

A neglected species, *Gyromitra ambigua* (Karst.) Harmaja, n. comb., and *G. infula* s. str. in Fennoscandia

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In 1963, in late July I found in Kuusamo (North Finland) some conspicuous specimens of *Gyromitra*. They were much like *G. infula* except for the striking violet tinge in the colours of the cap and the stipe. Later I studied the specimens for microscopical characters and found that the spores in particular were different from those of the typical brown-coloured *G. infula* of southern Finland. It became clear that what had been called «*G. infula*» in reality consisted of two independent but closely related species. The taxon proxime to *G. infula* has been almost completely neglected. Only P. A. Karsten has described it at the species level and he gave it the name «*Helvella ambigua* Karst.».

I have examined microscopically the Norwegian, Swedish and Finnish collections labelled as *G. infula*, 333 specimens altogether, and will in the following give the descriptions of the two species as well as conclusions on their ecology and distribution based on the specimens and the label notes.

Gyromitra infula ([Schaeff.] Fr.) Quélet in Ench. Fung., p. 272, 1886.

Basionym: *Helvella infula* [Schaeff.] Fries in Syst. Myc. II, p. 17, 1822. — Typus: Because J. C. Schaeffer left no material behind, the lectotype of *Helvella Friesiana* Cke (see later) is here proposed for the neotype. That specimen is apparently the only one collected by E. Fries which has been labelled «*Helvella infula*» by him.

Synonyms: ? *Helvella rhodopus* Krombholz in Naturgetr. Abb. Besch. Schwämme, 3. Heft, p. 23, Taf. XIX: fig. 11—13, 1834. — Typus:

No material of Krombholz existing. Accordingly a *nomen dubium*.

Helvella Friesiana Cooke in Mycogr. 1., p. 195, fig. 333, 1875. — Typus: Lectotype (selected here) studied. The type material in the Berkeley Herbarium at Kew (K) consists of one sole specimen which was collected by E. Fries at Uppsala, Sweden and labelled «*Helvella infula*» by him. The date lacks but it is surely after 1822.

Physomitra infula ([Schaeff.] Fr.) Boudier in Hist. Class. Discom. Eur., p. 35, 1907.

Physomitra infula v. *Friesiana* (Cke) Boudier in Hist. Class. Discom. Eur., p. 35, 1907.

Helvella infula f. *Friesiana* (Cke) Bresadola in Iconogr. Myc. 23, tab. 1167, 1932.

Gyromitra infula f. *gyrosa* Benedix in Kulturpflanze 14, p. 363, 1966. — Typus: A type specimen has not been designated for which reason the name of the form is a *nomen invalidum*. The description and the excellent photographs clearly indicate *G. infula*.

Cap up to 12 cm high and 14 cm broad, indistinctly hygrophanous, mostly red-brown when wet, e. g. 7 C 11 (MAERZ and PAUL 1950), sometimes darker and even 8 E 9, when dry pale brown to blackish brown, very rarely with a slight violet tint, very often whitish hoary from discharged spores, more or less regularly mitra-like already when young (rarely with three lobes). The outer edge of the lobes is seamed from top down to the margin of the cap. Very rarely is the cap irregularly lobate without distinct «horns». The cap is attached to the stipe only at the margin and the stipe accordingly continues as a distinct columella in the hollow cap. The cap surface is often almost even but it is not infrequently irregularly rugose and with mostly minute folds.

Stipe 3—12 cm × 15—30 mm, indistinctly

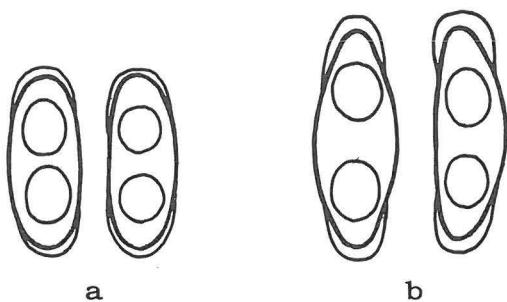


Fig. 1. Spores of a) *Gyromitra infula* (Finland, Lohja, leg. H. Harmaja), b) *G. ambigua* (holotype). Drawn x 1000 in heated Cotton Blue.

hygrophanous, pale brown to greyish lila, of other colour and paler than the hymenium, of equal thickness, cylindrical and solid when young, later getting hollow and the walls often growing together so that it becomes more or less compressed when old (it is not, however, distinctly cellular internally as in *G. gigas*). The surface is throughout fluffy with very short pallid hairs. At the base there is sparsely whitish tomentum.

Flesh pale, in the stipe less brittle than in the cap, brakes cheese-like everywhere.

Smell not distinct.

Taste of both the cap and the stipe mild.

Spores (17,0—) 20,0—23,0 (—26,0) x 7,0—10,0 μ m, mostly uniseriate, oblong-subfusiform with

broad rounded apices, thickest in the middle, slightly inequilateral, with two large drops; wall smooth and rather thick (ca. 0,5—0,6 μ m), hyaline in KOH, yellowish in Melzer's; perispore present, slightly (1,0 μ m at most) off from the spore wall at the spore apices where thus two inconspicuous appendages are formed, otherwise usually appressed onto the wall (exceptionally everywhere off from the spore wall), periplasma deep blue in Cotton Blue; no reticulum (Fig. 1); spore deposit slightly yellowish.

Asci 200—260 x 10—20 μ m (total length), eight-spored, cylindrical, especially when young reddish brown in KOH and darker, reddish brown to melleous in Melzer's; wall rather thin (ca. 0,4 μ m), hyaline to yellowish in KOH as well as Melzer's, not differentiated anywhere; apex obtuse-truncate, neither tapering nor curved; ascostome straight.

Paraphyses very thin-walled, \pm straight, sometimes branching below, septate, capitate to sub-clavate, \pm abruptly expanding to a roundish head as much as 13,0 μ m broad and covered with a more or less thick layer of red-brown mass (in both KOH and Melzer's; sometimes the stalk is encrusted below the head, too), contents dirty yellowish brownish to red brown in KOH as well as Melzer's (Fig. 2).

Excipulum throughout of *textura intricata* with some protruding, \pm undifferentiated hyphal ends, hyphae 4,0—13,0 μ m broad, wall thin, hyaline to

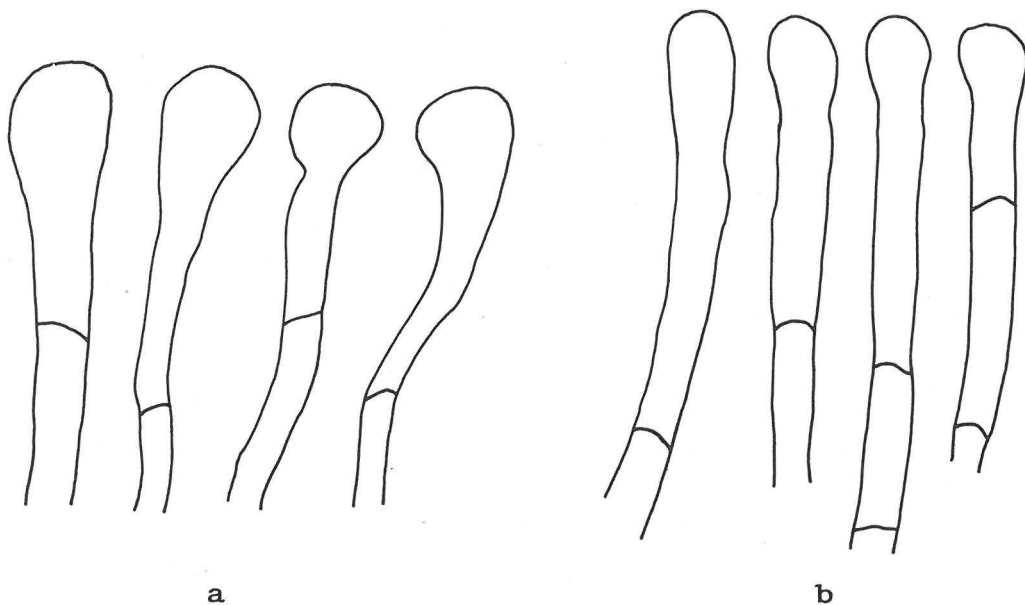


Fig. 2. Tips of paraphyses x 1 000. a) *Gyromitra infula* (Sweden, Kinnarumma, leg. F. Karlvall), b) *G. ambigua* (Finland, Kuusamo, leg. T. Ahti 22026). Encrustations have not been drawn.

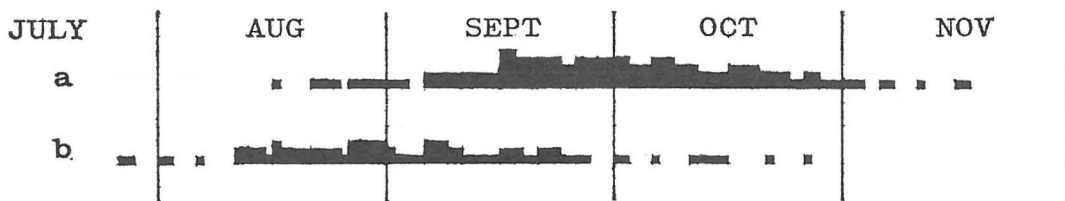


Fig. 3. Fruiting times of *Gyromitra infula* (a) and *G. ambigua* (b). Each month is divided into six periods of five days. A period consists of 25 mm² in the diagram. One square of 1 mm² has been blackened when one specimen from the area of this study has been collected on any of the five days of the corresponding period.

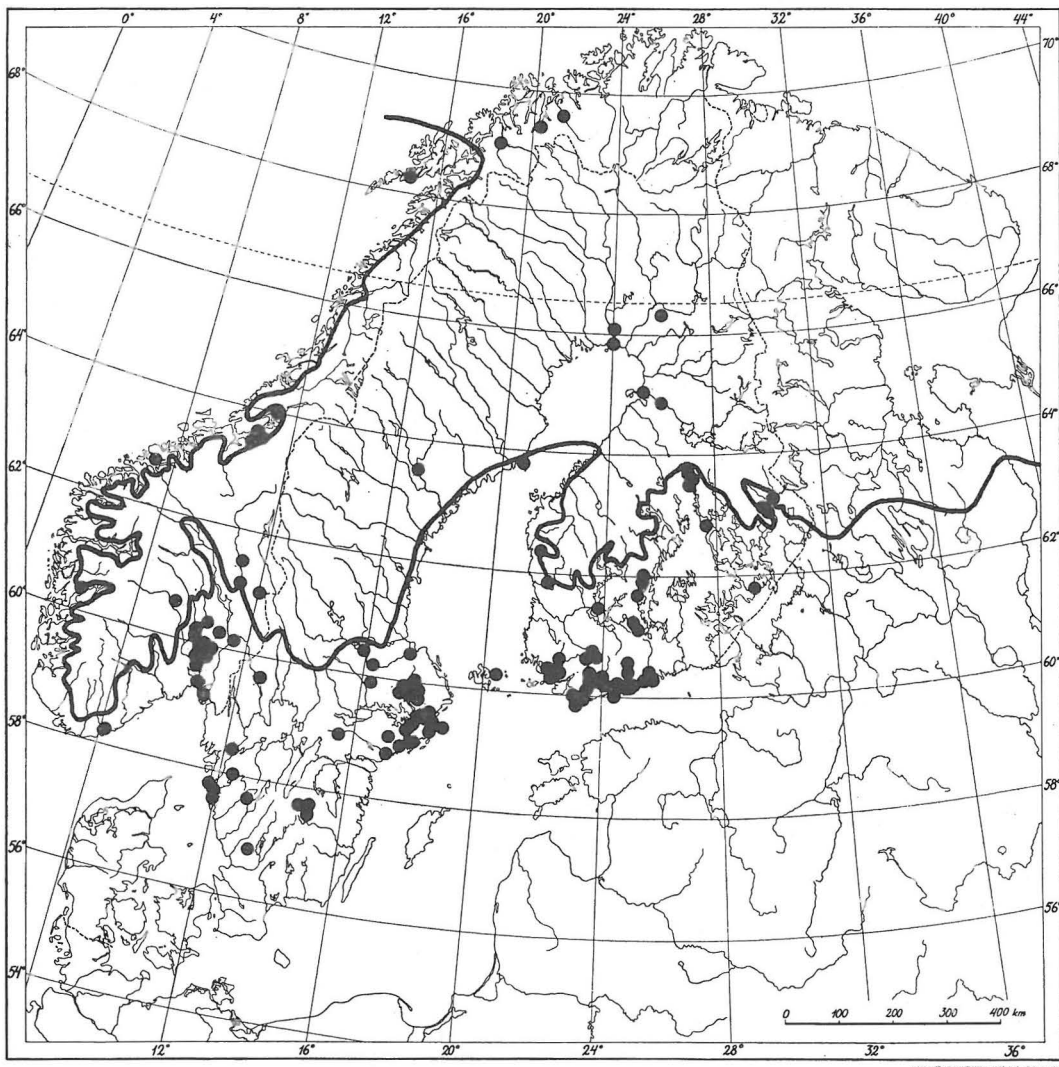


Fig. 4. Distribution of *Gyromitra infula* in Norway, Sweden and Finland. The line indicates the northern (and eastern) limit of the South Boreal Vegetation Zone according to AHTI, HÄMET-AHTI & JALAS 1968.

yellowish in KOH, yellowish in Melzer's, thin to thick-walled laticiferous hyphae with a diameter of 3,0—15,0 μm abundant in inner parts, their contents rusty brown in KOH and rusty brown to melleous in Melzer's.

Cortex of the hollow stipe throughout of *textura intricata* but the hyphae more tightly interwoven in the outer part, hyphae 4,0—25,0 μm broad, wall rather thin, yellowish in KOH, pale yellow in Melzer's. On the outer as well as the inner surface there is a narrow layer of thin to rather thick-walled hyphae with rich intracellular pigment rusty brown in KOH, rusty brown to melleous in Melzer's, some of them slightly protruding, especially at the outer surface.

Occurs solitary or in groups near conifers (spruce, *Picea abies*, almost always present) from grass-herb rich forests to dry heath forests, very often in decaying wood (mostly of *Picea*, rarely *Pinus sylvestris* or *Betula*), otherwise especially on various kind of bare soil, sometimes on burnt areas, very rarely even among charcoal, often where the surface of earth has been disturbed, e.g. by roads and paths, from the latter half of August to the middle of November (Fig. 3). Frequent but rather strictly confined to the Hemiboreal and South Boreal Vegetation Zones in Fennoscandia (nomenclature of vegetation zones according to AHTI, HÄMET-AHTI & JALAS 1968) occurring mostly below the altitude of 200 m the highest record being at 500 m (for distribution, see Fig. 4).

Distribution according to specimens examined.

NORWAY: Østfold. Kråkerøy parish (1 specimen); Rygge (1). — Akershus. Asker (3); Baerum (3); Nannestad (3); Nes (2); Nesodden (1); Oslo (6). — Hedmark. Elverum (1). — Oppland. Fåberg (2); Gran (1); Ringeby (1). — Buskerud. Hole (1); Nes (1); Norderhov (1); Røyken (1). — Vest-Agder. Tveit (1). — Hordaland. Kvam (1). — Møre & Romsdal. Bolsøy (1). — Sør-Trøndelag. Malvik (2). — Nord-Trøndelag. Frosta (1); Skatval (2); Steinkjer (1). — Nordland. Vågan (1). — Troms. Målselv (1); Nordreisa (1); Storfjord (1).

SWEDEN: Småland. Femsjö (2); Nässjö (1); N. Sandsjö (1); N. Solberga (1). — Västergötland. Göteborg (3); Kinnarumma (1); Långared (2). — Bohuslän. Lane-Ryr (1). — Värmland. Arvika (1). — Södermanland. Bo (1); Gryt (1); Huddinge (1); Nyköping (1); Salems (2); Södertälje (1); Tyresö (1); Vagnhärad (1); Ösma (1). — Uppland. Bondkyrka (7); Börje (1); Danderyd (1); Danmark (1); Djurö (1); Haga (1); Läby (1); Ramsta (1); Rasbo (1); Ö. Ryd (1); Skogs-Tibble (1); Stockholm (4); Tynningö (1); Uppsala (1); Uppsala-Näs (3); Vaksala (2); Vänge (2); Älvkarleby (1); Årentuna (1); Össeby-Garn (2). — Västmanland. Avesta (1); Västerfärnebo (1). — Dalarna. St. Skedevi (1). — Angermanland. Ådals-Liden (1). — Västerbotten. Sävar (1). — Norrbotten. Nedertorneå (2).

FINLAND: Ahvenanmaa. Vårdö (1). — Varsinais-Suomi. Aura (1); Bromarv (1); Karjalohja (2); Kisko (1); Lohja mlk. (5); Nousiainen (1); Parainen (2); Piikkiö (2); Pohja (5); Suomensjärvi (1); Turku (2). — Uusimaa. Espoo (9); Helsinki (6); Helsinki mlk. (3); Hyvinkää (5); Järvenpää (1); Kirkkonummi (2); Porvoo (2); Porvoo mlk. (2); Sipoo (2); Tammisaari (1); Tammisaari mlk. (2); Tuusula (7). — Satakunta. Siikainen (1). — Etelä-Häme. Jämsänkoski (1); Koskenpää (1); Kuhmoinen (1); Lammi (2); Somerniemi (1); Somero (1); Tammela (6); Tampere (2). — Etelä-Savo. Punkaharju (2). — Etelä-Pohjanmaa. Kauhajoki (1). — Pohjois-Häme. Virrat (1). — Pohjois-Savo. Iisalmi (7); Iisalmi mlk. (3); Kuopio (1); Vieremä (2). — Pohjois-Karjala. Kontiolahti (1); Pielisjärvi (3). — Pohjois-Pohjanmaa. Karunki (1); Muhos (1); Oulu (3); Rovaniemi mlk. (1).

Discussion.

Morphological, ecological and distributional differences between *G. infula* and *G. ambigua* are discussed in connection with the latter species.

In the colour of the hymenium and the measures of the spores of *G. infula* I have observed slight variation which is at least to some extent genotypically determined. Once I found a fruitbody with bifurcate stipe and the both branches wore a normally developed cap. The inequilaterality of the spores has probably never been reported before though it can be seen at least in the photograph of BENEDIX (1966, p. 362).

According to KARSTEN (1871, p. 34) «*Helvella infula*» is rather frequent in southern Finland to as far north as the province of Etelä-Pohjanmaa. NANNFELDT (in NANNFELDT & DU RIETZ 1952, p. 205—206) tells that «*Gyromitra infula*» is rather frequent in most of Scandinavia (= Sweden + Norway) but seems to be lacking in Denmark. From the last-named country I have accordingly received no specimens of the species nor have I found any note in literature concerning its occurrence there. It is somewhat strange that *G. infula* has not been found in Scania and Denmark though *Picea* and *Pinus* are commonly cultivated there. It probably will be discovered later in those districts, too. The specimens of «*G. infula*» (in UPS and S, at least) in Fungi Exsiccati Suecici, Nr. 367, represent actually that species.

BENEDIX (1960, p. 10—11) writes that *G. infula* is more or less pronounced carbonicolous, and in 1966 (p. 362) he says that the species [s. str.] consists of two forms with different ecology. On the basis of the ma-

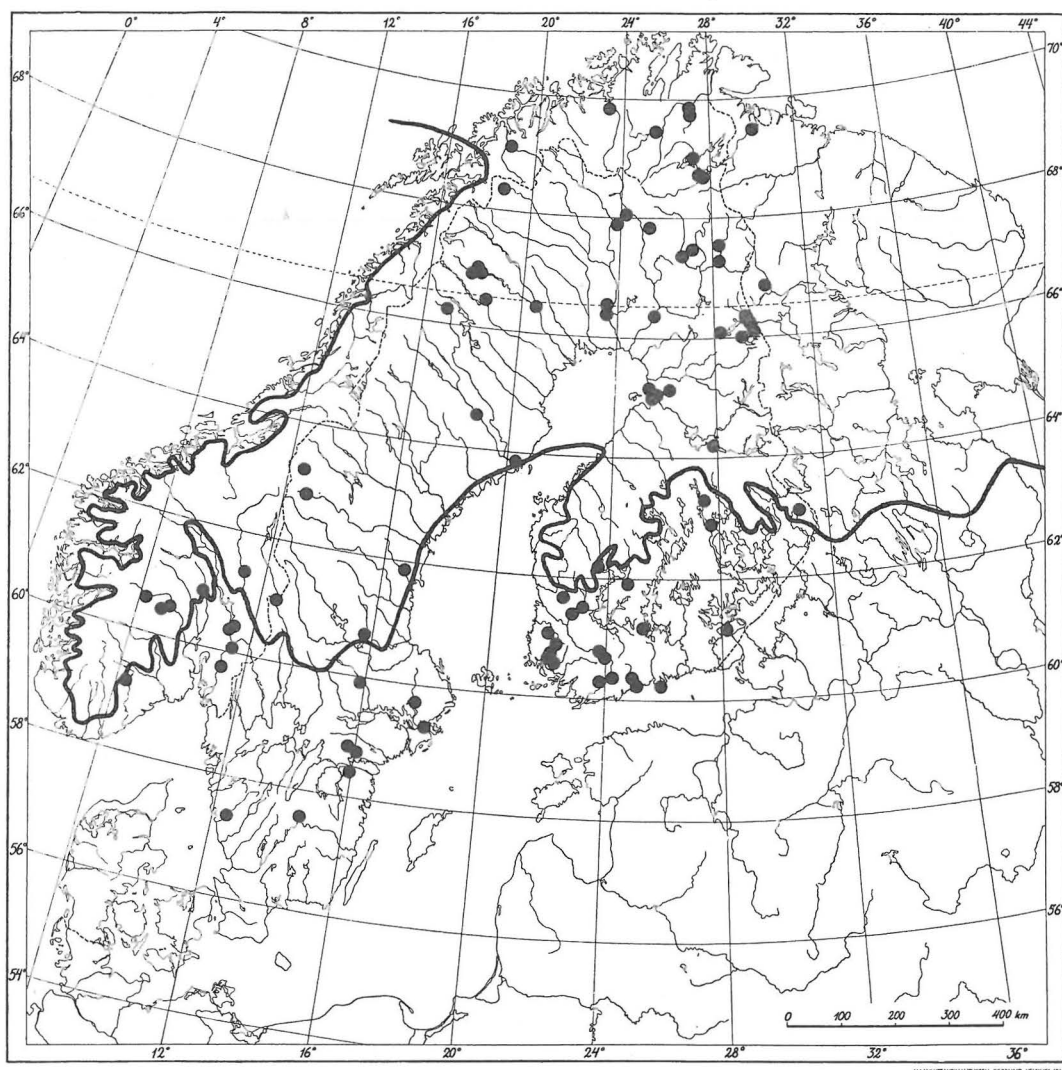


Fig. 5. Distribution of *Gyromitra ambigua* in Norway, Sweden and Finland (one locality belongs at present to USSR). The line as in fig. 4.

terial of the present study I cannot support these observations. *G. infula* has been collected but rarely from recently burnt areas and I have not been able to correlate variation, e.g. in the cap form, with different substrate preference.

Gyromitra infula seems to have a wide circumpolar distribution, in the southern part of the boreal coniferous zone at least. I have seen specimens from the neighbourhood of J. C. Schaeffer's native town in Bavaria and from eastern as well as western North America and the species occurs in Asia, too, according to the picture and spore dimensions in IMAZEKI and HONGO 1965, p. 126.

Gyromitra ambigua (Karst.) Harmaja, n. comb.

Basionym: *Helvella ambigua* Karsten in Medd. Soc. F. Fl. Fenn. 5, p. 53, 1879. — Typus: Holotype at Helsinki (H), studied: «*Helvella infula* **similis*. Mustiala ad lignum in adustis 30 juli 1866». The holotype of *H. ambigua* is the same as that of *H. infula* v. *similis*, because Karsten himself refers in 1879 to his former variety as a synonym.

Synonyms: *Helvella infula* v. *elongata* v. Post in sched.

Helvella infula v. β *similis* Karsten in Bidr. Känned. Finl. Nat. Folk 19 (Mycol. Fenn. 1), p. 34, 1871. — Typus: Holotype is the same specimen as that of *Helvella ambigua* Karst. *Gyromitra infula* v. *apiculatispora* Raitviir in

Eesti NSV Tead. Akad. Toim., Biol. Seeria 14, p. 322, 1965. — Typus: Holotype at Tartu (TAA), studied: «U.S.S.R., Regio Tjumen, distr. nation. Jamalo-Neneticum, 20. 8. 1964 leg. E. Parmasto».

The fruit-body resembles much that of *G. infula*, but in the colours of the cap and stipe there is mostly a more or less distinct violet tinge, especially when fresh. The fruit-body is smaller on the average and the cap is usually darker (even black when dry) and but very seldom whitish hoary. When young and sometimes later, too, the hymenium is smooth, but with age it often gets irregularly wrinkled.

Smell not distinct.

Taste of both the cap and the stipe mild.

Spores 22,0—33,0 (—37,5) × 7,5—12,0 μm (excluding the perispore ca. 20,0—29,0 [—34,5] μm long), mostly uniseriate, subfusiform to broadly fusiform, inequilateral, with two large drops; wall smooth and rather thick (ca. 0,5—0,6 μm), hyaline in KOH, yellowish in Melzer's; perispore surrounds the spore, but it is usually observable only at the apices where it is inflated and off from the spore wall forming an appendage of varying breadth (1,5—3,0 μm), periplasma deeply staining in Cotton Blue, no reticulum (Fig. 1); colour of spore deposit unknown but it may be deeper than that of *G. infula*.

Asci 210—280 × 10—20 μm (total length), eight-spored, cylindrical, especially when young reddish brown in KOH and darker, reddish brown to melleous in Melzer's; wall rather thin (ca. 0,4 μm), hyaline to yellowish in both KOH and Melzer's, not differentiated anywhere; apex obtuse, neither tapering nor curved; ascostome straight.

Paraphyses very thin-walled, ± straight, occasionally branching below, septate, clavate to subcapitate, ± gradually expanding to the tip which is 10,0 μm broad at most, encrusted and intracellular pigments exactly as in *G. infula* (Fig. 2).

Excipulum and the anatomy of the stipe even in details as in *G. infula*.

Occurs solitary or in groups, obviously always near pines (*Pinus sylvestris*), almost always on barren sandy soil, very often along roads and paths (rarely on burnt areas, among charcoal, in decaying wood or on the margins of pine bogs), from late July to the end of October (Fig. 3). In the whole Fennoscandia, but mostly in northern parts and at higher elevations (up to 1 000 m but apparently always, however, below the tree limit of the Scotch Pine), accordingly ± frequent in the North Boreal and Middle Boreal Vegetation Zones (Fig. 5). It seems, however, to be lacking in the treeless oroarctic (alpine) belt.

Distribution according to specimens examined.

NORWAY: *Akershus*. Eidsvoll (1); Enebakk (1); Nannestad (2); Nes (2). — *Oppland*. Fluberg (1); Ringeby (1). — *Buskerud*. Hol (1); Nes (2); Nore (1). — *Telemark*. Fyresdal (2). — *Troms*. Målselv (1). — *Finnmark*. Alta (1); Karasjoki (1); Sør-Varanger (1).

SWEDEN: *Småland*. Bringetofta (1). — *Östergötland*. Bankekind (1); Simonstorp (3); Skedevi (1). — *Västergötland*. Horred (1). — *Värmland*. N. Finnskoga (1). — *Uppland*. Alsike (1); Stockholm (1). — *Västmanland*. Skinnskatteberg (1). — *Dalarna*. Sundborn (1). — *Hälsingland*. Norrbo (1). — *Härjedalen*. Storsjö (1). — *Jämtland*. Åre (1). — *Västernorrland*. Umeå (1). — *Norrbottnen*. Övertorneå (4). — *Lycksele Lappmark*. Lycksele (1). — *Pite Lappmark*. Arjeplog (2). — *Lule Lappmark*. Jokkmokk (4). — *Torne Lappmark*. Jukkasjärvi (1).

FINLAND: *Varsinais-Suomi*. Karjalohja (1); Kustavi (1); Masku (2); Nousiainen (1); Turku (1); Vihti (1). — *Uusimaa*. Helsinki (2); Porvoo mlk. (1); Tuusula (2). — *Satakunta*. Lappi (1); Mouhijärvi (1); Noormarkku (1); Tyrvää (1); Yläne (1). — *Etelä-Häme*. Kuorevesi (1); Lammi (2); Somerniemi (3); Tammela (4). — *Etelä-Savo*. Taipalsaari (2). — *Pohjois-Häme*. Virrat (1). — *Pohjois-Savo*. Kuopio (1); Lapinlahti (1). — *Pohjois-Karjala*. Pielisjärvi (1). — *Kainuu*. Kajaani (1). — *Pohjois-Pohjanmaa*. Haukipudas (2); Oulu (1); Rovaniemi mlk. (1); Ylikiminki (1). — *Kuusamo*. Kuusamo (5); Posio (1); Salla (1); this locality belongs at present to USSR). — *Kemin Lappi*. Kittilä (2); Muonio (1); Savukoski (4); Sodankylä (2). — *Inarin Lappi*. Inari (7); Utsjoki (10).

Discussion.

This interesting species is very proximate to *G. infula*, and it is probably a northern derivative of the latter. From *G. infula* it differs in many respects, however. The spores are the most important character which separates the two species from each other while the macroscopic features alone very often do not permit a positive identification. The spores of *G. ambigua* are longer (even without the perispore), broader, the true spore apex is narrower and the spores thus more clearly fusiform, and the perispore is more inflated at the spore apices. As in *G. infula* there is some variation, at least to some degree genotypically determined, in the length and breadth of the spores as well as the extent to which the perispore is inflated. In *G. ambigua* the paraphyses enlarge more gradually to the apex, which is somewhat narrower on the average. The fruit-body is smaller on the average and it has mostly a distinctly violet tinge. The cap is darker, too, than in *G. infula* and when dry, it is usually brownish hoary from discharged spores rather than whitish. The seam at the outer side

of the lobes of the cap seems to be less prominent and tighter and the hymenium is more often wrinkled. *G. ambigua* is perhaps always found near pines and it grows nearly uniformly on poor sandy soil (it is a good indicator of meagre soil) whereas *G. infula* occurs mostly on less meagre sites, especially near *Picea* and is very often found in decaying wood. Even in districts where both species grow under a similar climate the fruit-bodies of *G. ambigua* occur on the average some weeks earlier, which difference becomes more pronounced by the fact that the latter favours higher altitudes and accordingly has a more northern distribution (Figs. 3, 4 and 5).

It is an interesting phenomenon among fleshy fungi that species respond to climate within a rather small geographical area, as is seen in Fig. 4. Though the material could be much larger, it is remarkable that the northern and eastern limit of the South Boreal Vegetation Zone according to AHTI, HÄMET-AHTI & JALAS (1968) delimits rather strictly the occurrence of *G. infula* northwards (and eastwards in the Norwegian mountain range). The same line obviously delimits the common occurrence of *G. ambigua* southwards and westwards especially in Norway and Sweden (Fig. 5). The two species thus to some degree complement each other as to distribution, biotope, and fruiting-time. The northern limit of *G. infula* falls mostly within the range of the spruce whereas its southern limit may well be determined by the southern limit of the spruce. In the case of *G. ambigua*, roughly speaking the reverse is true: its northern (and alpine) limit coincides with that of the pine while in the south and west it is more or less rare because of unsuitable

climate (and apparently for the scarcity of suitable biotopes, too). All in all, the distribution of the two species together covers the whole Boreal Coniferous Zone in Fennoscandia.

It is probable that the northern limit of the South Boreal Zone will prove to be an important distributional limit for many fleshy fungi, especially for a number of species of mykorrhiza-forming genera and e.g. *Mycena*.

In this century only v. SCHULMANN (1958, p. 59 and 1961, p. 95: s.n. *Gyromitra* sp.) and RAITVIIR (1965, p. 322: s.n. *Gyromitra infula* v. *apiculatispora* Raitv.) have noted the existence of *G. ambigua*. In addition, in some Norwegian, Swedish as well as Finnish collections of *G. ambigua* (labelled mostly as *G. infula*) there are hand-written notes in which it has quite correctly been assumed that the specimens do not represent *G. infula*, but, rather, another taxon.

G. ambigua has a circumpolar distribution like *G. infula* but a more northern one. I have seen one specimen from Canada, Yukon Territory, and another from northern Siberia, Regio Tjumen (the holotype of *G. infula* v. *apiculatispora* Raitv.). In connection with the description of his variety RAITVIIR (op.c., p. 322) designates as a paratypus a specimen from the United States, Montana, Glacier National Park. The description and spore figure of «*G. infula*» from Alaska in WELLS and KEMPTON (1968) refer clearly to *G. ambigua*. *G. ambigua* may be more or less common in northern continental districts and mountains of Eurasia and North America.

The author is indebted to the staff members of various herbaria. I am also grateful to Dr. P. Isoviita, Helsinki, for nomenclatural advice.

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