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# ON 'CORDYCEPS CAPITATA'

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(With 3 Text-figures)

*Cordyceps capitata* does occur in the Netherlands, but is shown to be far less common than *C. canadensis*, a species not previously recorded. A brief review of the European literature demonstrates that practically all descriptions refer to *Cordyceps canadensis*. Both species are described and their differences indicated.

It has been generally supposed by mycologists in the Netherlands that there are only two species of *Cordyceps* in this country parasitic on *Elaphomyces*, viz. *C. capitata* and C. *ophioglossoides*. According to the literature it would seem that this fact was also held to be true for Europe. Recently, however, Dr. M. A. Donk drew my attention to a paper by Mains (*1957*), from which it became apparent that two more species occur on the continent. These are *Cordyceps japonica* Lloyd (resembling *C. ophioglossoides*) and *C. canadensis* Ell. & Ev. (resembling *C. capitata*). As it is almost certain that in the Netherlands the mycogenous species of *Cordyceps* were exclusively identified on macroscopical characters, a revision was undertaken of the material available in the herbaria indicated as follows: AMD (Hugo de Vries Laboratories, Amsterdam), GRO (Botanical Laboratory, Department of Systematic Botany, Groningen), L (Rijksherbarium, Leiden), U (Botanical Museum and Herbarium, Utrecht), and WAGW (Biological Station, Wijster).

From this investigation it appears that (i) *Cordyceps japonica* is not represented, (ii) *C. ophioglossoides*, the commonest species, has been correctly identified, and (iii) both *C. canadensis* and *C. capitata* occur in this country. For the sake of completeness *Cordyceps ophioglossoides* is included in the following key, but its description, being well-known, is omitted.

### Key to the mycogenous species of Cordyceps

1a. Stipe directly attached to the host, abruptly enlarged into fertile head.
  2a. Cortex of the fertile head with a palisade-like ectal layer. Part-spores usually fusiform and more than 4 $\mu$ broad, the cell-walls thickened at the ends which are often truncate . . . . . *C. canadensis*
  2b. Cortex of the fertile head pseudoparenchymatous throughout. Part-spores cylindrical, less than 4 $\mu$ broad, thin-walled at the ends which are rounded . . . . . *C. capitata*
1b. Stipe attached to the host by means of chrome-yellow rhizomorphs, gradually enlarged into fertile head . . . . . *C. ophioglossoides*

### CORDYCEPS CANADENSIS Ell. & Ev.—Figs. 1, 2

*Cordyceps canadensis* Ell. & Ev. *in* Bull. Torrey bot. Cl. **25**: 501. 1898.

MISAPPLIED NAME: *Torrubia capitata* (Holmskj. ex Schmidt) Link *sensu* Tul., Sel. Fung. Carp. **3**: 22. 1865.

DESCRIPTIONS: Mains (*1957*: 248), Kobayasi & Shimizu (*1960*: 84).

Stromata solitary, more rarely two together, consisting of a fertile head borne on a stipe. Head sharply delimited from the stipe, abruptly enlarged, ovoid to hemispherical, 4–10 mm high, 6–12 mm broad, dark brown to black (in the dried material), dry, dull, roughened from the protruding ostioles of the perithecia. Stipe slender, 35–75 × 2–7 mm, equal or tapering or broadening upward, becoming furrowed and hollow, furfuraceous, olivaceous yellow, darkening with age.

Cortex of ascogenous portion pseudoparenchymatous, but ectal layer palisade-like, consisting of parallel rows of cells 1.8–2.2 μ wide.

Perithecia immersed, ellipsoid, at the top narrowed into the ostiole, 800–950 × 300–450 μ. Asci cylindrical, long-stalked, 12–16 μ wide, with hemispherically thickened wall at the apex. Spores filiform, colourless, breaking into numerous 1-celled part-spores; part-spores fusiform to ellipsoid, usually somewhat pinched near the ends which are often truncate, (19.7–)22.5–49.5(–62) × 4–5(–9.5) μ, with the cell-walls thickened at both ends.

MATERIAL EXAMINED: —

NOORD-HOLLAND: Bloemendaal, Naaldenveld, Oct. 1920, *K. B. Boedijn* (AMD); Bloemendaal, Schapenduinen, Oct. 1915, Miss *C. Cool* (L); 's-Graveland, "Boekesteyn", 11 Oct. 1957, *J. Daams* (L); Hilversum, Oct. 1919, *J. Kleming* (AMD); Hilversum, 16 Oct. 1918 coll.? (L); Hilversum, "Zonnestraal", 1 Sept. 1957, *J. Daams* (L).

UTRECHT: Baarn, "Groeneveld", 26 Sept. 1935, *W. J. Lütjeharms* (L); Maartensdijk, "Beukenburg", Oct. 1936, *C. E. B. Bremekamp* (U).

GELDERLAND: Doetinchem, "Slangenburg", 10 Sept. 1935, coll. ? (L); Ede, 23 Nov. 1915, *J. L. F. de Meyere* (L); Putten, 16 Sept. 1956, *L. de Haas* (L).

OVERIJSEL: Delden, "Twickel", 28 Sept. 1929, *W. J. Lütjeharms* (L); Steenwijk, "De Eese", 2 Oct. 1960, *A. D. Masselink* (WAGW).

DRENTE: Diever, Berkenheuvel, 22 Oct. 1958, *J. J. Barkman 5852* (WAGW); *R. A. Maas Geesteranus 12746* (L); Lhee, 19 Sept. 1961, *J. J. Barkman* 7052 (WAGW); Spier-Lhee, Kibbelhoek, 25 Sept. 1960, *J. J. Barkman* 6758 (WAGW).

### CORDYCEPS CAPITATA (Holmskj. ex Schmidt) Link—Fig. 3

*Clavaria capitata* Holmskj., Fung. dan. **1**: 38, pl. [14]. 1790. — *Sphaeria capitata* (Holmskj.) Pers., Comm. Fung. clav. 13. 1797. — *Corynesphaera capitata* Dumort., Comm. bot. 92. 1822 (nomen nudum; without reference to previously published description). — *Mitrasphaera capitata* Dumort., Comm. bot. 92. 1822 (nomen nudum; without reference to previously published description). — *Sphaeria capitata* (Holmskj.) *ex* Schmidt, Mykol. Hefte **2**: 26. 1823; Fr., Syst. mycol. **2**: 324. 1823. — *Cordylia capitata* (Holmskj. ex Schmidt) Fic. & Schub., Fl. Dresden **2**: 332. 1823. — *Xylaria capitata* (Holmskj. ex Schmidt) Loudon, Encycl. Pl. 1024. 1829. — *Cordyceps capitata* (Holmskj. ex Schmidt) Link, Handb. Erkenn. Gewächse **3**: 347. 1833 ("*capitatus*"). — *Torrubia capitata* (Holmskj. ex Schmidt) Tul., Sel. Fung. Carp. **3**: 22 *pl. 2 figs.* 10–15. 1865 (misapplied). — Type: Holmskj., Fung. dan. **1**: pl. [14] 1790 (selected).

DESCRIPTIONS: Mains (*1957*: 247), Kobayasi & Shimizu (*1960*: 83).

Stromata solitary, consisting of a fertile head borne on a stipe. Head sharply delimited from the stipe, abruptly enlarged, ovoid, 7–10 mm high, 5–8 mm broad, black (in the dried material), dull roughened from the protruding ostioles of the perithecia. Stipe slender, 40–50 × 2–9 mm, equal or tapering or broadening upward, becoming furrowed and hollow, furfuraceous, olivaceous yellow, darkening with age.

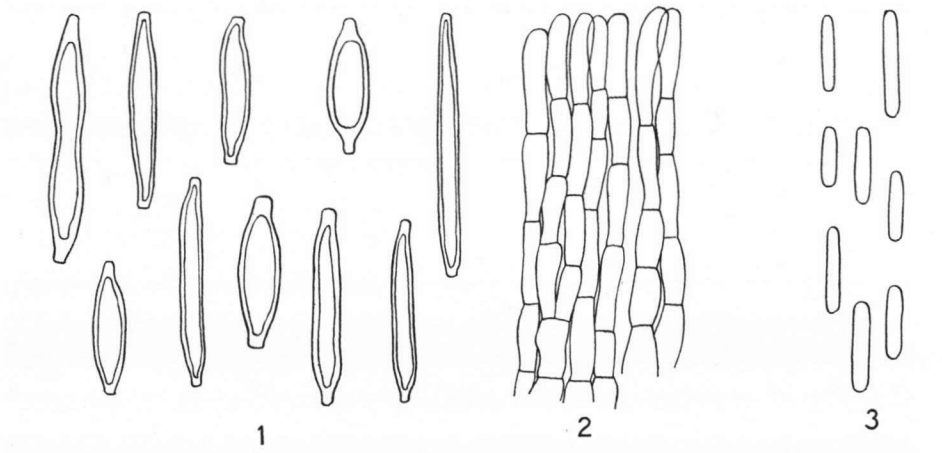
Cortex of ascogenous portion pseudoparenchymatous throughout (but in the material available too badly preserved to allow a drawing to be made).

Perithecia immersed, ellipsoid to ovoid, at the top narrowed into the ostiole, 580–720 × 200–350 μ. Asci cylindrical, long-stalked, 6–12 μ wide, with hemispherically thickened wall at the apex. Spores filiform, colourless, breaking into numerous 1-celled part-spores; part-spores cylindrical, with rounded ends, (7.3–) 12.5–22.5 × 2.2–3.6 μ, very thin-walled, with the walls not thickened at the ends.

MATERIAL EXAMINED: —

UTRECHT: Baarn, Baarnse Bos, Oct. 1887, *C. A. J. A. Oudemans* (L); Huis ter Heide, Dec. 1916, Miss *J. A. R. van Stolk* (L).

Mains (*1957*: 248), arguing that it was not possible to determine from Fries's description to which species (*Cordyceps canadensis* or *C. capitata*) the name *Sphaeria capitata* applied, accepted Mougeout & Nestler 763 as the lectotype. I do not consider this procedure a commendable one, for it ignores all the work accomplished




Figs. 1, 2. *Cordyceps canadensis* Ell. & Ev. — 1. Part-spores (× 600). — 2. Ectal layer of cortex of ascogenous portion (× 1400).

Fig. 3. *Cordyceps capitata* (Holmskj. ex Schmidt) Link. — Part-spores (× 600).

and knowledge accumulated before Fries appeared on the scene. Fries himself liberally drew from the data contributed by his predecessors, and the mere fact that later his 'Systema mycologicum' was proclaimed the starting-point book, should not imply that the pre-Friesian sources need no longer be taken into consideration.

In the present case of *Sphaeria capitata* it is not Fries but Schmidt who prior to that author revalidated the specific epithet. The following is a purely theoretical case, but it shows the dangerous consequence. For, suppose Schmidt had indicated an exsiccatum (other than Mougeot & Nestler 763 mentioned by Fries), which very likely would have stood more than a fair chance of representing *Cordyceps canadensis*, the procedure followed by Mains would have resulted in *Sphaeria capitata* Schmidt turning out a completely different species from *Sphaeria capitata* Fr., whereas, in fact, they were based on the same type.

The choice of the type may need some comment. Holmskjold (*1790*: 41) indicated, in addition to his own specimens found near Aarhuus, those collected by Oeder in Sjelland and depicted in Flora danica, Fasc. 9: pl. 540. 1770. Both the illustrations of Holmskjold and Oeder are syntypes, but I prefer the former as it gives slightly more information. Although macroscopically there is very little that can serve to tell *Cordyceps canadensis* from *C. capitata*, the complete lack of any lustre of the surface of the fertile portion (a character marked by Kobayasi & Shimizu) would point in the direction of Holmskjold's plate actually representing *Cordyceps capitata*.

Several authors, like Fries, Link, and the Tulasnes, included *Sphaeria agariciformis* Bolt. [Hist. Fung. Halifax **3**: 130 *pl. 130.* 1789 ("*agariciformia*"). — *Cordyceps agariciformis* (Bolt.) *ex* Seaver *in* N. Amer. Fl. **3**: 53. 1910 ("*agariciformia*")] in the synonymy of *Cordyceps capitata*. It is hard to decide whether that is correct or not owing to the technique in which Bolton's plate was executed. In some of the specimens depicted the shading of the ascogenous portion suggests a somewhat shining surface, in others the head seems to be mat.

It may come as a surprise that in the Netherlands *Cordyceps canadensis* (heretofore unrecorded for this country) turns out to be more common than *C. capitata*, but this is in agreement with the situation as reported by Kobayasi & Shimizu for Japan (*1960*: 85). The general position in Europe may not be widely different, although from the references enumerated below one might even come to the conclusion that true *Cordyceps capitata* is practically non-existent.

DENMARK.—Christiansen (*1931*: 358) described the fertile portion as slimy and the accompanying photograph exhibits a highly shining surface. Although the width of the part-spores was stated to be 2.5–4.8 $\mu$, which is unusually narrow, the drawing of a single part-spore clearly shows the thickened cell-wall at both ends. Munk (*1957*: 77) found the asci and spores respectively c. 15 $\mu$ and 5–6 $\mu$ broad. Both descriptions refer to *C. canadensis*.

FINLAND.—Karsten (*1873*: 202) gave the following description "Sporae ... in articulos fusoideo-elongatos vel subbacillares 25–40 mmm. longos, 6 mmm. crassos ...": this is *C. canadensis*.

FRANCE.—Mougeot & Nestler, Stirp. cryptog. vogeso-rhen. No. 763 represents true *C. capitata*. The species described and illustrated by the Tulasnes (l.c.) is *C. canadensis*.

GERMANY.—Hennig (*1960*) described the spores as "Fadenförmig, 30–60 × 5–6 μ [these measurements obviously refer to the part-spores], in verschieden lange zylindrische oder spindelförmige Stücke zerfallend". Migula (*1913*: 766) found the asci 15 μ broad, the spores 5–6 μ broad. Ricken (*1920*: 336) described the [part-] spores 25–60 × 5–6 μ. Winter (*1887*: 152), from whom subsequent German authors seem to have borrowed, described the spores as "fadenförmig, aus zahlreichen, meist spindel- oder stäbchenförmigen, seltner cylindrischen ... Gliedern bestehend, deren Länge zwischen 25 und 60 μ schwankt, bei einer Dicke von 5–6 μ". All descriptions refer to *C. canadensis*. However, the following collection actually represents *Cordyceps capitata*: Baden, Rastadt, Niederwald, Nov. 1877, *J. Schroeter* (GRO).

GREAT-BRITAIN.—The description given by Dennis (*1960*: 148) of the part-spores as "cylindrical with solid ends" is unmistakable for *C. canadensis*, and the same holds true for the width of the spores which is said to be 3–6 μ. Only, the shortest length of the part-spores, given as 7 μ, would seem to point to *C. capitata* being intermixed.

POLAND.—Schroeter (*1894*: 278) measured the width of the asci as 15 μ and that of the spores as 5–6 μ; this is *C. canadensis*.

SWITZERLAND.—de Jaczewski (*1895*: 191) found the spores "filiformes ... 5–6 μ de large ... se séparant en un grand nombre de segments légèrement fusiformes de 25–60 μ de long." The same measurements were recorded in 'Schweizer Pilztafeln' (*1954*: No. 74). Both descriptions refer to *C. canadensis*.

Kobayasi & Shimizu (*1960*: 85) tabulated the differences between *Cordyceps canadensis* and *C. capitata*. To these the following may be added. In *Cordyceps canadensis* the part-spores are extremely variable as to size and shape (which was well observed by the Tulasnes), their ends are often truncate, and the cell-wall is thickened at the ends. In *Cordyceps capitata* there is much less variability in size and practically none in shape. The ends of the part-spores are rounded and the cell-wall, which is thinner than in the preceding species, is not thickened at the ends.

I am under obligation to Dr. J. J. Barkman (Wijster), Dr. J. Lanjouw (Utrecht), Dr. A. D. J. Meeuse (Amsterdam), and Dr. R. van der Wijk (Groningen) for the loan of specimens.

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