Karstenia 18: 1—19. 1978

The boletes of Finland 1. Genus Boletus

PAAVO KALLIO and HELI HEIKKILÄ

KALLIO, P. and HEIKKILÄ, H. 1978: The boletes of Finland 1. Genus Boletus. — Karstenia 18: 1—19.

The Finnish taxa of the genus *Boletus* are presented. *Boletus impolitus* Fr. is recorded for the first time from Finland as are also *B. edulis* Bull. ex Fr. ssp. *edulis* f. *arcticus* Vassilk., f. *aurantioruber* (Dick & Snell) Vassilk. and f. *citrinus* (Pelt.) Vassilk. The problem of the delimitation of *B. spadiceus* (Fr.) Quél. and *B. lanatus* Rostk. is discussed.

The Finnish distributions are given for all the taxa, mostly on the basis of herbarium material. The only species found throughout the country are *B. edulis, B. piperatus* and *B. subtomentosus;* most of them are quite southern in their distribution, many occurring only in the oak zone. Their ecology is discussed.

Paavo Kallio, Institute of Biology, University of Turku, SF-20500 Turku 50, Finland
Heli Heikkilä, Kuopio Museum, Department of Natural History, Kauppakatu 23, SF-70100 Kuopio 10, Finland

Introduction

P.A. Karsten, a mycological pioneer in Finland, devoted his thesis (Karsten 1859) to the polyporaceous fungi in SW Finland, a group which at that time included the boletes. Karsten (1876) reported less than 20 bolete species from Finland, although he mentioned 50 species in his book 'Rysslands, Finlands och den Skandinaviska halföns hattsvampar' (Karsten 1882). Most of Karsten's observations and collections were made in Tammela in South Häme, where Karsten taught at Mustiala Agricultural College. The number of bolete species known from Finland has grown in this century: Tuomikoski (1955b) listed 26 species certainly found in Finland, and a few varieties and subspecies; Kallio (1976) listed 49. The area from which the herbarium collections were taken has also become wider.

Finland and Fennoscandia as a whole are of special interest from the point of view of taxonomical and geographical studies on fungi (cf. Hintikka 1931, Nannfeldt 1959), and represent a marginal area for the group of boletes. Many features typical of the nemoral zone extend from Central Europe to the northern border of the 'oak zone' in Fennoscandia, which is one of the most important mycogeographical limits in this part of Europe (Kallio 1963, Bresinsky 1969). Another important geographical limit is the northern border of coniferous forests. The coniferous zone lying between these two limits is the western extension of the transcontinental taiga forest, where the number of agarics is very high (Nannfeldt 1959). North of this zone is the subarctic birch zone with oroarctic areas on the mountain tops, which correspond to the arctic in many respects (Ahti et al. 1968); in fact, the northernmost problems of bolete taxonomy and ecology can be studied already in Fennoscandia. This bioclimatic zonation is reflected in the distribution of boletes in Finland. An idea of the temperature gradient existing between the south and north of the country can be obtained from the accumulated temperatures of the growing season, which are 1300 day degrees in South Finland and ca. 500 in northernmost Lapland, or from the corresponding lengths of the growing season, which are ca. 200 and 110 days. The differences in the moisture conditions are not very great. However, in the SW corner of Finland fruit body development is limited by low moisture more often than in other parts of the country.

Being mycorrhizal fungi, many of the boletes are restricted to the distribution area of a certain host tree species. This partly accounts for the special character of the fungal flora of the oak zone. The limits of the coniferous forests are also reflected in the distributions of some fungi, and some special larch-mycorrhiza boletes are limited to areas with planted larch (*Larix*) species.

The geology of Finland is rather uniform from the ecological point of view. Acid Archean bedrock predominates. There are only a few limestone areas and small outcrops of other less acid and basic

rocks, which are usually clearly reflected in the vegetation. Some such areas are found in the SW archipelago, where remnants of Silurian formations also occur (Eklund 1934, Hinneri 1972).

In Finland human influence is strongest in the southern part of the country; areas where the original ecosystems are almost undisturbed are still found in Lapland. The degree of human interference may also be important as a factor determining the distribution of boletes.

In this paper we have tried to collect recent information on the Finnish bolete flora. Our own experience is mainly restricted to the SW corner of Finland, the northernmost part of Lapland, around the Kevo Subarctic Research Station, and the area around Kuopio in eastern Finland. The observations of living material have been most important, but there are some species which we have not found ourselves. The collections in H, TUR, KUO and OULU have been taken into consideration, though not all the specimens are identifiable.

The boletes have already been well described in several publications, but many of the descriptions of species have neglected the regional variation possibly existing in their morphology and ecology. One of our aims has been to improve the knowledge of the range of variation. Finland is particularly suitable for a study of the variation shown by bolete species occurring at the margins of their ranges. We have tried to compare our specimens with the descriptions in the studies of Kallenbach (1926—38), Singer (1965, 1967), Watling (1970) and others, and have given detailed descriptions only in the cases where the variation range seems to need some amplification. Short characterizations are, however, given for all the taxa.

Descriptions of the distribution of the boletes in Finland are impaired by the fact that the different parts of the country have not been studied equally thoroughly. The areas most intensively investigated lie around centres of scientific activity or the residences of enthusiastic mycologists. Therefore, most of the information comes from the country around Tammela, Helsinki, Turku, Kuopio, Oulu and the Kevo Subarctic Research Station in Utsjoki. Lately, however, the general public appears to have become more interested in fungi. The authors have presented some maps in the hope that they may prompt field studies of these fungi, encouraging collectors to find new localities for 'rare' species.

In the lists of herbarium specimens the authors' names have been abbreviated to PK and HH.

The data on the distribution outside Finland are mainly obtained from the literature. The most important sources were: *Singer (1965, 1967), Kallenbach (1926—38), Watling (1970), Knudsen (1974)* and *Kalamees & Lasting (1974).* When these sources are cited the year of publication is normally omitted.

The data on the distributions in Sweden and Norway are not taken from monographs, but mainly from special papers published in various periodicals. Some herbarium material has been seen by the senior author in the Naturhistoriska Riksmuseet (S) in Stockholm, and Dr. Gro Gulden has kindly given us information about the herbarium specimens of many species in the Botanical Museum of the University of Oslo (0). Vassilkov's papers (1955, 1966) have been useful for the area east of Finland. Also the collections in the herbarium of the Komarov Botanical Institute of the Academy of Sciences, Leningrad, USSR, and discussions with Dr. B.P. Vassilkov yielded much information, particularly concerning the Kola Peninsula and the areas round Leningrad.

The data concerning the ecology, dependence on tree species, etc. are based on our personal observations and information on the labels of herbarium material. We have also tried to compare these data with the reports in the literature.

A key to the genera and species of Boletaceae was given by the senior author in an earlier publication (Kallio 1976). The species are listed in alphabetical order.

Fig. 1. Typical habitat of many southern boletes. Parainen, Lenholm. Photo P. Kallio.

Boletus albidus Rocques
(*B. radicans* Pers. ex Fr.)

Usually in groups. Cap grayish white, often with a tint of ochre, particularly at the disc; diameter up to 14 cm in our material. Surface smooth, somewhat tomentose in young specimens and cracked when old. Stem 10 cm tall and 3—4 cm thick (exceptionally 6.5 cm thick; S. Hietavuo, oral comm.), yellowish brown or yellow on the lower part without any reddish touch (we have not seen quite young specimens). Surface clearly reticulate with light yellow net, which is absent from the tomentose basal part. Pores and tubes lemon yellow, later somewhat greenish, easily turning blue when touched. Flesh whitish or yellowish in cap, whitish in stem, turning intense blue, without red colour changes. Taste usually somewhat bitter and unpleasant (but according to Hietavuo not in all specimens!).

(*B. fechtneri* Velen., which closely resembles *B. albidus,* has not been collected in Fnland so far. It differs from *B. albidus* in the absence of bitter taste and in the red touch in stem and flesh).

Distribution in Finland. One locality (Kallio 1976): Varsinais-Suomi, Parainen: Lenholm, where several specimens were collected in 1972 and 1975, most of them rather old and big. In TUR 11 specimens collected by HH, Ravanko and PK, in H one by Niemelä in 1972.

Total distribution. Abundant only in warmer regions in Central Europe (Pilát & Dermek 1974), but distributed throughout the beech-oak zone in Europe and N Africa (Singer). Unevenly distributed in Britain — mostly in S England; only one record from Ireland (Watling 1970 and 1974). Three finds in Poland (Skirgiello 1960). In Estonia e.g. on the islands and close to Tallinn (Kalamees & Lasting). In Denmark only in the south (Knudsen) but common in some areas (Møller & Nielsen 1965). In Norway not yet found (G. Gulden, in litt.). In Sweden up to Uppland but rare; 13 localities known in 1956 (Andersson 1956). No records from the Leningrad area (B.P. Vassilkov, oral comm.)

Ecology. The locality in Finland is one of the most favourable habitats for exacting southern fungi. Besides the ca. 30 fruit bodies of *B. albidus* seen by the authors, *B. erythropus, B. queletii* and *B. chrysenteron* have also been found. Some other agarics typical of the oak zone in Finland (Kallio 1963) also occur, e.g. *Amanita pantherina, Russula cyanoxantha, R. pseudointegra, Tricholoma sulphureum, T. columbetta* and the mycorrhizal fungi of *Quercus: Lactarius quietus* and *L. azonites.*

The area is pasture land bordered by woods (Fig. 1). There are some big old oaks on the margin, but the field layer is mostly meadow-like, containing many gramineous species and some sedges; in spring, however, *Anemone nemorosa, Hepatica nobilis, Ranunculus ficaria* and other geophytes are typical components. The soil is rich in nutrients and the pH value close to 6. Limestone occurs close to the area, and lime dust spreading from the Parainen lime factory may also have some effect (cf. Rautavaara 1950). The habitat is open to the south and apparently very favourable as regards the temperature conditions. It is one of the most typical representatives of xerothermic meadow habitats in the SW archipelago of Finland and is known for its southern flora elements (cf. Hinneri 1972). Chemical analyses of fruit bodies collected in this area suggest some correlation between the general requirements for limestone and the Ca content of boletes (Hinneri 1975).

In Sweden also, the species 'prefers light and dry woods and park meadows on hard lime rich soil' (Andersson 1956). All studies on the ecology of the species emphasize its dependence on oak (Kallenbach, Vassilkov 1955, Andersson 1956, Skirgiello 1960, Singer, Watling 1970 and 1974, Pilát & Dermek 1974), but other trees are also often mentioned: *Fagus sylvatica, Betula allegheniensis* (= *lutea*) and *Tilia.* The importance of calcareous soil is stressed by Watling (1963). The time of appearance in Central Europe and Estonia is July-October in Finland apparently August-September.

Boletus badius Fr.
(*Xerocomus badius* (Fr.) Kühn. ex Gilb.)

In Finland rather small; cap mostly less than 12 cm in diameter. In Central Europe much larger caps also measured (Singer). Cap even chestnut — dark brown, its colour mostly representing the darker end of range in Kallenbach's Table 45; somewhat tomentose when young. Stem mostly less than 10 cm high and 1—2 cm thick, of the same colour as the cap but lighter. Hymenium yellow with a tint of green, easily turning blue when touched. Flesh yellowish white, variably turning blue, particularly at the stem apex and close to the tube layer. The characteristics of the Finnish specimens agree well with the descriptions of both Singer and Watling, but Watling does not mention that the pore layer has a greenish tint even when not touched (cf. Kallenbach). Apparently rather uniform in Finland.

Distribution in Finland. (Fig. 2). The northern limit lies in the coniferous forest zone. Not uncommon in S Finland, but never abundant (cf. Tuomikoski 1955a). So far found only up to the latitude of Vaasa and Kuopio (ca. 63°N), e.g. not found around Oulu, the centre of mycological field rese-

arch in central Finland (at 65°N). No records from Lapland in spite of rather intensive collecting.

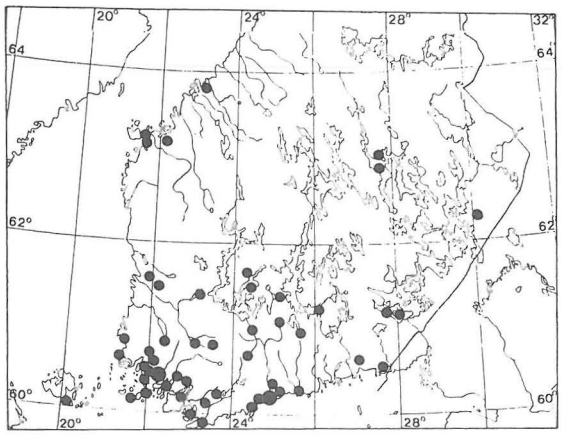

Fig. 2. Distribution of *B. badius*. The large dots indicate localities with more than 7 specimens. Unlisted records of 1977 included.

List of herbarium specimens:
Ahvenanmaa. Lemland, 1974 Haeggström (H). — *Varsinais-Suomi.* Askainen, 1972 von Haartman (H). Bromarv, 1975 Korhonen (2 exx. H). Halikko, 1961 Pato (TUR). Karjalohja, 1960 Såltin (TUR, OULU). Kemiö, 1966 Siltanen (TUR). Korppoo, 1961 PK (TUR); 1961 Kukkonen (TUR). Paimio, 1974 Mäkinen (TUR). Parainen, 1967 Hietavuo (TUR); 1972 PK (TUR). Pohja, 1960 Såltin (H); 1965 Såltin, 2 locs. (TUR). Rymättylä, 1974 Tuomikoski (H); 1961 PK (TUR). Turku, 1937 Frey (H); 1960 PK, 7 locs. (TUR); 1970 and 1974 PK (TUR). Uusikaupunki, 1957 Laine (TUR); 1960 Laine & PK (TUR). — *Uusimaa.* Espoo, 1936 Malmström, 2 locs. (H); 1975 Saarenoksa (H). Helsinki, 1934 Malmström (H); 1936 and 1940 Frey (H); 1949 Malmström (H); 1950 Rautavaara (H); 1952 Tuomikoski (H); 1972 Aalto, 2 locs. (H); 1975 Saarenoksa (H). Kerava, 1940 Merikallio (H). Kirkkonummi, 1966 Hase (H); 1975 Saarenoksa (H). Porvoo, 1925, 1929, 1934 and 1937 Nyberg (H); 1937? Frey (H). Porvoo rural district, 1927, 1932 and 1937 Nyberg (H); 1974 T. & E. Suomalainen (2 exx. H). Sipoo, 1971 Haeggström (H); 1975 Saarenoksa, 3 locs. (H). Tuusula, 1940 Malmström, 2 locs. (H). — *Etelä-Karjala.* Vehkalahti, 1972 and 1974 Fagerström (H). Virolahti, 1965 Rintanen, 2 locs. (H, OULU). — *Satakunta.* Kullaa, 1972 Ulvinen (OULU); 1974 Ohenoja (OULU). Noormarkku, 1967 Såltin (TUR). Yläne, 1960 PK, 2 locs. (TUR). — *Etelä-Häme.* Heinola rural district, 1970 Haikonen (H). Hämeenlinna, 1974 Ohenoja (OULU). Jokioinen, 1974 Ohenoja (OULU, TUR); 1975 Ohenoja (OULU). Lahti, 1970 Haikonen (H). Lammi, 1974 Hakala (KUO). Loppi, 1949 and 1952 Tuomikoski (H). Orivesi, 1959 Jääskeläinen (H). Padasjoki, 1972 Tuomikoski (H). Sahalahti, 1975 Linkoaho (OULU). Tammela, 1871 and 1887 Karsten (H). — *Etelä-Savo.* Taipalsaari, 1970 Vitikainen (H). — *Etelä-Pohjanmaa.* Mustasaari, 1973 Ulvinen (OULU). Vaasa, 1952 Malmström (H). Vöyri, 1952 Malmström (H). — *Pohjois-Savo.* Kuopio, 1967 von Wright (KUO); 1967 Hakala (KUO); 1974 HH (KUO). Siilinjärvi, HH (KUO). — *Keski-Pohjanmaa.* Kaarlela, 1951 Rauhala (H), identification somewhat uncertain.

Total distribution. Apparently very wide distribution area in Europe, Siberia, Mongolia and North America (Kallenbach, Singer). Common in Czechoslovakia (Pilát & Dermek 1974), Great Britain (Watling), Germany (Kallenbach), Estonia (Kalamees & Lasting), Denmark (very common, Knudsen), S Sweden (Ingelström 1940) and eastern and western parts of S Norway; not found north of Leka in Nord-Trøndelag (G. Gulden, in litt.; cf. also Stordal 1971).

Ecology. According to Tuomikoski (1959), a typical habitat of the species is mesic spruce forest of *Oxalis-Myrtillus* type. It also grows in dry pine forests, e.g. in the archipelago of Turku: in Korppoo, Rymättylä and Parainen; in Turku, Uusikaupunki, Paimio and Yläne. In Korppoo and Parainen it occurred together with *Suillus granulatus;* Eklund (1943b) has also found these two species together. *B. badius* has been collected in pure oak forests, too, in Turku: Muhkuri and Ruissalo. In Ruissalo *Alnus glutinosa* once was the only tree in the vicinity of the fungus. In H there is a specimen from Helsinki, Oulunkylä (coll. 1972 Aalto), which was growing close to *Acer platanoides.* In Central Europe *B. badius* occurs mostly in coniferous forests (Kallenbach, Haas 1933 and 1971, Stordahl 1953, Pilát 1954, Neuhoff 1956, Bresinsky & Zeitlmayr 1960, Skirgiello 1960, Singer, Watling 1968 and 1970, Kalamees & Lasting) and has been found together with almost all the native coniferous tree species. Oak (Kallenbach, Nathorst-Windahl 1956, Neuhoff 1956) and beech (Schmitt 1970) have also been mentioned. In cultures, Bille Hansen (1962) has observed mycorrhiza formation only with *Pinus sylvestris.*

It is possible that the species is saprobic or a facultative mycorrhizal fungus (Kallenbach, Benedix 1963, Watling 1963 and 1968). Singer believes that it is only rarely able to form mycorrhizae with broad-leaved trees. The fruit body formation without symbiosis in culture conditions (Pantidou 1964) suggests saprobic nutrition (cf. also Böhme 1953), as does also the fact that it 'may continue to fruit long after conifers have disappeared from the area' (Watling: 17).

The northernmost localities, in Kuopio and Vaasa, appear to have rich litter (as in *Oxalis-Myrtillus* type forests) and rather good soil conditions. In other localities, human influence has probably caused enrichment of the soil. According to Singer, *B. badius* occurs on calcareous soil, but perhaps more often on soil poor in limestone; according to Kallenbach, it seems indifferent to soil pH in Central Europe. Schmitt (1970) regards the species as basophilous, but in the study area of Haas (1971) it is acidophilous (cf. Heinemann 1975). Some degree of basophily is perhaps often typical in Finland.

However, the reasons for the northern limit of the species in Finland may be supposed to be mainly climatic. The accumulated temperature is ca. 1100—1200 dd in this area. The temperature may affect the fungus directly or via litter formation or via the mycorrhizal partner. Fruit body formation may be correlated with the amount of assimilates in the tree, which is dependent on the thermal conditions. The disappearance of the species or poor fruit body formation caused by parasitic fungi in spruces (Haas 1971) may also be due to lowered production of assimilates in the host.

Boletus calopus Fr.

(*B. pachypus* Fr.)

In Turku, Piispanristi, Karsten (1876) found a species which he named *B. pachypus*. He explicitly mentioned the network on the red and yellow stem. As other characteristics also differentiated it from related species, misidentification can practically be ruled out, although no collection can be found.

The species belongs to a group with a clearly reticulated bright red and yellow stem. The reticulation is almost white and the red colour in the stem is more conspicuous than that of the somewhat similar *B. fechtneri* (cf. Kallenbach: Tables 43 and 49). The hymenophore is yellow and the cap pale yellowish gray or almost umber.

Distribution in Finland. Ahvenanmaa, Lemland: Apalholm, on meadow close to oaks, 16.VIII.1977 Tuomikoski & Korhonen (H); Varsinais-Suomi, Turku: Karsten (1876).

Total distribution. From W Europe to the Far East (Singer). In Sweden, the country of the type locality (in Femsjö), the species is not uncommon in the south; also several specimens (S) from the Stockholm area. Fairly common in the beech forest area (Nannfeldt 1952). In Norway around Oslo, and in the west up to north of Bergen, some 15 localities altogether (Stordal 1955: Fig. 3). In Denmark rare, but occurring throughout the country (Knudsen). In Estonia two localities known: close to Tartu and in Tallinn (Kalamees & Lasting).

Ecology. Oak is mentioned in the habitats in some papers (e.g. Watling, where beech is also mentioned, Stordal 1955, Vasil'eva 1973). Apparently, however, coniferous forests and sandy, acid soil are not excluded. Nathorst-Windahl (1956) mentions coniferous forests, but also broad-leaved and mixed forests in S Sweden. In Estonia it grows in both coniferous and broad-leaved forests (Kalamees & Lasting). Schmitt (1970) reports that it grows on acid soil in both coniferous and broad-leaved forests. According to Singer, it favours *Abies, Picea, Pinus* and *Fagus*. Pearson (1950) mentions beech and conifers as its companions. Hence the habitat in Turku, Piispanristi, may be a typical one, although Karsten does not give any details about it ('In silva Pispanristi prope Åbo').

Boletus chrysenteron Bull. ex St-Amans

(*Xerocomus chrysenteron* (Bull. ex St-Amans) Quél.)

Known by its olive or reddish brown cap, which is minutely tomentose and cracks with age, showing reddish flesh under the cuticle. However, there may be great variation in the same clone. In Pilát (1969, Fig. 7) very little red is seen in the cap. Cap size mostly below 8 cm. Pores lemon-yellow, turning greenish when old, rather large and angular. Flesh cream in cap except beneath cuticle, in stem reddish buff. Stem mostly shorter than diameter of cap, slender, lemon-yellow at apex, turning red downwards, ornamented with red flocks, particularly in lower part of stem. Distinguished from *B. subtomentosus* (*B. lanatus*) by red colour in stem and usually (but not always) by reddish nuance under cuticle.

Distribution in Finland (Fig. 3). Karsten (1859) mentions the species from Turku. The other localities include Viipuri (Thesleff 1919), Porvoo (Nyberg 1935), Korppoo and Houtskari (Eklund 1943b), Lemland in Ahvenanmaa (Stenlid 1947), Parainen, Tammisaari and Karkkila (von Schulmann 1960). Kallio (1963) lists several localities (cf. also Kallio & Kankainen 1967), all in the oak zone of SW Finland. The species is mainly restricted to this zone. Von Schulmann (1957) reported it from Lapinlahti in E Finland, but as no specimens have been preserved, this find is not marked in our map.

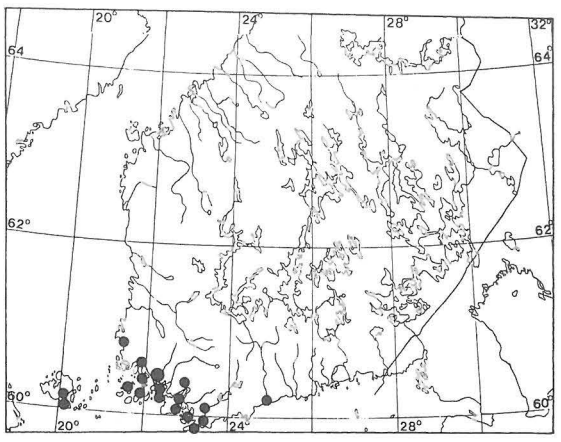

Fig. 3. Distribution of *B. chrysenteron*.

List of herbarium specimens:
Ahvenanmaa. Jomala, 1964 PK (TUR). Lemland, 1971 Haeggström (H). — *Varsinais-Suomi.* Bromarv, 1975 Tuomikoski (H); 1975 Korhonen (H). Halikko, 1968 Nyman (TUR). Kemiö, 1965 PK (TUR). Korppoo, 1966 PK (TUR). Mietoinen, 1969 Ohenoja (OULU). Nauvo, 1972 Ravanko & HH (TUR). Parainen, 1965 PK (TUR); 1965 Hietavuo, 3 locs. (TUR). Pohja, 1960 Såltin (H, OULU). Rymättylä, 1961 PK (TUR). Turku, 1952 PK, 3 locs. (H, TUR); 1955, 1956, 1960, 2 locs., 1961 and 1972 PK (TUR); 1961 Pato (OULU, TUR). Uusikaupunki, 1960 Laine (TUR). Västanfjärd, 1961 Malmström (H). — *Uusimaa.* Helsinki, 1948 Tuomikoski (H). Tammisaari, 1960 von Schulmann (H). Tammisaari rural district, 1937 Frey (H); 1955 Laine (H); 1966 H. & I. Luther (H); 1971 Väisälä & Niemelä (H).
Total distribution. In Europe apparently up to the northern boreal zone. Apparently circumpolar in the temperate zone, but secondarily also more widely distributed (Singer). Very common throughout the British Isles (Watling) and in Denmark (Knudsen). Apparently common in S Sweden (Ingelström 1940, Nathorst-Windahl 1956). In Norway scattered in coastal areas north to Ålesund (cf. Stordahl 1971). In N and W Estonia (Kalamees & Lasting). Found in some places round Leningrad (B.P. Vassilkov, oral comm.).

Ecology. In Finland mostly in oak forests. Common in all well-investigated oak stands in SW Finland. Also in many places without oaks in the oak zone, e.g. in hazel copses (Korppoo, Karheri). Thesleff (1919) mentions moist alder forest. In Sweden (S) specimens from Småland found under spruce. Spruce is also mentioned from Norway (Stordal 1953), and from the east shore of the Baltic Sea (Urbonas et al. 1974). Coniferous forests are known as habitats in Central Europe (Haas 1933 and 1971, Pilát 1954, Singer) and the Far East (Vasil'eva 1973), but oak is also mentioned in most descriptions. Watling (1974) does not include the species among the 'oak boletes'. In Finland it should be sought for in the many hazel localities N of the oak zone, to study the roles of the host and climate. According to Neuhoff (1956), *B. chrysenteron* belongs to a group of species preferring basic or only slightly acid soil. This was the case in the habitats of our finds. On the other hand, Haas (1971) regards the species as acidophilous; in his study area it occurs in soil with a pH between 3.3 and 3.7 Schmitt (1970) also emphasizes the acidity of the soil. It seems that the ecological range in Finland is narrower and the species requires soil with a higher pH.

Boletus edulis Bull. ex Fr.

B. edulis forms a polymorphic group which has caused taxonomic difficulties. *B. aereus* Bull. ex Fr. is unlikely to be found in Finland, since it has its northernmost known localities in Gotland, and is a strictly calcicolous fungus (Singer). *B. edulis* ssp. *reticulatus* and ssp. *pinicola* are here considered to be subspecies, and all the other taxa (in Vassilkov 1966) are classified as forms. Owing to their greater morphological and ecological (f. *arcticus*) differences, f. *citrinus,* f. *aurantioruber* and f. *arcticus* may deserve higher taxonomic rank (variety or subspecies), but our material is too scanty to decide this matter.

B. edulis ssp. **edulis** (cf. Singer 1967: 25)

'Cap date-brown to bay, chestnut or dark brick-colour with a whitish hoariness at first especially at the margin which is gradually lost on expanding although a white line usually remains at the margin, smooth to rugulose throughout, dry at first but soon greasy and in wet weather slightly viscid, polished'. This description by Watling suits the Finnish material well, although the white colour (Watling: 21; cf. also Singer 1967: 24) is not so clear in our material. The largest cap was measured in the Kevojoki valley in Utsjoki, Lapland, the diameter being 31 cm. The stem varies from cylindrical to clavate and is rarely correlated with the colours of the cap, i.e. the different forms have variable stem shapes. The flesh is white and does not change colour when cut.

Distribution in Finland. One of the most common species in Finland (Tuomikoski 1955a) from the south to Lapland (cf. Kallio & Kankainen 1964 and 1966).

Total distribution. A holarctic species, all over Europe (Singer).

Variability. Vassilkov (1966) has presented a large number of forms separated on the widely varying colours. We have tried to group our material according to his descriptions.

A dark form, 'pileo fuscescente, interdum cinerascenti-fuscescente, saepe cum maculis pallidioribus' (Vassilkov 1966: 12), has been found several times in Turku, Ruissalo. It grows in oak forests and is apparently *B. edulis* f. *quercicola* Vassilk. The lightest-coloured, mostly light brown form occurring in birch forests we have regarded as f. *betulicola* Vassilk. This form is not, however, common in the birch forests around Kevo, Lapland, where *B. edulis* is rare, and apparently represented by two forms: f. *betulicola* and f. *piceicola.* The rest of the *B. edulis* forms common in Finland belong either to f. *piceicola* ('euedulis') or to f. *laevipes* (Mass.) Vassilk., whose stem is always (?) cylindrical and lacks a net. Three other forms remain: f. *arcticus* Vassilk., f. *aurantioruber* (Dick & Snell) Vassilk. and f. *citrinus* (Pelt.) Vassilk.

B. edulis f. *arcticus* Vassilk. is a small (cap diam. up to 7 cm in our material), hard form, with a light ochraceous, whitish-margined cap. It has been found in Utsjoki (Inarin Lappi) on three fjelds: Erdigvaara, reg.alp. 28.VIII. 1960 PK (TUR); Jesnalvaara 25.VIII. 1974 PK (TUR); Ailigas 1974 PK (TUR). — Vassilkov (1966) has described f. *arcticus* from the Khibiny mountains, Kola Peninsula. The habitat is alpine tundra in both Khibiny and Finnish Lap-

land. Dependence on *Betula nana* is obvious in both areas. Reports of *B. edulis* growing in Alaskan tundra with *Vaccinium, Ledum* and *Carex* without any mention of birch (Kobayasi et al. 1967) may relate to f. *arcticus.*

B. edulis f. *aurantioruber* (Dick & Snell) Vassilk. The collections from Utsjoki, Lapland, in TUR contain a specimen which belongs to this form, agreeing well with the description of Dick & Snell (1965): cap surface 'a very dark brown-red, dark ferrugineous-red or deep reddish-orange when young, later orange-reddish - - -, often blotched with pale yellowish-tan and more yellowish toward the margin'. There is also some pink or red colour in the stem. Our specimen corresponds to this description much better than to the colours in Plate 32 in Snell & Dick (1970), where the colour is light and bright and does not accord with the description. Colour slides kindly sent us by E. and W. Snell agree completely with ours. This form has apparently not been reported in Europe before (cf. Vassilkov 1966 and the footnote in Singer 1967: 28). In America it is found under 'all the northern conifers' (Snell & Dick 1970). Our specimen was collected in the northernmost pine forest area in Finland, on the west slope of Kenespahta ridge on a sandy trail 1974 PK (TUR). The trees possibly associated with it were *Pinus sylvestris, Betula pubescens* and *Populus tremula.*

B. edulis f. *citrinus* (Pelt.) Vassilk. There are two collections in OULU, whose colour corresponds exactly to the description of Vassilkov (1966): ochraceous lemon-yellow, later bright yellow ('yarko zholtaya'). The specimens are the only ones known from Finland: Pohjois-Pohjanmaa, Haukipudas: Korvenkylä, Kalimenoja 13.IX. 1969 Ohenoja (also in KUO); 28.IX. 1969 Ulvinen. Mixed forest (according to the labels and oral comm., birch and spruce). The form is apparently rare throughout Europe, but common in North America, and has perhaps been introduced to Europe (Singer). It has probably been found in Denmark (Möller 1956), but there it is reported to grow together with beech, while it is usually found in coniferous forests, particularly with American *Picea, Abies* and *Pinus* species. In the USSR the species is known from a few areas in the European part, from spruce-pine forests. The locality in Finland corresponds to the main habitat of the form.

Mention should also be made of the sterile form of the species: *B. edulis* 'f. sterilis'. In 1973 a very tall mushroom resembling *B. edulis,* with a bright yellow pore layer, was found in Turku, Ruissalo oak forest. Dr. Watling, who happened to be in Turku at that time, identified it as 'f. sterilis' (cf. Watling: 21). It seemed to be sterile. This form has probably been found in Ruissalo earlier, but not collected for herbarium.

B. edulis ssp. **pinicola** (Vitt.) Sing.

(*B. pinicola* (Vitt.) Venturi, *B. pinophilus* Pilát & Dermek)

Cap up to 15 cm (smaller than in the other main taxa of the group), purplish or vinaceous red brown. Mostly very clearly rugulose, as young somewhat tomentose, very hard. Stem up to 12 cm high and 50 mm thick, at the base always somewhat reddish and clearly reticulate. Tubes and pores as in ssp. *edulis,* whitish — greenish yellow, not changing colour. Flesh almost white, except close to cap surface and in outernmost stem layer, where it shows a tint of the reddish cap colour (more or less vinaceous).

Distribution in Finland. Common all over the country. Collected even in the northernmost pine zone in Lapland, up to the solitary pines in Utsjoki, close to 70°N.

Total distribution. Common throughout the coniferous zone of Eurasia and also occurring in N Africa (Singer, Vassilkov 1966). Also introduced in pine plantations (Watling). Evidently rare in Denmark (Knudsen), but common in Estonia (Kalamees & Lasting), in SE Norway (Stordal 1971) and evidently also in Sweden. Also on Kola peninsula up to the pine forest limit (Mikhailovsky 1975).

Ecology. In Finland there are no proper studies on the host species of ssp. *pinicola.* It probably grows mostly under pine, favouring dry ecosystems and old pine forests. However, there appear to be other closely related taxa, e.g. the less reddish coloured var. *fuscoruber* Forqu. (Singer), which may confuse the general picture of its ecology, and ssp. *edulis* is also able to grow under pine. In Central Europe ssp. *pinicola* is found with different species of *Pinus, Picea abies* and *Abies alba* (Singer), and also under *Fagus* (Schmitt 1970). The distribution of the taxon is apparently determined more by the mycorrhizal partner than by the soil characteristics. In the archipelago of Turku it has been found in calcareous soil, together with some typically basophilous fungi, particularly *Suillus granulatus* and *Boletus luridus,* in habitats where the common pine mycorrhizal fungi are rare (e.g. *Suillus luteus* and *S. bovinus*). On the other hand, the most typical habitats in Finland appear to have acid soil, so that the species seems to be indifferent to soil pH.

B. edulis ssp. **reticulatus** (Schaeff. ex Boud.) Konr. & Maubl.

(*B. reticulatus* Schaeff. ex Boud.)

This subspecies is both morphologically and ecologically rather clearly separable from the other infraspecific taxa of *B. edulis,* often being considered a separate species.

In our material the cap is smaller than the average for *B. edulis,* the diameter being mostly below 15 cm. In Bromarv, Framnäs, however, much larger specimens have been found (M. Korhonen, oral comm.). Colour of cap very light grayish yellow — light cinnamon — fulvous. Slightly tomentose when young — more so than other taxa in the *B. edulis* group. Cap surface mostly without the rugosity typical of, e.g., ssp. *pinicola* and some other forms, but cracking somewhat with age.

Stem concolorous with the cap but paler, covered with clear network, often down to the base. Tubes and pores at first white but later greenish yellow. Flesh in our specimens white, turning yellowish or slightly brownish, as in the description by Singer. Watling's description: 'consistently vinaceous throughout' does not fit the Finnish form. The colour in Pilát (1969, Fig. 3 in Table 2) is yellower than in our fungus.

There is one specimen in H (Ahvenanmaa, Lemland: Nåtö, 13.VIII.1972 Haeggström) which differs clearly from the type described above, but may be closely related, and is perhaps the taxon mentioned by Watling (1970: 15; cf. also p.20) as close to *B. reticulatus, B. aestivalis* s. stricto with 'Cap pale straw-colour or buff with flush of ochreous; stem coloured as the cap ...'. In the description of Haeggström's specimen when fresh, the cap is 'mustard yellow' and tomentose, the stem yellow-brown with a brown net. The tubes yellow with reddish yellow pores. The flesh turning light reddish with very slight blue nuances. Altogether, it is very different from all the other ssp. *reticulatus* specimens.

Distribution in Finland. Found in some places in the SW corner of Finland, so far only in the oak zone. In Turku common and abundant in some years in the oak forests of Ruissalo and Katariinanlaakso. No localities are known in the eastern part of the Finnish oak zone (Fig. 4).

List of herbarium specimens:
Ahvenanmaa. Lemland, 1972 Haeggström (*'B. aestivalis'*, cf. above; H). — *Varsinais-Suomi.* Bromarv, 1976 Tuomikoski & Korhonen (H). Lohja, 1977 Harmaja (H). Parainen, 1966 Hietavuo (TUR). Rymättylä, 1960 PK (TUR); 1975 Tuomikoski (H). Turku, 1960, 3 locs., 1962 and 1977, 3 locs. PK (TUR); 1972 Raudaskoski (TUR).

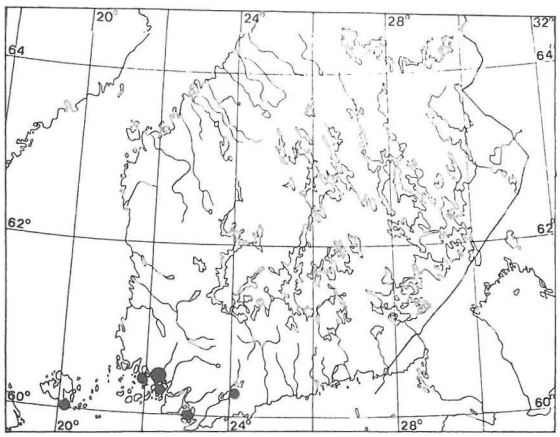

Fig. 4. Distribution of *B. edulis* ssp. *reticulatus*.

Total distribution. Apparently common and abundant in Central and Western Europe (Singer, Leclair & Essette 1969, Watling) up to Fennoscandia, although the general picture is confused by taxonomical problems. Not known in the Leningrad area (B.P. Vassilkov, oral comm.). In Estonia a few samples from N and W, the islands included (Kalamees & Lasting). In Denmark a few finds, probably rare (Knudsen). In Norway evidently two finds from the S coast (G. Gulden, in litt.). In Sweden apparently in many places in the oak zone (according to specimens in S) at least up to Värmland (Jacobsson 1976). In the oak zone in Finland occurrence apparently the same as in Sweden: 'rather rare' (Nathorst-Windahl 1956).

Ecology. In Finland ssp. *reticulatus* has so far been found only in oak forests. Oak is normally considered the host plant. Singer also mentions *Fagus* and *Betula,* and, according to Pilát & Dermek (1974), it is occasionally found in coniferous forests. The study of the ecology is hampered by the very confused nomenclature (cf. Singer 1967). Watling gives beech as a second tree and Vassilkov (1966) mentions *Quercus-Carpinus* forests.

Typical habitats are fairly open dry meadows beside forests. Rarer among the more luxuriant vegetation in oak forests (cf. Kallio 1963). In the exsiccate of Lundell & Nannfeldt (no. 2601) the habitat is described as 'dry sunny grass-grown woods with oak, spruce and *Juniperus communis*', which exactly corresponds to the typical habitat of ssp. *reticulatus* in Finland. According to Pilát (1954), mostly in glades and at the edge of woods.

In Central Europe this fungus is apparently not very exacting as regards the soil; a typical habitat is oak-birch forest on acid soil (Neuhoff 1956). In Finland, however, the soil of the best oak forests and the land at their margins is mostly less acid. The best bolete habitats in Turku also have *B. luridus, B. erythropus* and *B. edulis* ssp. *reticulatus.* Bresinsky & Zeitlmayr (1960) mention these three species from 'Lohwälder' in Bavaria. Vassilkov (1966) writes that calcareous soils are typical of the habitat of ssp. *reticulatus.*

In Central Europe (Pilát 1954) and Estonia (Kalamees & Lasting) the species is considered to be a summer mushroom, appearing in May-July, in Estonia in June. In Finland, however, all the collections are from August-September (cf. also Vassilkov 1966).

Boletus erythropus (Fr.) Krombh.

(*B. miniatoporus* Secr.)

Cap umber or snuff-brown, darker than in *B. queletii,* at margin often lighter and with yellowish tint; clearly and densely tomentose when young, dark blue on bruising, below 12 cm in diam. in Finnish

material. Stem yellow at apex and more or less (orange) red towards base, covered with rather dark tomentum so that the stem may be very dark, especially when young, much darker than the figures in Kallenbach's Table 30. Tubes depressed around the stem, yellow, bluish green cut, pores orange red, on bruising instantly blue. In the Finnish material, the two closely related species *B. erythropus* and *B. queletii* appear to have fairly similar amyloid reaction (cf. Singer 1967: 60, 62).

Distribution in Finland (Fig. 5). Almost all the finds are from the oak zone, especially from SW Finland. Inland, there is an isolated locality in Tampere.

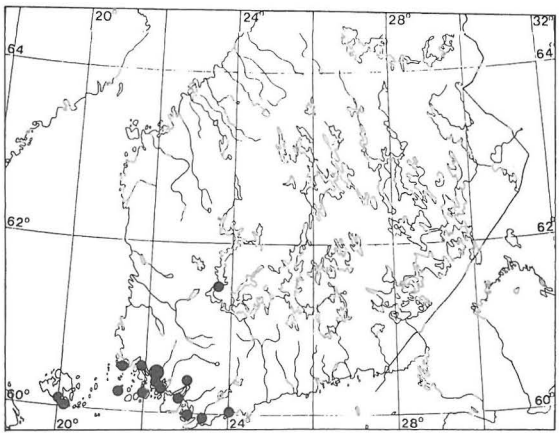

Fig. 5. Distribution of *B. erythropus*.

List of herbarium specimens:
Ahvenanmaa. Lemland, 1972 Haeggström (H). Maarianhamina, 1958 von Schulmann (H). — *Varsinais-Suomi.* Askainen, ca. 1965 von Haartman (H). Bromarv, 1957 and 1966 Tuomiskoski (H). Halikko, 1971 Nyman (TUR). Houtskari, 1942 Eklund (H). Kustavi, 1972 Kalske (TUR). Nauvo, 1969 Vaarama (TUR); 1971 PK (TUR). Parainen, 1972 Alho (TUR); 1972 Fritzén (TUR); 1972 Ravanko (TUR). Turku, 1960 PK (H, TUR); 1961, 1971 and 1974 PK (TUR); 1961 Pato (TUR); 1966 Karunen (TUR); 1967 Mäkinen (TUR). — *Uusimaa.* Inkoo, 1960 A.-M. & M. Langenskiöld (H). Tammisaari rural district, 1960 von Schulmann (H). — *Etelä-Häme.* Tampere, 1965 Rantala (TUR).

There are some additional records of the species in the literature. Eklund (1943b) records it from Korppoo, Strömma, and Luther & Luther (1965) from Tammisaari, Tvärminne. Cf. further Tuomikoski (1959), von Schulmann (1960 and 1963), Kallio (1963) and Kallio & Kankainen (1967). Cf. also information about Karsten's find labelled *Tubiporus luridus* from Merimasku, Kaita (Karsten 1876, 1882 and 1889) and the comments in Kallenbach, Malmström (1943a) and Luther & Luther (1965).

Total distribution. Europe, Asia Minor, Africa, North America; in Central Europe very common (Singer, Kallenbach), and common throughout Great Britain (Watling). In Fennoscandia southern; in the oak zone in S Sweden fairly common (Andersson 1943, Nathorst-Windahl 1956), but not reaching 'limes norrlandicus' (cf. Kallio 1963). In S Norway not uncommon, the distribution area reaching along the west coast up to Stjørdal, N of Oslo (Stordal 1955). In Denmark common throughout the country (Knudsen). Not mentioned by Kalamees and Lasting (cf. also Urbonas et al. 1974). In the Leningrad area, one known locality in Oranienbaum, under oaks (B.P. Vassilkov, oral comm.).

Ecology. Oak was already mentioned in the first habitat description in Finland (Eklund 1943b). The localities of Framnäs (in Bromarv), Ruissalo and Katariinanlaakso (in Turku) are among the most typical oak woods in Finland, and oak is also mentioned on the labels of specimens collected in Askainen, Kakskerta (Turku) and Parainen. The species has, however, been found to be independent of oak. Luther & Luther (1965) report that there were no oaks close to their find in Tvärminne. Other localities without oak are those in Kustavi and Tampere. In the latter, *Betula* has been mentioned as the possible host. The connection with oak has been mentioned in Scandinavia, too (Andersson 1943, Nathorst-Windahl 1956), and in more southern areas (Neuhoff 1956, Lobanow 1960, Vassilkov 1955). In Central Europe, however, the species is not so often associated with oak as in N Europe. The trees most frequently mentioned are *Fagus, Picea* and *Abies* (Kallenbach, Singer, Pilát & Dermek 1974). In England, in mixed and broad-leaved woods, especially under *Fagus* and *Quercus* (Watling, Pearson 1950).

In Finland the habitat is the same as for *B. luridus, B. chrysenteron* and *B. edulis* ssp. *reticulatus.* All of these are mostly found in open, microclimatically warm habitats; most typical are grassy patches around old oaks at the margin of fields, with less acid soil than is general in Finnish coniferous forests. The species is more calciphilous here than in Central Europe, where it is acidophilous (Kallenbach) or does not appear to require calcareous soil (Watling 1963, Singer).

Boletus hemichrysus Berk. & Curt.

(*B. sulphureus* Fr.)

The species was recorded from Finland by Kallio (1963, 1976). The identification, based mainly on Pearson's (1950) description, was made by N. Malmström. Now, after a thorough re-examination of the specimen in H, we can confirm this determi-

nation. The main colours accord well with the description by Watling and the ground colour agrees with that given by Singer, but there is more reddish-rust, especially in the centre of the cap. The colours are as in Kallenbach's Table 25: 17 (which is the same as Table I, Fig. 19 in Singer). The description by Pearson (1950): 'pale sulphur or golden, silky tomentose; often with reddish patches' fits our specimen perfectly. The hymenophore is not pure yellow, as in the description of Singer, but greenish yellow, as in the descriptions of Watling and Pearson.

The stem colour is 'pale lemon-yellow, ... becoming spotted rust' (Watling) and the stem surface smooth to fibrillous (Singer). Our specimen is a densely caespitose group of seven fruit bodies, and the single stems are much more slender than those illustrated in Kallenbach or in the descriptions of Singer and Watling, who give the sizes 10 × 3.5 and 4—15 × 1—5 cm, respectively. All stems in our specimen are slender — the biggest ones 10—12 × 1.5 cm. The caespitose feature is apparently typical of the species, being seen in Kallenbach's table and even more clearly in Watling's Fig. 22, and being specifically mentioned by Watling and Pearson (1950).

The spores are somewhat bigger than in Watling's description (6—8.5 × 3—3.5 μm), but stay within the range given by Singer (5.5—11.0 × 2.7—4.8 μm).

Distribution in Finland. The only specimen found so far is from Varsinais-Suomi, Turku: Ruissalo, 17.IX. 1955 PK (in H).

Total distribution. The wide distribution area, stretching from N America to Europe and the Far East, includes many of the European countries and, according to Singer, extends to Denmark, although Knudsen does not mention it. Found twice in Poland (Skirgiello 1960). Not recorded from Norway (G. Gulden, in litt.). From Sweden reported by Fries (1849), and according to S. Lundell (oral comm.), it has also been found later in Uppsala, the area where the first find was made.

Ecology. The habitat in Ruissalo is not typical of the species. In all descriptions pine or other conifers and/or coniferous sawdust are mentioned in the habitat of the species. The Finnish habitat was a broad-leaved forest dominated by oak. There were, however, both *Pinus cembra* and *Abies balsamea* (introduced) close to the place and also a heap of twig litter.

Boletus impolitus Fr.

(*Xerocomus impolitus* (Fr.) Quél.)

The Finnish specimens with light ochraceous yellow — tawny cap, the younger fruit body somewhat lighter; the older specimen with somewhat rugose surface, as described by Singer, and minutely but evenly tomentose; the larger cap 11 cm in diam. Stem 7 cm long and ca. 3 cm thick, almost concolorous with cap, without reticulation. Flesh light, white-yellow. Hymenial layer light brown. The surface layer of the cap seems to have been loose, because fairly big light yellowish areas have been caused by cutting the fresh material. The specimens in S are very similar in colour, though more robust than our material. The surface structure is the same, as is also the structure and the colour of the pore layer.

Distribution in Finland. TUR contains two fruit bodies from Varsinais-Suomi, Parainen: Lofsdal, Lenholm, 4.IX. 1972 Alava & Alho. The specimens are well preserved and have all the characters diagnostic of *B. impolitus*.

Total distribution. In Europe and N Africa widely distributed (Kallenbach) in the area of oak (Singer). In Britain southern (Watling). In Denmark rare, but more common in the southern part of the country (Knudsen). In Norway found twice (Blytt 1905, Egeland 1911). In Sweden (according to specimens in S) found in many places in Uppland, Gotland, Östergötland and, according to N. Suber (oral comm.), in Gestrikeland. In Estonia found only once (Kalamees & Lasting). Not known in the Leningrad area (B.P. Vassilkov, oral comm.).

Ecology. Oak is the tree typically mentioned with *B. impolitus* (Kallenbach, Singer, Watling, Knudsen), and growing in the Finnish habitat. The meadow in Lenholm faces south and is bordered by oaks. It is the habitat of several southern fungi (cf. p. 3); the vegetation has features indicative of calcareous soil. Watling and Kallenbach mention clayey soil. Calcareous soil has not been considered important in Central Europe, but was noted in Denmark (Knudsen). In Sweden typical habitats are meadow patches around oaks (N. Suber, oral comm., and many specimen labels in S).

Boletus lignicola Kallenb.

(*Pulveroboletus lignicola* (Kallenb.) Pilát)

The only Finnish sample is in rather good condition and is accompanied by a description of the fresh material: 'one ex. only, 5.5 cm, slightly tomentose, at first yellow, the turning green-bluish. A red flush is also seen in the cap. Tubes decurrent, drab orange ('schmutzig orange'). Stem slender, 10 mm thick,

olivaceous yellow. Spores 6.1—7.8 × 2.5—3.4 μm.' This description does not agree in all details with those given by Kallenbach, Singer and Watling. In the dry material, however, the subtomentose cap cuticle is still yellow and the stem now agrees well with the description of Watling: 'dark rusty tawny at the apex ..., minutely granular'. The somewhat decurrent tubes are seen in Kallenbach's Table 25: 15 and mentioned by Kallenbach and Singer.

Distribution in Finland. One specimen in H, collected by von Schulmann in Uusimaa, Inkoo: Fagervik 6.VIII. 1963.

Total distribution. The species is rare in Europe, but it is known from Germany, Czechoslovakia, and perhaps France (Singer). Found in two localities in Denmark (Knudsen). We have seen no records from Estonia, Norway or Sweden.

Ecology. The Finnish specimen was probably attached to the root of an old dead pine tree. Association with pine is mentioned in several descriptions of its habitat (Singer, Watling, Knudsen). It is also known to grow together with *Larix* (Kallenbach, Jansen 1946).

Boletus luridus Schaeff. ex Fr.

This species of the *luridus* group is easily recognized by its rather robust and swollen, strongly reticulate stem, in which the meshes of the net are narrow and acute-angled. The stem colour is more or less yellow and orange-flushed when young, but dark rusty-red when old. In many Finnish specimens it is much darker than in Kallenbach's Tables 15 and 16. The stem surface is rather firm and can still be identified when the cap is totally decayed (in material from Korppoo and Rymättylä 1974; cf. also Malmström 1943a). Although very variable in colour, *B. luridus* can hardly be confused with other Finnish species, but when it is very young, the stem is sometimes difficult to identify in herbarium material. The cap size seems to be the same in Finnish material as in the Central European fungi (Singer: up to 19 (—30) cm in diameter), the largest diameters being over 20 cm in Korppoo, Åvensor.

Distribution in Finland (Fig. 6). Excluding Katariinanlaakso in Turku, all the known localities are in the SW archipelago. Apparently not rare on the Ahvenanmaa mainland (von Schulmann 1955), where the first definite find in Finland was made (Malmström 1943a: Maarianhamina, Ramsholm). Also reported from Ahvenanmaa by Eklund (1943b: Lemland, Mellanvik) and Stenlid (1947: Lemland, Apalholmen, also seen in Nåtö). Eklund (1943b) found it in Nauvo, Wecklax Näs, too, and Kallio (1963) has reported it from Turku, Katariinanlaakso. Karsten (1867) reported it from Merimasku, Kaita, near by Naantali (cf., however, p. 9).

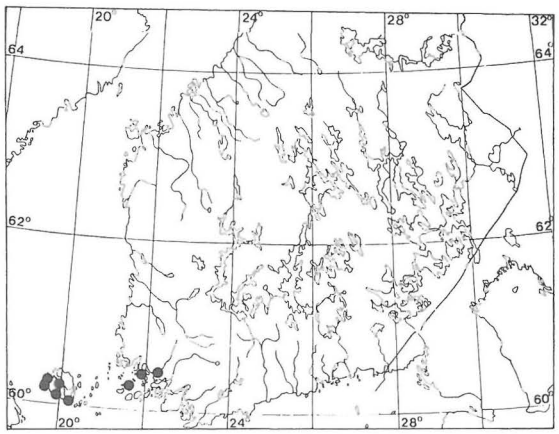

Fig. 6. Distribution of *B. luridus*.

List of herbarium specimens:
Ahvenanmaa. Eckerö, 1948 von Schulmann (H); 1963 Siltanen et al. (TUR). Finström, 1953 Cedercreutz (H). Jomala, 1958 von Schulmann (H). Lemland, 1938 Häyrén (H); 1963 Kankainen et al. (OULU, TUR). — *Varsinais-Suomi.* Korppoo, 1974 PK (TUR, KUO). Rymättylä 1974 PK (TUR). Turku, 1960 PK (TUR).

Total distribution. From Europe and N Africa to the Far East and to N America (Kallenbach, Singer). Apparently common in the Central European lowlands (Pilát 1954) and in Britain (Watling). Evidently fairly common in the oak area in S Sweden (Ingelström 1940, Andersson 1943), where many more finds are known than in Finland. Nannfeldt (1952) records it as scattered. Not extending up to Uppsala (Lundell 1932). In Norway rare, a few finds, mostly in the SE part (Stordal 1955 and 1971); northernmost find in Vikna in Nord-Trøndelag (Gulden & Schumacher 1977). In Denmark common in most parts of the country, except W Jutland (Knudsen). In N and W Estonia not uncommon (Kalamees & Lasting). In the Leningrad area known from Oranienbaum, under oaks (B.P. Vassilkov, oral comm.).

Ecology. Although the most common associated tree in the literature is oak (Kallenbach, Pilát 1954, Vassilkov 1955, Lobanow 1960, Skirgiello 1960, Singer, Einhellinger 1969, Watling 1970 and 1974, Pilát & Dermek 1974), it is by no means the only tree, and other broad-leaved trees have generally been reported together with oak. Schmitt (1970) mentions only *Fagus, Carpinus* and *Picea.* According to Stodal (1971), in Norway the species occurs in broad-leaved an mixed coniferous forests. *Tilia,* under which the fungus was growing in Katariinanlaakso, is sometimes mentioned as the host. In

Finland, not generally associated with oak, although the localities are in the oak zone. Oak is not mentioned on the labels of Finnish herbarium material, or in the literature (cf., however, Karsten's (1876) record from Merimasku, Kaita 'in querceto'). In Åvensor it grew close to *Betula* and *Juniperus communis,* in Pähkinäinen (Rymättylä) close to *Corylus avellana.* Apparently a mycorrhizal fungus, but not specialized (cf. also Bresinsky 1969). Possibly only a facultative mycorrhizal fungus (cf. Einhellinger 1969).

The distribution in Finland indicates that it requires a temperate climate. The only mainland habitat is a south-facing, rather open slope with a rich southern flora element (Nikoskelainen 1955). The other localities are also open, with high insolation and apparently high soil temperature.

The Finnish distribution also indicates that it requires calcareous soil. Ahvenanmaa is the area of Silurian deposits, the locality in Åvensor, Korppoo, is close to an old limestone quarry, and Eklund (1943b) mentions calcareous soil in connection with the find in Nauvo. Calciphilous plants occur in the locality in Rymättylä. The species may apparently be expected in several places where calcareous soils are common, e.g. Parainen, Västanfjärd and Nauvo — Korppoo. Calcareous soil has often been mentioned in the literature, too (Kallenbach, Andersson 1943, Michael & Hennig 1960, Singer, Watling 1970 and 1974, Schmitt 1970, Stordal 1971).

Boletus piperatus Bull. ex Fr.

(*Suillus piperatus* (Bull. ex Fr.) O. Kuntze, *Chalciporus piperatus* (Bull. ex Fr.) Bataille)

This seems to be one of the species that is easy to delimit and has little variability. 'Characterised by the peppery taste, cinnamon cap and stem, rust coloured pores and lemon-chrome flesh in stem base' (Watling). A taxon identical or related to var. *amarellus* (Quél.) Sing. may occur in Finland, especially in Lapland. We have seen specimens in which the cap is more yellowish and light-coloured and the stem is short (2—3 cm). The taste was not investigated, because the possibility that this was var. *amarellus* had not been considered.

Distribution in Finland (Fig. 7). From southernmost Finland up to Lapland (and to the coast of the Arctic Ocean) evenly distributed but not always abundant.

Total distribution. The whole of Europe, particularly in the north (coniferous zone), in Siberia, East Asia and North America (Singer).

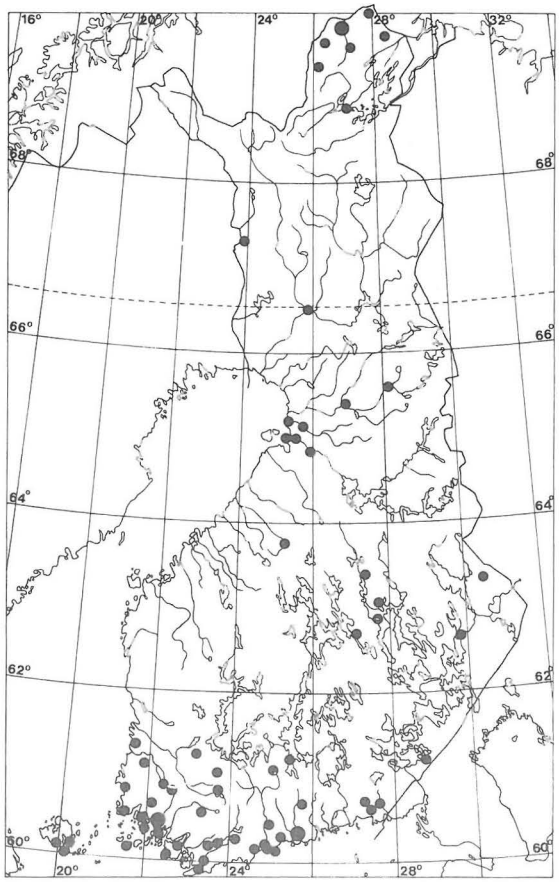

Fig. 7. Distribution of *B. piperatus.*

Ecology. Occurs both in luxuriant oak forests near Turku and in dry pine forests throughout the country up to the northernmost isolated pine forests in Utsjoki. In spruce forests and all kinds of coniferous, mixed and broad-leaved forests. In subarctic and subalpine birch forests. Also found above the birch forest line in low alpine heaths in Utsjoki (Kallio & Kankainen 1964), with different dwarf shrubs: *Empetrum hermaphroditum, Loiseleuria procumbens, Vaccinium vitis-idaea,* and apparently *Betula nana* (at a distance of 3 m). In Norway also observed above the timber line in *Salix* scrub, up to 1250 m (Stordal 1971). Apparently mycorrhizal with woody plants by very eurytopic.

In Great Britain 'especially in birch scrub or mixed birch and pine' (Watling), but also 'under exotic trees'. Singer lists many different trees: *Pinus, Picea, Abies, Tsuga, Pseudotsuga, Cedrus, Fagus sylvatica, Quercus, Carpinus, Betula, Populus.* Schmitt (1970) mentions spruce, pine and

Fagus. In the Far East in coniferous (also *Larix*) forests (Vasil'eva 1973). In Estonia in pine and mixed forests (Kalamees & Lasting). According to Singer, on both limestone and acid bedrock (cf. also Schmitt 1970 and Heinemann 1975). In Finland no correlation with the bedrock observed.

In Central Europe the season is very long, from May to November. In Finland specimens have been collected from the beginning of July until October.

Boletus porosporus (Imler) Watl.

(*Xerocomus porosporus* Imler)

Some of our specimens agree well with the description: 'Cap - - - dark olivaceous brown with paler margin, becoming more sepia to cigarbrown ...' (Watling), but a light brown colour (cf. Knudsen 1975) is also typical of the species. The surface of the cap is cracked and the light yellow — almost white — flesh seen underneath differentiates the species from *B. chrysenteron*. The cap size is the same or a little smaller than in *B. chrysenteron*. The stems of the two species are similar in form and size, but in our material of *B. porosporus* they mostly lack the red colour so typical of *B. chrysenteron*. The stem colour is the same in the Finnish and Danish material (Knudsen 1975), but in the material of Watling from England it can be 'with or without bay or brown-vinaceous to blood-red zone'. In Fig. 32 in Pilát & Dermek (1974) the red stem is almost similar to that of *B. chrysenteron* in Fig. 33. The pore layer is yellow with an olivaceous nuance, especially when older; and turns bluish on bruising. There are hardly any differences in the cystidia or other microscopical characteristics — except the spores — between the species and *B. chrysenteron*.

In our identification the spore characteristics, the pore or truncate form, in *B. porosporus* have been decisive. Like Knudsen (1975), we must point out that these characteristics are not seen in all the spores.

The problem whether there are two species with pores in the spores i.e. *B. truncatus* and *B. porosporus* (cf. Singer 1965 and 1967, Knudsen 1975) must remain unsolved for the present in Finland, because fresh material with the original colours is needed and we have mostly used herbarium specimens. We have, however, one rather slender specimen with red in the stem which has a shape different from the main type (corresponding closely with the description of *B. truncatus* in Singer).

Distribution in Finland (Fig. 8). The localities of the porosporous specimens are in SW Finland, in the oak zone.

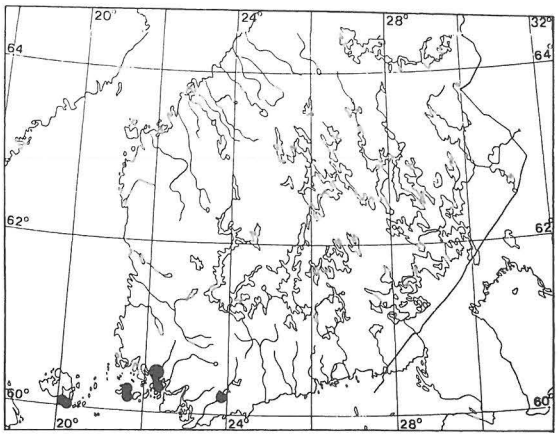

Fig. 8. Distribution of *B. porosporus*.

List of herbarium specimens:
Ahvenanmaa. Lemland, 1965 Toppari (H); 1972 Haeggström (H). — *Varsinais-Suomi*. Korppoo, 1941 Eklund (H); 1962 PK (TUR); 1974 PK (TUR, KUO). Lohja rural district, 1963 and 1965 Toppari (H). Parainen, 1965, 2 locs., Hietavuo (TUR). Rymättylä, 1961 PK (TUR). Turku, 1955, 1956, 2 locs., 1957, 2 locs., 1960, 2 locs., 1961, 2 locs. and 1971, 3 locs. PK (TUR); 1976 PK et al. (KUO); 1961 Julin (TUR); 1968 Kankainen (TUR).
Total distribution. As the species has been difficult to identify, it has been poorly known, especially in North Europe. However, it is 'widespread and probably not uncommon' (Watling) in Britain and evidently also in Denmark (Knudsen 1975). In Norway one find in Østfold (G. Gulden, in litt.). Apparently throughout the oak zone in Fennoscandia.

Ecology. In Finland all the known localities are in the south, in places where many southern fungi have been found. Ruissalo which has one of the largest oak forests in Finland may be regarded as a typical habitat. All the localities have hazel and a rich, exacting vascular flora. Oak is present in most of the habitats. Watling mentions 'mixed broadleaved woods, usually with oak intermixed'. All the localities in Finland have vegetation indicative of basic soil and some are known to have occurrences of limestone (Korppoo: Åvensor and Lohja). Heinemann (1975) reports that species grows on slightly acid or neutral soil.

Boletus queletii Schulz.

(*B. erythropus* sensu Pers., non sensu Fr.)

Morphologically close to *B. erythropus* (Fr.) Krombh., but colour of cap lighter and more variegated, mostly with orange and even yellow tinge. The description of Kallenbach agrees especially well with the Finnish material (which is well

described in the specimen labels of Hietavuo in TUR). Stem also lighter than in *B. erythropus,* with less continuous tomentum. The cap measurements (9, 15 and 17.5 cm) agree well with those in the literature (Singer: 4—5 cm, Watling: 57—210 mm and Vasil'eva 1973: 100—120 mm). The material is too scanty for a discussion of the different colour forms in Finland (cf. Watling).

Distribution in Finland. B. queletii is one of the southernmost species. The only area known is Parainen, close to Turku, where Hietavuo (1969) made the first finds.

List of herbarium specimens:
Varsinais-Suomi. Parainen: Peksor, 31.VIII.1965 Hietavuo (TUR); Lenholm, 30.VIII. 1966 Hietavuo (TUR); 11.IX. 1972 PK (TUR, KUO); 23.IX. 1975 PK & Nyman (TUR).

Total distribution. Apparently throughout the Eurasian distribution area of oaks (Singer) to the Far East (Vasil'eva 1973). 'Not uncommon in southern Sweden' (N. Suber, oral comm.), also found in the Stockholm area. In Denmark found only in the south, where it is rare or very rare, but may have been confused with *B. erythropus* (Knudsen). Not yet recorded from Norway (G. Gulden, in litt.). Not mentioned by Kalamees & Lasting from Estonia. Not known in the Leningrad area (B.P. Vassilkov, oral comm.)

Ecology. The Finnish localities of *B. queletii* are all very similar: open park-like forest margins with oak (Fig. 1), and resemble its habitats in Central Europe (Kallenbach). The soil reaction measured in the habitats in Finland was pH 6.4—7.2, high values for this country, where limestone is rare (cf. the description of the Lenholm area on p. 3). According to Kallenbach, in Central Europe largely indifferent to soil pH.

All the Finnish finds are close to oak, which is often mentioned together with *B. queletii* in the literature (Singer, Watling 1970 and 1974, Vasil'eva 1973, Pilát & Dermek 1974). However, this fungus is apparently not entirely dependent on oak, since Watling also mentions *Fagus* and *Tilia* as its companions. Kallenbach and Schmitt (1970) also mention *Fagus,* and coniferous trees have been reported (Singer). Other characteristic fungal species in the same habitats in Parainen are *B. albidus, B. erythropus, B. chrysenteron* and some other agarics (cf. p. 3). The species will probably also be found in Korppoo and other calcareous areas in the SW archipelago of Finland.

Boletus rubellus Krombh.

(*B. versicolor* Rostk.?)

In this study, this species includes all the fungi with red cap cuticle and red stems, yellow hymenium with large and thin-walled tubes, close to *B. chrysenteron.* This means that the problem of the delimitation of *B. rubellus* (with a large number of synonyms given by Singer 1967) and *B. versicolor* Rostk. sensu Watling (1970) has been left unsolved. Only dry material was available for this study, and fresh material is needed for discerning differences in the trama structure (cf. Singer 1965 and 1967) and colour nuances.

Material exists whose characteristics fit the description in Singer (1967). Dr. Watling has seen a specimen from Turku, Ruissalo, in fresh condition, and the habitus and main colouration resembled the *B. versicolor* type sensu suo: it was more slender than *B. chrysenteron,* the stem being 70 × 6—8 mm at the base, and light red with yellow in the apex. The cap cuticle was finely cracked and brown red. In other specimens, taken here to belong to *B. rubellus,* the cap has been redder. A specimen in TUR collected by Hakala from Asikkala, Rutalahti (under alder) represents a different type: very small, cap size between 10 and 25 mm (in dry material); in the label, the colour is said to change to blue.

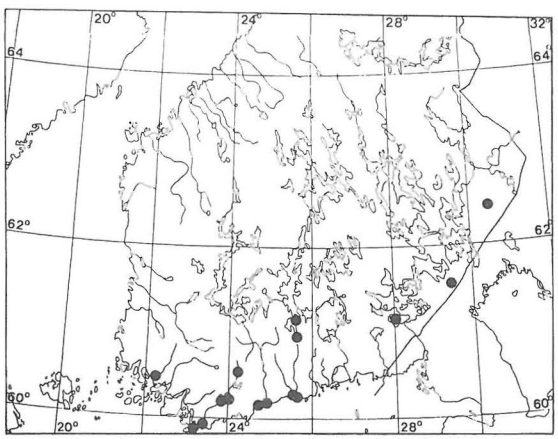

Fig. 9. Distribution of *B. rubellus.*

Distribution in Finland. According to present knowledge, *B. rubellus* is restricted to S (SE) Finland (Fig. 9).

List of herbarium specimens:
Varsinais-Suomi. Karkkila, 1954 von Schulmann (H). Lohja, 1961 Toppari (H). Lohja rural distr., 1961 Toppari (H). Parainen, 1967 Hietavuo (TUR). Turku, 1974 PK & Mäkinen (TUR). — *Uusimaa.* Helsinki, 1958 Malmström (H); 1971 von Bonsdorff (H). Kauniainen, 1953 Nyberg (H). Porvoo rural distr., 1927 Nyberg (H); 1974 Suomalainen (H). Tammisaari, 1957 von Schulmann (H). Tammisaari rural distr., 1966 I. & H. Luther (H). — *Etelä-Häme.* Asikkala, 1960 Hakala (TUR). Lahti, 1960 von Bonsdorff (H). — *Etelä-Savo.* Taipalsaari, 1971 Vitikainen (H). —

Laatokan Karjala. Parikkala, 1955 von Schulmann (H). — *Pohjois-Karjala.* Tuupovaara, 1967 Takala (OULU).

Total distribution. Very widely distributed and apparently polymorphous. The type specimen is from Czechoslovakia (Singer). In Denmark lacking or very rare (Knudsen). In Norway very rare, a few finds in the south (Hvoslef 1959, Lund 1959, G. Gulden in litt.). Fairly common in S Sweden, judging from the material in S. Not mentioned by Kalamees & Lasting from Estonia (cf. also Urbonas et al. 1974).

Ecology. *Betula* is mentioned in five labels in the Finnish herbarium specimens, *Alnus* in three. Although *Fagus, Quercus* and *Carpinus* are given by Singer as the most typical hosts, a possible case of association with *Betula* is also mentioned (cf. also Kallenbach). In S England *B. versicolor* is 'certainly characteristic of the oak woods' (Watling). The Finnish finds from Turku, Ruissalo, are also from oak forest, with *Alnus glutinosa,* another possible host. The habitats are often influenced by man: parks, gardens, pasturages etc., as is also reported from Central Europe (Kallenbach).

Boletus satanas Lenz

In Korppoo, in the SW archipelago of Finland, Eklund found a specimen which cannot be any other taxon than *B. satanas* (Eklund 1943a). The colour of the pores, 'intense purple red, dark greenish blue on pressing', and the thick reticulate stem with zones of yellowish orange and yellow, and a 'violet red' base agree well with *B. satanas.* The change in the colour of the flesh to 'intense sky-blue' is also characteristic of the species. The cap colour, however, was not very typical ('fairly pale graybrownish with light brown areas'). Although the literature for the identification of boletes at Eklund's disposal was very limited — perhaps only Ingelström (1940) for *B. satanas* — the possibility of misidentification can be ruled out, since Eklund had earlier found *B. luridus* and *B. erythropus,* the other red-pored boletes. The herbarium specimen in H, 'Ab, Korpo, Skofatt, 10.IX. 1941 Ole Eklund', also corresponds to the specimens of *B. satanas* in S. Although the colours are not preserved, the characteristic features of the stem pattern and some zonation can still be seen.

Distribution in Finland. The above mentioned locality in Varsinais-Suomi, Korppoo is the only known locality in Finland.

Total distribution. The species belongs to the Central European flora, which extends, although very rarely to N Europe, being a representative of *Quercus-Carpinus* forests (Bresinsky 1969). In Denmark only in the south and very rare (Knudsen). No certain finds in Norway (G. Gulden, in litt.). In Sweden known from Gotland and also Uppsala (Eriksson 1967, Singer). In Estonia e.g. on the islands (Kalamees & Lasting), which closely resemble Gotland in environmental features.

Ecology. In all ecological descriptions said to be dependent on calcareous soil and a warm habitat (Kallenbach) — perhaps more so in the North than in Central Europe. These demands are fulfilled in the Swedish and Estonian habitats. Although restricted to the oak zone in the North, not dependent on oak alone; *Fagus, Corylus, Castanea* and *Carpinus* (Singer, Pilát 1954, Pilát & Dermek 1974) have also been mentioned with it. Eriksson (1967) describes the habitat in Gotland as a meadow with hazel, ash, elm, oak and lime. Although Eklund (1943a) does not mention the nearby tree species, both oak and hazel may occur on the S coast of Långviken in Korppoo, which is known for its basophilous flora and calcareous soil ('mergel'). The Finnish locality was open pasture land, which indicates a xerothermic microclimate. Presumably, this kind of southern fungus does not often form fruit bodies in Finland, since it does so only occasionally in Denmark (Møller & Nielsen 1965, Stricker 1949). Eriksson (1967), who has observed it in several years in Gotland, states that it seems to occur only in warm and otherwise favourable summers.

Boletus subtomentosus L. ex Fr.

(*Xerocomus subtomentosus* (L. ex Fr.) Quél. incl. *B. spadiceus* (Fr.) Quél. and *B. lanatus* Rostk.)

It seems most difficult to delimit the above three taxa according to Watling, particularly as additional infraspecific variation has led to the separation of many further taxa of different ranks. Their differentiation from *B. chrysenteron* and *B. porosporus* is easier.

The descriptions of the cap colour of the *B. subtomentosus* group in Singer and Watling fit the Finnish material well. The more or less yellowish colour is, however, more prominent than in these descriptions. This apparently means that var. *luteolus* Velen. is invoved. The cap colour does not provide any distinguishing characteristics, because in both *B. spadiceus* (partly a synonym with *Xerocomus coniferarum* Sing.) and *B. subtomentosus* the tomentum may be more or less olivaceous (Watling) or not (Singer 1965) and both may have brick-colour nuances under the tomentum.

Nor are these taxa distinguished by the colour of the flesh of the cap: in *B. spadiceus* it is pure white, cream to straw-colour or lemon-yellow only above tubes, ... '(Watling) and in *B. subtomentosus*' pale

lemon-yellow or straw-colour, more strongly yellow above tubes, ...' (Watling). *B. lanatus* has white flesh in the cap (Watling). The trama in all the taxa is of *Phylloporus* type (Singer 1965). The literature gives very confusing reports on the colour changes in the cap and stem flesh (e.g. with NH_4OH), and the are no differences in the anatomical structure or spore sizes. However, it seems to be generally accepted that distinguishing characteristics are provided by the stem. In all the taxa the stem has a pale ground colour (white, yellowish, brownish, copper-brown etc.). In *B. subtomentosus* it has fine punctation, sometimes arranged in a pattern (rows but not network). In *B. spadiceus* it has a pattern of ribs (reticulation), which is darker tahan the main colour.

After examining the Finnish material of this group, we have the feeling that the only taxon in Lapland is *B. subtomentosus.* There, too, the fungi show all the cap colours described in the group, including brown without any olivaceous tone. The yellow colour is very common. In one type the cap colour is close to honey (Michael & Henning 1958, colour 30). In this type, which is often rather slender (stem length more than 1½ × cap diameter), the stem is white — almost white — yellowish (Michael & Hennig colour 28) and sometimes densely punctated. In another quite opposite type, the cap is dark brown (Michael & Hennig colour 9), often darker in the centre and more or less cracked in irregular small patches. The stem is also darker than in the previous type and sometimes as dark as the cap. The stem is often short — the length equal to the cap diameter. The size of the fruit bodies varies: in the biggest ones the cap diameter is 9 cm, but most of them are much smaller. Of the 61 herbarium specimens from Inari Lapland in TUR, one quarter are the light, slender type, one quarter are closer to the dark, short type and half cannot be assigned to either form. The colour of the hymenium is somewhat greenish yellow (Michael & Hennig colour 33), turning green-blue; clear orange has been mentioned for one specimen. — In the herbarium of the Komarov Institute, the dark form, which seems to be common in the Kola peninsula also, is labelled *B. leguei* Boud. (which is apparently a synonym of *B. spadiceus;* cf. Singer). In these specimens there was, however, no reticulation in the stem.

Our material from around Turku, in southernmost Finland, includes all these types and some additional variation. Whether this variation covers that included in *B. spadiceus* by Singer (and apparently in *B. spadiceus* and *B. lanatus* by Watling 1970) is not quite clear.

The Finnish collections contain a few dark brown specimens whose stems seem to be of the *B. spadiceus* type, but which have hardly any other characteristics diagnostic of that taxon. The specimens closest to *B. spadiceus* are the following: Varsinais-Suomi, Turku: 'Mikkolanmäki', 23.X 1960 PK (TUR); Uusimaa, Helsinki: Käpylä, 12.VIII. 1936 Puolanne (H) and Pohjois-Pohjanmaa, Ylikiiminki: Niemenkylä, 16.VIII. 1971 Uotila (H). — All these specimens have a very clear and large brown net on the stem. They correspond well to Fig. 30 in Pilát & Dermek (1974). Karsten (1876) has recorded *B. spadiceus* from Turku, Ruissalo.

The third type in our material often occurs in oak forests. It seems to be closer to *B. chrysenteron* in the shape. The cap is brown, not olivaceous or yellow. The surface of the cap is often cracked in the same way as in *B. chrysenteron,* but without any red colour underneath. The stem is brown, but may have a red tinge. The colour is not far from that in Singer's illustrations (1965, Table 11: Figs. 5—6) representing a 'Laubwaldform' (*X. lanatus*). These specimens also show some similarities to the fungus pictured in Cetto (1971: 494, *B. ferrugineus*), although their cap colour is less reddish. The white flesh accords with *B. lanatus* in Watling. Karsten's (1882) *B. spadiceus* from Ruissalo with its unchanging white flesh may be this taxon. Macromorphologically *B. porosporus* is also close to *B. lanatus* and therefore a microscopic examination of the spores is needed in the identification.

Examination of the Finnish material inclines us to treat *B. spadiceus* and *B. lanatus* as infraspecific taxa in *B. subtomentosus.* Owing to the confusions in the literature and the great variability of the group, we hesitate to treat them as independent species.

Distribution in Finland. B. subtomentosus is common all over the country up to northernmost Lapland (cf. Kallio & Kankainen 1964). According to Tuomikoski (1955a), it is one of the commonest bolete species in Finland. *B. spadiceus* apparently also has a wide distribution. The *B. lanatus* type is southern and perhaps restricted to the oak zone. We know it only from oak forests close to Turku.

Total distribution. According to Singer, *B. subtomentosus* is a holarctic species. *B. spadiceus* is known form S and Central Europe up to Denmark. Also recorded from Norway by Blytt (1905). Apparently owing to confusions in the taxonomy, both it and *B. lanatus* are very poorly known.

Ecology. B. subtomentosus is found in widely differing habitats: in all Finnish forest types and also in Lapland above the birch forest zone in

Empetrum hermaphroditum — Betula nana heaths (cf. also Stordal 1971). Apparently not obligately mycorrhizal with trees. Often found in hemerobic meadow-like habitats. The observations on the other taxa are scanty. The *B. lanatus* type is a fungus of herb-rich broad-leaved forests, especially oak-forests. *B. spadiceus* occurs under pine. These habitats correspond roughly to those reported by Singer and Watling.

Species possibly found or expected to occur in Finland

Several species known in S Sweden may be expected to be found in Finland, although the Stockholm area, where many of the southern Swedish boletes are found, lies ca. 50 km south of the southernmost Finnish areas. There are Finnish habitats with the same features as, e.g., Lovö or Djurgården in Stockholm, with oaks, open fields, and high soil pH and temperature, for instance in Parainen, Lenholm which has many southern fungi, and no doubt in other places in the SW archipelago. Many of these species are also found in Estonia. A search for the following species may be expected to yield results.

B. appendiculatus (Schaeff. ex Fr.) Secr.

This species, which resembles *B. edulis,* but is yellow-stemmed, may once have been found in Karjaa (Varsinais-Suomi, S Finland), but the specimen in TUR was not described when fresh and the identification is not certain. In Sweden in Blekinge, Bohuslän and Gotland (specimens in S) and, according to N. Suber (oral comm.), also in the Stockholm region. In Norway rare, a few finds in the south (Størmer 1932, G. Gulden, in litt.). Found only once in Estonia (Kalamees & Lasting). Apparently mainly dependent on oak (Watling) and limestone (Kallenbach, Singer).

B. cramesinus Secr.
(*Aureoboletus cramesinus* (Secr.) Watl.)

This is a small, slender fungus, which resembles *B. subtomentosus* to some extent, but has a viscid, red cap and a beautiful lemon-yellow pore layer. Known in several places in Stockholm, but collected most in Lovö (cf. also Jacobsson 1976). Some finds in SE Norway (Ramm & Stordal 1955). On find in Denmark (Knudsen). In Estonia, in Tartu and Saaremaa (Kalamees & Lasting). Under oak and beech (Kallenbach, Singer), apparently basophilous.

B. fechtneri Velen.
(*B. appendiculatus* ssp. *pallescens* Konr.)

Eklund (1943b) may have found this species in Varsinais-Suomi, Korppoo, but the name *B. aestivalis* (which Eklund uses without an author) has also been used for *B. edulis* ssp. *reticulatus,* and no herbarium specimen has been found. In Sweden (S) several specimens from Uppland, especially Lovö. Jacobsson (1976) reports it from Bohuslän. In Norway two finds near Bergen (G. Gulden, in litt.). A few finds in Denmark (Knudsen) and two in Estonia (Kalamees & Lasting). Depends on oak or beech (Singer, Watling, Knudsen) and limestone (Kallenbach).

B. parasiticus Bull. ex Fr.

A specimen in TUR (Varsinais-Suomi, Kaarina: Karpanmäki 8.IX. 1960 Heinonen) may represent this species, but we are not sure of the identification. This species is apparently recognized without difficulty when found in nature as a parasite of *Scleroderma,* but the characteristics (anatomical) of herbarium specimens are slightly ambiguous. An excellent map of the European distribution is presented by Lange (1974). It shows that the species is as common in Denmark as in the centre of its range. It seems to be rather common in SW Sweden (cf. also Nannfeldt 1952) and in Norway (cf. also Høeg 1944 and Eckblad & Gulden 1974). Since *Scleroderma* is common in Finland (cf. Kallio 1963), the species should be sought for in the archipelago, where many subatlantic plants have been found.

B. pulverulentus Opat.

A record from Finland by Malmström (1943b) was later shown by Malmström to be based on a misidentification (cf. Andersson 1956). Apparently dependent on *Fagus, Carpinus* or *Quercus* (Kallenbach, Singer, Watling, Pilát & Dermek 1974), and more southern than the other species in the list. Rare in Denmark (Knudsen), found in Sweden up to Västergötland, Rackeby (Andersson 1956), although rare.

B. rhodoxanthus (Krombh.) Kallenb.
(*B. purpureus* Pers.?)

Several specimens from Sweden (S), from the surroundings of Stockholm, many of them from Lovö. In Denmark only a few finds (Knudsen). In the north apparently dependent on oak and calcareous soil (cf. Singer).

Acknowledgements. We are deeply indebted to Dr. Gro Gulden, Dr. Teuvo Ahti, Mrs. Esteri Ohenoja, Lic. Phil. and Mr. Tauno Ulvinen, Lic. Phil., for reading the manuscript and giving most valuable advice. We are also very grateful to Dr. B.P. Vassilkov for most fruitful discussions. We wish to thank the numerous collectors who have placed material at our disposal. The junior author acknowledges financial support from Suomen Kulttuurirahasto, Pohjois-Savon rahasto.

References

Ahti, T., Hämet-Ahti, L. & Jalas, J. 1968: Vegetation zones and their sections in northwestern Europe. — Ann. Bot. Fennici 5: 169—211.

Andersson, O. 1943: Studier över Boletaceer. — Bot. Not. 1943: 185—202.

- » -1956: Three rare or little known boletes in Sweden. — Friesia 5: 180—189.

Benedix, E.H. 1963: Bemerkungen zur Mykorrhiza im System der Boletazeen. — Int. Mykorrhizasymposium, Weimar 1960: 35—40. Jena.

Bille Hansen, E. 1962: Skovtraeernes ektotrofe mykorrhiza. En oversigt. — Bot. Tidsskr. 58: 213—240.

Blytt, A. 1905: Norges Hymenomyceter. — Vidensk. Selks. Skrifter 1. Math.-Naturv. Kl. 1904, 6: 1—164. Christiania.

Bresinsky, A. 1969: Zur Erforschung der europäischen Grosspilzflora — Probleme, Möglichkeiten, Beiträge. — Z. Pilzkunde 35: 179—212.

Bresinsky, A. & Zeitlmayr, L. 1960: Die Pilze de 'Kapuziner Hölzls' und des 'Nymphenburger Schlossparks'. — Ber. Bayer. Bot. Ges. 33: 11—19.

Böhme, M. 1953: Zur Standortkenntnis einiger Röhrenpilze. — Z. Pilzkunde 15: 15—16.

Cetto, B. 1971: I funghi dal vero. — 619 pp. Trento.

Dick, E.A. & Snell, W.H. 1965: Notes on boletes 15. — Mycologia 57: 448—458.

Eckblad, F.-E. & Gulden, G. 1974: Distribution of some macromycetes in Norway. — Norw. J. Bot. 21: 285—301.

Egeland, J. 1911: Meddelelser om norske hymenomyceter 1. — Nyt Mag. Naturv. 49: 341—380.

Einhellinger, A. 1969: Die Pilze der Garchinger Heide. — Ber. Bayer. Bot. Ges. 41: 79—130.

Eklund, O. 1925a: Boletus luridus Schaeff. och Parmelia acetabulum (Neck.) Dub. från Ab, Korpo. — Meddel. Soc. Fauna Flora Fennica 48: 114—116.

- » -1925b: Boletus luridus i Korpo. — Meddel. Soc. Fauna Flora Fennica 49: 59.

- » -1934: Eine pflanzengeographische Neueinteilung Südwest-Finnlands. — Mem. Soc. Fauna Flora Fennica 10: 272—288.

- » -1943a: Boletus satanas Lenz., für Finnland neu. — Mem. Soc. Fauna Flora Fennica 18: 2.

- » -1943b: Zur Pilzflora des Schärenarchipels SW-Finnlands. — Mem. Soc. Fauna Flora Fennica 18: 2—21.

Eriksson, G. 1967: Boletus satanas funnen på Gotland. — Svensk Bot. Tidskr. 61: 322—323.

Fries, E. 1849: Summa vegetabilium Scandinaviae. Sectio posterior. — 572 pp. Upsaliae.

Gulden, G. & Schumacher, T. 1977: Giftsopper och soppforgiftninger. — 116 pp. Oslo.

Haas, H. 1933: Die bodenbewohnenden Grosspilze in den Waldformationen einiger Gebiete von Württenberg. — Bot. Centralblatt 50: 35—134.

- » -1971: Makromyzetenflora und Kernfäulebefall älterer Fichtenbestände auf der Schwäbischen Alb. — Mitt. Ver. Forst. Standortskunde Forstpflanzenzüchtung 20: 50—59.

Heinemann, P. 1975: Les Bolétinées. — 34 pp. Bruxelles.

Hietavuo, S. 1969: Boletus queletii Schulzer in Parainen, SW-Finland. — Karstenia 9: 35—36.

Hintikka, T.J. 1931: Sienimaantieteellisestä (mykogeograafisesta) tutkimuksesta varsinkin Suomessa. — 49 pp. Helsinki.

Hinneri, S. 1972: An ecological monograph on eutrophic deciduous woods in the SW archipelago of Finland. — Ann. Univ. Turku (A 2) 50: 1—131.

- » -1975: Mineral elements of macrofungi in oak-rich forests on Lenholm Island, inner archipelago of SW Finland. — Ann. Bot. Fennici 12: 135—140.

Hvoslef, R. 1959: Soppkontrollen i Fana 1958. — Våre Nyttevekster 54: 12—13.

Høeg, O.A. 1944: Om Scleroderma aurantium Pers. og Boletus parasiticus Fr. — Blyttia 2: 65—70.

Ingelström, E. 1940: Svampflora. — 216 pp. Stockholm.

Jacobsson, S. 1976: Svampåren 1974—1975 i sydvästra Sverige. — Göteborgs Svampklubb Årsskrift 1975—76: 63—67.

Jansen, J.P. 1946: Boletus lignicola Kbch (1929) fundet i Danmark. — Friesia 3: 159—160.

Kalamees, K. & Lasting, V. 1974: Eesti puravikulised. — 48 pp., 32 pls. Tallinn.

Kallenbach, F. 1926—1938: Die Röhrlinge (Boletaceae). In: Die Pilze Mitteleuropas 1. — 138 pp., 55 pls. Leipzig.

Kallio, P. 1963: Zur Verbreitung einiger in Finnland südlichen Pilze, besonders in der südwestlichen Eichenzone. — Karstenia 6—7: 35—76.

- » -1976: Tatit — Boletaceae. — In: Ulvinen, T. (ed.), Suursieniopas: 37—49. Helsinki.

Kallio, P. & Kankainen, E. 1964: Notes on the macromycetes of Finnish Lapland and adjacent Finnmark. — Rep. Kevo Subarctic Res. Sta. 1: 178—235.

- » -1966: Additions to the mycoflora of northernmost Finnish Lapland. — Rep. Kevo Subarctic Res. Sta. 3: 177—210.

- » -1967: Contributions to the macromycetes in the oak zone of Finland. — Karstenia 8: 9—13.

Karsten, P.A. 1859: Sydvestra Finlands polyporeer. — 47 pp. Akad. Afhandl. Helsingfors.

- » -1867: Finlands ekonomiska flora. 1. Basidbärande svampar. — 46 pp. Åbo.

- » -1876: Mycologia fennica. 3. Basidiomycetes. — Bidrag Känned. Finl. Natur Folk 25: 1—377.

- » -1882: Rysslands, Finlands och den Skandinaviska halföns hattsvampar. Sednare delen: pip-, tagg-, hud-, klubb- och gelésvampar. — Bidrag Känned. Finl. Natur Folk 37: 1—257.

- » -1889: Kritisk öfversigt af Finlands basidsvampar (Basidiomycetes; Gastero- & Hymenomycetes). — Bidrag Känned. Finl. Natur Folk 48: 1—470.

Knudsen, H. 1974: De danske rørhatte. — Meddel. Foren. Svampekundskabens Fremme 1974: 25—56.

- » -1975: Nogle nye danske rørhatte. — Meddel. Foren. Svampekundskabens Fremme 1975: 28—40.

Kobayasi, Y., Hiratsuka, N., Korf, R.P., Tubaki, K., Aoshima, K., Soneda, M. & Sugiyama, J. 1967: Mycological studies of the Alaskan Arctic. — Annual Rep. Inst. Fermentation, Osaka 3: 1—138.

Lange, L. 1974: The distribution of macromycetes in Europe. — Dansk Bot. Arkiv 30 (1): 7—105.

Leclair, A. & Essette, H. 1969: Les Bolets. — Atlas Mycologiques 2: 1—135.

Lobanow, N.N. 1960: Mycotrophie der Holzpflanzen. — pp. Berlin.

Lund, E. 1959: Angående Bolétus versicolor. — Våre Nyttevekster 54: 30.

Lundell, S. 1932: Bidrag till Upsala-traktens Hymenomycetflora 1. Vårdsätra naturpark. — Kungl. Svenska Vetenskapsakad. Skrifter i Naturskyddsärenden 22: 1—33.

Lundell, S. & Nannfeldt, J.A. 1934—1961: Fungi exsiccati Suecici praesertim Upsalienses. — Uppsala.

Luther, H. & Luther, I. 1965: Ett fynd av Boletus miniatoporus Secr. i Tvärminne. — Mem. Soc. Fauna Flora Fennica 41: 32—36.

Malmström, N. 1943a: Boletus luridus Schaeff. från Åland. — Mem. Soc. Fauna Flora Fennica 18: 68—70.
- » -1943b: Boletus pulverulentus Opat. och B. castaneus Bull., nya för Finland. — Mem. Soc. Fauna Flora Fennica 18: 70—73.
Michael, E. & Hennig, B. 1958: Handbuch für Pilzfreunde 1. — 260 pp. Jena.
- » -1960: Handbuch für Pilzfreunde 2. — 328 pp. Jena.
Mikhailovsky, L.V. 1975: Makromitsety (poryadok Agaricales) Khibinskogo gornogo massiva. — Avtoreferat. Botanicheskiy Institut Akad. Nauk SSSR. 23 pp.
Möller, F.H. 1956: Two little known Danish mushrooms: Boletus fragrans Vitt. and Boletus edulis var. citrinus Pelterau. — Friesia 5: 312—316.
Møller, H. & Nielsen, N.J. 1965: Oversigt over fund af storsvampe på Vestlolland. — Friesia 7: 389—502.
Nannfeldt, J.A. 1952: Fungi. — In: Nannfeldt, J.A. & Du Rietz, G.E., Vilda växter i Norden 4. Mossor, lavar och svampar: 190—333. Stockholm.
- » -1959: The mycofloristical exploration of Scandinavia, especially Sweden. — Friesia 6: 167—213.
Nathorst-Windahl, T. 1956: Zur Verbreitung der Agaricales in den Wäldern des südvestlichen Schwedens. — Friesia 5: 319—324.
Neuhoff, W. 1956: Die Milchlinge (Lactarii). — Die Pilze Mitteleuropas 2: 1—248. Bad Heibrunn.
Nikoskelainen, R. 1955: Katariinanlaakson ja sen lähiympäristön putkilokasvisto. — Turun Ylioppilas 4: 229—248.
Nyberg, W. 1935: Några i Borgå och dess omnejd funna, sällsyntare svamparter. — Mem. Soc. Fauna Flora Fennica 10: 20—23.
Pantidou, M. 1964: Cultural studies of Boletaceae: carpophores of Xerocomus badius and Xerocomus illudens in culture. — Canad. J. Bot. 42: 1147—1149.
Pearson, A.A. 1950: British boleti. — 19 pp. London and Hull.
Pilát, A. 1954: Pilze. — 343 pp. Amsterdam.
- » -1969: Houby Československa ve svém životním prostředí. — 268 pp. Praha.
Pilát, A. & Dermek, A. 1974: Hribovité huby. — 207 pp. Bratislava.
Ramm, W. & Stordal, J. 1955: Gull-rørsopp, Boletus auriporus Peck 1872 funnet i Norge. — Blyttia 1955: 96—100.
Rautavaara, T. 1950: Kalkkitehtaan vaikutusta sienikasvillisuuteen? (Summary: The influence of a lime factory on the mushroom vegetation.) — Karstenia 1: 85.
Schmitt, J.A. 1970: Strobilomycetaceae, Boletaceae, Paxillaceae und Gomphidiaceae im Saarland, mit einer chemotaxonomischen Studie von 27 Arten. — Z. Pilzkunde 66: 77—94.
von Schulmann, O. 1955: Pilzstudien in Finnland. — Karstenia 3: 17—68.
- » -1957: Pilzstudien in Finnland 2. — Karstenia 4: 27—61.
von Schulmann, O. 1960: Zur Kenntnis der Basidiomyceten Finnlands. — Karstenia 5: 5—99.
Singer, R. 1965: Die Röhrlinge 1. — Die Pilze Mitteleuropas 5: 1—131, 21 pls. Bad Heilbrunn.
- » -1967: Die Röhrlinge 2. — Die Pilze Mitteleuropas 6: 1—152, 26 pls. Bad Heilbrunn.
Skirgiello, A. 1960: Grzyby (Fungi). — 130 pp., 30 pls. Warszawa.
Snell, W.H. & Dick, E. 1970: The boleti of northeastern North America. — 116 pp., 87 pls. Lehre.
Stenlid, G. 1947: Några anteckningar om Ålands svampflora. — Mem. Soc. Fauna Flora Fennica 23: 82—90.
Stordal, J. 1953: Notater om storsopp i Våle, Vestfold. — Friesia 4: 267—295.
- » -1955: Utbredelsen av noen Boletus-arter i Norge. — Blyttia 13: 71—78.
- » -1971: Soppene i farger. Ed. 2. — 200 pp. Oslo.
Stricker, P. 1949: Seltene Pilze und ihre Standorte im Oberrheingebiet. — Z. Pilzkunde 1949: 6—16.
Størmer, P. 1932: Polyporus umbellatus (Pers.) Fr. og Boletus appendiculatus Schaeff. funnet i Norge. — Nyt Mag. Naturv. 70: 409.
Thesleff, A. 1919: Studier öfver basidsvampfloran i sydöstra Finland, med hänsyn till dess sammansättning, fysiognomi, fenologi och ekologi. — Bidrag Känned. Finl. Natur Folk 79 (1): 1—140.
Tuomikoski, R. 1955a: Sientemme yleisyydestä ja sienikirjojemme lajistosta. 1. Tatit — Sienitietoja 1955 (2): 3—4.
- » -1955b: Suomen tatit (Boletaceae). — Sienitietoja 1955 (2): 5—7.
- » -1959: Sienet värikuvina. — 246 pp. Porvoo & Helsinki.
Urbonas, V., Kalamees, K. & Lukin, V. 1974: Konspekt izucheniya agarigovykh gribov Litovskoj SSR, Latviyskoy SSR, Estonskoy SSR. (Summary: The list of the Agaricales flora of the Baltic Republics (Lithuania, Latvia, Estonia). — 130 pp. Vilnjus.
Vasil'eva, L.N. 1973: Agarikovye shlyapochnye griby (por. Agaricales) Primorskogo kraya. — 331 pp. Leningrad.
Vassilkov, B.P. 1955: Ocherk geograficheskogo rasprostraneniya shlyapochnykh gribov v SSSR. — 86 pp. Moskva and Leningrad.
- » -1966: Belyy grib. — 131 pp. Moskva and Leningrad.
Watling, R. 1963: Notes on British boleti 2. — Trans. Bot. Soc. Edinburgh 39, 414—431.
- » -1968: The larger fungi of the Kindrogan area. — Scottish Field Assoc. Annual Rep. 1967: 28—46.
- » -1970: Boletaceae, Gomphidiaceae, Paxillaceae. — In: British fungus flora: Agarics and boleti 1. — 125 pp. Edinburgh.
- » -1974: Macrofungi in the oak woods of Britain. — In: Morris, M.G. & Perring, F.H. (eds.), The British oak: 222—234.

Accepted for publication
on July 12, 1977