Studies on Persoon's original material of Clavariaceae deposited at the Nationaal Herbarium Nederland, Leiden

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Twenty specimens of expected members of Clavariaceae from Persoon's herbarium in Leiden were studied. Only observations on specimens of *Clavaria pratensis* agree with recent treatment of the species as synonym of *Ramariopsis corniculata*. Specimens of *C. helvola* and *C. eburnea* represent various taxa, but some of them are also representatives of these names in recent concept. The single specimen of *C. furcata*, a species synonymised recently with *Ramariopsis corniculata*, is probably identical with Ramaria *stricta*. The single specimen of *C. pistilliforma* represent a taxon related to *C. argillacea*, and it is not identical with *C. vermicularis* as suggested in literature. Specimens of *C. alba* and *C. vitellina* were infected by parasitic fungi and their collapsed microscopical structures does not allow any interpretation. Most of the specimens were collected in the last period of Persoon's active research of fungi and none of them should be connected with protologue and used as a type.

Keywords: *Clavaria*, *Ramariopsis*, taxonomy, type studies.

Christian Hendrik Persoon (1761–1836) was the first successful mycological taxonomist. He improved Linnaeus' division of the "ordo fungi" according to the type of hymenophore and split those divisions down to genera. Most of them are still in use. For example, the classification of agarics based on the colour of the spore print is one of several elements of his system accepted until now. Publications C. H. Persoon and E. M. Fries were considered as starting point of mycological taxonomy (in pre Tokyo versions of International Code of Botanical nomenclature). Names of the Ustilaginales, Uredinales and the gasteromycetes adopted by Persoon (1801) are sanctioned and have priority to all older synonyms, according to Art. 13.1 of the actual version of the Code (Vienna code, McNeil et al. 2006). A large number of Persoon's names is still in use for common and rare fungi.

Persoon published several comprehensive publications on almost all taxa known in his period (Persoon 1796, 1801, 1822). Clavaroid fun-

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gi (simple club-shaped or branched coral-shaped fungi with smooth hymenium) were the only group of fungi studied by Persoon with special emphasis (Persoon 1797a, 1797b), but this group comprised several unrelated taxa of Basidiomycetes and Ascomycetes. Persoon included all taxa nowadays classified as Clavariaceae (Petersen 1978 and Corner 1950) in the single genus *Clavaria*. He described dozens of *Clavaria* species as new or re-described already known species (e.g. Persoon 1797a described and accepted 69 species of the genus *Clavaria*). Several authors from the last century treated the various *Clavaria* species described by Persoon as members of Clavariaceae (e.g. Cotton & Wakefield 1919, Overeem 1923, Donk 1933, Corner 1950, Petersen 1968a, Petersen & Olexia 1969, Jülich 1984). However, many of Persoon's *Clavaria* species are members of *Ramaria*, *Clavulina* or other genera from different families. Tab. 1 summarises the species described by Persoon, which are considered as members of Clavariaceae according to literature cited above. Most of the names are now treated as synonyms. Several names were synonyms since Fries (1821) and this concept has been accepted by later authors. Only two publications (Coker 1923, Donk 1933) contain also observations on original material from Persoon.

In the Nationaal Herbarium Nederland Leiden (L) the major part Persoon's fungal collection is deposited (Stafleu & Cowan 1983). Four specimens of *Clavaria* are also deposited in herbarium LG, Liège (*C. cristata*, *C. pasona*, *C, pratensis* and *C. seringae*). The aim of this study is a taxonomical revision of Clavariaceae described by Persoon based on original material deposited in the herbarium L (Leiden) and a comparison of the original concept with recent interpretations of the species.

Material and Methods

In order to check actual interpretation of species described by Persoon, several publications were studied. The most important were Coker (1923), Overeem (1923), Donk (1933), Corner (1950), Jülich (1984) and Knudsen (1997). According to these publications, 25 species described by Persoon are considered as members of Clavariaceae. Ten of them are documented in Persoon's herbarium in Leiden. Twenty specimens from Persoon's herbarium expected to belong to Clavariaceae were studied during a one-week stay in the Nationaal Herbarium Nederland, Leiden (L). This represents the major part of all Clavariaceae specimens described by Persoon available in L. Specimens of *C. fumosa*, C. *chionea* and *C. argillacea* could not be studied due to lack of time during the scientific visit (all available material is listed in Tab. 1). Micro-morphological characters were observed using an Olympus BHS BH-2 microscope (oil-immersion × 1000). Microscopical structures were scanned with a Soft Imaging Systems camera (SIS Colorview I)

and measured using Olympus Cell^D software. Enlarged, scanned pictures of spores were used for measuring with an accuracy of 0.1 µm. Microscopic observations were made in ammoniacal Congo red, after a short pre-treatment with aqueous KOH to improve tissue dissociation and matrix dissolution.

Measurements of spores are given in the form "(minimum) mean ±standard deviation (maximum)", based on N = 20. Spore measurements exclude spines. The length/width quotient Q is given. Most of the hyphal structures were collapsed and did therefore not allow detailed measurements.

Many taxa described by Persoon were published in his monographical publication entitled "Coryphaei clavarias ramariasquae …" (Persoon 1797a) and part of this publication was published separately in the same year in his other monograph entitled "Commentario de

Tab. 1. – Species of Clavariaceae described by Persoon and their recent concepts. Abbreviations of books follow Stafleu & Cowan (1983). Abbreviation of genera: *C.* – *Clavaria* and *R.* – *Ramariopsis*. The accepted names are classified to genera following Petersen (1978), C. – *Clavaria*, R. – *Ramariopsis*. The recent concepts follow literature listed in "Material and Methods". Epithets accepted and in use are printed in bold. Species deposited in Persoon's herbarium in Leiden are marked with an asterisk; the number of specimens deposited is given afterwards.

Persoon's publication	Page	Species names	Recent concept
Neues Mag. Bot. 1, 1794	117	*C. flavipes*	*C. straminea*
	117	*C. fasciculata*	*R. fusiformis*
Observ. mycol., 1796	31	***C. fumosa*** *1	*C. fumosa*
	32	*C. aurantiaca*	*R. helvola* ?
	60	*C. ericetorum*	*C. argillacea* ?
Coryph. Clav. Ramar., 1797	183	*C. pratensis* *7	*R. corniculata*
	183	***C. subtilis***	*R. subtilis*
	183	*C. macropus*	*R. subtilis* ?
	184	*C. furcata* *1	*R. corniculata* ?
	189	***C. crocea***	*R. crocea*
	201	***C. helveola*** *4	*R. helvola*
	203	*C. rufa*	*R. helvola* ?
	204	*C. angustata*	*R. helvola* ?
	206	***C. argillacea*** *3	*C. argillacea*
	207	*C. striata*	*C. vermicularis* ?
	210	*C. nigrita*	*C. asperulospora* ?
	210	*C. solida*	*C. vermicularis* ?
	213	*C. falcata*	*C. acuta* ?
Syn. meth. fung., 1801	594	*C. ceranoides*	*R. fusiformis*
	603	*C. eburnea* *2	*C. vermicularis* ?
Mycol. eur. 1, 1822	170	*C. vitellina* *1	*R. corniculata* ?
	167	*C. chionea* *3	*R. kunzei*
	161	*C. alba* *1	*C. rugosa* ?
	175	*C. cochleariformis*	*R. fusiformis* ?
	183	*C. pistilliforma* *1	*C. vermicularis* ?

fungis clavaeformibus …“ (Persoon 1797b). Although, recent online nomenclatural databases (e.g. CABI 2004) accept “Commentario …” (Persoon 1797b) as the place of original descriptions of Persoon’s species, I follow Durand (1907), who considers “Coryphaei …” (Persoon 1797a) as published first.

Results

Most specimens of Persoon’s herbarium are contaminated by parasitic fungi. Hyphal structures are collapsed and often un-interpretable. For this reason it is hardly possible in many cases to check some important characters normally used for classification and delimitation of Clavariaceae, such as the presence of clamps, the structure of the subhymenium and the trama, the thickness of hyphae, the size of basidia etc. They are described bellow only in those cases where they were conserved in suitable form and distinguishable from hyphae of contaminating fungi. Spores are one of the most important microscopic features for the taxonomy of Clavariaceae as they are used for both, generic and infrageneric classification (e.g. delimitation of *Ramariopsis* according to Corner 1950 and Petersen 1978) and also for the delimitation of species (e.g. keys published by Jülich 1984 and Knudsen 1997). The spores were conserved in suitable form in most cases (Tab. 2).

Almost all specimens, except *Clavaria corniculata* (L0115745), were glued to a background paper together with original notes on fragments of other papers. These notes were hand written with dark brown/black ink. Sometimes handwritings were done with an ink of a different color (paler or darker brown, blue or also red) and apparently by different persons. This is the case in *C. alba* L0115667 (Fig. 1).

I attributed the most common type of handwritings to Persoon, as showcased in *C. alba* L0115744 (Fig. 2). Some specimens collected by other mycologists (recognizable by different types of handwritings, signature or initials) were sometimes associated with notes or determinations written by the handwriting I attributed to Persoon (e.g. “alba?” on the Fig. 1). Vincent Demoulin (Université de Liège, pers. comm.) confirmed that the type of handwriting presented on Fig. 2 is typical for Persoon, the writing corresponded with samples of Persoon’s handwritings published by Burdet (1977). Half of the specimens studied were surely not collected by Persoon (Tab. 3). Also, there were often names in red ink not written by Persoon.

Some specimens were accompanied with revision sheets of M. A. Donk and C. Cool (Fig. 3 and 4). Donk wrote his revisions sometimes directly onto the background paper of the specimen by pencil (such notes are accompanied with his initials). The specimens in Persoon’s herbarium were sorted according to the name type written on the bottom of background paper. Those names were added by the technical

Tab. 2. – Spore characters of specimens from Persoon's herbarium. Abbreviations of genera: *Cl.* – *Clavaria*, *Cu.* – *Clavulina*, *Ra.* – *Ramaria*, *Rs.* – *Ramariopsis*.

Names in Persoon's herb.	Number of specimen	Spore length (µm)	Spore width (µm)	Length/width quotient	Results of recent revision
alba Pers. 1822	L0115667	not observed			*Cu. coralloides*
alba Pers. 1818	L0115744	7.9–8.4–8.9	6.7–7.2–7.6	1.11–1.18–1.25	undetermined
corniculata	L0115745	3.4–3.9–4.4	2.7–3.2–3.7	1.11–1.21–1.32	*Rs. crocea*
eburnea	L0115713	6.1–6.6–7.1	3.5–3.8–4.2	1.61–1.74–1.86	*Cl. vermicularis*
	L0115714	4.3–4.9–5.5	2.9–3.1–3.3	1.44–1.58–1.72	*Rs. cf. minutula*
furcata	L0115727	ca. 8.9–10	ca. 3.6–3.9	ca. 2.47–2.56	*Ra. stricta*
helvola	L0115729	5.6–6–6.4	4.7–5.1–5.5	1.12–1.18–1.24	*Rs. helvola*
	L0115730	5.7–6.2–6.8	4.8–5.1–5.4	1.13–1.22–1.31	*Rs. helvola*
	L0115731	5.2–5.7–6.2	4.2–4.4–4.7	1.17–1.29–1.4	*Rs. cf. laeticolor*
	L0115732	5.4–6–6.5	4.1–4.4–4.6	1.25–1.36–1.47	*Rs. cf. laeticolor*
helvola var. dispar	L0115733	5.5–6–6.4	5–5.5–5.9	1.04–1.1–1.16	*Rs. corniculata ?*
pistilliforma	L0110542	8.8–9.7–10.7	4.3–4.8–5.3	1.79–2.05–2.3	*Cl. argillacea ?*
pratensis	L0110543	4.9–5.3–5.7	4.6–5–5.4	1.02–1.06–1.11	*Rs. corniculata*
	L0110544	7.1–7.8–8.5	5.7–6.1–6.5	1.19–1.28–1.37	*Cu.* sp.
	L0110545	5.6–5.9–6.2	5.3–5.6–6	1.02–1.05–1.07	*Rs. corniculata*
	L0110546	4.9–5.2–5.5	4.5–4.8–5.1	1.04–1.08–1.12	*Rs. corniculata*
	L0110547	5.9–6.4–7	5.4–5.8–6.2	1.03–1.11–1.18	*Rs. corniculata*
	L0110548	5.8–6.3–6.7	5.4–5.8–6.2	1.02–1.08–1.13	*Rs. corniculata*
	L0110549	4.6–5–5.4	4.3–4.6–5	1.02–1.07–1.13	*Rs. corniculata*
vitellina	L0110588	not observed			undetermined

staff of the herbarium. The typed names did often not agree with the names on original handwritings but they followed the synonymy of Persoon's publications as discussed below.

Clavaria alba Pers., Traité champ. comest.: 255. 1818.

Description in Pers., Mycol. eur. 1: 175, 1822. – [Clavaria] alba, solitaria submagna tota alba incrassata subturbinata. Habitat in Italia. Antecedente paullo minor, sed pro ratione parum crassa, extus intusque alba, solida. Esculenta ex Batana.

Material examined. – prope St. Cloud, herb. Pers. (L0115667).

Description of micromorphological characters. – Spores indeterminable among spores of a contaminating fungus. – Tramal hyphae without clamps, parallel, intermixed with wide, thick-walled hyphae probably of contaminating fungus. – Hymenium thin, ca. 25 µm thick, subhymenium of strongly intricoid hyphae, composed of short puzzled cells.

Notes. – Persoon (1822) recognized two different taxa as *C. alba*. The first one, described on the page 161 has branched basidiomata and

corresponds to specimen L0115744 (Fig. 5). The second taxon described on the page 175 (with reference to original description by Persoon 1818) is unbranched and clustered, and corresponds to specimen L0115667 (Fig. 6). Microscopical features of specimens L0115667 were un-interpretable, but the synonymy with *C. vermicularis* Scop.: Fr., as suggested by Donk (1933), could not be excluded. Coker (1923) reported – probably based on this specimen – smooth, oval, 3.5–3.8 × 4–5 µm spores, which correspond to the recent concept of *C. vermicularis*. The majority of later authors (e.g. Donk 1933, Corner 1950) attributed the name *C. alba* to Persoon (1822), but the description of Persoon on the page 175 clearly refers to his previous publication (Persoon 1818). Although, Persoon (1818, 1822) referred to Battarra (1755) and Micheli (1729), both authors did not publish the name validly, as they did not apply binomial nomenclature and published it as "*Clavaria major alba*".

Conclusion**. –** Microscopical structures observed on the specimen studied were un-interpretable and did neither prove nor contradict its determination as *C. vermicularis*.

***Clavaria alba* Pers.,** Mycol. eur. 1: 161, 1822. [nom. ileg., later homonym of *C. alba* Pers, Traité champ. comest.: 255, 1818.]

Protologue. – [Clavaria] alba, ramossisima candida, ramis rectiusculis, dichotomis acutis. Minus frequens provenit in sylvis abiegnis. Tota glaberrima et candida, ased basi interdum violascens. Caul. subtenuis, interdum etiam distinctus nullus. Rami dichotomi: nunc recti, nunc flexuosi et teretes.

Material examined. – forêt de Châtelterault, Yienne, leg. Delastre, herb. Persoon (L0115744).

Description of micromorphological characters. – Spores (7.5–) 7.9–8.4–8.9 (–9.2) × (6.2–) 6.7–7.2–7.6 (–8.1) µm, Q = (1.03–) 1.11–1.18–1.26 (-1.32), broadly ellipsoid to subglobose, smooth, thick-walled with ca. 0.3–0.5 µm thick walls, length of hillar appendage 0.7–0.9 µm (Fig. 5). – Hyphae without clamps. – Basidia probably 2-spored.

Notes. – This specimen (L0115744) corresponded with the original description of *C. alba* of Persoon (1822) on page 161, the basidiomata were branched (Fig. 5). Relatively large, broadly ellipsoid spores (Fig. 5) and moderately long hillar appendage are typical for the members of the genus *Clavulina*. The original description contains references to descriptions of *Clavaria coralloides* by Sowerby and Holmskjold (as "*coralloides alba*"). Coker (1923) and Knudsen (1997) treated this species within the genus *Clavulina*. The specimen L0115744 was associated with the note of M. A. Donk (by pencil on the background paper), who identified it as "*rugosa – kromholzii*". However, Donk (1933) did not include it in the list of synonyms of *C. rugosa* (Bull.) J. Schröt. He described *C. rugosa* as unbranched or weakly branched

Figs. 1–4. Examples of various handwritings on fragments of papers attached to specimens in Persoon's herbarium: **1.** Original sheet of Delastre with Persoon's correction "alba ?" on specimen L0115744. **2.** Original sheet of Persoon on specimen L0115667. **3.** Handwriting of M.A. Donk written on background paper on specimen L0115744. **4.** Revision sheet of C. Cool attached to the specimen L0110588.

species (in contradiction to the specimen L01157544, see Fig. 5). The name *C. alba* published by Persoon (1822) on page 161 is illegitimate, because of the priority of the formerly published homonym (Persoon 1818). Corner (1950) correctly included *C. alba* described on page 161 (Persoon 1922) as synonym of *Clavulina cristata* var. *coralloides* (L.: Fr.) Corner (recently accepted as *C. coralloides* (L.: Fr.) J. Schröt.; e.g. Knudsen 1997).

Conclusion. – The specimen studied is definitely a member of the genus *Clavulina*. The white basidiocarps with acute branches fit perfectly to *C. coralloides*.

***Clavaria eburnea* Pers.,** Syn. meth. fung.: 603, 1801.

Protologue. – [Clavaria] eburnea, cespitosa congesta fragilis nivea. Hab. satis frequens in sylvis umbrosis ad terram nudam, colore et fragilitare distincta. Stipes subhyalinus. Clavulae in adultis parum compressae, arcuatae, acutae.

Material examined. – prope Parisio, herb. Pers. (L0115713); prope Turan, herb. Pers. (L0115714).

Description of micromorphological characters. – Both collections had small smooth dacryoid spores, but collection L0115713 had larger spores and hyphae without clamps.

1. L0115713 – specimens with larger spores. – Spores (5.7–) 6.1–6.6–7.1 (–7.6) × (3.1–) 3.5–3.8–4.2 (–4.5) µm, Q = (1.46–) 1.61–1.74–1.86 (–2.03), smooth, ellipsoid or dacryoid, length of hillar appendage 0.7–0.9 µm (Fig. 7). – Hyphae without clamps.

2. L0115714 – specimens with smaller spores. – Spores ca. 4.1–4.9–6.2 × 2.8–3.1–3.5 µm, Q = 1.41–1.58–1.77, thin walled, ellipsoid or slightly amygdaloidal, length of hillar appendage ca. 0.8 µm (Fig. 8). – Hyphae with clamps.

Notes. – The studied collections of *Clavaria eburnea* differed not only in micromorphological characters, but also in the habit of their basidiomata. Collection L0115713 had thicker, clustered basidiomata (Fig. 7), while L0115714 exhibited slender, simple basidiomata (Fig. 8). The first collection has all characters typical for *C. vermicularis* Scop.: Fr. (Corner 1950). The second collection has spores as described for *Ramariopsis minutula* (Boud. & Galz.) R. H. Petersen (Petersen 1966), a clamp-bearing, white species which – according to my experiences – can form simple basidiomata. Coker (1923) reported smooth, oval spores of 3.5 × 4.5–6 µm for both specimens in Persoon's herbarium. Based on these findings he included the species in synonymy of *C. vermicularis*.

Conclusion. – The revision of one specimen determined by Persoon as *C. eburnea* confirmed its expected identity with *C. vermicularis* The second, morphologically different specimen suggested a wide concept of the species by Persoon.

***Clavaria furcata* Pers.,** Coryph. Clav. Ramar.: 184, 1797.

Protologue. – Cl. furcata: subramosa flava, caule gracili elongato, bis terneque surcatim divido, ramulis subfastigiatis. Prov. in sylvis fagineis inter muscos & c. Desc. caulis gracilis sursum ramosus dichotomus, subcompressus, 1.5 lin. crassus; una cum ramis, 3 unc. sere longus, in β., quae major, basi subtomentosus; rami arcuati dividi, ramuli nunc obtusi, nunc acuti. Color in fungo juniori nitidus, sere sulphureus, dein opacus, e flavo subrufescit.

Material examined. – [no locality], herb. Pers. (L0115727).

Description of micromorphological characters. – After a long effort it was possible to identify a few spores only, which are probably no contaminants. Spores 8.9–10 × 3.6–3.9 µm, subcylindrical, minutely rough, thin-walled, length of hillar appendage ca. 2 µm (Fig. 9). – Hyphae with clamps, and with distinctly thickened walls.

Notes. – Thick walled hyphae and slightly rough cylindrical spores are typical for species of *Ramaria stricta* (Pers.) Quél. s. l. Spore size is typical for the species in a narrow sense (Jülich 1984). Coker (1923) include *C. furcata* to the synonymy of *C. corniculata*, but without any explanation. C. Cool reported spores of 4–5 µm and four spored basidia on the revision sheet (from Aug. 1926).

Conclusion. – The studied specimen is probably identical with *Ramaria stricta*.

***Clavaria helveola [helvola]* Pers.,** Coryph. Clav. Ramar.: 201, 1797.

Protologue. – Cl. helveola: gregaria, solida, clavulis strictis, subcylindricis flavis: apice dein cinnamomea. Hab. in faginetis, ad terram. Desc. Gregaria & cespitosa quidem crescit haecce species, clavule vero basi non connatae, neque fibi dense approximatae sunt, hae longitudinae inaequales, utplurimum 1–1.5 unc. altae, unam lincam & ultra crassae, longitudinaliter nonnunquam sulcatae, surfum parum modo incrassatae, intus solida. Color opacus flavus, apex primo concolor, sed mox, fungo exciccato, ad dilute cinnamomeum tendit. Stipes equidem distinctus non adest, quo praecedenti familiae affinis haecce species, sed habitu cresscendi modo cum reliquis subsequentibus Clavariis convenit.

Material examined. – in pascuis apricis, prope Mendon, herb. Pers. (L0115729); in colis graminosis, ..., autumno, prope Mendon, herb. Pers. (L0115730); sur la terre parmi le ga..., ..., Pontivy, Bretagne, aut. 1811, herb. Pers. (L0115731); [no locality], herb. Pers. (L0115732); Dépt. Yienne, leg. Delastre, herb. Pers. (L0115733, *β dispar*).

Description of micromorphological characters. – Two of the studied collections have broadly ellipsoid spores with large blunt spines, two other has smooth, ovoid or subtriangular spores and the specimen determined as " *β dispar*" has smooth, subglobous spores.

1. L0115729 and L0115730 – specimens with ellipsoid spiny spores. – Spores (5–) 5.6–6.1–6.6 (–7.4) × (4.3–) 4.7–5.1–5.4 (–5.6) µm, Q = (1.09–) 1.13–1.21–1.29 (–1.38), with sparse (5–6 in outline), large (0.8–1 µm high),

blunt spines, legth of hillar appendage 1.2–2.2 µm (Fig. 10). – Basidia 4-spored?

2. L0110547 and L0110548 – specimens with subtriangular or ovoid smooth spores. – Spores (5–) 5.3–5.8–6.4 (–7.1) × (3.9–) 4.2–4.4–4.7 (–5) µm, Q = (1.13–) 1.2–1.32–1.44 (–1.58), thin walled, length of hillar appendage 1.2–1.6 µm (Fig. 11). – Basidia 4-spored. – Hyphae with clamps.

3. L0115733 specimen with subglobous spores. – Spores (5.3–) 5.5–6–6.4 (–7) × (4.5–) 5–5.5–5.9 (–6.6) µm large, Q = (1.02–) 1.04–1.1–1.16 (–1.2), smooth, hillar appendage ca. 1.2 µm long (Fig. 17). – Basidia 2- and 4-spored, with clamp connections on the base.

Notes. – Two specimens with spiny spores are representatives of the recent concept of *C. helveola* (Petersen 1968a) while the other two specimens correspond to *Ramariopsis laeticolor* (Berk. & M.A. Curt.) R. H. Petersen (Petersen 1968a, 1988). The specimen determined as "*β dispar*" is probably an unbranched form of *R. corniculata* (Schaeff.: Fr.) R. H. Petersen. It can be assumed that Persoon did not observe micromorphological characters and he treated various, simple yellow taxa as one species. Coker (1923) did not found any spores typical for clavaroid fungi on two of the studied specimens of *C. helveola* in Persoon's herbarium. He used this name for a species nowadays known as *C. gracillima* Peck (= *C. luteoalba* Rea) (Petersen 1968b). Donk (1933) rejected previous interpretation of the name *C. helveola* by Cotton (1906) and Coker (1923), as synonym of *C. luteoalba* Rea. He accepted the species with spiny spores as *C. inaequalis*. Donk did not mention if he found spiny spores on a specimen from herbarium of Persoon, but two of the specimens (L0115729 and L0115731) are provided with his revision sheets. He identified them as *C. inaequalis* (= *C. helveola* in his sense). He did probably not investigate them with the aid of a microscope, because one of the specimens bears smooth spores. Persoon (1797a) published the name *C. helveola* in the original description and he followed this orthography later (Persoon 1801), but finally Persoon (1822) changed the epithet to "*C. helvola*" in accordance to the sanctioning work (Fries 1821). Only one specimen in the herbarium L was named by Persoon as "*helvola*" all others were labeled with names which were included as synonyms of the species in his publications (Persoon 1797a, 1822).

Conclusion. – Two *C. helveola* specimens could be identified as *R. helveola* in the actual concept, two specimens were identified as *R. laeticolor* and one specimen might be *R. corniculata*. Persoon's concept of the species comprises probably various unbranched yellow taxa.

***Clavaria pistilliformа* Pers.,** Mycol. eur. 1: 183, 1822.

Protologue. – [Clavaria] pistilliformа, gregaria, candida, stipite elongato subtenui, clavulis incrassatis obtusis intus cavis. Hab. in pascuis apricis, autumni ini-

tio. Clavulae equidem non cylindricae, saltem non in omnibus, apice obtusae, quo praesertim ab antecedente differt, qua etiam minor, nec basi unita. Ulterius tamen observari meretur.

Material examined. – ..., Novembre, herb. Pers. (L0110542).

Description of micromorphological characters. – Spores (8.4–) 8.8–9.7–10.7 (–12) × (3.4–) 4.3–4.8–5.3 (–5.7) µm, Q = (1.75–)1.79–2.05–2.3 (–2.85), oblong or subcylindrical, smooth, thin-walled, length of hillar appendage 0.7–0.9 µm (Fig. 13). – Hyphae un-interpretable. – Basidia hardly recognizable, probably 4-spored, relatively long, narrowed towards the base and probably also with accurate clamps at the base.

Notes. – The studied specimen of *Clavaria pistilliforma* is not provided with any notes of Donk and Coker. Those authors did not discuss their observations in their publications (Donk 1933, Coker 1923). It can be assumed that *C. pistilliforma* was included as synonym of *C. vermicularis* Scop.: Fr. by both authors based on Persoon's description only. Persoon identified the specimen as "*Clavaria bifurca* Bull.?" (on the herbarium sheet). The determination of a collector indicated on separate fragment of the paper is "*cylindrica* Bul. t. 463! f. 1", exactly the same reference was accompanied to the original description. This reference to Bulliard's plate might be the reason, why this specimen is held in the Persoon's herbarium under name *C. pistilliforma* (the name was typewritten only). The studied specimen is probably identical with *C. argillacea* Pers. in the actual concept, the narrow and long cylindrical spores (Fig. 13), hollow, often clustered basidiomata with obtuse tips (according to Persoon 1822) are typical for this species (Corner 1950). However, the color of basidiomata in the original description is described as "candida" (snow white) and *C. argillacea* is known as a distinct yellowish species.

Conclusion. – The studied specimen represents a taxon with long subcylindrical spores similar to those of *C. argillacea*, and different from *C. vermicularis*, to which it should be a synonym according to literature.

***Clavaria pratensis* Pers.,** Coryph. Clav. Ramar.: 183, 1797.

Protologue. – Cl. pratensis: flavescens, caule breviuscule, ramis geniculatis divaricatis, ramulis subfastigiatis obtusis. Hab. sero autumno non infreq. in pratis, locisque aliis graminosis; graminibus nonnunquam tota cincta aut obtecta, reraeque profunde inmersa, ita ut apices solummodo prominent. Forma est obconica unc. 1 longa & lata. Caulis basi subalbicans, tenuis, lin 1 crassus, subnicurvus ubi ramos emittit, incrassatur; rami ipsi confertisubdifformes divaricant, ramuli crassitudine inaequales, subfastigiati. Color ex flavo-ochraceus. Substantia duriuscula. Sapor parum virosus.

Material examined. – Dépt. St. Yienne, leg. Delastre, herb. Pers. (L0110543); elle vient dans les bois parmi les herbes, elle n'est jamais plus grande, herb. Pers. (L0110544); no locality, leg. Desmar, herb. Pers. (L0110545); in pratis et

pascuis apricis, inter gramina ..., herb. Pers. (L0110546); [no locality], herb. Pers. (L0110547); in pascuis siccis, octobr. et novemb., leg. Mougeot, herb. Pers. (L0110548); [no locality], herb. Pers. (L0110549).

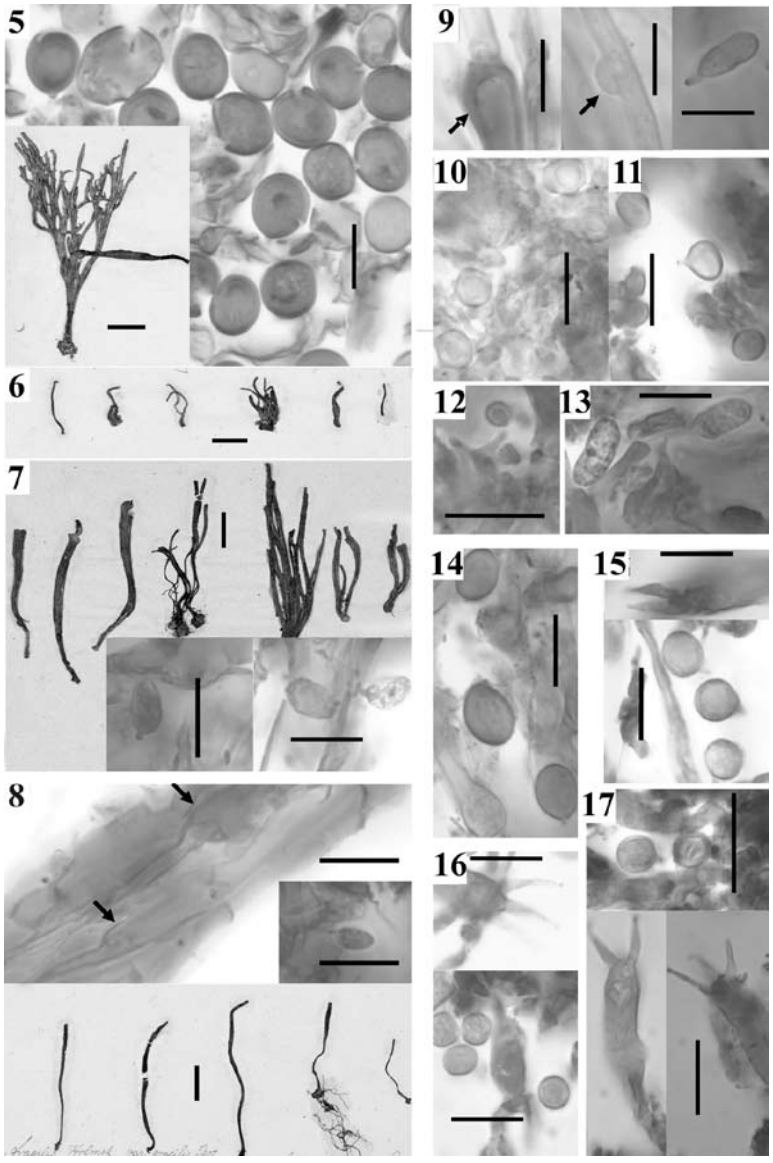
Description of micromorphological characters. – Six of the seven studied specimens had subglobose smooth spores with prominent hillar appendages and one (L0110544) has broadly ellipsoid spores and shorter hillar appendages. Two of the specimens with subglobose spores had 2-spored basidia (L0110547 and L0110548), the other four had 4-spored basidia. The descriptions of all of these three morphotypes are below, measurements are listed in Tab. 2.

1. L0110544 – specimen with ellipsoid spores and short hillar appendages. – Spores (6.5–) 7.1–7.8–8.5 (–9.5) × (5.4–) 5.7–6.1–6.5 (–7.1) µm, Q = (1.12–) 1.19–1.28–1.38 (–1.52), broadly ellipsoid, smooth, thick walled, length of hillar appendage 0.5–0.8 µm (Fig. 14). – Basidia 2-spored, often with secondary septa, observable when collapsed.

2. L0110547 and L0110548 – specimens with subglobose spores and 2-spored basidia. – Spores (5.4–) 5.9–6.3–6.8 (–7.8) × (5.1–)5.4–5.8–6.2 (–6.5) µm, Q = (1–) 1.03–1.1–1.16 (–1.27), subglobous, smooth, thin walled, length of hillar appendages 1.3–1.9 µm (Fig. 15). – Basidia 2-spored.

3. L0110543, L0110545, L0110546 and L0110549 – specimens with subglobose spores and 4-spored basidia. – Spores (4–) 4.8–5.3–5.8 (–6.3) × (3.9–) 4.5–5–5.5 (–6.2) µm, Q = (1–) 1.02–1.07–1.11 (–1.18), subglobose, smooth, thin walled, length of hillar appendage 1–1.5 µm (Fig. 16). – Basidia 4-spored.

Notes. – Shape and size of spores, bisporic basidia and secondary septa in collapsed basidia observed in specimen (L0110544) are characters typical for the genus *Clavulina* (Petersen 1967). All other seven specimens have spores with the shape and a hillar appendage typical for *Ramariopsis corniculata* (Schaeff.: Fr.) R. H. Petersen (Petersen 1968a). The 2-spored collections have in average larger spores and longer hillar appendages (Tab. 2), as described for *R. corniculata* f. *bispora* Pilát (Pilát 1958, Corner 1970). All these observations are in accordance with previous revisions of the material. M. A. Donk provided most of the specimens with his identification as "*corniculata*" except of L0110544 which he treated as a member of the genus *Clavulina*. C. Cool studied two of the 4-spored specimens and he identified them as "*C. corniculata*", as I did. Coker (1923) reported 4.5 × 4.8–5.5 µm spores for "the types of *C. pratensis* in the herbarium of Persoon". Persoon (1822) accepted both *C. pratensis* and *C. corniculata* as separate species and he described the first as yellow-ochre with obtuse branches and the second as yellow-rusty or brown with acute branches. Revision of the specimens of *C. corniculata* from Persoon's herbarium (L0115745) revealed small, broadly ellipsoid, warted spores attached to 4-spored basidia (Tab. 2, Fig. 12), those characters together



Figs. 5–17. Morphology of *Clavaria* specimens held in Persoon's herbarium: **5.** *C. alba* (L0115744) spores and basidiomata. **6.** *C. alba* (L0115667) basidiomata. **7.** *C. eburnea* (L0115713) basidiomata and spores. **8.** *C. eburnea* (L0115714) clamps, spore and basidiomata. **9.** *C. furcata* (L0115727) thick-walled hyphae, clamp and spore. **10.** *C. helvola* (L0115730) spores. **11.** *C. helvola* (L0115731) spores. **12.** *C. corniculata* (L0115745) juvenile spores attached on basidium. **13.** *C. pistilliforma* (L0110542) spores. **14.** *C. pratensis* (L0110544) spores. **15.** *C. pratensis* (L0110548) 2-spored basidia and spores. **16.** *C. pratensis* (L0110544) 4-spored basidia and spores. **17.** *C. helvola* β *dispar* (L0115733) spores, 2- and 4-spored basidia. Bar = 10 µm for microscopic structures and bar = 1 cm for basidiomata.

with Persoon's description fit to recent concept of *Ramariopsis crocea* (Pers.: Fr.) Corner (Schild 1971).

Conclusion. – Seven of eight specimens are identical with *Ramariopsis corniculata*, two of them represented the bisporic form. One specimen is a member of *Clavulina*. *Clavulina corniculata* in the sense of Persoon is probably identical with *Ramariopsis crocea*.

***Clavaria vitellina* Pers.,** Mycol. eur. 1: 170, 1822.

Protologue. – [Clavaria] vitellina, caespitosa laete flava, caule tenuissimo, simpliciter ramoso, ramulis furcatis obtusis fuscis. Hab. in sylvis umbrosis ad terram. Altitudine modo unciali, sed caespitem sublatum sistit.

Material examined. – in silv. St. Cloud, herb. Pers. (L0110588).

Description of micromorphological characters. – Prevailing type of spores (3.9–) 4.1–4.5–4.9 (–5.7) × (3.3–) 3.4–3.8–4.2 (–4.5) µm, Q = (1.04–) 1.09–1.18–1.26 (–1.38), broadly ellipsoid, finely warted, produced by a contaminating fungus. – Hyphae and basidia un-interpretable, but hyphae in subhymenium apparently with clamps.

Tab. 3. – Clavariaceae in Persoon's herbarium: Collectors and original identifications.

***Clavaria* species**	**Number of specimen**	**Collector**	**Original determination**	**Persoon's determination**
alba	L0115744	Delastre	*C. botrytis* Pers.	*C. alba* ?
alba	L0115667	Persoon	C. alba	
pistilliforma	L0110542	not Persoon	*C. cylindrica* Bull.	*C. bifurca* Bull.?
vitellina	L0110588	Persoon	C. vitellina	
furcata	L0115727	Persoon	C. furcata	
pratensis	L0110543	Delastre	*Clavaria* sp.	*C. pratensis*
	L0110544	not Persoon	*Clavaria* sp.	*C. pratensis*
	L0110545	Desmazières	cf. *C. alba* Pers.	var. of *C. pratensis* ?
	L0110546	Persoon	*C. pratensis* Pers.	
	L0110547	Persoon	*C. pratensis* Pers.	
	L0110548	Mougeot	*C. pratensis* Pers. ?	*C. pratensis* Pers.
	L0110549	Persoon	C. pratensis	
helvola	L0115729	Persoon	*C. pascua* var. ...	
	L0115730	not Persoon	*C. cylindrica* β *lutea* Bull.	*C. helvola* Pers.
	L0115731	not Persoon	*C. lutea* DC.	*C. pascua*
	L0115732	Persoon	*Clavaria simplicissima* Wild.	
helvola var. dispar	L0115733	Delastre	*C. corniculata* Schaeff.	*C.* β *dispar* Pers.
eburnea	L0115713	Persoon	colour variant of *C. eburnea* ?	
	L0115714	not Persoon	*Clavaria* sp.	*C. eburnea*

Notes. – Coker (1923) reported spores 4–4.5 µm wide like in *C. muscoides* L. (= *C. corniculata* Schaeff.: Fr). C. Cool found similar, 4–5 µm wide spores (revision sheet from Aug. 1926). Donk (1933) did not find any spores which are clearly from the original fungus. I observed spores which are apparently from contaminating fungi with warted surface, similar and indistinguishable from spores of *Ramariopsis crocea* (Pers.) Corner, but such spores were not attached to basidia.

Conclusion. – The spores typical for *R. corniculata* were not observed, the spores resembling those of *R. crocea* might be those of a parasitic fungus and the identity of the fungus remains unclear.

Discussion

Light microscopy is one of the most common, most important and widely used methods for myco-taxonomic research. Many of morphologically similar taxa are distinguishable only by microscopy. However, light microscopy was not as far developed to be suitable for fungal taxonomy before the second half of nineteenth century. For example, striking large spines on spores of *Ramariariopsis helvola* were defined first by Britzelmayr (1887), who described it as a new species *Clavaria dissipabilis* Britzelm. Thus, it is not surprising that most of the Persoon's specimens labeled with the same name represent various species. Specimens of *C. helvola* and *C. eburnea* are good examples. On the other hand, it is uncertain why Persoon used various names for some species. Some of them were already included as synonyms in protologues. For example, only one specimen of *R. helveola* (described by Persoon 1797a) is determined by Persoon as "*helvola*" (orthographic variant used since Persoon 1822), one specimen is determined as *C. simplicissima* Wild. – included in synonymy of *C. helveola* in the protologue. Two other specimens are determined as "*C. pascua*" – a provisional name, which was first not accepted by Persoon. The name appeared only in a later publication in parenthesis following the name "*helvola*" (Persoon 1822; Tab. 3).

Despite the fact that only one out of 18 specimens studied was supplemented with the information about the year of the collection (*C. helvola* L0115731 collected in "Aut. 1811"), it seems that most specimens in Persoon's herbarium were collected after the publication of "Coryphaei …" (Persoon 1797a, major part of his clavaroid fungi were described there). Among the 17 species published in first publications by Persoon (1794, 1796, 1797a) only four are documented in his herbarium, but six out of eight species published later (Persoon 1801, 1818, 1822) are deposited in his herbarium (Tab. 1). Also if brief or missing data on locality of collections are considered, it is impossible to connect any of the studied specimens with protologues. However, this does not mean that none of the specimens was used in original description. Among the material which was not studied during my stay

in Leiden, there was a specimen of *C. chionea* Pers. (described by Persoon 1822) labeled by Cotton (revision sheet from 28. October 1909) as the type of the species based on the similar collection site indicated on herbarium sheet and in protologue ("prope Parisio").

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