages in spore development. Bar = 10 μm. B. Mature spores. Bar = 5 μm.

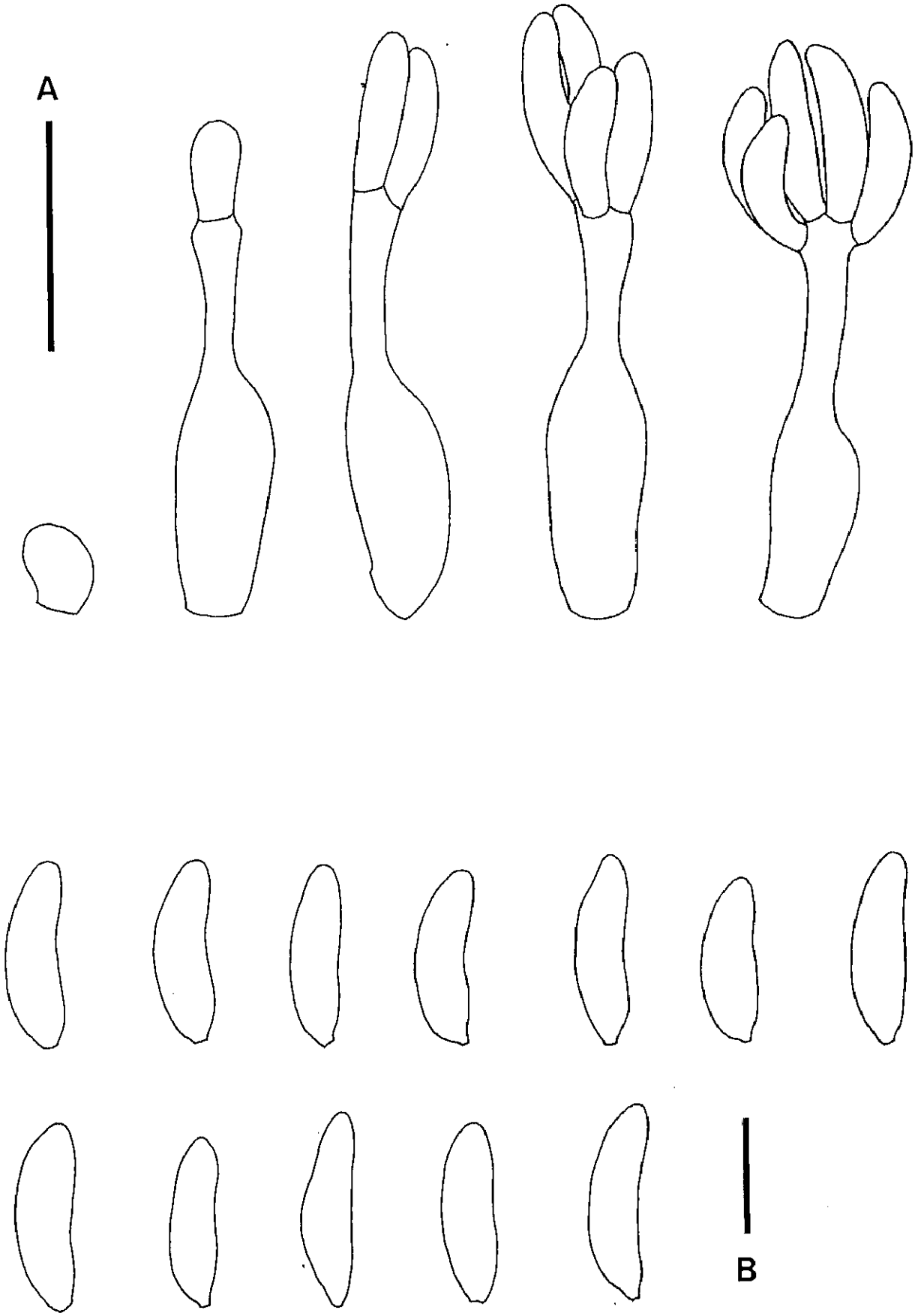

A
B

Fig. 2-11. *Mycoemilia scoparia* (tentative name). Successive stages in zygosporogenesis. A. Initiation of the zygosporogenesis. Two progametangia (fertile branchlets) develop from each zygophore and conjugate at the tips. B. The conjugant (= young zygospore) enlarges. C. Two young zygospores. Globular contents of zygospores start appearing. D. Young zygospore grows to be nearly globose. E. Zygospore wall getting thicker. F. Nearly mature zygospore. Globules continue to aggregate to be a large one. G. Mature zygospore with a single large globule. H. Minutely punctate surface of a mature zygospore. Bars = 10 μm.

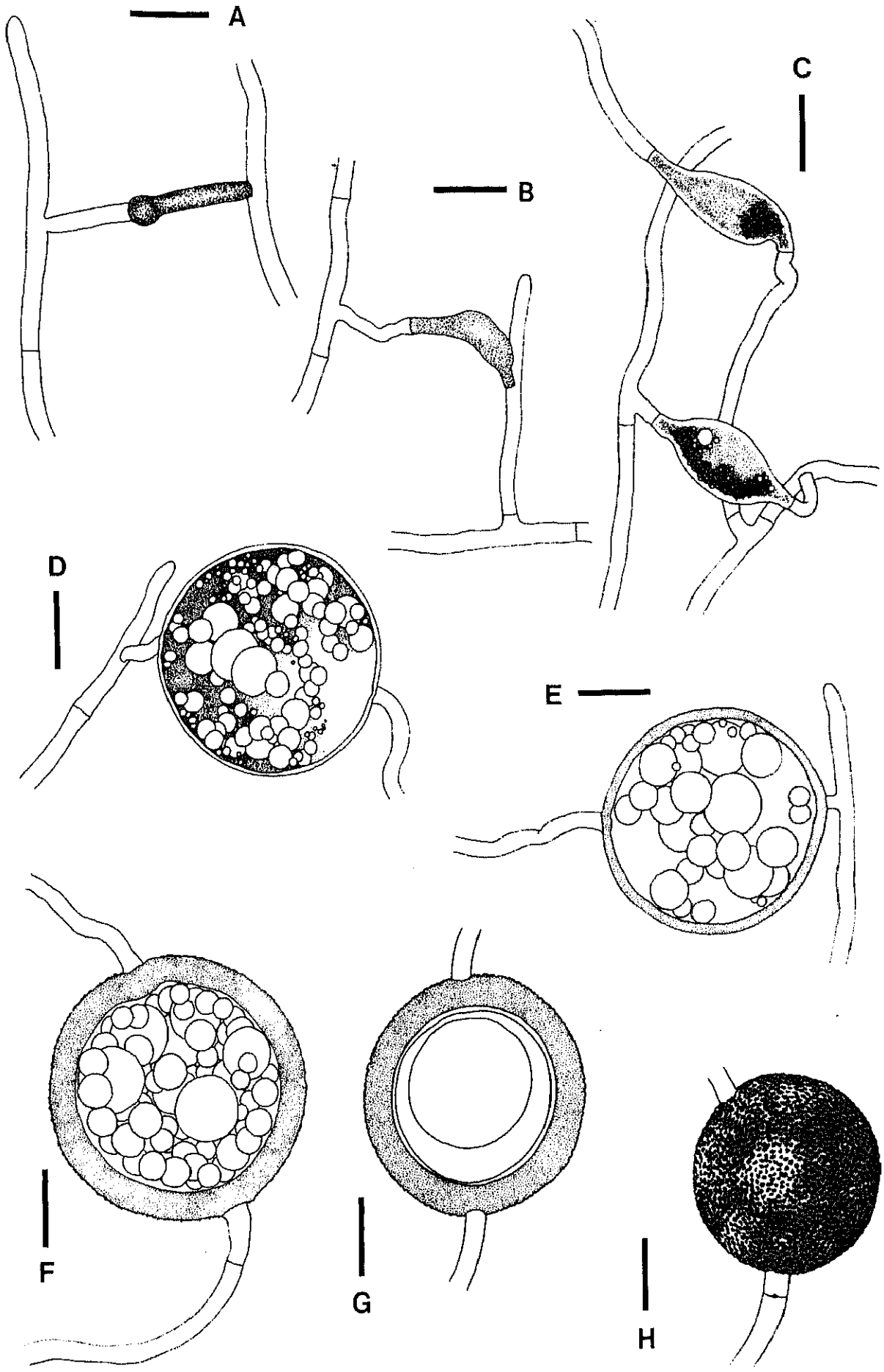

A
B
C
D
E
F
G
H

Fig. 2-12. *Ramicandelaber brevisporus* (tentative name). A. Sporophore incubated on 1/2 ME-YE agar. Bar = 40 μm. B. Sporophore incubated on 0.1% CMA agar. Bar = 40 μm. C. Rhizoids developed from the basal cell of a sporophore. Bar = 5 μm. D. Fertile parts of sporophore. Fertile branchlets are verticillate. Bar = 20 μm. E. Fertile part. Sporocladia formed on fertile branchlets and bearing pseudophialides. Asexual spores have shed out from pseudophialides. Bar = 5 μm. F. Two sporocladia before producing (right) and in producing a pseudophialide (left). Bar = 5 μm. G. Septa of a sporangiophore and the origin of a lateral branch. Bar = 5 μm. H. Mature spore. Bar = 5 μm.

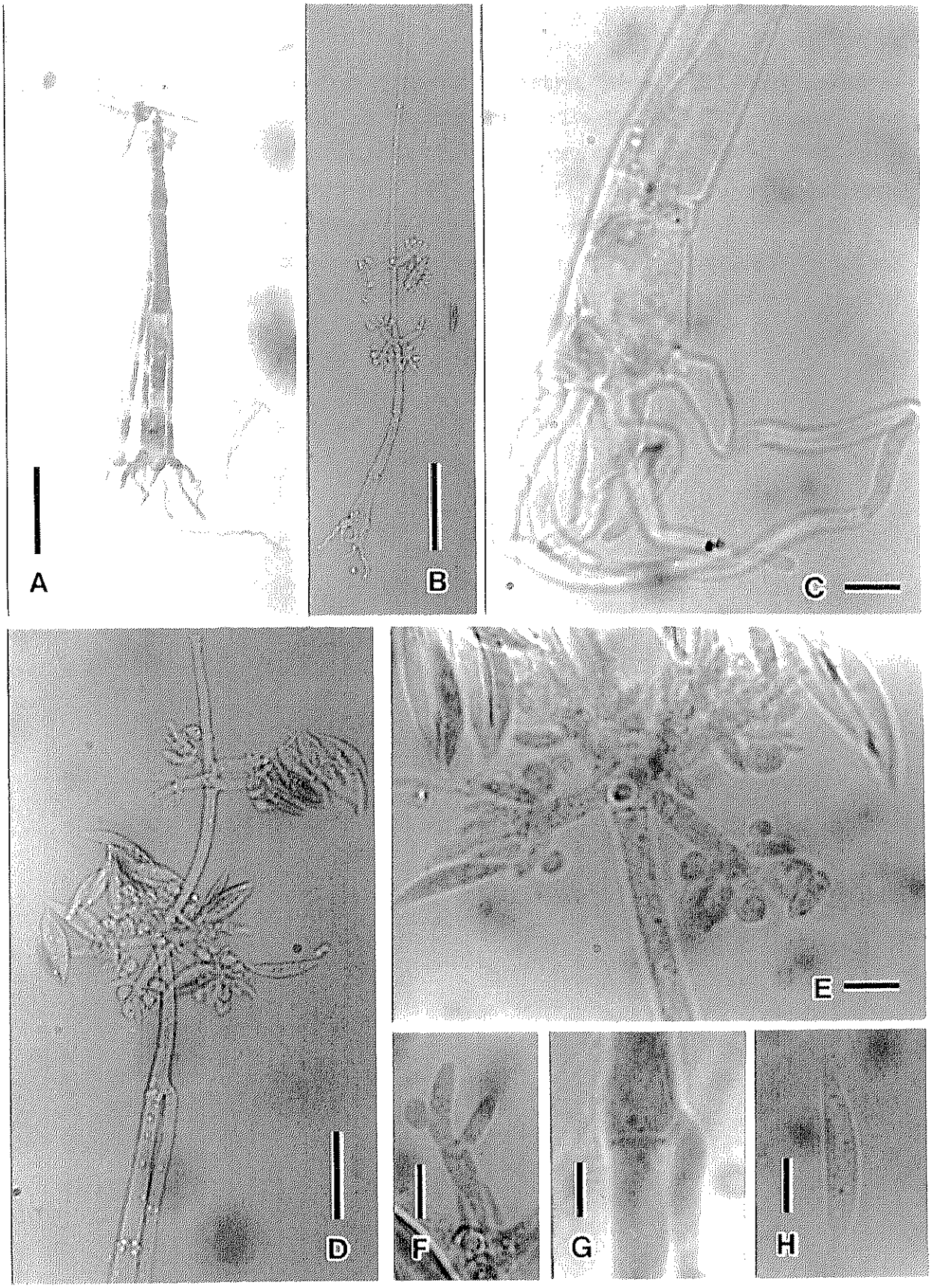

A
B
C
D
E
F
G
H

Fig. 2-13. *Ramicandelaber brevisporus* (tentative name). A. Habit sketch of sporophores. WITHOUT SCALE. B. Sporophore cultivated on 1/2 ME-YE agar. Bar = 40 μm. C. Insufficiently developed sporophore cultivated on 1/2 ME-YE agar. Bar = 40 μm. D. Fertile part, with verticillate fertile branchlets. Sporocladia bearing pseudophialides in producing spores on them. Bar = 10 μm. E. Seven sporocladia showing successive stages in producing pseudophialides and spores. Bar = 5 μm. F. Five mature spores. Bar = 10 μm. G. Hyphal connections between two aerial hyphae. Bar = 5 μm.

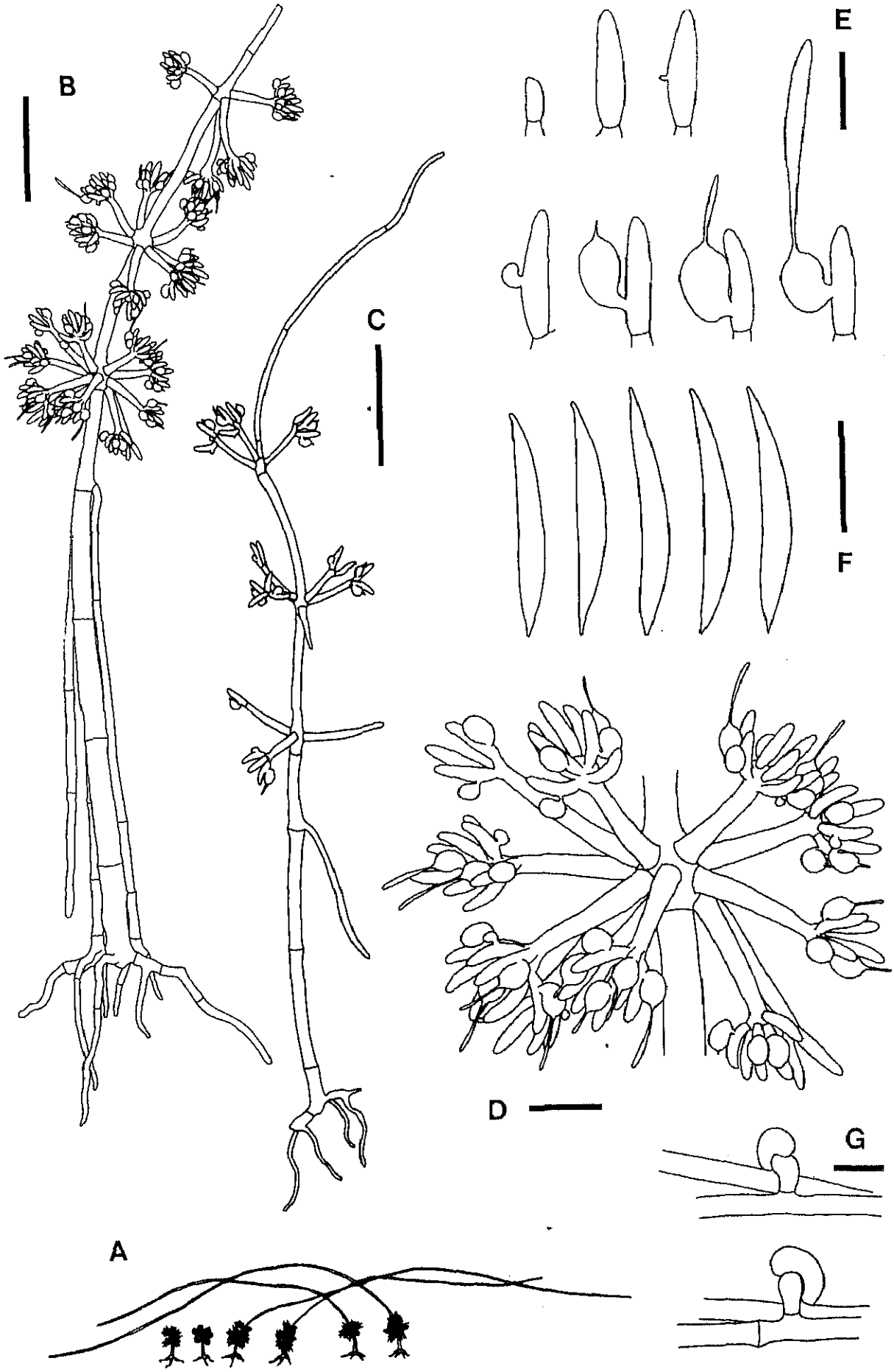

B
C
E
F
D
G
A

Fig. 4-1. Sporocladial types and groups of the genera of the Kickxellales. Five types of sporocladia and 3 groups of genera were identified in the Kickxellales. The typification of sporocladia was based upon the two natures of the sporocladia, and the grouping of the genera was founded on the asexual and sexual sporogeneous morphologies. ■: Sporocladia; fertile branchlets of the Kickxellales. In the *Coemansia* group (*Coemansia* type, *Linderina* type, and *Myconymphaea* type) and *Ramicandelaber* group (*Ramicandelaber* type), sporocladia bear sporogeneous pseudophialides on them. In the *Spiromyces* group (*Spiromyces* type), sporocladia generate spores without intermediated by pseudophialides. ■: Pseudophialides; sporogeneous cells of the Kickxellales except in the *Spiromyces* group. In the *Coemansia* group, a sporocladia-component cell bears plural pseudophialides. The *Spiromyces* group has no pseudophialides. In the *Ramicandelaber* group, a sporocladia-component cell bears only a single pseudophialide. ■: Asexual spores. Sporangiospores in the *Coemansia* group. Conidia in the *Spiromyces* group. Presumed to be conidia in the *Ramicandelaber* group, although whether the spores are in conidial or sporangiosporic conditions are undecided. *: A tentative name of this undescribed genus.

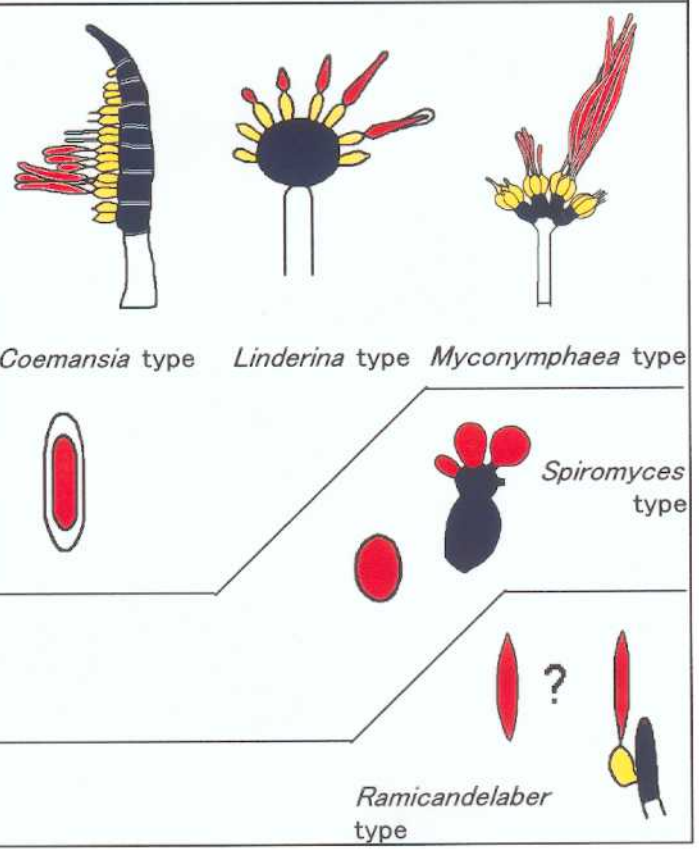
genus	types of sporocladia	groups of the genera	diagrams of the asexual sporogeneous apparates
Coemansia	*Coemansia* type	*Coemansia* group	
Dipsacomyces			
Kickxella			
Martensella			
Martensiomyces			
Spirodactylon			
Linderina	*Linderina* type		
Myconymphaea	*Myconymphaea* type		
Spiromyces	*Spiromyces* type	*Spiromyces* group	
*Mycoemilia**			
Ramicandelaber	*Ramicandelaber* type	*Ramicandelaber* group	

Fig. 4-1. Sporocladial types and groups of the genera of the Kickxellales.

Fig. 4-2. Comparative synopsis of the groups of the Kickxellales and the other kickxellids. ■ : Fertile branchlets. Called as sporocladia in the Kickxellales, sporiferous branchlets in the Dimargaritales, generative cells in the Harpellales. ■ : Pseudophialides (Kickxellales). Pseudophialides are homologous with collar regions of generative cells of the Harpellales (left). In the Harpellales, only the *Pteromaktron* has subsidiary cells (right). ■ : Asexual spores. Sporangiospores in the *Coemansia* group, the Dimargaritales, and the Harpellales. Conidia in the *Spiromyces* group. The spores are presumed to be conidia in the *Ramicandelaber* group, or else those would be sporangiospores. In this figure, the appendages of the spores of the Harpellales are omitted. ■ : Suspensors of zygospores.

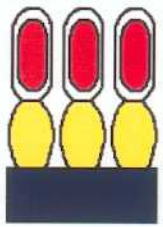
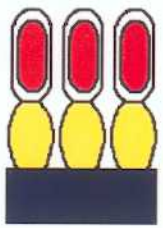
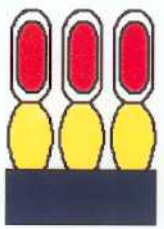
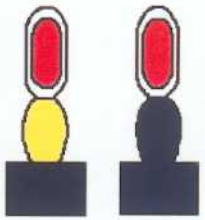
order	Kickxellales					Dimargaritales	Harpellales
groups of the genera	*Coemansia* group			*Spiromyces* group	*Rami-candelaber* group		
types of sporocladia	*Coemansia* type	*Linderina* type	*Myco-nymphaea* type	*Spiromyces* type	*Rami-candelaber* type		
asexual sporo-geneous cell							
asexual spore					 ?		
zygospore		not found	not found		not found		

Fig. 4–2. Comparative synopsis of the groups of the Kickxellales and the other kickxellids.

Fig. 5-1. A comparison of the septal structures of the kickxellids. While all the kickxellids fundamentally share a type of septa, differences are known in the shape and the solubility of septal plugs between them. As concerned the morphology, the plugs of the *Coemansia* type, the *Linderina* type, and the Harpellales are lenticular where known, while those of the *Spiromyces* type and the *Ramicandelaber* type are rather flatter. The plugs of the *Myconymphaea* type have a minute protuberance. Two obvious protuberances associate with the plugs of the Dimargaritales. With regard to the solubility, all kickxellids but the Dimargaritales are insoluble in KOH and acidic stains. *: The solubility of septal plugs to 2-3% aqueous solution of KOH and acidic stains.

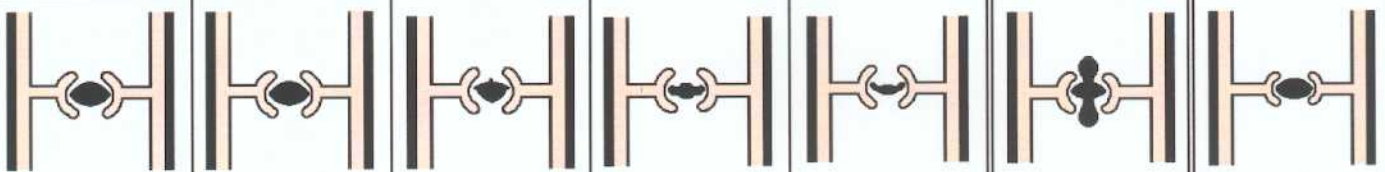
orders	Kickxellales					Dimargaritales	Harpellales
groups of the genera	*Coemansia* group			*Spiromyces* group	*Ramicandelaber* group		
sporocladial types	*Coemansia* type	*Linderina* type	*Myconymphaea* type	*Spiromyces* type	*Ramicandelaber* type		
septal structures	Septum (cross wall) has a large central septal pore occupied with a fundamentally lenticular plug. The septum (cross wall) is bifurcate around the pore.						
cell wall	Cell wall composed of two layers: electron dense and thin outer layer and electron lucent and thick inner layer; the latter is continuous to the cross wall						
septal protuberances	absent	absent	present	absent	absent	present	absent
diagrams of septal structures							
diagrams of septal plugs							
solubility of septal plugs*	stable					soluble	not examined

Fig. 5-1. A comparison of septal structures of the kickxellids.

Fig. 5-2. *Myconymphaea yatsukahoi*. Longitudinal section through a septum of a vegetative hypha. The cross wall is continuous with the electron lucent layer of the cell wall. The membranous organelle might be endoplasmic reticulum. cr: Cross wall (= septum). cw: Cell wall. mo: Membranous organelle. mp: Septal plug (= median plug). sp: Septal pore. × 5,400.

Fig. 5-3. *Myconymphaea yatsukahoi*. Longitudinal section of a septal plug of a vegetative hypha. cr: Cross wall (= septum). mp: Septal plug (= median plug). × 7,200.

Fig. 5-4. *Myconymphaea yatsukahoi*. Oblique section of a septal plug and its upper protuberance of a vegetative hypha. cr: Cross wall (= septum). mp: Septal plug (= median plug). pr: Protuberance of septal plugs. × 7,200.

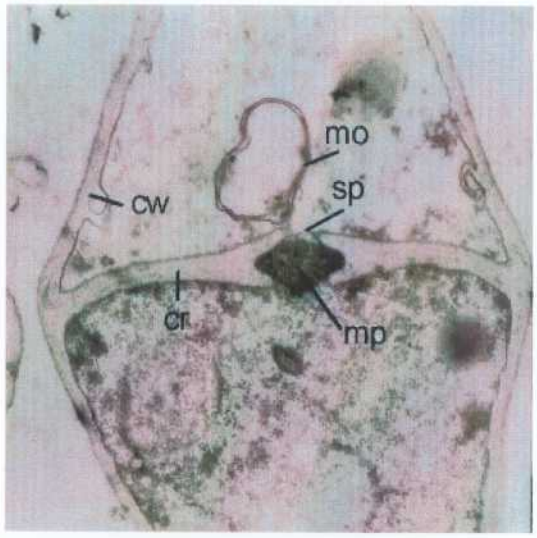


Fig. 5-2

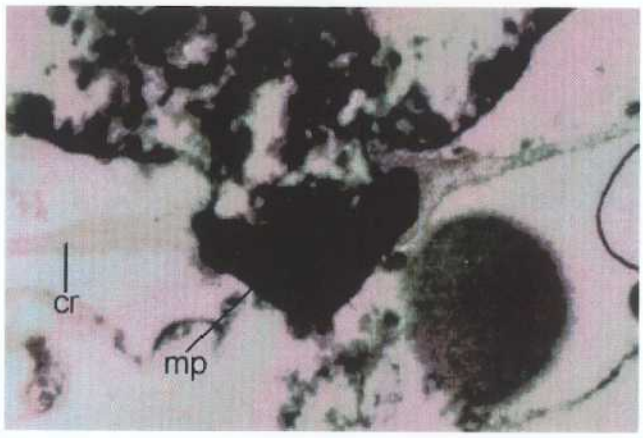


Fig. 5-3

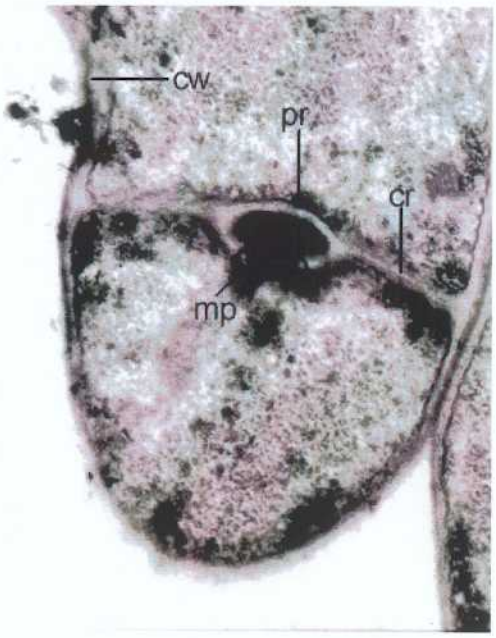


Fig. 5-4

Fig. 5-5. *Mycoemilia scoparia* (tentative name). Longitudinal section through a cross wall of a vegetative hypha. cr: Cross wall (= septum). cw: Cell wall. mp: Septal plug (= median plug). sp: Septal pore. × 5,400.

Fig. 5-6. *Mycoemilia scoparia* (tentative name). Longitudinal section through a septal pore. cr: Cross wall (= septum). mp: Septal plug (= median plug). sp: Septal pore. × 9,000.

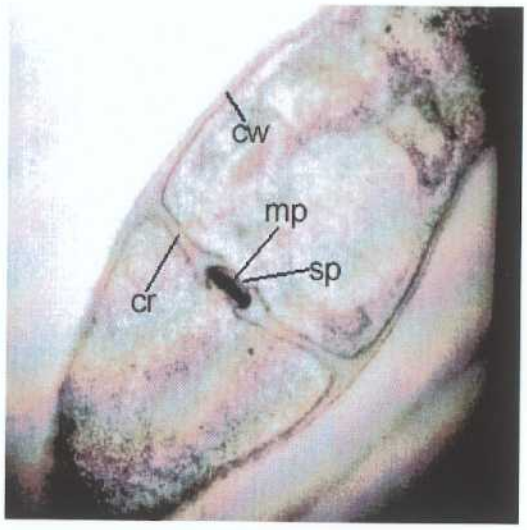


Fig. 5-5

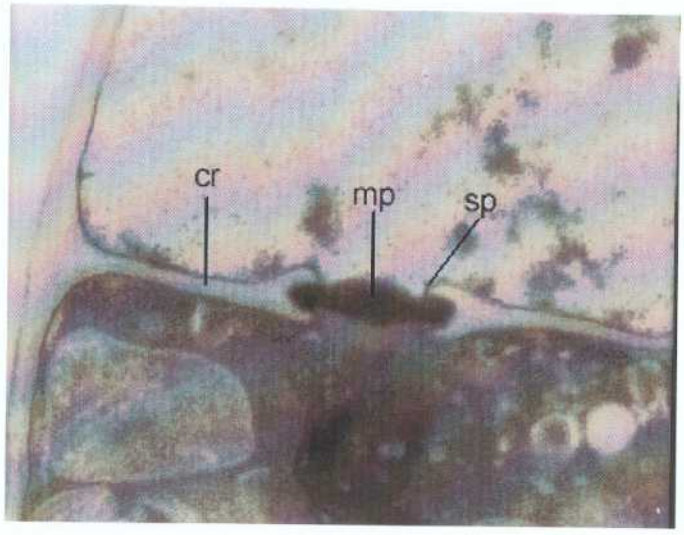


Fig. 5-6

Fig. 5-7. *Ramicandelaber brevisporus* (tentative name). Longitudinal section through a cross wall of a vegetative hypha. cr: Cross wall (= septum). cw: Cell wall. mp: Septal plug (= median plug). sp: Septal pore. × 9,000.

Fig. 5-8. *Ramicandelaber brevisporus* (tentative name). Longitudinal section through the septal plug. cr: Cross wall (= septum). cw: Cell wall. mp: Septal plug (= median plug). sp: Septal pore. × 7,200.

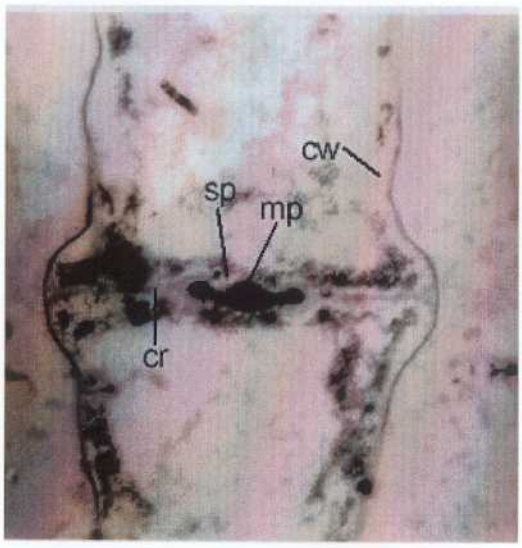


Fig. 5-7

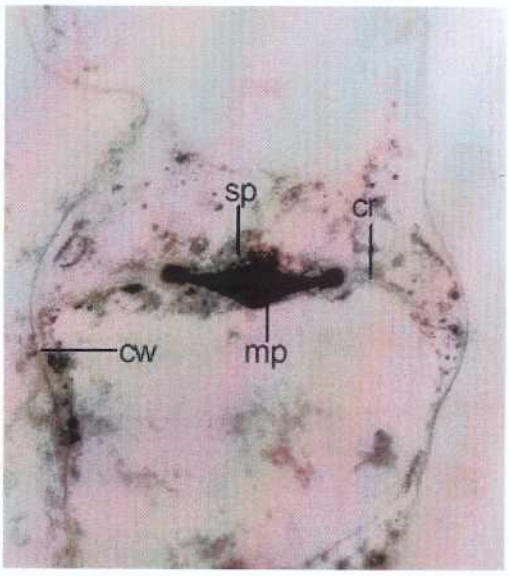
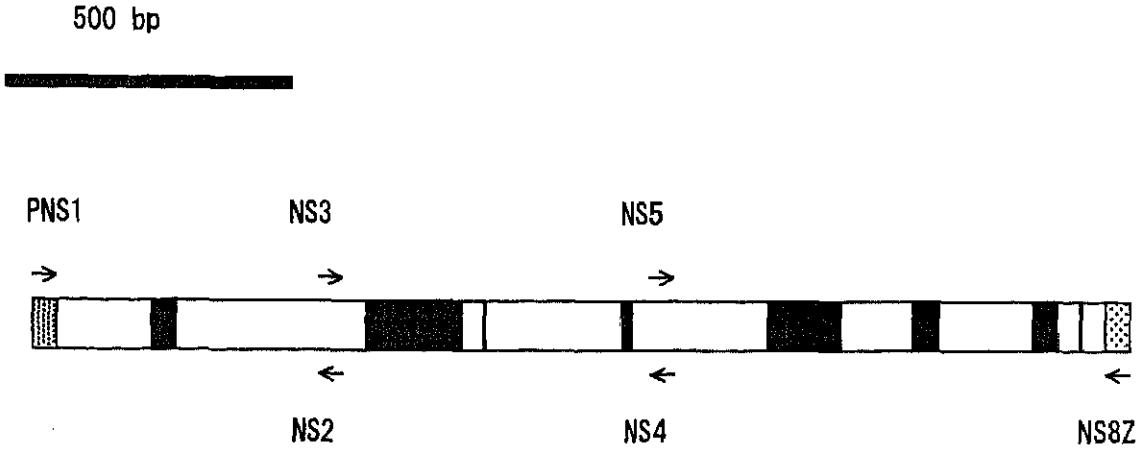


Fig. 5-8



: Included characters

: Excluded characters

: Not sequenced

PNS1: 5'-CCAAGCTTGAATTCGTAGTCATATGCTTGTCTC-3'

NS2: 5'-GGCTGCTGGCACCAGACTTGC-3'

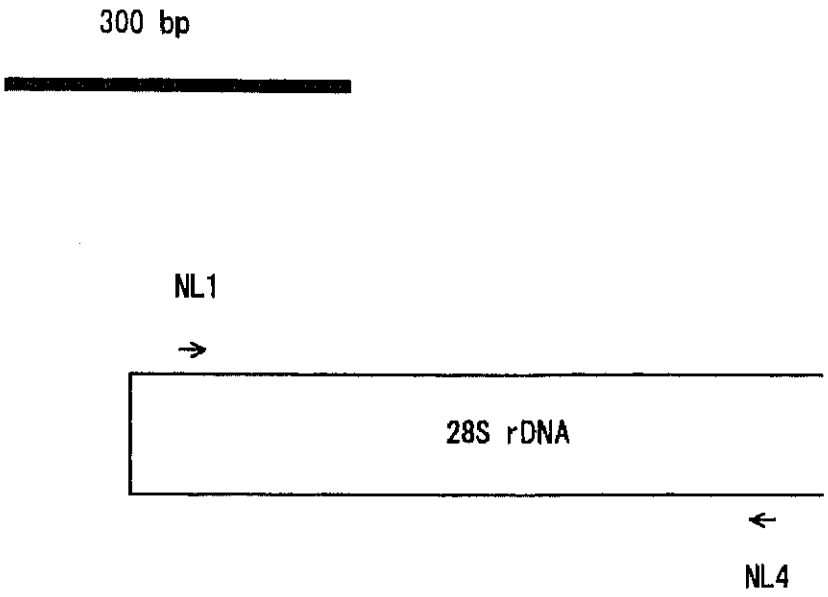
NS3: 5'-GCAAGTCTGGTGCCAGCAGCC-3'

NS4: 5'-CTTCCGTCAATTCCTTTAAG-3'

NS5: 5'-AACTTAAAGGAATTGACGGAAG-3'

NS8Z: 5'-TCCGCAGGTTCACCTACG-3'

Fig. 6-1. Sequences of 18S rDNA primers utilized in this study. Based on the Fig. 1 in O' Donnell et al. (1998). NS2, NS3, NS4, and NS5 were designed by White et al. (1990), and PNS1 and NS8Z were referred from O'Donnell et al. (1998).



NL1: 5'-GCATATCAATAAGCGGAGGAAAAG-3'

NL4: 5'-GGTCCGTGTTTCAAGACGG-3'

Fig. 6-2. Sequences of 28S rDNA primers utilized in this study. Based on the Fig. 24.1. in O' Donnell (1993).

Fig. 6-3. Neighbor-joining tree of the Zygomycota and the Chytridiomycota based on 18S rDNA sequences of the 53 taxa. Distance measures were calculated using the HKY85 model (Hasegawa et al. 1985). Clade stability is indicated by bootstrap percentages above nodes.

Fig. 6-4. Neighbor-joining tree of the Fungi based on 28S rDNA sequences of the 38 taxa. Distance measures were calculated using the HKY85 model (Hasegawa et al. 1985). Clade stability is indicated by bootstrap percentages above nodes.

Fig. 6-5. Strict consensus of 1 most parsimonious tree based on 28S rDNA sequences of the 38 taxa. Bootstrap values are indicated on nodes.

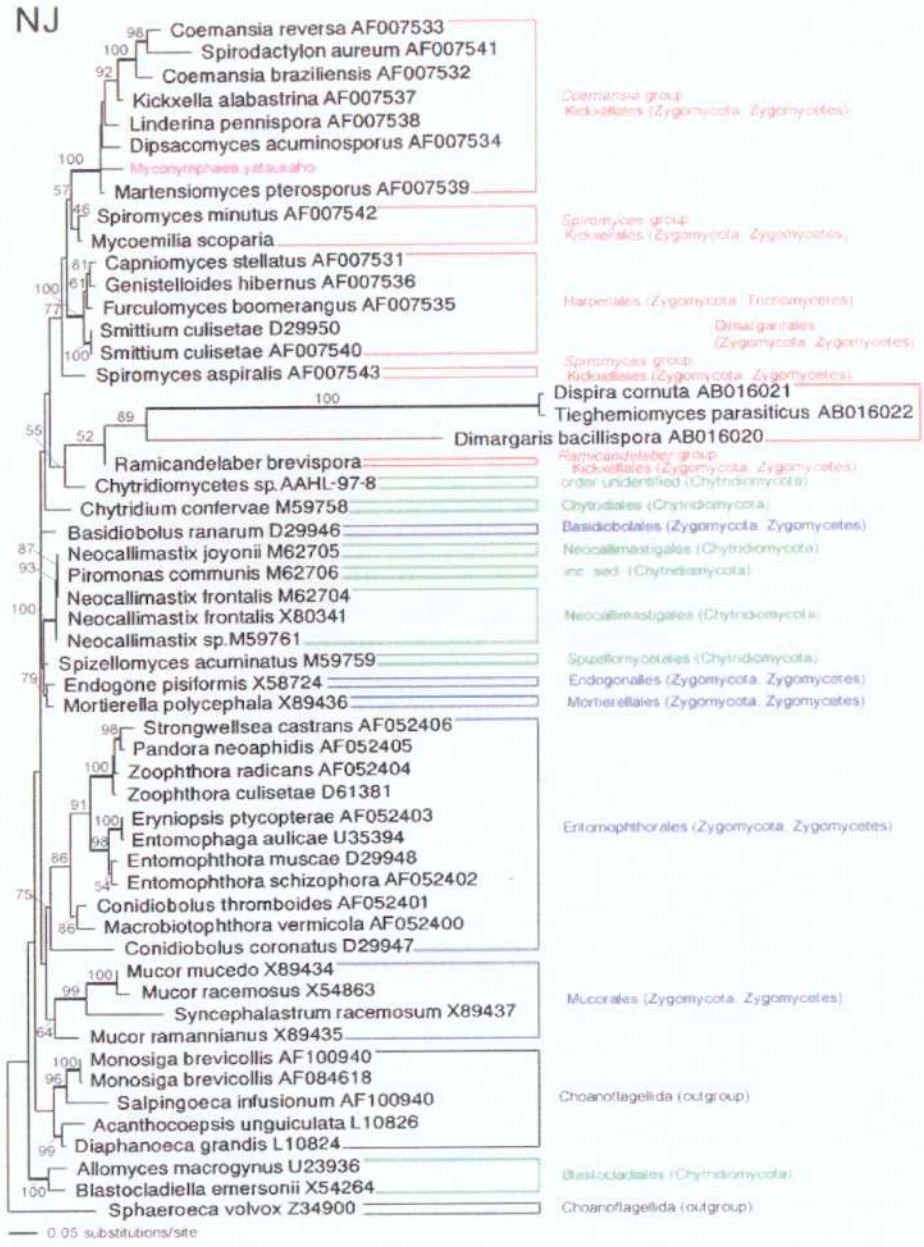


Fig. 6-3. Neighbor-joining tree based on 18S rDNA sequences.

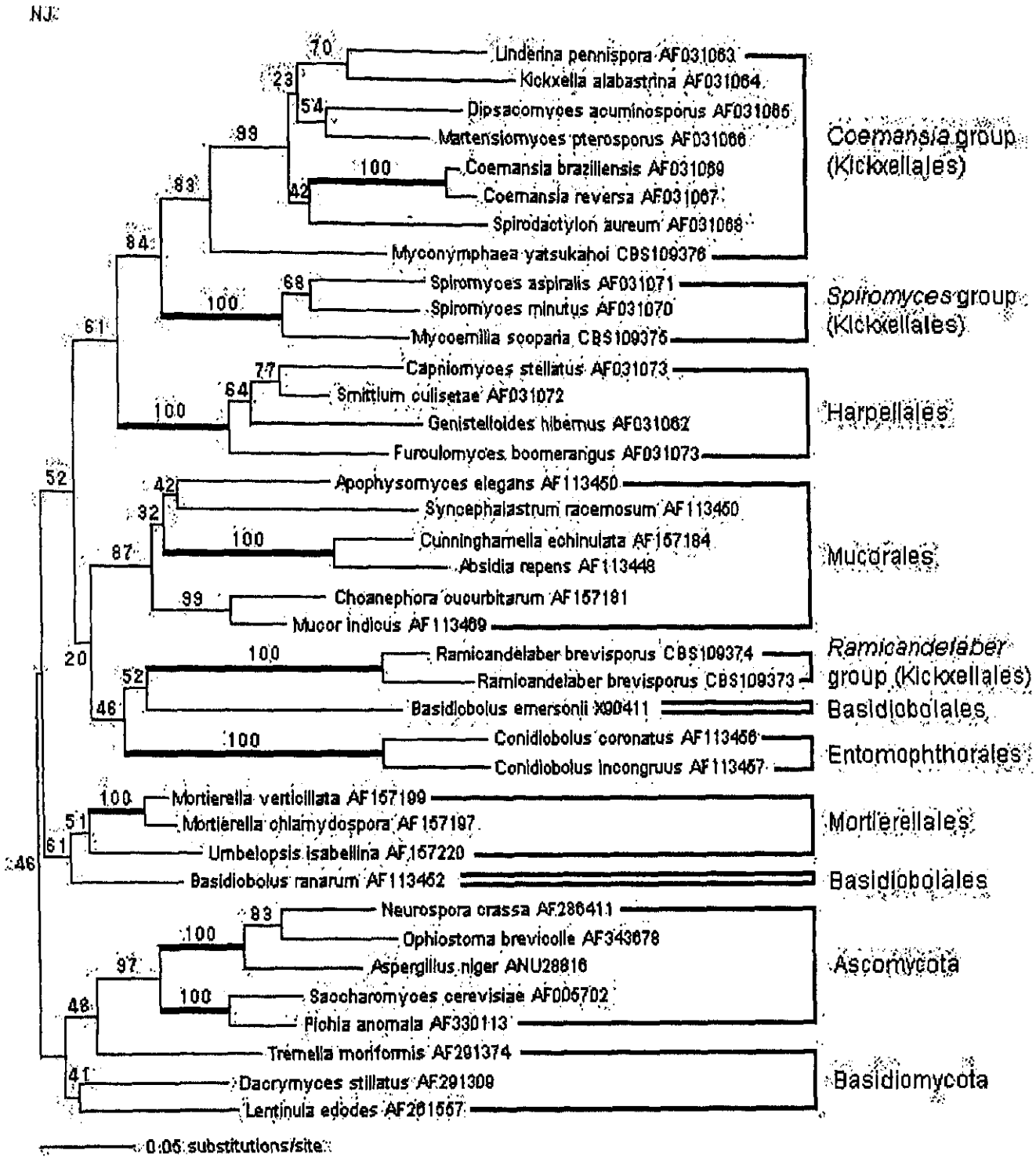


Fig. 6-4 Neighbor joining tree based on 28S rDNA sequences

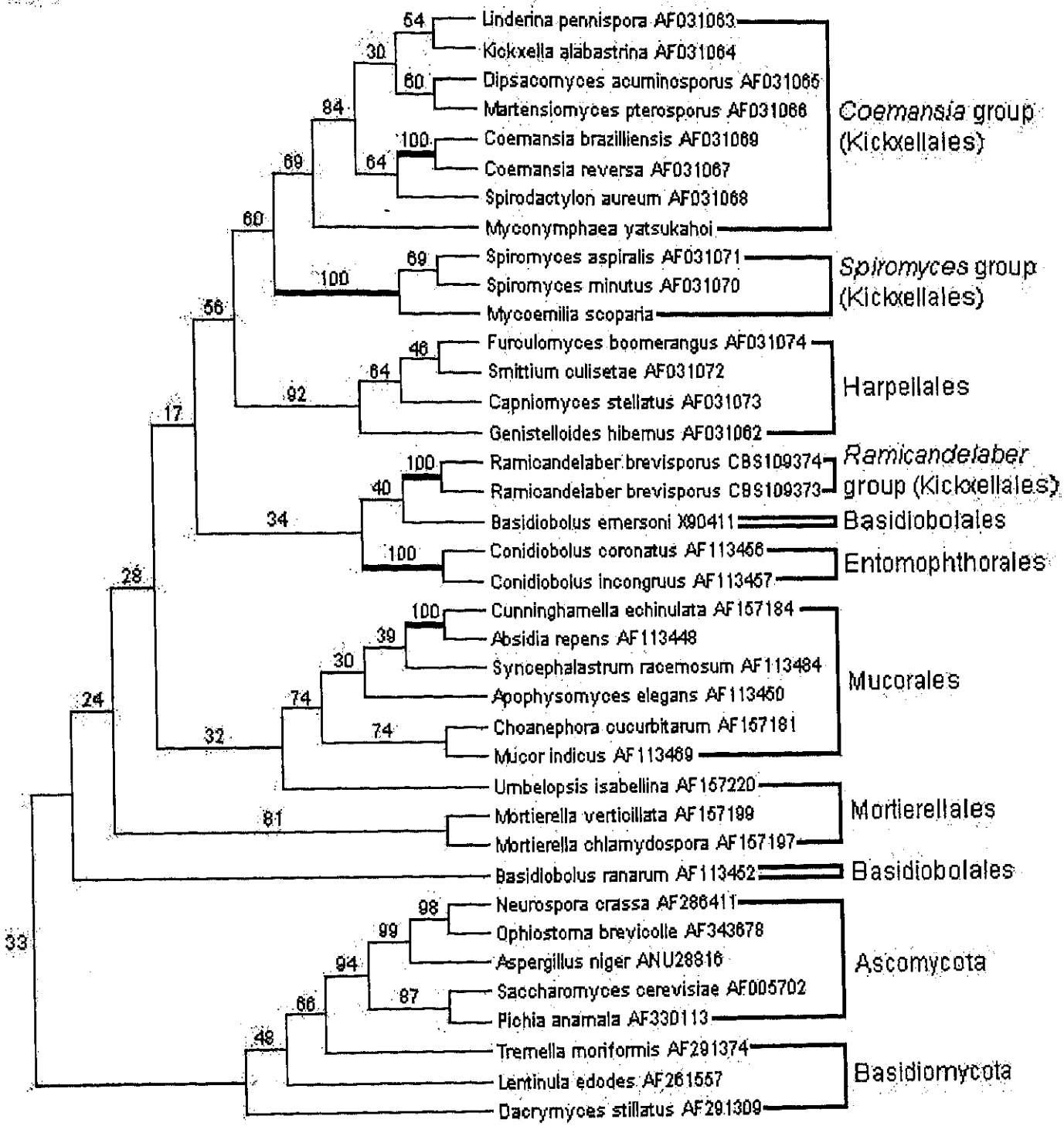


Fig. 6-5. Most parsimonious tree based on 28S rDNA sequences.

Fig. 7-1. Taxonomic conclusions of the Kickxellales *sensu lato* (*s. l.*) and the Kickxellaceae *s. l.*

Based on optical microscopic morphologies (chapter 4), ultrastructure of septa (chapters 5), and rDNA sequence analyses (chapter 6), the Kickxellales *s. l.* is divided into three orders: Kickxellales *sensu stricto* (*s. str.*), Spiromycetales (tentative name), and Ramicandelaberales (tentative name). Each orders consists of one family: Kickxellaceae *s. str.*, Spiromycetaceae (tentative name), and Ramicandelaberaceae (tentative name). *1: The rDNA sequences of *Martensella* were not available. *2: A tentative name of this undescribed genus.

genus	results of the present study			taxonomic conclusions of the present study		precedent taxonomic system
	optical microscopic morphology	septal structures	rDNA analyses	family	order	
Coemansia	*Coemansia* group		*Coemansia* clade	Kickxellaceae *sensu stricto*	Kickxellales *sensu stricto*	Kickxellales *sensu lato* = Kickxellaceae *sensu lato*
Dipsacomyces						
Kickxella						
Martensella[*1]						
Martensiomyces						
Spirodactylon						
Linderina						
Myconymphaea						
Spiromyces	*Spiromyces* group		*Spiromyces* clade	Spiromycetaceae (undescribed, tentative name)	Spiromycetales (undescribed, tentative name)	
Mycoemilia[*2]						
Ramicandelaber	*Ramicandelaber* group		*Ramicandelaber* clade	Ramicandelaberaceae (undescribed, tentative name)	Ramicandelaberales (undescribed, tentative name)	

Fig. 7–1. Taxonomic conclusions of the Kickxellales *sensu lato* and the Kickxellaceae *sensu lato*.

Fig. 7-2. A comprehensive comparative synopsis of the kickxellids.
Most conspicuous characteristics that delimit the kickxellid orders are indicated. The characteristics are selected from habits, asexual and sexual reproductive morphologies, and septal structures. *: The solubility of septal plugs to 2-3% aqueous solution of KOH and acidic stains.

characteristics		orders				
		Kickxellales *sensu lato*			Dimargaritales	Harpellales
		Kickxellales *sensu stricto*	Spiromycetales	Ramicandelaberales		
habit	nutritional mode	saprobes, or facultative mycoparasites	saprobes	saprobes	parasites on mucoralean species	parasites (or commensals or symbionts) of insects
asexual reproductive morphology	sporogeneous cell	pseudophialide	sporocladium	pseudophialide	sporiferous branchlet	sporocladia or pseudophialide
	No. of cells construct a sporocladium	1 or plural	1	1	–	plural
	No. of spores on a sporogeneous cell	1	plural	1	plural	1
	asexual spore	sporangiospore	conidium	conidium?	sporangiospore	sporangiospore
	No. of spores in a sporangiole	1	–	–	2	1
sexual reproductive morphology	surface of zygospores	smooth where known	punctulate	not found	punctulate (or smooth)	smooth
	contents of zygospores	plural, ubiquitous	single, eccentric	not found	single, eccentric	absent
septal structures	protuberance of septal plugs	basically absent	absent	absent	present on the both sides	absent
	solubility of plugs*	insoluble	insoluble	insoluble	soluble	not examined

Fig. 7–2. A comprehensive comparative synopsis of the kickxellids.